BANK OF GREECE
EUROSYSTEM

Working Paper

The macroeconomic impact of structural reforms in product and labour markets: trade-offs and complementarities

Dimitris Papageorgiou
Evangelia Vourvachaki

197

OCTOBER 2015

BANK OF GREECE
Economic Analysis and Research Department – Special Studies Division
21, E. Venizelos Avenue
GR-102 50 Athens
Tel: +30210-320 3610
Fax: +30210-320 2432

www.bankofgreece.gr

Printed in Athens, Greece
at the Bank of Greece Printing Works.

ISSN 1109-6691

THE MACROECONOMIC IMPACT OF STRUCTURAL REFORMS IN PRODUCT AND LABOUR MARKETS: TRADE-OFFS AND COMPLEMENTARITIES

Dimitris Papageorgiou
Bank of Greece

Evangelia Vourvachaki
Bank of Greece

ABSTRACT

This paper studies the impact of product and labour market structural reforms and the effects of their joint implementation with alternative debt consolidation strategies. The set-up is a DSGE model calibrated for the Greek economy. The results show that structural reforms produce important long-run GDP gains that materialize earlier, the faster the reforms are implemented. When implemented jointly with fiscal consolidations, structural reforms may amplify the short-run costs of fiscal tightening. The GDP dynamics depend on the fiscal instrument used for public debt consolidation. In the long run, however, there are complementarity gains irrespective of the fiscal instrument used.

JEL Classification Codes: E27, E62, O4.
Keywords: Structural reforms, Debt consolidation, Small open economy, General equilibrium model

Acknowledgements: The authors would like to thank Heather Gibson, Tryphon Kollintzas and Apostolis Philippopoulos for comments and suggestions. Helpful comments by participants at the Bank of Greece seminar series, the First Workshop on Public Sector Reforms / AUEB, and conference participants of the International Conference on Public Policy and Public Sector Reforms (Delphi, 2015) and CRETE (Chania, 2015) are greatly appreciated. We are grateful to Heather Gibson and Dimitrios Sideris for their support throughout this project. The views expressed in this paper are those of the authors and do not necessarily reflect those of the Bank of Greece.

Correspondence:
Dimitris Papageorgiou
Economic Analysis and Research Department
Bank of Greece,
21 El. Venizelos Av. 10250 Athens, Greece
Email: DPapageorgiou@bankofgreece.gr / dpapag@aueb.gr
Tel: +30 2103203826

"In every press conference since I became ECB President, I have ended the introductory statement with a call to accelerate structural reforms in Europe. The same message was also conveyed [...] in three quarters of all press conferences since the introduction of the euro." Mario Draghi (President of the ECB)[1]

1. Introduction

In this paper we investigate the macroeconomic effects of structural policies that remove obstacles to the efficient allocation of resources and correct potential market failures. In this regard, we address the following questions: What is the impact of structural reforms in product and labour markets in the short and long run? What is the role of the pace and timing of implementing a reform? We further consider cross-policy interactions. In particular, we examine the impact of structural reforms when they are implemented jointly with debt consolidation policies: Do structural reforms alleviate the costs of debt consolidation? To do so, we provide a quantitative assessment of different policies using a Dynamic Stochastic General Equilibrium (DSGE) model that is calibrated for the Greek economy.

Our findings point out strong positive long-run GDP gains from implementing structural reforms in the product and labour markets. Namely, reductions of 10 percentage points (pp) in non-tradable price and private-sector wage mark-ups result in gains that amount to around 9% of GDP. These gains materialize earlier the sooner and the faster the reforms are implemented. The results also suggest that the fiscal instrument used to stabilize debt matters for the impact of the simultaneous implementation of structural reforms and debt consolidations in the short to medium-term. A capital tax-based debt consolidation that reduces the public debt-to-GDP ratio by 10pp is found to be the most recessionary option in terms of GDP losses in the short-run when combined with product market reforms, while a labour-tax based one is the most recessionary option in conjunction with labour market reforms. In the long run, the gains of the two policies complement each other with the additional GDP gains being in the range of 0.4%-4%. The main mechanism at work is that structural reforms improve the economy's productive capacity on a permanent basis, thereby increasing the tax base. As a result, structural reforms create additional fiscal space that can be used to further decrease tax rates and/or increase government

[1] Introductory speech by Mario Draghi at the ECB Forum on Central Banking, Sintra, 22 May 2015.

expenditures. This mechanism works in the opposite direction in the short run depending on the instrument used to achieve debt consolidation.

Our results have strong policy implications, particularly for the Euro Area (EA) countries. The recent double-dip recession in the EA due to the 2007-2008 financial crisis and the subsequent sovereign debt crisis triggered a strong demand for structural reforms in markets featuring regulatory obstacles to competition. It also triggered demand for consolidating the public in countries that needed to restore their public finance sustainability and market confidence. While the EA is back on the recovery track, the need for further structural reforms and tight fiscal balances remains high. This is because structural reforms are seen as a means to improve EA structural competitiveness and resilience to adverse shocks in the future. Together with fiscal consolidations they aim to address current and future global imbalances (e.g. see European Commission 2014, OECD 2014, IMF 2015).

As concerns the regulatory obstacles to competition in product and labour markets, Figures 1a and 1b present respectively OECD countries' scores in the indices for Product Market Regulation (PMR) and Employment Protection Legislation (EPL) for the years 2008 and 2013. From both structural indices it is clear that European countries are away from international best practices, particularly for the case of labour markets. Comparing the scores across time reveals a substantial reform effort in Europe between 2008 and 2013. The highest reform activity is recorded in the EA-periphery. At the same time, most of the EA-periphery countries undertook structural reforms together with large-scale fiscal consolidation (see OECD 2013, European Commission 2014).

A notable example in this respect is Greece. In particular, Greece ranked first among OECD countries according to its degree of adoption of structural policies between 2011-2012 (see OECD 2013). Also, Greece implemented a large and sustainable fiscal consolidation effort that resulted in a budget deficit reduction by 13pp of GDP between 2009-2013 (19pp of GDP reduction in terms of structural deficit; see Bank of Greece). In light of these, this paper studies the effects of structural reforms and debt consolidations policies for the Greek economy.

The model used is a New-Keynesian DSGE model for a small open economy featuring a tradable and a non-tradable sector, a number of real and nominal frictions in the product and labour markets, no monetary policy independence and a rich set of fiscal instruments that allows us to examine tax and spending based fiscal consolidation strategies. We also include a number of stylized financial market imperfections, such as liquidity constrained households, working capital loans and a sovereign risk channel in the spirit of Corsetti et al (2013). The approach taken is summarized as follows: We first calibrate the model for the 2000-2009 period, namely the pre-crisis period. Then, departing from the benchmark calibrated economy we investigate the short- and long-run effects of the different policies.

The implications of this study are more general than the selected country application. It contributes to the literature that focuses on the interaction between structural reforms and fiscal policies in the context of the DSGE framework. A number of studies in the literature investigate the macroeconomic implications of fiscal consolidations alone, e.g. Coenen et al. 2008, Forni et al. 2010a, or structural reforms alone, e.g. Gomes et al. 2011, Forni et al. 2010, Cacciatore et al. 2012 and Vogel, 2014a. As such, they abstract from the cross-policy trade-offs and complementarities resulting from the interaction of these policies. Instead, the literature has put a considerable emphasis on the cross-effects of the monetary policy regime and structural reforms, e.g. Eggertsson et al. 2014, Vogel, 2014b, Gerali et al. 2015a. Structural reforms are studied together with debt consolidations in Vogel, 2012, Anderson et al 2014, and Gerali et al. 2015b. They abstract however from the role of the choice of the fiscal instrument and reform implementation path.

This paper is organized as follows. Section 2 presents the theoretical model. Section 3 provides the details of our calibration strategy and the long-run solution, Section 4 describes our simulations and presents the main results. Finally, Section 5 concludes.

2. The theoretical model[2]

2.1. Households

The economy is populated by a continuum of households of mass one, indexed by $h \in [0,1]$, of which a fraction indexed by $i \in [0,1-\lambda]$ are referred as the

[2] A detailed technical Appendix with the analytical solution of the model is available by the authors upon request.

"Ricardian" or "optimizing households", and a fraction indexed by $j \in (1-\lambda,1]$ are referred as the "non-Ricardian" or "liquidity constrained households". Optimizing households have unrestricted access to the capital or financial markets, where they can invest in the form of physical capital, government bonds and internationally traded bonds. Liquidity constrained households are not able to lend or borrow, so that they consume only their disposable labour income in each period. Both households supply differentiated labour services and act as wage setters in monopolistically competitive markets.

2.1.1. Ricardian households

Each Ricardian household i has preferences over consumption and hours worked that are represented by the intertemporal utility function:

$$U_i = E_0 \sum_{t=0}^{\infty} \beta^t u\left(C_{i,t} - \xi^c \bar{C}_{i,t-1}, H_{i,t}\right) \tag{1}$$

where $\beta \in (0,1)$ is the discount factor, $C_{i,t}$ is the "effective consumption" (defined below) of Ricardian households at t, $H_{i,t}$ is total hours worked at t, $\xi^c \in [0,1)$ is a parameter that measures the degree of external habit formation in consumption, $\bar{C}_{i,t-1}$ is average (per household i) lagged-once effective consumption. Effective consumption $C_{i,t}$ is defined as a linear combination between private consumption, $C_{i,t}^p$, and public goods and services at time t, Y_t^g, produced by the government (such as education, justice, hospitals, etc.):

$$C_{i,t} = C_{i,t}^p + \vartheta Y_t^g \tag{2}$$

where $\vartheta \in [-1,1]$.[3]

The instantaneous utility function is of the form:

---

[3] See also e.g. Christiano and Eichenbaum (1992), Forni et al. (2010) and Economides et al. (2013) for a similar formulation.

$$u\left(C_{i,t}-\xi^c \bar{C}_{i,t-1}, H_{i,t}\right)=\log\left(C_{i,t}-\xi^c \bar{C}_{i,t-1}\right)-\kappa \frac{H_{i,t}^{1+\gamma}}{1+\gamma} \tag{3}$$

where γ is the inverse of Frisch labour supply elasticity and $\kappa > 0$ is a preference parameter related to work effort. Each household i supplies hours worked in the private sector, $H_{i,t}^p$, and the public sector, $H_{i,t}^g$. As in Ardagna (2001) and Forni et al. (2009), hours of work can be moved costlessly across the two sectors and are perfect substitutes in the utility function, so that $H_{i,t} = H_{i,t}^p + H_{i,t}^g$ in each period t.

The household can save in the form of physical capital, $I_{i,t}$, domestic government bonds, $B_{i,t}$, and foreign bonds, $F_{i,t}^p$. It receives labour income from working in the private sector, $w_{i,t}^p H_{i,t}^p$, and the public sector, $w_{i,t}^g H_{i,t}^g$, where $w_{i,t}^p$ and $w_{i,t}^g$ are the real wage rates in the private and public sectors respectively. The household rents out capital to firms and receives capital income, $r_t^k u_{i,t} K_{i,t}^p$, where r_t^k is the real return to the effective amount of private capital services, $K_{i,t}^p$ is the physical private capital stock and $u_{i,t} > 0$ is the utilization rate of capital. The household also earns interest income from domestic government and internationally traded bonds that pay a gross nominal interest R_t and R_t^H at time $t+1$, respectively. In addition, households own all domestic firms, so that they receive their profits as dividends, $Div_{i,t}$. Finally, it receives lump-sum government transfers, $G_{i,t}^{tr}$. The household pays taxes on consumption, $0 \le \tau_t^c < 1$, on labour income, $0 \le \tau_t^l < 1$, capital earnings and dividends, $0 \le \tau_t^k < 1$, and lump-sum taxes, T_t . The budget constraint of each Ricardian household i is:

$$\begin{aligned}
&\left(1+\tau_t^c\right) C_{i,t}^p + \frac{P_t^I}{P_t^C} I_{i,t} + \frac{B_{i,t+1}}{P_t^C} + \frac{S_t F_{i,t+1}^p}{P_t^C} = \\
&\qquad = \left(1-\tau_t^l\right)\left(w_{i,t}^p H_{i,t}^p + w_{i,t}^g H_{i,t}^g\right) + \left(1-\tau_t^k\right)\left(r_t^k u_{i,t} K_{i,t}^p + Div_{i,t}\right) + \qquad (4) \\
&\qquad\qquad + R_{t-1}\frac{B_{i,t}}{P_t^C} + R_{t-1}^H \frac{S_t F_{i,t}^p}{P_t^C} + G_{i,t}^{tr} - T_t - \Gamma_t^h
\end{aligned}$$

where P_t^C and P_t^I are the prices of a unit of the private consumption final good and the investment final good, respectively, and S_t is the nominal exchange rate (expressed in terms of the domestic currency per unit of foreign currency). The households face costs when they adjust their private foreign asset holdings, Γ_t^h, whenever the private foreign assets-to-GDP ratio, $\frac{S_t F_{i,t+1}^p}{P_t^Y Y_t^{GDP}}$, deviates from its long-run target level, $\overline{f}$. In particular, $\Gamma_t^h\left(S_t, F_{i,t+1}^p, P_t^Y, Y_t^{GDP}\right) = \frac{\xi^f}{2} P_t^Y Y_t^{GDP}\left(\frac{S_t F_{i,t+1}^p}{P_t^Y Y_t^{GDP}} - \overline{f}\right)^2$, where Y_t^{GDP} is the economy's real GDP and P_t^Y is the GDP deflator (so that $P_t^Y Y_t^{GDP}$ is the nominal GDP), and $\xi^f \geq 0$ is the adjustment cost parameter.[4]

The private capital stock evolves over time according to the following law of motion:

$$K_{i,t+1}^p = \left(1 - \delta^p\left(u_{i,t}\right)\right) K_{i,t}^p + \left[1 - S\left(\frac{I_{i,t}^p}{I_{i,t-1}^p}\right)\right] I_{i,t}^p \tag{5}$$

where S is a convex adjustment cost function for investment, as in Christiano et al. (2005):

$$S\left(\frac{I_{i,t}^p}{I_{i,t-1}^p}\right) = \frac{\xi^k}{2}\left(\frac{I_{i,t}^p}{I_{i,t-1}^p} - 1\right)^2 \tag{6}$$

where $S(1) = S'(1) = 0$ and $\xi^k \geq 0$ is an adjustment cost parameter. We assume that the depreciation rate of private capital depends on the rate of capacity utilization and is a convex function that satisfies $\delta'^p > 0$, $\delta''^p > 0$, so that $\delta^p\left(u_{i,t}\right) = \delta^p u_{i,t}^{\varphi}$, where

[4] This specification ensures that foreign private assets are stationary; see Schmitt-Grohe and Uribe (2003) for details.

$\delta^p \in (0,1)$ and $\varphi > 0$ are respectively the average rate of depreciation of private capital and the elasticity of marginal depreciation costs.[5]

2.1.2. Non-Ricardian households

Liquidity constrained households have the same preferences as the optimizing ones that are given by (3), where now the index is *j*. They receive labour income from working in the private and public sectors, but have no access to the capital or financial markets, so that each period they consume their after-tax wage income and lump-sum government transfers. The period-by-period budget constraint of each household j is:

$$\left(1+\tau_t^c\right)C_{j,t} = \left(1-\tau_t^l\right)\left(w_{j,t}^p H_{j,t}^p + w_{j,t}^g H_{j,t}^g\right) + G_{j,t}^{tr} \tag{8}$$

where $H_{j,t}^p$ and $H_{j,t}^g$ are respectively hours worked in the private and public sector by household j and $G_{j,t}^{tr}$ are lump-sum government transfers. As in Coenen et al. (2013), we allow for a possibly uneven distribution of government transfers across Ricardian and Non-Ricardian households.

2.2 Wage setting and the evolution of wages in the private sector

We assume that wages in the private sector are set by monopolistic unions, following the approach in Gali et al. (2007) and Forni et al. (2009). More specifically, households supply differentiated labour varieties to a continuum of unions $h \in [0,1]$, each of which represents a specific labour variety. Every variety is uniformly distributed across households, so that each union ultimately represents $1-\lambda$ fraction of Ricardian households and λ of non-Ricardian households. Every period, each union sets the wage rate for its workers by trading off the utility derived from private sector labour income and the disutility of the total work effort, taking the demand for the differentiated labour variety h as given. At the same time, private sector firms and the public sector allocate labour demand uniformly across the h labour varieties independently of the type of households, which implies that hours worked by each

[5] The variable capital utilization is found to be an important determinant for the transmission of fiscal policy shocks; see e.g. Mertens and Ravn (2011).

type of household are equal: $H_{j,t}^{h,p} = H_{i,t}^{h,p} \equiv H_{h,t}^{p}$ and $H_{j,t}^{h,g} = H_{i,t}^{h,g} \equiv H_{h,t}^{g}$. Therefore, each period a typical union h chooses the wage rate, $w_{h,t}^{p}$, in order to maximize the following objective function:

$$L_w = \lambda\left[\Lambda_{h,t}^{NR}\left(1-\tau^{l}\right)w_{h,t}^{p}H_{h,t}^{p}\right]+\left(1-\lambda\right)\left[\Lambda_{h,t}^{R}\left(1-\tau^{l}\right)w_{h,t}^{p}H_{h,t}^{p}\right]-\kappa\frac{H_{h,t}^{\ 1+\gamma}}{1+\gamma} \tag{9}$$

subject to

$$H_{h,t}^{p} = \left(\frac{w_{h,t}^{p}}{w_{t}^{p}}\right)^{-\frac{\mu_t^W}{\mu_t^W-1}} H_t^p \tag{10}$$

$$H_{h,t} = H_{h,t}^{p} + H_{h,t}^{g} \tag{11}$$

where equation (10) is the demand for the differentiated labour input h, H_t^p is total labour demand in the private sector, w_t^p is the aggregate wage rate in the private sector, $\Lambda_{h,t}^{NR}$, $\Lambda_{h,t}^{R}$ are respectively the marginal utilities of consumption of non-Ricardian and Ricardian households of labour variety h that are used as weights for the labour income earned by working in the private sector. Also, $\mu_t^W / \left(\mu_t^W - 1\right) > 1$ is the elasticity of substitution across the differentiated labour services. As we demonstrate below, $\mu_t^W > 1$, has a natural interpretation as a wage markup in the private labour market.

Restricting attention on a symmetric equilibrium in which all unions choose the same wage, the first order condition for the above problem is:

$$w_t^{*p}\left(\frac{\lambda}{MRS_t^{NR}}+\frac{1-\lambda}{MRS_t^{R}}\right)=\mu_t^W \tag{12}$$

where w_t^{*p} is the optimal wage rate chosen by the unions, while $MRS_t^{NR} = \dfrac{\kappa H_t^{\gamma}}{\left(1-\tau^{l}\right)\Lambda_t^{NR}}$ and $MRS_t^{R} = \dfrac{\kappa H_t^{\gamma}}{\left(1-\tau^{l}\right)\Lambda_t^{R}}$ are the marginal rates of substitution between consumption and leisure of the non-Ricardian and Ricardian households, respectively. Note that when $\lambda = 0$ ($\lambda = 1$), i.e. all households are Ricardian (non-Ricardian), then μ_t^W reduces to a markup of the optimally chosen real wage rate over the marginal rate of substitution between consumption and leisure of the Ricardian (non-Ricardian) households.

Following Hall (2005) and Blanchard and Gali (2007), we introduce further rigidities in the labour market by assuming that real wages respond sluggishly to labour market conditions as a result of some unmodeled imperfections. In particular, the real wage rate in the private sector is modelled as a weighted average of lagged-once wage rate and the wage rate chosen by the unions:

$$w_t^p = \left(w_{t-1}^p\right)^n \left(w_t^{*p}\right)^{1-n} \tag{13}$$

where $0 \leq n \leq 1$ denotes the degree of real wage rigidities and w_t^{*p} is given by (12).[6] This formulation aims to capture the rigidities found in the Greek labour market (see discussion in European Commission, 2010).[7]

2.3. The production in the private sector

The production sector of the economy is as follows: There are monopolistically competitive domestic intermediate good firms that produce goods that are either tradable or non-tradable. The continuum of firms producing differentiated varieties of tradables, indexed by $f^T \in [0,1]$, sell their output domestically or abroad (recorded as exports). The continuum of firms producing differentiated varieties of non-tradables, indexed by $f^N \in [0,1]$, sell their output only domestically. There is also a continuum of monopolistically competitive firms importing intermediate goods, indexed by $f^M \in [0,1]$. All types of intermediates are used as inputs for the production of consumption and investment final goods. The latter are produced by perfectly competitive firms and are sold to domestic households and the government.

[6] See also Uhlig (2007), Malley et al. (2009) and Kliem and Uhlig (2013) for a similar specification. Microfoundations for quation (13) can be found e.g. in Petrongolo and Pissarides (2001), Hall (2003) and Christoffel and Linzert (2010).

[7] Papageorgiou (2014) finds that this specification captures well the aggregate dynamics of hours worked and real wages in Greece.

2.3.1. Domestic final good firms

Final good firms combine purchases of tradable intermediate goods with non-tradable goods to produce: private consumption good, C_t^p, private investment good, I_t^p, public consumption good, G_t^{gc} and public investment good, G_t^{gi}.

The representative producer of the private consumption good combines a bundle of tradable consumption intermediate goods, C_t^T, with a bundle of non-tradable intermediate goods, C_t^N, using a constant elasticity of substitution (CES) production function:

$$C_t^p = \left[\omega_C^{\frac{1}{\varepsilon_C}} \left(C_t^T \right)^{\frac{\varepsilon_C - 1}{\varepsilon_C}} + (1-\omega_C)^{\frac{1}{\varepsilon_C}} \left(C_t^N \right)^{\frac{\varepsilon_C - 1}{\varepsilon_C}} \right]^{\frac{\varepsilon_C}{\varepsilon_C - 1}} \tag{14}$$

where $\omega_C \in [0,1]$ measures the weight of tradable goods in the production of the final private consumption good, and $\varepsilon_C > 0$ is the elasticity of substitution between tradable and non-tradable consumption goods. In turn, the tradable intermediate consumption good bundle is a CES function of the domestically produced bundle of tradable intermediate consumption goods, C_t^D, and the bundle of imported intermediate consumption goods, C_t^M:

$$C_t^T = \left[\omega_{TC}^{\frac{1}{\varepsilon_{TC}}} \left(C_t^D \right)^{\frac{\varepsilon_{TC} - 1}{\varepsilon_{TC}}} + (1-\omega_{TC})^{\frac{1}{\varepsilon_{TC}}} \left(C_t^M \right)^{\frac{\varepsilon_{TC} - 1}{\varepsilon_{TC}}} \right]^{\frac{\varepsilon_{TC}}{\varepsilon_{TC} - 1}} \tag{15}$$

where $\omega_{TC} \in [0,1]$ measures the home bias in the production of the tradable intermediate consumption good, and $\varepsilon_{TC} > 0$ is the elasticity of substitution between domestic and imported intermediate consumption goods.

The intermediate consumption good bundles combine the differentiated varieties that are supplied by the intermediate good firms. Specifically, the varieties supplied by each tradable intermediate good firm f^T, $C_{f^T,t}^D$, each non-tradable intermediate-good firm, f^N, $C^N_{f^N,t}$, and each importing firm f^M, $C^M_{f^M,t}$, are respectively combined using the CES technology into: $C^D_t = \left(\int_0^1 \left(C^D_{f^T,t} \right)^{\frac{1}{\mu^T_t}} df^T \right)^{\mu^T_t}$, $C^N_t = \left(\int_0^1 \left(C^N_{f^N,t} \right)^{\frac{1}{\mu^N_t}} df^N \right)^{\mu^N_t}$, and $C^M_t = \left(\int_0^1 \left(C^M_{f^M,t} \right)^{\frac{1}{\mu^M_t}} df^M \right)^{\mu^M_t}$, where $\mu^T_t, \mu^N_t, \mu^M_t > 1$ are the intratemporal elasticities of substitution between different varieties within each type of intermediate consumption good. As we show below, $\mu^T_t, \mu^N_t, \mu^M_t$ represent markups in the markets of domestic and imported intermediate goods.

Taking prices as given, the final private consumption good firm optimally chooses its demand for each intermediate good variety. From the zero profit condition we get the price index for tradable consumption goods, $P^{TC}_t = \left[\omega_{TC} \left(P^D_t \right)^{1-\varepsilon_{TC}} + \left(1-\omega_{TC}\right)\left(P^M_t \right)^{1-\varepsilon_{TC}} \right]^{\frac{1}{1-\varepsilon_{TC}}}$ and the price index of a unit of the final consumption good (i.e. the Consumption Price Index), $P^C_t = \left[\omega_C \left(P^{TC}_t \right)^{1-\varepsilon_C} + \left(1-\omega_C\right)\left(P^N_t \right)^{1-\varepsilon_C} \right]^{\frac{1}{1-\varepsilon_C}}$, where P^D_t, P^N_t, P^M_t are the prices of domestic tradable, non-tradable and imported intermediate consumption goods, respectively. Optimal decisions regarding the production of the final private investment good are derived in an analogous manner (see the Appendix for details).

Turning to the final public consumption and investment goods, we assume they are produced using only non-tradable intermediate goods, so that $G^{gc}_t = GC^N_t$ and $G^{gi}_t = GI^N_t$, where $GC^N_t = \left(\int_0^1 \left(GC^N_{f^N,t} \right)^{\frac{1}{\mu^N_t}} df^N \right)^{\mu^N_t}$ and $GI^N_t = \left(\int_0^1 \left(GI^N_{f^N,t} \right)^{\frac{1}{\mu^N_t}} df^N \right)^{\mu^N_t}$.[8]

[8] Coenen et al. (2008) and Stahler and Thomas (2012) make a similar assumption.

2.3.2 Intermediate good firms

2.3.2.1 Intermediate good firms in the tradable and non-tradable sector

Each tradable and non-tradable intermediate good, $Y_{f^T,t}$, $Y_{f^N,t}$, is produced by a continuum of monopolistically competitive intermediate goods firms indexed by $f^T \in [0,1]$ and $f^N \in [0,1]$ respectively, according to the production technologies:

$$Y_{f^T,t} = A_t^T \left(K_{f^T,t}\right)^{a_T} \left(H_{f^T,t}\right)^{1-a_T} \left(\bar{K}_t^g\right)^{a_G} - \Phi_T \tag{16}$$

$$Y_{f^N,t} = A_t^N \left(K_{f^N,t}\right)^{a_N} \left(H_{f^N,t}\right)^{1-a_N} \left(\bar{K}_t^g\right)^{a_G} - \Phi_N \tag{17}$$

where $a_T, a_N > 0$ are the output elasticities of capital services in the tradable and non-tradable sectors respectively, and $a_G > 0$ is the output elasticity of public capital.[9] Finally, $\Phi_T, \Phi_N \geq 0$ are the fixed costs of production, and A_t^T, A_t^N are sector-specific total factor productivity levels.

2.3.2.2 Intermediate good firms in the tradable sector

Domestic intermediate good firms in the tradable sector solve a two-stage problem. In the first stage, each firm takes as given the factor prices, r_t^k and w_t^p, and chooses $K_{f^T,t}, H_{f^T,t}$ in order to minimize total real input cost. We introduce a working capital channel in the form of a “cash-in-advance” constraint in the spirit of Mendoza (2010). In particular, at the beginning of each period, each firm borrows from international lenders in order to cover a fraction v_t of their total labour costs in advance of revenues’ receipt. The working capital loan is repaid by the end of the period at the domestic country gross interest rate, R_t^H. Thus, the intratemporal problem of each firm involves the minimization of their costs, inclusive the costs of serving their intra-period working capital loan:[10]

[9] The production functions have increasing returns to scale with respect to all productive inputs even though there are constant returns with respect to private capital and labour, as in Baxter and King (1993) and Leeper et al. (2010).

[10] See Appendix 1 in Mendoza (2010) on how the static working capital problem is equivalent to a dynamic firm problem, as the one featuring in Uribe and Yue (2006).

$$\min_{K_{f^T,t},H_{f^T,t}} r_t^k K_{f^T,t} + w_t^p H_{f^T,t} + \left(R_t^H - 1\right) v_t w_t^p H_{f^T,t} \tag{18}$$

subject to (16). The first-order conditions are:

$$\left(1 + v_t \left(R_t^H - 1\right)\right) w_t^p = \left(1 - a_T\right) \frac{Y_{f^T,t} + \Phi_T}{H_{f^T,t}} mc_{f^T,t} \tag{19}$$

$$r_t^k = a_T \frac{Y_{f^T,t} + \Phi_T}{K_{f^T,t}} mc_{f^T,t} \tag{20}$$

where $mc_{f^T,t}$ is the Lagrange multiplier associated with the technology constraint, that is, the real marginal cost in terms of the consumer prices, P_t^C. Because firms borrow to cover part of their labour costs, the marginal cost of labour is higher than the wage rate in the private sector. As a result, increases in either the share of labour costs that are financed through working capital loans, or in the domestic interest rate, directly increase the cost of labour and thereby reduce labour demand. Since all firms rent inputs at the same input prices and have all access to the same technology, it follows that the real marginal cost will be the same across all firms: $mc_{f^T,t} = mc_t^T$.

The labour input, $H_{f^T,t}$, is a composite aggregate of household-specific varieties, $H_{f^T,t}^h$, $H_{f^T,t} = \left(\int_0^1 \left(H_{f^T,t}^h \right)^{\frac{1}{\mu_t^W}} dh \right)^{\mu_t^W}$. Each firm decides the demand for each labour variety h, so as to minimize its labour costs, $\int_0^1 w_{h,t}^p H_{f^T,t}^h dh$, taking as given the real wage rate $w_{h,t}^p$. The optimal demand is $H_{f^T,t}^h = \left(\frac{w_{h,t}^p}{w_t^p} \right)^{-\frac{\mu_t^W}{\mu_t^W - 1}} H_{f^T,t}$ where $\mu_t^W / \left(\mu_t^W - 1\right) > 1$ is elasticity of substitution across the differentiated labour services and w_t^p is the aggregate real wage index in the private sector that is given by $w_t^p = \left(\int_0^1 \left(w_{h,t}^p \right)^{\frac{1}{1-\mu_t^W}} dh \right)^{1-\mu_t^W}$.

In the second stage, intermediate good firms in the tradable sector choose the price that maximizes discounted real profits. As in Christoffel et al. (2008), firms charge different prices at home and abroad, setting prices in producer currency. In both domestic and foreign markets, we assume that prices are sticky à la Calvo (1983). In particular, each period $t \geq 0$, the firm f^T optimally resets prices with a constant probability $1-\theta_p^D$, when it sells its differentiated product in the domestic market, and with probability $1-\theta_p^X$, when it sells its product abroad. The firms that cannot optimize, partially index their prices to aggregate past inflation according to the price indexation schemes, $P_{f^T,t}^D = P_{f^T,t-1}^D \left(\Pi_{t-1}^D\right)^{x_D}$ and $P_{f^T,t}^X = P_{f^T,t-1}^X \left(\Pi_{t-1}^X\right)^{x_X}$, where $P_{f^T,t}^D$ denote the domestic price of good f^T and $P_{f^T,t}^X$ its foreign price, $\Pi_t^D = P_t^D / P_{t-1}^D$, $\Pi_t^X = P_t^X / P_{t-1}^X$ and P_t^D, P_t^X are the aggregate domestic and export price indices (defined below), respectively. The indexation parameters $x_D, x_X \in [0,1]$ determine the weights given to past inflation.[11] Therefore, the price of a firm that has not been able to optimally reset prices for τ periods in the domestic market is $P_{f^T,t+\tau}^D = P_{f^T,t}^D \prod_{s=1}^{\tau} \left(\Pi_{t+s-1}^D\right)^{x_D}$. Similarly, in the foreign markets the price is $P_{f^T,t+\tau}^X = P_{f^T,t}^X \prod_{s=1}^{\tau} \left(\Pi_{t+s-1}^X\right)^{x_X}$.

Each firm f^T that optimally resets its price in the domestic market in period t, knows the probability θ_p^D that the price will be in effect τ periods ahead, and chooses the optimal price $P_{f^T,t}^{*D}$ in order to maximize the discounted sum of expected real profits (in terms of the consumer prices P_t^C), by taking aggregate domestic demand, Y_t^D, and the aggregate price index in the domestic market, P_t^D, as given. Thus, each firm f^T maximizes:

$$\max_{P_{f^T,t}^D} E_t \sum_{\tau=0}^{\infty} \left(\beta\theta_p^D\right)^{\tau} \frac{\Lambda_{t+\tau}^R}{\Lambda_t^R} \left\{ \left(\prod_{s=1}^{\tau} \left(\Pi_{t+s-1}^D\right)^{x_D} \frac{P_{f^T,t}^D}{P_{t+\tau}^D} - mc_{t+\tau}^D \right) Y_{f^T,t+\tau}^D \frac{P_{t+\tau}^D}{P_{t+\tau}^D} \right\} \tag{21}$$

[11] Note that $x_D, x_X = 0$ denotes no indexation and $x_D, x_X = 1$ is total indexation.

subject to

$$Y_{f^T,t}^{D}=\left(\prod_{s=1}^{\tau}\left(\Pi_{t+s-1}^{D}\right)^{x_D}\frac{P_{f^T,t}^{D}}{P_{t+\tau}^{D}}\right)^{-\frac{\mu_{t+\tau}^{T}}{\mu_{t+\tau}^{T}-1}}Y_{t+\tau}^{D} \tag{22}$$

where $mc_t^D = P_t^C mc_t^T / P_t^D$ is the real marginal cost in terms of the domestic price index and $\Lambda_{t+\tau}^R / \Lambda_t^R$ is the ratio of the marginal utilities of consumption of Ricardian households - that are the owners of the firms - according to which firms value future profits.[12] Since all firms face the same marginal cost and take aggregate variables as given, any firm that optimizes will set the same price, $P_{f^T,t}^{*D} = P_t^{*D}$. Thus, the first-order condition of the above problem is:

$$E_t\left(\beta\theta_p^D\right)^{\tau}\frac{\Lambda_{t+\tau}^R}{\Lambda_t^R}\left(\prod_{s=1}^{\tau}\left(\frac{\left(\Pi_{t+s-1}^{D}\right)^{x_D}}{\Pi_{t+s}^{D}}\right)\frac{P_t^{*D}}{P_t^{D}}\right)^{-\frac{\mu_{t+\tau}^{T}}{\mu_{t+\tau}^{T}-1}}Y_{t+\tau}^{D}\frac{P_{t+\tau}^{D}}{P_{t+\tau}^{D}}\left[\prod_{s=1}^{\tau}\left(\frac{\left(\Pi_{t+s-1}^{D}\right)^{x_D}}{\Pi_{t+s}^{D}}\right)\frac{P_t^{*D}}{P_t^{D}}-\mu_{t+\tau}^{T}mc_{t+\tau}^{D}\right]=0 \tag{23}$$

According to the above expression firms set nominal prices so as to equate the average future expected marginal revenues to average future expected marginal costs.[13] The aggregate domestic index evolves according to

$$P_t^D=\left(\left(1-\theta_p^D\right)\left(P_t^{*D}\right)^{\frac{1}{1-\mu_t^T}}+\theta_p^D\left(P_{t-1}^{D}\left(\Pi_{t-1}^{D}\right)^{x_D}\right)^{\frac{1}{1-\mu_t^T}}\right)^{1-\mu_t^T}.$$

Similarly, the associated first-order condition of each firm f^T that optimizes its price in the foreign markets in period t, is:

$$E_t\left(\beta\theta_p^X\right)^{\tau}\frac{\Lambda_{t+\tau}^R}{\Lambda_t^R}\left(\prod_{s=1}^{\tau}\left(\frac{\left(\Pi_{t+s-1}^{X}\right)^{x_X}}{\Pi_{t+s}^{X}}\right)\frac{P_t^{*X}}{P_t^{X}}\right)^{-\frac{\mu_{t+\tau}^{X}}{\mu_{t+\tau}^{X}-1}}Y_{t+\tau}^{X}\frac{P_{t+\tau}^{X}}{P_{t+\tau}^{C}}\left[\prod_{s=1}^{\tau}\left(\frac{\left(\Pi_{t+s-1}^{X}\right)^{x_X}}{\Pi_{t+s}^{X}}\right)\frac{P_t^{*X}}{P_t^{X}}-\mu_{t+\tau}^{X}mc_{t+\tau}^{X}\right]=0 \tag{24}$$

---

[12] Note that in equilibrium the marginal utility of consumption is equal across all Ricardian households, that is, $\Lambda_{i,t} = \Lambda_t^R$.

[13] In the case of fully flexible prices, $\theta_p^D = 0$, the above condition reduces to the static relation, $P_t^{*D} = \mu_{t+\tau}^T P_t^C mc_{t+\tau}^T$, which states that the price is equal to a markup over the nominal marginal cost.

where $mc_t^X = P_t^C mc_t^T / P_t^X$ is the real marginal cost in terms of the aggregate export price index, and the aggregate export price index evolves according to $P_t^X = \left(\left(1-\theta_p^X\right)\left(P_t^{*X}\right)^{\frac{1}{1-\mu_t^X}} + \theta_p^X \left(P_{t-1}^X \left(\Pi_{t-1}^X\right)^{x_X} \right)^{\frac{1}{1-\mu_t^X}} \right)^{1-\mu_t^X}$. The optimal decisions for non-tradable and importing intermediate good firms are derived in a similar manner.

2.4. Foreign sector

There is a representative foreign final good firm that purchases the differentiated exported goods, $Y_{f,t}^X$, produced by the domestic tradable intermediate good firms f^T, and transforms them into a homogeneous final good Y_t^X via the CES technology:

$$Y_t^X = \left(\int_0^1 \left(Y_{f^T,t}^X \right)^{\frac{1}{\mu_t^X}} df^T \right)^{\frac{1}{\mu_t^X}} \tag{25}$$

where $\mu_t^X > 1$ is related to the intratemporal elasticity of substitution between the differentiated outputs supplied by the domestic intermediate good firms, $\mu_t^X / \left(\mu_t^X - 1\right) > 1$. The foreign firm takes prices of the exported differentiated goods $P_{f^T,t}^X / S_t$ (expressed in terms of the foreign currency) as given, and chooses the optimal amounts of differentiated inputs to minimize the total input costs, $\int_0^1 \left(P_{f^T,t}^X / S_t \right) Y_{f^T,t}^X df^T$, subject to (25), so that the optimal demand function for each input $Y_{f^T,t}^X$ is $Y_{f^T,t}^X = \left(\frac{P_{f^T,t}^X}{P_t^X} \right)^{-\frac{\mu_t^X}{\mu_t^X - 1}} Y_t^X$, where $P_t^X = \left(\int_0^1 \left(P_{f^T,t}^X \right)^{\frac{1}{1-\mu_t^X}} df^T \right)^{1-\mu_t^X}$ is the aggregate price index of the exported domestic intermediate goods and Y_t^X is total foreign demand for domestic intermediate goods. The latter is $Y_t^X = \left(\frac{P_t^X / S_t}{P_t^{X^*}} \right)^{-\varepsilon_X} Y_t^*$, where $P_t^{X^*}$ is the price of foreign competitors in the export markets, Y_t^* is foreign economy output and $\varepsilon^X > 0$ is the price elasticity of export demand.

2.5. Government and public sector production

The government levies taxes on consumption, on income from labour and capital earnings, and lump-sum taxes. It also issues one-period government bonds in the domestic bond market, B_{t+1}^{g}, and the international markets, F_{t+1}^{g}. Total tax revenues plus the issue of new government bonds are used to finance government consumption, G_t^c, investment, G_t^i, transfers, G_t^{tr}, and the compensation of public sector employees, $w_t^g H_t^g$. Moreover, the government pays interest payments on past domestic public debt, R_t, and foreign public debt, R_t^H. The government budget constraint in per-capita terms is:

$$\begin{aligned}\frac{B_{t+1}^{g}}{P_t^c}+\frac{S_t F_{t+1}^{g}}{P_t^C}+\tau_t^c C_t^p+\tau_t^l\left(w_t^p H_t^p+w_t^g H_t^g\right)+\tau_t^k\left(r_t^k u_t K_t^p+Div_t\right)+T_t &= \\ =\frac{P_t^N}{P_t^C}G_t^c+\frac{P_t^N}{P_t^C}G_t^i+G_t^{tr}+w_t^g H_t^g+\left(R_{t-1}\frac{B_t^g}{P_t^C}+R_{t-1}^H\frac{S_t F_t^g}{P_t^C}\right)\end{aligned} \tag{26}$$

Therefore, the government has eleven policy instruments, $X_t \in \left\{\tau_t^c,\tau_t^l,\tau_t^k,T_t,w_t^g,H_t^g,G_t^c,G_t^i,G_t^{tr},B_{t+1}^g,F_{t+1}^g\right\}$, out of which ten can be exogenously set. To ensure fiscal solvency, one of the policy instruments follows a rule that reacts systematically to deviations of the public debt-to-GDP ratio from a target level:

$$X_t = X_{t-1}+\phi_1^d\left(D_t^y-\bar{d}\right)+\phi_2^d\left(D_t^y-D_{t-1}^y\right) \tag{27}$$

where $D_t^y \equiv \frac{D_t}{P_{t-1}^y Y_{t-1}^{GDP}}$ is the debt-to-GDP ratio in the beginning of period *t*, $\bar{d}$ is the target value of the public debt-to-GDP ratio, and $\phi_1^d,\phi_2^d > 0$ are reaction parameters. It is convenient to define the share of total public debt held by domestic agents at the end of period t as $\zeta_t \equiv \frac{B_{t+1}^g}{D_{t+1}}$, for $0 \le \zeta_t \le 1$, so that $S_t F_{t+1}^g = (1-\zeta_t)D_{t+1}$, and $D_{t+1} = B_{t+1}^g + S_t F_{t+1}^g$. On the production side, following e.g. Forni et al. (2010) and Economides et al. (2013), it is assumed that the government combines public spending on goods and services, G_t^c, and public employment, H_t^g, to produce public goods Y_t^g by using the following production function:

$$Y_t^g = A_t \left(G_t^c\right)^{\chi} \left(H_t^g\right)^{1-\chi} \tag{28}$$

where $0 \le \chi \le 1$ is a technology parameter.

The law of motion of public capital in per-capita terms is:

$$K_{t+1}^g = \left(1-\delta^g\right) K_t^g + G_t^i \tag{29}$$

where $\delta^g \in \left(0,1\right)$ is the depreciation rate of public capital stock and $K_0^g > 0$ is given.

2.6. World capital markets and sovereign spreads

We introduce a sovereign risk channel through which sovereign default risk influences economic activity by assuming that domestic households and the government pay a positive interest rate risk premium when they participate in the international markets. In particular, following the approach e.g. in Schmitt-Grohe and Uribe (2003) and Forni and Pissani (2013), we allow the possibility the interest rate at which the home country borrows from the international markets, R_t^H, bears a risk-premium term, $\tilde{\psi}_t \ge 0$, that introduces a wedge between the home country and risk-free foreign nominal interest rate, R_t^*:

$$R_t^H = \max\left\{R_t^* + \tilde{\psi}_t, R_t^*\right\} \tag{30}$$

As in Christiano et al. (2010) and Garcia-Cicco et al. (2010), the risk-premium term is a function of fundamentals of the domestic economy:

$$\tilde{\psi}_t = \psi^d \left(\exp\left(D_{t+1}^y - \overline{d}\right) - 1\right) \tag{31}$$

where $\psi^d \geq 0$ is a sovereign risk parameter. The risk premium component in the right hand side of (31) reflects the risk of a sovereign default and constitutes a sovereign risk channel through which sovereign default risk affects the real economy, in line with the recent evidence provided in Corsetti et al. (2013). In particular, when public debt-to-GDP ratio rises above its target level, a spread emerges in the interest rate, raising it above the risk-free rate, which is consistent with the recent empirical evidence (see e.g. Ardagna et al. 2008, Schuknecht et al. 2009 and Roeger and in't Veld 2013).

Therefore, the presence of country risk that induces a positive spread in the home country interest rate above the risk-free rate, implies higher borrowing costs for optimizing households and the government, and higher working capital financing costs for firms.

2.7. Monetary policy regime

We model the domestic economy as a member of a currency union in the sense that the nominal exchange rate, S_t, is exogenously set, and at the same time, there is no monetary policy independence. In turn, the domestic nominal interest rate on government bonds, R_t, is endogenously determined by the risk-free foreign nominal interest rate and the risk-premium component.

3. Calibration and steady-state solution

The model is calibrated for the Greek economy at a quarterly frequency. The data source is Eurostat, unless otherwise stated. The data covers the period 2000-2009.[14] Table 1 reports the calibrated parameters and average values of the fiscal policy variables in the data. The calibration strategy and most of the parameter values are taken from Papageorgiou (2014). Below we note the calibration of additional parameters.

3.1. Calibration

We define as tradables sector the sum of agricultural, industry (excluding construction), and tourism related (transportation, hotels and restaurants) activities.

[14] We focus on the period during which Greece is part of the euro area and before the sovereign debt crisis in early 2010.

Non-tradable sector includes the remaining business sector activities.[15] We calibrate the price markups for the tradable and non-tradable sector to match the respective net profit margins. The latter are calculated using national accounts at the industry level.[16] The resulting values are $\mu_t^T = 1.35$ for tradables and $\mu_t^N = 1.46$ for non-tradables. These values are broadly in the range with those reported in the literature for other euro-area countries, e.g. see Forni et al (2010). We assume that the markup for importing activities is the same as the markup for the domestic tradable sector. The markup for the private sector wages and the export sector are set as in Papageorgiou (2014), equal to $\mu_t^W = 1.15$ and $\mu_t^X = 1.11$, respectively.

We normalize the level of long-run aggregate productivity in the non-tradable sector, A_t^N, equal to one and calibrate the long-run aggregate productivity in the tradable sector A_t^T so that it is consistent with the different markups across the two sectors.[17] We otherwise have symmetry across the tradable and non-tradable sectors as concerns the labour shares, Calvo parameters and inflation indexation parameters. The economy-wide labour share is calibrated in a consistent way with our definition of tradables and non-tradables and following the methodology described in Papageorgiou (2012) by assuming that the self-employed earn an imputed labour income. The share of labour costs of the private sector financed with working capital loans, v, is set equal to the fraction of working capital loans in all new loans of non-financial firms.[18] Finally, we set the fixed costs in either sector to ensure that dividends would be non-negative and close to zero across the policy experiments.

As concerns the parameters of the CES consumption and investment technologies, ω_C, ω_I, that measure the weight of tradable goods in the production of the final good, we calibrate them to match the share of tradables (domestic tradables

[15] We exclude real estate activities from business activities as they include imputed owner rents. Also, we exclude public administration and defence and compulsory social security contributions as these categories refer to the public sector.
[16] Specifically, the net profit margin (*NPM*) is defined as the share of the net operating surplus in gross value added. The net operating surplus excludes depreciation costs and is adjusted to exclude the imputed labour income of the self-employed in each sector. The imputed labour income of the self-employed for each sector, tradable or non-tradable, is proxied by assuming that each self-employed person earns a wage rate equal to the average compensation per employee. Gross markup is computed as $1/(1-NPM)$.
[17] In particular, it is calibrated as the ratio of the marginal cost in the non-tradable sector to the one in the tradable sector.
[18] This information is taken by the European Commission's Survey on Access to Finance of Enterprises.

and imports) in aggregate consumption and investment, respectively. The home bias parameters ω_{TC}, ω_{TI} are respectively calibrated to match the share of imported consumption goods in total private consumption and the share of imported investment goods in total private investment. The elasticities of substitution between tradable and non-tradable consumption and investment goods, $\varepsilon_C, \varepsilon_I$, are both set equal to 0.5, following the work of Gomes et al. (2011). [19]

Regarding fiscal policy instruments, the long-run values of public spending on goods and services and public investment as shares of output, hours worked in the public sector and the values of the effective tax rates are set equal to their average values in the data. We set the share of total public debt held by domestic agents equal to one, and the share of government transfers that is allocated to liquidity constrained households equal to their share in population. The target level of the public debt-to-GDP ratio, $\bar{d}$, is set equal to 100% on annual basis, that corresponds to the average value of the public debt-to-GDP ratio in the data over the sample period.

Finally, we normalize to one the values for the utilization rate for capital, the prices of imported intermediate goods, and inflation rates for all types of intermediates. Also, we set the adjustment cost parameter for foreign asset holdings, ξ^f, to the lowest possible value so as to ensure that the equilibrium solution for foreign assets is stationary.

[Table 1 about here]

3.2. Steady-state solution

Table 2 reports the model's long-run solution. In this solution, we exogenously set the long-run level of the debt-to-GDP ratio equal to the target level $\bar{d}$. Given the calibrated value of the discount factor, it follows that the long-run value of the net private foreign asset position is pinned down by the parameter $\bar{f}$, and that the interest rate premium is zero. As is common in similar studies, the parameter $\bar{f}$ is set equal to zero, which implies a zero net foreign asset position for the private sector. One of the remaining fiscal policy instruments should be residually determined to satisfy the long-run government budget constraint. We set lump-sum taxes equal to zero and choose government transfers as share of GDP to play that role. Notice that,

[19] This is close to the average value added share of tradable activities that is close to 40%.

in order to satisfy the government budget constraint, the share of transfers has to fall below its value in the data (from 0.1833 to 0.1154).

[Table 2 about here]

4. Policy experiments

4.1 Methodology

We first focus on competition enhancing reforms in the non-tradable sector and the private sector labour market. In the model, the measure of the degree of competitiveness in these sectors is the relevant markup. The lower the level of the markup, the closer these markets are to perfect competition. Following the literature, we define a structural reform in the non-tradable sector as a gradual reduction in the respective markup by 10pp within a time period of ten years. Similarly, we define a structural reform in the private sector labour market, as a gradual 10pp reduction in the wage markup that is achieved over ten years. The reforms are permanent and fully credible, which means that households and firms fully anticipate the transition paths and the new post-reform equilibrium. Our baseline scenario assumes a constant pace of implementation, meaning that the markups decline to their new permanently lower level along a linear path.

We also consider two scenarios where structural reforms have different implementation paths than the baseline one, in order to single out the importance of the pace and timing of reform implementation. In particular, we first examine a scenario in which reforms are fully implemented in ten years, as in our baseline case, but the pace of implementation is slower in the first years of transition ("implementation delays"). Second, we study a scenario where the reforms are fully implemented on a "one-off" basis. In this case, markups are reduced in period $t = 0$ by 10pp. In all cases, to isolate the impact of the structural reforms we assume that lump-sum taxes adjust to stabilize the public debt-to-GDP ratio and ensure fiscal solvency.

Next, we study the impact of the simultaneous implementation of structural reforms and debt consolidation. The latter is defined as a permanent reduction in the debt-to-GDP ratio by 10pp over ten years. We examine fully credible tax-based and spending-based consolidations. In each experiment, one fiscal policy instrument endogenously adjusts to achieve the debt-to-GDP target, while the rest of the policy instruments remain constant at their pre-reform steady-state levels.[20]

We explore how these reforms affect the economy both in the long run and along the transition path to the new post-reform steady-state in each case.

4.2. Structural reforms in product and labour markets

4.2.1 Structural reform in the non-tradable sector

Figure 2 displays the dynamic responses for a number of major macroeconomic variables following the structural reform in the non-tradable sector. Table 3 presents the long-run effects. The first-order impact of the decline in the price markup is a decrease in the price of the non-tradable intermediate goods that leads households to substitute tradable with non-tradable consumption goods. At the same time, the lower price of non-tradable goods exerts downward pressure on domestic inflation, which implies an increase in the domestic real interest rate. In turn, this reduces investment demand that has an adverse effect on the production of non-tradables in the short run. In contrast, tradable sector output increases due to the higher external demand given the improved external competitiveness (higher real exchange rate). The latter is driven by the decline in domestic CPI. Ultimately, on the impact period the effect on GDP is negative. However, from the second quarter onwards the non-tradable sector reform delivers sizable gains in output. This is because as prices in the non-tradable sector continue to decrease, consumption demand increases leading firms to increase labour and investment demand. As Table 3 shows, in the new long run, GDP, private consumption, investment and hours worked in the private sector increase by 4.2%, 3.7%, 6.9% and 0.8%, respectively. Non-tradables expand more relative to tradables (by 5.5% compared to 3.7%, respectively).

4.2.2 Structural reform in the private sector labour market

Figure 3 illustrates the responses from the structural reform in the private sector labour market. The first-order effect of the wage markup decline is a reduction in the wage rate, and therefore in the labour income of households that face a negative income effect. At the same time, there is an intratemporal substitution effect that induces optimizing households to decrease labour supply. The latter effect exerts

[20] The feedback coefficients in the debt rule (see equation 27) are set in each experiment so that they ensure that the debt-to-GDP ratio reaches its target level over a period of ten years.

upward pressures on real wages that negatively affects labour demand on impact. The net effect on impact is a reduction in hours worked and an increase in consumption. At the same time, expectations about future lower wages lead firms to substitute capital with labour, leading to a decline in investment demand. The higher domestic consumption demand along with higher demand for exports result in an increase in the output of the tradable sector. In contrast, the production of non-tradables decreases on impact, due to the lower investment demand. Although GDP increases on impact due to the higher consumption demand, the lower demand for investment leads to a decrease in GDP in the following quarters. In the subsequent periods of transition, the reduction in the wage markup eventually reduces real wages and thus the labour costs for the firms that allows them to decrease prices and increase labour demand. Higher hours worked raise the labour income of households leading to higher consumption demand. Ultimately, there is an increase in the production of both sectors and private investment.

As reported in Table 3, in the post-reform equilibrium, GDP, private consumption, investment and hours worked in the private sector increase by 4.4%, 4.7%, 3.0% and 4.5%, respectively. The output gains in the tradable sector are much higher compared to the non-tradable sector (6% compared to 3.6%, respectively).

[Table 3 about here]

4.2.3 The impact of the pace of implementation

In this Section we examine the implications of alternative paths of reform implementation and how they compare to our baseline scenario of the gradual constant-pace implementation. Recall that we consider two alternative scenarios. First, a reform scenario with "implementation delays", where the pace of implantation is slower in the first years of transition relative to the baseline, and second, a "one-off" scenario, where the reforms are fully implemented in period $t = 0$. Figures 4 and 5 summarize the results for the reforms in the product and labour market, respectively. All series plotted are percentage deviations from our baseline scenario. Note that the economy eventually converges to the same steady-state across the different policy experiments.

Concerning reforms in the non-tradables sector, in the case of "implementation delays", the markup reduction is delayed in the short run compared to the baseline.

Although consumption is higher than in the baseline case in the first quarters, the expectations about future price declines lead to lower private consumption in the following periods compared to the baseline. This, combined with the significantly lower investment, leads to a smaller increase in GDP over the reform implementation period. In the first three years, implementation delays cost cumulatively around 4% of GDP. In contrast, the "one-off" path brings forward the reform gains and GDP is higher than in the baseline scenario throughout the period during which the latter is implemented.

Similar results are obtained for the labour market reform case. In particular, in the presence of implementation delays, real wages and hence labour costs and prices are higher along the period of the reform implementation relative to the baseline. Consequently, private consumption and investment and hence GDP are lower. On the other hand, a "one-off" implementation immediately reduces real wages which translates into a lower real marginal cost that allows firms to decrease prices. Private consumption and investment, as well as exports are higher than in the baseline scenario over the first ten years.

To summarize, regarding the short-to-medium term effects, the results point out that the pace of the implementation matters: The key message is that the faster and the sooner the reforms are implemented, the larger the GDP gains.

4.3. Structural reforms and fiscal consolidation

4.3.1. The GDP impact of fiscal consolidation

We now turn our analysis to the macroeconomic effects of the simultaneous implementation of structural reforms and fiscal consolidation. First, to isolate the effects of fiscal policy, we examine the impact of debt consolidation policies that permanently reduce the debt-to-GDP ratio by 10pp. We consider both tax and spending based fiscal consolidations. Next, we study the impact on debt consolidation policies that are simultaneously implemented with structural reforms in the product or labour market.

[Table 4 about here]

As is shown in Figure 6 and Table 4 (first column), debt consolidation has a negative impact on GDP in the short to medium-term and a positive one in the long run irrespective of the policy instrument used. In terms of output losses in the short and medium-run, the best policy to reduce public debt is via increases in consumption taxes and decreases in government transfers and public sector employment. In contrast, a fiscal consolidation based on increases in the capital income taxes is the most harmful option in the short run, followed by reductions in public sector wages and increases in labour taxes. The main channel through which higher capital taxes affect GDP is that they directly reduce the after-tax return to capital, exerting a strong negative impact on capital utilization and private investment over time (see Figures 8a-8b).[21] Table 4 shows (first column) that the highest increase in long-run GDP is observed when the capital tax rate is used to consolidate public debt, followed by the labour tax rate and public sector wages. The positive long-run effects following a fiscal consolidation are due to the improvement in public finances that allows the government to reduce tax rates, and/or increase government expenditures. The only exception is the case of government transfers, where there is a negative, although negligible, impact on GDP in the long run.[22] These results are consistent with previous findings in the literature; see e.g. Coenen et al. (2008) and Forni et al. (2010) Papageorgiou (2012) and Stahler and Thomas (2012).

Figure 7 illustrates the path that each fiscal instrument follows in order to achieve the fiscal goal of the 10pp debt ratio reduction. Government expenditure instruments decline up to 2 pp of GDP in the short-to-medium term. The largest required reduction of 2pp is recorded in the case of government wages as share of GDP, while the lowest in the case of government transfers as share of GDP that need to decrease by up to 1.4pp. Turning to the tax policy instruments, the capital tax rate needs to increase by 6 pp in the short term, while labour and consumption tax rates by up to 2.5 pp. The capital tax rate needs to increase by way more in the short run due to the strong recessionary impact of the instrument which has an adverse effect on the tax base. In the long run, once the debt target is achieved, the government has the fiscal room to increase government expenditures and decrease tax rates. In particular, the expenditures are around 0.5pp of GDP above their initial steady-state values. The new long-run level of the tax rates is around 1pp lower than the original level.

[21] Regarding the general equilibrium effects of each policy instrument, see Papageorgiou (2014).

[22] This is because the higher long-run transfers have a strong positive income effect on liquidity constrained households that puts upwards pressures on real wages. The latter leads to a reduction in labour demand and the consumption of optimizing households (see also Coenen et al. 2013).

4.3.2. Simultaneous implementation of fiscal consolidation and structural reforms

We now focus on the simultaneous implementation of debt consolidation with the structural reform in the non-tradable sector. Figure 9 displays the transition paths of the GDP for the first twelve quarters. The series plotted are percentage deviations from the case when there is debt consolidation without any structural reforms (refer back to results of Figure 6), so as to highlight the impact of structural reforms. The long-run GDP effects are in Table 4 (second column).

First, we consider tax-based consolidations. In all cases, the GDP losses are higher in the short run as compared to the case of debt consolidation alone. This is due to the short run adverse effects of the product market reform on GDP that are amplified when combined with higher distortionary taxes. In particular, as Figures 8a-8b show, the reduction in private consumption, investment and hours worked is larger than in the case of debt consolidation alone. In addition, regarding the paths of the tax rates, Figure 7 shows that the lower GDP worsens the public debt dynamics and therefore calls for larger increases in taxes in the short run that further dampen output. In terms of output losses in the short run, the least harmful tax policy instrument to consolidate public debt remains the consumption tax rate, while the most harmful tax policy instrument is the capital tax rate.

As the positive impact of the structural reform on GDP starts to take place, this creates additional fiscal room as compared to the case when fiscal consolidations stand alone. In particular, the structural reform in the non-tradable sector increases the tax base, and thereby tax revenues, that allows the government to consolidate the public debt with lower tax increases in the medium-to-long run. In the long run, the tax rates are lower by around 1.5pp relative to the case when there is debt consolidation alone (see Figure 7). As Table 4 reports (second column), the increase in long-run GDP is in the range between 4.9% and 9.7%, suggesting that the effects of the joint implementation of structural reforms and tax-based consolidations are more than additive (recall the long-run impact of the structural reform in Table 3). That is, these policies are complements in the long run. The complementarity gains range between 0.5% and 4%, with the latter corresponds to the case where the fiscal room is filled by a further reduction in the capital taxes. These results are broadly in line with the findings in Gerali et al. (2015b).

As regards spending-based consolidations, Figure 9 shows that the reduction in the GDP in the first quarters of transition is larger than in the case where debt consolidation stands alone. The only exception to this is when the consolidation is based on reductions in public employment. In such a case, the decrease in public employment is higher when combined with product market structural reform (see Figure 7), thereby exerting a stronger downward pressure on private sector real wages allowing firms to increase labour demand. The largest GDP losses in the short run are observed when public wages are used to reduce public debt. In the subsequent periods of transition, the stimulus induced by the structural reform on output creates additional fiscal space through higher tax revenues allowing the government to increase government expenditures more than in the case with no structural reform. The increase of GDP in the new equilibrium is between 4.2% and 4.6%, with the complementarity GDP gains being on average 0.4%.

We now consider the case where debt consolidation policies are jointly implemented with reforms in the private labour market (see Figure 9 and Table 4, column 3). It is noteworthy that GDP is higher than the case of debt consolidation alone, in both the short and long run. The only exceptions are the cases where debt consolidation is based on increases in labour taxes or reductions in government transfers, where GDP is lower in the short run mainly due to lower hours worked and investment demand. In the following periods of transition, lower labour cost allows firms to increase labour demand, thereby increasing the labour income of households that boosts consumption demand offsetting the short run adverse effects on GDP. Consequently, there is no need for a more aggressive fiscal consolidation effort compared to the case with only debt consolidation (see Figure 7). Over time, the fiscal room allows for a reduction in the tax rates, or an increase in government expenditures that ranges between 0.5%-4.1% and 0.1%-0.7%, respectively.

Regarding the pace of the implementation of structural reforms, Figures 10 and 11 show that delaying the implementation of reform produces lower GDP gains throughout the implementation period compared to the baseline implementation scenario. The GDP losses due to implementation delays are analogous to those when structural reforms stand alone.

5. Conclusions

In this paper we first studied the short- and long-run effects of structural reforms that make the product and labour markets more competitive in a small open economy with no monetary policy independence. We found important long-run gains resulting from such policies, but pointed to the scope for short-to-medium term losses.

We next examined the interaction of structural reforms with a wide set of tax/spending based fiscal consolidations and find that structural reforms do not unambiguously alleviate the fiscal consolidation costs. Our key message is that the fiscal instrument used for debt consolidation and the pace of implementing the structural reforms matter. We show that capital taxes are most recessionary in the short-run when combined with product market reforms, while in the case of labour market reforms the most recessionary fiscal instrument are labour taxes. Instead, consumption taxes and government employment involve overall smaller short-run losses compared to the rest policy instruments. This said, benefits for the long-run GDP would be highest if the fiscal space that the structural reforms create over time is used to further reduce labour and capital taxes as the new lower debt target is reached. As concerns the pace of reform implementation, we highlighted that any delays involve real costs, thereby amplifying the fiscal consolidation costs.

Our results support the persistent calls for the joint implementation structural reforms and debt consolidations, and underscore the importance of designing different policies in an integrated framework and tailor-made manner. As such, they support recent policy initiatives in Europe along this direction.

References

Anderson, D., Hunt, B., Snudden, S., 2014. Fiscal consolidation in the euro area: How much pain can structural reforms ease? Journal of Policy Modeling 36, 785-799.

Ardagna, S., 2001. Fiscal policy composition, public debt and economic activity. Public Choice 109, 301-325.

Blanchard, O., Gali, J., 2007. Real wage rigidities and the new Keynesian model. Journal of Money, Credit and Banking 39, 35-65.

Cacciatore, M., Duval, R., G., Fiori, 2012. Short-term gain or pain? A DSGE model-based analysis of the short-term effects of structural reforms in labour and product markets. OECD Economics Department Working Papers, No. 948, OECD Publishing.

Calvo, G. A., 1983. Staggered prices in a utility-maximizing framework. Journal of Monetary Economics 12, 383-398.

Christoffel, K., Coenen, G., Warne, A., 2008. The New Area-Wide Model of the Euro Area - A Micro-Founded Open-Economy Model for Forecasting and Policy Analysis. Working Paper Series 944, European Central Bank.

Christoffel, K., Linzert, T., 2010. The role of real wage rigidities and labor market frictions for unemployment and inflation dynamics. Journal of Money, Credit and Banking 42, 1435-1446.

Christiano L.J., Eichenbaum, M., 1992. Current real business cycle theories and aggregate labor market fluctuations. American Economic Review 82, 430-450.

Christiano, L.J., Eichenbaum, M., Evans, C., 2005. Nominal rigidities and the dynamic effects of a shock to monetary policy. Journal of Political Economy 113, 1-45

Christiano, L.J., Trabandt, M., Walentin, K., 2011. DSGE models for monetary policy analysis, in Handbook of Macroeconomics, volume 3, edited by B. M. Friedman and M. Woodford, 285-367, Elsevier, North-Holland.

Coenen, G., Mohr, M., Straub, R., 2008. Fiscal consolidation in the euro area: long run benefits and short-run costs. Economic Modeling 25, 912-932.

Coenen, G., Straub, R., Trabandt, M., 2013. Gauging the effects of fiscal stimulus packages in the euro area. Journal of Economic Dynamics and Control 32, 367-386.

Corsetti, G., Kuester, K., Meier, A., Muller, G., 2013. Sovereign risk, fiscal policy and macroeconomic stability. The Economic Journal 123, F99-F132.

Economides G., Papageorgiou, D., Philippopoulos, A., Vassilatos, V., 2013. Smaller Public Sectors in the Euro Area: Aggregate and Distributional Implications. CESifo Economic Studies 59, 536-558.

Eggertsson G., Ferrero, A., Raffo, A., 2014. Can Sructural reforms help Europe?, Journal of Monetary Economics 61, 2-22.

European Commission, 2010. The economic adjustment programme for Greece. European Economy, Occasional Papers No. 61, May 2010.

European Commission, 2014. Report on Public Finances in EMU. European Economy 9/2014.

Forni, L., Monteforte, L., Sessa, L., 2009. The general equilibrium effects of fiscal policy: estimates for the euro area. Journal of Public Economics 93, 559-585.

Forni, L., Gerali, A., Pisani, M., 2010. The macroeconomics of fiscal consolidations in euro area countries. Journal of Economic Dynamics and Control 34, 1791-1812.

Forni, L., Gerali, A., Pisani, M., 2010. Macroeconomic effects of greater competition in the service sector: The case of Italy. Macroeconomic Dynamics, 1-32.

Forni, L., Pissani, M., 2013. Macroeconomic effects of sovereign restructuring in a Monetary Union: A model-based approach. IMF Working Paper No. 13/269.

Gali J., Lopez-Salido, D., Valles, J., 2007. Understanding the effects of government spending on consumption. Journal of the European Economic Association 5, 227-270

García-Cicco, J., Pancrazi, R., Uribe, M., 2010. Real Business Cycles in Emerging Countries? American Economic Review 100, 2510-2531.

Gerali, A., Notarpietro, A., Pisani, M., 2015a. Structural reforms and zero lower bound in a monetary union. Working Paper No. 1002, Bank of Italy.

Gerali, A., Notarpietro, A., Pisani, M., 2015b. Macroeconomic effects of simultaneous implementation of reforms after the crisis. Working Paper No. 997, Bank of Italy.

Gomes, S., Jacquinot, P., Mohr, M., Pisani, M., 2011. Structural reforms and macroeconomic performance in the euro area countries: A model-based assessment. Working Paper Series 1323, European Central Bank.

IMF, 2015. Euro area policies: 2015 Article IV consultation. Country Report No. 15/204. International Monetary Fund.

Hall, R., 2003. Wage determination and employment fluctuations. NBER Working Paper No. 9967.

Hall, R., 2005. Employment Fluctuations with Equilibrium Wage Stickiness. American Economic Review 95, 50-64.

Kliem, M., Uhlig, H., (2013). Bayesian estimation of a DSGE model with asset prices. Discussion Paper No. 37/2013, Deutsche Bundesbank.

Malley, J., Philippopoulos, A., Woitek, U., 2009. To react or not? Fiscal policy, volatility and welfare in the EU-3. European Economic Review 53, 689–714.

Mendoza, E., 2010. Sudden stops, financial crises, and leverage. American Economic Review 100, 1941-1966.

Mertens, K., Ravn, M., 2011. Understanding the aggregate effects of anticipated and unanticipated policy shocks. Review of Economic Dynamics 14, 27–54.

Monacelli, T., 2005. Monetary policy in a low pass-through environment. Journal of Monet, Credit and Banking 37, 1047-1066.

OECD, 2014. Economic Policy Reforms: Going for growth.

OECD, 2013. Economic Policy Reforms: Going for growth.

Papageorgiou, D., 2012. Fiscal policy reforms in general equilibrium: the case of Greece. Journal of Macroeconomics 34, 504-522.

Papageorgiou, D., 2014. BoGGEM: A dynamic stochastic general equilibrium model for policy simulations. Working Paper No. 182, Bank of Greece.

Petrongolo, B., Pissarides, C., 2001. Looking into the Black Box: A Survey of the Matching Function. Journal of Economic Literature 38, 390-431.

Philippopoulos, A., Varthalitis, P., Vassilatos, V., 2013. Optimal fiscal action in an economy with sovereign premia and without monetary independence: An application to Italy. CESifo, Working Paper, No. 4199.

Roeger, W., in't Veld, J., 2013. Expected sovereign defaults and fiscal consolidations, European Economy, Economic Papers 479, April 2013.

Schmitt-Grohé S. and Uribe M., 2003. Closing Small Open Economies. Journal of International Economics 61, 163-185.

Stahler, N., Thomas, C., 2012. Fimod – A DSGE model for fiscal policy simulations, Economic Modelling 29, 239-261.

Uhlig, H., 2007. Explaining asset prices with external habits and wage rigidities in a DSGE model. American Economic Review 97, 239-243.

Uribe, M., Yue, V.Z., 2006. Country spreads in emerging countries: Who drives whom? Journal of International Economics 69, 6-36.

Vogel, L., 2012. Structural reforms, fiscal consolidation and external rebalancing in monetary union: A model-based analysis. Economic Modelling 29, 1286-1298.

Vogel, L., 2014a. Nontradable sector reform and external rebalancing in monetary union: A model-based analysis. Economic Modelling 29, 1286-1298.

Vogel, L., 2014b. Structural reforms at the zero bound. European Economy. Economic Papers 537.

Table 1: Calibration

Parameter or Variable	Description	Value
γ	Inverse of the Frisch elasticity of labour supply	1
ϑ	Substitutability/complementarity between private and public goods	0.05
ξ^c	Habit persistence	0.60
β	Time discount factor	0.9897
κ	Preference parameter	21.64
λ	Fraction of liquidity constrained households	0.35
$1-a_T, 1-a_N$	Labour elasticity in production - Tradables, Non-Tradables	0.58
a_T, a_N	Gross capital elasticity in production	0.42
a_g	Public capital elasticity in production	0.0376
A^N	Long-run aggregate productivity - Non-Tradables	1
A^T	Long-run aggregate productivity - Tradables	0.9241
δ^p	Private capital quarterly depreciation rate	0.0172
δ^g	Public capital quarterly depreciation rate	0.0107
φ	Elasticity of marginal depreciation costs	1.6032
μ_t^W	Markup on private sector wages	1.15
μ_t^D	Markup - domestic tradables	1.352
μ_t^N	Markup - domestic tradables	1.463
μ_t^X	Markup - foreign markets	1.1
μ_t^M	Markup - importing firms	1.352
n	Degree of real wage rigidity	0.6491
$\theta_p^D, \theta_p^N, \theta_p^M$	Calvo parameters	0.7059
θ_p^X	Calvo parameter - foreign markets	0.697
x_D, x_N, x_X, x_M	Indexation parameters	0.26
ν	Share of wages financed by working capital loans	0.4
χ	Productivity of public spending on goods and services	0.3547
ω_C	Bias towards tradables in the production of consumption goods	0.66
ω_I	Bias towards tradables in the production of investment goods	0.44
ω_{TC}	Home bias in the production of tradable consumption goods	0.328
ω_{TI}	Home bias in the production of tradable investment goods	0.2
ε_C	Elasticity of substitution between tradable and non-tradable consumption goods	0.5
ε_I	Elasticity of substitution between tradable and non-tradable investment goods	0.5
ε_{TC}	Elasticity of substitution between imported and domestic tradable consumption goods	3.351
ε_{TI}	Elasticity of substitution between imported and domestic tradable investment goods	6.352
ε_X	Elasticity of exports	1.4

Φ_T	Fixed cost parameter	0.06
Φ_N	Fixed cost parameter	0.1431
$p^D G^c / p^Y Y^{GDP}$	Government purchases of goods and services-to-GDP ratio	0.077
$p^D G^i / p^Y Y^{GDP}$	Government investment-to-GDP ratio	0.038
τ^c	Tax rate on consumption	0.16
τ^l	Tax rate on labor income	0.29
τ^k	Tax rate on capital income	0.23
T_t	Lump-sum taxes	0
h^g	Hours worked in the public sector	0.04
ξ^k	Private capital adjustment cost parameter	0.9
ξ^f	Adjustment costs for net private foreign assets-to-GDP ratio	0.01
ζ_t	Share of domestic public debt	1
ϕ_1^d, ϕ_2^d	Feedback parameters on total public debt-to-GDP ratio	0.012, 0.17
ψ^d	Risk-premium coefficient on total public debt-to-output ratio	0.04/16
$\bar{d}$	Target level of total public debt-to-GDP ratio	4
$\bar{f}$	Target level of net private foreign assets-to-GDP ratio	0
$\bar{\lambda}$	Share of total government transfers allocated to liquidity constrained households	0.35

Table 2: Data averages and long-run model solution

Variable	Data Averages	Long Run Solution
Total private consumption-to-GDP ratio	0.668	0.681
Private investment-to-GDP ratio	0.198	0.171
Total hours worked	0.242	0.242
Hours worked in the private sector	0.202	0.202
Private capital-to-GDP ratio	10.11	9.953
Public capital-to-GDP ratio	1.853	3.514
Total public debt-to-GDP ratio	4	4
Government transfers-to-GDP ratio	0.183	0.115
Net private foreign asset position-to-GDP ratio	-0.08	0
Exports-to-GDP ratio	0.226	0.270
Total imports-to-GDP ratio	0.345	0.268

Note: (i) Average data over the period 2000-2009, (ii) A positive value of the private net foreign asset position-to-GDP ratio means that domestic households are net lenders.

Table 3: Long-run effects of structural reforms in product and labour markets

Variable	Product Market Reform	Labour Market Reform
Real GDP	4.23	4.41
Output in the tradable sector	3.74	6.04
Output in the non-tradable sector	5.52	3.57
Total private consumption	3.70	4.71
Private investment	6.93	2.98
Hours worked in the private sector	0.81	4.47
Real wages in the private sector	4.42	-1.73
Real exchange rate	5.04	2.53
Exports	2.31	3.65
Imports	0.65	1.04

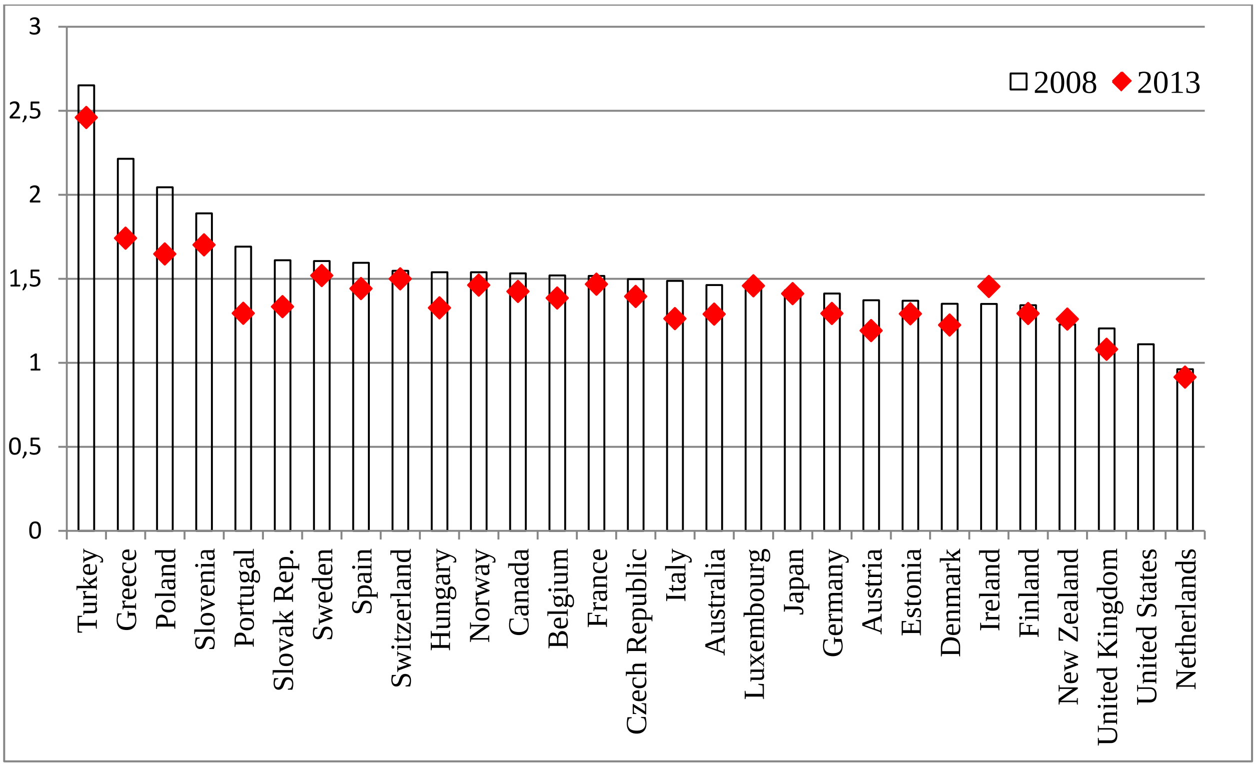
Note: All variables are expressed as percentage deviations from the initial steady state.

Table 4: Long-run effects of debt consolidation and structural reforms

	Debt consolidation	Debt consolidation + product market reform	Debt consolidation + labour market reform
GDP			
Government purchases	0.25	5.12	5.36
Government wages	0.36	5.58	5.84
Government employment	0.03	4.36	4.53
Government transfers	-0.05	4.04	4.18
Labour tax	0.37	5.54	5.88
Consumption tax	0.18	4.87	5.10
Capital tax	1.58	9.68	10.12
Consumption			
Government purchases	-0.28	2.71	3.60
Government wages	-0.15	3.19	4.11
Government employment	-0.41	2.24	3.08
Government transfers	-0.06	3.50	4.47
Labour tax	0.40	5.10	6.29
Consumption tax	0.19	4.39	5.45
Capital tax	1.16	7.62	8.90
Investment			
Government purchases	0.25	7.83	3.95
Government wages	-0.09	6.61	2.59
Government employment	-0.25	6.01	1.94
Government transfers	-0.04	6.80	2.82
Labour tax	0.25	7.82	3.99
Consumption tax	0.12	7.36	3.45
Capital tax	3.25	18.23	14.80
Private sector employment			
Government purchases	0.19	1.48	5.19
Government wages	-0.14	0.32	3.89
Government employment	-0.38	-0.58	2.92
Government transfers	-0.06	0.61	4.23
Labour tax	0.38	2.14	5.96
Consumption tax	0.18	1.46	5.17
Capital tax	0.00	0.88	4.55

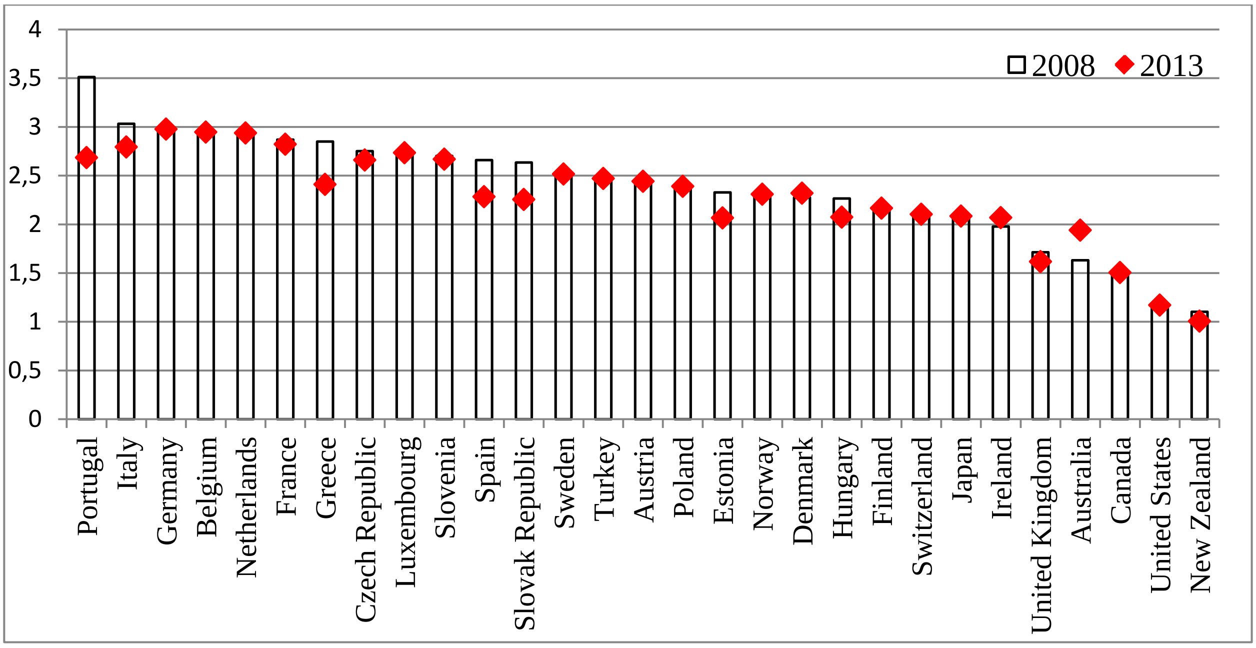
Note: All variables are expressed as percentage deviations from the initial equilibrium.

Figure 1a:OECD Product Market Regulation Index



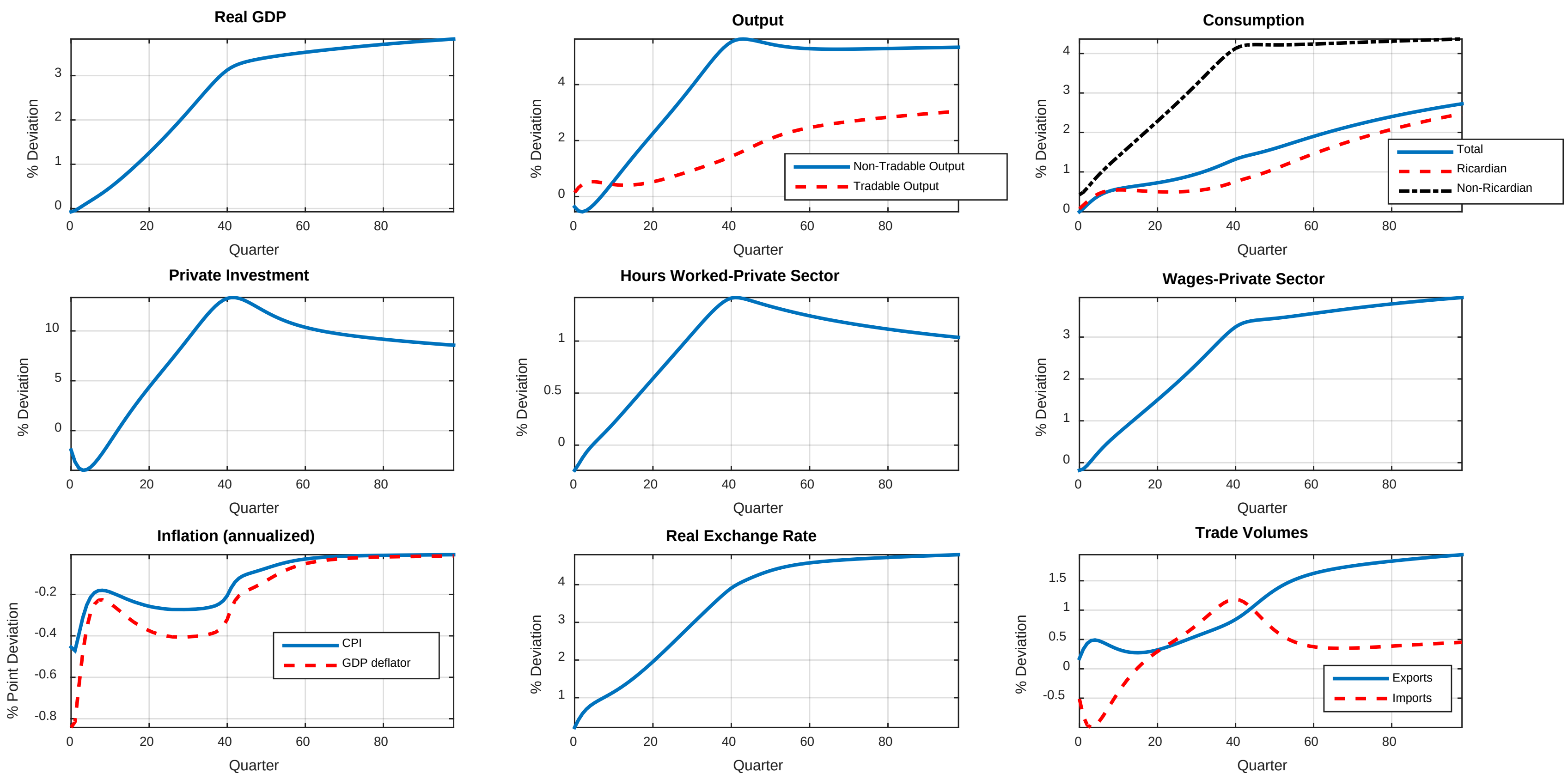
Note: Overall Product Market Regulation index. The index ranges between 0 and 6, with lower index scores denoting a lower degree of regulatory obstacles to competition. There is no 2013 update for the index for the United States.

Figure 1b: OECD Employment Protection Legislation Index



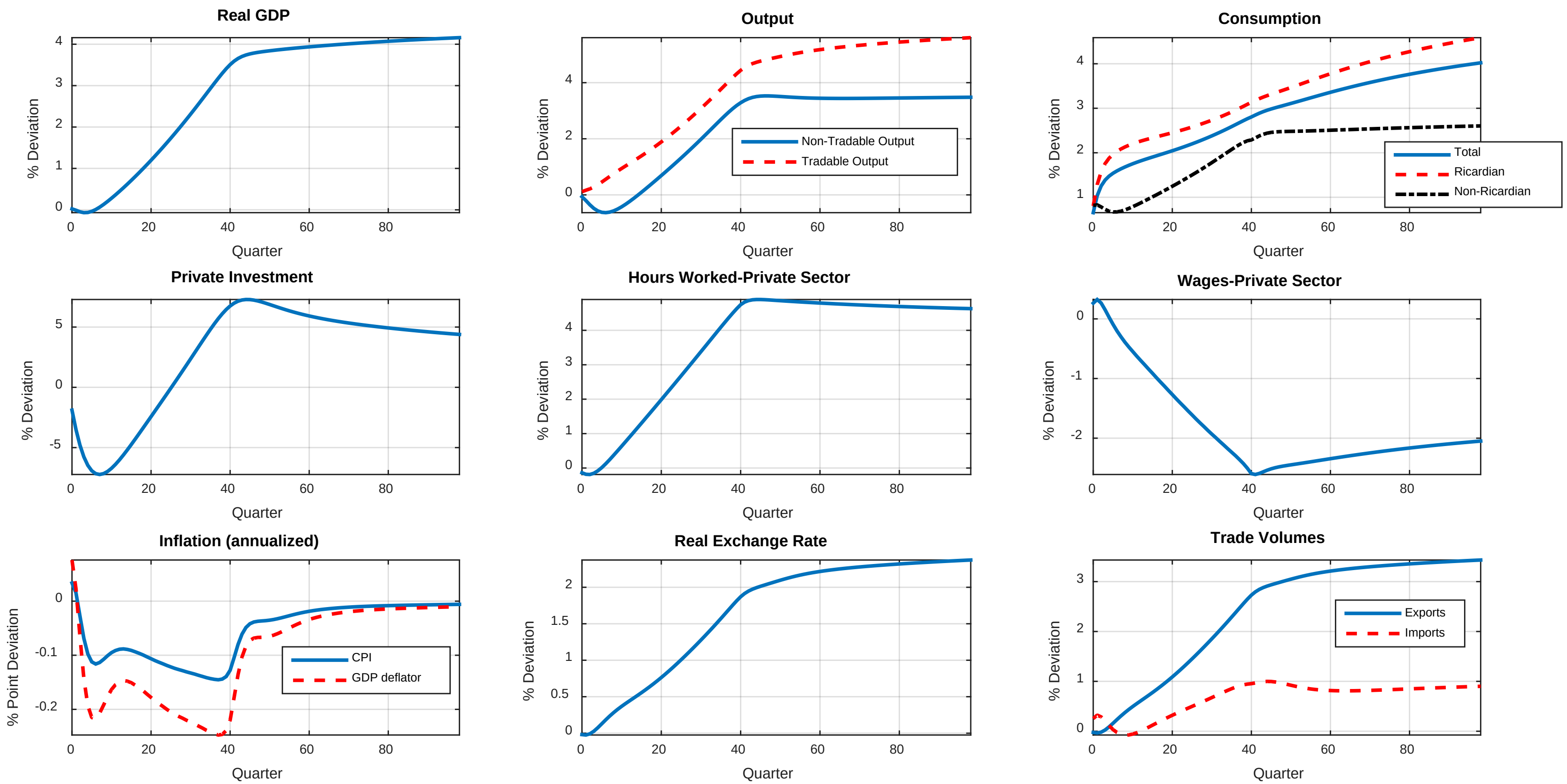
Note: Employment Protection Legislation index for regular contracts. The index ranges between 0 and 6, with lower index scores denoting the a lower degree of employment protection.

Figure 2: Transitional dynamics of the product market reform (non-tradable sector reform)



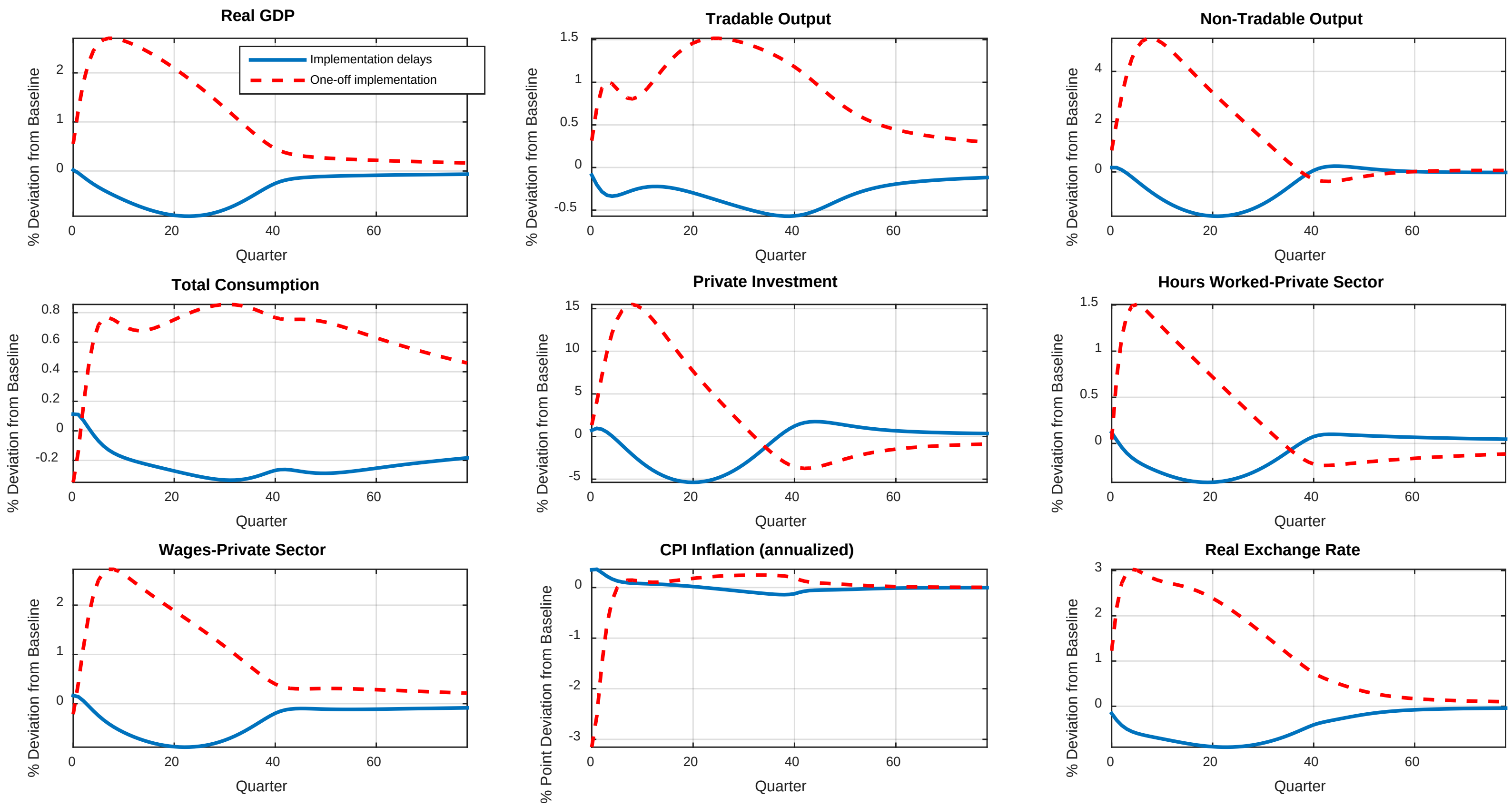
Note: All variables are expressed as percentage deviations from the initial steady-state, with the exception of inflation that is in percentage point deviations.

Figure 3: Transitional dynamics of labour market reform



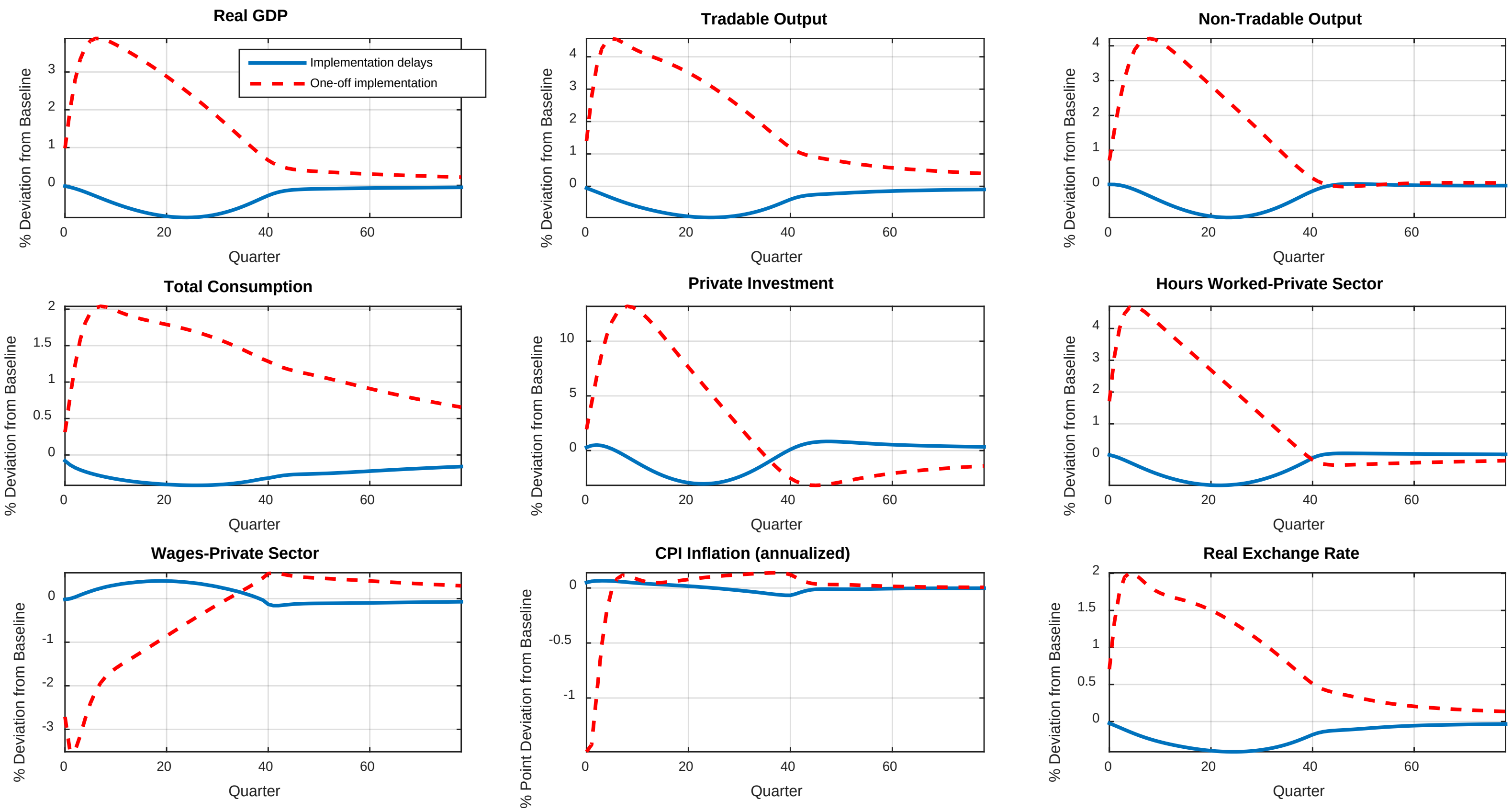
Note: All variables are expressed as percentage deviations from the initial steady-state, with the exception of inflation that is in percentage point deviations.

Figure 4: Non-tradable sector reform – Alternative implementation scenarios



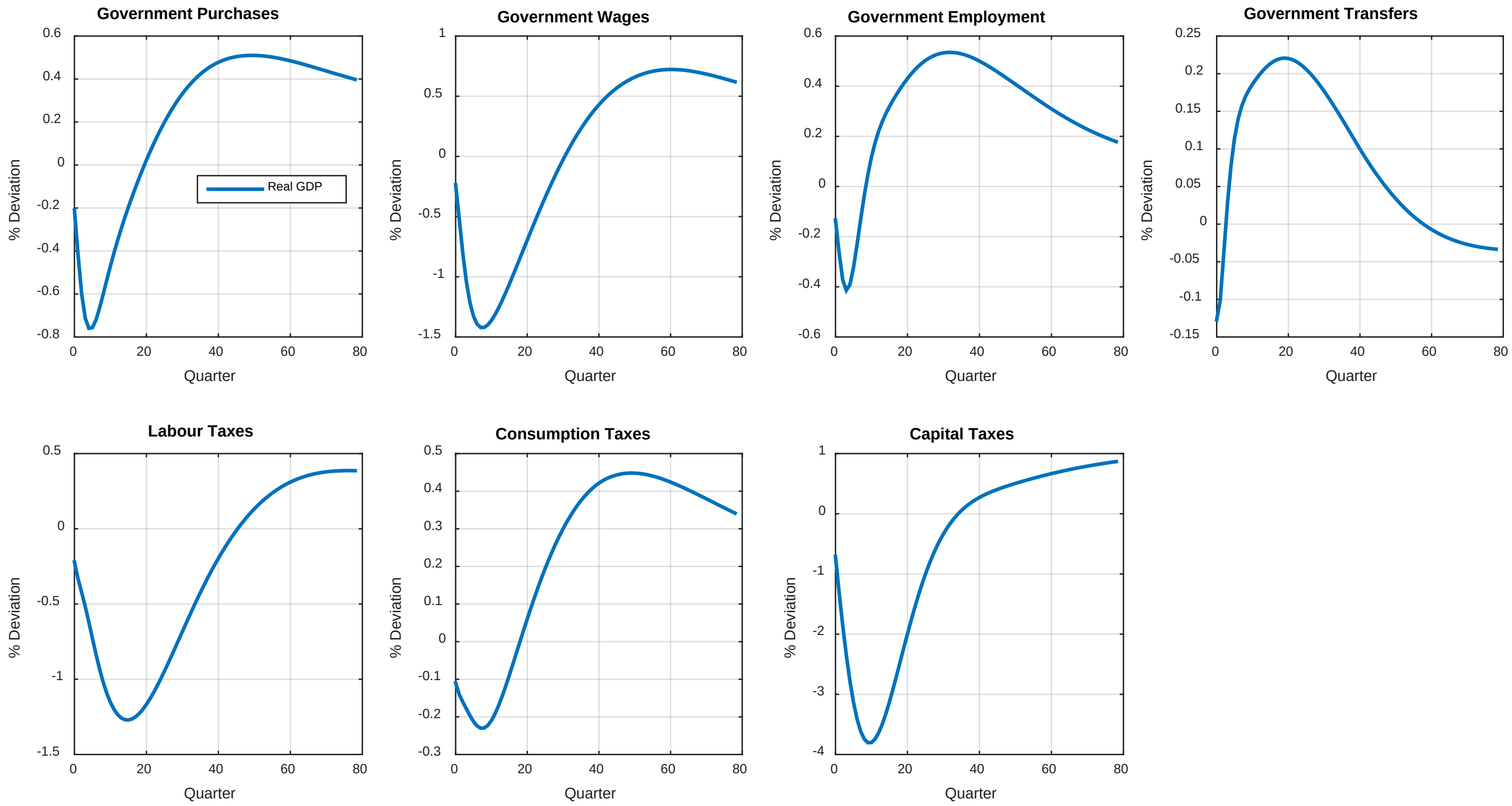
Note: All variables are expressed as percentage deviations from the baseline reform scenario, with the exception of inflation that is in percentage point deviations.

Figure 5: Labour market reform – Alternative implementation scenarios



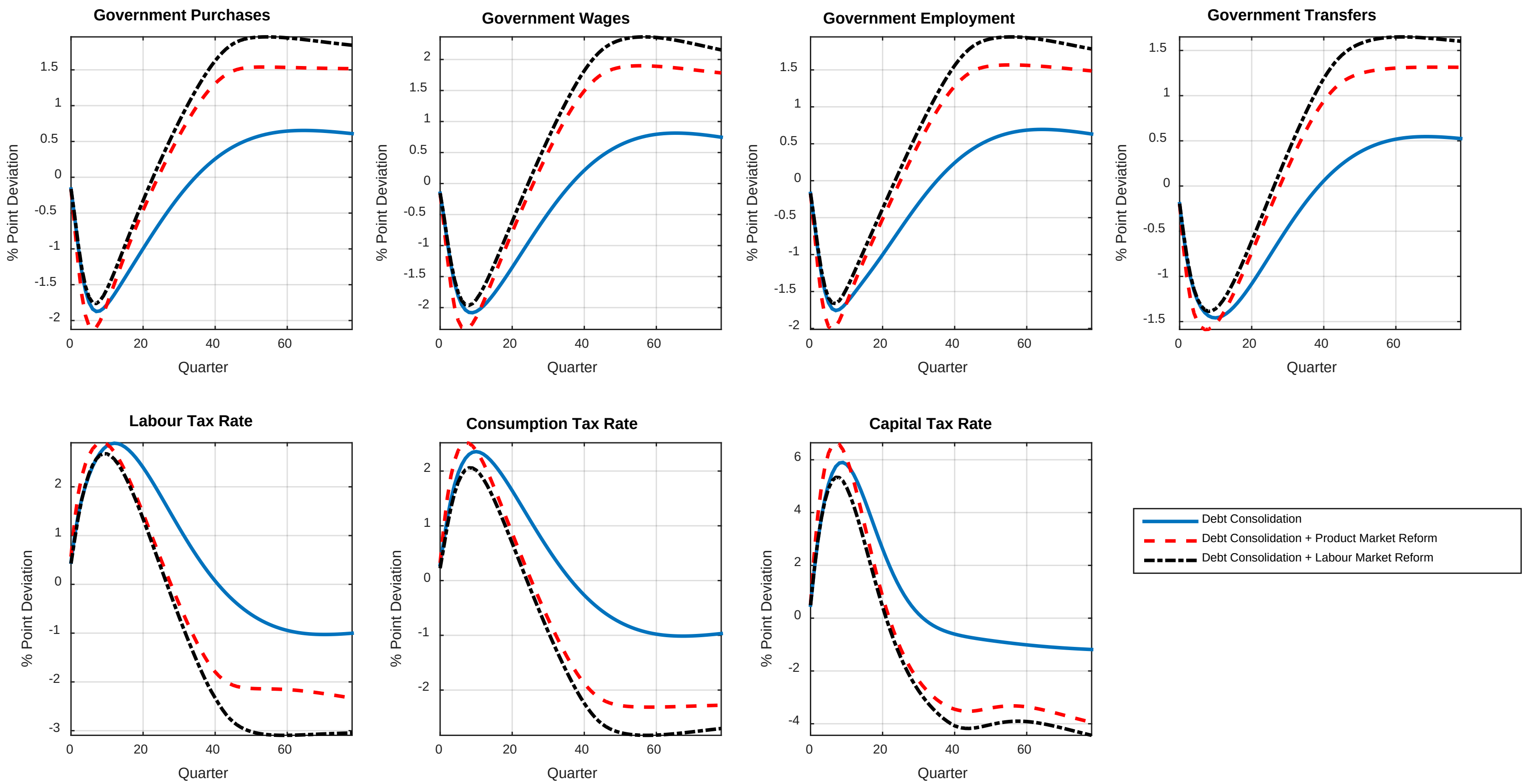
Note: All variables are expressed as percentage deviations from the baseline reform scenario, with the exception of inflation that is in percentage point deviations.

Figure 6: GDP effects of tax and spending based debt consolidations alone



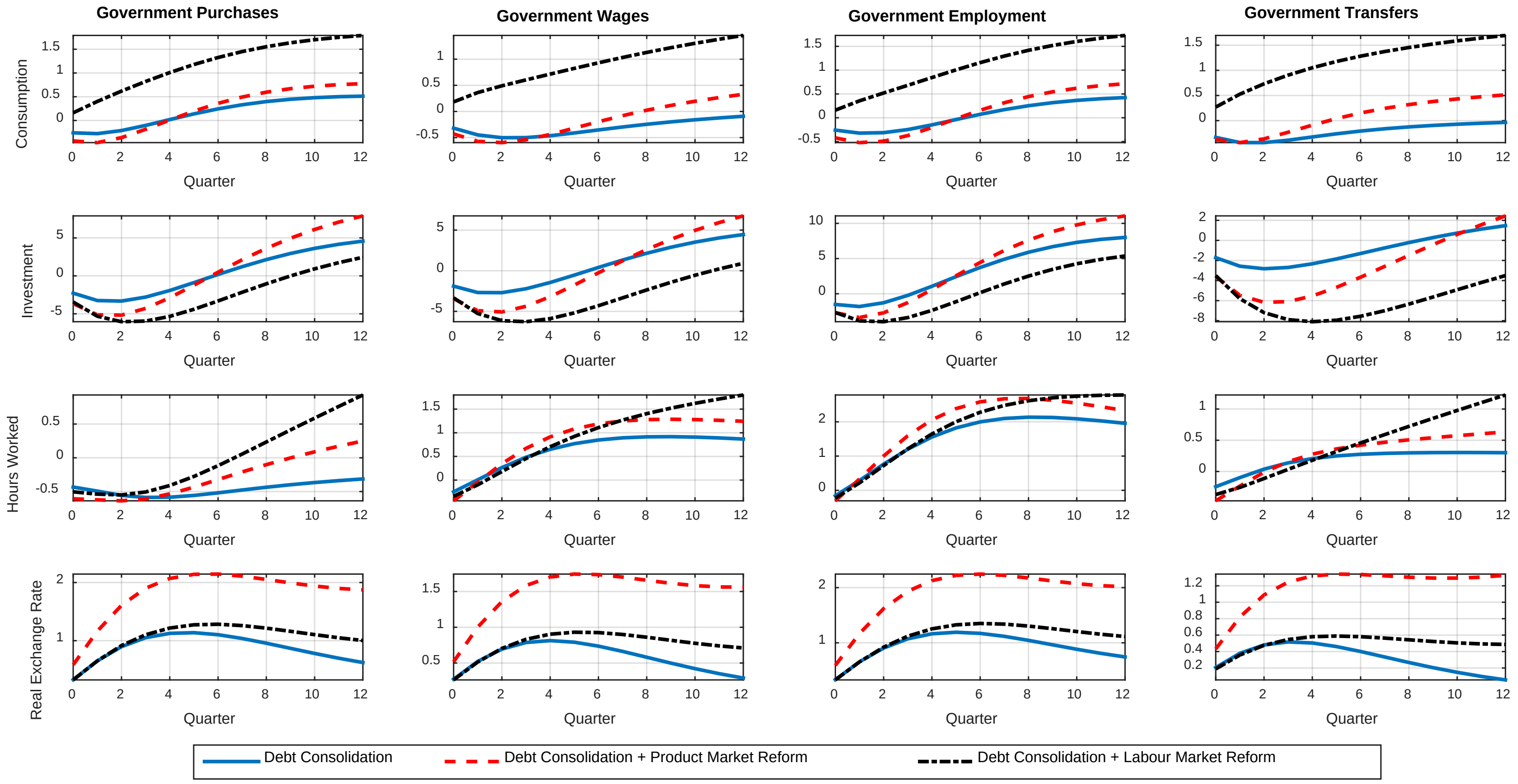
Note: Expressed as percentage deviations from the initial steady state.

Figure 7: The dynamic paths of alternative fiscal instruments



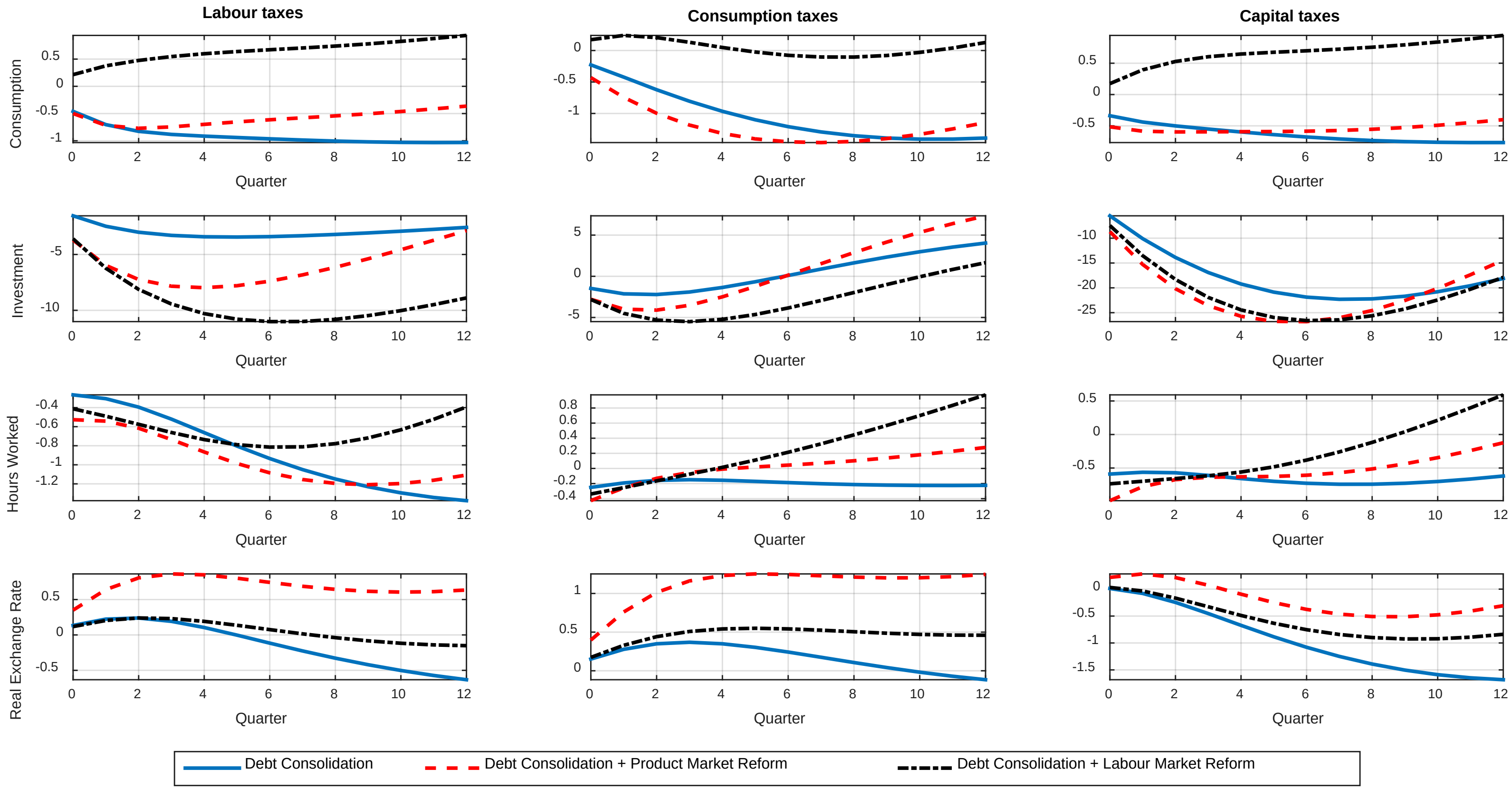
Note: All variables are expressed as percentage point deviations from the initial steady state. Government purchases and government transfers are expressed as share of GDP. Plots for government wages and employment correspond to the wage bill of the public sector as share of GDP.

Figure 8a: Effects on key variables of the simultaneous implementation of debt consolidation and structural reforms



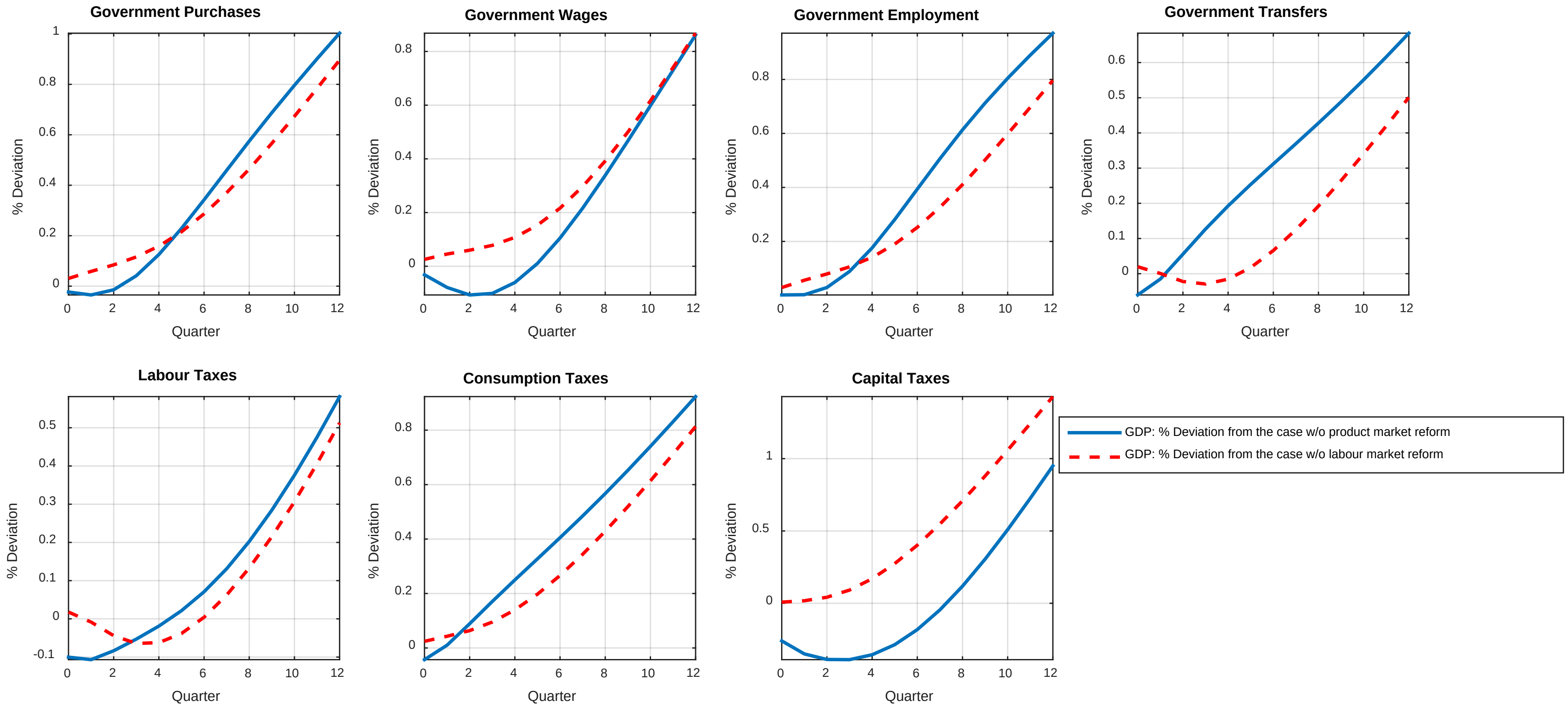
Note: All variables are expressed as percentage point deviations from the initial steady state.

Figure 8b: Effects on key variables of the simultaneous implementation of debt consolidation and structural reforms



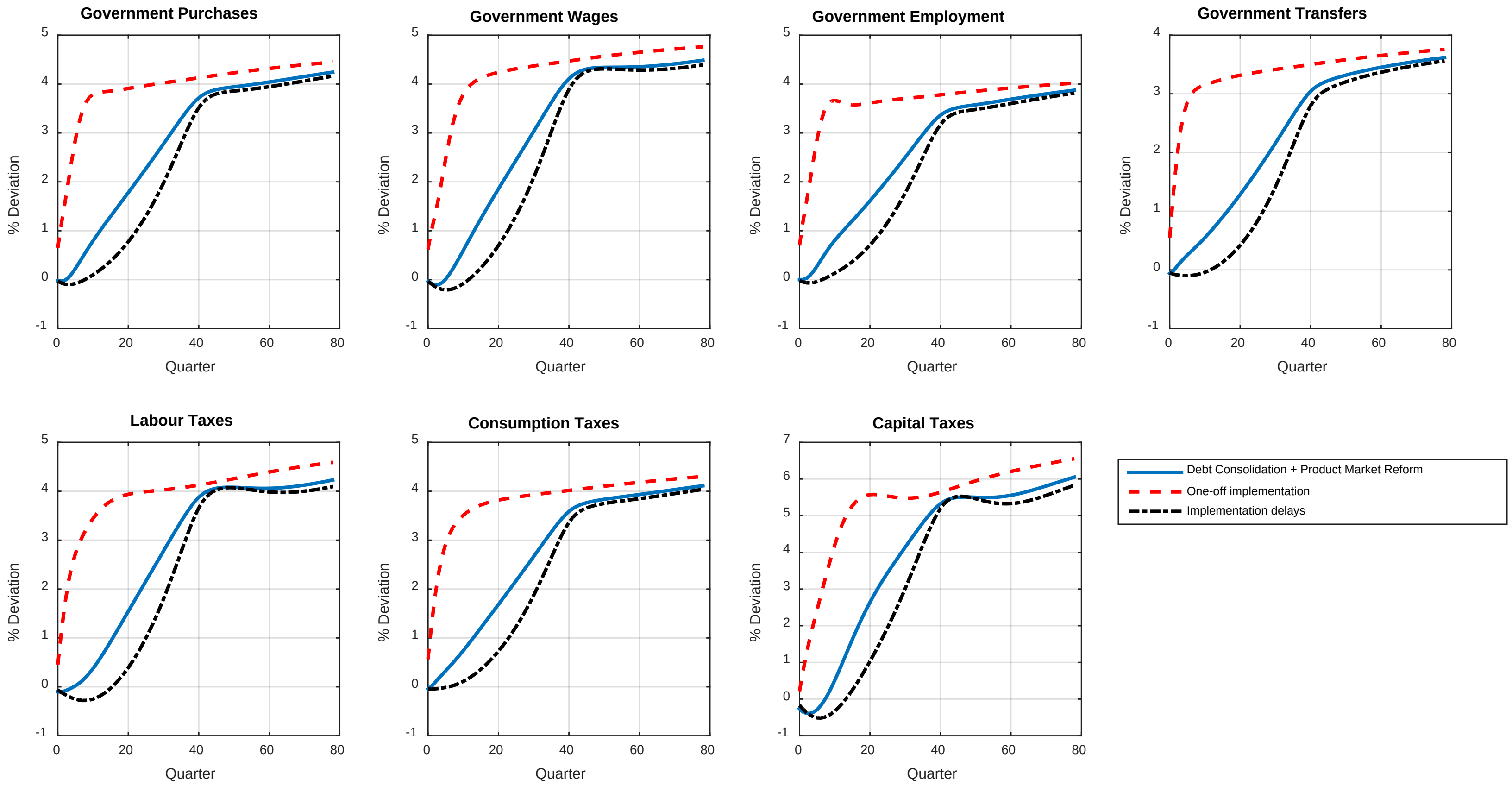
Note: All variables are expressed as percentage points deviations from the initial steady state.

Figure 9: Short-run GDP effects of the simultaneous implementation of debt consolidation and structural reforms



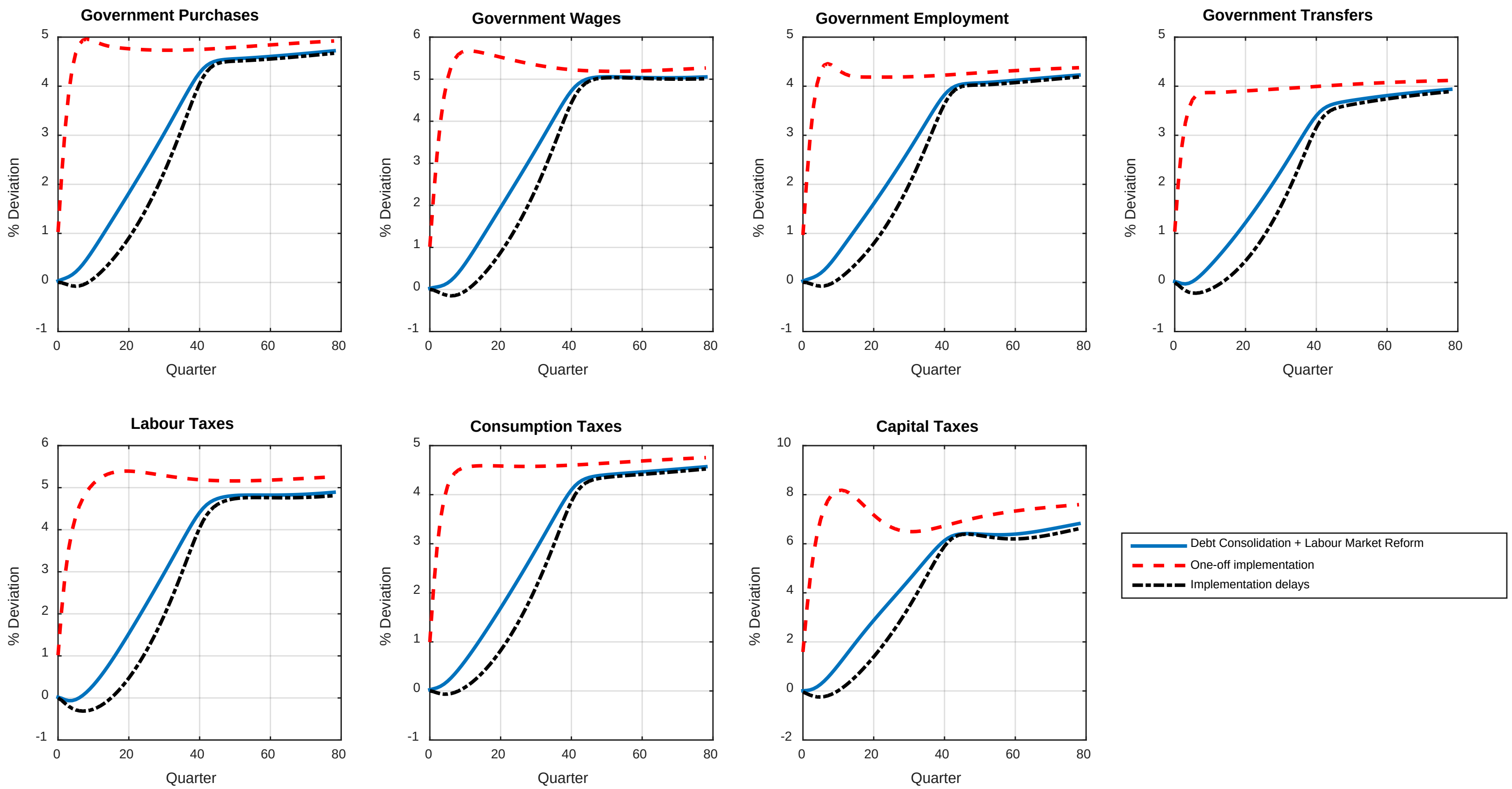
Note: All variables are expressed as percentage deviations from the scenario with only debt consolidation.

Figure 10: The GDP effects of alternative debt consolidation strategies and implementation paths for the product market reform



Note: Expressed as percentage deviations from the scenario with only debt consolidation.

Figure 11: The GDP effects of alternative debt consolidation strategies and implementation paths for the labour market reform



Note: Expressed as percentage deviations from the scenario with only debt consolidation.

BANK OF GREECE WORKING PAPERS

185. Adam, A., and T., Moutos, "Industry-Level Labour Demand Elasticities Across the Eurozone: Will There Be Any Gain After the Pain of Internal Devaluation?" July, 2014.

186. Tagkalakis, O.A., "Fiscal Policy, Net Exports, and the Sectoral Composition of Output in Greece", September 2014.

187. Hondroyiannis, G. and D., Papaoikonomou, "When Does it Pay To Tax? Evidence from State-Dependent Fiscal Multipliers in the Euro Area", October 2014.

188. Charalambakis, C. E., "On Corporate Financial Distress Prediction: What Can we Learn From Private Firms in a Small Open Economy?, November 2014.

189. Pagratis, S., E., Karakatsani and E. Louri, "Bank Leverage and Return on Equity Targeting: Intrinsic Procyclicality of Short-Term Choices", November 2014.

190. Evgenidis, A. and C., Siriopoulos, "What are the International Channels Through Which a US Policy Shock is Transmitted to the World Economies? Evidence from a Time Varying Favar, January 2015.

191. Louzis, D. P., and A.T., Vouldis, "Profitability in the Greek Banking System: a Dual Investigation of Net Interest and Non-Interest Income", February 2015.

192. Papaspyrou, S.T, "EMU 2.0 - Drawing Lessons From the Crisis - a New Framework For Stability and Growth", March 2014.

193. Litina, A and T, Palivos, "Corruption and Tax Evasion: Reflections on Greek Tragedy", June 2015.

194. Balfoussia, H. and H.D. Gibson, "Financial Conditions and Economic Activity: The Potential Impact of the Targeted Longer-Term Refinancing Operations (TLTROS)", July 2015.

195. Louzis, P. D., "Steady-State Priors and Bayesian Variable Selection in VAR Forecasting", July 2015.

196. Zografakis, S. and A., Sarris, "The Distributional Consequences of the Stabilization and Adjustment Policies in Greece During the Crisis, with the Use of A Multisectoral Computable General Equilibrium Model", August 2015.