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The analyses, opinions and findings of these papers represent the views of the authors, they are not necessarily those of the Banco de Portugal or the Eurosystem

Please address correspondence to
Banco de Portugal, Economics and Research Department
Av. Almirante Reis 71, 1150-012 Lisboa, Portugal
Tel.: 351 21 313 0000, email: estudos@bportugal.pt

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Euro area structural reforms in times of a global crisis*

Sandra Gomes†

Banco de Portugal and ISEG-Lisbon School of Economics & Management

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Abstract

The global financial crisis that started in mid-2007 brought back to the monetary policy debate the issue of the zero lower bound on nominal interest rates and the policy options available when this is a binding constraint. Given the significative macroeconomic impact of the crisis it has also brought to the forefront of the discussion ways to revive economic growth. This paper looks at structural reforms as a policy option of economic stimulus for an economy where the zero lower bound binds. We focus in the euro area economy. Our main results show that structural reforms may have positive short run effects that reduce the size of a recession and if coordinated they can drive the euro area out of the zero lower bound. We also show that the short to medium run impact of structural reforms is also crucially dependent on the design of such reforms, namely if the reforms are implemented gradually or not and if the reforms are announced (or perceived) as temporary or permanent. Finally, we show that the zero lower bound does not change significantly the impact of the reforms if the reform is permanent but it does have an important effect if the reform is transitory.

JEL codes: E52, F42, F47.

Keywords: Zero Lower Bound; Structural reforms; Monetary Policy; Dynamic general equilibrium models.

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†Email: sandra.cristina.gomes@bportugal.pt

1 Introduction

The global financial crisis that started in mid-2007 brought back to the monetary policy debate the issue of the zero lower bound (ZLB) on nominal interest rates and the policy options when this is a binding constraint. In fact, in response to the crisis central banks around the world reduced rapidly policy rates. By 2009, policy rates in the major world economies were at or below 1 per cent and have stayed at very low level. See Figure 1. The financial crisis led the world economy into a sharp recession. This has also brought to the forefront of the discussion ways to revive economic growth.

In the literature, several policy strategies to pursue when interest rates have reached their lower bound (or to avoid that they do) have been put forward . Some contributions focus on alternative ways of conducting monetary policy, such as price-level targeting (Eggertsson and Woodford (2003), Svensson (2003), Wolman (2005)) or exchange-rate targeting (McCallum (2000), Svensson (2003), Coenen and Wieland (2004)). Another large strand of the literature analyses the use of fiscal policy. Among recent contributions, Christiano, Eichenbaum, and Rebelo (2011) and Erceg and Lindé (2012) focus on increases in government spending when the ZLB binds; Eggertsson (2011) and Coenen, Erceg, Freedman, Furceri, Kumhof, Lalonde, Laxton, Lindé, Mourougane, Muir, Mursula, de Resende, Roberts, Roeger, Snudden, Trabandt, and in't Veld (2012) analyses the effect of different policy instruments at the ZLB and Gomes, Jacquinot, Mestre, and Sousa (2010) analyse if a variety of fiscal policy instruments in the euro area can alleviate the effects of a deep recession that has led interest rates to the ZLB and whether they should be coordinated internationally.

This paper looks at a different option of economic stimulus when monetary policy is constrained by the ZLB, in particular structural reforms. We focus in particular in the euro area economy that has struggled to get out of the economic crisis that followed the global financial crisis and that was subsequently worsened by the European sovereign debt crisis. The crisis implied persistent and severe output losses in the short-run and most likely also resulted in output losses

in the long-run, i.e. in a fall in potential output.[1] Arguably, the euro area has been faced with a low potential growth even before the crisis (see Gros, Durrer, Jimeno, Monticelli, and Perotti (2002) and European Commission (2014)). In fact, since the beginning of the 2000s the euro area has shown steadily decreasing potential output growth according to European Commissions data (see Figure 2). One of the reasons often pointed out to explain this is an insufficient degree of competition in the labour and services markets. There are several contributions to the literature on structural reforms, namely using DSGE models. Regarding the contributions focused on the euro area, Bayoumi, Faruqee, Laxton, Karam, Rebucci, Lee, Hunt, and Tchakarov (2004) analyze the effects of greater competition in the euro area as a whole in product and labour markets; Jonsson (2006) analyzes the welfare cost of imperfect competition in the product and labour market using a closed economy dynamic general equilibrium model parameterized to fit the euro area; Everaert and Schule (2008) compute a similar analysis focusing on the effects of synchronized structural reforms in the euro area; Forni, Gerali, and Pisani (2010) analyze the role of greater competition in the Italian services sector in a two country model of the euro area; more recently, Gomes, Jacquinot, Mohr, and Pisani (2013) assess the domestic and cross-country macroeconomic implications of competition-enhancing reforms implemented in the euro area regional services and labour markets and analyse the benefits to each region of coordination.

The long-run impact of an increase in competition in the labour and services markets is positive, see Gomes, Jacquinot, Mohr, and Pisani (2013). However, the extent to which these type of structural reforms can stimulate an economy in the short run and at the same time help to escape the ZLB restriction has to be assessed empirically. We analyse this issue by simulating a dynamic general equilibrium model of the euro area. In particular, we simulate EAGLE (Euro Area and Global Economy) model (see Gomes, Jacquinot, and Pisani (2012)), an open economy model of the euro area. The euro area is composed of two blocs, that we calibrate to a small bloc that weighs around 10 per cent of the euro area and roughly matches the characteristics of

[1] On the macroeconomic impact of severe financial and banking crisis see for example Reinhart and Rogoff (2008), Cerra and Saxena (2008), Claessens, Kose, and Terrones (2009) or Haugh, Ollivaud, and Turner (2009) as well as European Commission (2014)).

an euro area country or group of countries of the so called periphery.

Even though there is an extensive literature on structural reforms, only a few papers have looked at the implementation of structural reforms when the ZLB binds. Fernández-Villaverde, Guerrón-Quintana, and Rubio-Ramírez (2011) use a simple 2-period model to study how supply-side policies, including an increase in price competitiveness, may help to push an economy out of the ZLB. By reducing mark-ups in the future, these policies generate a wealth effect that increases the desire to consume today and decreases the desire to save, thus addressing the low demand problem at the core of the ZLB situation. Since the economy is at the ZLB, this wealth effect is not offset by monetary policy, which would have been the case in normal times, i.e. outside the ZLB. The results in this paper are illustrative of the mechanisms at work in a relatively stylised model. Eggertsson, Ferrero, and Raffo (2014) based on a DSGE with two equally-sized countries argue that structural reforms that reduce product and labor market markups can have short-run contractionary effects if implemented during a crisis when the ZLB binds. However, unlike Fernández-Villaverde, Guerrón-Quintana, and Rubio-Ramírez (2011) they focus on an immediate reduction in markups. Also the analysis is also focused on the case of permanent reforms. The contractionary impact they show is short-lived and not very large.

Following Gomes, Jacquinot, Mestre, and Sousa (2010), we induce a recession that drives the model into the ZLB constraint, by hitting the world economy with a sequence of unexpected demand shocks. This implies a deep recession in the euro area and the policy rates remain trapped at zero for around 2 years. Then we simulate an increase in competition in the labour and in the services markets. We assess their short run effectiveness in alleviating the economic recession and in countering the ZLB both when reforms are implemented unilaterally and coordinated across countries in the monetary union. We also analyse the importance of some design characteristics as well as the impact of the cyclical position as well as the ZLB constrain on the short to medium run impact of the reforms.

Our main results are as follows. If the reforms are implemented in a small bloc of the euro

area, the labour market reform has a positive effect on GDP in the short to medium run while it takes longer for the services market reforms to have a significant impact on (domestic) GDP. However, given the small weight of the block in the euro area economy, the unilateral reforms have no effect in terms of the euro area wide policy rate that remains trapped at the ZLB for the same number of periods. Looking at the coordinated case, a similar reduction of markups in the labour and the services markup, the reform in the labour market markup is more successful in stimulating euro area GDP in the short run than the services reform. However, the reduction in the wage markup accentuated deflation in the euro area which implies that interest rates remain at the ZLB for the same number of periods, while the services market reform pushes the euro area out of the ZLB. We also show that the short to medium run impact of structural reforms is also crucially dependent on the design of such reforms, namely if the reforms are implemented gradually or not and if the reforms are announced (or perceived) as temporary or permanent. Finally, we show that the ZLB does not change significantly the impact of the reforms (compared to "normal" times) if the reform is permanent but it does have an important effect if the reform is transitory.

The remainder of the paper is organised as follows. In Section 2 we present the main features of the EAGLE model and the calibration. In Section 3 we describe the induced recession and show the results of the simulated reforms, both in the small euro area bloc and the coordinated case. In Section 4 we analyse the impact of changing some key features of the reforms. Section 5 analyses weather the impact of the reforms depends on the cyclical position of the economy at the time of implementation and on the fact that the ZLB on nominal interest rates is binding at the time of implementation. Section 6 concludes.

2 The model setup and calibration

The model The EAGLE (Euro Area and the Global Economy) model is dynamic general equilibrium model of the euro area within the world economy (see Gomes, Jacquinot, and Pisani

(2012) and Gomes, Jacquinot, and Pisani (2010)). In the model, the euro area is a monetary union with two different blocs: the home block and the rest of the euro area (REA) bloc. The model has two other blocs: the United States (US) and the Rest of the World (RW).

Each bloc comprises a continuum of households, firms and a monetary and fiscal authority. Each household h is infinitely lived, and gains utility from consuming a final good (assuming external habit persistence in consumption) and disutility from working, according to the following lifetime utility function:

$$E_t \left[\sum_{k=0}^{\infty} \beta^k \left(\epsilon_{t+k}^C \frac{1-\kappa}{1-\sigma} \left(\frac{C_{t+k}(h) - \kappa C_{H,t+k-1}}{1-\kappa} \right)^{1-\sigma} - \frac{1}{1+\zeta} N_{t+k}(h)^{1+\zeta} \right) \right] \tag{1}$$

where β $(0 < \beta < 1)$ is the discount factor, σ $(\sigma > 0)$ denotes the inverse of the intertemporal elasticity of substitution and ζ $(\zeta > 0)$ is the inverse of the elasticity of work effort with respect to the real wage (Frisch elasticity). The parameter κ $(0 \leq \kappa \leq 1)$ measures the degree of external habit formation in consumption. Finally ϵ_t^C is a consumption preference shock.

Households decide how to allocate their time between work and leisure. Households supply differentiated labour to all domestic firms in a monopolistic manner, thus exerting limited bargaining power and charging markups over the marginal rate of substitution between labour and consumption. So they supply a lower amount of labour than under perfect competition. We assume wages are sticky *à la* Calvo (1983) with indexation. Households own the domestic capital stock, which they rent to domestic firms that they also own. The market for capital is competitive, and capital accumulation is subject to standard investment adjustment costs. Labour and physical capital are immobile internationally. Households buy and sell two bonds, one issued domestically in domestic currency and the other is an international bond issued in zero net supply worldwide. Following Benigno (2009), when households sell or purchase the international bond they pay a premium to financial intermediaries. The size of this premium is a function of the aggregate net asset position of the country and therefore can be seen as reflecting the cost of intermediation. This intermediation cost guarantees that the net foreign

assets are stationary. In the case of the monetary union, we assume there is a bond denominated in the common currency which is traded across the countries member of the union. Again this bond incorporates an intermediation cost with the purpose of guaranteeing the stationarity of the model.[2]

In what regards the production side, there are firms producing final goods and a continuum of differentiated intermediate goods. In each bloc there are three final goods produced in a perfectly competitive market: a consumption good, an investment good and a public good. Consumption and investment final goods are produced using all available intermediate goods as inputs to a Constant Elasticity of Substitution (CES) technology and allowing for home bias, whereas the public good is a composite of only non-tradable intermediate goods. In each bloc, there are many varieties of intermediate goods, each produced by a single firm under monopolistic competition. The market power implies that firms set nominal prices by charging a markup over marginal costs and produce an amount of goods which is lower than in the case of perfect competition. Each intermediate good is produced by using domestic labour and domestic capital, combined with a Cobb-Douglas technology. Prices are sticky *à la* Calvo (1983), with indexation (following Christiano, Eichenbaum, and Evans (2005) and Smets and Wouters (2003)). Intermediate goods are either non-traded or traded internationally. Final goods are produced with non-traded intermediate goods, domestic traded goods and imported traded goods. Imports are subject to short-term adjustment costs that temporarily lower the response of demand to changes in relative prices. There is international price discrimination since firms set prices in the currency of the importing country.

The government purchases the public good and finances its expenditures with public debt and taxes on the domestic private sector. There are *lump-sum* and distortionary taxes, levied on the price of consumption, the rental rate of capital, wages and dividends. Standard fiscal rules that target the level of public debt ensure fiscal stability in each bloc. The monetary authority

[2]Note that there is no sovereign default risk in the model and so the debt of all countries is (and is perceived by the markets) as default free.

sets the national short-term nominal interest rate by means of a Taylor-type interest rate rule (Taylor (1993)). The nominal interest rate is set as a function of the year-on-year consumer price inflation deviation from its steady-state value as well as the quarterly output growth, as follows:

$$\left(R_t^4 - \bar{R}^4\right) = \rho_R \left(R_{t-1}^4 - \bar{R}^4\right) + (1-\rho_R)\,\rho_\pi\left(\pi_{4,t} - \bar{\pi}_4\right) + \rho_y \left(\frac{gdp_t}{gdp_{t-1}} - 1\right) \tag{2}$$

where R is the (quarterly) nominal interest rate, $\bar{R}$ its steady-state value, π_4 is the year-on-year consumer price inflation rate, $\bar{\pi}_4$ is the central bank inflation target (assumed to be constant), gdp is the gross domestic product. To capture inertia in the conduct of monetary policy, we assume that the current period policy rate reacts to its one period-lagged value. In the case of the euro area, the central bank sets the interest rate for the whole area on the basis of area-wide indicators, i.e. euro area-wide inflation and gross domestic product. We also impose that nominal interest rates are bounded from below at zero, i.e.

$$R_t \geq 0 \tag{3}$$

Degree of competition Given that the purpose of our analysis is the study of the macroeconomic impact of competition enhancing reforms in the labour and goods markets, the monopolistic competition framework is of crucial importance and as such we describe it in more detail in what follows, starting with the labour market setup. Each household offers a specific kind of labour services that is an imperfect substitute for services offered by other households and set its wage to maximize lifetime utility (1). In steady state, the first order condition for labour supply, N, is:

$$\frac{W}{P^C} = \frac{\eta}{\eta-1}\lambda^{-1}N^{\zeta}, \eta > 1 \tag{4}$$

where W/P^C is the real wage (expressed in units of domestic consumption), λ is the marginal utility of consumption and η is the elasticity of substitution between labour varieties. The markup is $\eta/\left(\eta-1\right)$. Thus, the higher the elasticity of substitution between labour varieties the

lower the markup and the higher employment in terms of hours, for a given wage. As such, the markup reflects imperfect competition in the labour market.

In the intermediate goods market, imperfect competition is introduced in a similar way. There is a large number of firms offering a continuum of different products that are imperfect substitutes. Each product is made by one monopolistic firm, which sets prices to maximize profits. The elasticity of substitution between products of different firms determines the market power of each firm. In steady state, in each sector (tradables and services sectors) the first order condition for price setting is:

$$\frac{P^Y}{P^C} = \frac{\theta}{\theta - 1}\frac{MC}{P^C}, \theta > 1 \tag{5}$$

where P^Y/P^C is the relative price of the generic intermediate good Y and MC/P^C is the real marginal cost of producing Y. The markup is $\theta/(\theta - 1)$. The higher the elasticity of substitution θ, the lower the implied markup and the higher the production level, for a given price. Thus, the markup reflects imperfect competition.

Summing up, in EAGLE markups are modeled by a single parameter in each national market (labour, tradable intermediate good, nontradable intermediate good), as in other similar models based on the monopolistic competition framework. We thus simulate the impact of structural reforms by permanently modifying the elasticity parameters, and consequently the degree of competition in the considered market. The higher the elasticity of substitution between varieties, the lower the markup and the closer the market is to perfect competition.

Calibration The euro area is split in a small and a large bloc. The small bloc weights around 10 per cent of the euro area and broadly features represents a small country or group of countries of the euro area periphery. As mentioned before, the model has two other blocs, the US and the RW. The steady-state ratios have been set to match actual national accounts data and the key behavioural parameters have been chosen using information in the literature, some of which are invariant across countries while others have been modified to match country-specific information,

such as the steady-state ratios of nominal domestic demand components to GDP. See Tables 1 and 2. The bias towards domestic tradable goods and the weight of non-traded goods in the consumption and investment baskets are set to match the shares of imported and services goods in the considered economy, given the values of the intratemporal and intertemporal elasticities of substitution. Nominal and real rigidities allow to produce realistic dynamic adjustment patterns. See table 3. Regarding monetary policy, an identical calibration of the Taylor rules in all the blocs is assumed, and for all blocs, the inflation target is set at 2 per cent. See Table 4. Given the severity of the recession that hits the global economy, we assume a fast response of policy to the developments in the economy. This means that, following Gomes, Jacquinot, Mestre, and Sousa (2010), we set the lagged interest rate parameter in the Taylor rules to zero. This leads to a faster reduction in interest rates and an earlier onset of the ZLB condition.[3] The steady-state real interest rate was set at 1% p.a., in line with the average real rate over the period 1999 to 2009.[4] Regarding the calibration of the fiscal policy rule, the parameter measuring the reaction of taxes to public debt is set to achieve debt sustainability and hence model stability.

As for the calibration of (initial) steady-state markups, we assume that markups in the euro-area services and labour markets are higher than the corresponding values in the US and the RW. In each region, the markup in the non-tradable sector is higher than that in the labour market. For the euro area, the labour market markup is higher than the markup in the manufacturing sector. In other words, in the euro area the degree of competition is particularly low in the services sector. See Table 5. Our calibration is broadly in line with similar studies, such as Bayoumi, Faruqee, Laxton, Karam, Rebucci, Lee, Hunt, and Tchakarov (2004), Faruqee, Laxton, Muir, and Pesenti (2007) and Everaert and Schule (2008), that mostly rely on estimates by Jean and Nicoletti (2002) and Martins, Scarpetta, and Pilat (1996) and Oliveira Martins and Scarpetta (1999).

[3]This is a technical device to help activate more easily the ZLB constraint, not an actual policy recommendation.

[4]It would be even lower if we take the more recent period.

3 The impact of structural reforms in crisis times

In this section we describe how we lead the world economy into the ZLB and then we analyze the impact of structural reforms in the labour and services (proxied by non-tradable goods) markets.

As explained in more detail in the previous section, we simulate the impact of competition enhancing structural reforms by permanently modifying the elasticity parameters in the markets under consideration, which are inversely related to the degree of substitutability across product and labour varieties, and hence the underlying level of competition. Thus, the higher the elasticity of substitution between varieties, the lower the markup and the closer that market is to perfect competition.

We assume that the structural reforms are implemented gradually over a period of five years. The simulations are run under perfect foresight, thus eliminating any uncertainty about the credibility of the reforms. We first analyse a scenario where the reforms are implemented unilaterally by the smaller euro area bloc and then we show the euro area-wide coordinated case.

3.1 The recession

As a first step in the analysis we have to generate a situation where the ZLB restriction is binding. To do so we follow Gomes, Jacquinot, Mestre, and Sousa (2010) and induce a recession that drives the model into the ZLB constraint, by hitting the world economy with a sequence of unexpected demand shocks.[5] In particular, consumption and investment in all blocs of the model are shocked for 6 consecutive periods, through an intratemporal preference shock and a shock to the Tobin's Q equation in each period. The shocks amount to roughly 4% of consumption and 0.2% of Tobin's Q *ex-ante* (in each period). Note that the agents are unaware of future shocks, but once a shock hits the economy then agents correctly anticipate the results of each shock. These shocks drive the interest rate in all the blocks to the ZLB for around 2 years. The euro area undergoes a deep recession, with GDP falling by close to 7 per cent 2 years after the first

[5]For simplicity we assume that the lower bound on interest rates is zero, even though it may differ slightly from that level, see for example McCallum (2000) and Yates (2004).

shock hits, while inflation falls by around 1.8 percentage points.

3.2 The structural reforms

In this section we first present the results of labour and services market reforms in a small bloc of the euro area. In both cases, we simulate the impact of a reduction of markups of roughly 15 p.p. in the small euro area bloc (henceforward Home bloc), gradually implemented over a period of five years starting from the fourth period of the crisis. Then we show the euro area wide coordinated case.

3.2.1 Small euro area bloc

Figure 3 shows the impact of a permanent decrease of the markup over wages of around 15 p.p. in the Home bloc on domestic GDP, consumption, investment and inflation rate. This reduction in the wage markup takes it to the level in the U.S. bloc. Compared to the no-reform scenario, this reform implies a considerably less marked contraction of GDP in the reforming bloc over the short and medium-run. The trough in GDP goes from a fall slightly larger than 6 per cent two years into the recession in the no-reform scenario to a 3.7 per cent drop after one year and a half from the start of the simulation. Both consumption and investment show a smaller contraction that in the no-reform case. On the one hand, consumption benefits from higher labour income associated with increased hours worked.[6] On the other hand, as the reform is implemented over a period of roughly 5 years, firms anticipate cheaper labour input and adjust accordingly the capital stock, thus stimulating investment. The labour market reform implies also a larger fall of inflation, as the reform implies a reduction in the marginal costs in both the tradable and non-tradable sector.

Figure 4 shows the impact of a similar reduction in the services price markup. This reform is not successful in alleviating the recession in the first year of implementation of the reform. In fact, in the first year after the start of the reform (the reform starts to be implemented in

[6] The reform makes the labour input cheaper, so hours worked increase smoothly. Real wages fall, but less strongly.

the fourth quarter of the simulation), the impact of this reform on Home bloc's GDP is very small. Over this period, consumption, investment and imports (not shown) present more marked contractions than in the no-reform scenario.[7] After two years, GDP shows a faster increase to a higher steady-state level, given a faster increase of investment and, to a lesser extent, also of consumption. As for inflation, the reform in the services sector makes non-tradables goods cheaper and, given their large weight on the consumption basket, inflation in the short-to-medium run shows a much more pronounced fall than in the no-reform case.

The reforms simulated could potentially help to alleviate the zero lower bound constraint, as in the short to medium run they lessen the severity of the recession. However, this effect is partially offset by a larger fall of inflation. In addition, the reform is implemented unilaterally in a small bloc of the euro area while the euro area interest rate is set taking into account area wide variables. Thus, macroeconomic developments in the reforming bloc has a limited impact on the euro area monetary policy stance. In fact, neither of the reforms simulated alleviates the ZLB constraint in the euro area. The boost to the Home bloc's GDP together with limited spillovers to the rest of the euro area do not imply a strong enough increase in euro area GDP to take the policy rate away from the ZLB. [8]

3.2.2 Coordinated case

In the previous section we saw that unilateral reforms do not help to alleviate the ZLB constraint in the euro area. We now analyse the impact of the same type of reforms reforms when they are implemented in a coordinated fashion in the euro area. Figures 5 and 6 show the impact of the coordinated labour and services markets reforms, respectively, on euro area variables. Both reforms have a positive impact on euro area GDP, that is more significant in the case of wage reform. But the impact on inflation is very different between the two types of reforms.

[7]As the reform is implemented gradually, households anticipate that services will be cheaper in the future, when their supply will be higher and thus, given the high services content od the consumption basket, households postpone consumption to future periods, when it will be cheaper.

[8]For an analysis of the spillovers of this type of reforms in the euro area see Gomes, Jacquinot, Mohr, and Pisani (2013).

While the wage reform leads to a reduction of markups in the tradable and non-tradable sector that translates into a sharper drop in euro area consumer prices, the services market reform makes non-tradable goods cheaper relative to tradable goods. The reform in the services sector pushes downwards non-tradable price inflation (after an increase in the first period) but upwards tradable-goods price inflation (produced in the two euro area blocs) and import prices (of the two blocs) amid a large real effective exchange rate depreciation. Thus, while the wage reform accentuates the fall of euro area inflation, via a decline in firm's marginal costs, in the case of the services reform there is a smaller decrease of consumer price inflation, also in contrast to what happens in the case of a unilateral services market reform. [9] This different behaviour in inflation translates into a higher interest rate in the euro area in the case of the services market reform and thus the euro area economy escapes the ZLB. In contrast, the labour market reform does not reduce the time spent at the lower bound.

4 The design of the structural reforms

In the previous section we analysed wether a permanent increase in competition can in the short run stimulate an economy that is a deep recession that led policy rates to the lower bound. We assumed that the reforms are implemented gradually starting from the fourth period of the simulation, that they are permanent and agents know this with certainty and that, at the start of implementation, the reforms were unanticipated by the agents. In this section we analyse the impact of changing the design of the reforms.

4.1 Gradual versus one-off reforms

Up to now we assumed that the reforms are implemented gradually over a period of roughly five years.[10] In this subsection we analyse the impact of assuming instead a one-off reform. This

[9] Note that in the case of a unilateral services market reform is unilateral, the real effective exchange rate depreciation of the reforming bloc is much lower and import prices increase by less and thus consumer price inflation tracks more closely the decline in services price inflation.

[10] I.e., after five years the markups have basically reached their new steady-state level.

means that each reform is implemented in full in the fourth period of the simulations (markups thus jump to their new steady-state level) and this is unanticipated by the agents. Figures 7 and 8 report the results of a permanent one-off reduction of markups in each the two sectors by 15 p.p. as well as of the gradual reforms. We focus on the coordinated case.

Regarding the euro area nominal interest rate, the impact of changing the design of the structural reforms has considerably different impact across the two types of reforms. The one-off labour market reform reduces the time spent at the ZLB compared to the no-reform and the permanent reform cases. As for the services market reform, the one-off reform leaves the period spent at the ZLB unchanged compared to the no-reform scenario, whereas the gradual reform led the economy out of the ZLB. This very different impact in terms of the monetary policy response to the reform relates to the behaviour of inflation. In fact, the one-off reform leads to higher consumer price inflation in the case of the wage reform but to a more marked drop of inflation in the services market reform. This is due to a much sharper drop of the non-tradable good inflation in the case of the services market reform, as the fall in prices is front-loaded since the reform is no longer gradual. The milder drop in GDP growth in the case of the services market reform (compared to the gradual reform) also pushes interest rates higher and thus contributes to a shorter ZLB period in this case.

In terms of the macroeconomic performance of the euro area, the one-off services market reform is the most successful in terms of lessening the recession, as consumption (and exports, not shown in the figure) falls by less and investment increases faster. However it is the wage reform (both gradual and one-off) that results in a smaller contraction of consumption.

4.2 Permanent versus temporary reforms

In the previous sections we assumed that the increase in competition in the labour and services markets is permanent and that agents know this with certainty. However, it is reasonable to think that the reduction in markups may be temporary or, even if announced as permanent, agents perceive them as temporary (in our deterministic framework, this will be the actually

outcome). In this subsection we simulate a temporary reform, in particular a 15 p.p. reduction of markups in each sector, that is not anticipated and is implemented in the fourth quarter of the simulation but then this reduction in markups is gradually reversed. Three years from the start the reforms are almost completely undone.

Figures 7 and 8 also present the results of the temporary reforms in the labour market and services market, respectively. Contrary to the permanent case, the temporary reforms are not successful in offsetting the economic recession. The impact on inflation is different across reforms compared to the permanent reform implemented gradually, as the labour market reform implies a smaller fall of inflation while the services market reform deepens it. Consequently, a temporary labour market reform reduces the time the economy is trapped at the ZLB by two quarters compared to the no-reform scenario, while the permanent reform actually increased the ZLB period by one quarter. In contrast, the services reform no longer makes the economy escape the ZLB as was the case with the permanent reform. In fact, the temporary reform lengthens the period the economy is at the ZLB by two quarters compared with the no-reform scenario (anticipates the ZLB by one quarter and then delays leaving by one quarter also).

Looking more carefully into the macroeconomic implications of temporary reforms, as mentioned above the impact of temporary reforms in terms of euro area GDP is muted. Consumption is basically unchanged compared to the no-reform case. On the one hand, given that reforms are temporary consumers do not benefit from the wealth effect a permanent reform (that increases real income in steady state in both cases) that boosts consumption in the short to medium run. On the other hand, consumers also do not adjust much consumption because they like to smooth consumption and the transitory reform is relatively short-lived.[11] In both type of reforms, the temporary reforms deepen the fall in investment. The impact in terms of inflation is very different in each sector. While a temporary wage reform has an upward impact on inflation, a temporary services market reform implies a much bigger fall of consumer prices than the no-reform

[11]In the case of a permanent reform in the services sector, consumption was pushed down while the reform is being implemented as consumers anticipate cheaper services, a large part of the consumption basket, in the future.

case. Note that temporarily higher competition in the services market translates into a short run decline in services prices that is concentrated in the period of the reform and consequently translates into consumer prices.

5 Cyclical conditions, the ZLB and the macroeconomic impact of structural reforms

In this section we analyse wether the impact of the reforms depends on the cyclical position of the economy at the time of implementation (i.e. the fact that reforms are implemented when the economy is in a severe recession as opposed to the steady state) and on the fact that the lower bound on nominal interest rates is binding at the time of implementation.[12]

We compare the impact of each reform in three cases: (i) starting from the steady state, (ii) after inducing a recession (as described in section 3.1) but allowing the interest rate to take negative values (i.e. positing a unconstrained policy rule) and iii) after inducing a recession and imposing the ZLB on nominal interest rates (i.e. the same scenario as in section 3.2.2). As we want to isolate the impact of each reform under different circumstances, in each case we compute the deviation of each variable from a specific baseline that is different across simulations. In particular, the baseline is the response to a simulation where we exclude the reform. Thus the baseline is: for case (i) the steady state, for case (ii) a recession with an unconstrained policy rule and for case (iii) a recession with a constrained policy rule. Comparing simulations (i) and (ii) we can assess the importance of initial conditions while comparing (ii) with (iii) gives us the impact of the imposed ZLB non-linearity.

Figures 9 to 12 show the results of alternative scenarios regarding euro area services and labour market reforms (a 15 p.p. reduction in markups), first permanent and then temporary.

The impact of initial conditions is very small both in the case of permanent reforms and in the case of transitory reforms. Indeed, the responses of the variables considered almost overlap

[12]Note that in a linear model the starting conditions are irrelevant, whereas in EAGLE, as it is a non-linear model, a change in initial conditions could impact the results.

in cases (i) and (ii). As for the impact of imposing the ZLB restriction, while the response of the variables considered is very similar in the case of permanent reforms, significant changes arise in the case of transitory reforms. Notice that this restriction will be important to the extent that the central bank would want to change interest rates but it is constrained by the fact that they cannot go below zero. This will impact the results if the reform would imply a cut in interest rates that is not possible because the interest rate is at the ZLB (due to the recession shock) but also in the case a reform would imply an increase in interest rates, as the increase from the ZLB (i.e. starting from zero) will be smaller than in the case of an unconstrained policy rule. When the reform is permanent, imposing the ZLB does not imply an important difference in the interest rate behaviour (the maximum difference is around 0.5 p.p.) and as such this constraint does not impact much the results. In contrast, transitory reforms imply a significantly different nominal interest rate path, in particular in the case of a services reform. In fact, in this case the reform would imply the need for a significant cut of the interest rate that is not possible due to the ZLB constraint. As a result of the lack of policy accommodation, the services reform implies a smaller expansion of GDP as consumption and, especially investment, contract.

6 Concluding remarks

This paper analyses the effectiveness of structural reforms in stimulating an economy that is in a deep recession that led interest rates to the ZLB. We focus on the euro area. While the long-run impact of an increase in competition in the labour and services markets is positive, the extent to which these type of structural reforms can stimulate an economy in the short run and at the same time help to leave the ZLB is an empirical issue that should be analyse within a structural model. Thus, we take a large scale model of the euro area that is suited to analyse the type of questions we study. First, by using a multi-sector model allows us to focus on reforms in the services market and on the labour market, that usually present lower degrees of competition, namely compared to the manufacturing sector. Second, using a model where the euro area is

a two-bloc monetary union allows us to analyse the issue of coordination of reforms within the euro area.

We find that structural reforms are successful in alleviating the impact of a recession but coordination is needed to achieve a reduction of the time spent at the ZLB. We also show that the short to medium run impact of structural reforms is crucially dependent on the design of such reforms, namely if the reforms are implemented gradually or not and if the reforms are announced (or perceived) as temporary or permanent. Finally, we find that the short to medium run impact of the reforms is only significantly affected by the ZLB constraint in the case of transitory reforms.

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Table 1: Steady-State National Accounts (percentage of GDP)

	Home	REA	US	RW
Private consumption	54.7	60.0	64.0	64.0
Private investment	24.0	20.0	20.0	20.0
Public expenditure	21.3	20.0	16.0	16.0
Imports	28.7	12.2	8.7	8.1
Public debt (% of yearly GDP)	60.0	60.0	60.0	60.0
Share of services sector	53.5	57.4	60.9	60.9
Share of world GDP	1.3	19.9	29.9	48.9

Notes: REA=Rest of euro area; US=United States; RW=Rest of the world.

Table 2: Households and Firms Behavior

	Home	REA	US	RW
Households				
Subjective discount factor	$1.01^{-0.25}$	$1.01^{-0.25}$	$1.01^{-0.25}$	$1.01^{-0.25}$
Depreciation rate	0.025	0.025	0.025	0.025
Intertemporal elast. of substitution	1.0	1.0	1.0	1.0
Habit persistence	0.75	0.75	0.75	0.75
Inverse of the Frisch elast. of labour	2.00	2.00	2.00	2.00
Tradable Intermediate Goods				
Cobb-Douglas bias toward capital	0.27	0.20	0.19	0.21
Nontradable Intermediate Goods				
Cobb-Douglas bias toward capital	0.32	0.35	0.30	0.30
Final consumption goods				
Substitution btw domestic and imp. goods	2.50	2.50	2.50	2.50
Bias toward domestic goods	0.19	0.77	0.82	0.82
Substitution btw tradables and nontrad.	0.50	0.50	0.50	0.50
Bias toward tradable goods	0.45	0.45	0.35	0.35
Final investment goods				
Substitution btw domestic and imp. goods	4.30	4.30	4.30	4.30
Bias toward domestic goods	0.07	0.73	0.84	0.62
Substitution btw tradables and nontr.	0.50	0.50	0.50	0.50
Bias toward tradable goods	0.75	0.75	0.75	0.75
Imports				
Substitution between consumption imports	2.50	2.50	2.50	2.50
Substitution between investment imports	4.30	4.30	4.30	4.30

Notes: REA=Rest of euro area; US=United States; RW=Rest of the world.

Table 3: Real and Nominal Rigidities

	Home	REA	US	RW
Real Rigidities				
Investment adjustment	6.00	6.00	4.00	4.00
Variable cap. utilisation	0.007	0.007	0.007	0.007
Import adjustment (consumption)	2.00	2.00	2.00	2.00
Import adjustment (investment)	1.00	1.00	1.00	1.00
Nominal Rigidities				
Households				
Wage stickiness	0.75	0.75	0.75	0.75
Wage indexation	0.75	0.75	0.75	0.75
Manufacturing				
Price stickiness (domestically produced goods)	0.92	0.92	0.75	0.75
Price indexation (domestically produced goods)	0.50	0.50	0.50	0.50
Price stickiness (imported goods)	0.25	0.75	0.75	0.75
Price indexation (imported goods)	0.50	0.50	0.50	0.50
Services				
Price stickiness	0.92	0.92	0.75	0.75
Price indexation	0.50	0.50	0.50	0.50

Notes: REA=Rest of euro area; US=United States; RW=Rest of the world.

Table 4: Monetary Policy

	EA	US	RW
Inflation target	1.02	1.02	1.02
Interest rate inertia	0.0	0.0	0.0
Inflation gap parameter	2.0	2.0	2.0
Output growth parameter	0.75	0.75	0.75

Notes: EA=Euro area; US=United States; RW=Rest of the world.

Table 5: Price and Wage Markups

	Home	REA	US	RW
Manufacturing (tradables) price markup	1.20	1.20	1.20	1.20
Services (nontradables) price markup	1.50	1.50	1.28	1.28
Wage markup	1.30	1.30	1.16	1.16

Notes: REA=Rest of euro area; US=United States; RW=Rest of the world.

Figure 1: Policy rates

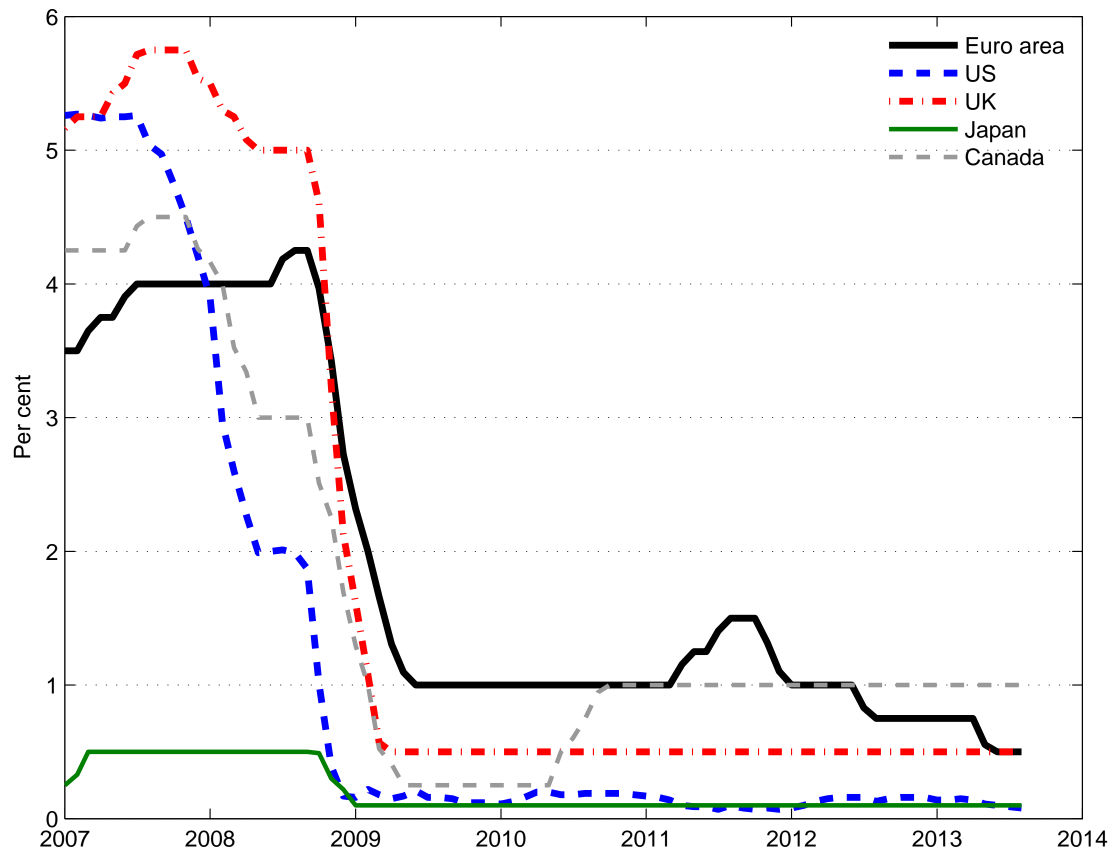


Figure 2: Euro area potential output growth

Source: European Commission AMECO database and author's calculations.
Note: Euro area with 17 countries. Before 1997, backdated with data for the euro area with 12 countries.

Figure 3: Labour market reform in a small euro area bloc

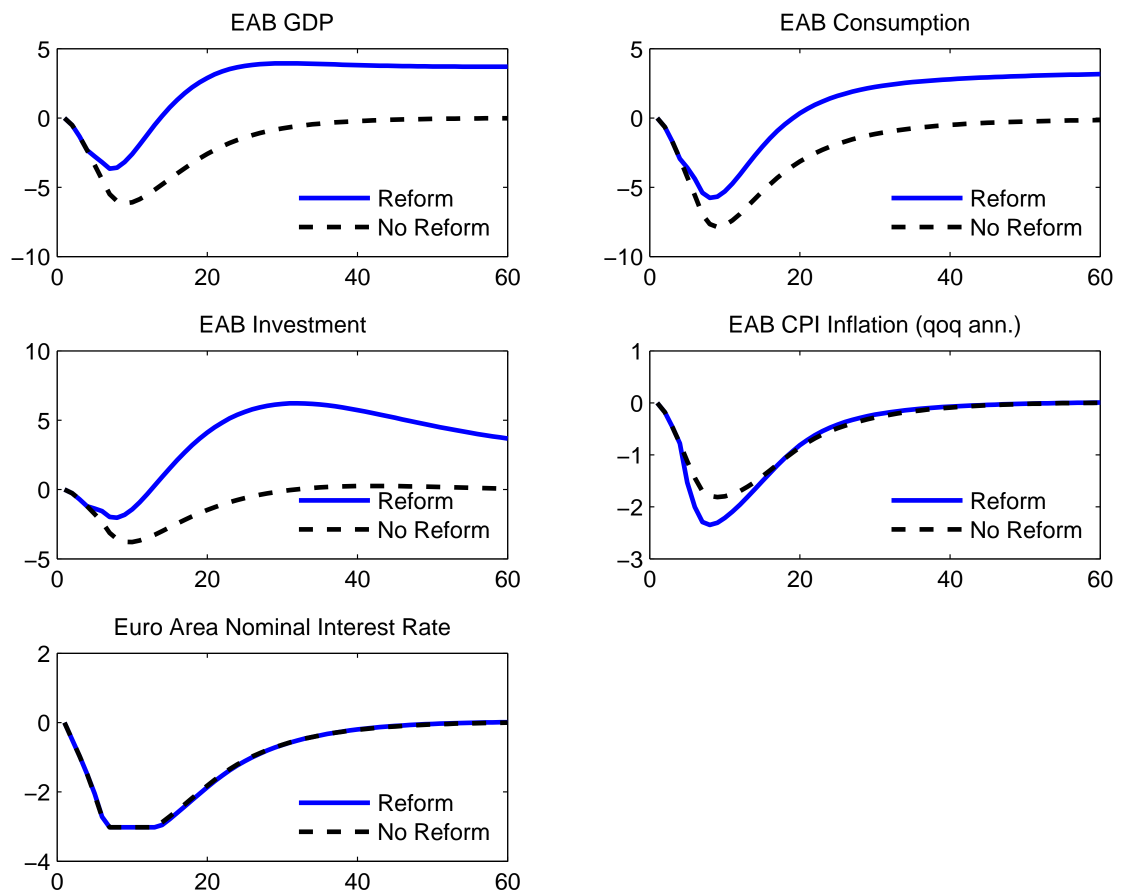


Figure 4: Non-tradable goods market reform in a small euro area bloc

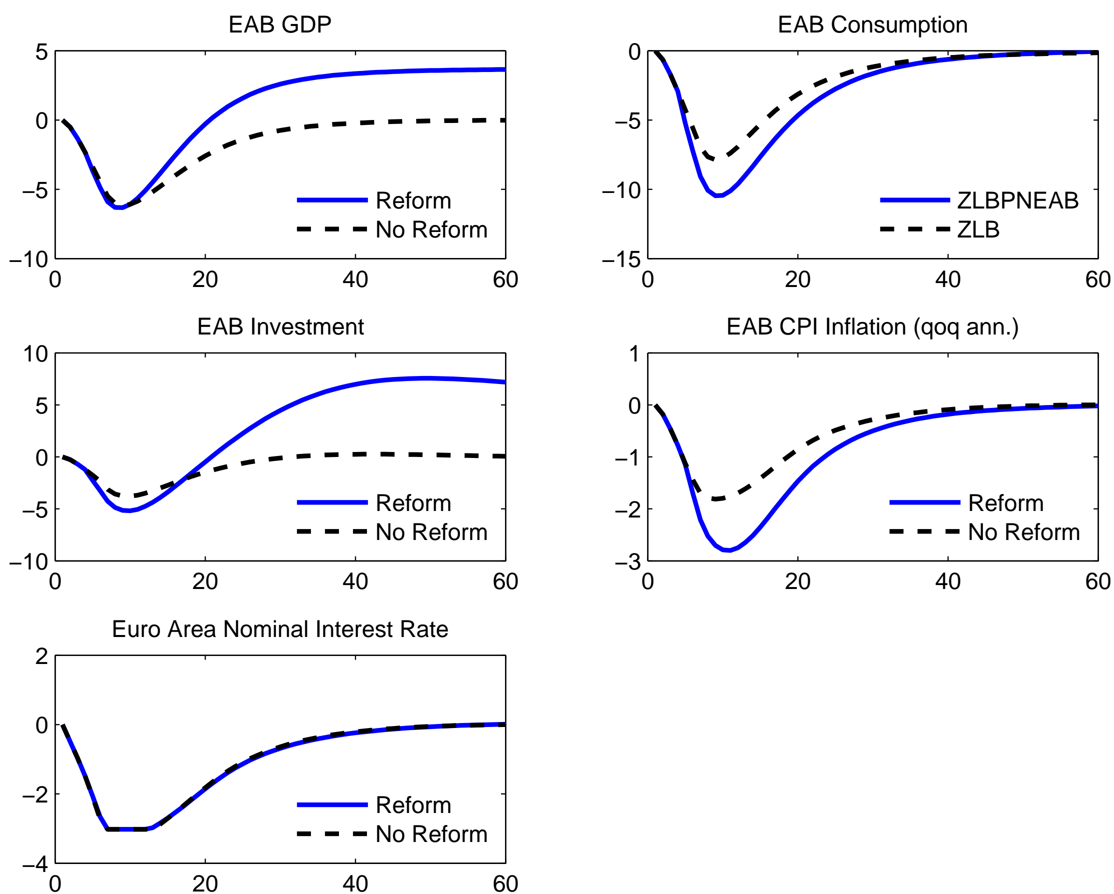


Figure 5: Euro area wide labour market reform

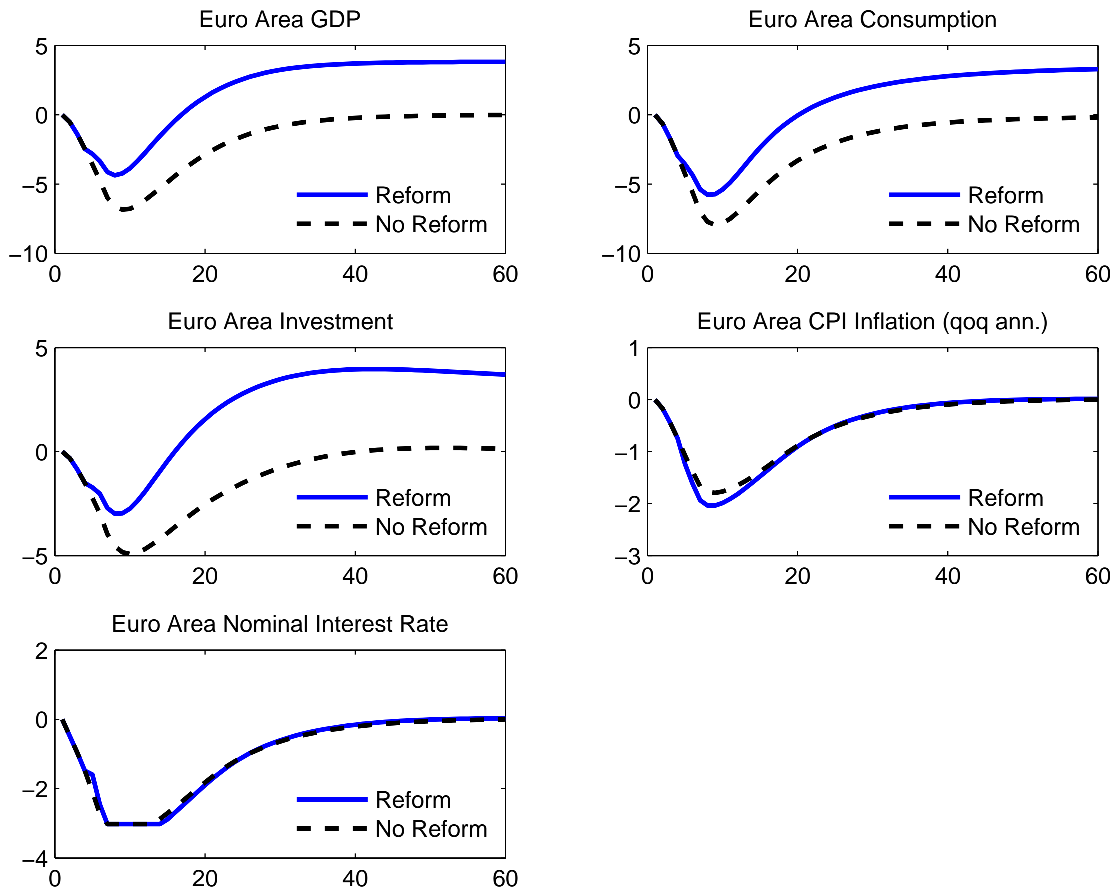


Figure 6: Euro area wide services market reform

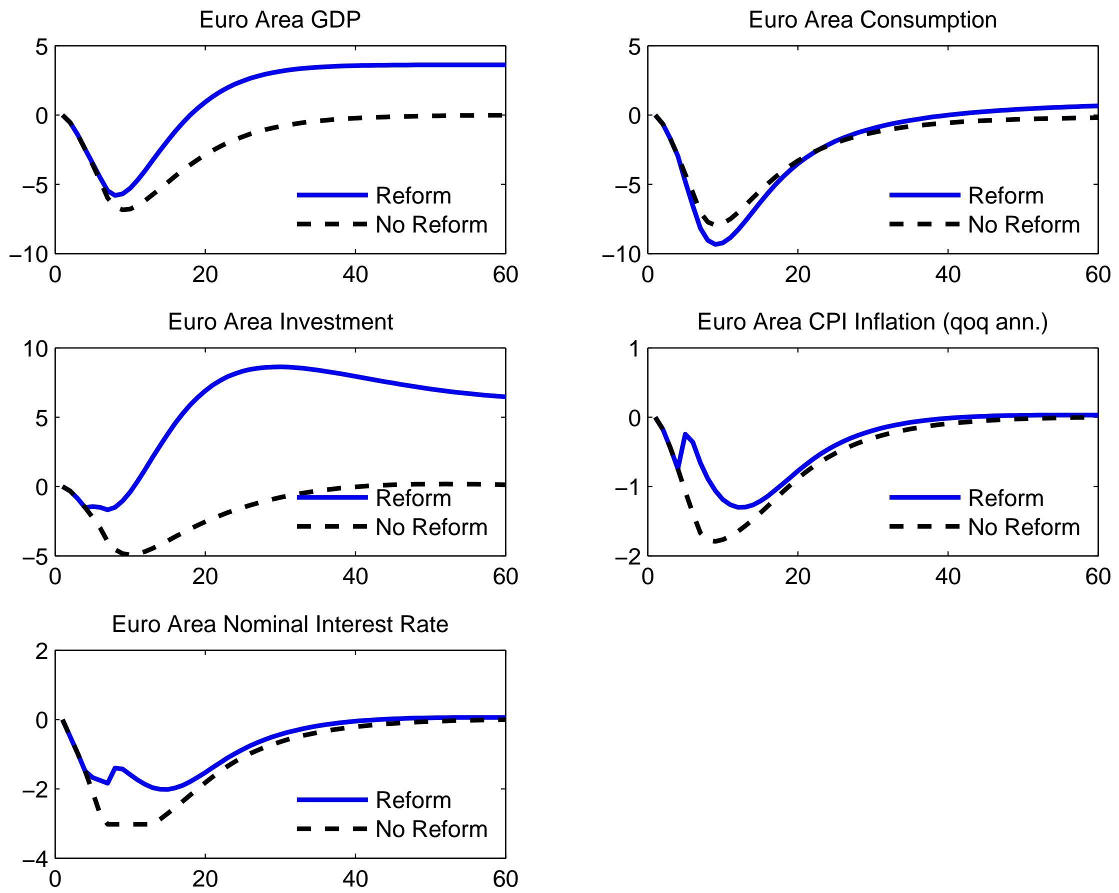


Figure 7: The design of the labour market reform

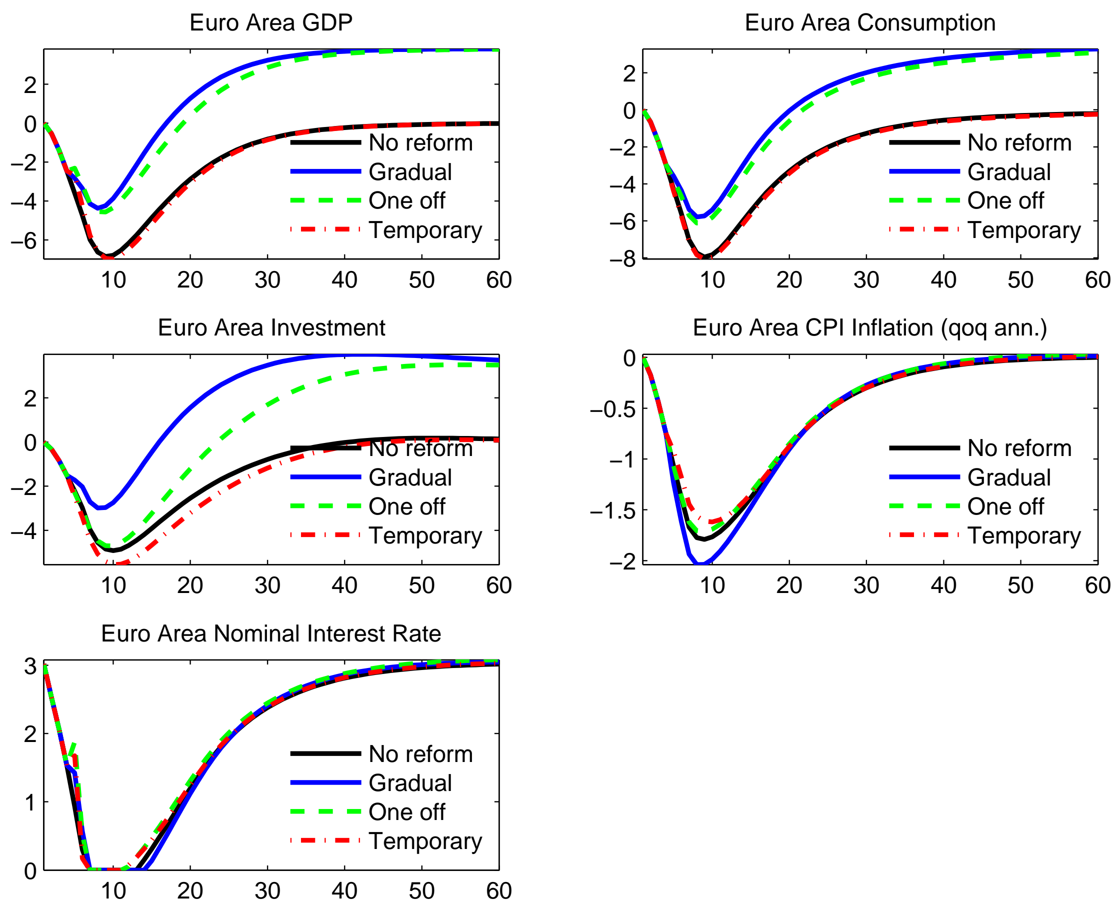


Figure 8: The design of the services market reform

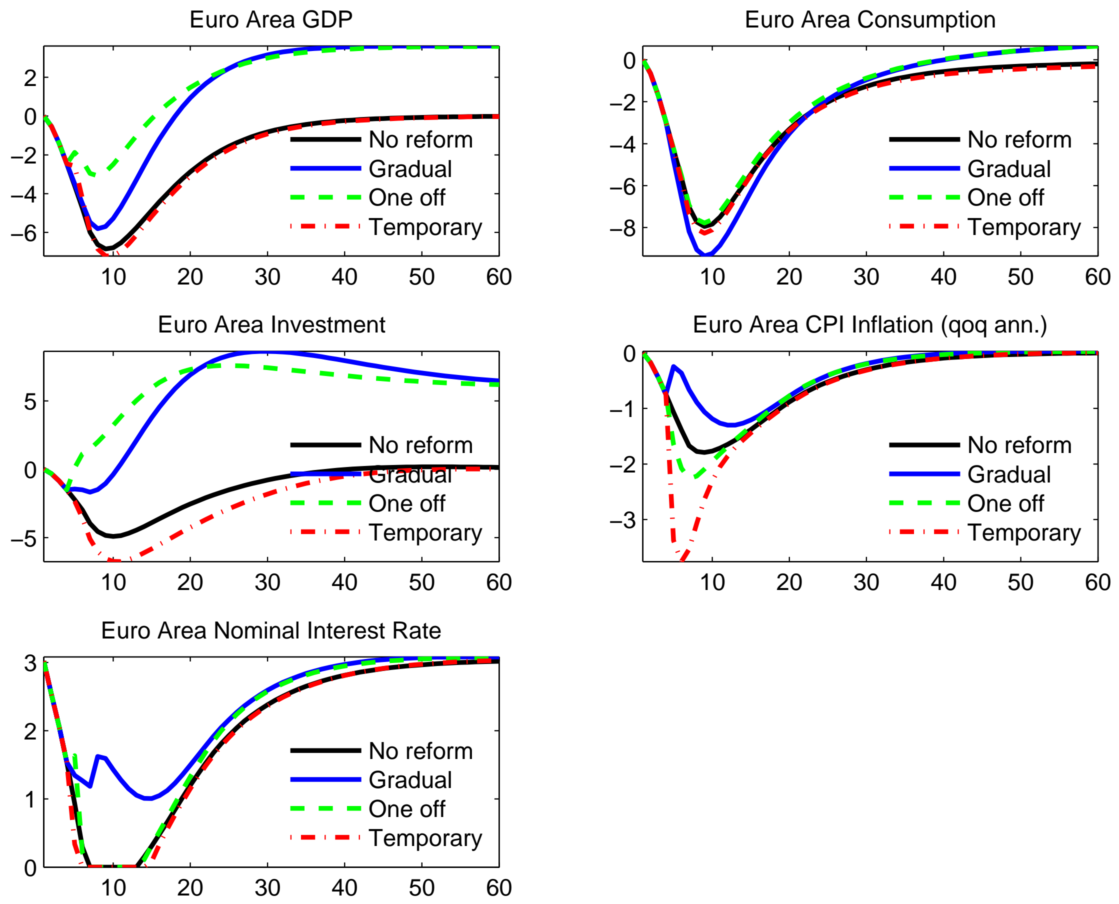


Figure 9: Permanent labour market reform impact: with and without recession, with and without ZLB

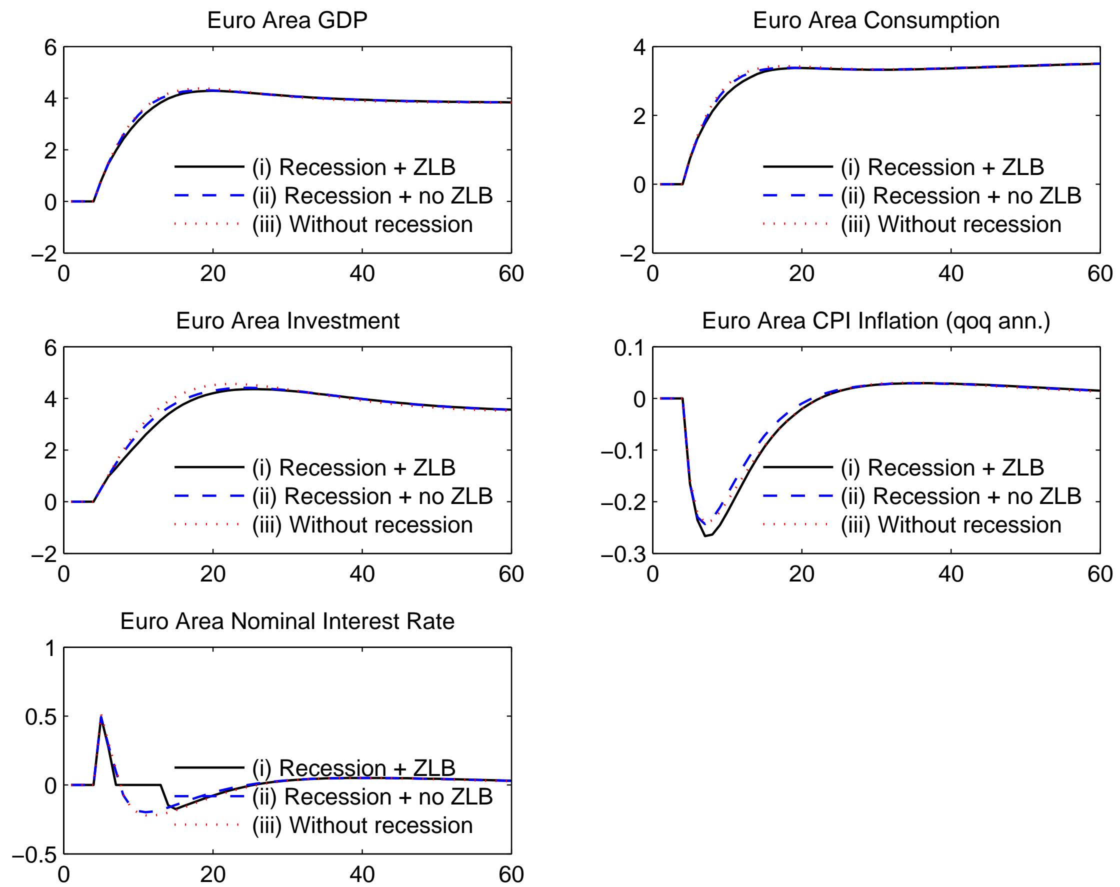


Figure 10: Permanent services market reform impact: with and without recession, with and without ZLB

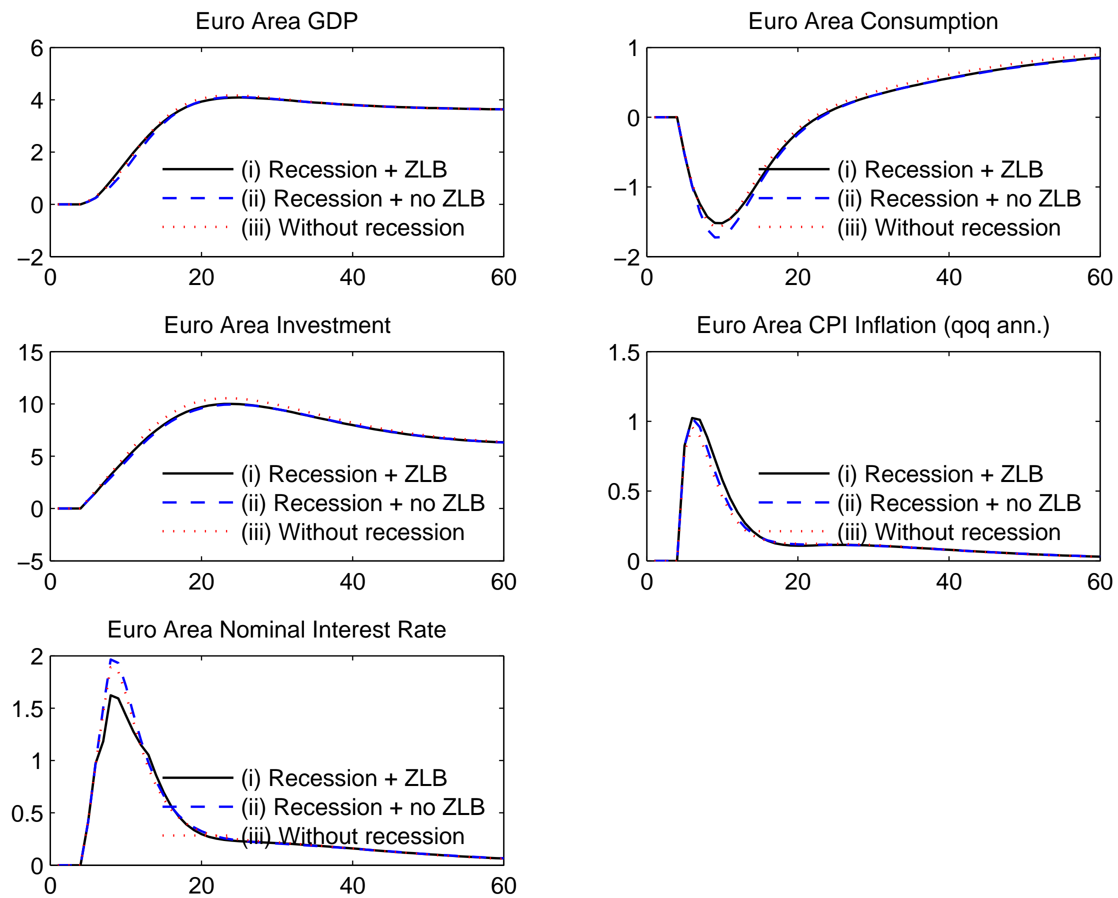


Figure 11: Transitory labour market reform impact: with and without recession, with and without ZLB

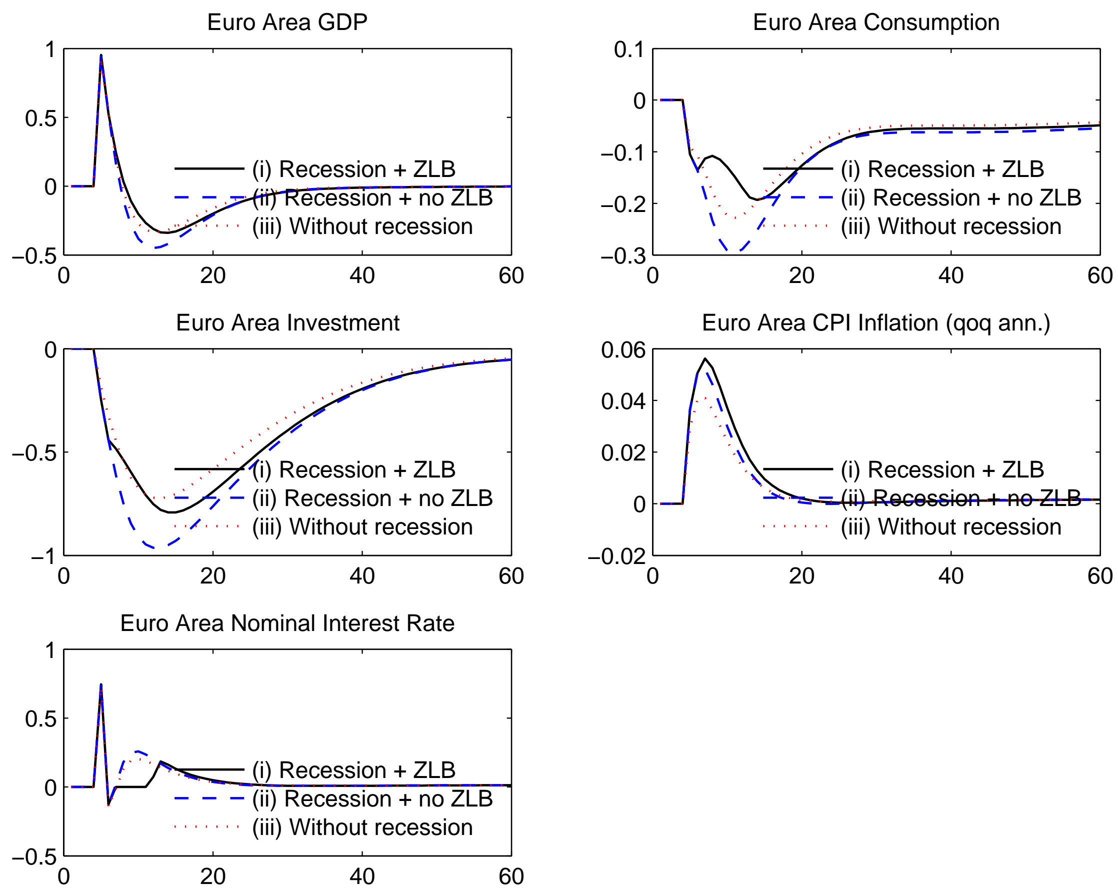
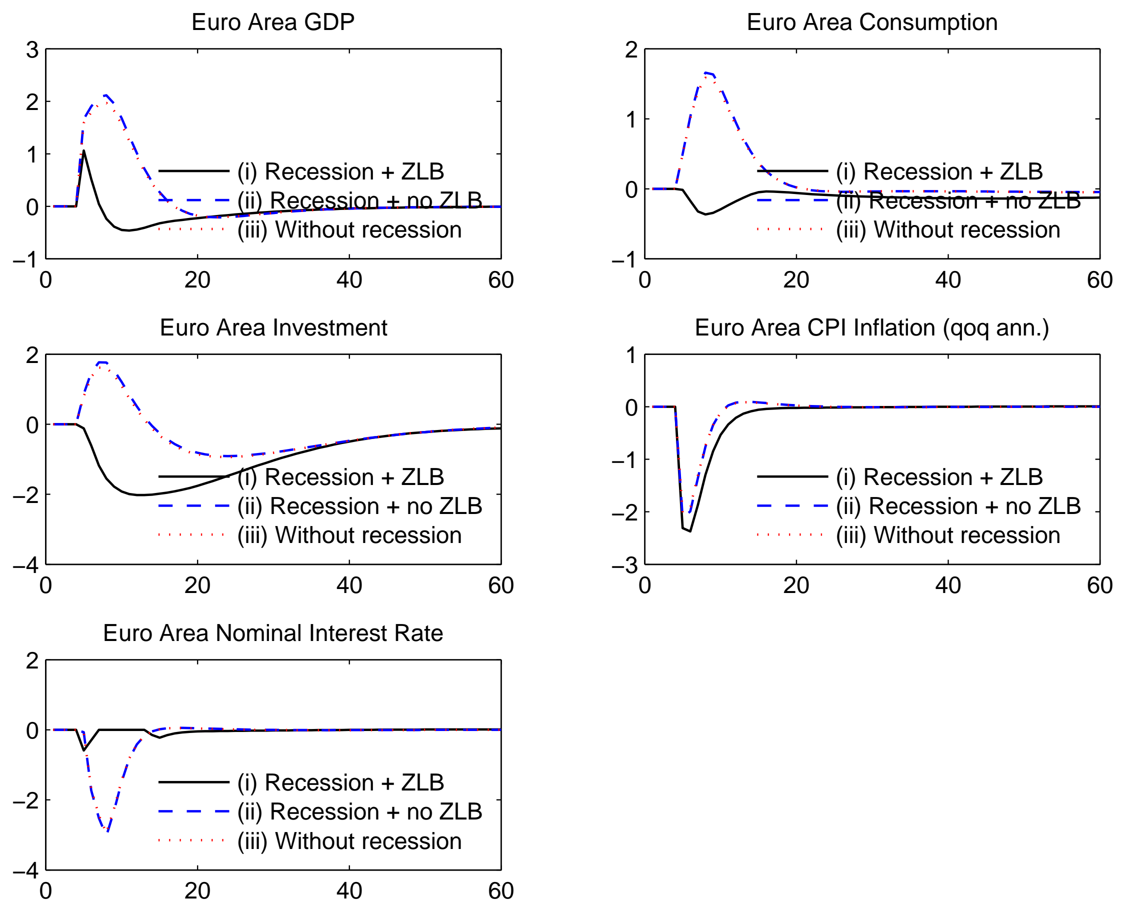


Figure 12: Transitory services market reform impact: with and without recession, with and without ZLB



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