

# THE IMPACT OF THE RECOVERY AND RESILIENCE FACILITY ON THE GREEK ECONOMY

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## ABSTRACT

This paper assesses the macroeconomic impact of the stimulus and the structural reforms supported by the Recovery and Resilience Facility (RRF) on the Greek economy. The set-up is a Dynamic Stochastic General Equilibrium (DSGE) model that is augmented to account for the main features of Greece's plan under the RRF framework. The results suggest that the full and timely implementation of the Recovery and Resilience Plan (RRP) implies significant benefits to the Greek economy. Real GDP, private investment and employment can potentially increase by 6.9%, 20% and 4%, respectively, by 2026. Tax revenues also increase, creating fiscal space that can be used to further boost economic activity. The implementation of structural reforms included in the RRP is necessary for maintaining important benefits also in the long run. The results indicate that the potential increase in long-run GDP from selected quantifiable reforms ranges between 6% and 9.9%, with gains extending to other macro variables.

**Keywords:** Recovery and Resilience Facility; fiscal policy; structural reforms

**JEL classification:** E27; E6; O4; O52

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## Η ΕΠΙΔΡΑΣΗ ΤΟΥ ΜΗΧΑΝΙΣΜΟΥ ΑΝΑΚΑΜΨΗΣ ΚΑΙ ΑΝΘΕΚΤΙΚΟΤΗΤΑΣ ΣΤΗΝ ΕΛΛΗΝΙΚΗ ΟΙΚΟΝΟΜΙΑ

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## ΠΕΡΙΛΗΨΗ

Το παρόν άρθρο εκτιμά τις δυνητικές οικονομικές επιδράσεις στην ελληνική οικονομία των δαπανών και των διαρθρωτικών μεταρρυθμίσεων που αναμένεται να χρηματοδοτηθούν μέσω

επιχορηγήσεων και δανείων από τον ευρωπαϊκό Μηχανισμό Ανάκαμψης και Ανθεκτικότητας. Η εκτίμηση γίνεται με τη χρήση του Δυναμικού Στοχαστικού Υποδείγματος Γενικής Ισορροπίας (Dynamic Stochastic General Equilibrium model) της Τράπεζας της Ελλάδος, το οποίο έχει διευρυνθεί ώστε να αντανakλά επαρκώς τις υποθέσεις εργασίας που γίνονται ως προς τη χρήση των πόρων και την υλοποίηση των μεταρρυθμίσεων που προβλέπονται στο Εθνικό Σχέδιο Ανάκαμψης και Ανθεκτικότητας. Η ανάλυση διαχωρίζει τον τρόπο με τον οποίο οι επιχορηγήσεις και τα δάνεια επιδρούν στην οικονομική δραστηριότητα και το δημόσιο χρέος. Συγκεκριμένα, η επίδραση των επιχορηγήσεων εξετάζεται μέσω αύξησης των δημόσιων επενδύσεων και της δημόσιας κατανάλωσης, οι οποίες όμως δεν αυξάνουν το δημόσιο χρέος. Τα δάνεια επιβαρύνουν το δημόσιο χρέος και εισάγονται στο υπόδειγμα ως έμμεσες επιδοτήσεις επενδύσεων (implicit investment subsidies), η αύξηση των οποίων μειώνει το κόστος για κάθε μονάδα παραγωγικών επενδύσεων του ιδιωτικού τομέα, ενισχύοντας τα κίνητρα για ιδιωτικές επενδύσεις. Ως αποτέλεσμα, κινητοποιούνται ενδογενώς ιδιωτικοί πόροι για επενδύσεις πλέον του ποσού των δανείων.

Τα αποτελέσματα υποδεικνύουν ότι η πλήρης και έγκαιρη εφαρμογή του Εθνικού Σχεδίου συνεπάγεται σημαντικά οφέλη για την ελληνική οικονομία. Το πραγματικό ΑΕΠ, οι ιδιωτικές επενδύσεις και η απασχόληση μπορούν δυνητικά να αυξηθούν κατά 6,9%, 20% και 4%, αντίστοιχα, έως το 2026. Τα φορολογικά έσοδα επίσης αυξάνονται μέσω της διεύρυνσης της φορολογικής βάσης, δημιουργώντας έμμεσα πρόσθετο δημοσιονομικό χώρο που μπορεί να χρησιμοποιηθεί για μειώσεις φορολογικών συντελεστών ή αυξήσεις δαπανών, ενισχύοντας περαιτέρω την οικονομική δραστηριότητα.

Η συνολική επίδραση του Εθνικού Σχεδίου στην οικονομία μπορεί να διαχωριστεί στην επίδραση των επιχορηγήσεων και των δανείων και στην επίδραση των διαρθρωτικών μεταρρυθμίσεων. Η οικονομική μεγέθυνση που χρηματοδοτείται μέσω επιχορηγήσεων και δανείων αυξάνει το επίπεδο του πραγματικού ΑΕΠ κατά περίπου 4,3% το 2026. Οι διαρθρωτικές μεταρρυθμίσεις οδηγούν σε περαιτέρω αύξηση του επιπέδου του ΑΕΠ κατά 2,6% το 2026.

Τα αποτελέσματα επίσης υποδεικνύουν ότι οι διαρθρωτικές μεταρρυθμίσεις έχουν τη δυνατότητα να οδηγήσουν μακροχρόνια σε μια μόνιμη αύξηση της παραγωγικής ικανότητας της οικονομίας, καθώς συνεπάγονται μετάβαση σε ένα νέο σημείο ισορροπίας με υψηλότερο επίπεδο παραγωγικότητας, μεγαλύτερη προσφορά εργασίας και πιο αποτελεσματική κατανομή των παραγωγικών πόρων. Συγκεκριμένα, στην παρούσα ανάλυση εξετάζονται τρεις κατηγορίες διαρθρωτικών μεταρρυθμίσεων που μπορούν να ποσοτικοποιηθούν: α) μεταρρυθμίσεις που βελτιώνουν τον ανταγωνισμό στις αγορές προϊόντων και υπηρεσιών, β) μεταρρυθμίσεις που υποστηρίζουν τη μεγαλύτερη συμμετοχή στο εργατικό δυναμικό και γ) μεταρρυθμίσεις που ενισχύουν τη συνολική παραγωγικότητα της οικονομίας. Επιπλέον, γίνεται προσπάθεια να συνεκτιμηθεί και η επίδραση μεταρρυθμίσεων που αφορούν τον ψηφιακό μετασχηματισμό της δημόσιας διοίκησης. Τα ευρήματα δείχνουν ότι η εφαρμογή αυτών των μεταρρυθμίσεων δύναται να οδηγήσει σε αύξηση του επιπέδου του πραγματικού ΑΕΠ μακροχρόνια μεταξύ 6% και 9%, με τις θετικές επιδράσεις να επεκτείνονται και σε άλλες μακροοικονομικές μεταβλητές. Τα οφέλη για την οικονομία θα είναι διατηρήσιμα μακροχρόνια μόνο εφόσον υπάρξει πλήρης υλοποίηση των προβλεπόμενων μεταρρυθμίσεων. Χωρίς τις προβλεπόμενες μεταρρυθμίσεις τα οικονομικά οφέλη του Εθνικού Σχεδίου θα είναι βραχυπρόθεσμα και η οικονομία θα επιστρέψει σταδιακά στην αρχική της κατάσταση.

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## I INTRODUCTION

The aim of this paper is to assess the potential macroeconomic effects of the Recovery and Resilience Facility (RRF) on the Greek economy in the context of a Dynamic Stochastic General Equilibrium (DSGE) model. Our approach can be summarised as follows. First, we calibrate the model to account for the current state of the Greek economy. Then, departing from the calibrated economy, we feed the model with the paths of the expenditures financed by the RRF. We also provide a quantitative assessment of a subset of the structural reforms planned by the Greek authorities to complement the RRF-backed expenditures. In doing so, we use information from structural indicators and we map changes in these indicators onto the model's appropriate exogenous variables.

The RRF is at the core of the temporary recovery instrument “Next Generation EU” (NGEU), representing the EU's key response to the COVID-19 crisis. The RRF will provide to all EU Member States up to EUR 672.5 billion to support investments and reforms, of which EUR 312.5 billion in the form of grants and EUR 360 billion in the form of loans (at 2018 prices). The aim is to mitigate the economic and social repercussions of the COVID-19 pandemic, promote smart, sustainable and inclusive growth, and enhance resilience of the EU and its Members States, while taking account of the challenges and

opportunities of the green and digital transitions. The RRF entered into force on 19 February 2021.

In order to receive support from the RRF, Member States need to submit national “recovery and resilience plans” (RRPs) outlining their reform and investment programmes, as well as their targets, milestones and estimated costs. According to the RRF Regulation, the plans should address the recommendations of the European Semester and contribute to the strengthening of the growth potential, job creation, and economic and social resilience, as well as to the implementation of the European Pillar of Social Rights. At least 37% of the funds should support the green transition and 20% the digital transformation. The plans shall comprise measures for the implementation of reforms and public investment through a comprehensive and coherent package, which may also include public schemes that aim to incentivise private investment. The plans might also include cross-border or multi-country projects, fostering synergies across counties.

The funding by the RRF will be available for three years (2021-2023) but the payments can be extended to six years (until 2026). Member States can request up to 13% pre-financing for their RRPs, which applies to both grants and loans. Grants will be allocated to Member States using specific allocation keys reflecting their population size and economic conditions, including the impact of the pan-

demic.<sup>1</sup> The maximum amount of loans that a Member State can request amounts to 6.8% of its GNI in 2019 at current prices.

Greece submitted its comprehensive RRP (“Greece 2.0”) on 27 April 2021, requesting a total of EUR 30.5 billion in support under the RRF. Loans under the RRF are meant to be used for the financing of private investment. The plan is structured around four pillars: (a) green transition; (b) digital transition; (c) employment, skills and social cohesion; and (d) private investment and economic and institutional transformation.

Research on the effects of the RRF on the EU economies in the context of micro-founded general equilibrium models is rather limited so far. Bańkowski et al. (2021) examine the potential effects of the NGEU instrument on the euro area and selected euro area countries (Germany, Italy, Portugal and Spain).<sup>2</sup> However, the study abstracts from examining the impact of structural reforms that accompany the use of NGEU funds. The present paper attempts to fill this gap and contribute to the literature on the effects of policy reforms.<sup>3</sup>

The results of our analysis suggest that the full implementation of the stimulus and the reforms envisaged by the Greek RRP can potentially increase the level of real GDP by 6.9% by 2026. Private investment increases by around 20% in 2026 and employment by 4%. This amounts to the creation of around 180,000 additional jobs by 2026. At the same time, the tax base increases, leading to a rise in the tax revenues-to-GDP ratio of 2.8 percentage points (pp) in 2026. This implies an improvement in the primary surplus of the general government by an equivalent amount (additional fiscal space).

The total effect of the RRP on the economy can be decomposed into the effect of grants and loans and the effect of structural reforms. The stimulus financed by grants and loans raises the level of real GDP by around 4.3% in 2026. Moreover, the stimulus financed by loans

allocated to private investment leads to a boost in private investment of around 20% over the stimulus period. The results also suggest that the impact of loans on output is larger than that of grants.

Structural reforms lead to a further increase of 2.6% in the level of GDP in 2026. Unlike the temporary stimulus financed by grants and loans, however, reforms have the potential to lead to a permanent increase in the productive capacity of the economy. The levels of real output, private investment and employment are expected to increase by around 6%, 8.5% and 4%, respectively, in the long run. Importantly also, the reforms lead to a permanently higher tax base, so that tax revenues as a percentage of GDP increase by around 2.5 pp in the long run.

It should be stressed that our estimates of the effects of structural reforms may be interpreted as a “lower bound”, in the sense that it is not possible to quantify all the reforms envisaged by the Greek RRP in a transparent way and based on reliable estimates from the empirical literature. In particular, we quantify three sets of structural reforms: reforms that improve competition in product markets; reforms that support higher labour force participation; and productivity-enhancing reforms.

1 In particular, 70% of the maximum financial contribution (frontloaded in 2021-22) should be calculated based on the population, the inverse of GDP per capita and the relative unemployment rate of each Member State. The remaining 30% (committed in 2023) should be calculated based on the population, the inverse of GDP per capita, and, in equal proportion, the change in real GDP in 2020 and the aggregated change in real GDP during the period 2020-21 (on the basis of the Commission’s Autumn 2020 Economic Forecast for data not available at present, to be updated by 30.6.2022 with actuals).

2 European Commission (2020) also provides some estimates for the effects of the NGEU funds on the EU-27 economy. Canova and Pappa (2021) provide an empirical investigation of the effects of the NGEU funds on the EU economy. They show that the NGEU can be useful in creating jobs and boosting productivity and investment projects. However, they find asymmetric macroeconomic responses across regions. More recently, the European Commission (2021) in the context of its formal assessment of the Greek RRP has provided some estimates of the effects of the NGEU on the economy without including the possible positive impact of structural reforms.

3 See among many others Coenen et al. (2008), Uhlig (2010) and Drautzburg and Uhlig (2015). For the Greek economy, see Papageorgiou (2012), Dellas et al. (2017), Papageorgiou and Vourvachaki (2017), Gourinchas et al. (2017) and Economides et al. (2017, 2021).

**Table 1 Expected RRF disbursements by year**

	2021	2022	2023	2024	2025	2026	2021-2026 total
RRF funds (EUR billions)	3.97	5.31	5.31	5.31	5.31	5.31	30.50
<i>of which</i>							
Grants	2.35	3.15	3.15	3.15	3.15	3.15	18.08
Loans	1.61	2.16	2.16	2.16	2.16	2.16	12.42

Source: Authors' calculations on the basis of Ministry of Finance information (22.3.2021).

In addition, we estimate that reforms that improve the efficiency of the public sector, namely digitalisation, resulting in a reallocation of labour away from unproductive activities due to red tape and administrative costs and towards productive activities, have the potential to further boost long-run GDP by 3.9%. Reforms improving the quality of governance, the rule of law and the judicial system efficiency are not quantified in this exercise, but also have a great potential to increase productivity and allocative efficiency, thereby leading to significant additional long-run gains in terms of GDP per capita.

The rest of the paper is organised as follows. Section 2 describes the stimulus plan backed by the RRF. Section 3 describes the model and discusses the methodology used to assess the impact of the RRF. Section 4 reports the main results. Section 5 discusses the potential effects of the structural reforms included in the Greek RRP which are not easily quantifiable. Section 6 concludes.

## 2 STIMULUS FINANCED BY THE RRF

In order to quantify the impact of higher spending under the RRF, we need to make assumptions on the following: (a) the total amount of RRF funds available for Greece; (b) the expected flow of disbursements of the RRF funds over time; and (c) the distribution of funds across possible uses. These assumptions are based on information from the Greek Ministry of Finance and the Greek RRP as of 22.3.2021.

As regards the amount of RRF funds, it is assumed that Greece will request the maximum available funds from the RRF and will have the necessary administrative and operational capacity to complete the contracting of the total available amount for loans and grants during 2021-23, as well as to fulfil all the relevant milestones and targets on time in order to achieve full absorption of the funds by 2026. In particular, EUR 30.5 billion is expected from the RRF cumulatively in the 2021-26 period, of which EUR 18.1 billion in grants and EUR 12.4 billion in loans.

Concerning the expected disbursements, in 2021 Greece expects to receive the prepayment of 13% of both total grants and loans, in line with the RRF Regulation. For the period 2022-26, disbursements of the remaining grants and loans are evenly allocated (see Table 1), which reflects a smooth implementation of the Greek RRP. The working assumption is that the RRF disbursements are used to finance expenditures within the same calendar year.

Turning to the use of the funds, it is assumed that 67% of the RRF grants is channelled to finance government investment. The remaining 33% of the grants is used to finance government consumption.<sup>4</sup> The full amount of the loans is used to finance private investments. It is further assumed that the additionality principle applies, i.e. all grants and loans under the RRF finance new investments and reforms that would not materialise otherwise.

<sup>4</sup> A constant over time allocation of fund uses is assumed. Government consumption mainly regards intermediate consumption.

### 3 METHODOLOGY

#### 3.1 DESCRIPTION OF THE MODEL

To evaluate the impact of policy changes, we use a version of the Bank of Greece micro-founded Dynamic Stochastic General Equilibrium (DSGE) model that includes the main characteristics commonly shared among the structural models used by most central banks and international institutions, as well as some features that are important for adapting the model to the Greek economy.<sup>5</sup>

In particular, the domestic economy is modelled as a small open economy that belongs to a currency area in the sense that the nominal exchange rate is exogenous and there is no monetary policy independence. In the absence of monetary policy autonomy, the domestic nominal interest rate is determined by an exogenously given, risk-free, foreign nominal policy interest rate and a risk-premium component. The domestic economy consists of a large number of households, firms and a government. There are two types of households differing in their ability to participate in asset markets. The first type of households has access to the financial markets and can transfer wealth intertemporally by trading bonds and accumulating physical capital, whereas the second type of households is assumed to be liquidity constrained in the sense that it cannot lend or borrow. Both types of households receive labour income by working in the private and the public sectors.

As regards the labour market in the private sector, households supply differentiated labour services, and there are labour unions that act as wage setters in monopolistically competitive labour markets. As a result, private sector wages can pay a premium above the marginal product of labour due to labour unions' bargaining power (wage premium). Concerning the production sector, the model features monopolistically competitive firms that produce tradable and non-tradable differentiated goods. Firms in the tradable sector

sell their output domestically and to the rest of world (recorded as exports), while firms in the non-tradable sector sell their output only domestically. Firms set prices of their differentiated output according to the Calvo-type scheme with partial indexation. Prices are equal to a mark-up over the marginal cost, a feature that provides rationale for policies that increase competitiveness in the product market. All types of intermediate goods are used as inputs for the production of consumption and investment final goods. The final goods are produced by perfectly competitive firms and are sold to domestic households and the government.

The model also includes a relatively detailed fiscal policy block. In particular, the government hires labour and combines public consumption and public employment to produce public goods that provide direct utility to households. It levies taxes on consumption, taxes on income from labour and capital earnings, as well as lump-sum taxes, and issues one-period government bonds in the domestic bond market and the international markets. Total tax revenues together with the issue of new government bonds are used to finance public purchases of goods and services, public investment, government transfers and public sector wages. Public investment is used for the accumulation of public capital that induces production externalities to the private sector, thereby affecting the productivity of the private sector's factors of production, namely capital and labour. The model also features sovereign risk premia that are positively correlated with government indebtedness (measured by the public debt-to-GDP ratio), thereby introducing a sovereign risk channel through which sovereign default risk is transmitted to the real economy.

Finally, the model includes a number of nominal and real frictions, such as habit formation in consumption, investment adjustment costs

<sup>5</sup> For details of the main features of the model, see Papageorgiou (2014) and Papageorgiou and Vourvachaki (2017).

and variable capital utilisation that have been empirically identified as playing an important role in the transmission of structural shocks. Overall, the model captures well the key features of the Greek economy and thus provides a parameterised general equilibrium model suitable for policy simulations.

For the purpose of assessing the impact of the RRF on the Greek economy, the model is appropriately augmented in order to allow for a different treatment of grants and loans received under the RRF. Specifically, in line with the design of the RRF, grants are treated as budgetary neutral transfers to the government that allow an increase in government expenditures (consumption and investment) without bearing any impact on public debt. Instead, loans bear a burden on public debt. According to the Greek authorities, each year the RRF loans will be channelled as loans to the private sector for investment purposes at a very favourable interest rate and with the aim to mobilise additional private funds. In the model, the RRF loans are introduced as implicit investment subsidies accruing to every unit of private investment. These investment subsidies reduce the price of investment for every unit spent by the private sector, thereby endogenously creating incentives to mobilise even higher resources for private investment compared with just adding the amount of RRF loans to the original level of private investment. The loans are assumed to be repaid by the private sector by 2058 through non-distortionary lump-sum taxes.

### 3.2 DESIGNING POLICY SIMULATIONS

Our approach to assessing the impact of the investments and reforms included in the Greek RRP is summarised as follows. First, the model is calibrated, i.e. specific values are assigned to the structural parameters of the model and the exogenous policy instruments, in order to capture the current state of the Greek economy. The main source of data is Eurostat data at an annual frequency.<sup>6</sup> In particular, the exogenous fiscal policy instruments are set equal to their

average values in the data over the period 2017-19. This period is the reference level of the policy instruments across the simulations. As is usual in the relevant literature, we assume that the economy is at its steady state and that the RRP is agreed and starts to be implemented in 2021.<sup>7</sup>

Then, to examine the effects of the induced stimulus, i.e. of the RRF grants and loans, we feed the model with the exogenous paths of the fiscal variables (government investment and consumption) and the investment subsidy to the private sector (see Section 2), and we obtain the paths of key macroeconomic variables of interest expressed in percentage deviations from the steady state. It should be noted that after 2026 the government spending instruments and the investment subsidy return to their initial pre-RRF (pre-reform and pre-stimulus) levels.

Finally, to examine the effects of the structural reforms, we map selected reforms incorporated in the Greek RRP onto the relevant exogenous variables/parameters of the model (see the next section for details).

Three sets of policy simulations are conducted:

- 1) Evaluation of the impact of the expenditures relating to grants and loans (without structural reforms), compared with a policy-neutral baseline.
- 2) Evaluation of the impact of the structural reforms. Section 3.4 presents our approach to mapping a selection of these reforms onto the model's various exogenous variables. The selection hinges on the feasibility of this exercise in view of the challenges embedded in quantifying structural reforms.
- 3) Joint evaluation of policy changes under (1) and (2).

<sup>6</sup> For the calibration strategy, see Papageorgiou (2014) and Papageorgiou and Vourvachaki (2017).

<sup>7</sup> See also Uhlig (2010) and Drautzburg and Uhlig (2015) for a similar approach.

### 3.3 MAPPING STRUCTURAL REFORMS ONTO POLICY CHANGES IN THE MODEL

The Greek RRP includes an extensive list of reforms that are organised into axes that fall under four pillars: (a) green transition; (b) digital transition; (c) employment, skills and social cohesion; (d) private investment and economic and institutional transformation.<sup>8</sup>

In order to assess the economic impact of the structural reforms envisaged under the Greek RRP, it is necessary to map these reforms onto the model's appropriate exogenous variables, namely to identify the main channel through which a specific reform affects economic outcomes.<sup>9</sup> However, not all of the reforms under the Greek RRP are quantifiable. Therefore, this empirical exercise is restricted to the quantification of a subset of reforms that can be linked to structural indicators and for which the empirical literature offers reliable guidance regarding the sensitivity of key economic variables with respect to changes in these indicators.<sup>10</sup> As a result, our estimates of the effects of structural reforms may be viewed as a “lower bound”, to the extent that not all reforms are quantifiable. We discuss below the uncertainties surrounding these estimates and the limitations in quantifying the full set of structural reforms envisaged under the Greek RRP.

In addition to the issue of mapping the reforms onto the model's exogenous variables, one needs to assess the size of the reform in question. It should be noted that quantitatively assessing *ex ante* the size of the Greek RRP reforms is presently challenging, as legislative actions and a more thorough specialisation of the structural interventions are still pending. Indeed, this task is challenging even when the legislative acts are available. A further reason why the *ex ante* assessment of the size of the reforms is challenging is that there is uncertainty as to the time needed for reforms to affect economic outcomes, as well as regarding the speed and successful completion of reform implementation.<sup>11</sup> The joint effect from the

interaction between reforms is also difficult to properly identify and measure.

In all experiments, the size of the reforms, i.e. the size of the exogenous shocks to the model, are set so as to close Greece's gap to EU average practices (as measured in 2019 or 2020) by 2030 by at least 50%. Using some closure of the gap to EU practices is a plausible anchor, given that the RRF aims “to achieve an economic and social recovery, resilience and convergence”.<sup>12</sup> It should also be stressed that already by design of the policy experiments, structural reforms are expected to take longer to yield full effect compared with the RRF stimulus. Such an approach is in line with the one adopted in the extant literature that focuses on the medium- to long-run effects of reforms. Finally, it is assumed that policy reforms are credibly announced and begin to be implemented in 2021.

In particular, three sets of reforms corresponding to three distinct model channels are considered in the present empirical assessment:

**(i) Reforms that enhance competition in the product market:** The reforms in the Greek RRP that fall into this category include the simplification of the procedures of the Ministry of Infrastructure and Transport (axis 4.6), actions for the simplification of the business environment and its upgrading in quality and safety (axis 4.7), trade facilitation (axis 4.7), and the creation of a single tax and social security contributions' collection mechanism aiming to decrease administrative burden and compliance cost (axis 4.1).

<sup>8</sup> For the Greek RRP as submitted to the European Commission in April 2021, see <https://www.minfin.gr/web/guest/tameio-anakampses>.

<sup>9</sup> A detailed mapping table is available by the authors upon request. For example, axis 4.2 under pillar 4 includes also actions for “reforming public administration”, which is understood as primarily affecting positively the level of TFP.

<sup>10</sup> A similar approach is followed in European Commission (2016). The study also discusses the challenges in quantifying the impact of structural reforms.

<sup>11</sup> See also discussion in Box IV.5 in Bank of Greece, *Interim Report on Monetary Policy*, December 2019, pp. 113-117 (in Greek).

<sup>12</sup> See [https://ec.europa.eu/commission/presscorner/detail/en/QANDA\\_20\\_949](https://ec.europa.eu/commission/presscorner/detail/en/QANDA_20_949).



To examine the impact of this set of reforms, we link changes in the regulatory burden captured by the OECD Product Market Regulation (PMR) index for services sectors with changes in the mark-ups in the product market (OECD indices for 2019).<sup>13</sup> The impact of the relevant reforms is simulated by a gradual permanent reduction of 1.026 pp in the price mark-up of intermediate goods-producing firms by 2030. The size of the reform is such that the gap to the EU average practices in terms of the regulatory burden to firm entry and operation is gradually closed by 2030.

**(ii) Reforms that support higher labour force participation (labour supply):** The reforms that belong to this category include most of the reforms that promote job creation and participation in the labour market (axis 3.1), like pension reforms, and active and passive labour market policies. This category also includes reforms aiming to improve education, vocational education and training and skills (axis 3.2), as well as reforms to increase access to effective and inclusive social policies (axis 3.4). In the latter, reforms supporting an accessible and high-quality childcare favour women's labour force participation.

The impact of these labour market reforms is simulated by cumulatively increasing labour supply by around 4% by 2030. The size of the reform is such that half of the gap to the 2019 EU average labour force participation rate is closed by 2030 (Eurostat LFS data).<sup>14</sup>

**(iii) Productivity-enhancing reforms:** Two groups of reforms that work out towards increasing the total factor productivity (TFP) of the economy are considered in the empirical exercise.

First, reforms that improve the business environment, *inter alia* by lifting the regulatory obstacles to competition. This group includes reforms that improve competitiveness and promote private investments and exports (axis 4.7), like reforms that ease doing business or actions which contribute to the simplification of the business

environment. The impact of these reforms is simulated by assuming that the gap to the EU average practices in product market regulation as measured by the OECD (overall) PMR index is closed by 2030 (OECD indices for 2019). Using results from empirical studies, we are able to map changes in product market regulation affecting allocative efficiency, and thereby labour productivity, onto changes in TFP.<sup>15</sup> These estimates suggest a permanent increase in TFP of 1.22%. It is assumed that TFP gradually increases to its permanently higher level by 2030.

Second, reforms that enhance the digitalisation of the economy, as specified under the second pillar of the plan like the actions aiming to support switching to broadband connections and transition to 5G technology (axis 2.1), as well as under the third pillar of the plan such as the e-skill-enhancing reforms included in re-skilling/upskilling measures and active labour market policies (axes 3.1 and 3.2). Simulating the impact of these reforms is guided by the European Commission's earlier estimates on the impact of digital structural reforms.<sup>16</sup> Following the same approach, we quantify the impact of selected indicators of digitalisation on TFP and labour productivity, either directly or through an improvement in the allocative efficiency. As concerns the size of the reform, it is assumed that the gap between Greece and the EU average is closed by 2030 in terms of the percentage of total population employed as IT specialists (2019 Eurostat data) and in terms of the percentage of enterprises using DSL or other fixed broadband connection (2020 Eurostat data). The estimates suggest a permanent increase of 1.89% in the level of TFP.

All in all, the above estimates imply that the level of TFP increases permanently by 3.11% by 2030.

<sup>13</sup> See Thum-Thyssen and Canton (2015).

<sup>14</sup> The labour force participation rate concerns individuals aged 15-74. It needs to be noted that the model does not feature unemployment, or changes in the population, so that labour force participation changes fully reflect changes in employment.

<sup>15</sup> See Canton et al. (2014) and European Commission (2013). Similar conclusions are reached on the basis of OECD estimates reported in Égert (2018).

<sup>16</sup> See Lorenzani and Varga (2014).

## 4 SIMULATION RESULTS

### 4.1 EFFECTS OF GRANTS AND LOANS

Table 2 reports the effects of RRF funds (grants and loans) on key macroeconomic variables. All variables are expressed in percentage deviations from their steady state values, with the exception of the tax revenues-to-GDP ratio that is expressed as percentage point changes. Panel A of the table reports the joint effects of grants and loans. Panels B and C of the table report the decomposition of these joint effects into the effects of grants and the effects of loans, respectively. Chart A1 in Appendix A presents the dynamic effects for key macroeconomic variables over the period 2021-50.

Regarding the propagation mechanism following an increase in grants in the model, the main impact on the economy stems from government investment (which is allocated the largest share of grants). Higher government investment induces both demand- and supply-side effects. More specifically, an increase in government investment raises aggregate demand, leading firms to increase demand for labour and capital services. The demand-side effect on labour brings about an increase in private sector average real wages and employment, generating a rise in labour income. In turn, the rise in labour income triggers an increase in private consumption that further boosts aggregate demand. The supply-side effects relate to the accumulation of public capital as a result of government investment. Higher public capital leads to higher private sector productivity (see Section 3.1). As regards the effects from the increase in government consumption, the main channel at work is the rise in aggregate demand, which raises labour and capital income and further boosts aggregate demand. Higher government investment and consumption generate inflationary pressures in the short run, owing to the rise in labour costs and the rental rate of capital that increase the marginal cost of firms. Consequently, domestic products become less

competitive, which in turn dampens demand for exports in the short run, while demand for imports increases.

Next, regarding the effects of an increase in loans that are modelled as implicit investment subsidies, the first-order effect is a reduction in the price of investment, which creates incentives for the private sector to increase investment spending. Eventually, there is a strong increase in investment demand for as long as private investment is subsidised, which fosters capital accumulation. At the same time, firms increase demand for labour in order to meet higher domestic demand. Despite the higher labour costs, the marginal cost of firms decreases in response to the lower rental rate of capital, thereby generating deflationary pressures. The fall in domestic prices signals an improvement in the country's competitiveness, thereby leading to a rise in exports. At the same time, increased labour income induces households to increase private consumption, which further stimulates aggregate demand. The results in Table 2 suggest that the joint impact of grants and loans (Panel A) leads to an increase of 4.31% in the level of GDP in 2026. Private investment also increases, reaching a peak of around 21% in 2025. Employment in the private sector increases by more than 2% during the stimulus period. The rise in the tax base boosts tax revenues as a share of GDP by 1.56 pp in 2026. It should be noted that after 2026, when the stimulus period ends, the economy gradually converges to the initial steady state. Nevertheless, the speed of convergence to the initial steady state is low, so that the positive effects on GDP are found to be long-lived even after 20 years, mainly due to accumulation in the capital stock over the stimulus period that has lasting effects. Similar results are found by the European Commission (2021), which shows that the effects of the NGEU in Greece could lead to an increase in GDP of between 2.1% and 3.3% by 2026, as well as by Bańkowski et al. (2021).

Finally, it should be stressed that the stimulus financed by loans allocated to private invest-

**Table 2 Effects of grants and loans**

Panel A Joint effects of grants and loans								
Variable	2021	2022	2023	2024	2025	2026	10 years	20 years
Real GDP	2.23	3.30	3.72	3.72	4.25	4.31	2.08	0.56
Private investment	7.71	14.06	18.36	20.64	20.78	18.42	2.14	-3.92
Employment – private sector	1.49	2.36	2.50	2.52	2.43	2.23	0.03	-0.51
Tax revenues / GDP	0.79	1.23	1.41	1.53	1.58	1.56	0.55	0.25
Panel B Effects of grants								
Variable	2021	2022	2023	2024	2025	2026	10 years	20 years
Real GDP	1.04	1.29	1.23	1.26	1.33	1.45	0.30	0.29
Private investment	-0.17	-0.36	-0.49	-0.54	-0.49	-0.34	0.71	0.89
Employment – private sector	1.04	1.17	1.03	1.00	1.01	1.08	0.09	0.04
Tax revenues / GDP	0.45	0.55	0.51	0.50	0.52	0.56	0.05	0.09
Panel C Effects of loans								
Variable	2021	2022	2023	2024	2025	2026	10 years	20 years
Real GDP	1.19	2.00	2.47	2.77	2.91	2.85	1.73	0.27
Private investment	7.75	14.16	18.51	20.81	20.92	18.47	1.35	-4.78
Employment – private sector	0.46	1.20	1.47	1.52	1.42	1.16	-0.06	-0.54
Tax revenues / GDP	0.34	0.67	0.88	1.01	1.05	0.99	0.49	0.16

Source: Authors' estimations.

Note: All variables are expressed in percentage deviations from their steady state values, with the exception of the tax revenues-to-GDP ratio that is expressed in percentage point changes.

ment has a larger impact on GDP compared with grants. This is due to the significant increase in investment demand and the accumulation of the private capital stock, as well as to the country's enhanced competitiveness that boosts exports. Conversely, the stimulus financed by grants crowds out private investment and consumption in the short run, while at the same time it generates inflationary pressures that dampen demand for exports.<sup>17</sup>

#### 4.2 SIZE OF SPENDING MULTIPLIERS

Table 3 presents the implied present-value output multipliers for grants, loans and total funds. We report cumulative present-value multipliers, which are preferred over impact multipliers or period-by-period flow changes in output and policy instruments, because they embody the full dynamics associated with

exogenous policy instruments and properly discount macroeconomic effects at longer horizons.<sup>18</sup> In particular, the present-value multiplier  $T$  years after a change in the respective policy instrument is defined as:

$$\varphi_t = \frac{\sum_{t=0}^T \left( \prod_{j=0}^t (R_{t+j})^{-1} \right) \Delta Y_{t+j}}{\sum_{t=0}^T \left( \prod_{j=0}^t (R_{t+j})^{-1} \right) \Delta F_{t+j}} \quad (1)$$

where  $\Delta Y_{t+j}$  and  $\Delta F_{t+j}$  are, respectively, the level changes in output and the respective policy instrument of interest (i.e. grants and the investment subsidy) compared with their pre-

<sup>17</sup> The reason for the decrease in private investment is the temporary increase in the price of investment that is driven by the rise in the price of non-tradable goods. The latter is due to the increase in demand for non-tradable inputs that are used in the production of government consumption and investment.

<sup>18</sup> See also Uhlig (2010) and Leeper et al. (2010) for a similar approach.

**Table 3 Present-value discounted multipliers**

	2021	2022	2023	2024	2025	2026	10 years	20 years
Grants	0.73	0.70	0.69	0.68	0.68	0.70	0.75	0.91
Loans (investment subsidy)	1.22	1.40	1.57	1.71	1.81	1.87	2.80	3.50
Total funds	0.93	0.99	1.05	1.10	1.15	1.18	1.56	1.95

Source: Authors' estimations.

policy reform equilibrium values, and  $R_{t+j}$  is the model-based nominal return on government bonds, which is used as the discount rate.

The results in Table 3 indicate that the multiplier for the investment subsidies is higher than 1 already in the first period. It reaches a value of 1.87 in 2026, which means that a EUR 1 cumulative increase in investment subsidies over the period 2021-26 results in a GDP gain equal to EUR 1.87 in present value terms. In the long run, the multiplier converges to a value equal to 3.5. The multiplier for grants is found to be lower than 1, with a value of about 0.7 over the period 2021-26, which is within the range of values found in the relevant literature (see among others Kilponen et al. 2019).<sup>19</sup> The long-run multiplier for grants is 0.91. Regarding the overall multiplier for total RRF funds (grants and loans), its value is 1.18 over the 2021-26 period and converges to 1.95 in the long run.

#### 4.3 EFFECTS OF STRUCTURAL REFORMS

Table 4 reports the effects from the structural reforms examined. It should be noted that the structural reforms are assumed to be permanent, which means that the economy moves towards a new long-run equilibrium (steady state). Panel A reports the joint effects of all reforms considered in this assessment. Panels B, C and D report, respectively, the results of reforms that enhance competition in the product market, reforms that support higher labour force participation, and productivity-enhancing reforms.

Looking at reforms that enhance competition in the product market (Panel B), the first-order

effect is a decrease in the price of goods that are produced and sold domestically, which increases domestic demand for these goods, while reducing demand for imported goods (import substitution). Tradable sector output increases due to higher external demand that is driven by improved external competitiveness. Higher aggregate demand leads to a rise in demand for labour, which boosts the labour income of households (the real wage also increases), thereby triggering a rise in private consumption that further boosts labour and investment demand. Eventually, output and investment increase by 1.25% and 2.35%, respectively, in the new long run. The higher tax base leads to a rise of 0.5 pp in the tax revenues-to-GDP ratio.

Next, reforms that promote higher labour force participation (Panel C) and eventually lead to a rise in labour supply push private sector wages downwards, leading to a fall in labour costs in the short run that allows firms to increase demand for labour. The marginal cost of firms decreases, thus exerting a downward pressure on domestic prices, which translates into a drop in domestic inflation and an improvement in the terms of trade that triggers a rise in exports. Despite the reduction in the average real wage, the total labour income in the economy eventually increases and leads to

<sup>19</sup> An important determinant of the magnitude of the impact from government investment on output is the output elasticity of public capital. Typical values in the relevant literature range between 0.05 and 0.1; see e.g. Baxter and King (1993), Leeper et al. (2010) and Clancy et al. (2016). We follow Baxter and King (1993) and set the output elasticity of public capital equal to the government investment-to-GDP ratio found in the data. This implies a value equal to 0.046, which is in the lower range of values used in the literature. Higher values would produce stronger responses of output especially at longer horizons (see e.g. De Jon et al. 2017 and Leeper et al. 2010).

**Table 4 Effects of structural reforms**

Panel A Joint effects of selected reforms								
Variable	2021	2022	2023	2024	2025	2026	10 years	20 years
Real GDP	0.36	0.68	1.07	1.53	2.05	2.60	4.86	5.99
Private investment	-0.79	-1.12	-1.01	-0.50	0.32	1.39	6.28	8.46
Employment – private sector	-0.25	-0.09	0.23	0.68	1.20	1.74	3.86	4.15
Tax revenues / GDP	0.29	0.50	0.67	0.84	1.02	1.21	1.98	2.52
Panel B Reforms that enhance competition in the product market								
Variable	2021	2022	2023	2024	2025	2026	10 years	20 years
Real GDP	0.11	0.20	0.29	0.37	0.47	0.57	0.99	1.25
Private investment	-0.10	-0.09	0.01	0.19	0.44	0.73	1.97	2.35
Employment – private sector	-0.07	-0.06	-0.06	-0.04	-0.03	0.00	0.08	0.06
Tax revenues / GDP	0.05	0.10	0.14	0.17	0.21	0.24	0.40	0.51
Panel C Reforms that support higher labour force participation								
Variable	2021	2022	2023	2024	2025	2026	10 years	20 years
Real GDP	0.15	0.30	0.51	0.78	1.09	1.42	2.79	3.52
Private investment	-0.59	-0.92	-0.97	-0.77	-0.36	0.22	3.08	4.68
Employment – private sector	-0.07	0.13	0.47	0.91	1.40	1.91	3.92	4.28
Tax revenues / GDP	0.16	0.27	0.37	0.46	0.57	0.68	1.13	1.47
Panel D Productivity-enhancing reforms								
Variable	2021	2022	2023	2024	2025	2026	10 years	20 years
Real GDP	0.09	0.18	0.27	0.37	0.49	0.60	1.06	1.19
Private investment	-0.10	-0.14	-0.10	0.01	0.17	0.37	1.22	1.44
Employment – private sector	-0.11	-0.16	-0.19	-0.19	-0.19	-0.17	-0.17	-0.21
Tax revenues / GDP	0.07	0.12	0.16	0.20	0.24	0.28	0.42	0.50

Source: Authors' estimations.

Note: All variables are expressed in percentage deviations from the initial steady state values, with the exception of the tax revenues-to-GDP ratio that is expressed in percentage point changes.

a rise in private consumption that further boosts domestic demand. Real GDP and private investment increase by 3.52% and 4.68%, respectively, in the new long run. The rise in households' labour income and private consumption leads to an increase of 1.47 pp in the tax revenues-to-GDP ratio in the long run.

Finally, structural reforms that boost productivity (Panel D) bring about a rise in the marginal productivity of private inputs and a decrease in real marginal costs. This enables firms to increase demand for investment and labour and reduce the prices of domestically pro-

duced goods, thereby boosting exports. At the same time, the rise in labour and capital income induces households to increase private consumption. In the long run, output and investment increase by 1.19% and 1.44%, respectively.

Overall, structural reforms can jointly contribute to an increase in the levels of real GDP, private investment and employment of around 6%, 8.5% and 4%, respectively, in the long run. In addition, the reforms can permanently increase the tax base and lead to a boost of around 2.5 pp in tax revenues as a percentage of GDP.

**Table 5 Overall effect of the RRF**

Variable	2021	2022	2023	2024	2025	2026	10 years	20 years
Real GDP	2.61	3.98	4.78	5.55	6.27	6.90	7.00	6.55
Private investment	7.18	13.32	17.7	20.35	21.15	19.75	8.70	4.77
Employment – private sector	1.24	2.26	2.70	3.16	3.58	3.93	3.92	3.65
Tax revenues / GDP	1.09	1.74	2.09	2.38	2.62	2.80	2.56	2.80

Source: Authors' estimations.

Note: All variables are expressed in percentage deviations from the initial steady state values, with the exception of the tax revenues-to-GDP ratio that is expressed in percentage point changes.

#### 4.4 JOINT EFFECTS OF RRF FUNDS AND STRUCTURAL REFORMS

Table 5 summarises the overall impact of the RRF, including both the effects of the stimulus and the effects of the quantified structural reforms.

The results in Table 5 suggest that the full implementation of the Greek RRP can potentially increase the level of real GDP by 6.9% in 2026. It can boost private investment and employment by more than 20% and 4%, respectively, over the same period. At the same time, the tax revenues-to-GDP ratio increases by 2.8 pp, creating fiscal space that allows for a reduction in the tax rates or an increase in government spending that can further boost economic activity. Chart A2 in Appendix A presents the dynamic effects for key macroeconomic variables over the period 2021-50.

## 5 DISCUSSION

As discussed in Section 3, several groups of reforms envisioned in the Greek RRP are important but not easily quantifiable. They operate via multiple channels, shaping the framework conditions and institutional arrangements of the economy and influencing indirectly the effectiveness of other reforms. Examples include reforms that aim to improve the institutional quality, understood as government effectiveness, regulatory qual-

ity, rule of law and control of corruption, via the modernisation of public administration (axes 2.2 and 4.2), increased efficiency of the judicial system (axis 4.3) and improvements in the tax collection structures (axis 4.1). The impact of such complementary, horizontal and far-reaching reforms has not been explicitly addressed in the present empirical assessment, but is considered as a significant upside risk. Hence, conditional on our methodological approach, our estimates may be interpreted as a “lower bound”.

There is substantial cross-country evidence that high quality of institutions is strongly correlated with subsequent long-term growth,<sup>20</sup> social welfare and inclusiveness. Reforms improving governance and the rule of law have great potential to reduce transaction and rent-seeking costs, support innovation and entrepreneurship, and increase productivity and allocative efficiency. A number of studies suggest that rent-seeking is associated with substantial welfare costs and tends to affect innovators and young firms more negatively than established producers, as the former lack strong lobbies. Low quality of institutions can be a key determinant of rent-seeking behaviour. Examples include ineffective or partial rule of law, absent or weakly enforced property rights, and insufficient control of corruption.<sup>21</sup> It is worth noting that, on the basis of OECD

<sup>20</sup> In a seminal paper, Kaufmann et al. (1999) find that a one standard deviation improvement in governance results in per capita income increasing by a factor of between 2.5 and 4.

<sup>21</sup> For a discussion, see among others ECB (2018).

estimates, reforms that would close the gap between Greece and the average practices in terms of the rule of law in other Southern European countries that share common experiences and features with the Greek economy (Italy, Spain, Portugal) might deliver long-run gains in GDP amounting to about 9%.<sup>22</sup> Reforms that reduce the gap to the average EU practices in terms of rule of law, judicial efficacy, cost of contract enforcement, or the time of insolvency procedures also relate to strong productivity effects. It is also worth noting that judicial efficacy seems to have a positive impact on average firm size, the increase of which is one of the main targets of the Greek RRP under pillar 4.

The digitalisation of public administration is a reform that also plays an important role in the Greek RRP under pillar 2, but it is rather complex and less straightforward to capture empirically and disentangle its effects on the economy. Reforms and investments to step up the digitalisation of the public sector and use data strategically for user-driven public services (axis 2.2) are expected to enhance the public sector's efficiency and governance, reduce administrative costs and rent-seeking activities by various groups, and improve transparency and accountability, thus supporting labour productivity, long-term growth and social welfare. Greece has made progress in digital government but still lags significantly behind the EU or the OECD average.<sup>23</sup>

Given the importance of this reform, also in terms of the relative size of the allocated budget in the Greek RRP, we provide in Appendix B the results of a separate simulation exercise that assesses the impact of the digitalisation of public administration. The results suggest that a reallocation of labour away from unproductive activities due to red tape and administrative costs and towards productive activities has the potential to boost long-run output by 3.9%. The results should be treated with caution and only as an indication of the potential gains from such a reform, bearing in mind the novelty and the complexity of the approach.

Finally, a number of reforms included in the Greek RRP but not explicitly modelled hereby are expected to increase significantly the resilience of the Greek economy to shocks, particularly in terms of its recovery capacity. Three groups of reforms stand out: (a) green reforms that boost climate resilience (axis 1.4); (b) primary healthcare system reforms (axis 3.3) that boost resilience to public health crises; and (c) protection of intellectual and physical property rights (axes 1.2, 4.2 on combatting illicit trafficking, 4.4 and 4.6) that increase the resilience of key economic sectors, such as culture and tourism, especially in a digital era. Economic resilience is also expected to be enhanced by reforms that increase flexibility in labour and product markets and labour mobility through a swift upskilling and reskilling of the labour force (pillars 3 and 4), as well as by reforms that support the shift to tradables, and in particular a higher degree of trade openness and further diversification of exports (axis 4.7). Finally, reforms that reduce the vulnerabilities of banks and further develop capital markets should increase financial resilience to shocks, shielding the economy from negative feedback loops between the real economy and the financial sector.

## 6 CONCLUSIONS

This paper looked into the short-term and long-term macroeconomic effects of the RRF-backed stimulus and structural reforms on the Greek economy. To do so, we have used a

<sup>22</sup> This is equivalent to an increase in Greece's ranking in the rule of law relative to the 2019 average of Italy, Spain and Portugal (from 60.6 to 75.4 percentile rank), see <https://info.worldbank.org/governance/wgi/Home/Reports>. For the OECD estimates, see *Economic Surveys: Greece*, April 2018, Table 6, p. 31.

<sup>23</sup> According to the OECD Digital Government Index, Greece ranked 29th out of 33 countries in 2019. Top performers have formal coordination mechanisms for cross-government ICT projects to steer digital government reforms. Meanwhile, training civil servants in digital skills is crucial to be able to effectively implement digital government policies. According to the eGovernment Benchmark by the European Commission, Greece ranked 25th out of 27 EU countries in 2018-19 in public services provided to both citizens and businesses. Greece is the country with the lowest performance in both digitisation and penetration. Countries can improve the penetration level by increasing the number of people that submit official forms online to administrative authorities or by automating processes and requesting fewer forms from citizens.

DSGE model appropriately modified to capture the specificities of the Greek economy and of the Greek RRF. Moreover, we have made explicit a number of working assumptions necessary for this quantification exercise, including assumptions on the size, disbursement and use of the RRF funds, as well as assumptions about the implementation pace and size of selected reforms included in the Greek RRF. One important advantage of using a structural model is that we are able to shed light on the channels through which the different expenditures or structural policies ultimately affect real outcomes and to build an understanding of how policy changes interact with the decisions of households and firms.

The results highlight that the RRF constitutes a significant growth opportunity for the Greek economy. The full and timely implementation of the RRF has the potential to bring about significant benefits to the Greek economy. Real GDP is expected to increase by 6.9% in 2026. This increase largely reflects the effect of the RRF-backed stimulus to productive public and private investments during 2021-26. The results underscore the strong multiplier effects of channelling the RRF loans to the private sector as a means of leveraging private investment.

In the long run, sustaining higher real GDP depends crucially on the full implementation of structural reforms that would close at least partly Greece's present structural gap to the EU average practices along key attributes. In this case, real GDP increases by 6.5% by 2040

compared with the pre-RRF state. Addressing Greece's structural challenges in terms of the quality of governance, rule of law, judicial efficiency and the quality of public administration could bring about additional gains. An illustration involving the digitalisation of public administration suggests additional long-run gains in real GDP of about 4%. By sharp contrast, without any structural reforms that improve the economic environment on a permanent basis, real GDP would gradually return to its pre-RRF level.

Moreover, the results point to gains in terms of investment, employment and tax revenues extended also to the long run. The gains in terms of the tax revenues-to-GDP ratio hint at the potential to further boost activity by using the additional fiscal space to reduce the size of the distortionary taxes or increase government spending.

At the same time, the RRF presents a strong challenge for the Greek public administration to deliver its ambitious plan within the tight envisaged time schedule. Delays or mishaps in the implementation and less than full absorption of the RRF funds would curtail the potential benefits from the RRF that this study has underlined. In this respect, it is further important to push forward structural reforms that would enhance the capacity and efficiency of public administration, as well as the capacity of the private sector to support growth in the long run through new productive investment projects and sustainable jobs.



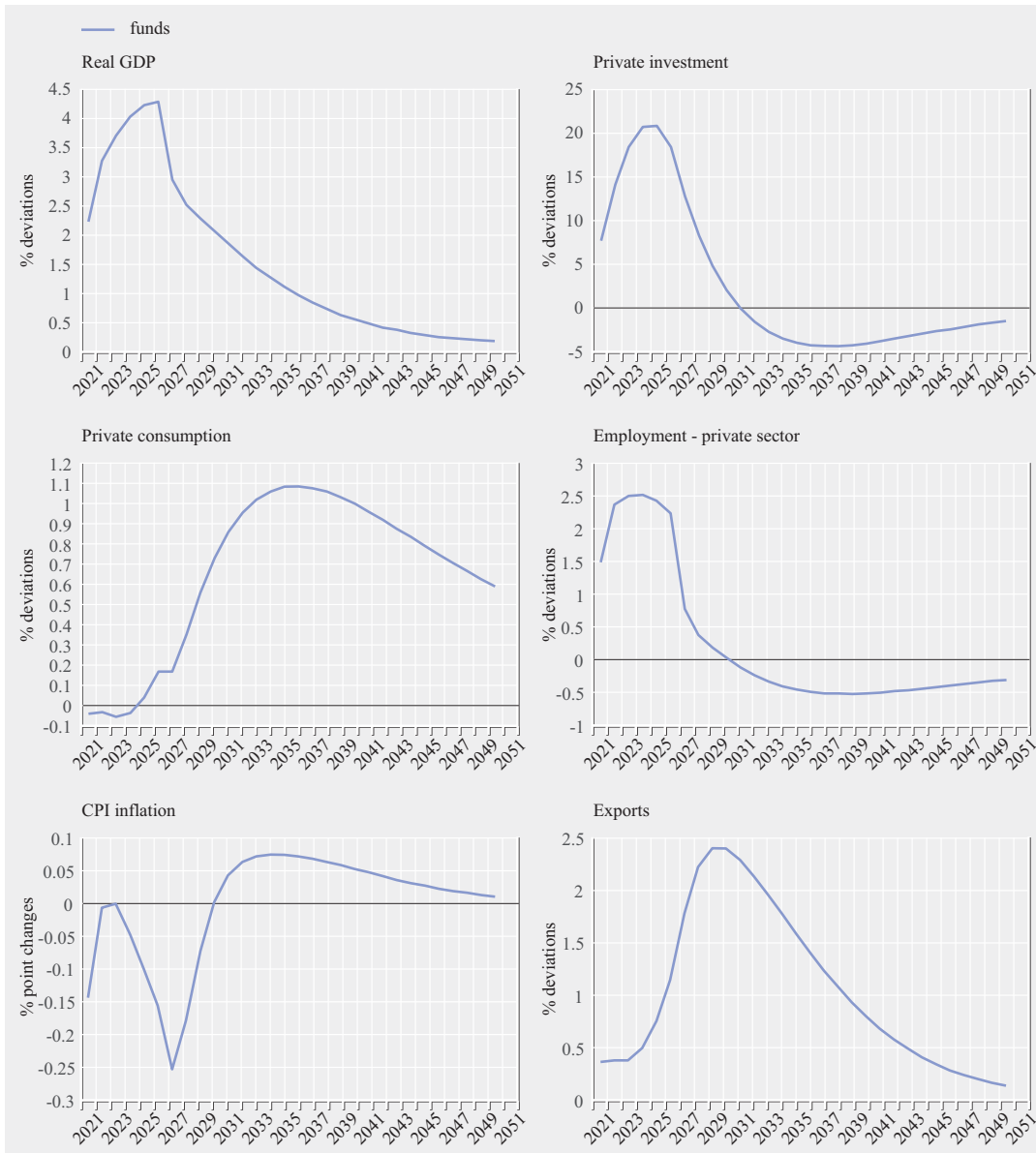
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# APPENDIX A

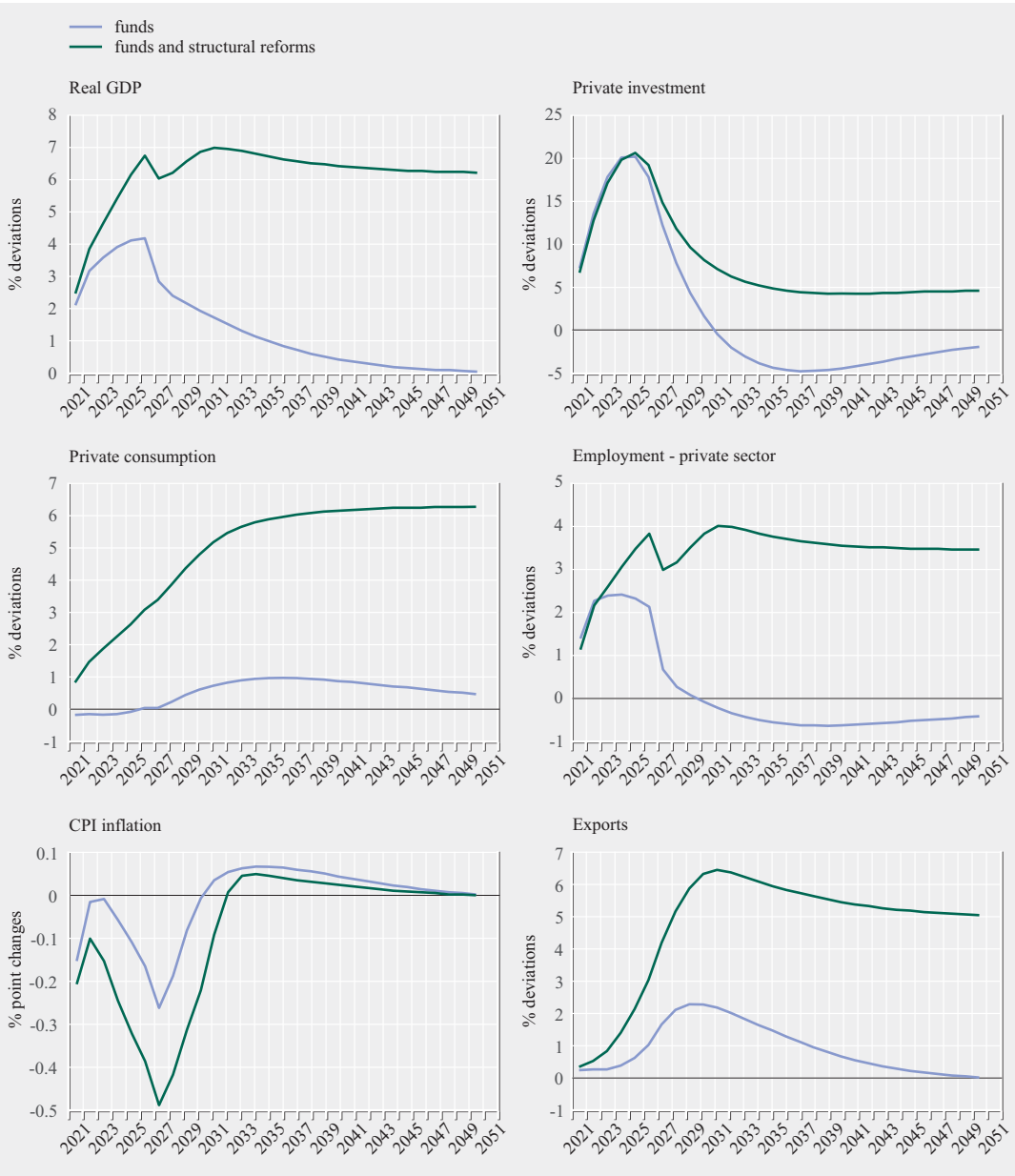
Chart A1 Dynamic effects of funds (grants and loans)



Source: Authors' estimations.

Note: All variables are expressed in percentage deviations from the steady state values, with the exception of CPI inflation that is expressed in percentage point changes.

**Chart A2 Dynamic effects of the RRF in total (funds and structural reforms)**



Source: Authors' estimations.

Note: All variables are expressed in percentage deviations from the steady state values, with the exception of CPI inflation that is expressed in percentage point changes. The chart does not include the effects from reforms related to the digitalisation of public administration.

## APPENDIX B

### EFFECTS OF THE DIGITALISATION OF PUBLIC ADMINISTRATION

In order to examine the effects of the digitalisation of public administration, we augment the model economy to account for unproductive use of resources and in particular the inefficient use of factor inputs that may result from the low efficiency of the public sector, the regulatory burden, the administrative costs on economic agents, etc. To do so, it is assumed that households allocate their available work effort time,  $H$ , between “productive work”,  $nH$ , and “unproductive activities”,  $(1-n)H$ .<sup>1</sup> What matters for the production of output is the amount of productive labour services  $nH$  that households supply to firms and receive a labour income. Engaging in unproductive activities involves a loss in utility for households. Reforms related to the digitalisation of public administration can be assessed through their impact on the fraction allocated to productive work,  $n$ . This is challenging because it requires an estimate for the share of productive work or unproductive activities. To obtain a value for this parameter, we link productive/unproductive work effort with the time that individuals can save from a digital interaction with the government, which is *de facto* assumed to be more efficient. To do so, we combine data on the share of individuals who interacted with public authorities via websites with the share of individuals who submitted completed e-forms. The estimated gap between Greece and the EU-27 is 10% in 2019 and is interpreted as the share of the available working time that is allocated to unproductive activities in excess of the EU average.<sup>2</sup> We simulate the effects of the digitalisation of public administration by assuming that Greece closes half of the gap with the EU by 2030 (i.e. the share of productive work increases by 5 pp or, equivalently, the share of unproductive activities is reduced by 5 pp). Table B1 summarises the effects of the reform.

**Table B1 Effects of the digitalisation of public administration**

Variable	2021	2022	2023	2024	2025	2026	10 years	20 years
Real GDP	0.18	0.35	0.59	0.89	1.23	1.60	3.10	3.91
Private investment	-0.63	-0.96	-1.00	-0.76	-0.29	0.36	3.51	5.22
Employment – private sector	-0.62	-0.94	-1.09	-1.14	-1.14	-1.11	-1.02	-0.62
Productive labour services ( $nH$ )	-0.07	0.17	0.56	1.05	1.60	2.17	4.39	4.78
Tax revenues / GDP	0.18	0.31	0.41	0.52	0.64	0.76	1.26	1.63

Source: Authors' estimations.

Note: All variables are expressed in percentage deviations from the steady state values, with the exception of the tax revenues-to-GDP ratio that is expressed in percentage point changes.

Regarding the propagation mechanism following the shock, the increase in the supply of productive work exerts downward pressure on demand for employment, since a given amount of output can now be produced with less labour. Eventually, employment and the average wage rate decrease during the period in which the share of productive work increases. Nevertheless, the share of productive labour services increases, leading to a boost in the labour income of households and private consumption (it should be recalled that households are paid for their productive work). In the short run, higher labour productivity allows firms to meet demand with less capi-

<sup>1</sup> The modelling approach follows Economides et al. (2021) and Angelopoulos et al. (2009). In their set-up, households divide their work effort between productive work and anti-social or rent-seeking activities and compete with each other for a fraction of a contestable prize.

<sup>2</sup> To compute this gap, we use data from Eurostat regarding the share of individuals who interacted with public authorities via websites and the share of individuals who submitted completed e-forms. The average of the two series in 2019 is 40% for Greece and 44.5% for the EU-27.

tal services, leading to a temporary drop in investment. The marginal cost of firms eventually decreases, allowing firms to reduce domestic prices, which in turn triggers a rise in export demand. In the new long run, real GDP and investment increase by 3.91% and 5.22%, respectively. Employment declines by 0.62%, but the productive labour services are 4.78% higher. Finally, the tax revenues-to-GDP ratio increases by 1.63% due to an increase in the tax base.