AN ASSESSMENT OF THE IMPACTS OF INFLATION ON GREEK PUBLIC FINANCES: MACROECONOMIC EFFECTS AND POLICY IMPLICATIONS

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ABSTRACT

In 2022, the global cost of living surged, pushing already rising global inflation to multi-decade highs. Our empirical analysis assesses the impact of high inflation on Greece's public finances (in terms of flows), considering the extraordinary economic circumstances arising from the pandemic crisis and the initial phase of the recent energy crisis. To this end, we use a small-scale Bayesian vector autoregressive model for the Greek economy to quantify the effects of an adverse price shock on the primary balance, tax revenue and primary spending (all normalised by nominal GDP), as well as on real output, distinguishing between the effects of a demand- and an external supply-driven shock to inflation. We find that the nature of an inflation shock, i.e. whether it is demand- or supply-driven, is important for correctly identifying the short-to-medium-term effects of inflation shocks on fiscal outcomes.

Keywords: price inflation; public finances; COVID-19 pandemic; energy crisis; Greece; Bayesian Structural VAR

JEL classification: H5; H6; E3; C11

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N A A O

ΕΚΤΙΜΗΣΗ ΤΩΝ ΕΠΙΠΤΩΣΕΩΝ ΤΟΥ ΠΛΗΘΩΡΙΣΜΟΥ ΣΤΑ ΔΗΜΟΣΙΑ ΟΙΚΟΝΟΜΙΚΑ ΤΗΣ ΕΛΛΑΔΟΣ: ΜΑΚΡΟΟΙΚΟΝΟΜΙΚΕΣ ΣΥΝΕΠΕΙΕΣ ΚΑΙ ΠΡΟΤΑΣΕΙΣ ΠΟΛΙΤΙΚΗΣ

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ΠΕΡΙΛΗΨΗ

Το 2022 το κόστος ζωής σε παγκόσμια κλίμακα αυξήθηκε, ωθώντας τον ήδη αυξανόμενο πληθωρισμό τιμών σε επίπεδα που δεν είχαν παρατηρηθεί επί δεκαετίες. Κύριο ερώτημα της εμπειρικής ανάλυσης είναι η αξιολόγηση του αντικτύπου του υψηλού πληθωρισμού στα δημόσια οικονομικά της Ελλάδος (σε όρους ροών), εξετάζοντας την επίπτωση των έκτακτων οικονομικών συνθηκών λόγω της πανδημικής κρίσης και της πρόσφατης ενεργειακής κρίσης, τουλάχιστον στην αρχική της φάση. Για το σκοπό αυτό, χρησιμοποιούμε ένα μικρής κλίμακας διανυσματικό αυτοπαλίνδρομο σχήμα κατά Bayes για την ελληνική οικονομία που μας επιτρέπει να ποσοτικοποιήσουμε τις επιπτώσεις της ανόδου του πληθωρισμού στο πρωτογενές δημοσιονομικό αποτέλεσμα, στα φορολογικά έσοδα και στις πρωτογενείς δημόσιες δαπάνες (όλα τα μεγέθη εκφράζονται ως ποσοστό του ονομαστικού ΑΕΠ), καθώς και στην πραγματική οικονομική δραστηριότητα. Κρίσιμης σημασίας για την αξιολόγηση των επιπτώσεων του πληθωρισμού είναι η προέλευση της πληθωριστικής διαταραχής. Διαπιστώνουμε ότι το είδος της πληθωριστικής διαταραχής, δηλαδή το αν οφείλεται σε διαταραχές στη συνολική ενεργό ζήτηση ή σε διαταραχές στη συνολική προσφορά, είναι σημαντικός παράγοντας για τον εντοπισμό των βραχυπρόθεσμων και μεσοπρόθεσμων επιπτώσεων στα δημοσιονομικά μεγέθη.



AN ASSESSMENT OF THE IMPACTS OF INFLATION ON GREEK PUBLIC FINANCES: MACROECONOMIC EFFECTS AND POLICY IMPLICATIONS*

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I INTRODUCTION

In 2022, the global cost of living surged, pushing already rising global inflation to multidecade highs. The world economy is now experiencing a radical shift towards greater vulnerability and higher uncertainty. This shift maps the changing contours the world economy faces today. Geopolitical confrontations, a health crisis, a long-term demographic decline and more frequent and more destructive climate-related natural disasters are unprecedented supply-driven shocks that increase economic and financial vulnerability and hold back potential global economic growth (IMF 2022c). Prominent international economic organisations are pointing to an imminent risk of the global economy slipping into a near-term recession. This risk stems from persistently high inflation and stagnating growth, as central banks across the world simultaneously raised interest rates and, therefore, borrowing costs to fight inflation and prevent inflation expectations from becoming unanchored (see Georgieva and Malpass 2022; Rogoff 2022; IMF 2023).

The global economic recovery from the COVID-19 pandemic was accompanied by an energy crisis and a resurgence of inflationary pressures affecting the real disposable income of households and business profits. In an environment already burdened by rising inflation, Russia's war of aggression against Ukraine and the ongoing hostilities have brought about renewed price increases for energy, food and industrial commodities, which feed into head-line inflation. Inflation expectations are also soaring amid continued supply-chain and trade disruptions, and weaker confidence in the economy. Eventually, heightened inflationary pressures seem to be quite persistent. In response

to rising energy prices and the higher cost of living, governments have taken emergency measures to support the most vulnerable. However, the increasing burden of these measures on national budgets entails significant fiscal costs, leading to an upending of fiscal plans.

The theoretical and empirical literature on the overall impact of high inflation on public finances is abundant. We take as a starting point the well-known Phelps effect (see Phelps 1973). Its key idea is that, in order to alleviate the burden of distortionary taxation, governments have the option to rely on monetary financing. Following the build-up of large stocks of debt in the aftermath of the global financial crisis of 2007-08, there was a renewed interest of economists in reconsidering the role of inflation in facilitating debt reductions. For example, Rogoff (2010), Blanchard et al. (2010), Aizenman and Marion (2011) and di Bartolomeo et al. (2015), inter alia, examine whether a positive non-negligible inflation rate might be an optimal public finance tool to deflate nominal public debt and limit debt accumulation in the long run. More recently, Wickens (2022) and Heer et al. (2020) also examine the effectiveness of policy in influencing public finances by producing a positive inflation rate.

The key purpose of this paper is to analyse the potential impact of high inflation on Greek public finances. Four key factors underpin our

^{*} This paper elaborates upon an initial idea briefly presented in Box 3 entitled "Impact of high inflation on public finances", *Monetary Policy 2021-2022: Executive Summary and Boxes*, 29-32, Bank of Greece, June 2022, available at https://www.bankofgreece.gr/ Publications/NomPol20212022_en_Summary_Boxes.pdf. An early version was presented at the Bank of Greece seminars held on 4 July 2022. We are most grateful to all participants in the seminar for their comments, as well as to Pablo Burriel Llombart, Ivan Kataryniuk di Costanzo and Stephan Haroutunian for fruitful discussions and insights on the issue. The views expressed in this article are of the authors and do not necessarily reflect those of the Bank of Greece. The authors are responsible for any errors or omissions.



decision to choose Greece as the reference point of our analysis. First, accelerating nominal GDP growth in 2022 led to a reversal of the so-called snowball effect. Nominal GDP growth is the combined effect of real GDP growth and, broadly speaking, price inflation. If this trend continues, it will be a key factor in rapidly reducing the high debt-to-GDP ratio. Second, public debt remains elevated relative to the country's nominal output, thus making debt sustainability sensitive to increases in borrowing rates. Third, the Greek government has embarked on an exceptionally bold package of financial support measures to shield households and businesses from the energy crisis.¹ However, if the initial inflationary shock persists, this support may intensify budgetary pressures by increasing primary spending, which may fuel inflation. Fourth, before entering the euro area, Greece traditionally faced long-lasting demand-driven inflationary pressures and strong inflation expectations.²

Our analysis examines the impact of high inflation on Greece's public finances³ (with a focus on the primary balance), considering the extraordinary economic circumstances arising from the pandemic crisis and the first phases of the Russian war of aggression in Ukraine, and the ensuing energy crisis.

By means of a standard small-scale Bayesian vector autoregressive model for the Greek economy, we quantify the effects of inflation shocks on government spending, tax revenue and the primary balance, all expressed as percentages of GDP. Our counterfactual analysis, by means of sign restrictions, considers the effects of an external supply-side and a demand-side shock to inflation on both fiscal variables and real growth, in the presence of a responsive monetary policy. We find that in the case of the Greek economy, the proper identification of the nature of the inflation shock, i.e. whether it is demand- or supply-driven, is important in order to correctly identify the medium-term effects on fiscal outcomes, when expressed as percentages of GDP. More specifically, a supply-side shock to inflation, despite

its insignificant short-term impact on the ratio of primary balance to GDP, leads to a mediumterm deterioration as a result of a decline in the ratio of total tax revenue to GDP, stemming from the estimated adverse effect on real growth. In the case of a demand-side shock to inflation, no significant effect is found either in the short or in the medium run. The key driver behind this type of inflation shock is the sizeable denominator effect that leads to parallel declines in tax revenue and primary spending, also when normalised by nominal GDP.

The rest of the paper is organised as follows: Section 2 describes briefly the evolution of the inflationary phenomenon; it explains both the short-term transitory factors and the structural dynamic factors that give rise to the inflation process. The latter are responsible for triggering a long-term upward inflation trajectory. Section 3 sets the framework for discussing the impacts of inflation on public finances, including the effect of inflation on the ratio of public debt to GDP. It presents the key policy dilemmas facing fiscal authorities: on the one hand, mitigating the negative effects of high inflation and, on the other hand, maintaining a credible fiscal balance. Section 4 sets the econometric framework used to quantify the effects and presents the empirical findings. Finally, Section 5 concludes.

2 PANDEMIC, WAR AND INFLATION: UNCOVERING THE RESURGENCE OF INFLATIONARY PRESSURES

Before the war in Ukraine, as EU countries were emerging from the pandemic altogether, headline inflation, despite being on the rise, remained muted (see Chart 1). Inflationary pressures were thought to be temporary, as they resulted from supply-demand mis-



¹ From September 2021 to January 2023, the Greek government allocated €9.5 billion or 5.2% of GDP. See Sgaravatti et al. (2023).

² For the process of inflation in Greece in the pre-euro era, see Gibson and Lazaretou (2001) and Hondroyiannis and Lazaretou (2007).

³ Abstracting from the stock of public debt and ensuing issues of debt sustainability.



Chart I Inflation in the euro area and Greece (October 2019-June 2023)

matches caused by pandemic-related supply shortages, temporary global trade disruptions and pent-up demand, especially for services (see Ha et al. 2021; European Parliament 2022). It was expected that the impact of resurging inflation would fade over time, as countries began to recover. Once global supply chains and production units returned to pre-pandemic normal, aggregate supply would adjust to the temporarily increased aggregate demand and, thus, inflation would return to its medium-term target.

Meanwhile, with a zero lower bound on interest rates and positive output growth rates, conditions were favourable for financing government spending by creating debt without an increase in taxes later (see Blanchard 2019; Hall and Sargent 2021, 2022). In other words, it was expected that a combination of robust growth and temporary inflation would bring down the public debt-to-GDP ratio, even in cases where the fiscal balance remained in deficit.

However, as the war escalates and general geopolitical instability prevails, price inflation is strengthening and becomes persistent. As seen in Chart 1, inflation appears to gain momentum. Currently, supply-side disruptions, particularly distortions in the world energy and food markets resulting from the war and the subsequent sanctions, are adding to inflation. After peaking in September 2022, inflation followed a slow downward trend towards the end of the year and beyond. However, taming inflation will take some time, as shown by the successive upward revisions of the forecast average rate of headline inflation in both the euro area and Greece (see Chart 2). According to the latest forecasts, inflation is expected to moderate further on the back of falling energy prices; however, food price inflation and core inflation are expected to prove more persistent, chiefly due to the lagged pass-through effect of falling energy prices. Thus, inflation is now seen as the most serious threat to stable and sustainable global economic growth. On this ground, fiscal tightening can ease the task of monetary policy in reducing inflation, while mitigating risks to financial stability.

Nonetheless, apart from the temporary factors that shape a short-term upward trend, there are also structural and dynamic factors behind a long-term upward inflation trend. *Structural factors* particularly affecting the supply side





Chart 2 Inflation in the euro area and Greece, projections 2023-2025

include: (i) a reversal of or retreat from economic integration and a fragmentation of global economy into distinct economic blocs with different ideologies, political and economic systems, technology standards, crossborder payment and trade systems and currency reserves that would heighten economic instability and raise enormous difficulties in international trade (Gourinchas 2022); (ii) an accelerated green transition, which would increase transition costs; and (iii) the climate crisis, entailing an increase in the frequency of extreme weather events and very high economic losses from natural disasters.

Dynamic factors refer to the role of central banks' credibility in anchoring inflation expectations and the possibility of de-anchoring of long-term inflation expectations, which would shift the expectations-augmented Phillips curve upwards and lead to higher unemployment and higher inflation (Carstens 2022). Also, trends like the ongoing Great Resignation that do not turn out to be driven by pandemic-related shortterm factors, but rather reflect a more profound change, initiate structural changes in the labour market by raising the share of mismatched workers. Hence, competition among employers to hire or retain employees may keep wage inflation and, therefore, price inflation high (see Faccini et al. 2022).

Beyond the aforementioned determinants, the wider effects of inflation *per se* are also directly related to its persistence. In particular, a low inflation rate causes changes in sectoral prices without spillover effects to other sectors. Conversely, high inflation activates inflationary expectations and thus causes spillover effects, which give inflation momentum and duration.⁴

3 MACROECONOMIC EFFECTS AND FISCAL POLICY DILEMMAS

It is often said that inflation is favourable for public finances. The main argument in this regard is that inflation raises nominal tax revenue mechanically and, by raising nominal GDP, it makes it easier, other things being equal, to repay a debt that has not changed (see Attinasi et al. 2016; End et al. 2015). Generally speaking, direct effects include the effects of



⁴ This happens when agents are not rational and forward-looking. See, for example, IMF (2022c).



Main channels through which inflation affects public finances (in levels)

indexing the parameters of the taxation system and the impact on nominal tax bases (see, for example, Beer et al. 2023). Indirect effects include the deterioration of economic and financial conditions. Nonetheless, the overall impact depends on the origin of inflation. In this section, we try to set out the various impacts of rising inflation on public finances.

Specifically, inflation has two main effects on the government budget and on the economy (see Figure above).

First, unexpectedly high inflation or an upside inflation surprise works as a current government debt reduction, since the real value of debt is repriced under new inflation expectations. This reduction in real debt drives down capital crowd-out and increases investment. Second, inflation directly affects government revenue from indexation. Higher inflation would push up tax allowances and nominal thresholds for income tax and social security contributions, which would reduce revenues. However, a higher indexation of excise duties and other indirect taxes, as well as a higher business tax rate multiplier would raise revenues. Additionally, as nominal incomes rise with inflation, nominal thresholds apply at lower real levels and increase the effective tax liability of taxpayers. The same also applies to capital income, since capital tax generally applies to nominal, not real, returns on investment. This means that not only nominal, but also real tax revenue would rise with inflation, which would generate an adverse effect on macroeconomic aggregates, as the real aftertax return on investment would fall. Summing up, the overall impact on government receipts would be small, especially when expressed as a percentage of nominal GDP.

Debt devaluation

An upside inflation surprise is a form of sovereign default. It works through two channels: by reducing the real value of government debt as well as the debt-to-GDP ratio, as nominal GDP increases with inflation. Inflation reduces the real wealth of savers and investors who hold fixed nominal return assets, such as nonindexed government bonds. If price inflation is expected, the real return on assets whose price accounts for inflation is maintained. An inflation surprise, however, produces an unexpected





Chart 3 Decomposition of annual changes in the debt-to-GDP ratio

loss in the real value of assets, since the income received by the holder of non-indexed assets has lost real purchasing power.⁵ Thus, unexpected inflation effectively transfers wealth from non-inflation-linked government bond holders to the government. Taking into account that the speed of public debt accumulation depends on two factors, namely (i) the primary balance and (ii) the difference between the interest rate and the growth rate, multiplied by the debt level, there is an immediate effect on debt servicing costs for the inflation-indexed percentage of debt, as any increase in the price level directly translates into higher principal values.⁶ For non-indexed debt, there is a progressive effect linked to the rise in market interest rates, as debt is refinanced.

In both cases, the debt burden increases. If nominal GDP increases by the same or even a higher amount, the debt-to-GDP ratio either remains constant or declines. At the current juncture, however, if real GDP is adversely affected by the energy-driven inflation shock, debt accumulates faster. Furthermore, if market interest rates rise much faster than inflation, the favourable effect of inflation on debt reduction through nominal GDP is moderated or even reversed. It becomes apparent that the sensitivity of the public debt-to-GDP ratio to inflation changes depends on the pass-through from inflation to expected nominal sovereign interest rates, which effectively captures the monetary policy response to the inflation shock.

To explicitly examine the effect of inflation on public debt dynamics, we use the standard decomposition of public debt change into its fundamental drivers, i.e. the primary balance, the implicit interest rate, the real GDP growth rate and the deficit-debt adjustment (see Hall and Sargent 2010), that is:

$$d_t = \frac{(1+r)}{(1+g)(1+\pi)} d_{t-1} + p_t + dda_t \tag{1}$$

where d_t is the ratio of nominal debt to nomi-



⁵ The longer the duration of the debt, the more it is affected by a permanent increase in inflation.

⁶ Inflation-linked bonds can help investors to hedge against inflation risk on the basis of the bond contract, since they increase in value during inflationary periods. They link the bonds' principal and interest payments to inflation and thus soften the real impact of inflation on bond holders.

nal GDP at time t, r is the implicit nominal interest rate calculated as interest payments divided by the amount of debt in the previous year, π is the inflation rate, g is the growth rate of real GDP, p_t is the net-of-interest budget deficit as a percentage of nominal GDP and dda_t is the deficit-debt adjustment as a percentage of nominal GDP.

With this decomposition, it is possible to analyse the sizeable impact that inflation exerts on public debt dynamics. Specifically, if the numerator in (1), i.e. the annual cost of debt servicing, increases faster than the nominal rate of GDP growth, then the debt-to-GDP ratio increases and a primary surplus is required for debt sustainability. But if the numerator grows at a slower rate than the denominator, then the debt ratio falls, even if the primary balance is in deficit. In other words, if inflation is moderate and temporary, fiscal policy does not react by increasing spending, and nominal interest rates rise at a much slower pace than inflation, then deficit countries will be offered the necessary time for a gradual fiscal adjustment.

In line with the above, Chart 3 assesses these effects as well as the contribution of all determinants described in equation (1) in the case of Greece. As can be seen, in 2022 inflation had the largest positive contribution to the fall in the public debt-to-GDP ratio (exceeding 14 percentage points of GDP).⁷

Tax and expenditure effects

Inflation causes tax distortions, given that tax bases and tax rates are typically defined in nominal terms. Tax is levied on nominal tax bases, such as wages and salaries, savings, profits and consumer spending. If there are no automatic indexation mechanisms, that is when non-indexed tax bracket thresholds are in place in a progressive tax system, then high inflation pushes nominal incomes into higher tax brackets. Known as "bracket creep" effect, this can create an inflationary fiscal drag, as taxpayers pay more money on taxes without any increase in their take-home income. This effect is

mainly associated with a progressive income tax system. Similarly, taxation of nominal returns on savings means that higher inflation leads to higher tax payments and, thus, lower real after-tax rates of return. On the other hand, fixed allowances, particularly on expenses and tax credits, are less influenced by high inflation rates. However, with increasing price levels, the present value of depreciation, which is fixed in nominal terms, falls short of the real capital cost, thereby depressing investment despite the increase in nominal revenues. Moreover, with fixed nominal interest rate charges on overdue payments, real rates are decreasing as inflation rises, thus making payment delays less costly. Conversely, higher inflation raises nominal interest payments on debt, allowing greater deductibility from taxable income.

Overall, given that wages remain subdued and are subject to higher effective tax rates, while any upward effect of price increases on the nominal value of sales for firms and, therefore, on their profits depends on the extent to which profit margins are squeezed by rapid cost increases, the positive effect on nominal income/revenue would be small. Furthermore, higher consumer prices push up nominal consumer spending and VAT revenue increases mechanically for a given volume of consumption.

However, tax bases in real terms move in a direction that depends on the origin of inflation. In particular, if inflation is linked to a rapid recovery in aggregate demand, tax bases increase not only nominally, but also in real terms, and public finances improve. Conversely, if inflation is linked to a supply shock, as is the case in the current energy crisis, then prices and nominal incomes rise, while real GDP, real disposable income and consumption decrease. Hence, public finances deteriorate substantially due to a decrease in tax bases.

The same also holds when inflationary pressures prove more persistent than expected.

⁷ For a similar accounting exercise for Spain, see de Cos et al. (2016).



Chart 4 Evolution of total tax revenue (TR), primary government spending (TPEXP) and primary balance (PB) since 2018



There is a risk of negative indirect or secondround effects in real terms, as economic agents pass through price rises to wage-price setting in an effort to maintain real wages, potentially leading to a price-wage spiral. To avoid the impact this may have on private agents' inflation expectations, which are a key driver of nominal wages, monetary policy tightening acts to reduce demand-driven inflation. Consequently, interest rates are raised to stop inflation expectations and wage claims from increasing. In this case, however, borrowing costs are rising for the public and the private sector alike, bringing about a worsening in economic and financial conditions.

Primary balance

Broadly speaking, inflation increases tax revenue, government spending and nominal GDP in parallel. However, in the short run, as government spending is only partially indexed and tax revenue increases faster than government expenditure, rising prices would improve the overall primary balance expressed in levels. In other words, for a given quantity of a tax base (e.g. income, consumption), if consumer prices rise, VAT revenue will also rise; if nominal wages and profits rise, personal and corporate income tax revenue as well as social security contributions will also rise.⁸ Nevertheless, this positive effect will quickly dissipate if there are some public expenditures that are indexed to prices (pensions, family benefits, house allowances and minimum income). More importantly, government spending will rise as other expenditure items are gradually indexed, such as civil service salaries, procurement contracts and support measures that governments take to protect the purchasing power of households and limit cost increases for companies.

However, when expressed as a percentage of nominal GDP⁹ (see Chart 4), the effect of the denominator can lead to a deterioration in the respective ratios of the primary balance, tax revenue or primary expenditures. In the case of the Greek economy, starting from 2018 and over a 6-year horizon, despite the significant windfall collected in 2022 and part of 2023, expressed as a percentage of GDP, total tax revenue remains almost the same, while primary expenditures decline, which, aside from

- 8 This should hold true in the case where income tax brackets are not adjusted for the trend of inflation (fiscal drag).
- 9 Which is more relevant from a debt sustainability point of view.



the unwinding of measures, admittedly also entails a strong denominator effect.

Fiscal policy dilemmas

The pandemic took a heavy toll on public finances, leaving a legacy of large deficits and high government debt. Currently, however, amid widespread high uncertainty and an inflation explosion, fiscal policy is confronted with two additional challenges: the first is to manage the impact of persistently high inflation on household and business budgets, so as to enable the continuation of post-pandemic recovery. The second is to simultaneously achieve a faster restoration of sound fiscal positions, by demonstrating flexibility and adaptability (see IMF 2022c, 2022a).

Specifically, the fiscal policy response to an inflation shock is closely associated with inflation persistence. In the short run, when inflation is low and temporary, the challenge for fiscal policy is to strike the right balance between tax rates and public spending, so as to, on the one hand, stimulate a stagnant economy, without, however, creating the risk of a rise in demand-driven inflation, and, on the other hand, safeguard fiscal balance in order to avoid the risk of debt becoming unsustainable. In the long run, if inflation indicators are surprisingly to the upside, the economy is probably at risk of overheating and a price-wage spiral could be in process. Then, monetary policy should react by raising interest rates at the cost of rising sovereign debt costs. A primary surplus is, therefore, required to safeguard debt sustainability, as interest rates rise faster than the inflation rate. Otherwise, if fiscal policy remains expansionary, inflation expectations will become de-anchored and fuel wage-price inflation, resulting in higher inflation rates. Going forward, economic adjustment will be painful, as it will require ever larger interest rate hikes as well as larger primary surpluses (see Blanchard and Pisani-Ferry 2022; Blanchard 2022; Leeper et al. 2019).

Summing up, in the short run, an inflationary shock, defined as a positive difference

between actual (ex post) and forecast (ex ante) inflation, exerts a positive impact on public debt dynamics. The reason is that unexpected, yet moderate, inflation can have a benign short-run effect on the primary balance-to-GDP ratio, since tax revenue is usually expressed as a percentage of nominal GDP. Moreover, when such inflationary surprise is due to shocks on the demand side, the pursuit of a countercyclical fiscal policy in order to stabilise the business cycle and prevent the economy from overheating results in a reiningin of government spending. In the case of costpush inflation, governments usually increase spending (grants and benefits) in an attempt to mitigate the recessionary effects of inflation on real incomes.

However, medium-to-long-term debt and fiscal sustainability depend on price stability, since persistently high inflation has a negative impact on real household and business income, leading to lower consumer and investment spending and, therefore, lower GDP growth. Moreover, persistently high inflation puts pressure on fiscal policy to increase public spending in order to boost domestic demand, thus posing the threat of a price-wage spiral. Monetary policy also comes under strong pressure to control inflation by raising interest rates, which would lead to higher nominal borrowing rates and, thus, higher debt dynamics in the medium term.

4 EMPIRICAL EVIDENCE: THE ECONOMETRIC FRAMEWORK

Our empirical investigation follows the Bayesian adaptation of a standard VAR model¹⁰ based on quarterly data for Greece covering the period 2000 Q1-2022 Q2. The chosen period captures the impact of three milestones on the course of the domestic economy, namely, Greece's entry to the EMU in

¹⁰ We make use of the BEAR toolbox (Dieppe et al. 2016). The employed model does not consider the case of a non-linear Phillips curve, as the one recently developed by Harding, Lindé and Trabandt (2022) to explain post-COVID inflation dynamics.



2001; the sovereign debt crisis of 2010 and the subsequent long-lasting economic crisis; the pandemic and, to a smaller extent, the initial effects of the recent Russian war of aggression in Ukraine. The general specification is as follows:

$$Y_{t} = A_{0} + \Sigma_{i=1}^{p} A_{i} Y_{t-i} + e_{t}$$
⁽²⁾

where Y_t denotes the vector of endogenous variables of the BVAR¹¹ model and *p* denotes lag structure (5 lags utilised). In our analysis, we assume $Y_t = (\pi_t, y_t, r_t, pb_t)$, where π_t denotes the quarterly average of HICP inflation (y-o-y), y_t is the annualised quarterly real growth rate of the Greek economy, r_t is the quarterly average of the 3-month Euribor and pb_t is the primary fiscal balance (expressed as a percentage of quarterly GDP). In the above simplified BVAR specification, we do not consider dynamics related to GDP deflators and debt, abstracting from feedback loops between deficit and debt in line with Bohn's (1998) literature.

We consider two different identification schemes with respect to structural shocks. The first one is the standard Cholesky decomposition of the variance-covariance matrix of the VAR residuals¹² and is used to provide an answer about the general effects of inflation on public finances (Model A).

To address the extent to which supply- and/or demand-driven inflation shocks also have important implications for fiscal policy in the Greek economy, we employ a second identification scheme by means of a sign restrictions version of the Bayesian VAR following the identification strategy of Fry and Pagan (2011), Shapiro (2022) and Jump and Kohler (2022). This identification scheme is used to assess the direct effects of high inflation on the primary balance by distinguishing between demand- and supply-driven shocks to inflation and real growth. In particular, external supplyside shocks related to disruptions in global supply chains and changes in spending patterns due to the COVID-19 pandemic pushed up inflation globally. At the same time, following the lockdowns during the pandemic, demand-side shocks related to pent-up demand¹³ and increased savings were also present and pushed up price inflation. Overall, countries experiencing high inflation immediately after the pandemic and during the war in Ukraine benefited from positive effects in the form of windfall tax revenue that enabled the adoption of measures to support households' income and firms' profits in a high inflation environment.

More specifically, under the second identification strategy (SVAR), we disentangle supply- and demand-driven shocks to inflation, considering the external supply-side shock as a purely cost-push shock that affects inflation and output. To do so, we extend our set of endogenous variables by including crude oil prices denoted by cop_t and denominated in euros (Model B).

Our adopted formation of demand- and supplyside shocks follows an identification strategy based on a standard textbook view.¹⁴ A demand shock moves both prices and real output (i.e. quantities) in the same direction along an upward-sloping aggregate supply curve, while supply shocks move prices and real output in opposite directions along a downward-sloping aggregate demand curve. In the latter case, and to better capture the effects of an external sup-

- 12 As assumed in Box 3, Monetary Policy 2021-2022: Executive Summary and Boxes, Bank of Greece, 2022.
- 13 At the heart of the New Keynesian theory lies the Phillips curve, which posits that inflation deviates from its expected path due to aggregate demand and supply factors. More recently, researchers have pointed to both supply and demand factors to explain the recent post-COVID inflation surge. For example, according to Jordà et al. (2022), strong demand shocks stemming from unemployment assistance, direct household transfers, child support, business loans and other pandemic assistance programmes had sizeable spillovers to inflation dynamics in 2022 in the case of the US economy. On a similar note, Ball et al. (2022) also attribute US inflation dynamics and supply-driven energy price increases, as well as to supply chain disruptions.
- 14 See Jump and Kohler (2022) and Shapiro (2022).



¹¹ Regarding the prior distributions for our BVAR model, we follow its simplest form and employ the Minnesota (or Litterman 1986) prior. In this framework, it is assumed that the VAR residual variance-covariance matrix is known. Moreover, we use optimal hyperparameter values from a grid search based on the seminal paper by Giannone et al. (2012), who propose a procedure that allows selection of hyperparameters that maximise the value of the marginal likelihood for the model. For details, see the BEAR toolbox technical guide.

Sign restrictions for macro model shocks (Model B)		
Variable/shock	Supply-side shock (cop _t)	Demand-side shock (π _t)
$\pi_{_{t}}$	+	+
r_t	+	+
y_t	-	+

ply-side shock, we impose block exogeneity¹⁵ between the domestic variables π_i , y_i , pb_i and cop_i that effectively denotes price-setting at the global level. This assumption can be seen as capturing the relatively small size of the Greek economy compared to other economies that directly affect global supply shocks (e.g. China, the United States, etc.).

The table provides a summary of the sign restrictions imposed to decouple the two types of assumed shocks following Faust (1998), Uhlig (2005) and, more recently, Shapiro (2022). The first column captures an external supply shock in the form of a cost-push shock that negatively affects real growth, while the demand-side inflation shock operates in the opposite way, affecting output positively. Given the current context of monetary policy tightening in the euro area, we also assume a responsive monetary policy that increases interest rates when both types of shocks materialise.¹⁶

5 IMPULSE RESPONSE ANALYSIS

Cholesky decomposition (Model A)

Under the first identification scheme, the typology of structural shocks follows the ordering of the variables in vector Y_t . More specifically, an inflationary shock (sized by one standard deviation) sequentially passes on to real output growth (y_t) , nominal interest rates (r_t) and, lastly, fiscal variables (i.e. the primary balance and its split into total tax revenue and primary spending, expressed as percentages of GDP). Under this assumption, relationships

are defined between reduced shocks in the first period, while every shock can be affected by any other shock in subsequent periods.

We also present scenarios for a differential monetary policy stance, by means of block exogeneity of variable r_i . In more detail, we present the case of an idiosyncratic inflationary shock, where r_i does not react to changes in π_i , y_i , and pb_i (denoted as passive monetary policy (MP) scenario) and compare it to a counterfactual where r_i increases, describing more clearly the case of a homogeneous horizontal shock across the euro area (denoted as responsive MP scenario).

Chart 5 shows the impulse responses to a positive shock to inflation based on our simplified four-variable BVAR model. It follows that the response of monetary policy is instrumental to the impact of inflation (top-right panel) on the macro and the fiscal side. A responsive MP scenario is estimated to be more detrimental to real activity (bottom-left panel), as well as to the primary balance as a percentage of GDP (bottom-right panel). Yet, in the latter case, some visible improvement in the response of the primary balance in the short run is not statistically significant and the same also holds over the medium term, despite some adverse effects resulting from the impact of inflation on real disposable income.

Chart 6 plots the response of total tax revenue and primary spending (both expressed as percentages of GDP) to an inflationary shock, assuming again a responsive monetary policy.¹⁷ The short-run inflexibility of primary spending in levels¹⁸ and the sizeable "denominator effect" yield the estimated adverse impulse

¹⁸ Inflexibility basically reflects persistency of budgetary appropriations during a fiscal year and lower indexation of various spending items as well.



¹⁵ On the formation of block exogeneity and the construction of external supply shocks, see the BEAR toolbox (Dieppe et al. 2016).

¹⁶ We make this assumption as we try to formulate a global supplyside shock where the ECB's monetary policy stance reacts to avoid a de-anchoring of inflation expectations. In the same context, we also abstract from the implied dynamics of GDP deflators.

¹⁷ Actually, we assume no block exogeneity. The case of passive monetary policy conveys similar dynamics to both total tax revenue and primary spending.

Chart 5 Shock to inflation ($\pi(t)$) by one standard deviation: impulse responses under passive vs responsive monetary policy (MP) scenarios



response, when primary spending is expressed as a percentage of nominal GDP.¹⁹ The relatively milder and lagged adverse effects on revenues, observed in the short to medium term, reflect the relatively cyclical nature of tax revenue due to the large share of indirect taxes²⁰ in total tax revenue and their direct link to private consumption and inflation.

Distinguishing inflation shocks into external supply and demand shocks: the sign restriction approach (Model B)

We proceed with the implementation of the assumed sign restrictions in our BVAR context. Chart 7 presents the obtained quarterly series of the demand- and supply-driven inflation shocks. It turns out that the series accord²¹ with the standard narrative concerning the

- 19 According to Bankowski et al. (2023), "...at the euro area aggregate level, the share of automatically indexed expenditure in 2022 is on average one-third of total government expenditure", which effectively leaves the rest of the primary spending items considered relatively less flexible to inflation shocks. In the case of Greece, the spending side indexation remains relatively limited, given the nominal wage freeze in the public sector for almost a decade now and the fact that the pass-through of higher borrowing rates to cash interest payments is very limited due to the virtually 100% share of fixed rate debt and the limited rollover needs.
- 20 According to the OECD (2023), the Greek taxation system traditionally relies heavily on indirect taxes and more specifically on taxes on production and sales.
- 21 Following Känzig (2021), we consider the correlation between the two shocks as a diagnostic control test. We found an admittedly low correlation (+0.18) between the demand and supply shocks, which implies a weak linear dependence between the two.





Greek economy not only during the sovereign crisis in early 2010 but also during the pandemic, when the necessary lockdowns had a negative impact on aggregate demand as well as on aggregate supply, given the global trade disruptions and supply chain bottlenecks. As shown in the chart, the impact of the war in Ukraine has a relatively limited weight, given that our sample period ends in the second quarter of 2022.





Chart 8 Impulse response functions of primary balance (PB) in the case of a demand-side and an external supply-side shock to price inflation



Note: Dashed lines denote statistical significance at the 68% level.



Chart 8 illustrates a comparison of the impulse response of the primary balance (as a percentage of nominal GDP) in the case of a demand and a supply shock to inflation. More specifically, in the short run, despite opposite median estimates (positive in the case of a demand shock and negative in the case of a supply shock), both shocks appear to have an overall insignificant effect on the primary balance-to-nominal GDP ratio. However, in the medium term, our model estimates a statistically significant negative impact in the case of a supply shock (cost-push inflation), which reflects the adverse effects of supply disrup-





Chart 10 Impulse response functions of total tax revenue (TR) and primary government spending (TPEXP) in the case of a demand-side shock

tions on real growth and disposable income. Indeed, during the same period, demand-driven inflation shocks have an insignificant effect on the primary balance, despite positive median estimates.

Charts 9 and 10 plot fiscal responses when replacing the primary balance with its main components, i.e. total tax revenue (TR) and primary spending (TPEXP),²² in the case of a supply- and a demand-driven shock.²³ The analysis provides no evidence of a significant short-run effect on either primary spending or tax revenue²⁴ (as a percentage of nominal GDP) from an external supply shock (see Chart 9). In the medium term, however, a negative impact should be expected on the revenue side, followed by an insignificant impact on total primary spending. These effects mainly capture the adverse first-round effects of a supply-driven inflation shock on households' real disposable income and real output growth.25

In the case of a demand-side shock to price inflation (see Chart 10), the insignificant effect on the primary balance (as a percentage of GDP) is broadly in line with the significant effects on primary spending and total tax revenue that overall cancel each other out in the short to medium run. These effects reverse right after, confirming the previously estimated response of the primary balance in Model A (see Chart 4). Same as before, the estimated short-run decline in primary spending compared to total tax revenue captures the inherent inflexibility of primary spending expressed in levels. At the same time, tax revenue includes both regular tax revenue and tax resources accrued from high energy prices, as the recent energy price hikes generated a considerable increase in government resources.²⁶ Lastly, comparing supply- and demand-driven shocks to inflation, the magnitude of the effects on total tax revenue (TR) follows a ratio of around 1:3. The same also holds in the

22 In doing so, we have also considered a reactive monetary policy followed by block exogeneity on the crude oil price variable (cop_i).

23 The historical decompositions of inflation and real growth with respect to supply- and demand-driven shocks are presented in Chart A1 of the Annex, while Charts A2 and A3 present the impulse response functions derived from Model B.

24 This implies that in the short run the estimated elasticity of nominal GDP and revenues (in levels) should be close to one.

- 25 Negative through the assumed sign restrictions.
- 26 The Energy Transition Fund is responsible for collecting revenues from the auctions of CO₂ rights. This additional source of revenues significantly contributed to the build-up of windfall revenues during the recent Russian war in Ukraine and helped the financing of fiscal measures during the energy crisis.



case of primary spending (TPEXP) (see Charts 9 and 10). This is suggestive of a more sizeable denominator effect in the case of a demanddriven compared to a supply-driven shock to price inflation.

6 CONCLUSIONS

This paper assesses the impact of an inflation shock on public finances in the case of the Greek economy. By means of a Bayesian vector autoregressive model, we quantify the effects of an inflation shock on primary spending, taxes and the primary balance, as well as on real output, by disentangling demand- from supply-driven shocks to inflation. Specifically, our empirical analysis compares a demand-driven inflation shock, which is found to have a significant denominator effect, and a supplydriven inflation shock with a significant negative effect on real growth. While in the short run (up to 4 quarters) one can safely expect tax revenue and primary spending to remain broadly stable when expressed as percentages

of nominal GDP, their medium-term profile is also associated with the nature of the shocks driving inflation hikes.

In particular, in the case of a demand-driven inflation shock, there is a positive, yet insignificant, impact on the ratio of primary balance to GDP, while in the case of a supply-driven inflation shock a clear deteriorating impact is estimated in the medium term (after 4-5 quarters). Lastly, demand-side shocks appear to have a negative impact on both tax revenue and primary spending (expressed in percentage points of GDP), though the two effects cancel each other out, resulting in an insignificant effect on the primary balance, whereas, in the case of an external cost-push inflation shock an adverse impact should be expected on tax revenue and the primary balance (expressed in percentage points of GDP) in the medium term. In conclusion, from a policy point of view, an evidence-based and informed view on the typology of inflation shocks is important for properly assessing the medium-term effects of inflation on fiscal outcomes and debt sustainability per se.



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ANNEX



Inflation

Chart AI Historical decomposition of real output growth and inflation into supply and demand

Source: Authors' own estimations.

Real output growth



Chart A2 Impulse response functions from a Bayesian SVAR in the case of a demand- and a supply-driven inflation shock. Fiscal variable in SVAR: total tax revenue (TR)





Chart A3 Impulse response functions from a Bayesian SVAR in the case of a demand- and a supply-driven inflation shock. Fiscal variable in SVAR: total primary government spending (TPEXP)



