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No Quick Fix: The Recovery and Resilience Plan and External Position in Greece

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No Quick Fix: The Recovery and Resilience Plan and External Position in Greece

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ABSTRACT: Greece has coped with large current account deficits and negative net foreign assets for a long time. Now, the country has an opportunity to address this vulnerability through the European Union's Recovery and Resilience Facility (RRF) and its associated Recovery and Resilience Plan (RRP). The plan involves large public investments and reforms, aimed at boosting Greece's long-term potential. The crucial question is: can this ambitious plan fix Greece's external imbalances over the long run? Using a small open-economy model, we track how the RRP may affect savings, investment, and external balances. We find that: (i) a successful RRP/RRF can correct most of Greece's external imbalances, through a large increase in public savings; (ii) the RRP/RRF is no magic bullet, as prudent macroeconomic policies will remain necessary to lock-in the positive effects over the long run.

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1. Introduction

For a long time, Greece has coped with persistent current account deficits and high external debt, leaving the country vulnerable to changes in external financing conditions. This vulnerability became especially evident during the Greek sovereign debt crisis of the 2010s. Although the country has implemented important reforms and corrected imbalances since then**,** the fundamental problem of external deficits remains a concern. Recent forecasts from the European Commission (EC), the International Monetary Fund (IMF), and the Organization for Economic Cooperation and Development (OECD) point to sustained current account deficits into the foreseeable future (Table 1). Importantly, these external "flow" deficits will come on top of large "stock" deficits: Greece's net international investment position (NIIP) stood at -136% of GDP at end-2023. And both the IMF and the EC expect the NIIP in Greece to remain the weakest among the euro area (EA) countries (EC, 2024b; and IMF, 2024b).

Table 1. Forecasts of Greece's current account balance, % of GDP

Institution	***2022***	***2023***	***2024***	***2025***	***2026***	***2027***	***2028***	***2029***
IMF (April 2024)	-10.1	-6.9	-6.5	-5.3	-4.5	-3.6	-3.1	-3.0
EC (May 2024)	-10.3	-6.3	-5.7	-5.3	-	-		
OECD (May 2024)	-10.1	-6.7	-6.0	-4.0	-	-		

Source: IMF (2024a), EC (2024c), OECD (2024)

This paper investigates whether a major new investment program, the European Union (EU)-funded Recovery and Resilience Plan (RRP), can fundamentally alter Greece's external economic trajectory. The RRP represents a large injection from the EU's Recovery and Resilience Facility (RRF) into the Greek economy: Greece receives about €36 billion (split into €18.2 billion of grants and €17.7 billion in subsidized loans, equivalent to 16% of Greece's 2023 GDP) over the period 2021-26. In parallel, Greece is implementing large investments and structural reforms aimed at boosting Greece's long-term growth potential. However, the crucial question is: will this investment boom lead to a sustainable improvement in Greece's external position or could it be derailed by domestic policy choices? Understanding this issue is vital not only for Greece but also for other countries considering large-scale investment and reform programs. We address this question using a dynamic general-equilibrium model to trace the impact of the RRP/RRF on Greece's external position.

Our main finding is that while the RRP/RRF presents a unique opportunity to put the external position on a more favorable trajectory, its success is not guaranteed. Prudent macroeconomic policies are essential to lock-in the RRP's benign effects that lead to a lasting reduction in Greece's external vulnerabilities. This finding points to a more cautious view on the merits of the RRF than in previous studies, which suggested that the Greek economy will draw significant benefits from the RRF. Most of these focused on the growth dividend through higher investment, labor force participation, and productivity, with the magnitude of the positive effect varying between 2%-6% of GDP by 2026 (Bańkowski et al. 2022; EC, 2024a; Malliaropulos et al., 2021, Pfeiffer et al. 2023). We use the most optimistic assessment as our starting point to demonstrate that the success of the program in terms of growth dividends may not translate into a similar success in structurally reducing

Greece's reliance on foreign borrowing and improve the country's long-term economic stability. We calibrate our baseline scenario to align it with the effects described in Malliaropulos et al. (2021), the most optimistic ex-ante assessment of effectiveness of the RRP/RRF available in the literature. We then analyze the trajectory of savings and investment following a successful RRP/RRF. Understanding the evolution of savings and investment also allows us to examine the current account, external debt and the external balance sheet (the NIIP).

Our dynamic general-equilibrium model sheds light on the interplay between public investment scale-ups, economic growth, and external debt in a small, open economy like Greece. This model belongs to the Debt Investment Growth (DIG) class, capturing important features relevant to the RRP/RRF in Greece: (i) the impact of large public investment scale-ups on output and debt levels; (ii) a detailed fiscal sector with several types of debt and policy rules; and (iii) and the influence of both household and government spending decisions on the balance of payments. The DIG model is widely used to conduct policy experiments in the context of investment scale-ups and structural reforms (Gurara et al., 2019). We conduct some simple yet instructive policy experiments to track the interaction between Greece's external position and changes in fiscal, macroprudential, and structural policies.

Our model offers two main insights. First, a well-executed RRP/RRF can go a long way towards unwinding Greece's external deficits, potentially leading to a substantial improvement in its NIIP. Our baseline scenario shows current account improvements by up to 2.6 percentage points of GDP (relative to a no RRP/RRF scenario) in 15 years, boosting the NIIP by close to 30 percentage points of GDP.

This positive outcome hinges on the RRP's ability to boost public savings, as a successful RRP/RRF generates a substantial fiscal dividend—fiscal balances rise by about 2.6 percentage points of GDP in the same timeframe. The 'implied fiscal balance-current account association' of 0.98 is large compared to empirical estimates in the literature, which typically focus on shorter horizons and examine crises episodes when fiscal policy is driving the external adjustment (Abbas et al., 2011; Abiad et al., 2009; Mohammadi, 2004; Tervala and Watson, 2022). We, in contrast, investigate the external effects of a grant-financed investment surge, accompanied with far-reaching structural reforms.

Second, and critically, we demonstrate that this positive outcome is not automatic—the RRP/RRF is no magic bullet. That is because a successful RRP/RRF could, paradoxically, sow the seeds of new threats to external sustainability. Intuitively, an investment-led economic boom creates pressures (political and otherwise) to use some of the economic dividend to boost consumption instead of repaying debt. If fiscal policy becomes overly expansionary (through large tax cuts) or if households increase borrowing significantly in anticipation of future income gains, the benefits of the RRP could be squandered, leading to much smaller improvements in the external position.

We interpret our findings as underscoring the importance of accompanying reforms and the surge in investments with prudent macroeconomic policies. That is, the RRP/RRF provides an opportunity, but prudent policy choices are essential to lock-in the positive effects over the long run. Greece's own economic experience in the run-up to the sovereign debt crisis in the euro area illustrates the detrimental effects of inappropriately loose macroeconomic policies.

Related literature

Our paper builds on recent studies examining the potential impact of the EU's Recovery and Resilience Facility on the Greek economy. These studies emphasize the RRF/RRP's potential to boost Greece's output through increased investments, productivity, and labor force participation (Bańkowski et al. 2022; EC, 2024a; Malliaropulos et al., 2021; Pfeiffer et al. 2023). This work connects to a broader literature on the economic effects of the EU's structural funds, often framed as fiscal expansions within a monetary union (Becker et al. 2013; Brueckner et al. 2023; Canova and Pappa, 2007 and 2025; Coelho; 2019). Our works extends this enquiry by specifically examining the RRP/RRF's impact on Greece's external position, a relatively neglected aspect to date.

We also relate our analysis to the literature on domestic savings, external balances, and external sustainability. Feldstein and Horioka (1980) found domestic savings to be tightly linked to domestic investment. In contrast, later evidence emphasizes the divergence of savings and investment and its implications for current account balances and external sustainability, particularly in capital-poor countries like Greece (Blanchard and Giavazzi, 2002; Chinn and Prasad, 2003; Giannone and Lenza, 2010; Milesi-Ferretti and Razin, 1996; Obstfeld and Rogoff, 2005 and 2009; Lane and Milesi-Ferretti, 2012). Our model reprises the positive co-movements between savings and investment for Greece, as the investment boom is grant-financed and leading to permanently higher incomes. We integrate the RRF as a crucial new factor shaping Greece's macroeconomic outlook and examine how policy responses to the RRP/RRF can influence the trajectory of external balances.

Methodologically, our paper employs a dynamic general equilibrium model, building on a body of work that uses models to assess macroeconomic consequences of public investment scale-ups (Berg et al., 2013; Guara et al. 2019; Melina et al., 2016; Deléchat et al., 2015; and Aligishiev and Moreau, 2024). Our DIG model allows us to unpack the interplay between public investment, domestic policies, private-sector responses, and external balances over the long run in Greece.

The rest of the paper flows as follows: Section 2 characterizes Greece's external position; Section 3 presents the intuition for why the RRP/RRF can affect domestic savings and external balances; Section 4 and 5 present our model and calibration, and Section 6 and 7 present the baseline results, as well as a set of policy experiments. Section 8 concludes.

2. Greece's external position

Figure 1 shows Greece's NIIP over time, compared with those of the other euro area countries that received financial assistance during the sovereign debt crisis. Greece's NIIP was the most negative across all euro area countries at the end of 2023. In the run-up to global financial crisis, Greece recorded large current account deficits, which led to sharp increases in external indebtedness. From 2009 onwards, the Greek economy started to shrink precipitously, worsening the debt burden—from peak to trough, real GDP per capita declined by 25%, an economic depression unparalleled in modern economic history (Chodorow-Reich et al., 2023). Greece suffered large fiscal deficits and a severe banking crisis, which added to the country's external debt burden.

Greece is a large net debtor to the rest of the world. Typically, high external debt leaves a country susceptible to swings in external financing conditions (Lane and Milesi-Ferretti, 2012). But this worry only applies to a limited extent to Greece over the next few years. About two-thirds of Greece's external liabilities are held by public-sector creditors at ultra-long maturities with low interest rates. External financing needs are projected to be relatively low, helping to insulate Greece from vagaries in external financing conditions.

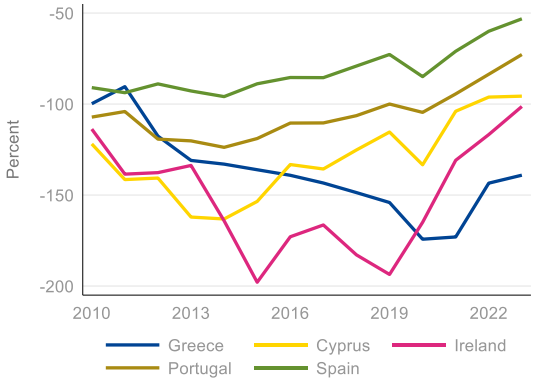
Ultimately, however, the net debtor position implies that Greece will need to generate external surpluses for a sustained period. Greece's own history would justify some skepticism. For over 40 years, Greece's current account was never in surplus, averaging -5% of GDP (compared to a surplus of +1% of GDP for the EU/EA over the same period).

The investments and reforms under the RRP/RRF are designed to address Greece's specific vulnerabilities that have stymied productivity and potential growth. Sectors that will receive significant new investments include green energy, digital infrastructure, health, and education and training. Reforms aim at strengthening the efficiency of the public administration, the judicial system, tax administration, and public investment management.

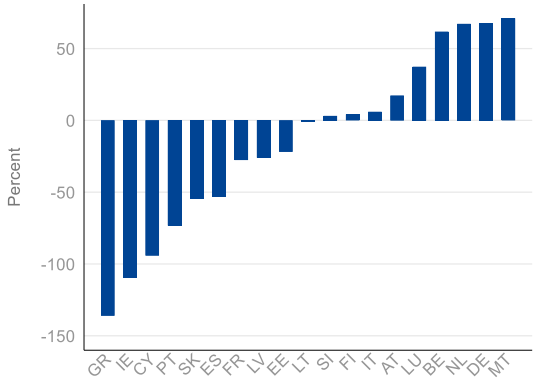
Figure 2 shows a sharp decline in Greece's net capital stock, which helped boost the return on capital—suggesting significant potential for new productive investments. According to the intertemporal theory of the current account, a capital-poor country like Greece can optimally run current account deficits to finance investments, provided these investments generate sufficient future returns. If RRF-funded investments are allocated efficiently, they will generate returns that exceed their cost of funds, leading to higher future output. To assess whether Greece's current account deficits can be consistent with this theory, we examine the potential impact of the RRF/RRP on national savings and investment, taking into account both the expected returns and intertemporal consumption-smoothing behavior—the topic we address in the next section.

Figure 1: Net international investment position (in % of GDP)

1.a Euro area countries with financial assistance programs during the sovereign debt crisis



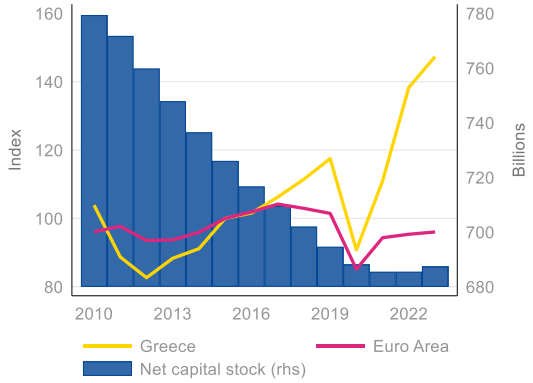
1.b Euro area countries at end-2023



Note: The first panel shows the net international investment position (in % of GDP) of the five euro-area countries that received financial assistance during the sovereign debt crisis. The second panel shows the net international investment position as of Q4 2023.

Source: AMECO, Eurostat.

Figure 2: Return on capital (Index; 2015=100) and net capital stock (in € billion)



Note: The chart shows returns on capital, calculated as net domestic income minus compensation of employees, divided by the current price of the net capital stock and expressed as an index that is equal to 100 in 2015. The net capital stock at constant prices is calculated as last year's value of the capital stock plus gross fixed capital formation minus the consumption of fixed capital.

Source: AMECO (Spring 2024).

3. National savings and the RRP/RRF

The current account equals the difference between gross national savings and gross capital formation (investment). Over time, the current account determines the NIIP (along with changes in the value of external assets and liabilities often associated with exchange rate movements). For that reason, we examine more closely the dynamics of national savings compared to investments.

Figure 3 shows the long-run average of the savings-investment balance for public and private sectors in Greece and the EA. Greece's external deficits over the past ten years are rooted in weak private-sector savings, rather than in the public sector. True, before the sovereign debt crisis, the savings-investment balance of the public sector in Greece was deeply negative. However, under the macroeconomic adjustment programs (2010-18), fiscal balances adjusted significantly, which helped to bring the public savings-investment balance closer to the average of the euro area. The private savings-investment balance held up well during the first part of the sovereign debt crisis but deteriorated from 2015 onwards.

A detailed look into the private-savings investment balance reveals that the household sector saves abnormally little in Greece, whereas corporate savings are close to the euro area average (IMF, 2022). The causes of low household savings in Greece are manifold: low labor force participation (especially by females and youth), low income per capita (Greece's income per capita at purchasing power parity is among the lowest in the euro area), and informality (estimates of informal income range between 20-30% of the size of the official economy; see Schneider and Asllani, 2022). Being underemployed, poor, and embedded in informal economic structures all contribute to reduced savings (Le Blanc et al., 2016).

The relationship between informality and savings deserves special attention. Pervasive informality is associated with low productivity and wages, and limited access to formal financial services (La Porta and Shleifer, 2014). People active in the informal economy often face low and unstable income. Low incomes relative to the cost of living constrain the ability to save: only 9% of the poorest 40% of the adult population in Greece were able to save any money (GPFI and World Bank, 2021). Informality may have also been a main transmission channel in the sovereign debt crisis in Greece, when large tax increases drove an increasing share of activity in the shadow economy, reducing tax revenue and precipitating a fiscal doom loop (Dellas et al. 2024).

In the context of low incomes and pervasive informality, the RRP/RRF can be particularly effective in stimulating incomes and savings. Two channels are worth highlighting:

- The RRF-financed investments and reforms directly aim at shrinking the size of the informal sector (EC, 2021), by making formal sector participation more attractive, easier to achieve, and harder to avoid. Modernizing and digitalizing government processes aim at lowering bureaucratic hurdles. Investments in improving tax collection capacity (rolling out electronic invoicing and real-time reporting systems) raise the threshold for businesses to operate informally. Financial and technical assistance to small and medium-sized enterprises (SMEs) provide additional support in formalizing their operations.

- RRF investment will raise the stock of public capital, which can positively affect the productivity of all other factors of production. Investments in green energy, 5G/fibreoptic infrastructure, and digital labour skills address binding growth constraints, which could significantly increase the number of higher-paying jobs in the formal economy.

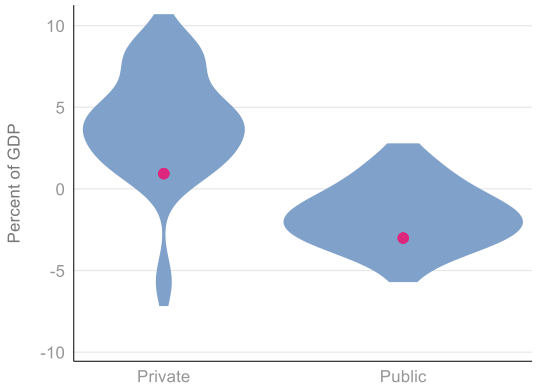
Lower informality would lead to more stable and predictable income for poor households. The shift towards formal employment may increase access to financial services and savings instruments, further facilitating savings (Karlan et al., 2014). Simultaneously, the productivity gains from RRF-financed investments would lift incomes onto a higher trajectory.

Annex I shows that Greece is the main beneficiary of financial support under the RRF in the euro area (when measured relative to the size of the economy). The implementation of the RRP has been progressing relatively well—Greece has successfully unlocked more than half of its allocated resources as of the first quarter of 2025. This progress suggests that the mechanisms for potentially boosting national savings are being put into place, though their full impact remains to be seen.

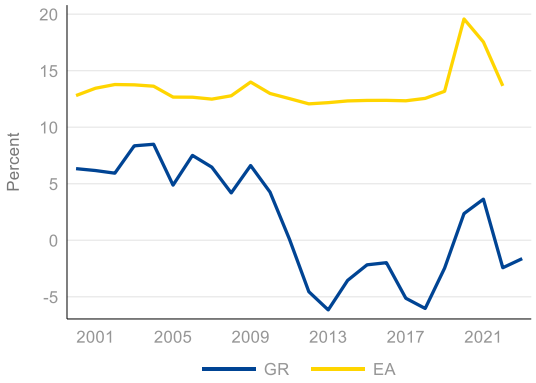
The next section explores the link between the RRP/RRF, national savings, and external balances in a systematic model-based approach.

Figure 3: National savings and investment

3.a Distribution of euro area public and private savings-investment balances



3.b Greece's household savings rate



Note: The first panel shows the density distribution of the 10-year average savings-investment balance of private and public sectors for all euro area countries (weighted equally). The width of the curve corresponds to the frequency of the data, estimated using VIOLINPLOT (Jann, 2022). The pink dot marks the 10-year average for Greece. The second panel shows the household savings rate for Greece and the euro area aggregate.

Source: AMECO, IMF staff calculations.

4. Modelling the domestic savings and the external position

Our starting point is the Debt, Investment, Growth (DIG) model (Melina et al., 2016).[2] This model is a flexible-price small open-economy dynamic general equilibrium model that aims to trace the macroeconomic effects of public investment scale-ups and economic reforms on long-run debt sustainability (Gurara et al., 2019). The model distinguishes between optimizing households who can borrow abroad and financially constrained households, as well as between firms operating in traded and non-traded good sectors. Prices are perfectly flexible, which allows us to abstract from monetary policy, incomplete exchange-rate pass-through, and differences between intra- and extra-currency union trade flows.

We focus on the paths of the investment-savings balance and external sector variables (the current account, external debt and the NIIP), which are determined by the underlying behavior of optimizing households and firms. We solve the model with a fully non-linear perfect foresight solution method, where households know the government's fiscal reaction function and anticipate their future income path. This section highlights the main features of the model and their relationship with the external position. For the full set of equations, see Annex V.

Production

Firms operate in the tradable and non-tradable sectors, with a representative firm in each sector choosing capital and labor as input to maximize discounted lifetime profits. The public investment scale-up from the RRP/RRF is assumed to be productive but subject to diminishing returns. Following Fournier and Koske (2010), we capture the productivity-enhancing and product market reforms (part of the RRP package) through a permanent, gradual increase in total factor productivity. Higher public capital and total factor productivity raise productivity of private factors and increases real output through:

$$y_{i,t} = z_{i,t}\left(k_{i,t-1}\right)^{1-\alpha_i}\left(L_{i,t}\right)^{\alpha_i}\left(k_{G,t-1}\right)^{\alpha_G} \quad \text{for } i = T, NT$$

where $y_{i,t}$ is the real sectoral output; $z_{i,t} = \overline{z_i} + \varepsilon_t^{TFP,RRP}$ is the total factor productivity; $L_{i,t}$ is labor input; $k_{i,t}$ and $k_{G,t}$ are private and public capital respectively. $\alpha_G \in (0,1)$ and $\alpha_i \in (0,1)$ govern the return on public capital and the labor share in production, respectively. *i* indexes the *traded* and *non-traded* sectors of production. The level of public capital is the sum of the stock of capital in the previous year, net of depreciation, and the new effective public investment. Formally:

$$k_{G,t} = \left(1 - \delta_{G,t}\right)k_{G,t-1} + \epsilon\left(g^I + \varepsilon_t^{I,RRP}\right)$$

[2] We use the latest member of the family, known as DIGNAR-19 model (Aligishiev et al., 2021). We can use TFP shocks and shocks to the disutility of labor to match model-based projections to external projections from other sources. We use this approach to align the model to the key results in Malliaropulos et al. (2021); see Annex III for details.

where $g_t^I = g^I + \varepsilon_t^{I,RRP}$ is the total public investment, including the RRP investment spending; $\delta \in (0,1)$ is the depreciation rate; and $\epsilon \in (0,1]$ governs the efficiency of public investment. Higher public investment expenditure increases the capital stock, which in turn increases the marginal product of private capital. Similarly, reforms directly increase the marginal product of capital. Higher marginal product of capital incentivizes the private sector to match higher public expenditure with more private investments.

The increase in public investment and total factor productivity also lifts domestic interest rates, since the domestic risk-free interest rate is linked to the expected return on domestic private physical capital (in both sectors) through:

$$R_t = (1-\delta_i) + E_t\left[\left(1-\overline{\tau^k}\right)(1-\theta_{t+1})(1-\alpha_i)p_{i,t+1}\frac{y_{i,t+1}}{k_{i,t}}\right] \quad \text{for } i = T, NT$$

where zero adjustment costs are assumed for simplicity, R_t is the gross interest rates on domestic bonds, $\left(1-\overline{\tau^k}\right)(1-\vartheta_t)(1-\alpha_i)p_{i,t}\frac{y_{i,t}}{k_{i,t-1}}$ is the marginal product of capital in traded and non-traded good sectors. The marginal product of capital is subject to a constant distortionary capital tax τ^k and a capital market distortion ϑ_t, which lowers investment. The degree of distortions reacts to the inflow of official capital under the RRP/RRF:

$$\frac{\vartheta_t}{\overline{\vartheta}} = exp\left(-\eta_\theta(k_{G,t} - \overline{k_G})\right)$$

where η_θ governs the sensitivity between the size of the distortion and the RRP investments. This relationship allows the model to approximate the catalyzing role of the RRP/RRF on private investment in Greece, allowing for persistent effects.

Households

The model incorporates two types of households. Both optimizing households and rule-of-thumb (RoT) households optimally set their labor supply. The reforms under RRP/RRF will affect households' labor/leisure trade-off (see section 5). . Formally, the household's labor supply is given by:

$$\varepsilon_t^{\kappa,RRP}\kappa^j = \lambda_t^j(1-\tau_t^L)w_t\left(L_t^j\right)^{-\psi} \quad \text{for } j = OPT, ROT$$

where L_t^j is the labour supply by each household type, w_t is the aggregate wage index, τ_t^L is the labor tax, λ_t^j is the marginal utility of consumption, and $\psi \geq 0$ is the inverse of Frisch elasticity of labor supply. $\kappa^j > 0$ is a parameter affecting the disutility of labor, while $\varepsilon_t^{\kappa,RRP}$ is a shock to the disutility of labor from structural reforms. Negative values of ε_t^{κ} increase the labour supply and put downward pressure on wages.

The response of aggregate consumption to a positive shock to productivity and investment depends on several factors. Optimizing households maximize life-time utility. Anticipating higher future income due to the RRP/RRF, they will want to increase current consumption. On the other hand, higher real domestic interest rates and the anticipated changes in the consumption tax rate are reasons to defer consumption to later periods. The relative strength of these two opposing channels is determined by the degree of risk aversion

(Fournier and Koske, 2010). This can be seen by augmenting the typical Euler equation with optimizing household income i_t as follows:

$$\left(\frac{c_{t+1}^{OPT}/i_{t+1}}{c_t^{OPT}/i_t}\right)^{\sigma} = \beta R_t \frac{(1+\tau_t^C)}{(1+\tau_{t+1}^C)} \left(\frac{i_{t+1}}{i_t}\right)^{-\sigma}$$

where c_t^{OPT} denotes consumption of the optimizing households, i_t denotes income of the optimising household, $\tau_t^c$is a distortionary consumption tax rate. $\sigma \geq 0$ and $\beta \in (0,1)$ are the risk aversion parameter and the discount factor respectively. Larger values of σ amplify the impact of tax and interest rate changes on consumption.

RoT households do not respond to anticipated improvements in productivity, which dampens the relationship between aggregate consumption and future productivity gains. RoT households are unable to smooth consumption over time. Aggregate consumption is given by:

$$c_t = \omega c_t^{OPT} + (1-\omega) c_t^{ROT}$$

where $c_t^{ROT}$is the consumption of the RoT household and ω is the share of optimising households. Consumption of the representative RoT household rises only when income rises or when consumption taxes are lowered. The introduction of user fees for public capital and the reduction in wages due to labor market reforms exert downward pressure on current income:

$$c_t^{ROT} = \frac{(1-\tau_t^L) w_t L_t^{ROT} + s_t rm^* + z_t - \mu k_{G,t-1}}{(1+\tau_t^C)}$$

where s_t is the real effective exchange rate, rm^* are remittances received from abroad (set at steady state level), z_t denotes government transfers, and $\mu k_{G,t-1}$ are the user fees for using government infrastructure. Lower values of ω reduce the positive relationship between aggregate consumption and future income growth.

Relative prices

Relative prices play an important role in determining the effects of the RRP/RRF. The model explicitly considers three relative prices for goods: the price of domestically produced traded good $p_{TH,t} \equiv \frac{P_{TH,t}}{P_t}$, the price of non-traded good $p_{N,t} \equiv \frac{P_{N,t}}{P_t}$, and the real effective exchange rate $s_t \equiv \frac{P_{F,t}}{P_t}$, which reflects the domestic price of the foreign (imported) good. These relative prices are directly linked to the composition of demand and therefore affect exports and imports.

A key determinant of relative prices is the home bias in private and public expenditure. Increases in consumption and investment due to the RRP/RRF, whether public or private, generally raise prices of domestically produced goods. However, relative prices in one sector may rise more than in another due to expenditure bias. For example, consider the relative demand functions for private consumption:

$$p_{N,t}^{\chi} c_{N,t} = \varphi c_t$$

$$p_{T,t}^{\chi-\chi^T} p_{TH,t}^{\chi^T} c_{T,t} = \varphi^T (1-\varphi) c_t$$

where $c_{T,t}$ and $c_{N,t}$ denote the domestic consumption of traded and non-traded goods, respectively. The parameter $\varphi \in (0,1)$ indicates the share of non-traded goods in aggregate consumption, and $\varphi^T \in (0,1)$ denotes the share of domestically produced tradable goods in the total consumption of traded goods.[3]

The response of relative prices in two sectors of the economy (to an increase in aggregate consumption) is governed by the respective spending biases and the intra-temporal elasticities of substitution: $\chi > 0$ for traded vs. non-traded goods, and $\chi^T > 0$ for domestically produced vs imported traded goods. Exports react more strongly if the share of non-traded goods φ is larger than the share of traded goods $\varphi^T(1-\varphi)$ in aggregate consumption. A similar logic applies to biases in investment.

Finally, the model allows for the composition of government expenditure between traded and non-traded goods to deviate from its steady-state value. The reason is that the new government spending under the RRP/RRF skews to imported goods compared to average government spending. Formally, the share of non-traded goods in government purchases is given by:

$$\nu_t = \frac{\left(\overline{p^G g}\right)\nu + \left(p_t^G g_t - \overline{p^G g}\right)\nu^*}{p_t^G g_t}$$

where ν is the steady state share of non-traded goods in government expenditures and ν^* is the share of non-traded goods in additional fiscal expenditures.

Relative prices also depend on the labor market. On the demand side, higher productivity lifts sectoral output, lowers relative prices, raises labor demand, and increases average wage in both sectors through:

$$\frac{w_{i,t}L_{i,t}}{p_{i,t}} = \alpha_i y_{i,t} \quad \text{for } i = T, NT$$

where $w_{i,t}$is the average sectoral wage and $\alpha_i \in (0,1)$ is the labor share in production. A higher α_i leads to a larger wage increase.

On the supply side, the labor market reforms increase the supply of labor in the two sectors, lowering wages and prices through:

$$\left(\frac{w_{i,t}}{w_t}\right)^{-\rho} L_{i,t} = \theta_i L_t \quad \text{for } i = T, NT$$

where $\theta_i \in (0,1)$ denotes the steady-state share of each sector's i aggregate labour supply, and $\theta_T + \theta_N = 1$, and $\rho \geq 0$ governs the degree of labour mobility. Higher θ_i translates into larger reduction in wages following labor market reforms. The model accounts for differences in labor share in output and imperfect mobility between sectors, allowing for asymmetric effects on sector prices and changes in relative prices due to the RRP/RRF.

[3] The total steady-state home bias in domestic consumption is given by $\varphi^T(1-\varphi)+\varphi$.

External sector

The trade balance reflects the relative response of domestic absorption and output, which in turn depends on composition of the RRP/RRF—such as the split between public investment and consumption, the impact on labor supply and productivity. Formally, the trade balance can be represented as:

$$tb_t = y_t - c_t - i_t - p_t^G g_t^I - p_t^G g_t^C - \Theta_t^{OPT*}$$

where $tb_t \equiv p_{TH,t}x_t - s_t m_t$ represents the trade balance, which is equal to total exports minus total imports, expressed in terms of the domestic consumption basket price. y_t denotes aggregate output, $p_t^G g_t^I$ is government investment, $p_t^G g_t^C = p_t^G\left(\overline{g^C} + \varepsilon_t^{C,RRP}\right)$ is government consumption including spending under the RRP/RRF, c_t and i_t are aggregate consumption and investment, respectively. Θ_t^{OPT*} are portfolio adjustment costs.

However, the current account also depends on primary and secondary income flows, such as those associated with the RRP/RRF and the costs of servicing Greece's external debt:

$$ca_t^d = tb_t + s_t rm^* + s_t gr_t^* - (\overline{R_d} - 1)s_t d_{t-1} - \left(R_{dc,t-1} - 1\right)s_t d_{c,t-1} - (R^* - 1)s_t b_{t-1}^*$$

where $s_t rm^*$ denote net remittances, $s_t gr_t^* = s_t(\overline{gr^*} + \varepsilon_t^{GR,RRP})$ denote official grants including those funding the RRP/RRF, $(R^* - 1)s_t b_{t-1}^*$ are interest payments on external private debt, while $(\overline{R_d} - 1)s_t d_{t-1}$ and $\left(R_{dc,t-1} - 1\right)s_t d_{c,t-1}$ are interest payments on external public commercial and concessional debt, respectively.

The sign and magnitude of the current account balance response, combined with the valuation changes from movements in the real effective exchange rate determine the path of the NIIP during and after the implementation of the RRP/RRF:

$$NIIP_t = \frac{s_t}{s_{t-1}} NIIP_{t-1} + \frac{ca_t^d}{s_t}$$

The NIIP reflects improvements in the current account balance. The current account mirrors the financial account, which in turn reflects the effects of fiscal surpluses used to repay external public debt. Formally:

$$ca_t^d = s_t fa_t = s_t(\Delta d_t + \Delta d_{c,t} + \Delta b_t^* + \Delta b_{EU,t}^*)$$

where fa_t is the financial account balance, b_t^* is the external private debt, while $d_{c,t}$ and d_t are the external public concessional and commercial debt, respectively. Δ denotes the first differences.

Fiscal rule and debt repayment

The stimulus generated by the RRP/RRF significantly affects public finances. The RRP/RRF leads to sizeable increases in government investment and consumption and a larger tax base. A fiscal rule determines the policy reaction to these developments. The government's budget constraint is given by:

$$p_t^G g_t^I + p_t^G g_t^C + z_t + (\overline{R_d} - 1)s_t d_{t-1} + (R_{dc,t-1} - 1)s_t d_{c,t-1} + (R_{t-1} - 1)b_{t-1}$$
$$= \tau_t^C c_t + \tau_t^L w_t L_t + (1 - \mu^K)\overline{\tau^K}(r_{T,t}^K k_{T,t-1} + r_{N,t}^K k_{N,t-1}) + \mu k_{G,t-1} + s_t g r_t^* + s_t \Delta d_t + \Delta b_t$$
$$+ s_t \Delta d_{c,t}$$

where b_t is the public domestic debt held by the optimizing households, μ^K is the share of the capital tax receipts paid back to optimizing households through rebates.[4] The external position also depends on fiscal policy. Expansionary fiscal policies can fuel consumption and imports, create wage pressures that undermine exports, and reduce the resources available to the government to repay foreign debt. The government uses distortionary consumption taxes to adjust the fiscal balance with a lag to deviations from a balanced budget rule, which is equivalent to stabilizing the debt-to-GDP ratio over the long term:

$$\tau_t^C - \tau_{t-1}^C = \zeta\left(\overline{\tau^C} + \frac{GAP_t}{C_t} - \tau_{t-1}^C\right)$$

where $\frac{GAP_t}{C_t}$ is the deviation from the target position of a balanced budget (positive values correspond to a fiscal deficit), relative to consumption, and $\zeta \geq 0$ is the parameter that governs the speed with which the government closes the fiscal gap through changes in consumption taxes. We assume that consumption taxes are the only domestic fiscal instrument available to the government to stabilize debt.[5] The logic of the rule is that the government raises (cuts) the tax rate in response to increases (decreases) in the fiscal deficit but does so gradually.

Public debt therefore accommodates a temporary mismatch between revenues and expenditures. The government chooses between domestic and external commercial debt according to:

$$\varkappa \Delta b_t = (1 - \varkappa)s_t \Delta d_{c,t}$$

where $\varkappa \in [0,1]$ governs this split, such that only external commercial debt is used to cover the fiscal gap when $\varkappa = 1$. The responsiveness of the tax rate to (unexpected) changes in fiscal balances affects the external position through several channels. For example, if the tax rate drops quickly in response to fiscal surpluses (corresponding to a negative fiscal gap), aggregate consumption will increase. The intertemporal profile of the boost to consumption, however, depends on the entire expected path of fiscal surpluses. Additional cuts in the tax rate in the future encourage optimizing households to shift some of their consumption to later periods (the trajectory of future tax rates is downward sloping). Tax adjustment also affects labor supply, as the marginal utility of consumption falls relative to the marginal utility of leisure, driving up wages. The subsequent reduction in labor input diminishes the marginal product of capital, thereby moderating the surge in private investment.

[4] Importantly, the capital tax is levied on the firm owned by the optimizing household in the model.

[5] For the purposes of this exercise, we limit fiscal adjustment to consumption tax only, setting other fiscal instruments to their respective steady state values. Formally, $z_t = \bar{z}$ and $\tau_t^L = \overline{\tau^L}$.

Higher wages, in turn, weaken exports and increase imports as the real exchange rate appreciates. Additionally, tax cuts result in smaller fiscal surpluses, which curtails the reduction in foreign debt and limits the improvement in the financial account.

Private capital inflows

More foreign borrowing amplifies the positive response of consumption during the initial phase of the RRP/RRF. Consistent with empirical evidence, our model assumes an inverse relationship between private capital inflows and the stringency of macroprudential policies (Eller et al., 2021). We approximate this relationship in a reduced-form approach by adjusting the parameter that determines the cost of issuing bonds to foreign investors.

As domestic interest rates increase, the relative cost of borrowing from abroad declines, with the foreign interest rate fixed at R^*. The inflow of foreign capital causes the real exchange rate to appreciate. This stimulates imports (relative to the demand for domestically-produced goods) and weighs on exports. The strength of this channel depends on the elasticity of portfolio adjustment costs $\eta^* > 0$ through:

$$R_t = E_t\left[\frac{s_{t+1}R^*}{s_t - \eta(b_t^{OPT*} - b^{OPT*})}\right]$$

where $b_t^{OPT*} = \frac{b_t}{\omega}$ is the stock of foreign debt by the optimizing households. These adjustment costs represent any extra costs the private sector faces when borrowing from abroad. In our interpretation, they depend on macroprudential policies that are a significant determinant of the costs of foreign borrowing. Looser macroprudential policies lower the costs of foreign borrowing, leading to an increase in private external debt.

Exports penetration and the terms of trade

The RRP/RRF affects exports throughs its effect on the supply of output of the traded sector and the relative demand for foreign goods. Formally:

$$\frac{x_t}{\bar{y}} = \left(\frac{s_t}{p_t^{TH}}\right)^{\chi^x}$$

where $\frac{s_t}{p_t^{TH}} = \frac{P_t^F}{P_t^{TH}}$ represents the terms of trade, $\bar{y}$ is the steady state external demand (exogenous to the model), and χ^x governs the sensitivity of exports to a change in the terms of trade. A lower χ^x implies that a larger reduction in relative prices is needed to achieve a given boost to exports—we think of the parameter as measuring the ease of export penetration in world markets.[6]

If the RRP/RRF succeeds in lowering the relative price of domestically produced tradeable output, exports will increase. If export penetration is challenging (implying a larger value for χ^x), the relative price

[6] Another way to define χ^x is as the Armington elasticity of substitution—the percentage change in foreign demand for Greek goods in response to a 1% change in their relative price. A lower elasticity implies that Greek and foreign goods are highly differentiated, meaning that even a large reduction in domestic prices may not significantly boost demand for Greek goods.

decline will be larger, which entails: (i) a larger shift of domestic demand toward traded goods; (ii) lower wages and labor income in the tradeable sector; and (iii) lower marginal productivity of capital and lower investment. Higher domestic demand for traded goods, combined with reduced output in the traded sector, can (partly) offset the decline in demand for imports, limiting the improvement in the overall trade balance.

To conclude the description of our model, we highlight several limitations. First, foreign direct investment is omitted, and the RRF/RRP only affects domestic investment endogenously through higher public capital and productivity. Second, the model does not include a detailed banking sector or different macroprudential instruments. Third, the model does not consider the possibilities of defaults and sudden stops, which means borrowing behavior and conditions do not reflect these risks (for example, Mendoza, 2010; and Bianchi, 2011; incorporate these risks and show that they can lead to more cautious borrowing behavior and higher current account balances). Finally, the model does not cover the informal sector, which could amplify the benefits of the RRP/RRF and does not incorporate demographic or lifecycle considerations. We leave the exploration of these limitations in the DIG model for future research.

5. The RRP/RRF shock and model parameters

We model the RRP/RRF through six different shocks: an increase in official grants ($\varepsilon_t^{GR,RRP}$), public investment ($\varepsilon_t^{I,RRP}$), public consumption ($\varepsilon_t^{C,RRP}$), official loans ($\varepsilon_t^{LN,RRP}$), total factor productivity ($\varepsilon_t^{TFP,RRP}$), and a reduction in the disutility of labor ($\varepsilon_t^{\kappa,RRP}$). In this section, we discuss the construction of these shocks and some of the model's crucial parameters, which determines both the magnitude and direction of the effects.

The RRP/RRF is at its core a significant ramp-up in public capital. The financial flows from the RRF (disbursements of grants and loans to Greece, as well as the associated spending by the government) correspond to the publicly available schedule at the time of writing (Hellenic Republic, 2023). We assume a €18.2 billion increase in official grants ($\varepsilon_t^{GR,RRP}$) that splits into 2/3 public investment spending ($\varepsilon_t^{I,RRP}$) and 1/3 public consumption ($\varepsilon_t^{C,RRP}$), in line with current government plans.[7] After the implementation phase of the RRP/RRF, government investment remains permanently higher to replace depreciating capital. The funding for depreciation-related investment does not come from EU grants (shocks to grants). The loans of €17.7 billion ($\varepsilon_t^{LN,RRP}$) increase external liabilities in line with the current disbursement schedule and are carried forward for a ten-year grace period before equally sized repayments start over a twenty-year period. Figure 4 displays the shock series, expressed in percent of 2020 GDP (€167.5 billion).

The RRP/RRF contains an ambitious reform agenda to modernize the economy. Reforms aim at boosting productivity, upskilling the labor force, reducing labor market barriers, and expanding childcare services. We approximate these reforms by setting sequences of TFP ($\varepsilon_t^{TFP,RRP}$) and labor disutility shocks ($\varepsilon_t^{\kappa,RRP}$) such as to match exactly the profile for GDP and employment from 2021 to 2030 in Malliaropulos et al. (2021) (see Annex III for details).[8] According to their results, the overall effect of the RRP/RRF on GDP and employment is 7 and 3.9 percent (relative to the initial steady state), respectively, over a period of ten years.

The model is calibrated at an annual frequency by matching the steady state to the data on the Greek economy. The risk aversion parameter σ is set at 1.78, to match the intertemporal elasticity of substitution estimated for Greece in Havranek et al. (2015). Following Papageorgiou (2014), we assume that 65% of households are optimizers and the inverse-Frisch elasticity ψ is 1. Following Bom and Ligthart (2014) and Calderón et al. (2015), the output elasticity to public capital α_G is 0.083.

The steady-state allocation of demand across traded, non-traded, and imported goods is calibrated using OECD Input-Output tables for 2019. The bias in private demand is set at φ = 0.366 and φ^T = 0.781. Accordingly, the domestic private consumption basket breaks down as follows: 40.5% of domestic traded

[7] Importantly, RRP grants are budget-neutral transfers that do not directly alter the fiscal gap or trigger adjustments in the model's fiscal rule. However, their use can indirectly affect the fiscal gap through the endogenous decisions of households and firms within the model (e.g., by affecting firm productivity).

[8] For a more granular approach to modelling market distortions and structural reforms, see Malliaropulos (2021). Importantly, capturing reform shocks using total factor productivity is an approximation. Product market reforms, when modeled as shocks to markups and barriers to entry, can generate quantitatively different trajectories for certain endogenous variables. However, the key headline indicators would follow similar paths to those observed in our approach.

goods, 34.9% of domestic non-traded goods, and 24.6% of imports. The composition of private investment is identical.[9]

The composition of government purchases is: 6% of domestic traded goods, 88.7% of domestic non-traded goods, and 5.3% of imports. As mentioned above, the RRF/RRP spending has a greater share of traded goods, as certain components (such as green investments) require imports. Accordingly, we set ν = 0.887 and ν^* = 0.33.[10] The elasticity of substitution between non-traded and traded goods is set at χ=0.44, following Stockman and Tesar (1995). We set the elasticity of substitution between domestic traded and imported goods at χ^T = 1.5, which is lower than the Armington elasticity linked to Greek exports (see below). Greece faces greater difficulty in reducing its reliance on imports than the global market in substituting away from Greek exports.

Labor income shares in the traded and non-traded sectors are both set at $\alpha_T = \alpha_N$ =0.6323, following Papageorgiou (2014). Greece's traded sector has a greater labor intensity compared to standard open economy models, largely due to the significant weight of the tourism industry.

The steady-state efficiency of public investment is set at 87%, aligning with the average public investment efficiency for the EU (Baum et al., 2020). To account for the positive impact of the loan-financed component of the RRP on private investment, we set the adjustment costs for private capital at 5—only one-fifth of the value used by Melina et al. (2016). Exports are assumed to respond to changes in the terms of trade, with the elasticity of substitution between traded Greek and foreign goods χ^x (Armington elasticity) set at 2.6 (Bajzik et al., 2020). The government's fiscal response to changes in the fiscal gap is small, with the fiscal reaction parameter ζ set to 0.02. This implies that the government accommodates changes in the fiscal gap primarily through net external borrowing—in our baseline, this assumption means that the government uses fiscal surpluses derived from the RRP/RRF for the repayment of external debt (i.e. we set $\varkappa = 1$). Finally, optimizing households face significant portfolio adjustment costs that limit their foreign borrowing under the baseline, with η^* set at 1.[11]

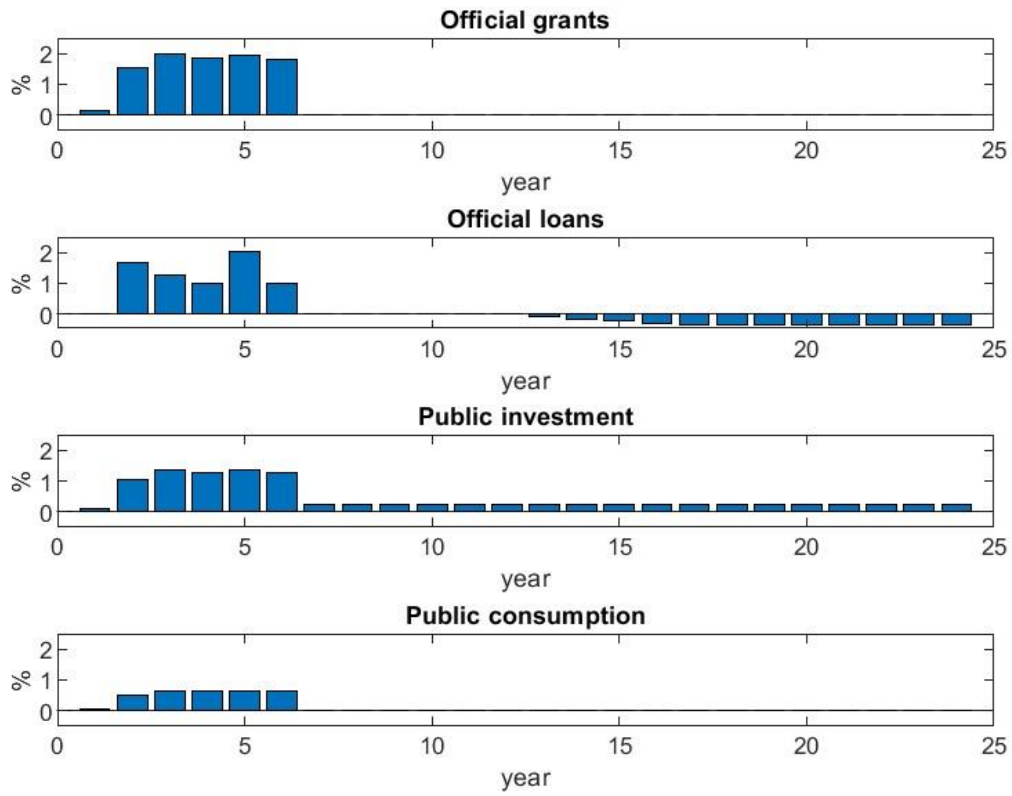
Table 2 presents key parameter values necessary to pin down the steady state. Additional parameters follow Melina et al. (2016). Annex IV presents sensitivity checks for several key assumptions, including the choice of the intratemporal elasticities, fiscal rules, and the composition of reform shocks.

[9] OECD Input-Output tables do not disaggregate gross fixed capital formation by its source of demand. Consequently, the calibration is based on sectoral biases in private and public consumption. Traded and non-traded sectors are classified using a 25% threshold for trade intensity, defined as the ratio of exports plus imports to sectoral output.

[10] These parameter values reflect a scenario in which additional RRF/RRP-related expenditure is evenly distributed across domestic non-traded goods, domestic traded goods, and imports.

[11] Our structural parameters and financing assumptions align with key calibration benchmarks widely used in policy analysis. For example, the macro-fiscal impact of the RRP/RRF is shaped by the assumed fiscal multiplier, which in a DGE model is influenced by several factors, including the elasticity of output to public capital, the home bias in government spending, investment adjustment costs, and the efficiency of public investment.

Figure 4: Non-reform RRF/RRP shocks (in percent of 2020 GDP)



Source: IMF staff calculations.

Table 2. Baseline calibration

Definition	Value	Definition	Value
Initial Values			
Exports to GDP	0.3805	Domestic real interest rate	0.0102
Imports to GDP	0.3983	Real interest rate on external commercial Debt	0.0102
Government consumption to GDP	0.2013	Real Risk-Free Rate	0.0001
Government investment to GDP	0.0342	Foreign real interest rate on savings	0.0001
Private investment to GDP	0.0911	Real Interest rate on concessional debt	0.0000
Government domestic debt	0.2004	Labour income tax rate	0.30
Private foreign debt to GDP	0.4935	Consumption tax rate	0.18
Government external commercial Debt	0.7123	Tax rate on capital Income	0.20
Concessional debt	0.9090	Share of non-traded goods in private demand	0.366
Government revenue to GDP	0.4539	Share of domestic traded goods in total private demand for traded goods	0.781
Grants to GDP	0.0031	Share of non-traded goods in government procurement	0.887
Long-run GDP growth	0.0154	Share of domestic traded goods in total traded goods procurement	0.532
Parameters			
Labour income share in non-traded sector	0.6323	Share of Optimising households	0.65*
Labour income share in traded sector	0.6323	Elasticity of portfolio adjustment costs	1
Labour supply share to the non-traded sector	0.4750	Elasticity of substitution between traded domestic and imported Goods	1.5
Private capital depreciation rate	0.0670	Elasticity of sovereign risk	0
Investment adjustment cost	5	Output Elasticity to public capital	0.083
Inverse of Frisch labour elasticity	1	Depreciation rate of public capital	0.0421
Risk aversion	1.78	Steady-State efficiency of public investment	0.87
Intra-temporal substitution elasticity of labour (b/w T/NT)	0.5	Elasticity of exports to terms of trade	2.6
Elasticity of substitution between traded and non-traded goods	0.44	Elasticity of investment distortion to RRP/RRF	0.5
Fiscal adjustment share by consumption tax	1	Adjustment share by external commercial debt (relative to domestic debt)	1
Fiscal adjustment share by labour tax	0	Adjustment speed of consumption tax to target	0.02
Labour tax response to debt/GDP	0	Consumption tax response to debt/GDP	0
Adjustment speed of government consumption to target	1	Adjustment speed of labour tax to target	1
Fiscal adjustment share by transfers	0	Fiscal adjustment share by government consumption	0
Transfers response to debt/GDP	0	Government consumption response to debt/GDP	0
Adjustment speed of transfers to target	1	Non-traded bias of additional government spending	0.33

6. Baseline results

Given our assumptions, the macroeconomic narrative of our baseline scenario is straightforward (Figure 5 and Annex II shows key macroeconomic variables under the baseline scenario). The new public investments under the RRF/RRP increase the stock of public capital, which in turn increases productivity of private capital and labor. Expected returns on capital increase, which puts upward pressure on domestic interest rates. As firms in traded and non-traded sectors build up their private capital stocks, diminishing returns on private capital set in while effect of productivity-inducing reforms slows down. Consequently, the expected marginal product of capital, Tobin's Q, and domestic interest rates decline over time.

Aggregate consumption initially rises rapidly, then much slower. Optimizing households, anticipating higher future income, prefer to smooth their consumption over time. Facing lower rates abroad, households borrow against their future income, increasing foreign private debt to finance the initial consumption surge. Meanwhile, rule-of-thumb households gradually increase consumption, driven only by rising incomes and a reduction in the consumption tax rate. Labor market reforms play a key role in shaping early labor market outcomes, initially reducing real wages. This, combined with higher labor force participation, stimulates output while containing the growth of aggregate consumption.

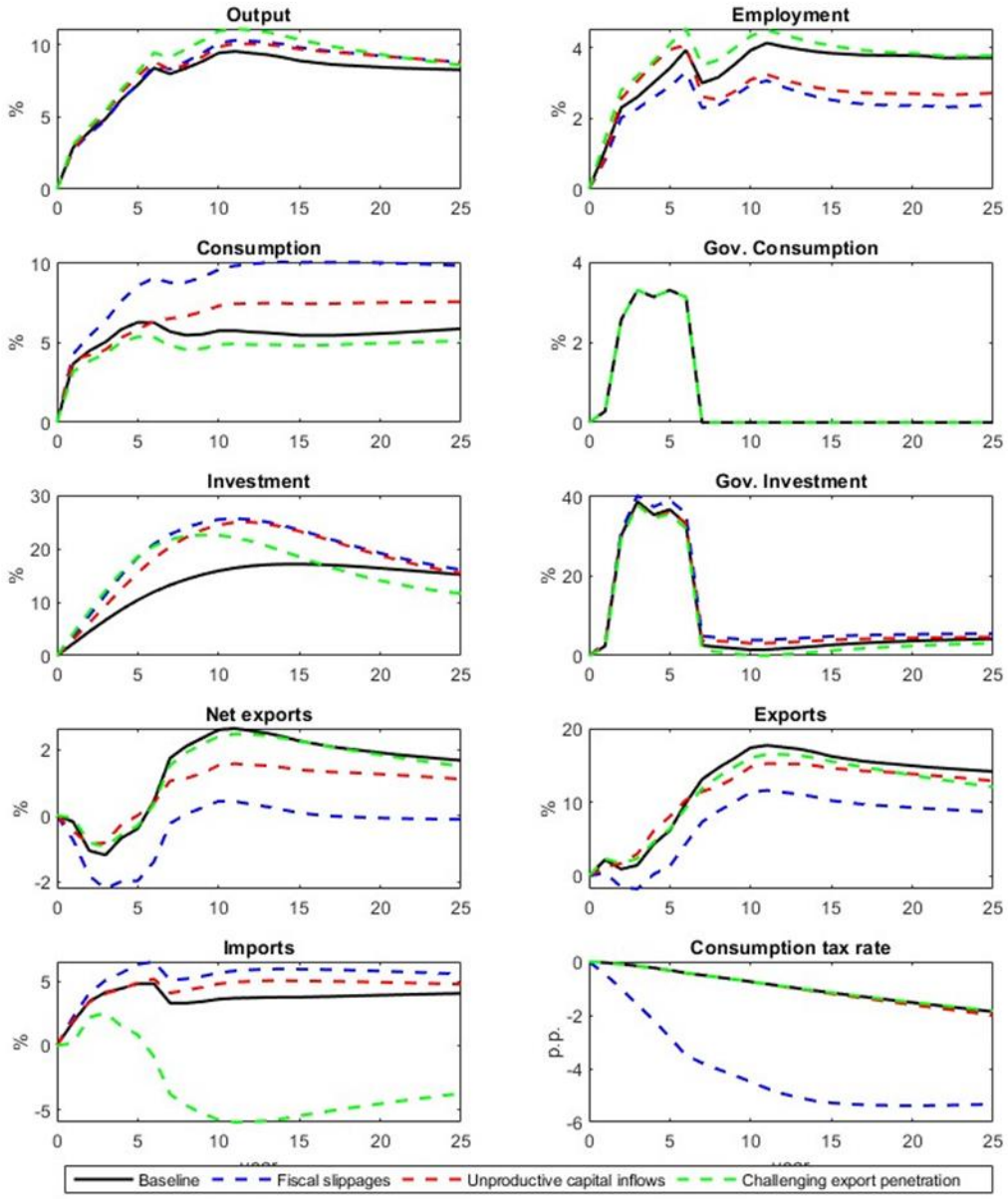
Investment adjustment costs represent a friction that slows down the accumulation of capital by firms, dampening output growth and allowing domestic absorption to outpace it—partly due to the rapid scale-up of government expenditure and debt-financed consumption. As productivity gains and wage compression reduce the relative price of traded goods, exports gradually increase. The larger share of domestic goods in current expenditure, initially offsets the depreciation pressure from reforms, allowing a rise in imports. The initial increase in imports outweighs the rise in exports, worsening the trade balance as domestic absorption exceeds output. Over time, as productivity gains materialize fully, domestic goods become more attractive, reducing the share of imports in domestic demand. The larger economic pie also gives a significant boost to tax collection through permanent increases in consumption and employment, as well as a temporary higher capital rents.

We now turn to the dynamics of national savings, the current account, and the NIIP. Figure 6 illustrates our mains results: private savings increase *temporarily* but public savings are *permanently* higher. During the implementation of the RRP/RRF, private savings rise as much as 1.4 percentage points of GDP, mostly due to higher employment and firm profits (which boosts income) and a relative tilt from consumption to investment, ultimately increasing private savings. However, over time, private savings (relative to GDP) revert close to the initial levels as investment in new capital tapers off. A constant fraction of the new higher capital stock requires replacing every year, which stabilizes private savings as a share of GDP over the long run. In contrast, public savings increase permanently because the government uses the increase in tax revenue and the relative decline in expenditures (relative to GDP) to boost fiscal balances, which then enable the repayment of outstanding external liabilities. The decline in public external debt therefore reflects the muted reaction of fiscal policy to changes in the fiscal gap in equation (4).

Greece's external position improves substantially, mirroring the permanent increase in national savings. The current account balance improves by 2.6 percentage points of GDP after 15 years.[12] The impulse to the current account generated by the RRF/RRP peaks at around 12 years after the start of the RRP and then gradually falls. This current account trajectory lends itself to a convenient interpretation. Consider that the most recent IMF WEO projections forecast a deficit of about 3 percent of GDP by 2029. The IMF's projection is conservative (less optimistic) in the assumed impact of the RRP/RRF on the level of GDP over the medium term. The effects we use to anchor our baseline scenario are significantly larger. The impact on the current account simulated by our model suggests that current account projections for the year 2029 with a more optimistic assumption about the success of the RRP/RRF may well be (much) closer to balance. The flipside of a permanently higher current account is the considerably more favorable NIIP. The response of the NIIP-to-GDP ratio is on a steady upward trajectory, reaching close to 30 percentage points of GDP after 15 years. The bulk of the improvement owes to the repayment of public external debt. A partial negative offset comes from negative valuation effects (due to the depreciation of the real exchange rate) and the new RRF-related liabilities, which are carried forward indefinitely.

[12] The current account does not deteriorate despite a reduction in the trade balance during the first six years of the RRP/RRF. Higher government expenditures on imports are funded by RRF-grants, neutralizing the direct impact of the RRP/RRF on the current account. Additionally, the reforms generate substantial productivity gains that boost exports, while relatively high portfolio adjustment costs limit the rise in imports. Pfeiffer et al. (2023), who focus on the effects of productive public investment and assume greater financial integration, find that the current account balance deteriorates in the medium term before improving.

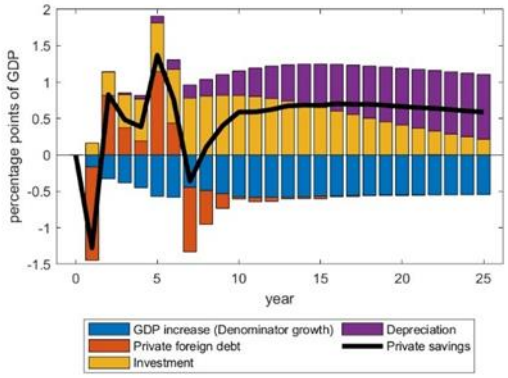
Figure 5: Key macro variables (in percent/percentage point deviations from steady state)



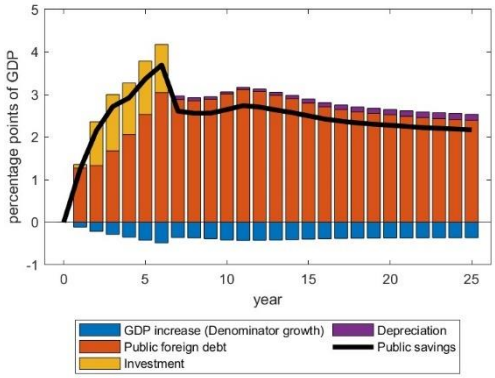
Source: IMF staff calculations.

Figure 6: Decomposition of RRP impact under the baseline scenario (in percentage points of GDP)

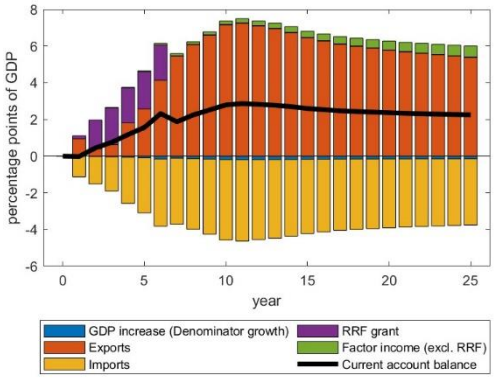
4.a Private savings



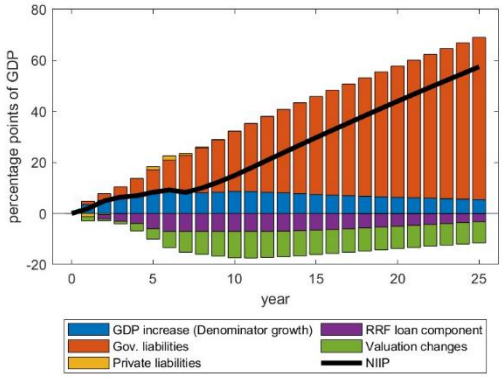
4.b Public savings



4.c Current account



4.d Net international investment position



Note: The top-left chart shows gross private savings, and the top-right chart shows public savings. The bottom-left chart shows the current account, and the bottom-right chart shows the net international investment position. All charts are expressed in percentage points of GDP and are measured relative to the initial steady state. Gross private savings in period t can be represented as the sum of the change in domestic bond holdings of households and investment in physical capital by firms in traded and non-traded good sectors less the change in external borrowing by households, i.e. $\Delta B_t + I_{T,t} + I_{N,t} - s_t \Delta B_t^*$. Gross public savings are the sum of government investment expenditure and repayment of public debt, i.e. $P_t^G I_t^G - \Delta B_t - s_t(\Delta D_t^C + \Delta D_t)$.

Source: IMF staff calculations.

7. Policy experiments

We acknowledge that our results in the preceding section paint an optimistic picture of Greece's prospects for rebalancing its external position. This section substantiates why the answer may be affirmative. The second main result of our paper is that a successful RRP/RRF by itself is not enough to guarantee a return to external sustainability, even under optimistic assumptions regarding the productive nature of additional government spending and reforms. The large improvement in the external position is not pre-ordained, and economic outcomes over the long run critically depend on domestic policies. If economic policies do not prioritize savings, reduction of external debt, and financial stability, Greece's external position will improve to a lesser extent. Through the lens of our model, supporting policies in three areas play a critical role to lock-in the positive impact on the external sector: (i) fiscal policy; (ii) macroprudential policy; and (iii) structural policies. Let us consider different policy settings in three alternative scenarios.

Scenario 1: Fiscal slippages

This alternative scenario imagines a systematically different conduct of fiscal policy. Instead of channeling the "fiscal dividend" (the area under the baseline fiscal balance trajectory) towards repaying public external debt, the government may decide to lower distortionary taxes. We capture this idea by increasing the fiscal reaction parameter ζ to 0.25, making the consumption tax rate more responsive to rising tax revenues. While this improves fiscal balance and reduces public debt, the government responds to the accumulating surplus by cutting taxes, which slows the repayment of outstanding debt.

The result is higher aggregate consumption, reduced labor supply, and increased wages, which partly offset the reduction in domestic prices. This leads to higher imports and lower exports. Figures 7 and 8, along with Annex II, illustrate the differences between our baseline and fiscal slippage scenario. Public external debt remains significantly higher—by over 25 percentage points of GDP—15 years into the RRP.

This scenario does not entail a welfare analysis. Using surplus tax revenue to cut distortionary tax rates stimulates domestic demand and consumption over and above the already strong impulse from the RRP/RRF. Household consumption is permanently higher, which could (under some household preferences) outweigh the positive effects from reducing external vulnerabilities by means of a higher NIIP. Our scenario simply shows that if fiscal policy prizes other objectives in addition to external debt reduction, the improvement of Greece's external position arising from a successful RRP/RRF would diminish. In the *fiscal slippages* scenario, the current account fails to improve relative to the initial steady state, and the NIIP is only higher by about 7 percentage points of GDP (compared to the improvement under the baseline of around 30 percentage points of GDP).

Scenario 2: Unproductive capital inflows

Greece's own recent economic history exemplifies how misallocated capital inflows can increase financial vulnerabilities. Following the entry into the European Monetary Union, Greece received substantial short-term capital inflows, which predominantly went into real estate, construction, and financing overseas expansions of banks (such as mergers and acquisitions). By 2009, non-performing loans (NPLs) reached almost 10% of total loans, eventually spiking to 50% during the sovereign debt crisis.

Unproductive capital inflows can fuel credit booms (Igan and Tan, 2017), heightening financial instability and underscoring the usefulness of macroprudential policies to mitigate these risks. Macroprudential policies primarily aim at safeguarding domestic financial stability, but they also tend to curtail excessive capital inflows (Ostry et al., 2011; Eller et al., 2021), thereby contributing to external stability.

The "unproductive capital inflows" scenario imagines that the costs for households when borrowing abroad diminishes, facilitated by looser macroprudential policies. Under the baseline, optimizing households borrow little in anticipation of rising incomes, because it is relatively costly to do so. If, portfolio adjustment costs decline, they will amplify the increase in consumption and produce a larger increase in foreign private debt. To explore this channel, we lower the portfolio adjustment costs parameter to η^*=0.0001 (instead of 1 in the baseline).

Figures 7 and 8 show that with lower adjustment costs, households borrow more to smooth consumption in anticipation of future income growth. This higher consumption drives up domestic prices, particularly for non-traded goods, raising wages and worsening the trade balance due to increased imports. Private debt inflows also put pressure on the exchange rate to appreciate and minimize fluctuations in interest rate differentials. After 15 years, households would borrow an additional 10 percentage points of GDP, with this borrowing used solely for consumption—hence the term "unproductive capital inflows".

This scenario drives home an important policy insight: a successful RRP/RRF, paradoxically, sows the seed of a new threat to external sustainability. Because of the expectation of a strong rise in income, households will pre-emptively increase consumption, due to the success of RRP/RRF in stimulating widespread productivity growth. Domestic residents will have a growing incentive to borrow from abroad where interest rates are lower.

Scenario 3: Smaller export penetration

This scenario imagines that Greece's exporters have a more difficult time in penetrating world markets, compared to the baseline simulation. This situation could arise because some structural policies under the RRP/RRF that aim specifically at making Greek exports more competitive in world markets are only partially implemented. In our model, we lower the elasticity of exports to the real effective exchange rate to $\chi^x = 1$ to explore the effects of a structural decline in export competitiveness.

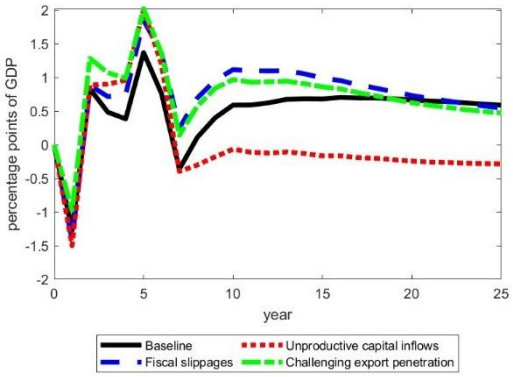
Figures 7 and 8, along with Annex II, show that the lower prices in the traded sector, necessary to deliver an increase in exports, reduce wages, which, under limited labor mobility, lowers household incomes

and consumption. Domestic demand shifts from imports to domestic goods, but output in the traded sector also declines due to reduced labor supply. This leads to a deterioration in the trade balance, as lower output in the traded sector and higher domestic consumption of traded goods dominate the reduction in imports.

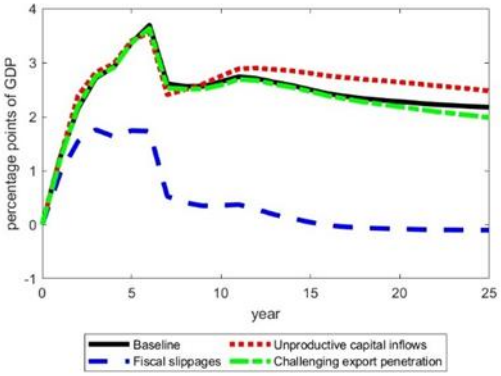
The depreciation of the exchange rate increases the negative valuation effect on external debt, reducing the improvement in the current account. As a result, the NIIP improves by less than in the baseline scenario, by about 19 percentage points compared to the improvement under the baseline of 30 percentage points.

Figure 7: RRP/RRF impact under alternative scenarios (in percentage points of GDP)

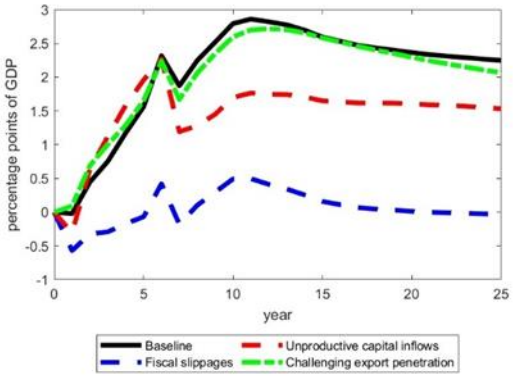
6.a Private savings



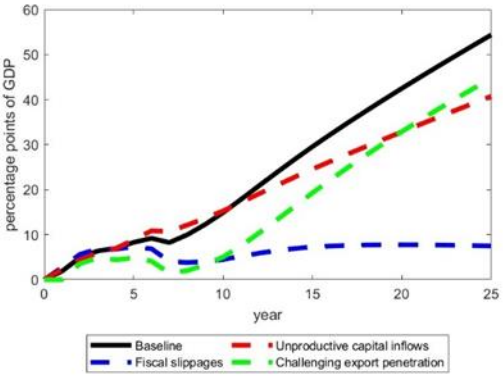
6.b Public savings



6.c Current account balance



6.d Net international investment position

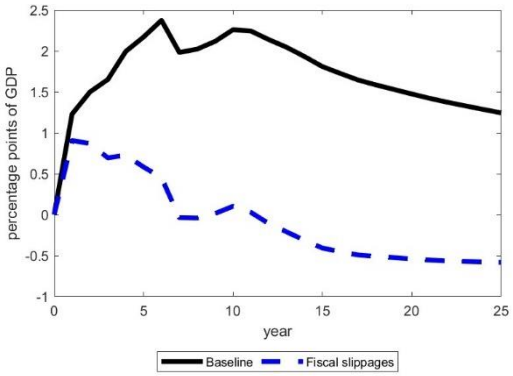


Note: The top-left chart shows the current account balance, and the top-right chart shows gross public savings. The bottom-left chart shows gross private savings, and the bottom-right chart shows the net international investment position. All charts are expressed in percentage points of GDP and are measured relative to the balanced growth path (which does not enjoy the benefits of the RRP/RRF).

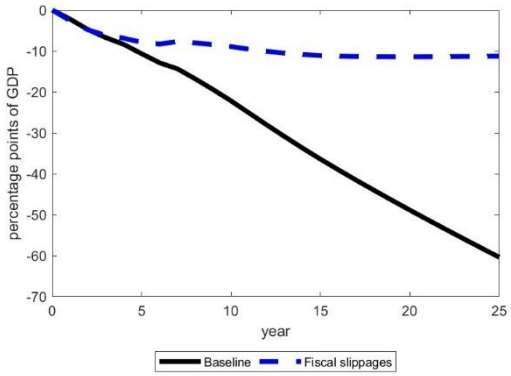
Source: IMF staff calculations.

Figure 8: Fiscal policy and debt and the real exchange rate under alternative scenarios (in percentage points of GDP)

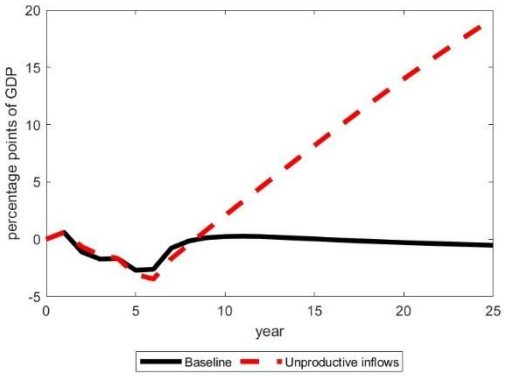
5.a Fiscal balance



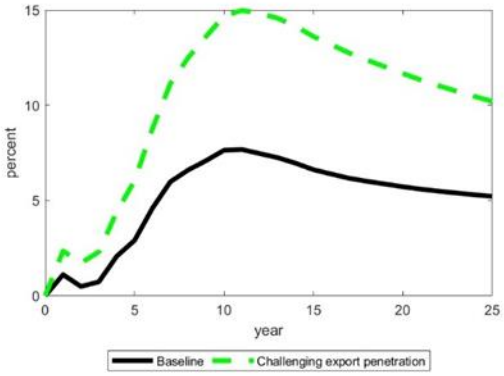
5.b External public debt



5.c External private debt



5.d Real exchange rate



Note: The top-left chart shows the public primary balance, and the top-right chart shows public external debt. The bottom-left chart shows private external debt, and the bottom-right chart shows a change in the index of the real exchange rate (increase means depreciation). All charts except the real exchange rate are expressed in percentage points of GDP and are measured relative to the initial steady state (which does not enjoy the benefits of the RRP/RRF). The real exchange rate growth is measured in percent deviations from the initial steady state.

Source: IMF staff calculations.

7. Discussion and conclusion

The RRP/RRF carries great promise for the Greek economy. Persistent current account deficits and a large net debtor position to the rest of the world have been a defining feature of the Greek economy and a significant economic vulnerability for decades. A key objective of the RRP is to improve Greece's external performance, reducing its reliance on foreign borrowing and improving Greece's NIIP. Our analysis investigates whether a successful RRP/RRF is, by itself, sufficient to achieve this goal.

We come to a nuanced conclusion. Under our baseline scenario, where the RRP/RRF successfully boosts productivity and employment, and where fiscal policy prioritizes debt reduction, we find a significant improvement in Greece's external position. The current account and the NIIP improve by up to 2.6 percentage points and 30 percentage points of GDP, respectively, after 15 years (compared to a scenario without the RRP/RRF). This finding reinforces the core argument supporting the RRP: well-targeted investments and reforms can lead to sustained economic improvements, including a much improved external position.

Our analysis also underscores a critical nuance: the RRP/RRF is not a guaranteed "quick-fix" for Greece's external challenges. Its ultimate success in securing external stability is highly contingent on accompanying domestic policies. If fiscal policy becomes overly expansionary (by channeling the RRP/RRF's fiscal dividend into tax cuts instead of debt reduction), the improvement in the external position can significantly diminish. Similarly, if households increase borrowing substantially in anticipation of future income gains (facilitated by looser macroprudential policies), the benefits of the RRP would be undermined. These findings contradict the notion that the RRP is a guaranteed solution to Greece's external imbalances and, instead, underscore the crucial role of prudent fiscal and macroprudential policies in ensuring the RRP/RRF sustainably reduces Greece's external vulnerabilities.

For policymakers in Greece (and other countries grappling with large externally-financed investment programs), our findings underline the importance of complementary domestic policies. The case for fiscal prudence that prioritizes debt reduction is well-known and internalized in Greece. However, the possibility of a new surge in foreign borrowing (capital inflows) has received less attention. Our paper points to the need to examine closely the interaction between macroprudential policies and capital inflows, particularly at a time when the RRP/RRF successfully boosts investment and productivity.

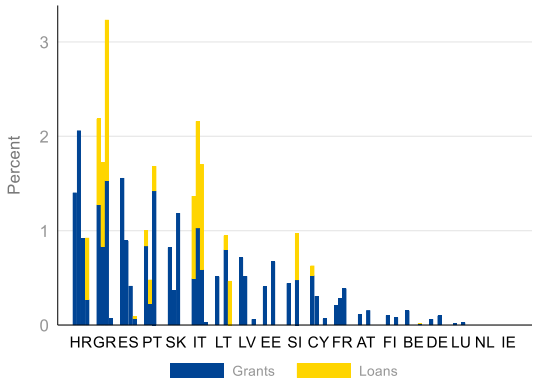
Given the limited role of private savings in driving the improvements in the external position under the baseline, our analysis also suggests value in policies aimed boosting private savings. One option could be to create greater incentives in the tax system to contribute to the fully-funded auxiliary pension system, particularly for low- and middle-income households. Additionally, Greece could benefit from tilting the composition of capital inflows towards productive foreign direct investment (FDI). Given FDI's critical role in technology transfer, establishing a world-class regulatory framework for FDI and targeted incentives in strategic sectors such as manufacturing, renewable energy, and research and development, could be effective in lifting current account balances in the long run.

In conclusion, the RRP/RRF is a powerful tool, but domestic policy remains a decisive factor in determining whether Greece can truly break free from its history of external imbalances and secure a more resilient economic future.

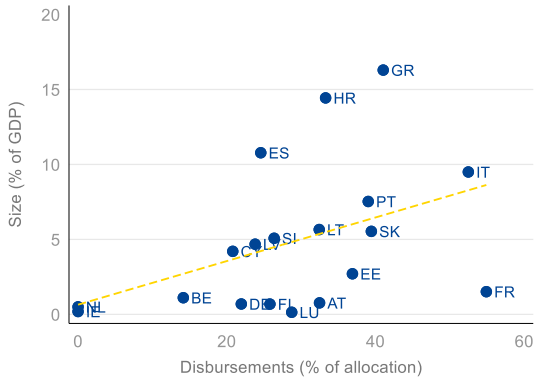
Annex I. RRF implementation in Greece

Figure AI-1: EU's Recovery and Resilience Facility

AI-1.a Disbursements of financial support under the EU's RRF by type (in % of GDP)



AI-1.b Total RRF allocation relative to disbursed funds

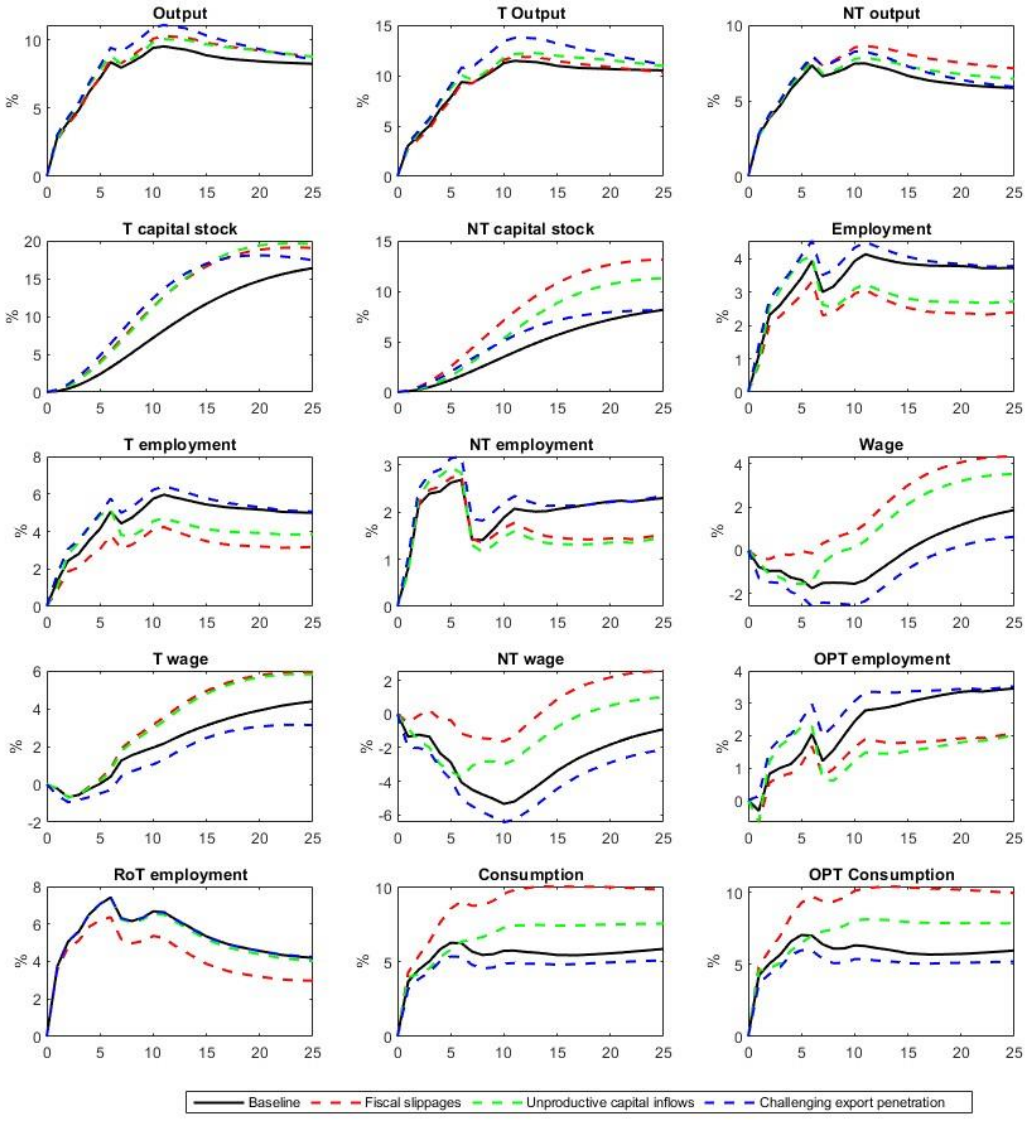


Note: Allocation already disbursed is presented as of Q1 2024.

Source: European Commission.

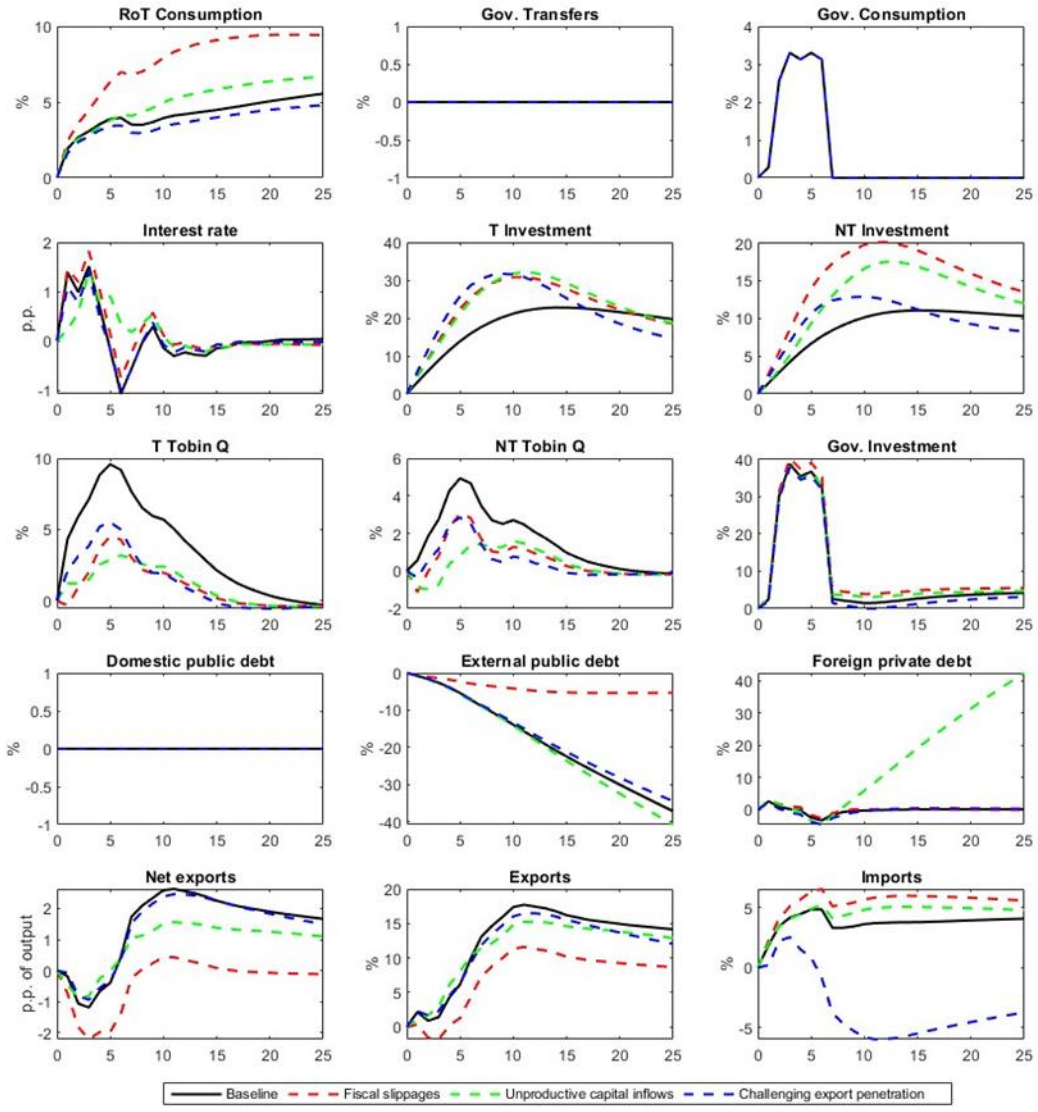
Annex II. Model variables and scenarios

Figure AII-1: Model variables



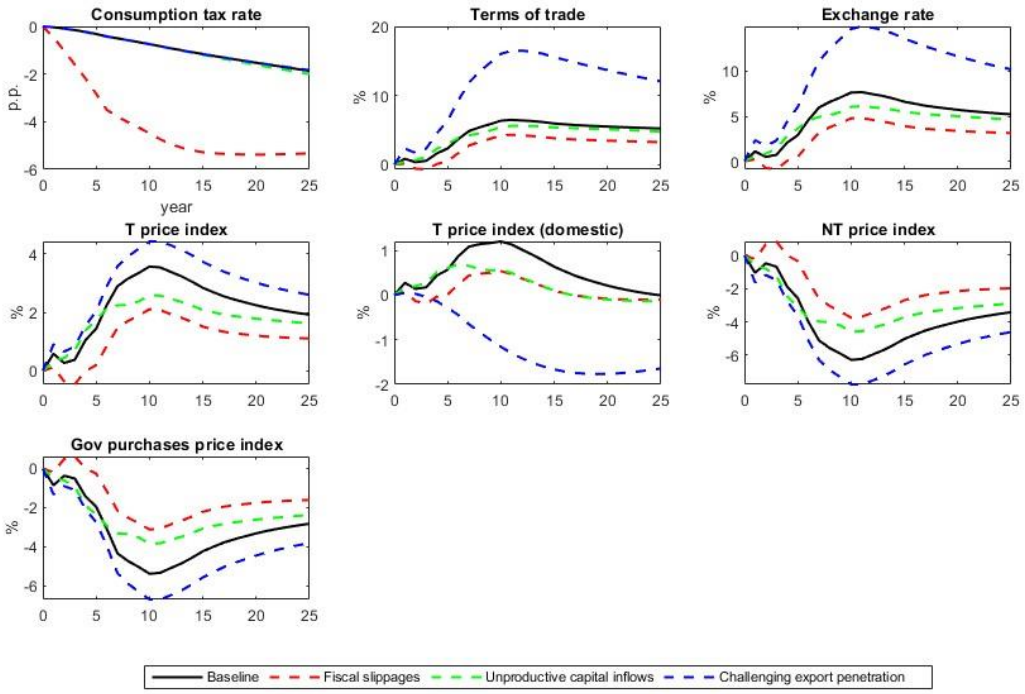
Source: IMF staff calculations.

Figure AII-1: Model variables (continued)



Source: IMF staff calculations.

Figure AII-1: Model variables (continued)

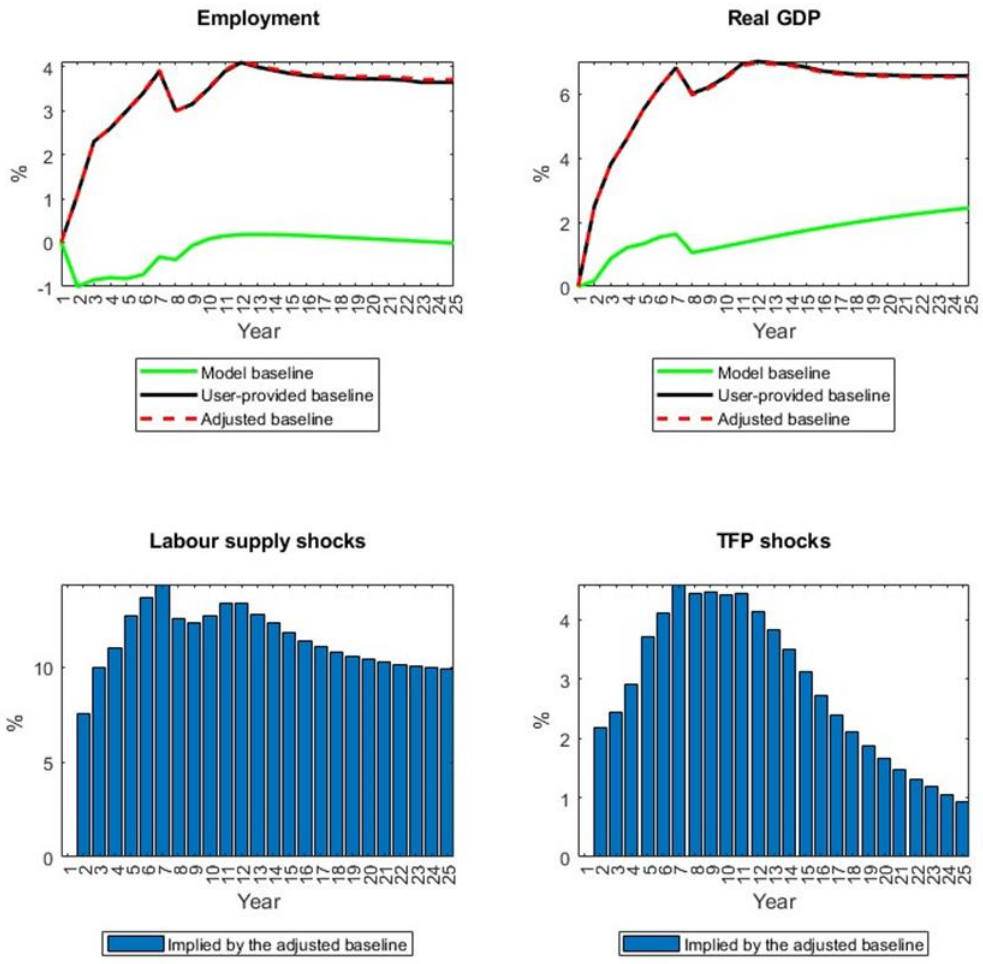


Source: IMF staff calculations.

Annex III. Matching baseline simulation to Malliaropulos et al. (2021)

To align our projections with those in Malliaropulos et al. (2021), we have identified sequences of shocks to the dis-utility of labor and total factor productivity (ε_t^{κ} and ε_t^{z}). These shocks enable our model to replicate the paths of employment and output for the first twenty years following the initiation of RRF/RRP, assuming that the gains achieved by year 20 are permanent relative to the balanced growth path. The figures below illustrate these shocks, as well as the employment and output trajectories in the absence of these shocks.

Figure AIII-1: Output, employment, and reform shocks



Source: IMF staff calculations.

Annex IV. Sensitivity checks

In a large open economy model with multiple shocks, such as the one used in this paper, various channels influence the results, with numerous parameters shaping the trajectory of macroeconomic variables. To assess the robustness of our findings and shed light on the drivers of our results, we conduct a sensitivity analysis on key assumptions related to parameters and policy choices.

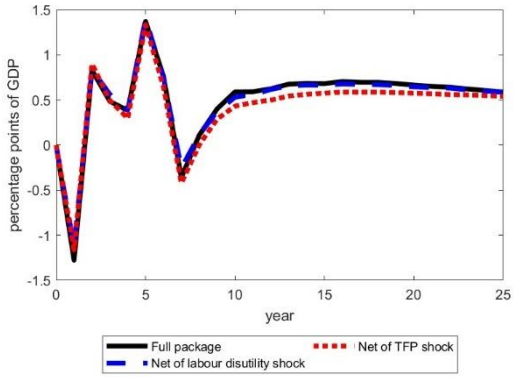
First, we explore whether the benefits of the reforms are contingent on shocks to labor preferences, specifically assessing the ability of RRP/RRF reforms to expand labor supply without driving up wages. Next, we analyze how our core findings change under different assumptions about the intratemporal elasticity of substitution between domestic traded and imported goods. Finally, we examine how the results depend on the fiscal rule by simulating alternative scenarios in which fiscal gaps are closed through labor taxes or transfers, rather than the baseline assumption where the consumption tax rate adjusts in response.

Sensitivity check 1: Dividends absent reform shocks

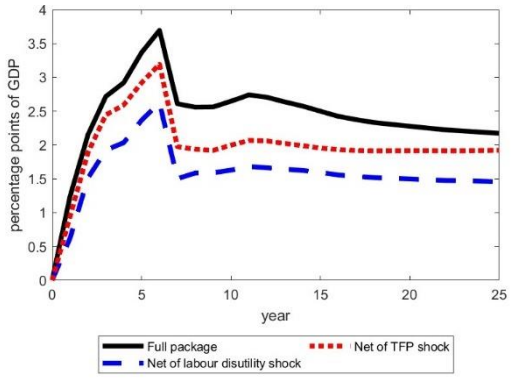
To assess the relative impact of reform-driven versus non-reform shocks, we analyze how our baseline results change when labor supply shocks are excluded from the model. We extend this experiment by also removing productivity shocks. As shown in Figure AIV-1, the external sector benefits from the RRF/RRP package are heavily dependent on the implementation of structural reforms alongside government spending. Without these reforms, the external position still improves, but to a significantly lesser extent compared to the full RRF/RRP package. Moreover, the current account deteriorates during the first five years of RRP implementation, consistent with the findings of Pfeiffer et al. (2023), who do not incorporate reform shocks in the analysis.

Figure AIV-1: Baseline RRP/RRF impact net of TFP and labour supply shocks.

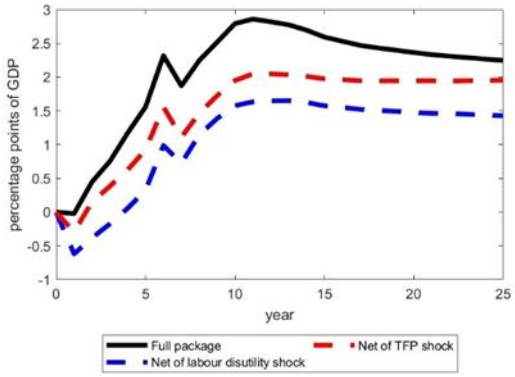
AIV-1.a Private savings



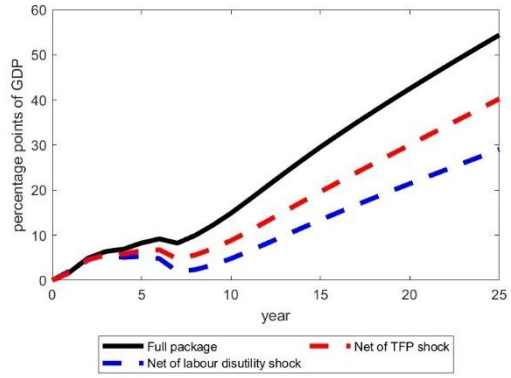
AIV-1.b Public savings



AIV-1.c Current account balance



AIV-1.d Net international investment position



Note: The top-left chart shows the current account balance, and the top-right chart shows gross public savings. The bottom-left chart shows gross private savings, and the bottom-right chart shows the net international investment position. All charts are expressed in percentage points of GDP and are measured relative to the balanced growth path (which does not enjoy the benefits of the RRP/RRF).

Source: IMF staff calculations.

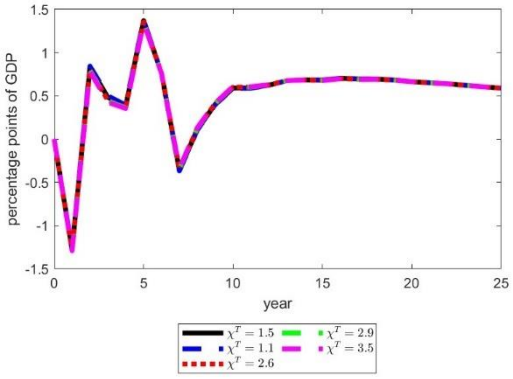
Sensitivity check 2: Intratemporal elasticity of substitution between domestic and imported traded goods.

The response of relative prices to the RRF/RRP package influences both the trade balance and external position. This subsection examines whether our baseline results are driven by our assumed intratemporal elasticity of substitution between domestic and imported traded goods.

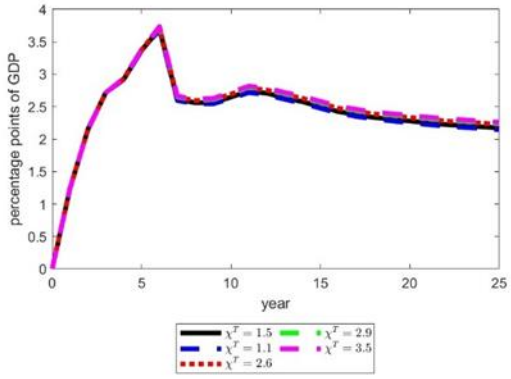
To test this, we deviate from our baseline assumption of χ^T = 1.5 in several ways. First, we consider a lower elasticity of χ^T = 1.1. Next, we use the mean Armington elasticity for annual data from Bajzik et al. (2020), setting χ^T = 2.6, aligning this parameter with the elasticity faced by Greek exports. Additionally, we test two even higher values, χ^T = 2.9 and χ^T = 3.5. *As shown in Figure AIV-2, our baseline results remain robust, regardless of the chosen elasticity parameter.*

Figure AIV-2: Baseline RRP/RRF impact under alternative elasticity assumptions

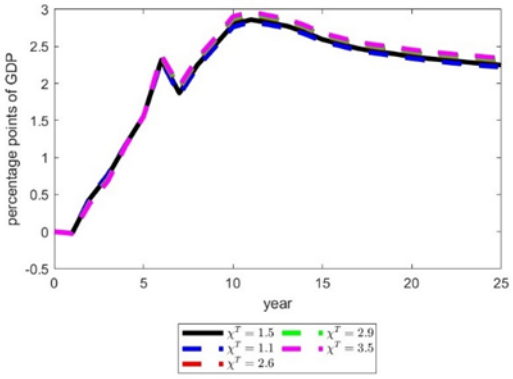
AIV-2.a Private savings



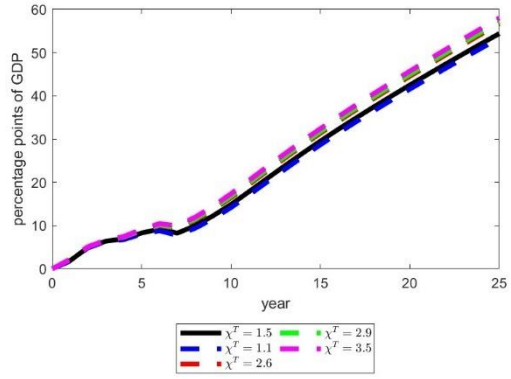
AIV-2.b Public savings



AIV-2.c Current account balance



AIV-2.d Net international investment position



Note: The top-left chart shows the current account balance, and the top-right chart shows gross public savings. The bottom-left chart shows gross private savings, and the bottom-right chart shows the net international investment position. All charts are expressed in percentage points of GDP and are measured relative to the balanced growth path (which does not enjoy the benefits of the RRP/RRF).

Source: IMF staff calculations.

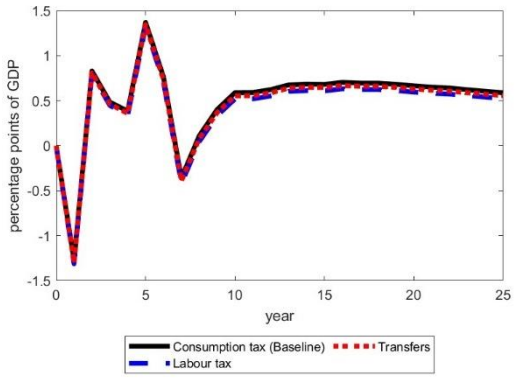
Sensitivity check 3: Alternative fiscal instruments

As illustrated in Figure AIV-3, choosing an alternative fiscal instrument has minimal impact on projections for private and public savings, the current account balance relative to GDP, and the NIIP-to-GDP ratio. For these projections, we set the responsiveness of first the labor tax rate and then transfers to 0.02, consistent with the reaction strength assumed for the consumption tax rate in the baseline scenario.

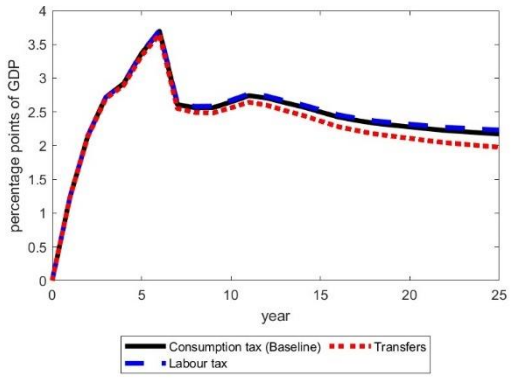
Similarly, Figure AIV-4 indicates that the results under the fiscal slippage scenario are largely unaffected by the choice of fiscal instrument. The improvement in the NIIP-to-GDP ratio is significantly smaller across all fiscal policy options, compared to the baseline case. Notably, using transfers as the adjustment instrument leads to a more modest GDP increase and a smaller current account balance improvement, resulting in a smaller improvement in the NIIP-to-GDP ratio. For these projections, we set the responsiveness of first the labor tax rate and then transfers to 0.25, aligning with the reaction strength assumed for the consumption tax rate in the fiscal slippages scenario.

Figure AIV-3: Baseline RRP/RRF impact under alternative fiscal rules (instruments)

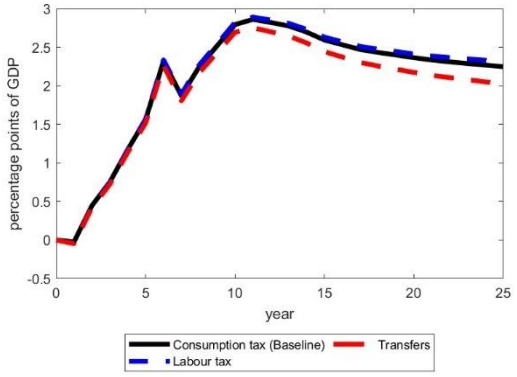
AIV-3.a Private savings



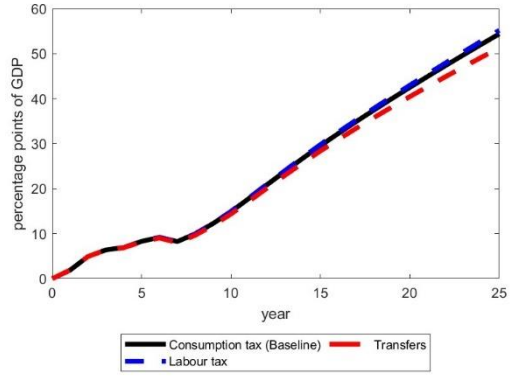
AIV-3.b Public savings



AIV-3.c Current account balance



AIV-3.d Net international investment position

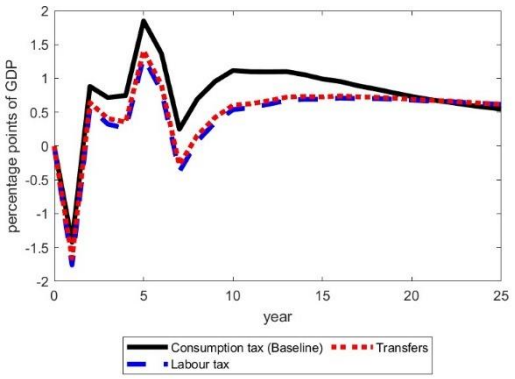


Note: The top-left chart shows the current account balance, and the top-right chart shows gross public savings. The bottom-left chart shows gross private savings, and the bottom-right chart shows the net international investment position. All charts are expressed in percentage points of GDP and are measured relative to the balanced growth path (which does not enjoy the benefits of the RRP/RRF).

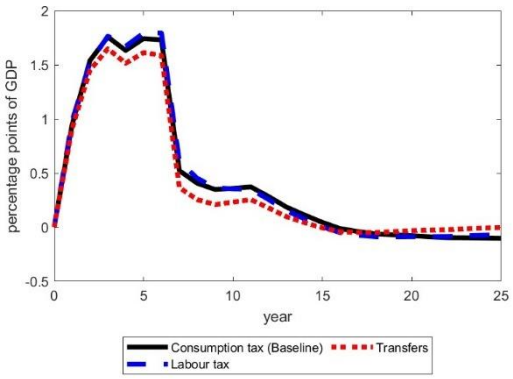
Source: IMF staff calculations.

Figure AIV-4: RRP/RRF impact for the fiscal slippages scenario under alternative fiscal rules (instruments)

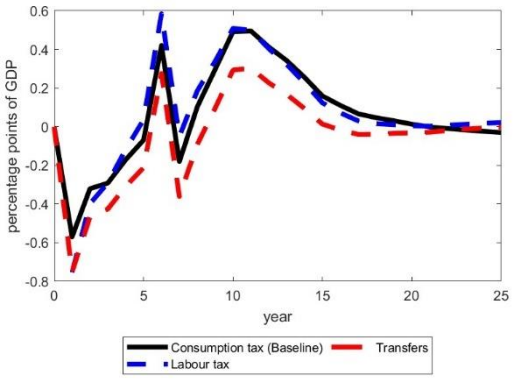
AIV-4.a Private savings



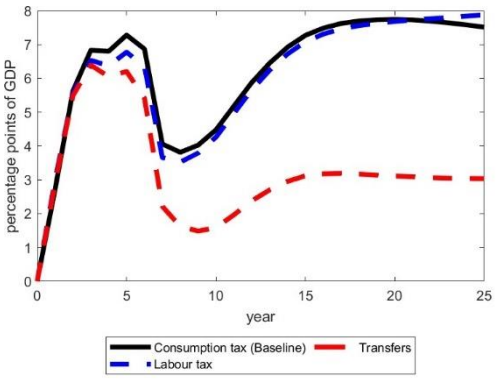
AIV-4.b Public savings



AIV-4.c Current account balance



AIV-4.d Net international investment position



Note: The top-left chart shows the current account balance, and the top-right chart shows gross public savings. The bottom-left chart shows gross private savings, and the bottom-right chart shows the net international investment position. All charts are expressed in percentage points of GDP and are measured relative to the balanced growth path (which does not enjoy the benefits of the RRP/RRF).

Source: IMF staff calculations.

Annex V. Equilibrium conditions

In this annex, we provide additional information about the model. The steady state is calculated numerically by solving a system of non-linear equations (using Matlab's fsolve function). The non-linear model is solved under perfect foresight. For simplicity, the below equilibrium conditions ignore trend growth rate under the balanced growth path.

Unit price of the consumption basket

$$1 = \left[\varphi p_{N,t}^{1-\chi} + (1-\varphi) P_{T,t}^{1-\chi}\right]^{\frac{1}{1-\chi}}$$

Price of the traded good basket

$$P_{T,t} = \left[\varphi_T p_{TH,t}^{1-\chi_T} + (1-\varphi_T) s_t^{1-\chi_T}\right]^{\frac{1}{1-\chi_T}}$$

Relative labor supply to tradable sector

$$L_{T,t} = (1-\theta)\left(\frac{w_{T,t}}{w_t}\right)^{\rho} L_t$$

Relative labor supply to non-traded good sector

$$L_{N,t} = \theta\left(\frac{w_{N,t}}{w_t}\right)^{\rho} L_t$$

Real wage index:

$$w_t = \left[\theta w_{N,t}^{1+\rho} + (1-\theta) w_{T,t}^{1+\rho}\right]^{\frac{1}{1+\rho}}$$

Marginal utility of consumption (Optimizers)

$$\lambda_t\left(1+\tau_t^C\right) = \left(c_t^{OPT}\right)^{-\sigma}$$

Labor supply (Optimizers)

$$\varepsilon_t^{\kappa} \kappa^{OPT} \left(L_t^{OPT}\right)^{\psi} = \lambda_t\left(1-\tau_t^L\right) w_t$$

Euler equation 1 (Optimizers)

$$\lambda_t = \beta E_t\left(\lambda_{t+1} R_t\right)$$

Euler equation 2 (Optimizers)

$$\lambda_t = \beta E_t\left[\frac{\lambda_{t+1} s_{t+1} R_{\square}^{*}}{s_t - \eta\left(b_t^{OPT*} - b^{OPT*}\right)}\right]$$

Risk premium for private debt (Optimizers)

$$R_t^* = R_{dc,t} + u$$

Consumption demand (Rule of Thumb)

$$\left(1 + \tau_t^C\right)c_t^{ROT} = \left(1 - \tau_t^L\right)w_t L_t^{ROT} + s_t rm^* + z_t - \mu k_{G,t-1}$$

Labor supply (Rule of Thumb)

$$L_t^{ROT} = \left[\frac{1}{\varepsilon_t^K \kappa^{ROT}} \frac{1 - \tau_t^L}{1 + \tau_t^C} \left(c_t^{ROT}\right)^{-\sigma} w_t\right]^{\frac{1}{\psi}}$$

Aggregation

$$c_t = \omega c_t^{OPT} + (1 - \omega)c_t^{ROT}$$
$$L_t = \omega L_t^{OPT} + \left(1 - \omega\right)L_t^{ROT}$$
$$b_t^* = \omega b_t^{OPT*}$$
$$b_t = \omega b_t^{OPT}$$

Production function (Non-traded good)

$$y_{N,t} = z_{N,t}\left(k_{N,t-1}\right)^{1-\alpha_N}\left(L_{N,t}\right)^{\alpha_N}\left(k_{G,t-1}\right)^{\alpha_G}$$

Capital law of motion (Non-traded good)

$$k_{N,t} = \left(1 - \delta_N\right)k_{N,t-1} + \left[1 - \frac{\kappa_N}{2}\left(\frac{i_{N,t}}{i_{N,t-1}} - 1\right)^2\right]i_{N,t}$$

Demand for labor (Non-traded good)

$$w_{N,t} = \alpha_N p_{N,t} \frac{y_{N,t}}{L_{N,t}}$$

Tobin's Q (Non-traded good)

$$q_{N,t} = E_t\left[\beta \frac{\lambda_{t+1}}{\lambda_t}\left(\left(1 - \delta_N\right)q_{N,t+1} + \left(1 - \tau^K\right)\left(1 - \vartheta_{t+1}\right)\left(1 - \alpha_N\right)p_{N,t+1}\frac{y_{N,t+1}}{k_{N,t}}\right)\right]$$

Investment (Non-traded good)

$$\frac{1}{q_{N,t}} = 1 - \frac{\kappa_N}{2}\left(\frac{i_{N,t}}{i_{N,t-1}} - 1\right)^2 - \kappa_N\left(\frac{i_{N,t}}{i_{N,t-1}} - 1\right)\frac{i_{N,t}}{i_{N,t-1}} + E_t\left[\beta \frac{\lambda_{t+1}}{\lambda_t}\kappa_N \frac{q_{N,t+1}}{q_{N,t}}\left(\frac{i_{N,t+1}}{i_{N,t}}\right)^2\left(\frac{i_{N,t+1}}{i_{N,t}} - 1\right)\right]$$

Production function (Traded good)

$$y_{T,t} = z_{T,t}\left(k_{T,t-1}\right)^{1-\alpha_T}\left(L_{T,t}\right)^{\alpha_T}\left(k_{G,t-1}\right)^{\alpha_G}$$

Capital law of motion (Traded good)

$$k_{T,t} = (1-\delta_T)k_{T,t-1} + \left[1 - \frac{\kappa_T}{2}\left(\frac{i_{T,t}}{i_{T,t-1}} - 1\right)^2\right] i_{T,t}$$

Demand for labor (Traded good)

$$w_{T,t} = \alpha_T p_{T,t} \frac{y_{T,t}}{L_{T,t}}$$

Tobin's Q (Traded good)

$$q_{T,t} = E_t\left[\beta \frac{\lambda_{t+1}}{\lambda_t}\left((1-\delta_T)q_{T,t+1} + (1-\tau^K)(1-\vartheta_{t+1})(1-\alpha_T)p_{T,t+1}\frac{y_{T,t+1}}{k_{T,t}}\right)\right]$$

Investment (Traded good)

$$\frac{1}{q_{T,t}} = 1 - \frac{\kappa_T}{2}\left(\frac{i_{T,t}}{i_{T,t-1}} - 1\right)^2 - \kappa_T\left(\frac{i_{T,t}}{i_{T,t-1}} - 1\right)\frac{i_{T,t}}{i_{T,t-1}} + E_t\left[\beta \frac{\lambda_{t+1}}{\lambda_t}\kappa_T \frac{q_{T,t+1}}{q_{T,t}}\left(\frac{i_{T,t+1}}{i_{T,t}}\right)^2\left(\frac{i_{T,t+1}}{i_{T,t}} - 1\right)\right]$$

Investment distortion

$$\frac{\vartheta_t}{\bar{\vartheta}} = exp\left(-\eta_\theta(K^G_{t-1} - \overline{K^G})\right)$$

Total factor productivity

$$z_{T,t} = \overline{z_T}\varepsilon^z_t$$
$$z_{N,t} = \overline{z_N}\varepsilon^z_t$$

Fiscal gap

$$gap_t = f_{\text{out},t} - f_{\text{in},t}$$
$$gap_t = \Delta b_t + s_t \Delta d_{c,t} + (\tau^C_t - \overline{\tau^C})c_t + (\tau^L_t - \overline{\tau^L})w_t L_t - p^G_t(g^C_t - \overline{g^C}) - (z_t - \bar{z})$$
$$f_{in,t} = \overline{\tau^C}c_t + \overline{\tau^L}w_t L_t + (1-\vartheta^K)\overline{\tau^K}(r^K_{T,t}k_{T,t-1} + r^K_{N,t}k_{N,t-1}) + \mu k_{G,t-1} + s_t g r^*_t + s_t \Delta d_t$$
$$f_{\text{out},t} = p^G_t g^I_t + p^G_t \overline{g^C} + \bar{z} + (\overline{R_d} - 1)s_t d_{t-1} + (R_{dc,t-1} - 1)s_t d_{c,t-1} + (R_{t-1} - 1)b_{t-1}$$

Financing the fiscal gap

$$\varkappa \Delta b_t = (1-\varkappa)s_t \Delta d_{c,t}$$

Fiscal targets

$$\tau^C_{\text{target},t} = \overline{\tau^C} + \lambda_1 \frac{gap_t}{c_t}$$
$$\tau^L_{\text{target},t} = \overline{\tau^L} + \lambda_2 \frac{gap_t}{w_t L_t}$$

$$z_{\text{target},t} = \bar{z} + \lambda_4 gap_t$$

Fiscal rules

$$\tau_t^C = \tau_{t-1}^C + \zeta_1\left(\tau_{\text{target},t}^C - \tau_{t-1}^C\right) + \zeta_2\left(\frac{b_{t-1} + s_{t-1}d_{c,t-1}}{y_{t-1}} - \frac{\bar{b} + \bar{s}\bar{d}_c}{\bar{y}}\right)$$

$$\tau_t^L = \tau_{t-1}^L + \zeta_3\left(\tau_{\text{target},t}^L - \tau_{t-1}^L\right) + \zeta_4\left(\frac{b_{t-1} + s_{t-1}d_{c,t-1}}{y_{t-1}} - \frac{\bar{b} + \bar{s}\bar{d}_c}{\bar{y}}\right)$$

$$\frac{z_t}{\bar{z}} = \frac{z_{t-1}}{\bar{z}} + \zeta_7\frac{\left(z_{\text{target},t} - z_{t-1}\right)}{\bar{z}} - \zeta_8\left(\frac{b_{t-1} + s_{t-1}d_{c,t-1}}{y_{t-1}} - \frac{\bar{b} + \bar{s}\bar{d}_c}{\bar{y}}\right)$$

Government spending

$$g_t = g_t^C + g_t^I$$
$$g_t^C = \overline{g^C} + \varepsilon_t^{RRFC}$$
$$g_t^I = \overline{g^I} + \varepsilon_t^{RRFI}$$

Government purchases price index

$$p_t^G = \left[\nu p_{N,t}^{1-\chi} + (1-\nu)p_{T,t}^{1-\chi}\right]^{\frac{1}{1-\chi}}$$

Price index for government purchases of traded goods

$$p_{T,t}^G = \left[\nu^T p_{TH,t}^{1-\chi^T} + (1-\nu^T)s_t^{1-\chi^T}\right]^{\frac{1}{1-\chi^T}}$$

Law of motion for public capital

$$k_{G,t} = (1-\delta_{G,t})k_{G,t-1} + \epsilon g_t^I$$

Debt-elastic risk premium on external government debt

$$R_{dc,t} = R^f + v_{dc}\exp\left[\eta_{dc}\left(\frac{d_t + d_{c,t}}{y_t} - \frac{\bar{d} + \bar{d}_c}{\bar{y}}\right)\right]$$

Exports

$$\frac{x_t}{\bar{x}} = \left(\frac{s_t}{p_{TH,t}}\right)^{\chi^X}$$

Imports

$$s_t m_t = p_{TH,t}x_t + c_t + i_{N,t} + i_{T,t} + p_t^G g_t + \Theta_t^{OPT*} - y_t$$

Current account deficit

$$ca_t^d = p_{TH,t}x_t - s_t m_t + s_t rm^* + s_t gr_t^* - (\overline{R_d} - 1)s_t d_{t-1} - \left(R_{dc,t-1} - 1\right)s_t d_{c,t-1} - (R_{t-1}^* - 1)s_t b_{t-1}^*$$

Balance of payment condition

$$\frac{ca_t^d}{s_t} = \Delta d_t + \Delta d_{c,t} + \Delta b_t^*$$

Total output

$$y_t = p_{N,t} y_{N,t} + p_{TH,t} y_{T,t}$$

Market clearing condition for non-traded goods

$$y_{N,t} = \varphi p_{N,t}^{-\chi}(c_t + i_{N,t} + i_{T,t} + \Theta_t^{OPT*}) + \nu p_t^{G-\chi} g_t$$

Market clearing condition for traded goods

$$y_{T,t} = \varphi^T \left(\frac{p_{TH,t}}{P_{T,t}}\right)^{-\chi^T} (1-\varphi) P_{T,t}^{-\chi}(c_t + i_{N,t} + i_{T,t}) + \nu^T \left(\frac{p_{TH,t}}{p_{T,t}^G}\right)^{-\chi^T} (1-\nu) \left(\frac{p_{T,t}^G}{p_t^G}\right)^{-\chi} g_t + \omega x_t$$

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