Fiscal Consequences of Structural Reform under Constrained Monetary Policy

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Abstract

Given the weak economic performance of many countries since the recent crisis, there is an increasing need for structural reforms aimed at promoting long run economic growth. Structural reforms can entail short run output costs unless offset by a demand expansion. When monetary policy is constrained and cannot carry out this short run expansion, there is a potential role for fiscal policy. The aim of this paper is to quantify the short run fiscal costs and long run fiscal benefits of reforms, and investigate how the design of reforms can affect this trade-off. The focus is on the Euro-area, which has been particularly affected by high unemployment. In the model, both the costs and benefits of reforms are generally small, although increasingly large reforms entail larger rises in deficit-to-GDP in the short run. Results suggest that reforms in labour markets have little effect on public finances in the long run, but their short run costs can be ameliorated by combining them with product market reforms.

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1 Introduction

Since the recent economic crises, many countries have continued to exhibit weak economic growth and high unemployment. For some, achieving full employment has been complicated by the need for fiscal consolidation, and monetary policy that is operating close to the effective lower bound. These short run policy constraints have increased the importance of measures to boost growth in the long run. Particular focus has been on structural reforms aimed at either increasing competition in product markets or increasing the flexibility of labour markets. However, the short run costs associated with these reforms are also affected by the short run policy constraints. In particular, with monetary policy constrained, there can be a role for fiscal policy to offset short run output costs while reforms are being implemented, but with the constraints on fiscal policy this fiscal expansion must also be offset by the long run gains from the reforms. This paper looks at the relationship between reforms and fiscal policy in this context, quantifying both the short run fiscal costs of reforms, and the long run impact of reforms on public finances, with the aim of seeing the extent to which the latter justify the former. This paper focuses on the Euro-area, which has been particularly affected by persistently high unemployment.

The slow recovery of countries within the Euro-area since the Great Recession has been widely documented. As summarised in the IMF World Economic Outlook, 2016, the Euro-area is still facing increasing levels of public debt, and has struggled to maintain adequate growth levels, with some countries facing especially high levels of unemployment. In this climate, policy-makers are turning to alternative policy measures to boost economic growth, with particular focus on structural reforms. Reducing structural rigidities can improve the efficiency of resource allocation, the competitiveness of countries within the single market and resilience to economic shocks.[1] The lack of competition and flexibility in countries such as Spain and Italy have been blamed for worsening the effects of the recent crisis and slowing their recovery. While structural reforms have been a key policy issue in these countries for many years, the crisis has renewed the momentum for their implementation. This can be seen, for example, with the Europe 2020 strategy, which, in contrast to the Lisbon Treaty, has induced active implementation of structural reforms in recent years.[2]

Despite the reforms which have already been legislated or implemented across the Euro-area, a lot remains to be done. As well as uncertainty about their future benefits, and their redistributive effects, the main obstacles for carrying out structural reforms are the potential short run costs. While reforms are expected to increase activity in

[1] See, for example, Griffith and Harisson (2004), Duval and Vogel (2008) and Gnocchi et al. (2015).

[2] See, for example, OECD (2013) and European Commission (2013, 2014) for analyses of the recent reforms implemented in southern Europe.

the long run, this can come at the expense of a short run contraction, which can itself be countered by short run policy measures to boost demand. On the one hand, papers such as Eggertsson et al. (2014) and Vogel (2014), which look at structural reforms as reductions in price and wage mark-ups, focus on the short run deflationary effect of reforms, which then require a demand expansion to stabilise inflation. On the other hand, Cacciatore et al. (2016) focus on the transitional costs of reforms by modeling slow or costly product and labour market adjustments. In their framework, reforms are not deflationary, but again the optimal policy response is to use a demand expansion to bring forward the long run gains from the reform.

In both cases, the expansionary policies to offset the short run costs of the reforms would typically be carried out by monetary policy. Therefore, in situations when monetary policy is constrained, reforms can be costly. This argument was made in the early days of the Euro-area, with monetary union acting as a monetary policy constraint since common monetary policy would no longer respond to inflation in individual countries. It has recently become relevant again with monetary policy constrained by the effective lower bound (ELB). As in other contexts, policy-makers have looked at the possibility of using fiscal policy to provide the necessary demand expansion, in order to mitigate the short run costs and so reduce the obstacles to reform.

Acknowledging the potential fiscal costs of reforms in a monetary union, the Stability and Growth Pact (SGP) has attempted to incorporate explicit exceptions for countries carrying out structural reforms.[3] For example, proposals laid out in 2002 state that "A small temporary deterioration in the underlying budget position of a member state could be envisaged, if it derives from the introduction of a large structural reform" (European Commission 2002). More recently, the European Commission has released a report reiterating the flexibility within the SGP rules for countries carrying out structural reforms (European Commission 2015). The head of the European Central Bank has noted the ability of fiscal authorities to facilitate the implementation of structural reforms, stressing that "existing flexibility within the [SGP] rules allows the budgetary costs of major structural reforms to be addressed and demand to be supported" (Draghi 2014a,b,c).

While a fiscal expansion can reduce the short run output or employment costs of reform, this can increase the fiscal deficit and public debt, and so requires sufficient fiscal space.[4] The formulation of the flexibility in the SGP rules highlights the trade-off

[3]Of course it should be noted that there are political issues at play here. See, for example, Beetsma and Debrun (2005) for a discussion of the politics of enforcing these 'flexible' SGP rules, and Beetsma and Debrun (2004) and Poplawski Ribeiro and Beetsma (2008) for a discussion of the political incentives to implement reforms when facing fiscal rules.

[4]There can also be direct budgetary costs from some reforms, but these tend to have negligible impact on the overall deficit.

between the short run and long run effects of accommodating the fiscal costs of reform. A short run fiscal expansion is desirable so long as the reform has a positive effect on public finances in the long run. This is particularly important at a time when fiscal consolidation itself is a key policy concern.

Whether the future gains can repay the costs of reforms, and the horizon over which this can materialise, is ultimately a quantitative question. This paper studies this issue using the framework of Eggertsson et al. (2014), extended to include a richer fiscal block. Reforms are simulated as a transition to a new steady state in which the wage and price mark-ups are reduced.

The simulations show that while reforms in normal times boost output in every period, reforms implemented when monetary policy is constrained entail output losses in the short run. This is true during a demand contraction when the interest rate is at the ELB, in line with Eggertsson et al. (2014), but also holds more generally whenever monetary policy does not act to stabilise inflation. Moreover, the fiscal block in this model shows that the fall in output also leads to a rise in the deficit-to-GDP ratio during the reform, even absent any active fiscal stimulus.

To address the underlying question of this paper, an active output stabilisation rule is introduced for the fiscal instrument, which induces a fiscal stimulus that offsets the short run output costs of the reforms under constrained monetary policy. This will entail an additional rise in the deficit, which captures the short run fiscal costs of the reform. In the long run, the deficit will reach a lower post-reform steady state, this is the long run fiscal gains from the reform.

The size of both the long run fiscal gains and the short run cost of the fiscal stimulus will depend on the model parameterisation and the precise reform being considered. In particular, comparing a symmetric reduction in both price and wage mark-ups against the same reduction in either one or the other, referred to as product and labour market reforms respectively, the model shows a clear fiscal advantage in carrying out product market reforms. In fact, in this model, labour market reforms create almost no decrease in the long run deficit-to-GDP ratio, but still necessitate a short run fiscal stimulus. This is because while the reform increases employment, and hence output, it also reduces wages, and so the net effect on the government's tax revenues is negligible. Of course, another way to interpret this result is that it is necessary to complement labour market reforms with simultaneous product market reforms so that the short run fiscal costs of the former can be justified by the long run gains of the latter.[5]

To illustrate the short run costs and long run benefits of reforms for relevant pa-

[5]It is worth emphasising here that, while the focus of this paper is on the fiscal impact of reforms, labour market reforms can have important implications in terms of bringing workers out of unemployment and offsetting hysteresis effects. This can be especially important over time, for example for countries such as Spain where youth unemployment is particularly high.

rameterisations, the model is re-calibrated for France, Italy and Spain. The reform simulated for each country removes 25% of the differential in the mark-up relative to Germany, considered to be the best-practice case. In the case of France, this implies a very small baseline reform which entails a short run fiscal stimulus of less than 0.1% of the pre-reform GDP, and a long run gain of 0.03pp in the deficit-to-GDP ratio. For Italy and Spain, where the baseline reform that is considered is larger, the short run costs are still modest, with a required fiscal stimulus of 0.3% and 0.4% respectively, while the long run gains are also larger, at around a 0.4pp lower deficit-to-GDP ratio for both countries. Hence the model implies that, for Italy and Spain, the reforms are much more self-financing in the long run. Furthermore, in the framework of the SGP, this stimulus would require a relatively small deviation from the 3% deficit-to-GDP target, at its peak around 0.03pp, 0.14pp and 0.16pp for the three countries respectively.

The rest of the paper is organised as follows. The next section will lay out the model. Section 3 shows comparative statics for different levels of structural rigidities, dynamic simulations of reform episodes, and quantitative comparisons of the fiscal costs and benefits of reform for different parameterisations of the model. Building on these quantitative comparisons, Section 4 compares the effects of different reform packages in France, Italy and Spain. Section 5 concludes.

2 The Model

The model closely follows that of Eggertsson et al. (2014), henceforth EFR. The economy consists of a two-block monetary union. Each block produces tradable and non-tradable goods using sector-specific labour, which is aggregated from the differentiated labour supplied by households. In each sector, there exist competitive firms using labour to produce intermediate goods, monopolistically competitive firms which use the intermediate goods to produce differentiated goods, and competitive retailers which aggregate these goods into the final goods. Households receive utility from a final consumption good, which is aggregated from non-tradables and both domestically-produced and foreign-produced tradables, as well as disutility from labour. Households save through domestic government bonds and an internationally traded risk-free bond. As well as issuing debt, the government collects taxes to finance transfers and wasteful consumption expenditures.

The following is an exposition of the 'Home' block of the union. The 'Foreign' block follows the same structure.

2.1 Household

There is a continuum of households of mass σ, indexed by j. Each household derives utility from consumption, $c_t(j)$, and disutility from labour, $n_t(j)$. The expected value of the infinite stream of utility is given by:

$$E_0 \sum_{t=0}^{\infty} \beta \, ß_t \, U(c_t(j), n_t(j)) = E_0 \sum_{t=0}^{\infty} \beta \, ß_t \left[\frac{c_t(j)^{1-\eta}}{1-\eta} - \frac{n_t(j)^{1+\varphi}}{1+\varphi} \right] \tag{1}$$

where β is the discount factor and $ß_t$ is an exogenous demand shock. In the utility function, η is the inverse of the intertemporal elasticity of substitution and φ is the inverse of the Frisch elasticity of labour supply.

The final consumption good is an aggregate of the tradable and non-tradable goods, given by:

$$c_t(j) = \left[(1-\theta)^{\frac{1}{\xi}} c_{Tt}(j)^{\frac{\xi-1}{\xi}} + \theta^{\frac{1}{\xi}} c_{Nt}(j)^{\frac{\xi-1}{\xi}} \right]^{\frac{\xi}{\xi-1}}$$

where the tradable consumption good is itself aggregated from domestic and foreign produced goods:

$$c_{Tt}(j) = \left[(1-\alpha)^{\frac{1}{\phi}} c_{Ht}(j)^{\frac{\phi-1}{\phi}} + \alpha^{\frac{1}{\phi}} c_{Ft}(j)^{\frac{\phi-1}{\phi}} \right]^{\frac{\phi}{\phi-1}}$$

where α captures the openness of the country (the inverse of the home-bias), and ϕ is the elasticity of substitution between domestic and foreign goods.

The intertemporal budget constraint is given by:

$$\begin{aligned} c_t(j) + b_{Gt+1}(j) + b_{Ft+1}(j) \leq (1-\tau^n) w_t(j) n_t(j) \\ + \frac{R_{Ht-1}}{\pi_t} b_{Gt}(j) + \frac{R_{Ft-1}}{\pi_t} b_{Ft}(j) + \Pi_t(j) + T_t \end{aligned} \tag{2}$$

where $b_{Gt}(j)$ is the real holdings of domestic government bonds, $b_{Ft}(j)$ is the real holdings of foreign bonds, R_{Ht} and R_{Ft} are the gross nominal interest rates on domestic and foreign bonds respectively, π_t is the gross inflation rate of the CPI, defined below, $w_t(j)$ is the real wage of household j, which will depend on the sector where household j works, $\Pi_t(j)$ are the profits from the monopolistically competitive firms, which will be discussed below, τ^n represents taxes on labour income, and T_t is a lump-sum transfer from the government.

The household delegates the labour supply decision to a labour union, which will be discussed below, and so takes $n_t(j)$ as given. Thus the household chooses $c_t(j)$, $b_{Gt+1}(j)$ and $b_{Ft+1}(j)$ so as to maximise lifetime utility (1), subject to the budget constraint (2)

in every period. Letting $\lambda_t(j)$ denote the multiplier on this constraint, the first order conditions for the households are:

$$c_t(j)^{-\eta} = \lambda_t(j) \tag{3}$$

$$ß_t\lambda_t(j) = \beta E_t ß_{t+1}\lambda_{t+1}(j)\frac{R_{Ht}}{\pi_{t+1}} \tag{4}$$

$$ß_t\lambda_t(j) = \beta E_t ß_{t+1}\lambda_{t+1}(j)\frac{R_{Ft}}{\pi_{t+1}} \tag{5}$$

Note that equations (4) and (5) imply that in equilibrium $R_{Ht} = R_{Ft}$.

For the optimal level of the final consumption good $c_t(j)$, the households choose the components, $c_{Nt}(j)$, $c_{Ht}(j)$ and $c_{Ft}(j)$ to minimise their expenditure, given the respective prices P_{Nt}, P_{Tt} and P^*_{Tt}. Firstly, for a given $c_{Tt}(j)$, the cost minimisation yields the following demand functions for home- and foreign-produced tradable goods:

$$c_{Ht}(j) = (1-\alpha)\left(\frac{P_{Tt}}{\mathcal{P}_{Tt}}\right)^{-\phi} c_{Tt}(j) \qquad \text{and} \qquad c_{Ft}(j) = \alpha\left(\frac{P^*_{Tt}}{\mathcal{P}_{Tt}}\right)^{-\phi} c_{Tt}(j)$$

where $\mathcal{P}_{Tt}$ is the aggregate price of the tradable consumption bundle, defined as:

$$\mathcal{P}_{Tt} = [(1-\alpha)P_{Tt}^{1-\phi} + \alpha(P^*_{Tt})^{1-\phi}]^{\frac{1}{1-\phi}}$$

Then, similarly, the composition of tradable and non-tradable consumption satisfies the following demand functions:

$$c_{Nt}(j) = (1-\theta)\left(\frac{P_{Nt}}{P_t}\right)^{-\xi} c_t(j) \qquad \text{and} \qquad c_{Tt}(j) = \theta\left(\frac{\mathcal{P}_{Tt}}{P_t}\right)^{-\xi} c_t(j)$$

where P_t is the aggregate price of the final consumption bundle, the CPI, defined as:

$$P_t = [(1-\theta)P_{Nt}^{1-\xi} + \theta\mathcal{P}_{Tt}^{1-\xi}]^{\frac{1}{1-\xi}}$$

2.2 Production

In each sector, labour inputs are used to produce intermediate goods. These goods are sold to a continuum of monopolistic firms which turn them into differentiated goods. Finally, a retailer buys all varieties of these good and produces a final good. For simplicity, the exposition of these steps will be carried out in reverse order, for the sector $k = T$, N, with $\theta_T \equiv \theta$ and $\theta_N \equiv (1-\theta)$ denoting the size of each sector.

Retailers A competitive retailer aggregates a continuum of differentiated goods, indexed by $i \in [0,1]$, as follows:

$$y_{kt} = \left[\left(\frac{1}{\theta_k} \right)^{\frac{1}{\epsilon_k}} \int_0^{\theta_k} y_{kt}(i)^{\frac{\epsilon_k - 1}{\epsilon_k}} di \right]^{\frac{\epsilon_k}{\epsilon_k - 1}}$$

where ϵ_k is the elasticity of subsitution betwen the different varieties.

Letting P_{kt} denote the price at which the retailer sells the final good y_{kt}, and $P_{kt}(i)$ denote the price at which they buy each good $y_{kt}(i)$, the profit of the retailer can be written as:

$$P_{kt} y_{kt} - \int_0^{\theta_k} P_{kt}(i) y_{kt}(i) di$$

Note that for $k = T$, this equation assumes that the law of one price holds. The zero-profit condition therefore defines the aggregate price as:

$$P_{kt} = \left(\frac{1}{\theta_k} \int_0^{\theta_k} P_{kt}(i)^{1-\epsilon_k} di \right)^{\frac{1}{1-\epsilon_k}}$$

The cost minimisation of this transaction yields the following demand schedule for each differentiated good:

$$y_{kt}(i) = \frac{1}{\theta_k} \left(\frac{P_{kt}(i)}{P_{kt}} \right)^{-\epsilon_k} y_{kt} \tag{6}$$

Monopolistic Firms There is a measure of mass θ_k of monopolistic firms producing differentiated goods in each sector. These firms buy intermediate goods at unit price MC_{kt}, and differentiate them with a technology that transforms one unit of intermediate goods into one unit of differentiated goods.

Following Calvo (1983), in any given period each firm can reset their price with a fixed probability $(1-\chi_p)$. A firm, i, that is able to reset their price chooses the optimal price level, $\tilde{P}_{kt}(i)$, so as to maximize expected profits given by:

$$E_t \sum_{s=0}^{\infty} \chi_p^s \Lambda_{t,t+s} \left(\tilde{P}_{kt}(i) - MC_{kt+s} \right) y_{kt+s}(i)$$

subject to the demand schedule, (6), where $\Lambda_{t,t+s}$ is a stochastic discount factor and $y_{kt}(i)$ is the output of firm i.

Since all firms are ex-ante identical, all optimising firms will choose the same price,

that is $\tilde{P}_{kt}(i) = \tilde{P}_{kt}$. The resulting expression for $\tilde{P}_{kt}$, is:

$$\tilde{P}_{kt} = \frac{\epsilon_k}{\epsilon_k - 1} \frac{E_t \sum_{s=0}^{\infty} \chi_p^s \Lambda_{t,t+s} MC_{kt+s} y_{kt+s} \left(P_{kt+s}\right)^{\epsilon_k}}{E_t \sum_{s=0}^{\infty} \chi_p^s \Lambda_{t,t+s} y_{kt+s} \left(P_{kt+s}\right)^{\epsilon_k - 1}} \tag{7}$$

Intermediate Goods Firms Intermediate goods, x_{kt}, are produced with the following technology:

$$x_{kt} = z_{kt} n_{kt}$$

where z_{kt} is an exogenous productivity factor, and n_{kt} is the aggregate labour input. For a given aggregate nominal wage, W_{kt}, the firm's profit maximisation yields the standard first order condition:

$$W_{kt} = MC_{kt} z_{kt}$$

The labour input is aggregated from the differentiated labour supply according to:

$$n_{kt} = \left[\left(\frac{1}{\theta_k \sigma} \right)^{\frac{1}{\gamma_k}} \int_0^{\theta_k \sigma} n_t(j)^{\frac{\gamma_k - 1}{\gamma_k}} dj \right]^{\frac{\gamma_k}{\gamma_k - 1}}$$

where γ_k denotes the elasticity of substitution between different labour types, and $\theta_k \sigma$ is the mass of households working in sector k in the Home economy. Since this aggregation is costless, the aggregate wage index must satisfy

$$W_{kt} n_{kt} = \int_0^{\theta_k \sigma} W_t(j) n_t(j) dj$$

and is therefore given by:

$$W_{kt} = \left(\frac{1}{\theta_k \sigma} \int_0^{\theta_k \sigma} W_t(j)^{1 - \gamma_k} dj \right)^{\frac{1}{1 - \gamma_k}}$$

The cost-minimisation problem of the firm gives the following demand schedule for each type of labour:

$$n_t(j) = \frac{1}{\theta_k \sigma} \left(\frac{W_t(j)}{W_{kt}} \right)^{-\gamma_k} n_{kt} \qquad \text{for } j \in k$$

2.3 Labour Union

The households delegate the labour supply decision to a labour union. As with price-setting, in any given period the union can reset the wage of each household with a fixed

probability $(1-\chi_w)$. When they are able to reset wages, the labour union chooses the optimal wage so as to maximise household utility, subject to the intermediate firm's demand for each labour type, in the relevant sector k.[6] Hence, the problem of the labour union is:

$$\max_{\tilde{W}_t(j)} \quad E_t \sum_{s=0}^{\infty} (\beta\chi_w)^s ß_{t+s} \left(\frac{c_{t+s}(j)^{1-\eta}}{1-\eta} - \frac{n_{t+s}(j)^{1+\varphi}}{1+\varphi} \right)$$

subject to:

$$\begin{aligned} c_{t+s}(j) &= (1-\tau^n)\frac{\tilde{W}_t(j)}{P_{t+s}} n_{t+s}(j) + \mathbf{X} \\ n_{t+s}(j) &= \frac{1}{\theta_k \sigma} \left(\frac{\tilde{W}_t(j)}{W_{kt+s}} \right)^{-\gamma_k} n_{kt+s} \end{aligned}$$

where the first constraint is the household's budget constraint, with irrelevant terms subsumed in $\mathbf{X}$.

As with prices, with ex-post symmetry, this gives the following forward-looking expression for optimal wages:

$$\tilde{W}_{kt}^{(1+\gamma_k\varphi)} = \frac{\gamma_k}{\gamma_k - 1} \frac{E_t \sum_{s=0}^{\infty} (\beta\chi_w)^s ß_{t+s} W_{kt+s}^{\gamma_k(1+\varphi)} \left(\frac{n_{kt+s}}{\theta_k \sigma} \right)^{1+\varphi}}{E_t \sum_{s=0}^{\infty} (\beta\chi_w)^s ß_{t+s} \lambda_{t+s} (1-\tau^n) w_{kt+s} W_{kt+s}^{(\gamma_k - 1)} (n_{kt+s}/\theta_k \sigma)} \tag{8}$$

2.4 Government

The government's expenditures consist of purchases of domestic non-tradable goods, g_t, and lump-sum transfers, T_t, while revenues come from labour income taxes. The government deficit is therefore given by:

$$d_t = \frac{P_{Nt}}{P_t} g_t + \sigma T_t - \tau^n (w_{Tt} n_{Tt} + w_{Nt} n_{Nt})$$

The budget constraint is defined by:

$$\frac{R_{Ht-1}}{\pi_t} b_{Gt} + d_t = b_{Gt+1}$$

To ensure stationarity of government debt, transfers respond to deviations of debt

[6] Since the union maximises the household's utility, this is equivalent to the formulation in EFR, and is still optimal from the perspective of the household.

from its steady state value, according to the rule:[7]

$$T_t = T\left(\frac{b_{Gt}}{b_G}\right)^{\rho_B}$$

Government consumption expenditures, as a ratio to GDP, react to deviations of output from its steady state according to:[8]

$$\frac{g_t}{y_t} = \left(\frac{g}{y}\right)\left(\frac{y_t}{y}\right)^{\rho_y}$$

2.5 Equilibrium

Risk-Sharing Notice that idiosyncratic shocks exist due to staggered wage-setting. The existence of contingent assets that allow perfect risk-sharing between domestic households is implicitly assumed, such that all consumption and savings decisions are the same. This implies that the j index can be dropped from the household's first order conditions. Furthermore, each household holds a diversified portfolio of shares in all domestic monopolistic firms. Therefore, the stochastic discount factor of these firms, $\Lambda_{t,t+s}$, can be defined as the generic household's price of transferring one unit of consumption between time t to $t+s$, and is given by:

$$\Lambda_{t,t+s} \equiv \beta^s E_t \frac{ß_{t+s}}{ß_t}\frac{\lambda_{t+s}}{\lambda_t}$$

Goods Market Clearing - Intermediate Goods Recall that the monopolistic firms use one unit of the intermediate good to produce one unit of their differentiated goods, such that:

$$x_{kt} = \int_0^{\theta_k} y_{kt}(i)di \tag{9}$$

This gives a simple expression for the aggregate nominal profits of the monopolistic firms:

$$\Pi_{kt} = P_{kt}y_{kt} - MC_{kt}x_{kt}$$

Plugging the demand schedule, (6), into equation (9) yields:

$$x_{kt} = y_{kt}\Delta_{kt}$$

[7] Variables without time subscripts denote the steady state values.

[8] In order to differentiate the impact of this fiscal stabilisation rule from the debt-targeting transfers rule, in the remainder of the paper the deficit will be defined net of the deviations of transfers from its steady state.

where the index of price dispersion is defined as:

$$\Delta_{kt} \equiv \int_0^{\theta_k} \left(\frac{P_{kt}(i)}{P_{kt}} \right)^{-\epsilon_k} di$$

Under the Calvo-pricing assumption, the price index can be written as:

$$P_{kt} = \left[(1-\chi_p)(\tilde{P}_{kt})^{1-\epsilon_k} + \chi_p (P_{kt-1})^{1-\epsilon_k} \right]^{\frac{1}{1-\epsilon_k}}$$

and this equation can be used to derive the law of motion of the price dispersion index:

$$\Delta_{kt} = \chi_p \pi_{kt}^{\epsilon_k} \Delta_{kt-1} + (1-\chi_p) \tilde{P}_{kt}^{\epsilon_k}$$

where $\pi_{kt} \equiv P_{kt}/P_{kt-1}$ is the inflation rate in sector k.

Goods Market Clearing - Final Goods Using the perfect risk-sharing assumption to aggregate over households, the market clearing conditions in the tradable and non-tradable sectors are given by:

$$y_{Tt} = \sigma c_{Ht} + \sigma^* c^*_{Ht}$$

$$y_{Nt} = \sigma c_{Nt} + g_t$$

Aggregate GDP is defined as:

$$y_t = (P_{Nt} y_{Nt} + P_{Tt} y_{Tt})/P_t$$

Asset Markets To ensure stationarity, the interest rate on foreign bond holdings is assumed to be a function of the level of bond holdings. That is:

$$R_{Ft} = R_t \exp\left\{ \psi \sigma \frac{b_{Ft+1}}{y_t} \right\}$$

where R_t is the union's common nominal risk free rate.

The aggregate household budget constraint, the budget constraint of the government, the zero-profit condition of the intermediate goods producers and the final good producers, yield the following law of motion for the foreign asset holdings

$$\sigma b_{Ft+1} = R_{Ft-1} \sigma b_{Ft} + P_{Tt} \sigma^* c^*_{Ht} - P^*_{Tt} \sigma c_{Ft}$$

where variables with an asterisk denote the Foreign counterparts. Market clearing in the asset markets requires $\sigma b_{Ft} + \sigma^* b^*_{Ft} = 0$.

2.6 Union-level Variables

The structure of the Foreign block is symmetric to that of Home block. The population of the union is normalised to 1, so that $\sigma^* = (1 - \sigma)$. Union-wide GDP and inflation rate are thus defined as

$$y_t^U = (y_t)^\sigma (y_t^*)^{1-\sigma}$$

$$\pi_t^U = (\pi_t)^\sigma (\pi_t^*)^{1-\sigma}$$

Monetary Policy There is an independent monetary authority which follows a Taylor rule targeting union-wide inflation, subject to a lower bound, R^{lb}. In particular, they set the interest rate according to:

$$R_t = \max\{R^{lb}, R\left(\pi_t^U\right)^{\rho_\pi}\}$$

2.7 Structural Reform

This framework gives rise to prices that are a mark-up over marginal costs, and wages that are a mark-up over the household's marginal rate of substitution between labour and consumption. This can be seen most clearly from the steady state versions of the optimal price- and wage-setting equations, (7) and (8):

$$P_k = \frac{\epsilon_k}{\epsilon_k - 1} P_k^x$$

$$w_k = \frac{\gamma_k}{\gamma_k - 1} \frac{(n_k/\theta_k \sigma)^\varphi}{(1 - \tau^n)\lambda_t}$$

These mark-ups are taken to be the consequence of structural rigidities, and their size is determined by the parameters ϵ_k and γ_k. These parameters therefore capture both the deep structural parameters, the elasticity of substitution between goods and labour inputs, and structural product and labour market policies.

For the case of product markets, this is in line with the endogenous firm entry framework of Bilbiie et al. (2012) and Cacciatore et al. (2016), where the elasticity of substitution between goods depends on the number of goods in the market, which in turn depends on the barriers to firm entry.[9] Reducing barriers to entry raises the number of firms, increases the elasticity of substitution and hence lowers the price mark-up.

[9]This is the case for the 'translog' specification of preferences. Lewis and Poilly (2012) and Lewis and Stevens (2015) estimate that model using IRF matching and full-information methods, respectively, and find that this channel is important for explaining the data.

Similarly for labour markets, in the framework of non-atomistic wage-setters developed in Gnocchi (2009), wage-setters internalise the effects of their decisions on the aggregate wage, and hence the perceived elasticity of labour demand, which determines the wage mark-up, is a weighted average of the elasticity of substitution among labour types and the elasticity of aggregate labour demand. Reducing the degree of centralisation in wage-setting reduces the weight on the latter, and so raises the perceived elasticity and lowers the wage mark-up.[10]

The advantage of this formulation, compared to the approach in EFR where excess rigidities are induced through distortionary taxes, is that it differentiates the effects of fiscal instruments, with direct budget implications, from excessive regulation that gives rise to structural rigidities. While this distinction was not important in the original EFR paper, it becomes particularly important here since the focus is predominantly on the interaction between these two types of macroeconomic policy. This alternative formulation has no implication for the steady state, since the elasticities only enter the steady state equations through the mark-up. It could, in principle, have some impact on the dynamics, but these differences are found to be negligible.[11]

3 Results

3.1 Calibration

For the purpose of this section, the model is calibrated as in EFR. Table 1 shows some of the key values used. Unless otherwise stated, parameters have the same value in the Home and Foreign blocks, which are calibrated as the Periphery and Core of the Euro-area respectively. For the fiscal variables, values common in the literature are used. Specifically, the steady state deficit-to-GDP ratio is set at 3% in line with the SGP limit, the labour income tax rate is set to 30% and the government spending-to-GDP ratio is set to 10%.

Table 2 summarises the baseline calibration of the structural rigidities. Wage and price mark-ups are assumed to be equal in a given sector. The tradable sector mark-up in both blocks is set to 15%, and the non-tradable sector mark-up in the Core (Foreign) block to 33%. The non-tradable sector of the Periphery (Home) block is assumed to face "excess" rigidities, here the initial elasticities are set to target a mark-up of 50%.

[10] To be precise, Gnocchi (2009) shows that the case where the elasticity of aggregate labour demand is *higher* than the elasticity of substitution among labour types, such that decentralisation could lead to a *rise* in the wage mark-up, can only occur under empirically implausible parameterisations.

[11] Results are available on request. It should also be noted that this framework is only valid for unanticipated changes, since otherwise the forward-looking price- and wage-setting rules under Calvo pricing would include time-varying elasticities of substitution. Looking at gradual or pre-announced reforms would require moving to Rotemberg pricing to circumvent this issue.

Parameter	Description	Value
Preferences		
β	Discount Factor	0.99
η	Inverse Elasticity of Intertemporal Substitution	2
φ	Inverse Frisch Elasticity of Labor Supply	2
ξ	Elasticity of Substitution Tradable/Non-tradable	0.5
θ	Share of Non-tradables	0.57
ϕ	Elasticity of Substitution Home/Foreign	1.5
α	Share of Imported Goods	0.38
Price and Wage Rigidities		
χ_p	Price Stickiness	0.66
χ_w	Wage Stickiness	0.66
Fiscal Policy		
τ^n	Labor Income Tax Rate	30%
g/y	Government Expenditure-to-GDP Ratio	10%
d/y	Government Deficit-to-GDP Ratio	3%
ρ_B	Debt Stabilisation Parameter	0.5
Union-level		
σ	Relative Block Size	0.5
ρ_π	Taylor Rule Parameter	10
ψ	Risk Premium Elasticity	0.001

Table 1: Parameter Values - Overview
Source: Eggertsson et al. (2014)

3.2 The Long Run Effects of Reform

In order to first understand the role of the non-tradable sector price and wage mark-ups in this model, it is useful to look at the steady states implied by different values of this mark-up in the Periphery. Figure 1 compares the steady state for mark-ups ranging from 0 to 100%. In each steady state the CPI is normalised to 1, and it is assumed that trade is balanced.

Panel a) shows aggregate GDP for the Periphery and the Euro-area as a whole.[12] Not surprisingly, increasing the degree of structural rigidities lowers total output in the Periphery. With a 50% mark-up, total output in the Periphery is around 17% below the steady state with no mark-up. As the Periphery is assumed to account for 50% of the Euro-area, union-wide GDP also falls, although not as steeply. The Periphery and Union level GDP are equal when the non-tradable sector mark-up in the Periphery is

[12]Note that the path of aggregat consumption is identical in this model, given balanced trade.

Target Description	Target Value	Parameter
Tradeable Sector Mark-up	1.15	$\epsilon_T = \gamma_T = 7.7$
Core Non-Tradeable Sector Mark-up	1.33	$\epsilon_N^* = \gamma_N^* = 4$
Periphery Non-Tradeable Sector Mark-up	1.50	$\epsilon_N = \gamma_N = 3$

Table 2: Parameter Values - Structural Rigidities
Source: Eggertsson et al. (2014)

equal to that in the Core, implying full symmetry across the two blocks.

Panel b) shows the effect on relative consumption and prices across sectors, in the Periphery. Increasing the non-tradable sector wage and price mark-ups directly raises the price of non-tradable goods. This pushes down on the level of non-tradable consumption. However, since tradable and non-tradable goods are complementary, the share of expenditure on non-tradable goods rises, and hence demand for the tradable goods also falls, albeit less steeply. This pushes down on the price of tradable goods.

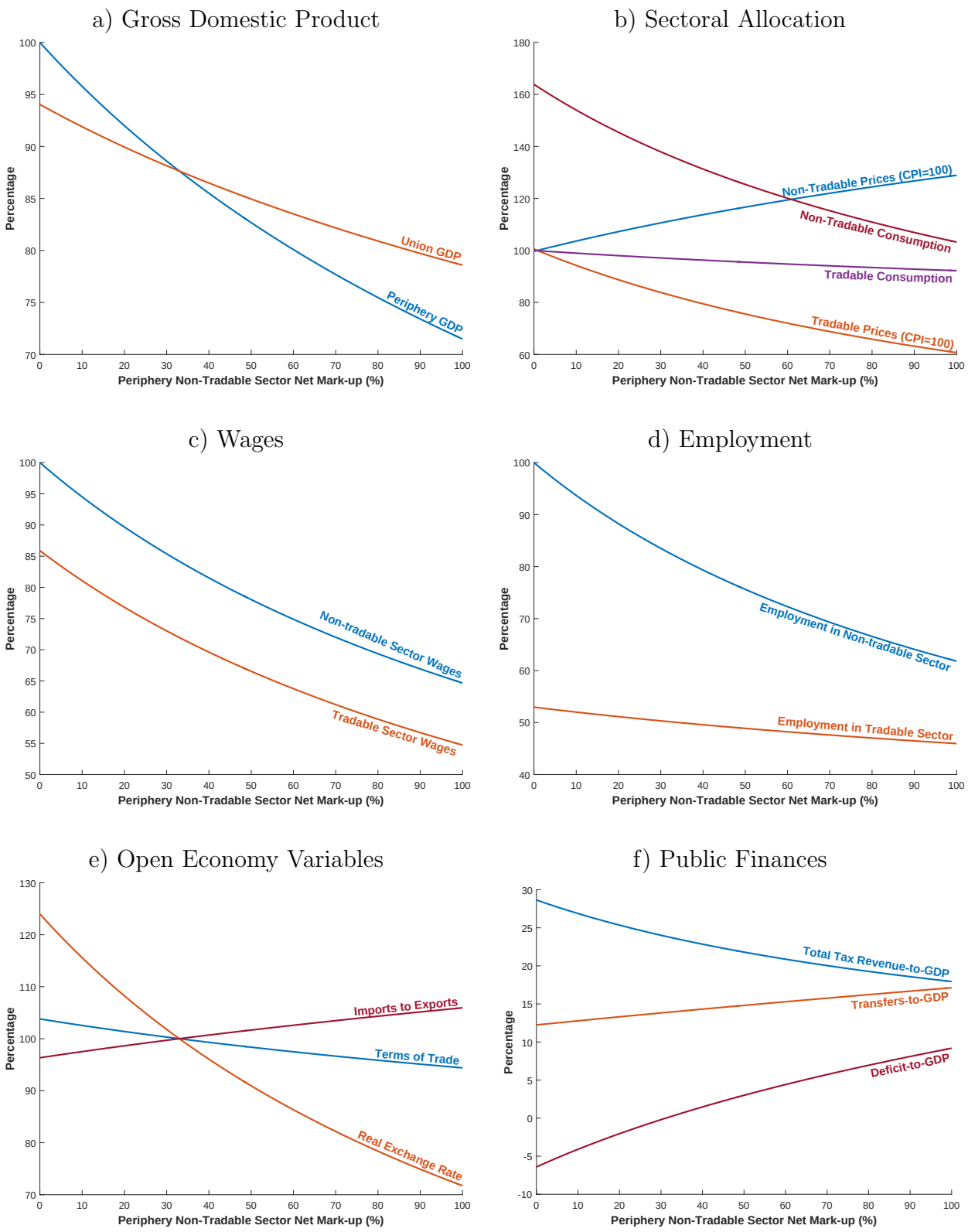
Panels c) and d) show the effect on wages and employment respectively. Falling demand for the tradable good lowers labour demand in this sector, hence pushing down on employment and wages, which further reinforces the fall in prices in this sector. Increasing the wage mark-up and increasing the price mark-up will have two opposing effects on the non-tradable sector wage. The former shifts labour supply inwards, pushing up on wages at a given level of employment, while the latter shifts labour demand inwards, lowering labour demand at a given wage. When raising both mark-ups together, non-tradable sector employment falls unambiguously, and, with the latter effect dominating in this parameterisations, wages also fall in equilibrium.

Panel e) shows the open economy variables. The upward pressure on domestic prices causes the real exchange rate, defined as P^*/P, to appreciate. This lowers the price of foreign tradable goods relative to domestically produced tradable goods, raising imports relative to exports. Hence the terms of trade, defined as P_T^*/P_T, falls (strengthens) to ensure balanced trade.[13]

To show the effects of the mark-ups on the government deficit, the steady state level of lump sum transfers, T, is first calibrated such that the steady state deficit-to-GDP ratio at the baseline calibration, with a 50% mark-up, is equal to 3%. The level of T is then held constant at each mark-up. With government expenditure fixed at 10% of GDP, this means that changing the mark-up affects the deficit-to-GDP through changes in tax revenues-to-GDP and through the denominator effect on T/y. Panel f) of Figure 1 shows that total tax revenue falls as a fraction of GDP, given the fall

[13]Note that the terms of trade and the real exchange rate are both equal to 1 when there is symmetry across the countries, namely when the Periphery non-tradable sector mark-up is equal to 33% as in the Core. In this case imports are also equal to exports.

Figure 1: Comparative Statics



Note: Periphery and Union GDP are shown relative to Periphery GDP when mark-ups are zero. Tradable and Non-tradable consumption are shown relative to tradable consumption when mark-ups are zero. Tradable wages and employment are each shown relative to their non-tradable counterpart when mark-ups are zero. All normalisations serve only to improve the readability of the Figure.

in both employment and wages in both sectors. Transfers as a fraction of GDP rises as GDP falls. These two effects both imply that the deficit-to-GDP ratio rises as the mark-up rises. In fact, for this calibration, mark-ups below around 30% would imply a steady state government surplus, while higher mark-ups can push the ratio up to around 7%.

Notice, also, that these effects are not linear: the same increase in the mark-up has a smaller effect when the mark-up starts off higher. In particular, the non-linearity of the effects on wages and employment feed into the tax revenues-to-GDP, and hence the deficit-to-GDP rises less steeply as the mark-up increases.

3.3 Comparison of Policy Scenarios

This section looks at the short run dynamics following a reform that reduces both price and wage mark-ups in the non-tradable sector of the Periphery block by 1%. The simulation is a deterministic transition from the initial pre-reform steady state towards the new steady state with the lower mark-up.[14]

The reform is simulated under different assumptions regarding monetary and fiscal policy. The purpose is to illustrate that a monetary expansion following a reform is necessary for the reform to be expansionary in the short run; without this, reforms reduce output for a few periods. Furthermore, when monetary policy is constrained, active fiscal stabilisation can be used to mitigate the output losses.

3.3.1 Structural Reforms under Constrained Monetary Policy

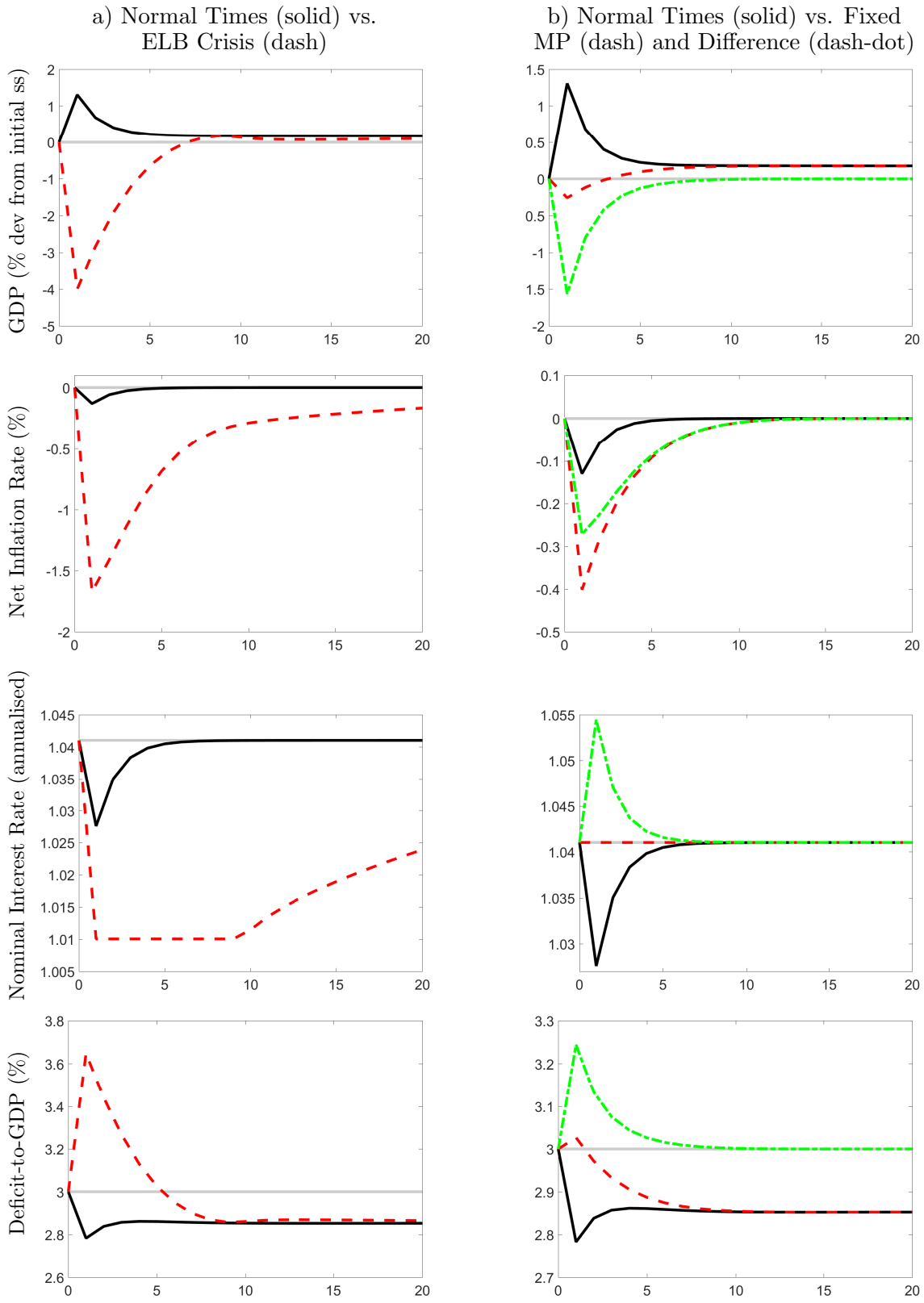
To start with, government spending is fixed at its steady state by setting $\rho_y = 0$, and only monetary policy acts to stabilise the economy during the reform.

Two forms of monetary policy constraint are considered. To begin with, in order to facilitate comparison with EFR, a shock to $ß_t$ is assumed to increase the stochastic discount factor, reduce demand, and so push the interest rate to $R^{lb} = 1.0025$.[15] Column a) of Figure 2 shows the results of these simulations for four key variables: Union-wide output and inflation, the common nominal interest rate and the deficit-to-GDP ratio of the Periphery block.

The black solid lines show the effects of reforms in normal times. The reform acts like a negative cost-push shock: it creates deflationary pressure, which induces

[14]The transition is based on the fully non-linear solution to the model, and is implemented in Dynare. The simulations are run for 200 periods.

[15]Following EFR, the lower bound is assumed to be strictly positive. More recently the ECB has lowered their policy rate below zero, suggesting that the lower bound is below zero. However, as will be demonstrated below, the level of the interest rate is not important in these simulations, only that monetary policy does not respond to stabilise inflation.



All responses are to a 1% reduction in mark-ups. Black solid lines in both columns show the reform in normal times. Red dashed lines in the first column show the case where the nominal interest rate hits its lower bound, and, in the second column, the case where the nominal interest rate is fixed at steady state. Green dash-dotted lines show the difference between the red dashed and black solid lines, and, for the interest rate and the deficit ratio, are shifted up by the steady state value for ease of viewing. X-axes show quarters.

Figure 2: Alternative Monetary Policy Scenarios

a monetary expansion, but the effect on output is positive in every period. On the other hand, as seen in the red dashed lines, reforms implemented in the ELB crisis are contractionary in the short run. While the short run contraction in output is predominantly a result of the discount factor shock, rather than the reform directly, this exercise highlights the fact that reforms implemented when monetary policy cannot provide a demand expansion do not provide the same boost to output in the short run. In other words, there is an interaction between the reform and the demand shock due to the monetary policy constraint, and a "naïve" expectation that the effect of the two together is the sum of the two effects is incorrect.

To further illustrate this point, Column b) of Figure 2 shows the effect of the reform under a second type of monetary policy constraint. Here, the interest rate is exogenously fixed at its steady state for a fixed length of time.[16] The purpose of this exercise is to highlight the effect of the constraint on monetary policy, abstracting from the direct negative demand effects which lead to the ELB crisis, at the same time neutralising the effect of monetary policy, keeping it fixed without any additional expansionary or contractionary effects. Importantly, in this exercise, all responses are directly due to the reform: removing the reform would make all of these responses flat, which is not the case for the simulations with the demand shock.

The red dashed lines show that even without the direct negative effects of the demand shock, the reform is contractionary in the short run when monetary policy is fixed. The deflationary effects of the reform are not offset by a demand expansion and so lead to a fall in output in the short run. The green dash-dotted lines show the difference between the fixed and active monetary policy, showing the net effect of fixed monetary policy.

The bottom row of each Column of Figure 2 shows the response of government deficit-to-GDP ratios for the Periphery block. As shown in the previous section, the reform reduces this ratio in the long run. Without any monetary policy constraint, the ratio falls immediately after the reform, as output, and hence also employment, rise immediately. Conversely, the ELB crisis raises the deficit in the short run, even absent a response of the fiscal instrument, due to the fall in both output and employment. Looking at the case with a fixed nominal interest rate, the deficit ratio rises slightly on impact, due to the short run contraction in output, and falls to the new lower level more gradually as output rises. The net effect of fixed monetary policy during the reform, shown in the green dash-dotted lines, is to raise the deficit-to-GDP ratio for almost 10 quarters.

[16] In particular, the monetary policy rule is specified as $R_t = \varepsilon^{MP} R + (1 - \varepsilon^{MP}) R \left(\pi_t^U\right)^{\rho_\pi}$ and ε^{MP}, a white noise zero-mean process, is set equal to 1 for 10 periods.

3.3.2 Structural Reforms with Active Fiscal Policy

This section repeats the same reform simulations, this time allowing government spending to respond by setting $\rho_y < 0$.[17]

The two Columns of Figure 3 again show the two cases of constrained monetary policy, comparing the cases with and without active fiscal policy.[18] Column a) shows that the fall in output during the ELB crisis induces a fiscal expansion, which can mitigate the deflationary pressures and thus mitigate the output losses in the short run, as well as speeding up the recovery towards the new, higher level of output. However, this comes at the cost of a larger and more persistent increase in the deficit-to-GDP ratio. In fact, this remains above its pre-reform level even after 20 quarters.

Column b) shows the alternative exercise in which the nominal interest rate is fixed at its steady state. Abstracting from the direct negative effects of the demand shock, active fiscal policy can fully eliminate the short run output losses. Responding to the contractionary pressure from the reform, the fiscal stabilisation rule calls for a rise in government spending-to-GDP. This demand expansion mitigates the deflationary pressure of the reforms. In this case, output is above the initial steady state in every period following the reform, at the expense of an elavated deficit-to-GDP level.

The green dash-dotted lines show the difference between the cases with and without active fiscal policy, and hence capture the effect of the reform under constrained monetary policy that is attributable to active fiscal stabilisation. In particular, active fiscal policy implies the deficit-to-GDP ratio remains above the pre-reform steady state for around 1 year after the reform, and above the baseline of no active policy for almost 3 years before reaching the new lower steady state.

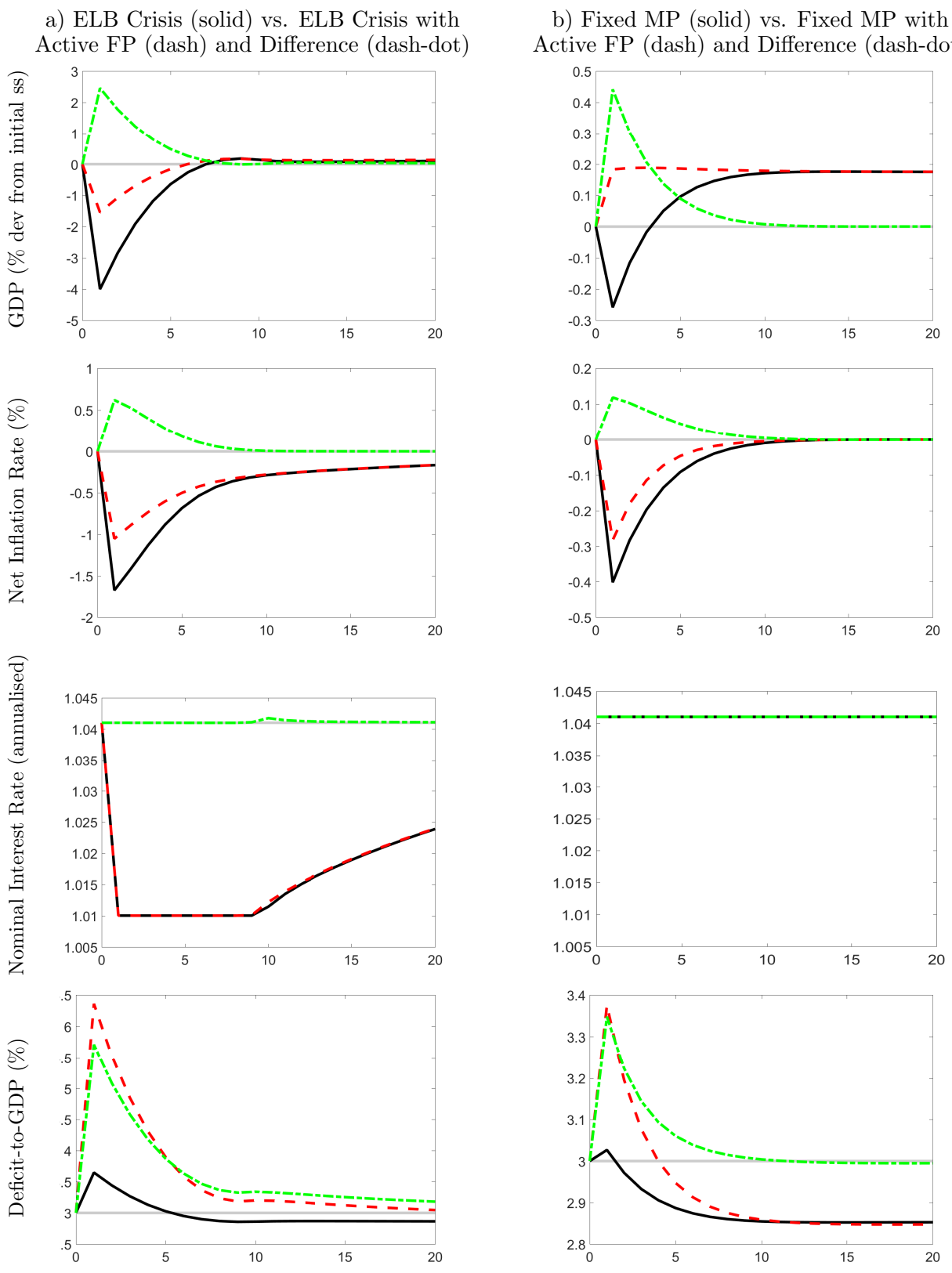
3.4 Quantitative Comparisons

The above analysis illustrated, somewhat qualitatively, the contractionary effects of reforms implemented when monetary policy is constrained, and the potential for active fiscal policy to offset the short run costs of reform. This section returns to the underlying question of how large the fiscal costs and benefits of reforms are, and to what extent, or under what conditions, the latter justify the former.

In this analysis, the value of ρ_y becomes important. In each simulation discussed below, this parameter is set as the smallest integer, in absolute value, such that Home output is above the initial steady state in every period following the reform. This gives

[17] In particular, $\rho_y = -200$. This is a very large number but serves only to excentuate the differences in the plots for ease of viewing. The calibration of this parameter will be dealt with in the quantitative exercises below.

[18] There is effectively a form of "monetary dominance" and fiscal policy is not considered to be active during normal times.



All lines show a 1% reduction in mark-ups. The first column shows the case where the nominal interest rate hits its lower bound, and the second column the case where the nominal interest rate is fixed at steady state. Black solid lines replicate the red dashed lines in Figure 2 and red dashed lines here show the case where government spending responds to deviations of output from steady state. Green dash-dotted lines show the difference between the red dash and black solid lines, and are shifted up by the steady state for the interest rate and deficit. X-axes show quarters.

Figure 3: Alternative Fiscal Policy Scenarios

the "smallest" fiscal stimulus which fully offsets the output losses of the reform.

To measure the size of this fiscal stimulus, the short run fiscal cost of the reforms, it is necessary to abstract from the direct effects of the demand shock, and isolate the additional effect of the active fiscal response. This means focusing on the difference between the response of deficit-to-GDP under exogenously fixed monetary policy with and without active fiscal policy. In other words, focusing on the green dash-dotted lines in the second column of Figure 3, which will be referred to as the "excess deficit". Two summary statistics are extracted from this:

1. **Cumulative excess deficit in transition** This is the sum of the excess deficit in each period that it is positive. This statistic is expressed as a ratio to the pre-reform GDP, and captures the total size of the short run fiscal stimulus following the reform.

2. **Peak deficit-to-GDP deviation** This is the largest value of the excess deficit-to-GDP. This statistic captures the additional amount of fiscal space required to carry out the stimulus, and will be useful for comparison against the provisions in the SGP for deviations from imposed deficit targets.

The long run benefit to public finances is measured by comparing the pre- and post-reform steady states of the model, looking in particular at:

3. **Fall in steady state deficit-to-GDP** This is the percentage point fall in deficit-to-GDP at the post-reform steady state relative to the initial steady state.

Finally, the extent to which the long run improvement in steady state deficit-to-GDP can justify the short run fiscal costs is quantified as:

4. **Time to repay** This is the number of quarters required at the new steady state, such that the 'excess surplus', i.e. the lower deficit, adds up to the cumulative excess deficit in transition, as defined above.

Excess Deficit in Transition	**Peak Deficit-to-GDP Deviation**	**Fall in steady state deficit-to-GDP**	**Time to Repay (Quarters)**
0.67%	0.23pp	0.15pp	4.86

Table 3: Summary Statistics Under Baseline Calibration

The values of these summary statistics under the baseline calibration, and the baseline reform scenario, are given in Table 3. The long run gain from the reform is a 0.15pp improvement in the long run deficit-to-GDP ratio. These numbers correspond

to the lines in Figure 3, except that here $\rho_y = -10$, which results in a fiscal stimulus with a total cost of 0.67% of the pre-reform GDP. The peak deviation of deficit-to-GDP from the baseline is 0.23pp on impact. At the new lower steady state deficit-to-GDP, this cost can be repaid in a little over 1 year.

Clearly, under the baseline reform scenario, the short run costs of carrying out a fiscal expansion are not particularly large and are outweighed by the long run gains. However, the precise numbers depend on the parameterisation of the model and the reforms. This is investigated by looking at the sensitivity of these statistics along two dimensions: firstly how they depend on the calibration of certain model parameters, and secondly how they depend on the reform that is being simulated.

3.4.1 Sensitivity to Parameterisation

In order to see how the fiscal costs and gains from the reforms depend on the parameterisation of the model, the summary statistics introduced above are computed for different values of: the relative size of the Home block, the initial level of the non-tradable sector mark-up, and the size of the government, as captured by the government spending-to-GDP ratio. Table 4 shows the results.

	Excess Deficit in Transition	**Peak Deficit-to-GDP Deviation**	**Fall in Steady State Deficit**	**Time to Repay (Quarters)**
Relative size of Home block				
20%	0.20%	0.08pp	0.15pp	1.45
30%	0.53%	0.19pp	0.15pp	3.82
50%	0.67%	0.23pp	0.15pp	4.86
Initial Mark-up				
33%	0.62%	0.21pp	0.18pp	3.65
50%	0.67%	0.23pp	0.15pp	4.86
60%	0.67%	0.23pp	0.13pp	5.47
Government Size				
5%	0.61%	0.21pp	0.16pp	4.05
10%	0.67%	0.23pp	0.15pp	4.86
30%	0.88%	0.30pp	0.09pp	10.84

Table 4: Sensitivity of Summary Statistics to Parameterisation

Relative Country Size The first panel shows that for smaller countries, the short run fiscal costs of the reform are lower. When the Periphery is assumed to be much smaller relative to the Core, it implies that the demand and supply coming from the Periphery has a smaller role in determining the prices of tradable goods. Hence the

reform, while still lowering the price of non-tradable goods, creates less deflationary pressure, and hence does not push down on output as much. In fact, the value of ρ_y for the different country sizes is -4, -8 and -10 respectively: the output costs of the reforms are smaller in each case, such that a weaker fiscal response is needed to offset these costs. Since the long run gains are determined domestically, and are equal regardless of the size of the economy, it takes significantly less time to repay the short run costs in a smaller country. The fiscal space required for a smaller country to carry out the reform, in terms of deviation from the SGP objectives, is also much smaller.

Initial Mark-up The second panel shows the results from varying the initial level of mark-ups in the Periphery Non-tradable sector. These results show that both the peak and the cumulative deficit cost of the reform is slightly lower when the initial level of rigidities are lower. This is because the smaller mark-up implies that demand is more price elastic, meaning that the deflationary effect of the reform translates to a smaller contractionary effect on output. Since the long run gain in deficit-to-GDP is also higher, echoing the non-linearity observed in Figure 1, overall the trade-off is larger when markets are initially more rigid, and the costs take longer to repay.

Size of Government The last panel shows the effect of different steady state levels of government spending-to-GDP. Since the government expenditure goes only to non-tradables, a larger government size means a larger share of the demand for the non-tradable goods comes from the government, who do not optimise expenditure in response to the price changes. This makes demand in the non-tradable sector less price elastic. In this case, the reform in this sector becomes more costly in terms of output in the short run, and so the necessary fiscal stimulus also becomes larger. At the same time, the long run fiscal gains from reform are also smaller, and this implies a considerably longer time to repay: over 10 quarters in the case of 30% steady state government spending-to-GDP.

3.4.2 Reform Design

The final step of the analysis is to compare different reform scenarios, looking in particular at the size of the reform and whether the reform is in price or wage mark-ups, labelled product market reforms (PMR) and labour market reforms (LMR) respectively. Table 5 shows the different summary statistics for these different reforms.

Reform Size The first panel shows the results from varying the size of the reform, comparing the baseline scenario of 1% to 5% and 10% mark-up reductions. The effects on the long run gain are almost precisely linear, although the overall time to repay

	Excess Deficit in Transition	Peak Deficit-to-GDP Deviation	Fall in Steady State Deficit	Time to Repay (Quarters)
Size of Reform				
1%	0.67%	0.23pp	0.15pp	4.86
5%	3.13%	1.07pp	0.75pp	4.41
10%	5.70%	1.99pp	1.53pp	3.85
Type of Reform				
LMR	0.13%	0.03pp	0.03pp	6.18
50-50	0.67%	0.23pp	0.15pp	4.86
PMR	0.62%	0.24pp	0.12pp	5.33

Table 5: Sensitivity of Summary Statistics to Reform Design

does fall slightly since the short run costs do not rise as steeply.[19] On the other hand, the larger reforms do imply larger deviations of deficit from steady state, with the 10% reform requiring a 2pp deviation of deficit-to-GDP. However this is clearly justified by the equally larger long run gains.

Reform Type Finally, the second panel explores the possibility of carrying out asymmetric reforms in product and labour markets. In particular, the symmetric 1% reduction in both price and wage mark-ups is compared against a 1% reduction in either price or wage mark-ups. These results show that product market reforms, which have a larger direct deflationary effect, are much more costly than labour market reforms, where the deflationary effect is mitigated by the subsequent rise in labour demand. However, a pure labour market reform, while implying only negligible deviation from the steady state deficit-to-GDP, also implies a very small gain in long run deficit-to-GDP. This is because while the reform increases employment, it also reduces wages, and this has a negative effect on the tax base. Accordingly, the trade-off between consolidation and reform is higher for labour market reforms.

4 Cross-Country Comparisons

Having seen the qualitative effects of reforms under alternative monetary and fiscal policy scenarios, and investigated quantitatively how these effects depend on the model parameterisation, this section now carries out a comparison of reform scenarios for different Euro-area countries. Specifically, the model is re-calibrated to represent dif-

[19] Although there was some non-linearity in the steady state deficit-to-GDP at different mark-ups, this is not strong enough to show up in the comparisons here. It would be more pronounced if much larger reforms were being considered.

ferent countries in the Euro-area, to look at the size of fiscal costs and benefits from different reform scenarios.

4.1 Calibration

The entire economy is taken to be made up of the four largest Euro-area economies: France, Germany, Italy and Spain. In accordance with the comparisons carried out above, for each of France, Italy and Spain, the relative size of the Home country, the steady state government deficit-to-GDP and expenditure-to-GDP ratios, and the initial mark-up in both the tradable and non-tradable sector are re-calibrated. In each case, the Foreign block is then calibrated to be the weighted average of the remaining three countries. Table 6 summarises the values used; all other parameters are kept at their baseline values.[20]

Country	Country size, σ	Deficit-to-GDP, d/y	Government size, g/y	Tradable Mark-up	Non-tradable Mark-up
France	30%	4%	25%	12%	26%
Germany	35%	-1.7%	20%	13%	25%
Italy	20%	3.5%	20%	15%	38%
Spain	15%	5%	20%	14%	40%

Note: Country size based on relative GDP. Government size given by final consumption expenditure of general government. All data come from Eurostat and refer to averages 2004-2013, except the estimates of mark-ups, which are taken from Hoj et al. (2007). For Spain, for which data is unavailable, the mark-ups are set at a slightly higher level than Italy, in line with OECD's Product Market Regulation Index, given that Hoj et al. (2007) show that their estimates are significantly correlated with this index.

Table 6: Calibration for Different Countries

4.2 Quantitative Results

For each country, the baseline reform considered is the reduction in the non-tradable mark-up that removes 25% of the difference relative to Germany, considered as the best-practice country. This means a baseline reduction in the mark-up of 0.25pp for France, 3.25pp for Italy and 3.75pp for Spain. This baseline reform is compared to the same size reductions in the price and wage mark-up separately, and to a larger reform, this time removing 50% of the difference in the mark-up relative to Germany.

The results are shown in Table 7, which also shows the long run gain in output for each reform, as a percentage of the pre-reform steady state, as well as the number of quarters until the economy reaches the new steady state. The output gains from reform

[20]The openness parameter, α, is altered in each case in line with the relative size of the country. This is necessary to ensure a feasible steady state is found.

in Italy and Spain are found to be much larger than France, although they start at higher mark-up levels, since the reforms considered are larger. The long run gain from PMR and LMR are identical in each case, and, despite potential interaction effects through price- and wage-setting, the effect of the baseline reform in both markets is the sum of the two effects. This is not true of the short run costs, however, which are always smaller for the baseline reform than the sum of the two separate reforms.

	Gain in S.S. Output	**Excess Deficit**	**Peak Deficit-to-GDP Deviation**	**Fall in S.S. Deficit**	**Time to S.S.**	**Time to Repay**
France						
Baseline	0.06%	0.07%	0.03pp	0.03pp	8	2.36
LMR	0.03%	0.03%	0.01pp	0.00pp	1	106.20
PMR	0.03%	0.06%	0.03pp	0.03pp	6	2.00
Larger	0.13%	0.14%	0.05pp	0.06pp	9	2.35
Italy						
Baseline	0.79%	0.33%	0.14pp	0.37pp	10	0.95
LMR	0.39%	0.28%	0.06pp	0.03pp	14	15.16
PMR	0.39%	0.23%	0.14pp	0.34pp	6	0.70
Larger	1.59%	0.64%	0.28pp	0.75pp	10	0.92
Spain						
Baseline	0.97%	0.37%	0.16pp	0.43pp	9	0.97
LMR	0.48%	0.42%	0.08pp	0.05pp	15	18.02
PMR	0.48%	0.00%	0.00pp	0.38pp	8	0.00
Larger	1.97%	0.74%	0.31pp	0.87pp	10	0.93

Table 7: Alternative Reform Design in Different Countries

In the case of France the baseline reform considered here entails a short run fiscal cost of less than 0.1% of the pre-reform GDP, and a long run gain of 0.03pp in the deficit-to-GDP ratio. At its peak, the fiscal stimulus requires a 0.03pp increase in the deficit-to-GDP ratio. The costs of this reform can be repaid in just over 2 quarters at the new steady state, although it takes 2 years to reach the new steady state. As before, increasing the size of the reform increases the short run costs and long run benefits in a linear fashion, and so the time to repay the costs is the same. The peak deficit-to-GDP deviation remains modest at 0.06pp. Again the labour market reforms are not found to increase the long run deficit-to-GDP ratio, and so the short run costs are unfeasible to repay, despite the economy reaching the new steady state very quickly. On the other hand, while the pure product market reform has a larger fiscal cost than the labour market reform, it achieves a long run improvement in the deficit-to-GDP ratio, and hence these costs can be repaid in two quarters.

There is a similar picture for Italy. As the baseline reform being considered is much larger, both the costs and gains are larger, though still modest with a peak

cost of 0.14pp and long run gain of 0.37pp in deficit-to-GDP. Despite taking slightly longer to reach the new steady state, the costs can be repaid even faster than the case of France, in fact in under one quarter. One notable difference, with respect to the calibration for France, is that in this case labour market reforms are in fact found to be more costly in the short run than product market reforms, and take longer to reach the steady state. Again, increasing the size of the reform does not affect the time to repay, but still does not require a larger deviation in deficit-to-GDP, with a peak value of 0.28pp.

Last but not least, the case of Spain again shows a similar pattern with respect to the different reform scenarios. As the largest reform considered, the gains in both output and deficit-to-GDP are larger, and hence justify the slightly higher short run costs. Again, the labour market reform is found to be more costly than the product market reform in the short run: in fact under this calibration, even with constrained monetary policy, the country is sufficiently small that the pure product market reform is not contractionary in the short run and so does not require any fiscal stimulus.

5 Summary and Concluding Remarks

Since the early days of the Euro-area, policy-makers have been discussing the role of fiscal policy in offsetting the short run costs of structural reforms, in order to facilitate their implementation, and this debate has again become relevant with monetary policy in the Euro-area close to the effective lower bound. To understand whether a government should invest time and public expenditure on the costs of structural reforms, it is important to compare the potential short run fiscal costs to the effects of those reforms on public finances in the long run. In particular, reforms which boost economic growth can improve the fiscal balance in the long run, and so be self-financing despite the fiscal costs in the short run.

Using the framework of Eggertsson et al. (2014), this paper has highlighted that structural reforms implemented when monetary policy is constrained can be contractionary in the short run. Furthermore, the fall in output also raises the deficit-to-GDP ratio during the reform, even absent any active fiscal stabilisation, before this ratio reaches a lower post-reform steady state. An active fiscal stimulus can offset the short run output costs of reform, but with an additional rise in the deficit, which captures the fiscal cost of the reform under constrained monetary policy.

Labour market reforms, of the type considered in this paper, entail very small improvements in the long run deficit-to-GDP ratio, because the improvement in tax revenues from higher employment is offset by weaker pay growth. Indeed, when the model is calibrated for France, the long run improvement is found to be so small

that even the modest fiscal stimulus needed in the short run cannot be repaid for over 2 decades by the negligible long run gains. For Italy and Spain, in this model, labour market reforms have lower long run gains, but also higher short run costs than product market reforms, and hence require several more years to repay. For Spain in particular, being a smaller country, product market reforms do not entail any short run costs according to this model. In all cases, the short run costs of simultaneous reforms in both labour and product market reforms are smaller than the sum of the costs of the two separate reforms, and hence it is always better to implement reforms together.

Both the long run gains and short run costs of reforms rise with the size of the reform in an almost-linear fashion, such that the trade-off between the two is relatively stable. Hence, although they would require larger reforms to reach the best-practice levels of competition, the model suggests that the short run costs of reforms in Italy and Spain are still justified by the long run gains. In fact, in both cases, following a reform that removes 25% of the mark-up differential with respect to Germany, the model reaches the new steady state and repays the short run costs in less than 3 years. In the short run, this would require a modest deviation of the deficit-to-GDP ratio from the initial steady state, of around 0.4pp for both countries.

There are three issues in particular that merit discussion. Firstly, considering alternative fiscal instruments in this framework could produce very different effects. This is true for both the debt-targeting fiscal rule and the output stabilisation rule. As the former rule is not of interest in itself in this paper, and is only used to ensure determinacy of public debt, lump-sum transfers are the natural policy instrument to keep its effects neutral. However, considering alternative instruments for this rule is non-trivial in this setting. Firstly because it acts as a destabilising rule, raising the deficit during booms and consolidating during recessions, and hence if government consumption expenditures are used here, this would interfere with the fiscal stabilisation. At the same time, if distortionary taxes were used, for either of the two fiscal rules, this would interfere with the reform process. Both labour income and consumption taxes are effectively a part of the wage and price mark-ups, respectively. Hence raising or reducing these tax rates during a reform would act like reducing or amplifying the reform itself. In terms of output stabilisation, while a tax-based fiscal stimulus could offset the effects of the reform in the same way as the spending-based stimulus, the reduction in the tax rates would imply a further reduction in the mark-up, which could amplify the negative effects of the reform. Hence the net effect is ambiguous.

Secondly, introducing capital into the model can produce different results. On the one hand, the existence of capital can change the effects of the discount factor shock on the macro-economy: an increased desire to save can be channeled towards investment,

thereby boosting aggregate demand. Structural reforms will also have a similar effect in the presence of capital, as the expectation of higher future productivity will increase investment and mitigate the short run contractionary effects of the reform despite the constraint on monetary policy. On the other hand, this would rely on a functioning financial intermediation sector, whereas the slowdown in investment in the Euro-area in recent years would suggest significant financial frictions are at play. In this case, this could further increase the gains from fiscal spending, particularly targeted at alleviating credit constraints and so bringing forward the long run effects of the reform.

Finally, the analysis in this paper focused on the primary deficit as the measure of public finances. However, some of the countries facing the highest need for reforms also faced particularly high borrowing costs throughout the crisis, increasing the costs of fiscal stimulus. Indeed, while this paper considered the SGP as the main fiscal constraint facing Euro-area countries, country risk premia can be considered as market-imposed fiscal constraints, and can be looked at in an analogous way. In particular, during a fiscal crisis when spreads are high, not only are borrowing costs high, the market may react negatively to any sign of a lack of fiscal restraint. On the other hand, if fiscal stimulus is accompanied by structural reforms, fiscal expansion should not be considered as a sign of unsustainable debt in the long run, so long as markets are following fundamentals. The question of how country specific spreads respond to fiscal policy is still an open question in the literature, and it would be interesting, in the future, to consider the role of long term structural policies in this issue.

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