Labor market reforms and current account imbalances - beggar-thy-neighbor policies in a currency union?

Timo Baas[1], Ansgar Belke[b]

[a]*Department of Economics, University of Duisburg-Essen, Universitätsstraße 2, D-45117 Essen, Germany*
[b]*Department of Economics, University of Duisburg-Essen, Universitätsstraße 2, D-45117 Essen, Germany and Institute for the Study of Labor (IZA), Schaumburg-Lippe-Strasse 5-9, D-53113 Bonn, Germany*

Abstract

Member countries of the European Monetary Union (EMU) have initiated wide-ranging labor market reforms in the last decade. This process is ongoing, as countries that are faced with serious labor market imbalances perceive reforms as the fastest way to restore competitiveness within a currency union. This fosters fears among observers about a beggar-thy-neighbor policy that leaves non-reforming countries with a loss in competitiveness and an increase in foreign debt. Using a two-country, two-sector search and matching DSGE model, we analyze the impact of labor market reforms on the transmission of macroeconomic shocks in both non-reforming and reforming countries. By analyzing the impact of reforms on foreign debt, we contribute to the debate on whether labor market reforms increase or reduce current account imbalances.

Keywords: Current account deficit, labor market reforms, DSGE models, search and matching labor market
JEL Classifications: E24, E32, F41, J64

*Corresponding author

1. Introduction

During the first decade after the creation of the European Monetary Union (EMU), a number of member states initiated wide-ranging labor market reforms. These reforms tend to have stabilized output and employment during the economic and financial crises. For this reason, countries that are faced with serious labor market imbalances[1], perceive reforms as the fastest way to restore competitiveness. Some observers, nevertheless, see labor market reforms embodying a beggar-thy-neighbor policy[2], leaving non-reforming countries with reduced competitiveness and increasing foreign debt which exacerbates macroeconomic imbalances within the currency union. Using a two-country, two-sector DSGE model with search and matching frictions, we derive the impact of labor market reforms not only on steady-state output, employment and average real wages but also on the transmission of macroeconomic shocks and the appearance of foreign debt in non-reforming countries. This should contribute to the debate on whether labor market reforms do indeed embody a beggar-thy-neighbor policy or rather add to macroeconomic stability within the union.

Reforming labor markets in countries that today are members of the Eurozone has a long tradition. In the 1980s and 1990s unemployment was high and persistent and, unlike the United States, growth did not contribute to a rise in employment (Salvatore, 1998). Thus, labor market institutions were perceived as part of the problem rather than the solution (Blanchard and Wolfers, 2000). In a nutshell, Nickell and Layard (1999) list six institutions that differ between the United States and European union countries ranging from taxation to barriers of geographic mobility. In the past three decades, these institutions underwent major transitions. Taxes on labor were reduced, employment rights modified, the benefits system as well as the education system reorganized, minimum wages introduced or abolished and barriers to geographical mobility lifted. Discussing all of these reforms is far beyond the scope of this paper, so that we concentrate on labor market institutions in a narrower sense, namely institutions related to benefit provision, placement as well as institutions related to laws and regulations of employee rights [3]. Since the 1990s, these institutions are addressed by reform proposals attempting to reduce European unemployment. The benefit system is criticized of being subject to massive moral hazard (Layard, Nickell, and Jackman, 1994) and in playing a significant positive role for unemployment Phelps (1994).

[1] The labor market imbalance debate sees an increase in competition with China and India as the main reason for wage pressure and higher unemployment in developed countries (Richard B. Freeman, 2006). For European countries that are subject to various forms of wage rigidities, this translates into higher unemployment (Avouyi-Dovi, Fougere, and Gautier, 2013; Fabiani, Galuscak, Kwapil, Lamo, and Room, 2010; Nickell, 1997) and must not be limited to countries facing current account deficits.

[2] Felbermayr, Larch, and Lechthaler (2012) demonstrate the economic rationale of this debate using traditional trade models and provide arguments for why this must not hold in modern trade theory.

[3] Labor taxation, skills and education, geographical mobility as well as trade unions and bargaining are not covered in this paper.

Bean (1994) argues that the behavior of unemployed workers is the major reason for a more persistent unemployment rate in Europe compared to the US. He recommends reforms that improve the sluggish adjustment of employment to macroeconomic fluctuations implying reductions in employment protection. Lindbeck (1996) sees a need for reforms that improve the labor-exchange or placement service. Most countries followed these reform recommendations, but the implementation varies significantly in scope and timing. In Western Europe during the 1980s and 1990s, benefit provision was more generous than they were in the 1960s and 1970s. Reforms at the beginning of the 2000s reversed this trend. Between 2001 and 2014, 12 out of 19 countries reduced benefits for long-term unemployed with only three countries increasing those benefits. Austria, Germany, Greece, France and Slovakia reduced the replacement rate [4] significantly by between 12.7 and 22.3 percentage points. For short-term unemployed, however, eight countries increased and six countries decreased the replacement rate.

Reforms intended to increase placement and matching started in the early 1990s. As the first of today's Eurozone countries, the Netherlands reorganized their public employment services in one stop agencies with placement, benefit provision and labor market measures all under one umbrella. Active labor market policies enabling unemployed to search faster and more efficient for jobs are implemented far easier in such centralized offices, as officers have more and better information available and are able to punish uncooperative clients. Ireland, Germany and Finland followed the one-stop agency approach at the beginning of the 2000s. As one of very view studies on this issue, Launov and Wälde (2016) estimate that in the case of Germany the PES reform contributes to 20 per cent of the decline of unemployment, compared with only 5 per cent of the reduction in unemployment benefits.

Finally, reforms were implemented targeting directly on labor market flexibility by changing laws and regulations of employee rights [5]. For temporary contracts, employment protection drastically declined in Germany and Denmark, while it is reduced to a lesser extend in Belgium, Greece, Italy and Portugal. The reduction in restrictions on temporary employment contributed to the emergence of a temporary employment industry that drastically diminishes the costs of

[4] The replacement rate is the share of a workers pre-unemployment income that is paid out by an insurance company or the state in case of unemployment as benefits.

[5]

1. In principle, a change in the firing costs of worker could be a forth channel through that reforms on employment protection affect the economy. We see, however, only in the UK, a non-EMU country, changes in employment protection for non-temporary workers. Zanetti (2011) discusses the impact of the UK reforms in his paper. The temporary worker agencies in Germany and other countries, instead, offer permanent contracts to their workers and are subject to the regular employment protection schemes that are not affected by reforms. We decided, therefore to focus on vacancy posting costs rather than on firing costs.

adjusting the workforce. In the following decade, temporary agency work doubled in Austria, Germany and Denmark and with some delay tripled in Italy and Finland[6].

The contribution of labor market reforms to competitiveness and the current account became a controversial subject of discussion after the financial market crises. According to Blanchard (2007), all these reforms either increased productivity or depressed wages. In a fixed exchange rate system it is possible to improve the current account balance by either of both ways, but the latter, albeit being less attractive, may work faster (Angelini, Ca' Zorzi, and Forster, 2014). In principle, imposing reforms to prevent currency devaluation is a widespread phenomenon (Bizuneh and Valev, 2014) and seems to be uncontroversial. In surplus countries of the Eurozone, however, reforms that lower wages are perceived as a form of internal devaluation that, similar to currency manipulation, creates comparative advantages (Brancaccio, 2012). In the public debate, thus, reforms that depress wages in non-deficit countries are related to beggar-thy-neighbor policies[7]. Using our model, we test to what extend labor market reforms indeed increase the foreign debt of a non-reforming country. This serves us as a hint on whether beggar-thy-neighbour policies possibly exist.

In the literature, most papers address the instantaneous impact of structural or labor market reforms on the current account. In this context, Kennedy and Slok (2005) argue that wages and prices decline after a reform shock. Hence, the country experiences a price advantage and so exports increase and imports decline. As a result, the current account balance improves in the short run, profitability increases with a time lag and the internal interest rate also increases. Investment goes up and foreign capital is attracted which, in turn, tends to reduce capital exports and, therefore, goods exports. After agents adjust to the shock, the current account surplus declines. Bertola and Lo Prete (2009) analyze the effects of rising income growth and income risk as a result of labor market deregulation. They argue in a similar way as Kennedy and Slok (2005) that labor market deregulation should improve the current account balance of the reforming country without much delay, since forward-looking individuals increase their precautionary savings in view of a higher uninsurable risk. Instead, Obstfeld and Rogoff (1995) argue that it would be rational for countries to borrow today in order to be compensated for the current pain of structural reforms. Hence, the current account balance should decline in the short run. But

[6]Carone, Pierini, Stovicek, and Sail (2009) provide an excellent overview of labor market reforms in Europe

[7]The core argument of this debate is that the Euro acts as a de facto foreign exchange intervention to keep the currency of reforming countries weak. A reforming country like Germany, as discussed by **?** who refers in his New York Times blog to Ian Fletcher, acts as a currency manipulator to create a current account surplus. Capital outflows from Germany to the periphery, then, are similar to Dollar purchases by China, as they prevent the breakup of the Euro and an appreciation of a new German mark. With the term "beggar-thy-neighbor" policy, the debate recourses to Adam Smith stating that a beggar-thy neighbor policy makes "commerce" a source of animosity. The term was also used for China's exchange rate policy during the last two decades.

since any future gains from structural reforms will be used to pay back the loans, we should observe a reversal and a positive current account surplus in the future. Annicchiarico, Di Dio, and Felici (2013) bring forward the argument that current account imbalances result from shifts in purchasing power towards individuals with higher saving propensities. In a model with two types of households that differ with regard to the Ricardian equivalence proposition this implies that non-ricardian households suffer to a greater extend from reform measures which, finally, improves the net foreign asset position.

Empirical evidence (Kennedy and Slok, 2005), however, suggests the impact of reform measures on the current account to be small. In this context, Chen, Milesi-Ferretti, and Tressel (2013) make the argument that the presence of asymmetric shocks in a specific institutional setting leads to strong current account imbalances, not the reform shock itself. Up till now, research on the influence of labor market institutions in such a world of stochastic shocks is scarce. In this context, and relating to the EMU, our paper contributes to close this gap by answering the question on weather labor market reforms affects the current account deficit of non-reforming countries by changing the speed and scope of labor market adjustment. For this purpose, we build a two-country two-sector DSGE model with search and matching frictions. This allows us to identify the impact of changes in the benefit system, an improvement in placement and a lower employment regulations on the current account imbalances that add-up to the foreign-debt of non-reforming countries. If reforms increase the foreign debt of non-reformers, some would speak of a "beggar-thy-neighbour policy".

Naturally, our model is not the first to address labor market frictions in a DSGE framework. Zanetti (2011) and Walsh (2005) use a similar approach to include labor markets, while Krause and Uhlig (2012) analyze the German reduction of the replacement rate by employing a model with different skill groups to focus on the effect of labor market reforms on high-skilled versus low-skilled workers. Krause and Lubik (2007), on the other hand, introduce real wage rigidities into a New Keynesian modeling framework distinguishing between sectors with high and low productivity. In addition to previous models, we follow Obstfeld and Rogoff (2006) and Ferrero, Gertler, and Svensson, Lars E. O. (2008) to include trade, international borrowing and preferences for the consumption of home tradables in a DSGE model with search and matching frictions. In this setting, households adjust consumption according to differences in the terms of trade so that international borrowing gives rise to a current account deficit or surplus. As the labor market stance has an influence on prices and productivity, reforms can have an impact on net exports and the current account.

The remainder of this paper is organized as follows. The following section introduces the model; the third section describes the calibration of the model to a typical EMU member state; the fourth section presents the steady-state results, the reaction of the model to differing shocks, and some robustness checks. The fifth section concludes.

2. The model

We build a two-country, two-sector currency union model with search and matching frictions in which a representative household maximizes lifetime utility according to the rational expectations hypothesis. In each period, the household faces the decision of whether to buy tradables from the domestic or the foreign economy, to buy non-tradables, to hold real money balances or to postpone consumption until later by buying bonds. Foreign and domestic tradable as well as non-tradable consumption goods sold by retailers are subject to staggered price setting (Calvo, 1983). Following Andolfatto (1996) and Merz (1995), we include the assumption of Uzawa-type preferences. This preference specification allows the model to be stationary, in the sense that the non-stochastic steady state is independent of initial conditions (Schmitt-Grohé and Uribe, 2003). Furthermore, the steady-state is always unique even in the presence of low elasticities of substitution between the tradable good bundles of the two countries (Bodenstein, 2011). There are two sectors of production in each country. Each sector is divided into two types of economic entities, firms which produce intermediate goods and retailers. The trade specification of the model resembles that of Obstfeld and Rogoff (2006) and, more specifically, Ferrero, Gertler, and Svensson, Lars E. O. (2008), with the exception that we impose staggered price setting on the level of the retailers (Bernanke, Gertler, and Gilchrist, 1999) rather than on the level of the firms. Furthermore, we assume a search and matching labor market with endogenous separations rather than staggered wage setting.[8] Introducing search and matching labor markets with endogenous separations is, to all our knowledge, a novel approach in the DSGE literature on current account imbalances.

The preferences of households are expressed by a nested utility function combining, on the one hand, non-tradables and tradables using a Cobb-Douglas function and, on the other hand, tradables from the domestic and foreign economies using a CES specification. This setting is specified in a way which reflects the fact that households have a preference for domestically produced products. Additionally, the assumption of a home bias gives rise to a "transfer effect", as Obstfeld and Rogoff (2006) call it, according to which a country sees a deterioration in its terms of trade if national expenditures decline. We use a setting with tradable and non-tradable goods, as in a world with exhausted or nearly exhausted factors, the possibility to shift resources from non-tradable to tradable production is a necessary precondition for a country to increase exports.

In both sectors of the economy we have nominal price rigidities. Given irrevocably fixed exchange rates due to our currency union setting, prices for tradable goods are identical in both countries. In a steady-state equilibrium, trade is always balanced. During adjustments following macroeconomic shocks, it might, nevertheless, be favorable for households in a given country to increase imports and run up debt. Financial markets are assumed to be imperfect in the

[8] Both deviations enable us to analyze labor market reforms as we include search and matching frictions and endogenous job-separations.

sense that only the bond of the domestic country is internationally tradable.

In our model, labor is, at least in the short run, not mobile between the two countries. As a result, the imbalances that arise are more persistent than they would be in a model with factor mobility. We use this assumption as, compared to the US, intra-EMU labor mobility is still small (Krause, Rinne, and Zimmermann, 2014).

More specifically, the labor markets in our model build on the search and matching model with endogenous job destruction developed by Mortensen and Pissarides (1994), in which a worker and a firm in each period have to decide whether to preserve or to terminate their relationship. Following Zanetti (2011), Krause and Lubik (2007) and Walsh (2005), we embed the labor market specification of the Mortensen-Pissarides model of den Haan, Wouter J., Ramey, and Watson (2000) in a New Keynesian setting.

In each period, unemployed workers search for a job and intermediate goods-producing firms want to fill their vacancies. The matching function describes the process of generating job matches by combining unemployed workers with open vacancies. In contrast to Krause and Uhlig (2012), where a new match can have an idiosyncratic productivity below the threshold level[9], we assume that the productivity of a new worker is always higher than the threshold to avoid instantaneous endogenous separations. When a match is generated, wage bargaining starts. After the firm and the worker have agreed on a specific wage training starts, enabling the match to become productive in the next period. At the beginning of each period, firm and workers are forced to separate with a given probability owing to disturbances exogenous to the model. If a match survives exogenous separations, the firm is still able to choose to post a vacancy or to keep the employee. As there are vacancy posting and firing costs for firms as well as search costs for workers, continuing a match might generate a surplus. This surplus occurs if firms and workers observe a productivity of the match that is above a threshold level at which the surplus is zero. Firms that have an open position post vacancies as long as the value of the vacancy is greater than zero. If the number of vacancies increases, however, the probability of finding a convenient match diminishes. This results in a reduction in the expected value of an open position. In equilibrium, free market entry ensures that the value of a vacancy is always zero.

To sum up, the model economy is characterized by nominal rigidities in the goods market and search and matching frictions in the labor markets. It consists of a representative household, a production sector comprised of representative intermediate goods-producing firms and a continuum of retail firms, indexed by i, with $i \in [0, 1]$ in each country of the currency union, as well as a common central bank. Firms producing tadables can sell their goods in both countries and households can engage in international borrowing.

[9]The threshold productivity defines a specific idiosyncratic productivity, where a firm is indifferent between continuing or separating a match.

2.1. The representative household

Our economy is inhabited by a large number of infinitive living identical households consuming aggregates of domestic and imported monopolistic goods (Dixit and Stiglitz, 1977). Owing to labor market search frictions, any household is either employed or unemployed. In general, labor is supplied inelastically. As a second source of income, households own shares in domestic firms and receive dividends D_t from them. We assume that households in the domestic economy and in the foreign country have the same preferences and factor endowments, defined over a composite consumption good C_t and real money holdings M_t/P_t. As described by Merz (1995), we assume a perfect insurance system where households can insure themselves against variations in income. This assumption removes heterogeneity among households within a given country and enables us to consider the optimization problem of a representative household maximizing expected lifetime utility. During each period $t = 0, 1, 2, \ldots$, the expected lifetime utility function is given by

$$E \sum_{t=0}^{\infty} \beta_t \left[\ln C_t + \kappa_m \ln \left(\frac{M_t}{P_t} \right) \right], \tag{1}$$

where $\beta_t = \frac{e^{\varsigma_t}}{1+\psi(\ln C_t - \vartheta)} \beta_{t-1}$ for $t \geq 0$, $\beta_0 = 1$ represents the endogenous discount factor, with the parameter ψ that is assumed to be small and the shock term ς_t, and κ_m that denotes a scaling parameter for utility from real money holdings with $\kappa_m > 0$. The consumption index C_t is defined as

$$C_t \equiv \frac{C_{Tt}^{\iota} C_{Nt}^{1-\iota}}{\iota(1-\iota)}. \tag{2}$$

Tradable goods $C_{T,t}$ can be obtained from the domestic $C_{H,t}$ or from the foreign economy $C_{F,t}$ while non-tradables $C_{N,t}$ are produced at home, only. Following Ferrero, Gertler, and Svensson, Lars E. O. (2008), we employ a Cobb-Douglas[10] specification with ι as the proportion of total expenditure devoted to tradable goods.

$$C_{T,t} = \left[\alpha^{\frac{1}{\gamma}} C_{H,t} + (1-\alpha)^{\frac{1}{\gamma}} C_{F,t}^{\frac{\gamma-1}{\gamma}} \right]^{\frac{\gamma}{\gamma-1}} \tag{3}$$

In this specification, γ measures the elasticity of substitution between home and foreign goods and α is the share parameter of the CES-function. Household demand is derived by minimizing costs for the specific goods bundles.

$$C_{H,t} = \alpha \left(\frac{P_{T,t}}{P_{H,t}} \right)^{\gamma} C_{T,t} \quad C_{F,t} = (1-\alpha) \left(\frac{P_{T,t}}{P_{F,t}} \right)^{\gamma} C_{T,t} \tag{4}$$

[10] We assume a unit elasticity between non-traded and traded goods which is typical but not undisputed in the literature. Based on the simulations of Obstfeld and Rogoff (2005) with an unit elasticity, a elasticity of two and one of 100, we don't expect a strong impact of the elasticity on our simulation results.

$$C_{N,t} = (1-\iota)\frac{P_t}{P_{N,t}}C_t \quad C_{T,t} = \iota\frac{P_t}{P_{T,t}}C_t,$$

where P_t denotes the price of a bundle of tradable and non-tradable goods, $P_{T,t}$ is the price index for domestic tradable and foreign tradable and $P_{N,t}$ for non-tradable goods. A household chooses consumption, nominal money and bond holdings subject to a budget constraint of the form

$$P_tC_t + B_t/R_t + M_t = B_{t-1} + P_tY_t + D_t + \varrho_t + M_{t-1}, \tag{5}$$

for $t = 0, 1, 2...$. At the beginning of period t, the household receives a lump-sum transfer ϱ_t from the central bank and dividends D_t from the representative intermediate-goods-producing firm. Total income amounts to Y_t. The household enters period t with bonds B_{t-1} and M_{t-1} units of money. Furthermore, the mature bonds providing additional B_{t-1} units which are all sold at the beginning of the period and might be used to purchase B_t new bonds at the nominal cost B_t/R_t with R_t as the nominal interest rate between t and $t+1$. Solving the intertemporal optimization problem, we derive the following first-order conditions:

$$\Lambda_t = C_t^{-1} \tag{6}$$

$$E_t\beta_{t,t+1} = E_t\frac{\pi_{t+1}}{R_t} \tag{7}$$

$$\frac{\kappa_m}{m_t} = \Lambda_t - \beta_t E_t\frac{\Lambda_t}{\pi_{t+1}}, \tag{8}$$

where Λ_t is the shadow price and $\beta_{t,t+1} = \beta_t\Lambda_{t+1}/\Lambda_t$ is the stochastic discount factor. Real money holdings are defined as $m_t = M_t/P_t$. Combining the first-order conditions with respect to C_t and B_t, equation (6) and equation (8), yields the standard consumption Euler equation:

$$\beta_t E_t\left(\frac{C_{t+1}}{C_t}\right)^{-1} = E_t\frac{P_{t+1}}{R_tP_t}. \tag{9}$$

We distinguish three different statuses of employment of the representative household: let U_t, $W_{j,t}^N$ and $W_{j,t}(a_t)$ denote respectively the present discounted value of an unemployed, newly employed and continuously employed worker, with j being an index for the two sectors of each economy. In case of unemployment, the worker enjoys a real return b and expects to move into employment with probability $p_j(\theta_{j,t})$, becoming employed either in the tradable or in the non-tradable sector. Therefore, the present discounted income stream of an unemployed worker is

$$U_{j,t} = b + E_t\beta_{t,t+1}\left[p_j(\theta_{j,t})W_{j,t+1}^N + (1-p_j(\theta_{j,t}))U_{j,t+1}\right]. \tag{10}$$

Following Pissarides (2000) , the flow value of being unemployed, $b = h + \rho_w w$, consists of the value of home production or leisure h and unemployment benefits

$\rho_w w$, where ρ_w represents the replacement ratio with $0 < \rho_w < 1$ and w the steady-state average wage. The second part of Equation (10) describes the expected capital gain from a change of state. As an equilibrium condition, the value of unemployment has to be identical in the both sectors ($U_t = U_{H,t} = U_{N,t}$).

The worker's value from holding a job with idiosyncratic match productivity $a_{j,t}$, that is assumed to be log-normal distributed with the cumulative distribution function $F(\cdot)$, is given by

$$W_{j,t}(a_{j,t}) = w_{j,t}(a_{j,t}) + E_t\beta_{t,t+1}\left[(1-\rho^x)\int_{\mathring{a}_{j,t+1}}^{\infty} W_{j,t+1}(a_{j,t+1})dF(a_{j,t+1}) + \rho_{j,t+1}U_{j,t+1}\right]. \tag{11}$$

Equation (11) tells us that an employed worker is paid a sector-specific wage $w_{j,t}(a_{j,t})$, and that if he or she survives exogenous and endogenous job destruction, which happens with a total probability of ρ_{t+1}, the match will start to produce goods.

The present-discounted value of a new match is

$$W^N_{j,t} = w^N_{j,t} + E_t\beta_{t,t+1}\left[(1-\rho^x)\int_{\mathring{a}_{j,t+1}}^{\infty} W_{j,t+1}(a_{j,t+1})dF(a_{j,t+1}) + \rho_{j,t+1}U_{j,t+1}\right]. \tag{12}$$

Please note, that equation (12) differs from equation (11) in the wages of new workers, only. The wages of new workers, $w^N_{j,t}$, will be different from those of continuing workers, $w_{j,t}(a_{j,t})$ owing to the presence of firing costs that a firm has to bear if it decides to fire a worker. As in the first period no endogenous job destruction takes place, firing costs in this period do not influence the wages of new workers.

2.2. Labor market matching

During each period $t = 0, 1, 2, \ldots$, an intermediate goods-producing firm posts a vacancy or continues the match from the previous period. Each single job has the status filled or vacant. Because of matching frictions, it is assumed that the process of job search and hiring is time-consuming and costly for both the worker and the firm. If a firm finds a suitable worker, both form a match. The number of job matches depends on the matching function $m_{j,t}(u_{j,t}, v_{j,t})$, where $v_{j,t}$ denotes the number of vacancies in both sectors of the economy, home-produced tradable and non-tradable goods $j = H, N$, and $u_{j,t}$ is the number of unemployed workers searching in sector j. We assume a Cobb-Douglas matching function, where ξ denotes the partial elasticities

$$m_{j,t}(u_{j,t}, v_{j,t}) = \chi u^{\xi}_{j,t} v^{1-\xi}_{j,t}, \tag{13}$$

$0 < \xi < 1$ and χ is a scale parameter reflecting the efficiency of the matching process. Defining labor market tightness as $\theta_{jt} = v_{j,t}/u_{j,t}$ and making use of the CRS property of $m_{j,t}$, we write the job-finding probability in sector j for an unemployed worker as

$$p(\theta_{j,t}) = m_{j,t}(u_{j,t}, v_{j,t})/u_{j,t} = \chi\theta_{j,t}^{1-\xi}, \tag{14}$$

and the probability that a searching firm in this sector will find a worker as

$$q(\theta_{j,t}) = m_{j,t}(u_{j,t}, v_{j,t})/v_{j,t} = \chi\theta_{j,t}^{-\xi}. \tag{15}$$

The tighter the labor market, the easier it is for unemployed workers to find a job. Equation (15) implies that the higher the number of vacancies v_{jt} for a given number of unemployed workers searching in this sector, $u_{j,t}$, the more difficult it is for firms to fill vacant positions.

At the beginning of any period t, job separations take place as a result of an exogenous negative shock with probability ρ_j^x. Firm and worker may decide to dissolve a match endogenously if the realization of the worker's idiosyncratic productivity of $a_{j,t}$ is below a certain threshold productivity $\mathring{a}_{j,t}$. The probability of endogenous job destruction is given by $\rho_{j,t}^n = P(a_{j,t} < \mathring{a}_{j,t}) = F(\mathring{a}_{j,t})$. The total job separation rate, therefore, is $\rho_{j,t} = \rho_j^x + (1 - \rho_j^x)\rho_{j,t}^n$. As in den Haan, Wouter J., Ramey, and Watson (2000), the idiosyncratic productivity $a_{j,t}$ is drawn from a log-normal distribution with mean μ_{ln} and standard deviation σ_{ln}.

Following Mortensen and Pissarides (1994), new matches have a productivity of $a_{j,t}^N$, which ensures that their productivity is always above the productivity threshold $\mathring{a}_{j,t}$, and that all jobs produce before being destroyed. New matches in t, $m_{j,t}$, become productive for the first time in $t+1$. Consequently, the employment in each sector evolves according to $n_{j,t} = (1 - \rho_{j,t})n_{j,t-1} + m_{j,t-1}(u_{j,t-1}, v_{j,t-1})$. As we normalize total employment to unity, the sum of unemployed persons becomes $u_t = (1 - n_{H,t} - n_{N,t})$.

The representative intermediate goods-producing firm

If an intermediate goods-producing firms posts a vacancy, it bears costs c_j. Labor is the only input in the production function. At the beginning of each period, old and new matches draw an idiosyncratic, job-specific productivity $a_{j,t}$. Production in each sector is subject to a productivity shock, common to all firms. If the realization of a worker's idiosyncratic productivity is above the reservation productivity $\mathring{a}_{j,t}$, the firms will produce output using labor. The total factor productivity $A_{j,t}$ follows an AR(1) process, $\ln(A_{j,t}) = \rho_{Aj}\ln(A_{j,t-1}) + \epsilon_{Aj}$, where ρ_{Aj} is the serial correlation coefficient with $0 < \rho_{Aj} < 1$ and ϵ_{Aj} follows a white noise process with standard deviation σ_{Aj}.

We define the present discounted value of expected profits from a vacant job as follows:

$$V_{j,t} = -c_j + E_t\beta_{t,t+1}\left[q_j(\theta_{j,t})J_{j,t+1}^N + (1 - q_j(\theta_{j,t}))V_{j,t+1}\right]. \tag{16}$$

With a probability of $q_j(\theta_{j,t})$, the firms matches with a worker and the match yields a return of $J_{j,t+1}^N$. With a probability of $1 - q_j(\theta_{j,t})$, the job remains

vacant with a return of $V_{j,t+1}$. As long as the value of a vacancy is greater than zero, a firm will post new vacancies. In equilibrium, free market entry drives the profit from opening a vacancy to zero, which implies $V_{j,t} = 0$ for any t. This yields the vacancy posting condition

$$\frac{c_j}{q_j(\theta_{j,t})} = E_t \beta_{t,t+1} J^N_{j,t+1}, \tag{17}$$

which states that the expected cost of hiring a worker, $c_j/q_j(\theta_{j,t})$, is equal to the expected profit generated by a new match.

The value of a newly hired worker enjoyed by a firm, therefore, is given by

$$\begin{aligned} J^N_{j,t} = \quad & mc_{j,t} \tfrac{P_{j,t}}{P_t} A_{j,t} a^N_{j,t} - w^N_{j,t} \\ & + E_t \beta_{t,t+1} (1 - \rho^x_j) \left[\textstyle\int_{\mathring{a}_{j,t+1}}^{\infty} J_{j,t+1}(a_{j,t+1}) dF_j(a_{j,t+1}) - F_j(\mathring{a}_{j,t+1}) T_j \right], \end{aligned} \tag{18}$$

where $mc_{j,t}$ denotes the sector-specific real marginal costs of providing one additional unit of output. We distinguish between endogenous and exogenous separations. With probability $1 - \rho^x_j$, the worker survives exogenous job destruction. For a surviving match, a realization of the idiosyncratic productivity below the critical threshold $\mathring{a}_{j,t+1}$ leads to endogenous separation and the firm incurs firing costs T_j.

Similarly, the present discount value of a continuing job with productivity $a_{j,t}$ to the employer is

$$\begin{aligned} J_{j,t}(a_{j,t}) = \quad & mc_{j,t} \tfrac{P_{j,t}}{P_t} A_{j,t} a_{j,t} - w_{j,t}(a_{j,t}) \\ & + E_t \beta_{t,t+1} (1 - \rho^x_j) \\ & \cdot \left[\textstyle\int_{\mathring{a}_{j,t+1}}^{\infty} J_{j,t+1}(a_{j,t+1}) dF_j(a_{j,t+1}) - F_j(\mathring{a}_{j,t+1}) T_j \right] \end{aligned} \tag{19}$$

In equations (18) and (19) the term $mc_{j,t} \frac{P_{j,t}}{P_t} A_{j,t} a_{j,t} - w_{j,t}(a_{j,t})$ represents the net return of a match, and $J_{j,t+1} - F_j(\mathring{a}_{j,t+1}) T_j$ represents the present discounted firm surplus, if the match is not destroyed.

In this model, an expression for the real marginal cost $mc_{j,t}$ can be derived by using equation (11) and the condition that a firm is indifferent between continuing a match and separating from the worker, $J_{j,t}(a^{\circ}_{j,t}) + T_j = 0$ (Mortensen and Pissarides, 2003). Combining these two equations and solving for $mc_{j,t}$, we obtain:

$$\begin{pmatrix} mc_{j,t} = \frac{P_t}{P_{j,t} A_{j,t} \mathring{a}_{j,t}} \\ w_{j,t}(\mathring{a}_{j,t}) - T_j \\ -E_t \beta_{t,t+1} (1 - \rho^x) \begin{bmatrix} \int_{\mathring{a}_{j,t+1}}^{\infty} J_{j,t+1}(a_{j,t+1}) dF_j(a_{j,t+1}) \\ -F_j(\mathring{a}_{j,t+1}) T_j \end{bmatrix} \end{pmatrix} \tag{20}$$

From equation (20), it can be seen that real marginal costs amount to the wage minus the the firing costs and the expected future return generated by the match,

weighted by the marginal product of labor. As pointed out by Trigari (2009), the real marginal costs are, in the presence of search and matching frictions, not equal to the wage divided by the marginal product of labor. Instead, they also depend on the expected present-discounted payoff of preserving a match, which internalizes the firing costs.

Wage bargaining

In each period, firms and workers bargain over the real wage for that period, regardless of whether they form a continuing or a new match. The wage is set according to Nash bargaining. The worker and the firm share the joint surplus and the worker receives the fraction $\eta \in [0, 1]$. Since the wage depends on the idiosyncratic productivity of the worker, the wage bargaining rules for continuing and new matches are given by

$$\eta(J_{j,t}(a_{j,t}) + T_j) = (1 - \eta)(W_{j,t}(a_{j,t}) - U_t), \tag{21}$$

and

$$\eta J^N_{j,t}(a_{j,t}) = (1 - \eta)(W^N_{j,t} - U_t), \tag{22}$$

respectively. The bargaining rule for continuing workers, represented by equation (21), internalizes firing costs T_j, whereas new workers are not subject to firing costs because in the period they are hired their idiosyncratic productivity a^N_{jt} is assumed to be above the critical threshold $\mathring{a}_{jt}$.

We can now derive the wage for continuing workers using the Bellman equations (10)-(13), (15)-(16) and the bargaining rules for continuing and new matches, equation (17) and (18)

$$w_{j,t}(a_{j,t}) = \eta \left[mc_{j,t} \frac{P_{j,t}}{P_t} A_{j,t} a_{j,t} + c_j \theta_{j,t} + (1 - \zeta_{j,t}) T_j \right] + (1 - \eta) b. \tag{23}$$

The agreed wage for new workers is equal to

$$w^N_{jt} = \eta \left[mc_{j,t} \frac{P_{j,t}}{P_t} A_{j,t} a^N_{j,t} + c_j \theta_{j,t} - \zeta_{j,t} T_j \right] + (1 - \eta) b, \tag{24}$$

where $\zeta_{j,t} = E_t \beta_{t,t+1}(1 - \rho^x_j)$.
The wages that new and continuing workers receive consist of two elements. First, if firms have complete bargaining power, the bargained wage will equal the benefits from unemployment b, which includes unemployment insurance payments and welfare captured by the replacement rate as well as the utility derived from not working. Second, if workers have complete market power, the wage will be the match revenue $mc_{j,t} \frac{P_{j,t}}{P_t} A_{j,t} a_{j,t}$, plus the saved hiring costs, $c_j \theta_{j,t}$, minus the present discounted firing costs, $\zeta_{j,t} T_j$, and plus the savings on

firing costs[11], T_j, in the case of continuing workers. In cases where the bargaining power of firms and workers is between these two extremes, the bargaining power of workers η attaches weight to the two elements. It follows from equation (24) that the wage of new workers differs from those of continuing workers as they do not include firing costs related to endogenous job separations in the initial period.

2.3. Retail firms

We assume a continuum of monopolistic competitive retailers on the unit interval indexed by i. Each retailer purchases goods from intermediate goods-producing firms and transforms them into a differentiated retail good using a linear production technology. During each period $t = 0, 1, 2, \ldots$ a retailer j of sector $j = H, F, N$ sells $Y_{j,t}(i)$ units of the retail goods at the nominal price $P_{j,t}(i)$. Let $Y_{j,t}$ denote the composite of individual retails goods which is described by the CES aggregator of Dixit and Stiglitz (1977):

$$Y_{j,t} = \int_0^1 \left[Y_{j,t}(i)^{(\epsilon-1)/\epsilon} di \right]^{\epsilon/(\epsilon-1)}, \tag{25}$$

where ϵ with $\epsilon > 1$ is the elasticity of substitution across the differentiated retail goods. Then, the demand curve facing each retailer i is given by

$$Y_{j,t}(i) = \left[\frac{P_{j,t}(i)}{P_{j,t}} \right]^{-\epsilon} Y_{j,t}, \tag{26}$$

where $P_{j,t}$ is the aggregate price index of home-produced or foreign-produced tradable and non-tradable goods

$$P_{j,t} = \left[\int_0^1 P_{j,t}(i)^{1-\epsilon} dj \right]^{1/(1-\epsilon)}, \tag{27}$$

for all $t = 0, 1, 2, \ldots$. As in Calvo (1983), only a randomly and independently chosen fraction $1-\nu$ of the firms in the retail sector are allowed to set their prices optimally, whereas the remaining fraction ν sets their prices by charging the previous period's price adjusted by steady-state inflation. Hence, a retail firm i, which can choose its price in period t, chooses the price $\hat{P}_{j,t}(i)$ to maximize

$$E_t \sum_{s=0}^{\infty} (\beta\nu)^j \beta_{t,t+s} \left[\left(\frac{\hat{P}_{j,t}(i)}{P_{j,t+s}} \right)^{-\epsilon} Y_{jt+s} \left(\frac{\hat{P}_{j,t}(i)}{P_{j,t+s}} - mc_{j,t+s} \right) \right], \tag{28}$$

where $\beta_{t,t+s}$ is the stochastic discount factor used by the firms and $mc_{j,t}$ stands for the real marginal costs. The first-order condition for this problem is

[11] Firing costs are assumed to affect endogenous separations, only. They do not occur for new workers in the first period, as the idiosyncratic productivity for those is per assumption above the threshold level.

$$\hat{P}_{j,t}(i) = \frac{\epsilon}{(\epsilon-1)} \frac{\sum_{s=0}^{\infty} (\nu\beta)^j E_t(\Lambda_{j,t+s} P_{j,t+s}^{\gamma} Y_{j,t+s} mc_{j,t+s})}{\sum_{s=0}^{\infty} (\nu\beta)^j E_t(\Lambda_{j,t+s} P_{j,t+s}^{\gamma-1} Y_{j,t+s})}. \tag{29}$$

2.4. The central bank

The central bank conducts monetary policy according to a modified[12] Taylor (1993) rule:

$$\begin{aligned} \ln(R_t/\bar{R}) = \quad & \rho_r \ln(R_{t-1}/\bar{R}) + \rho_y \left(\delta \ln(Y_t/\bar{Y}) + (1-\delta)\ln(Y_t^*/\bar{Y}^*)\right), \\ & + \rho_\pi \left(\delta \ln(\pi_{H,t}/\bar{\pi}_H) + (1-\delta)\ln(\pi_{F,t}^*/\bar{\pi}_F^*)\right) + mp_{r_t} \end{aligned} \tag{30}$$

where $\bar{R}$, $\bar{Y}$ and $\bar{\pi}_H, \bar{\pi}_F^*$ are the steady-state values of the gross nominal interest rate, output and gross inflation rate for domestically and foreign-produced goods, and $mp_{r_t} \overset{i.i.d.}{\sim} N(0, \sigma_{r_t}^2)$ is a shock to monetary policy. The coefficient of the degree of interest rate smoothing ρ_r and the reaction coefficients to inflation and output, ρ_π and ρ_y, are positive. The parameter δ denotes the relative steady-state size of the home country vice-versa the foreign country.

2.5. Trade

The real value of net exports is defined using the weighted difference between home production and tradable consumption $NX_t \equiv \frac{P_{H,t}Y_{H,t} - P_{Tt,t}C_{Tt,t}}{P_t}$. Using this definition, we specify total nominal bond holdings B_t according to

$$\frac{B_t}{P_t} = \frac{R_{t-1}B_{t-1}}{P_t} + NX_t. \tag{31}$$

We apply the standard incomplete markets model[13] and assume that international financial markets clear ($B_t + B_t^* = 0$), with B_t^* as nominal holdings of the domestic bond by foreign households, so that the net change of real bond holding reflects the current account $CA_t \equiv \frac{B_t - B_{t-1}}{P_t}$.

Given two sectors in each economy, it is convenient to define a set of relative prices. The relative price of non-tradables to tradables is defined as $X_t \equiv P_{N,t}/P_{T,t}$ and the terms of trade as $\top \equiv \mathrm{P_{F,t}}/\mathrm{P_{H,t}}$. Using these definitions and

[12] The article of Gerlach and Schnabel (2000) discusses the properties of Taylor rules within a European Monetary Union. They end up at the conclusion that a Taylor rule should be similar to pre-EMU ones. In this paper, our modified Taylor rule for the EMU-area follows this assumption.

[13] There is a wide discussion about the impact of imperfect financial market assumptions in open-economy models, e.g. Devereux and Sutherland (2011) discuss the impact of this assumption on monetary policy, while Bodenstein (2011) compares different imperfect market assumptions for open economies.

their foreign counterparts gives us the expression of the real exchange rate Q_t in terms of the relative price of non-tradables to tradables and the terms of trade

$$Q_t = \left[\frac{\alpha \top^{1-\gamma} + (1-\alpha)}{\alpha + (1-\alpha)\top_t^{1-\gamma}}\right]^{\frac{1}{1-\gamma}} \left(\frac{X_t^*}{X_t}\right)^{1-\iota}. \tag{32}$$

2.6. Domestic equilibrium conditions

In equilibrium, the value of an open vacancy is zero in both sectors. Making use of the vacancy posting condition (17), combined with equations (18) and (24), yields the job creation condition

$$\frac{c_j}{q_j(\theta_{j,t})} = (1-\eta)E_t\beta_{t,t+1}\left[mc_{j,t+1}A_{j,t+1}(a^N_{j,t+1} - \mathring{a}_{j,t+1}) - T_j\right]. \tag{33}$$

Equation (33) states that the expected hiring cost that a firm has to pay must be equal to the expected gain from a filled job. Jobs are destroyed by the firm when the realization of the worker's productivity is below the reservation productivity. The reservation productivity is defined as the value of a_{jt}, which makes the firm's surplus received from a job equal to zero,

$$J_{jt}(\mathring{a}_{j,t}) + T_j = 0. \tag{34}$$

The job destruction condition is derived using equations (19), (23) and (34) and is given by

$$\begin{array}{c} mc_{j,t}A_{j,t}\mathring{a}_{j,t} - b_j - \frac{\eta}{(1-\eta)}c\theta_t + (1-\zeta_{jt})T_j \\ +E_t\beta_{t,t+1}(1-\rho_j^x)mc_{j,t+1}A_{j,t+1}\int_{\mathring{a}_{j,t+1}}^{\infty}(a_{j,t+1} - \mathring{a}_{j,t+1})dF(a_{j,t+1}) \end{array} = 0 \ . \tag{35}$$

with $c_j\theta_{j,t}$ representing the average hiring costs of all firms in either of the two sectors of the economy.

As in Zanetti (2011), the equilibrium average real wage is a weighted average of continuing workers with weight $\omega^C_{j,t} = (1-\rho_{j,t})\frac{n_{j,t-1}}{n_{j,t}}$ while that for new workers is $1-\omega^C_{jt}$. Therefore, the average real wage is

$$w_{j,t} = \eta\left[mc_{j,t}A_{j,t}\overline{a}_{j,t} + c\theta_t + (\omega^c_{j,t} - \zeta_{j,t})T_j\right] + (1-\eta_j)b, \tag{36}$$

where $\overline{a}_{j,t} = \omega^C_{j,t}H(\mathring{a}_{j,t}) + (1-\omega^C_{j,t})a^N_{j,t}$ is the average idiosyncratic productivity across jobs and $H(\mathring{a}_{j,t}) = E(a_{,j,t}|a_{j,t} > \mathring{a}_{j,t})$ represents the average productivity for continuing workers. The aggregate output, net of vacancy costs, amounts to

$$y_{j,t} = n_{j,t}A_{j,t}\overline{a}_{j,t} - c_{j,t}v_{j,t}, \tag{37}$$

with $n_{j,t}$ as the number of workers employed in sector j. Non-tradable production must equal demand

$$Y_{N,t} = C_{N,t}\ Y^*_{N,t} = C^*_{N,t},$$

as must tradable production

$$Y_{H,t} = C_{H,t} + C^*_{H,t},$$

with $C^*_{H,t}$ as the demand for home tradable goods from abroad. Combining this relation with equation (31) reveals that the foreign trade balance in units of home consumption $Q_t NX^*_t$ must equal the negative home trade balance NX_t.

Now we make use of the market clearing condition for home production and include the demand functions for home-produced tradables, the definition of the real exchange rate and the definition of the terms of trade and the relative price of non-tradables to tradables, which yields

$$Y_{H,t} = \alpha \left[\alpha + (1-\alpha)\top_t^{1-\gamma}\right]^{\frac{\gamma}{1-\gamma}} C_{T,t} + (1-\alpha)\left[\alpha \top_t^{1-\gamma} + (1-\alpha)\right]^{\frac{\gamma}{1-\gamma}} C^*_{T,t}. \tag{38}$$

For domestic and foreign non-tradables we get

$$Y_{N,t} = \frac{1-\iota}{\iota}\left(X_t\right)^{-1} C_{T,t} \; Y^*_{N,t} = \frac{1-\iota_F}{\iota_F}\left(X^*_t\right)^{-1} C^*_{T,t}.$$

Given that bond markets clear, we are able to get an expression for net exports in terms of non-tradable to tradable prices and the terms of trade

$$NX_t = \left(X_t\right)^{\iota-1}\left\{\left[\alpha + (1-\alpha)\top_{\mathrm{t}}^{1-\gamma}\right]^{\frac{1}{1-\gamma}} Y_{H,t} - C_{T,t}\right\}.$$

Furthermore, the current account can be expressed as

$$CA_t = (R_{t-1}-1)\frac{B_{t-1}}{P_t} + NX_t.$$

Finally, we can express tradable consumption in terms of aggregate consumption for the home and the foreign country

$$C_{T,t} = \iota\left(X_t\right)^{1-\iota} C_t \; C^*_{T,t} = \iota\left(X^*_t\right)^{1-\iota} C^*_t.$$

In the steady-state equilibrium, the household's bonds and money holdings are $B_t = B_{t+1} = 0$ and $\varrho_t = M_t - M_{t-1}$, which ensures that any seigniorage revenue is rebated to the households. Furthermore, international financial markets must clear, which implies that $B_t + B^*_t = 0$, where B^*_t represents the nominal bond holdings of domestic assets by foreign households.

3. Calibration

Household preferences are characterized by six parameters: the steady-state discount factor, the partial elasticity for tradables and non-tradables, the elasticity of substitution between home and foreign-produced tradables, the home bias and the two elasticities of substitution for varieties of a tradable or non-tradable good. The periods of the model are calibrated to quarters and we

assume both countries and both sectors to be symmetrical. Parameters, therefore, are the same if not indicated otherwise. We set the steady-state discount factor to $\beta = .995$ which is in line with the most recent DSGE models of the Eurozone (Poutineau and Vermandel, 2015), and implies an annual steady-state interest rate of 2 percent. For relative risk aversion we choose the standard value of $\sigma = 2$ (Benchimol and Fourcans, 2012) while Smets and Wouters (2003) suggest a smaller value of 1 and Rabanal and Rubio-Ramirez (2005) estimate a posterior mean that implies a significantly higher risk aversion[14] of above 9.

In the literature we find a variety of definitions distinguishing tradables from non-tradables. We follow Schmillen (2013) who extend a study by Jensen and Kletzer (2012) for the service sectors to assign tradability to NACE sectors. Given this definition, the size of the tradable sector for France is slightly higher than 53 percent of GDP; for Italy the share is slightly higher than 57 percent and Germany has the highest tradable share at 62 percent. Some southern EMU countries like Greece, however, have much lower tradable shares. We set the tradable share to 55 percent, which in 2012 was the average for EMU countries and use this value to calculate the partial elasticities for the Cobb-Douglas function. We follow Obstfeld and Rogoff (2006) in setting the preference share parameter to $\alpha = 0.7$ and the elasticity of substitution between home and foreign tradables to $\gamma = 2.0$. The first value reflects the fact that Europeans and Americans attach a consumption weight of 70 percent to their own domestic products. The elasticity of substitution between home and foreign tradables is set according to Obstfeld and Rogoff (1995)[15].

We calibrate the labor market of the model to reproduce the structural characteristics of a typical EMU country. The unemployment rate is set to $u = 9.5$ percent, which is the long-term average among EMU countries. According to Hobijn and Sahin (2007), the quarterly separation rates are 6 percent for Spain and between 3 and 4 percent for France and Germany[16]. Given that the data reflects the period of the Great Moderation and that separations seem to have increased during the crisis, we set the total separation rate to $\rho = 0.05$, which is in the upper range of estimates. Unfortunately, the data does not contain information on the share of the endogenous and exogenous separation in the total separation rate, which, therefore, has to be calibrated using the job creation and job destruction function. The reservation productivity threshold of $\mathring{a} = 1.8$ is calculated at the steady-state intersection of the job destruction and job creation curve. We follow den Haan, Wouter J., Ramey, and Watson (2000) in assuming the idiosyncratic productivity to be log-normally distributed. As Germany is the biggest country in the Eurozone, we mimic the wage distribution of this country, which we have calculated using SOEP data. The mean of $F(.)$,

[14] We tested those values in a sensitivity analysis but the impact on current account imbalances and foreign debt was neglectable.

[15] Obstfeld and Rogoff (2000) and Obstfeld and Rogoff (2006) discuss the issue of an estimation bias using aggregate trade data which results in a lower than unity elasticity of substitution .

[16] The value for Germany is extremely close to $\rho = 0.03$, the separation rate calculated by Kohlbrecher, Merkl, and Nordmeier (2013) using German administrative data.

therefore, is calibrated at $\mu_{ln} = 2.54$ and the value of its standard deviation equal to $\sigma_{ln} = 0.48$. We, furthermore, assume that the productivity of new matches is always in the $0.95th$ percentile of $F(.)$ and therefore always above the threshold productivity $a^n > \mathring{a}$, which implies that new matches never separate. Matching efficiency[17] differs to a great extent in the Eurozone. Countries like France, Spain and Italy had a high matching efficiency in the past where estimates range between $\chi = 0.6$ and $\chi = 0.8$ (Ibourk, 2004; Destefanis and Fonseca, 2007; Ahamdanech-Zarco, Bishop, Grodner, and Liu, 2009). Germany is perceived to have a low efficiency, calibrated between $\chi = 0.2$ and $\chi = 0.3$ (Jung and Kuhn, 2014; Krause and Uhlig, 2012). Recently, efficiency has tended to increase in Germany (Fahr and Sunde, 2009; Hillmann, 2009) but shrunk in the other countries mentioned (Arpaia, Kiss, and Turrini, 2014). We, therefore, follow Lubik and Krause (2014) and set the matching efficiency[18] to $\chi = 0.5$, which is in line with the long-term unemployment level of the Eurozone.

The elasticity of a match w.r.t. unemployment is calibrated to $\xi = .7$, which reflects estimates by Burda and Wyplosz (1994) for Germany and France, Kohlbrecher, Merkl, and Nordmeier (2013) for Germany and Broersma (1997) for the Netherlands and is in line with the studies surveyed in Petrongolo and Pissarides (2001). As is standard in the literature, the Nash bargaining coefficient used in the wage-setting equation is set to $\eta = 0.5$, such that workers and firms have the same bargaining power[19]. The vacancy posting costs in the baseline scenario $c = 5.2$ and the unemployment benefits b are inferred from the steady-state job destruction and job creation conditions. The parameter measuring leisure is calibrated to $h = 0.3$, so that the income from not working (b and h) is worth 77 percent of w. Firing costs T are set to 67 percent, which is calculated as the EMU average using the World Development Indicators (WDI) database, while the replacement rate is 60 percent of the mean wage. This is in line with the study by van Vliet, Been, Caminada, and Goudswaard (2012) which calculates a replacement rate of between 50 and 60 percent for most EU-countries. The core countries of the Eurozone have values above 60 percent while Malta and members of the Eastern enlargement round have lower values (30 to 40 percent).

[17] The matching efficiency in the Eurozone is perceived to be lower than that of the United States (Jung and Kuhn, 2014). Lubik (2013) estimated the Beveridge curve for the US using data from 2000 to 2008. The point estimate for the matching efficiency is $m = 0.8$ which is significantly lower than the matching efficiency we set for the Eurozone. Most studies like Jung and Kuhn calibrate the US matching efficiency lower between 0.5 and 0.6.

[18] We also run the model with a significant lower matching efficiency of 0.23 following Jung and Kuhn (2014). The volatility of total vacancies and unemployment is too low in this specification, so that we returned to the standard specification. We could improve the buisness cylce statistics by setting the bargaining power according to Hagedorn and Manovskii (2008). If we, however, run the model with the standard matching efficiency and the Hagedon-Manovskii specification, the business cycle statistics better matched the data (Business cycle properties for this calibration are available in an online supplement). We did not use this specification as it was inconsistent with the long-term unemployment rate of EU-countries and the distribution of wages.

[19] A low bargaining power of workers specification following Hagedorn and Manovskii (2008) can be found in the online supplement to this paper (Table 3)

As is common in the literature, the parameter measuring the market power of retailer is set to $\varepsilon = 11$. This implies a mark-up over marginal costs of 10 percent and reflects empirical findings. The Calvo parameter that governs the frequency of price adjustments is, in accordance with Taylor and Woodford (1999), set to $\nu = 0.75$ such that the average binding of prices is 4 quarters. As is common, we normalize steady-state inflation to unity. The Taylor rule is calibrated following Taylor and Woodford (1999), and implies a monetary policy response to inflation equal to $\rho_\pi = 1.5$, a response to a change in output of $\rho_y = .5$ and a degree of interest rate smoothing of $\rho_r = .32$.

Finally, we specify the shock processes. In line with most of the literature, we calibrate the productivity shock such that the baseline model replicates the standard deviation of output in the Eurozone, which on average is 1.64. The standard deviation of the shock in either of the two sectors consequently amounts to $\sigma_a = 0.0087$, while the shock persistence parameter is $\rho_a = 0.94$. From Crespo-Cuaresma and Fernandez-Amador (2013) it follows that the standard deviation of time preference[20] shocks should be roughly similar to that of supply shocks from 1990 onward, while supply shocks had twice the standard deviation of time preference shocks in the 1960s. We set the standard deviation of the time preference shock to $\sigma_a = 0.013$ and the shock persistence parameter to $\rho_a = 0.94$ reflecting the importance of time preference shocks[21] for the Eurozone (Wyplosz, 2013). We follow the findings of Uhlig (2005) that monetary policy shocks contribute to less than 10 percent of the volatility of output in setting the standard deviation of the monetary policy shock to $\sigma_a = 0.0016$ with a persistence of $\rho_a = 0.25$. The matching efficiency shocks are assumed to have a standard deviation of $\sigma_a = 0.0016$ and a persistence of $\rho_a = 0.25$. These values are in-line with those of estimated DSGE models of the Eurozone (Smets and Wouters, 2003; Ratto, Roeger, and Veld, 2009; Zhang, 2013).

4. Results

In this section we present the results of our simulation exercise. In the first sub-section, we show the steady-state impact of three reform measures - a lower replacement rate, a reduction in vacancy posting costs and a higher matching efficiency - on the four sectors of our two-economy model. In the second sub-section we will discuss the impulse response functions (IRF) that show the adjustment of the economy after a transitory shock of one standard deviation and, finally, we will assess the robustness of our results.

4.1. Scenarios

Labor market institutions are widely believed to influence unemployment. Some, like unemployment benefits, change the equilibrium unemployment rate,

[20] Time preference shocks affect the intertemporal marginal rate of substitution on consumption, they are also referred to as demand shocks.

[21] We also account for asymmetric time preference shocks but, in difference to Wyplosz, assume the same standard deviation of shocks.

some, like employment protection and the efficacy of placement, change the nature of unemployment and may have ambiguous effects (Blanchard and Wolfers, 2000). Since the 1970s, reforms that affect benefit provision, employment protection and the organization of public and private employment agencies are common in the Eurozone (Turrini, Koltay, Pierini, Goffard, and Kiss, 2015). In this section, we discuss these reforms and their impact on three policy variables of our model, the replacement rate, vacancy posting costs and matching efficiency. While a change in the benefit system directly affects the replacement rate and a change in the PES business model directly affects matching efficiency, the impact of a reduction of employment protection is less clear.

In Europe, unemployment benefits in the 1980s and 1990s were higher than they were in the 1960s and 1970s (Jackman, 1998)and were attributed to increase the unemployment rate and unemployment persistence (Bean, 1994; Layard, Nickell, and Jackman, 1994; Lindbeck, 1996) as job search of the unemployed and reservation wages increase. To increase employment, most Eurozone countries cut the replacement rate between 2001 and 2014. The combined short and long-term average replacement rate for a worker being unemployed was reduced by 10 percentage points in Portugal, by 6 percentage points in France, Germany, and Spain and by 3 percentage points in Greece (OECD, 2016). By shifting from contributory to mean-tested benefits, Germany, beside some post-socialist countries, experienced the strongest drop in the replacement rate. A non-married worker with an average wage previously to unemployment experienced a drop of the replacement rate by 19 percentage points while that of a worker having a wage of 150 percent previously to unemployment was reduced even more drastically by 30 percentage points (OECD, 2016). Differently to Germany that had generous benefits prior to reforms, replacement rates for long-term unemployed in Greece, Italy, Portugal and Spain are traditionally low and were not subject to reforms. Today, the highest replacement rate for long-term unemployed is granted in Austria and the Benelux countries, while the replacement rates in Germany and France meet the EU-average.

In the economic literature, employment protection is one of the major reasons for unemployment persistence. In continental Europe, the introduction of fixed-term contracts and the abolishing of restrictions for temporary agency work was perceived as a way of doing both, reducing the costs related to employment protection and secure most employees from getting laid off. In the late 1990s, the first countries to introduce fixed-term contracts were France and Portugal. Spain, Italy and Germany followed in the mid 1980s. The legal design, however, is very different. Some countries require the same wage for fixed and permanent contracts, namely Belgium, France, Spain and the Netherlands, while others like France, Greece, Italy and Germany generally[22] prohibit the termination of fixed-term contracts before the expiration date. In most countries, other restrictions like a limitation of the duration of contracts or limitations to renewals apply. In

[22]There are some exceptions like misbehavior of the employee or the probation period in Germany when stated in the contract.

a second wave of reforms during the 1990s and early 2000s, Belgium, Germany, Greece, Italy, the Netherlands and Portugal lifted most of these restrictions. Today, Germany, Ireland and Latvia have the lowest requirements for fixed-term contracts in the Eurozone, while Estonia, France and Luxembourg have the highest.

The impact of lifting restrictions for fixed-term contracts relies on the reasons why firms use these contracts. Explanations are reduced firing costs Blanchard and Landier (2002) and efficiency gains in hiring and screening (Faccini, 2014; Portugal and Varejão, 2009/10/15; Lane, Stevens, and Burgess, 1996). Cahuc, Charlot, and Malherbet (2016), however, argue that regulations in continental Europe makes firing of temporary workers not necessarily easier and less expensive than firing permanent worker and refuse the reduced fire cost arguments. The latter explanation would imply an increase in matching efficiency. For firms it is more efficient and less costly to screen employees on the job (Bucher, 2010; Faccini, 2014; Kahn, 2010; Portugal and Varejão, 2009/10/15) before promoting them to permanent contracts. A result of the extended screening process and the reduction of uncertainty might be that employers are less reluctant in hiring new workers instead of keeping previously hired ones. This would increase matching efficiency, as more matches are created out of the same number of unemployed and vacancies. Half of the fixed-term contracts, however, do not exceed the probation period of permanent contracts, making it unlikely that these contracts are needed for screening purposes. In those cases it is, similar to employment agency work, firms hire worker out of a specific short-term labor demand that needs to be settled.

The main argument for an increase in matching efficiency by labor market reforms is, however, a more market-oriented service provision of public employment agencies and the opening-up of a market for private placement. The introduction of one-stop offices for the provision of services for the unemployed and benefit provision increased the scope of action of placement officers. Launov and Wälde (2016) claim that in the case of Germany these reforms attribute to 20% of the observed post-reform decline in unemployment that outpaces the impact of unemployment benefit reduction that they calculate to contribute to 5 % of the decline. For other countries, the reform of public employment services is less well documented.

For temporary work agencies, restrictions were lifted in the Netherlands already in the mid 1960s and in France and Germany in the early 1970s. Other countries like Austria, Belgium followed in the late 1980s, while Portugal, Spain and Italy remained restrictions till the mid or the late 1990s. In the last two decades, temporary employment agency work increased strongly in Austria and Germany from less than 1 to more than 2 percent of the workforce. Ireland could also increase temporary employment agency work strongly by more than one percentage point. Albeit of being at a high level (1.5 percent) already in the 1990s, the Netherlands increased the share of temporary employment agency work, while France and Luxembourg remained at a high level but reduced their share. Greece (0.1 percent), Italy (1.0 percent) and Spain (0.5 percent), instead, have a low level of temporary employment agency work.

The growth of temporary employment agency work is partially explained by their information providing role. The idea of these agencies screening workers for permanent employment goes back to Autor (2001) observing that temporary work agencies educate workers. As this education is only valuable for long-term relationships, he reasoned that education is part of a screening operation that intends to transfer workers to client companies for permanent employment. Similar to having fixed-term contracts for screening purposes, this increases the matching efficiency. Additionally, temporary employment agency work and to some extend fixed-term contracts are used to overcome short-term labor shortages when regular workers get ill, are in paternity / maternity leave or in times of a unusual high workload. This could explain the short duration of employment spells of temporary employment agency workers (Cahuc, Charlot, and Malherbet, 2016; Antoni and Jahn, 2009) and implies a reduction in vacancy posting costs.

4.2. Steady-state analysis

Our model is calibrated to reflect the structure of a typical EMU member state (see Section 3). In the benchmark scenario, both countries are symmetrical. In our three policy scenarios we have changed the labor market framework to reproduce the marginal impact of labor market reforms. The steady-state values of the four scenarios are presented in Table 1. The calibration of the model to the characteristics of a typical EMU member state results in a threshold productivity of 2.71. As there are only a small number of models with a search and matching framework and endogenous separations available, we have to compare this figure with a model calibrated for a non-EMU country. Our threshold productivity is slightly higher than the corresponding figures for the UK (Zanetti, 2011), an EU country but not a participant in the EMU. In the UK, unemployment benefits are lower compared to continental European countries. As the threshold productivity increases with an increasing benefits, we can explain these differences.

In the first policy scenario, the replacement rate for unemployed workers is reduced. Krause and Uhlig (2012), among others, consider the reduction of the replacement rate and the regime shift from an earnings-dependent to an earnings-independent system as crucial in explaining the large drop in unemployment in Germany. In the second scenario, we reduce vacancy posting costs. As mentioned earlier, a reduction in regulatory requirements for the posting of workers industry reduces the vacancy posting costs for firms, as there is an additional option for hiring workers with specific skills. In our third policy scenario, we follow Fahr and Sunde (2009), who analyze the increase in matching efficiency related to labor market reforms. The UK, the Scandinavian countries, the Netherlands and Germany introduced one-stop jobcentres to make it easier for the unemployed and the employers to connect.

4.2.1. Replacement rate

In our first policy scenario, we assume that the replacement rate of the domestic country is reduced by 1 percentage point (or roughly by two percent) compared to the benchmark rate.

Through this reform measure, the domestic country experiences lower wages[23], a decreasing threshold productivity[24] and a fall in endogenous separations. A more stable steady-state workforce, generally, decreases the necessity for firms to post vacancies[25]. The value of a vacancy increases, which results in an opposite effect, i.e. of increasing the probability of firms to open new positions. In our model, the latter effect dominates, thereby, increasing the number of vacancies. Both a rising number of vacancies and a falling unemployment rate increases labor market tightness sharply.

Vacancy posting costs

In the second policy scenario, we reduce the vacancy posting costs from 5.2 to 5.1 or by roughly two percent.

Table 1 reveals a rising labor market tightness, firms open more positions as costs shrink. As the reaction of the labor market tightness is stronger than the reduction of posting costs, it follows from equation (36) that wages rise in both sectors increasing the threshold productivity and endogenous separations. Given the productivity distribution that we calculated using the income distribution, this increase has only minor effects on total job separations. The most important impact of a reduction in vacancy posting costs is on the job creation condition (equation 33) where lower costs intensify the number of positions opened by the firms. Consequently, vacancies increase and the unemployment rate falls.

Matching efficiency

In our third policy scenario we raise the matching efficiency parameter from 0.5 to 0.51, or by roughly two percent.

The number of matches given both, the number of vacancies and the number of unemployed workers, increase. This has two implications for a firm. Firstly, as it becomes more likely that a position is filled, the costs of a match fall. The fall in the costs of a match, given the job destruction condition, increases separations, as it is less costly for a firm to replace workers. The threshold productivity and the number of transitions to unemployment, therefore, increase. The real wage also rises, since the average productivity increases with the rise in the threshold productivity. Secondly, an increase in matching efficiency also raises the probability of finding an appropriate worker in a given time span. With the increase in the speed of the matching process, unemployment declines. The magnitude of both effects depends on the calibration of the model. In our case, we observe a reduction in unemployment. The impact of an increase in matching speed outweighs the increase in job separations. Finally, firms can increase production as more workers are employed and the employed workers have a higher average productivity.

[23] This follows directly from the wage equation (36).
[24] A decrease in the threshold productivity follows from the job destruction condition (35).
[25] This results from the job creation (33)

For the foreign country, labor market reforms affect the sectoral division of production. In all our scenarios, output in the tradable goods sector increases. By shifting consumption towards the tradable goods sector the households in the foreign country can increase utility, given substitutability of non-tradable and tradable goods.

Table 1 on page 44 about here

4.3. Business cycle properties

In this section, we analyze the impact of labor market reforms on the business cycle dynamics of our model. We begin by discussing the plausibility of business cycles generated by the benchmark calibration of the model and compare the results with previous studies using similar models. In Table 2 we compare cross-correlations found in the data (Column 1) with the benchmark case (Column 2) and the three labor reform scenarios (Column 3 - 5).

Table 2 on page 45 about here

The co-movement of inflation and de-trended output is positive in countries being members of the Eurozone today (Andrle, Bruha, and Solmaz, 2013; Kiley, 1996). This is consistent with the findings of den Haan, Wouter J. and Sumner (2004), the price level appears to be counter-cyclical if inflation follows output positively and with a lag (Ball and Mankiw, 1994; Chadha and Prasad, 1994). In general, the co-movement of inflation and output is seen as an indicator that time preference shocks play an important role in determining business cycles in the Eurozone. The benchmark case can mimic the positive correlation of HP-filtered output and inflation. The correlation, however, is less strong in our model.

In most post-war studies of the US, wages are slightly pro-cyclical and this pro-cyclical behavior increases over time (Abraham and Haltiwanger, 1995). For Germany as the biggest economy in the Eurozone evidence is mixed. More recent studies like Marczak and Beissinger (2013) and Messina, Strozzi, and Turunen (2009) find a procyclical pattern, while P J Pérez (2001) using data up to the 1990s, find an counter-cyclical pattern for nominal and, as Lucke (1997), an acyclical pattern for real wages. The correlation we get from our model of a Eurozone country is surprisingly strong, especially for the tradable-goods sector. Verdugo (2014) also found strong pro-cyclical patterns after controlling for a composition effect during the recent Great Recession. To some extent, we might capture this effect by separating tradable and non-tradable goods. While our model matches the correlation of output and real wages for non-tradables, it fails to produce the strong correlation found for output and real wages in the

tradable goods sectors. However, more empirical research is needed to confirm that there really is a strong pro-cyclical pattern of Eurozone real wages.

The correlation of unemployment and vacancies has to be strongly negative for the US (Shimer, 2005). The correlation of Eurozone unemployment and vacancies seems to have the same sign but is slightly weaker. The model mimics the counter-cyclical relationship between unemployment and vacancies, but fails to produce the strong correlation. This is a typical phenomenon among models with endogenous job destruction, as fluctuations in the separation rate induce a positive relationship between unemployment and vacancies (Shimer, 2005; Zanetti, 2011).

As we have no wage rigidities in our model, real wages fluctuations are driven predominantly by fluctuations in productivity and in the labor force i.e. by searching either in the tradable or non-tradable sector. Endogenous separations, nevertheless, impose an counter-cyclical behavior on average real wages. Workers endogenously separate from firms if the idiosyncratic productivity is below a threshold level. The threshold level declines in a boom and increases with a recession. Given that workers, to some extent, are rewarded according to their individual productivity, the average wage increases in times of recession and is reduced in times of a boom. Whether wages are pro- or counter-cyclical depends, therefore, on the income distribution defining the idiosyncratic productivity of workers. In our model, real wages and inflation are procyclical and, as a consequence, real wages and inflation have to be positively correlated. By comparing the correlations of our model with the correlations derived from Eurozone (EA-12) time-series, we find a positive correlation for real wages and inflation in the tradable, but not in the non-tradable sector (Table 3). Some nominal wage rigidities might exist in the Eurozone, that prevent wages from adjusting to shocks. Wage rigidities can create an counter-cyclical pattern of real wages in some sectors of the economy. Radowski and Bonin (2010) find evidence for this hypothesis in their analysis of the wage-setting behavior of firms in Germany using survey data. According to their study, service sector firms tend to freeze nominal wages more frequently than firms in the manufacturing sector.

If we compare the benchmark standard deviations with the corresponding Eurozone (EA-12) figures we find a pattern common to most search and matching models. The volatility of vacancies and unemployment is significantly lower than that seen in the data (Shimer, 2005). The reason for this low volatility, however, is somehow different from that in previous models. If we compare standard deviations in the tradable and non-tradable sectors, they virtually match the data. The fluctuation of total unemployed and total vacancies, however, is much too low. The reason for this phenomenon is to be found in the assumption that workers can choose either of the two sectors in which to search for employment. A worker who has recently separated from a firm in the tradable sector is able to search for new employment in the non-tradable sector and vice-versa. If the shocks are not perfectly correlated, the labor market effects of productivity shocks on either one of the two sectors cancel out. If there is a positive productivity shock in the tradable goods sector, the share of unemployed workers searching

for a job in this sector, immediately increases. Vacancies in the tradable sector increase but those in the non-tradable good sector, because of an increase in labor market tightness, instantly drop. With a rise in vacancies in one sector and a drop in the other, overall fluctuations are small.[26] We, therefore, get the common result that our model is plausible except the results linked to the Shimer's puzzle.

There are three ways to cope with this problem: either to introduce the costs of switching occupations or by reducing the volatility of real wages and employment which would then increase the volatility of unemployment and vacancies or by including nominal wage rigidities. We followed Hagedorn and Manovskii (2008) who suggest altering the calibration of the Nash bargaining rule that determines wages. In the H-M calibration, we can, indeed, replicate a high volatility of vacancies and unemployment. Another way would be to introduce nominal and real wage rigidities. As Krause and Lubik (2007) show, the impact on volatilities cancels out in sticky price models, so we decided not to include sticky wages in our sticky price model.

In the third to fifth columns of Table 2 business cycle properties of the labor market reforms are presented. In general, fluctuations of vacancies and the unemployment rate increases slightly when the replacement ratio decreases and drops, if the matching efficiency increases. Fluctuations of real wages follow a reverse pattern. Vacancy posting costs reduce fluctuations in real wages, at least in the non-tradable goods sector, and increase fluctuations of vacancies and job-searchers in both sectors. The overall impact of reforms on business cycle properties, however, is small.

Business cycle properties look more favorable if we switch to a calibration with a low bargaining power for workers. The real wage depends in this setting to a great extent on unemployment benefits which we assume do not fluctuate. The volatility of real wages, therefore, is lower, while that of total vacancies and unemployment is much higher and in the case of unemployment benefits close to the volatility of the time series. Fluctuations in production are lower and more close to the time series than in the standard calibration. In this calibration, however, fluctuations in tradable goods production are lower than those in the non-tradable goods sector, which does not match the data. Cross correlations have, as in the standard calibration, the right sign. The only exception are real wages in the non-tradable sector which are negatively correlated to inflation, but strongly positively correlated in our standard calibration as well as in the calibration with a low bargaining power for workers. Correlations of real wages and output, as well as the correlation of output and inflation, are more close to the data in this calibration, but the negative correlation between vacancies and the unemployment rate is much too high.

Even though business cycle properties looked more favorable, we did not

[26] As we tried to be parsimonious and through we believe that the qualitative results of the labor market reform measures with regard to the benchmark scenario will not be affected, we did not introduce such costs here.

switch to the calibration with a low bargaining power for workers. The reason for this lies in the fact that steady-state values do not match the data. The proportion of workers looking for a job, given our assumptions on the distribution of income, is too high (31 percent).

4.4. Shock responses

In this section, we discuss the impulse responses to a positive domestic technology shock, a negative foreign technology shock, a time-preference shock affecting households living in the domestic economy and a monetary policy shock. With the exception of the monetary policy shock, all shocks are specified in a way to increase the debt of the foreign country.[27]

4.4.1. Domestic productivity shock

In Figures 1, 2 and 3, we have visualized the response of the model to a positive technology shock on domestic production of one standard deviation. On impact, output in both sectors increases while inflation declines (Figure 1). Owing to price rigidities, not all firms are able to adjust prices in the first period so that the response of prices to the shock is spread-out over time. The increased productivity of workers raises the value of a match, the threshold idiosyncratic productivity declines (Figure 3) and workers who would otherwise have been fired now remain employed and increase production instantly. Firms also start hiring unemployed workers as the value of an open position increases, but additional workers become productive with a delay of one period.

As separations diminish, we observe an increase in vacancies and a drop in the unemployment rate amplifying labor market tightness. Diminishing separations are exactly the reason why the average idiosyncratic productivity of workers declines. As prices in the non-tradable sector are more flexible regarding domestic shocks, the relative price of non-tradable to tradable goods (Figure 2) gets lower. Domestic households shift consumption towards non-tradable goods. Foreign households rather experience a drop in the prices of tradable goods produced in the domestic country and shift consumption towards these goods. As it is known that the shock is transitory, that terms of trade will improve in the future and that exchange rates are irrevocably fixed in a currency union, it is beneficial for households in the foreign country to go into debt (Figure 1).

Figure 1 on page 46 and Figure 2 on page 47 about here

In our model, wages are bargained in the second stage of a two-stage process. In the first stage, workers and firms decide whether to match or not, in the second stage the individual wages are negotiated according to, inter alia, the

[27] Please note that due to endogenous job destruction, the adjustment of the economy after a positive and negative shock is not symmetric (see also Pissarides (2000), chapter 2).

idiosyncratic productivity. The impact of the shock on average wages is not obvious. As total factor productivity increases, there is a positive stimulus on the average wage. The average idiosyncratic productivity, however, declines with falling endogenous separations, serving as a negative stimulus. In the first period after the shock, wages decline as job separations are reduced and average idiosyncratic productivity falls sharply, overcompensating for the increase in total factor productivity. In the second period, new workers hired in the first period begin their employment, raising average idiosyncratic productivity and, therefore, average wages (Figure 3).[28]

In both sectors, vacancies increase and the number of workers searching for employment drops, although this drop is more pronounced in the non-tradable sector. Job creation is stronger in the tradables sector and we see a shift from non-tradable to tradable employment in the first periods. With a declining demand among foreign households for domestic tradables, this pattern is reversed in later periods.

Figure 3 on page 48 about here

Replacement rate

All our four scenarios follow the pattern just sketched. In the first scenario, indicated by a broken line, we have reduced the replacement rate by one percentage point as compared to the benchmark scenario, indicated by a continuous line. The impact of an increase in total factor productivity is weaker when compared to the benchmark case (Figures 1 and 2). As we see in Table 1, the steady-state of this scenario is characterized by a high labor market tightness and a small labor-turnover[29] that imposes a low threshold productivity compared to the other scenarios. Generally, the impact of a productivity shock on job creation and job-destruction is lower if the steady-state labor market tightness is high, while a low threshold productivity increases the impact on job-creation but reduces the impact on job-destruction.

We see that the firms reduces endogenous separations less strongly and create more vacancies than in the benchmark, as they are not able to adjust employment in the same way by simply keeping workers. The increase in vacancies is only slightly above the benchmark but the reduction in unemployment is significantly lower. As in the benchmark case, we see a shift in employment from the non-tradable to the tradable sector. In sum, employment is lower in both sectors, as

[28] Please note that we assumed that the productivity of new workers is strongly above average in the first period to avoid immediate separations.

[29] Labor turnover is defined as the sum of hirings and separations. In our model, we distinguish an exogenous fixed separation rate and an endogenous separation rate being subject to economic conditions. In the steady-state, the number of hirings has to equal the number of total separations to keep the unemployment rate constant. Therefore, the number of endogenous separations determines differences among scenarios with regard to the steady-state labor-turnover.

is the change in production and in inflation. Foreign households tend to benefit less from net-exports and the increase in foreign debt of the foreign country is smaller than in the benchmark scenario. As competitiveness of the non-reforming country is higher and net-exports are lower, a reduction of the replacement rate does not satisfy the definition of a "beggar thy neighbor policy".

Vacancy posting costs

Our second policy scenario, indicated by a dotted line (Figures 1 and 2), shows a reduction in vacancy posting costs. As shown in the steady-state section, this makes hiring workers less costly and increases job-turnover and the threshold productivity. Lower vacancy posting costs directly increase the impact of the productivity shock on job-creation and job-destruction. The increase in the steady-state labor market tightness, nevertheless, has a reverse effect, while a higher steady-state threshold productivity decreases the impact of the shock on job-creation and increases it on job-destruction. Compared to the benchmark scenario, firms gain more from keeping workers employed. The more workers the firm holds, the fewer vacancies it posts. This effect is so strong that it can overcompensate for an increase in vacancies following a reduction in posting costs[30]. In sum, we see a tiny improvement in the terms of trade, an increase in net exports and an increase in foreign debt of the foreign country compared to the benchmark case. Differences to the benchmark, however, are small. In general, a reduction in vacancy posting costs might decrease competitiveness of the non-reforming country and increase foreign debt. Given the calibration on a typical EMU-country, the impact of this reform measure is small.

Matching efficiency

A third policy scenario, where we have increased the matching efficiency by two percent, is indicated by a dotted / broken line (Figures 1 and 2). Here we record a stronger increase in the tradable goods production as compared to the benchmark case. Gains in production are again caused by a stronger rise in employment and a stronger drop in unemployment. We, nevertheless, observe a weaker increase in vacancies. The reason for this effect is a strong increase in steady-state threshold productivity that dampens the impact of the productivity shock on job-creation. The increase in matching efficiency, however, is partly reversing this effect as it reduces the time workers spend searching for a job and, therefore, increases the value of an open position. A higher steady-state threshold productivity raises the effect of the shock on job-destruction by making it more beneficial for firms to reduce endogenous separations. In sum, more workers produce a higher output, as compared to the benchmark. Again, the

[30]By comparing these standard results with our sensitivity case, it can be easily seen that the impact of vacancy posting costs on a change in vacancies depends on the idiosyncratic productivity distribution. In our sensitivity scenario, where the standard deviation of the productivity distribution is smaller, the increase in vacancies due to cost reduction overcompensates the reduction in vacancies due to less separations. In the standard scenario, however, the impact is almost neutral.

increase in output necessitates a stronger drop in prices which, in turn, raises net exports and foreign debt of the foreign country. A reduction in matching efficiency, therefore, reduces competitiveness and may impose a "beggar thy neighbor policy".

4.4.2. Foreign productivity shock

In the previous section, a positive technology shock in the domestic country was the reason for an increase in the foreign country's foreign debt. A negative technology shock in the foreign country should also increase foreign debt for similar reasons. Unlike the case of the domestic country, we here analyze a shock that affects the tradable goods sector only. In the benchmark scenario, the negative technology shock improves the terms of trade in the domestic economy (Figure 4). As in the scenario with a positive technology shock, net exports increase and, consequently, the foreign country experiences a rise in debt. Households in both countries shift consumption from foreign tradables, where prices tend to rise, to tradables from the domestic economy. In sum, the prices of tradables rise, which is why domestic households shift from tradable to non-tradable consumption. The impact of the shock on tradable goods production in the domestic economy, therefore, is ambiguous. Demand by households for tradables shrinks as they shift from tradable to non-tradable goods but also increases as they move from foreign tradables to domestically produced ones. Additionally, households in the foreign country increase their demand for tradables produced in the domestic economy but reduce their overall demand for tradables. For EU member country with a high degree of openness, it is nevertheless likely, that the demand for domestically produced tradables will increase.

A stimulus in demand affects job-creation, job-destruction and wages in a similar way as a productivity shock. Firms post more vacancies and reduce the number of endogenous job separations. In our two sector setting, a rise in wages in one sector increases the value of job-search in this sector. As more workers search for jobs in the tradable sector and firms separate from less workers, production in the tradable sector increases while it first stagnates and then falls in the non-tradable sector. When the productivity shock fades out and foreign households repay their debt, we see a rebound of non-tradable and a reduction in tradable production.

Labor market reforms, again, affect the pattern of adjustment to a macroeconomic shock. The impact of the shock on employment is smaller if the replacement rate is lower. The effect of an increase in demand by foreign households is less pronounced if steady-state labor market tightness is higher. It decreases the impact of the shock on job-destruction and unemployment and enhances it on job-creation and vacancies. Additionally, if firms wish to raise employment, they have to increase the posting of vacancies by larger amounts than in the benchmark case as they cannot reduce endogenous separations that strongly. The steady-state threshold productivity is low which limits the adjustment via job-destruction and lowering endogenous seperation. In sum, the increase in output is weaker, reducing the impact on prices, and the shift in employment

from the non-tradable to the tradable sector. This results in a stronger rise in the prices of tradable goods than in the benchmark case and a smaller increase in net exports and foreign debt of the foreign country.

Figure 4 on page 49 about here

Again, as in the scenarios with a productivity shock affecting the domestic country, an increase in matching efficiency and a reduction in vacancy posting costs have a unidirectional impact on vacancies and unemployment. The reasons for the lesser impact of a shock on vacancies in these two scenarios as compared to the benchmark case are grounded in the high steady-state threshold productivity levels. These reduce the impact of the shock on job-creation and vacancies and increases it on job-destruction and unemployment. The threshold productivity effect is strong enough to compensates for an increase in vacancies through the vacancy posting cost reduction. In the matching efficiency scenario, similarly, the impact of the shock on job-creation and vacancies is smaller than in the benchmark scenario. Steady-state labor market tightness, however, is low so that this effect is not compensated for like in the vacancy posting cost scenario. Vacancies, therefore, are lower and the impact on job-destruction and unemployment is higher as is the adjustment of tradable production.

For the foreign country, a more flexible adjustment in the tradable sector of the domestic economy enhances the benefits of an increase in debt. We have seen that a reduction in the replacement rate weakens the economy's ability to reacting to productivity shocks. The adjustment of the foreign economy, therefore, has to be keener and the increase in foreign debt of the foreign country will be consequently lower. In the scenarios of vacancy cost reduction and of an increase in matching efficiency, the economy is more flexible in its ability to adjust employment, increasing domestic net exports and, consequently, the foreign country's foreign debt.

4.4.3. Time preference and monetary policy shocks

The time preference shock affects the stochastic discount factor in our model. Domestic households tend to discount the loss in utility of shifting consumption to future periods by a smaller amount. We observe a reduction in consumption which brings down prices in both sectors of the domestic economy. For foreign households, domestic tradables become relatively less expensive. Households in the foreign country shift consumption from foreign to domestically produced tradables and from the non-tradable to the tradable sector. In the domestic economy, we see a shift in production from the non-tradable to the tradable goods sector while in the foreign country tradable production declines. With rising net-exports, the foreign debt of the foreign country also increases (Figure 4).

The increase in foreign debt of the foreign country depends on the flexibility of the domestic country in shifting production from the non-tradable to the tradable

goods sector. In the scenario with an increase in matching efficiency, job creation and vacancies react weaker but job-destruction and a reduction in endogenous separations compensates for a less strong increase in vacancies. The drop in non-tradable production is stronger reducing the strength of price adjustment for domestic tradable and non-tradable goods. With a weaker reduction in tradable prices, foreign households reduce their demand for these goods and foreign debt reacts weaker than in the benchmark scenario. For domestic time preference shocks we cannot identify a "beggary thy neighbor policy" for any reform measure.

However, the increase in foreign debt of the foreign country is also lower when reducing the replacement rate. In this scenario the shift from non-tradable to tradable production is weaker as labor-turnover is lower and the threshold productivity is higher limiting endogenous separations. The limited supply of tradable goods, however, reduces the possibility of foreign households to shift demand from foreign produced to domestically produced tradables.

The impact of the shock in a scenario where we reduced vacancy posting costs, was stronger than in our other policy scenarios, where we reduced the replacement rate and increased matching efficiency. The reason for this phenomenon is that tradable output reacts more strongly than in the replacement rate reduction scenario but there is only a tiny impact on tradable prices. Lower vacancy posting costs directly translate into a higher consumption reducing the impact of the shock on prices. Foreign debt, therefore, increases by less than in the benchmark case but by more than in the other two scenarios.

A positive monetary policy shock has no impact on debt in the benchmark case. The transmission of monetary policy is identical in both countries. On impact, inflation diminishes and consumption increases. As prices adjust, both sectors have to reduce production and employment. In the scenario with a reduction in unemployment benefits, employment is less volatile in the domestic economy as compared to that of the initially symmetric foreign country. Prices in the foreign economy react more strongly than those of the domestic economy. Terms of trade in the domestic country improve and foreign households shift consumptions toward tradables and domestic tradables. The foreign debt of the foreign country rises (Figure 4). In the scenario with a fall in vacancy posting costs and an increase in matching efficiency, the domestic country reacts more strongly to the monetary policy shock and reduces output and employment more strongly than in the benchmark scenario. Domestic prices, therefore, are higher than foreign prices, the terms of trade worsen and we see a decline in the foreign country's foreign debt. In sum, the increase in vacancy posting costs and an increase in matching efficiency do not satisfy the "beggar thy neighbor definition" while a reduction in the replacement rate does. The overall impact of a monetary policy shock on debt, however, is small compared to productivity and time-preference shocks so that, typically a reduction in vacancy posting costs and an increase in matching efficiency increases the probability that there could be a "beggar thy neighbor policy" while a reduction in the replacement rate reduces this probability..

4.4.4. Sensitivity analysis

The results of our model clearly depend on the distribution of the idiosyncratic productivity shock that we calibrated in Section (3). Calibrating the model to reflect the properties of a typical member country of the EMU results in a low value for endogenous job destruction. The standard deviation of idiosyncratic productivity was 0.48, which is broadly in line with Trigari (2009). In this section, we lower the standard deviation to 0.38, which reduces the steady-state labor market tightness, given a steady-state threshold productivity of 2.73.[31] The threshold productivity is similar to that in the standard benchmark scenario, unemployment benefits are higher (9.1 compared to 8.5), while real wages are lower (12.5 compared to 13.1). Total output 12.3 is also lower as compared to the standard benchmark case of 13.

Reducing the standard deviation in the idiosyncratic productivity in all sectors of both countries raises the productivity threshold from 0.25 to 3. A new value for the equilibrium threshold productivity requires a new full set of calibrations. These new parameter values yield higher steady-state unemployment, lower average real wages, and a lower output. The qualitative results of the previous section, nevertheless, remain the same. In general, the impact of labor market reforms turns out to be weaker, the labor market is tighter and weaker in adjusting. The scenario with a reduction in the replacement rate (broken line) still has the lowest impact on tradable production and consumption after a positive domestic productivity shock. The foreign debt of the foreign country increases less strongly. The scenario with a higher matching efficiency (dotted / broken line) increases the flexibility of production and increases foreign debt of the foreign country most strongly. The scenario with an increase in vacancy posting costs remains to weakly increasing the foreign debt of the foreign country.

Figure 3 on page 48 about here

---

5. Conclusion

After the creation of the EMU, current account imbalances increased sharply. Blanchard and Giavazzi (2002) ascribe imbalances to a convergence mechanism, and Lane and Pels (2012) attribute them to asymmetric growth prospects that both lead to strong capital inflows in deficit countries. In addition to these more conventional explanations, there is a discussion about beggar-thy-neighbor-policies concerning to what extent structural reforms, and, more explicitly, labor market reforms, can be blamed instead. In this paper, we have examined the impact of three different types of labor market reform measures on foreign debt, namely a reduction in the replacement rate, reforms lowering vacancy posting

[31] The IRFs for the sensitivity analysis are available in the Figures supplement

costs and such that increase the matching efficiency. If reforms increase the foreign debt of the non-reforming country compared to a non-reform benchmark, there might exist a "beggar thy neighbor policy".

The first reform measure, a reduction in the replacement rate, reduces both steady-state unemployment and endogenous job destruction. Therefore, labor turnover is lower than in the benchmark, implying a weaker impact of shocks on output, prices and also on net exports. The adjustment of foreign debt of a non-reforming country is weaker when compared to the benchmark case. The reduction in the costs of posting a vacancy, resulting from our second reform measure, corresponds to a slightly stronger adjustment of foreign debt of the non-reformer. Firms in the reforming country are able to alter employment at a lower cost and, thus, more strongly. This result, however, depends on the calibration of the model. Reducing vacancy posting costs depresses wages and increases endogenous job-separations. The former increases and the latter decreases labor-turnover. By calibrating the model on typical EMU-member countries, we observe a slightly more flexible labor market strengthening the reaction of the foreign debt of the non-reforming country to macroeconomic shocks. The strongest increase in foreign debt, however, can be attributed to an increase in matching efficiency, resulting from our third reform measure. In this scenario, endogenous job-destruction increases, wages are unaffected and the length of time of a vacancy being open decreases. Labor turnover is higher and this amplifies the impact of a shock on employment, production and all macroeconomic variables related to changes in prices. A higher matching efficiency, thus, leads to an increase in employment and output in the steady-state, but comes at the cost of higher fluctuations in the presence of shocks.

The impact of labor market reforms on current account imbalances, therefore, relies on the specific bundle of reforms and on the shocks considered. All three types of labor market reforms reduce the impact of time preference shocks on net exports and the foreign debt of the foreign country. In the case of productivity shocks, reforms are ambiguous. For the EMU, nevertheless, fears about a beggar-thy-neighbor policy which leaves non-reforming countries with a loss of competitiveness and an increase in foreign debt cannot be corroborated by us for the specific bundle of reforms applied in the early and mid-2000s. The strong reduction in the replacement rate reduces the impact of productivity shocks on output and prices which more or less compensates for the effects of an increase in matching efficiency and a drop in vacancy posting costs. Future labor market reforms, however, might have an impact on current account imbalances if they concentrate on single measures or countries apply reforms unevenly.

References

Abraham, K. G., and J. C. Haltiwanger (1995): "Real Wages and the Business Cycle," *Journal of Economic Literature*, 33(3), 1215–1264.

Ahamdanech-Zarco, I., J. A. Bishop, A. Grodner, and H. Liu (2009): "Labor Market Efficiency in Spain: A Stochastic Frontier Approach," *East Carolina University Working Paper*, (0906).

Andolfatto, D. (1996): "Business Cycles and Labor-Market Search," *American Economic Review*, 86(1), 112–132.

Andrle, M., J. Bruha, and S. Solmaz (2013): "Inflation and Output Comovement in the Euro Area: Love at Second Sight?," *International Monetary Fund, Working Papers*, (13/192).

Angelini, E., M. Ca' Zorzi, and K. Forster (2014): "External and Macroeconomic Adjustment in the Larger Euro Area Countries," *European Central Bank, Working Paper Series*, (1647).

Annicchiarico, B., F. Di Dio, and F. Felici (2013): "Structural Reforms and the Potential Effects on the Italian Economy," *Journal of Policy Modeling*, 35(1), 88–109.

Antoni, M., and E. J. Jahn (2009): "Do Changes in Regulation Affect Employment Duration in Temporary Help Agencies?," *Industrial and Labor Relations Review*, 62(2), 226–251.

Arpaia, A., A. Kiss, and A. Turrini (2014): "Is Unemployment Structural or Cyclical? Main Features of Job Matching in the EU after the Crisis," *Institute for the Study of Labor, Policy Papers*, (91).

Autor, D. H. (2001): "Why Do Temporary Help Firms Provide Free General Skills Training?," *The Quarterly Journal of Economics*, 116(4), 1409–1448.

Avouyi-Dovi, S., D. Fougere, and E. Gautier (2013): "Wage Rigidity, Collective Bargaining, and the Minimum Wage: Evidence from French Agreement Data," *Review of Economics and Statistics*, 95(4), 1337–1351.

Ball, L., and N. G. Mankiw (1994): "Asymmetric Price Adjustment and Economic Fluctuations," *Economic Journal*, 104(423), 247–261.

Bean, C. R. (1994): "European Unemployment: A Survey," *Journal of Economic Literature*, 32(2), 573–619.

Benchimol, J., and A. Fourcans (2012): "Money and Risk in a DSGE Framework: A Bayesian Application to the Eurozone," *Journal of Macroeconomics*, 34(1), 95–111.

Bernanke, B. S., M. Gertler, and S. Gilchrist (1999): "The Financial Accelerator in a Quantitative Business Cycle Framework," in *Handbook of Macroeconomics. Volume 1C*, ed. by J. B. Taylor, and M. Woodford, Handbooks in Economics, vol. 15;, pp. 1341–1393. Elsevier Science, North-Holland, Amsterdam and New York and Oxford.

Bertola, G., and A. Lo Prete (2009): "Reforms, Finance, and Current Accounts," *Paper presented at the IZA/CEPR 11th European Summer Symposium in Labour Economics.*

Bizuneh, M., and N. Valev (2014): "The Devil You Know: Pegs versus Floats with Uncertain Outcomes," *Review of International Economics*, 22(4), 686–699.

Blanchard, O. (2007): "Adjustment within the Euro: The Difficult Case of Portugal," *Portuguese Economic Journal*, 6(1), 1–21.

Blanchard, O., and F. Giavazzi (2002): "Current Account Deficits in the Euro Area: The End of the Feldstein Horioka Puzzle?," *Brookings Papers on Economic Activity*, 33(2), 147–210.

Blanchard, O., and A. Landier (2002): "The Perverse Effects of Partial Labour Market Reform: Fixed-Term Contracts in France," *The Economic Journal*, 112(480), F214–F244.

Blanchard, O., and J. Wolfers (2000): "The Role of Shocks and Institutions in the Rise of European Unemployment: The Aggregate Evidence," *The Economic Journal*, 110(462), C1–C33.

Bodenstein, M. (2011): "Closing Large Open Economy Models," *Journal of International Economics*, 84(2), 160–177.

Brancaccio, E. (2012): "Current Account Imbalances, the Eurozone Crisis, and a Proposal for a 'European Wage Standard'," *International Journal of Political Economy*, 41(1), 47–65.

Broersma, L. (1997): "The Elasticity and Efficiency of Job Matching in Dutch Regional Labour Markets," *Papers in Regional Science*, 76(4), 449–465.

Bucher, A. (2010): "Hiring Practices, Employment Protection and Temporary Jobs," .

Burda, M., and C. Wyplosz (1994): "Gross Worker and Job Flows in Europe," *European Economic Review*, 38(6), 1287–1315.

Cahuc, P., O. Charlot, and F. Malherbet (2016): "Explaining the Spread of Temporary Jobs and its Impact on Labor Turnover," *International Economic Review*, 57(2), 533–572.

Calvo, G. A. (1983): "Staggered Prices in a Utility-Maximizing Framework," *Journal of Monetary Economics*, 12(3), 383–398.

Carone, G., F. Pierini, K. Stovicek, and E. Sail (2009): *Recent Reforms of the Tax and Benefit Systems in the Framework of Flexicurity*, vol. 43, February 2009 of *European economy. Occasional papers*. Publications Office, Luxembourg.

Chadha, B., and E. Prasad (1994): "Are Prices Countercyclical? Evidence from the G-7," *Journal of Monetary Economics*, 34(2), 239–257.

Chen, R., G. M. Milesi-Ferretti, and T. Tressel (2013): "External Imbalances in the Eurozone," *Economic Policy*, (73), 103.

Crespo-Cuaresma, J., and O. Fernandez-Amador (2013): "Business Cycle Convergence in EMU: A Second Look at the Second Moment," *Journal of International Money and Finance*, 37, 239–259.

den Haan, Wouter J., G. Ramey, and J. Watson (2000): "Job Destruction and Propagation of Shocks," *American Economic Review*, 90(3), 482–498.

den Haan, Wouter J., and S. W. Sumner (2004): "The Comovement between Real Activity and Prices in the G7," *European Economic Review*, 48(6), 1333–1347.

Destefanis, S., and R. Fonseca (2007): "Matching Efficiency and Labour Market Reform in Italy: A Macroeconometric Assessment," *Labour*, 21(1), 57–84.

Devereux, M. B., and A. Sutherland (2011): "Country Portfolios In Open Economy Macro–Models," *Journal of the European Economic Association*, 9(2), 337–369.

Dixit, A. K., and J. E. Stiglitz (1977): "Monopolistic Competition and Optimum Product Diversity," *The American Economic Review*, 67(3), 297–308.

Fabiani, S., K. Galuscak, C. Kwapil, A. Lamo, and T. Room (2010): "Wage Rigidities and Labor Market Adjustment in Europe," *Journal of the European Economic Association*, 8(2-3), 497–505.

Faccini, R. (2014): "Reassessing Labour Market Reforms: Temporary Contracts as a Screening Device," *The Economic Journal*, 124(575), 167–200.

Fahr, R., and U. Sunde (2009): "Did the Hartz Reforms Speed-Up the Matching Process? A Macro-Evaluation Using Empirical Matching Functions," *German Economic Review*, 10(3), 284–316.

Felbermayr, G., M. Larch, and W. Lechthaler (2012): "Labour Market Reforms in a Globalised World," *Intereconomics/Review of European Economic Policy*, 47(5), 307–312.

Ferrero, A., M. Gertler, and Svensson, Lars E. O. (2008): "Current Account Dynamics and Monetary Policy," *National Bureau of Economic Research, Working Papers*, (13906).

Gerlach, S., and G. Schnabel (2000): "The Taylor Rule and Interest Rates in the EMU Area," *Economics Letters*, 67(2), 165–171.

Hagedorn, M., and I. Manovskii (2008): "The Cyclical Behavior of Equilibrium Unemployment and Vacancies Revisited," *American Economic Review*, 98(4), 1692–1706.

Hillmann, K. (2009): "Does the Hartz IV Reform have an Effect on Matching Efficiency in Germany? A Stochastic Frontier Approach," *Munich Personal RePEc Archive (MPRA) Papers*, (22295).

Hobijn, B., and A. Sahin (2007): "Job-Finding and Separation Rates in the OECD," *Economics Letters*, 104(3), 107–111.

Ibourk, A. (2004): "Aggregate Matching Efficiency: A Stochastic Production Frontier Approach, France 1990-1994," *Empirica*, 31(1), 1–25.

Jackman, R. (1998): "European Unemployment: Why is it so High and What Should be Done About it?," in *Unemployment and the Australian Labour Market*, ed. by G. Debelle, and J. Borland, RBA Annual Conference Volume. Reserve Bank of Australia.

Jensen, J. B., and L. G. Kletzer (2012): "Tradable Services: Understanding the Scope and Impact of Services Offshoring," in *The WTO and Trade in Services. Volume 1*, ed. by B. Hoekman, pp. 337–381. Elgar Research Collection. Critical Perspectives on the Global Trading System and the WTO, vol. 20. Cheltenham, U.K. and Northampton, Mass.: Elgar.

Jung, P., and M. Kuhn (2014): "Labour Market Institutions and Worker Flows: Comparing Germany and the US," *Economic Journal*, 124(581), 1317–1342.

Kahn, L. (2010): "Employment Protection Reforms, Employment and the Incidence of Temporary Jobs in Europe: 1996-2001," *Labour Economics*, 17(1), 1–15.

Kennedy, M., and T. Slok (2005): "Structural Policy Reforms and External Imbalances," *Organisation for Economic Co-operation and Development, Economics Department Working Papers*, (415).

Kiley, M. T. (1996): "The Lead of Output Over Inflation in Sticky Price Models," *Board of Governors of the Federal Reserve System (U.S.), Finance and Economics Discussion Series*, (96-33).

Kohlbrecher, B., C. Merkl, and D. Nordmeier (2013): "The Matching Function: A Selection-Based Interpretation," *Labor and Socio- Economic Research Center (LASER) Discussion Papers*, (70).

Krause, A., U. Rinne, and K. F. Zimmermann (2014): "How Far Away is a Single European Labor Market?," *Institute for the Study of Labor, Discussion Papers*, (8383).

Krause, M. U., and T. A. Lubik (2007): "The (Ir)relevance of Real Wage Rigidity in the New Keynesian Model with Search Frictions," *Journal of Monetary Economics*, 54(3), 706–727.

Krause, M. U., and H. Uhlig (2012): "Transitions in the German Labor Market: Structure and Crisis," *Journal of Monetary Economics*, 59(1), 64–79.

Lane, J., D. Stevens, and S. Burgess (1996): "Worker and Job Flows," *Economics Letters*, 51(1), 109–113.

Lane, P. R., and B. Pels (2012): "Current Account Imbalances in Europe," IIS Discussion Paper Series(397).

Launov, A., and K. Wälde (2016): "The Employment Effect of Reforming a Public Employment Agency," *European Economic Review*, 84, 140–164.

Layard, R., S. Nickell, and R. Jackman (1994): *The Unemployment Crisis*. Oxford and New York and Oxford University Press.

Lindbeck, A. (1996): "The West European Employment Problem," *Weltwirtschaftliches Archiv*, 132(4), 609–637.

Lubik, T. (2013): "The Shifting and Twisting Beveridge Curve: An Aggregate Perspective," *Federal Reserve Bank of Richmond, Working Papers*.

Lubik, T. A., and M. U. Krause (2014): "Modeling Labor Markets in Macroeconomics: Search and Matching," *Federal Reserve Bank of Richmond, Working Papers*, (14-19).

Lucke, B. (1997): "An Adelman-Test for Growth Cycles in West Germany," *Empirical Economics*, 22(1), 15–40.

Marczak, M., and T. Beissinger (2013): "Real Wages and the Business Cycle in Germany," *Empirical Economics*, 44(2), 469–490.

Merz, M. (1995): "Search in the Labor Market and the Real Business Cycle," *Journal of Monetary Economics*, 36(2), 269–300.

Messina, J., C. Strozzi, and J. Turunen (2009): "Real Wages over the Business Cycle: OECD Evidence from the Time and Frequency Domains," *Journal of Economic Dynamics and Control*, 33(6), 1183–1200.

Mortensen, D. T., and C. A. Pissarides (1994): "Job Creation and Job Destruction in the Theory of Unemployment," *Review of Economic Studies*, 61(3), 397–415.

——— (2003): "Taxes, Subsidies and Equilibrium Labor Market Outcomes," in *Designing Inclusion: Tools to Raise Low-end Pay and Employment in Private Enterprise*, ed. by E. S. Phelps, pp. 44–73. Cambridge and New York and Melbourne and Cambridge University Press.

Nickell, S. (1997): "Unemployment and Labor Market Rigidities: Europe versus North America," *Journal of Economic Perspectives*, 11(3), 55–74.

Nickell, S., and R. Layard (1999): "Labor Market Institutions and Economic Performance," in *Handbook of Labor Economics*, ed. by David Card and Orley Ashenfelter, vol. Volume 3, Part C, pp. 3029–3084. Elsevier.

Obstfeld, M., and K. Rogoff (1995): "The Intertemporal Approach to the Current Account," in *Handbook of International Economics. Volume 3*, ed. by G. M. Grossman, and K. Rogoff, pp. 1731–1799. Handbooks in Economics, vol. 3 and Amsterdam and New York and Oxford and Elsevier, North-Holland.

——— (2000): "New Directions for Stochastic Open Economy Models," *Journal of International Economics*, 50(1), 117–153.

——— (2006): "The Unsustainable US Current Account Position Revisited," *CEPR Discussion Papers*, (5416).

OECD (2016): *OECD Tax-Benefit Model: Key Indicators (database)*. OECD Publishing.

P J Pérez (2001): "Cyclical Properties in the Main Western Economies," *Centre for Growth and Business Cycle Research Discussion Paper Series*, (33).

Petrongolo, B., and C. A. Pissarides (2001): "Looking into the Black Box: A Survey of the Matching Function," *Journal of Economic Literature*, 39(2), 390–431.

Phelps, E. S. (1994): *Structural Slumps: The Modern Equilibrium Theory of Unemployment, Interest, and Assets*. In collaboration with Hian Teck Hoon, George Kanaginis, and Gylfi Zoega and Cambridge and London and Harvard University Press.

Pissarides, C. A. (2000): *Equilibrium Unemployment Theory: Ex. mit 13-stelliger und ohne 13-stellige ISBN*. MIT Press, Cambridge, Mass. [u.a.], 2. ed. edn.

Portugal, P., and J. Varejão (2009/10/15): "Why Do Firms Use Fixed-Term Contracts?," .

Poutineau, J.-C., and G. Vermandel (2015): "Cross-Border Banking Flows Spillovers in the Eurozone: Evidence from an Estimated DSGE Model," *Journal of Economic Dynamics and Control*, 51, 378–403.

Rabanal, P., and J. F. Rubio-Ramirez (2005): "Comparing New Keynesian Models of the Business Cycle: A Bayesian Approach," *Journal of Monetary Economics*, 52(6), 1151–1166.

Radowski, D., and H. Bonin (2010): "Downward Nominal Wage Rigidity in Services: Direct Evidence from a Firm Survey," *Economics Letters*, 106(3), 227–229.

Ratto, M., W. Roeger, and J. i. t. Veld (2009): "QUEST III: An Estimated Open-Economy DSGE Model of the Euro Area with Fiscal and Monetary Policy," *Economic Modelling*, 26(1), 222–233.

Richard B. Freeman (2006): "Labor Market Imbalances: Shortages, or Surpluses, or Fish Stories?," *Federal Reserve Bank of Boston, Conference Series*, 51.

Salvatore, D. (1998): "Europe's Structural and Competitiveness Problems and the Euro," *World Economy*, 21(2), 189–205.

Schmillen, A. (2013): "Are Wages Equal across Sectors of Production? A Panel Data Analysis for Tradable and Non-tradable Goods," *Economics of Transition*, 21(4), 655–682.

Schmitt-Grohé, S., and M. Uribe (2003): "Closing Small Open Economy Models," *Journal of International Economics*, 61(1), 163–185.

Shimer, R. (2005): "The Cyclical Behavior of Equilibrium Unemployment and Vacancies," *American Economic Review*, 95(1), 25–49.

Smets, F., and R. Wouters (2003): "An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area," *Journal of the European Economic Association*, 1(5), 1123–1175.

Taylor, J. B. (1993): "Discretion versus Policy Rules in Practice," *Carnegie-Rochester Conference Series on Public Policy*, 39, 195–214.

Taylor, J. B., and M. Woodford (eds.) (1999): *Handbook of Macroeconomics. Volume 1C*, Handbooks in Economics, vol. 15;. Elsevier Science, North-Holland, Amsterdam and New York and Oxford.

Trigari, A. (2009): "Equilibrium Unemployment, Job Flows, and Inflation Dynamics," *Journal of Money, Credit, and Banking*, 41(1), 1–33.

Turrini, A., G. Koltay, F. Pierini, C. Goffard, and A. Kiss (2015): "A decade of labour market reforms in the EU: Insights from the LABREF database," *IZA Journal of Labor Policy*, 4(1), 353.

Uhlig, H. (2005): "What Are the Effects of Monetary Policy on Output? Results from an Agnostic Identification Procedure," *Journal of Monetary Economics*, 52(2), 381–419.

van Vliet, O., J. Been, K. Caminada, and K. Goudswaard (2012): "Pension Reform and Income Inequality Among the Elderly in 15 European Countries," *Munich Personal RePEc Archive (MPRA) Papers*, (32940).

Verdugo, G. (2014): "The Great Compression of the French Wage Structure, 1969-2008," *Institute for the Study of Labor, Discussion Papers*, (8088).

Walsh, C. E. (2005): "Labor Market Search, Sticky Prices, and Interest Rate Policies," *Review of Economic Dynamics*, 8(4), 829–849.

Wyplosz, C. (2013): "The Eurozone Crisis and the Competitiveness Legend," *Asian Economic Papers*, 12(3), 63–81.

Zanetti, F. (2011): "Labor Market Institutions and Aggregate Fluctuations in a Search and Matching Model," *European Economic Review*, 55(5), 644–658.

Zhang, J. (2013): "Unemployment Benefits and Matching Efficiency in an Estimated DSGE Model with Labor Market Search Frictions," .

Acknowledgments

We would like to thank Nauro F. Campos, Harald Hagemann, Iikka Korhonen, Michael Landesmann, Sherman Robinson, the participants at the annual meeting of the Allied Social Science Associations at San Francisco, the annual conference of the Verein für Socialpolitik at Münster and the Ecomod conference at Boston for their valuable comments and suggestions as well as Steffen Esser for excellent research assistance. This project has been funded by the University of Duisburg-Essen.

6. Tables and Graphs

Table 1: Steady state values

Variable	Benchmark	Decrease in replacement ratio	Decrease in the vacancy posting costs	Increase in matching efficiency
		change in percent	(unemployment rate in percentage points)	
Output	13.05	0.06	0.06	0.19
Unemployment benefits	8.48	-1.65	0.03	0.11
Labor market tightness	0.73	2.89	2.02	0.18
Unemployment rate	10	-0.2	-0.01	-0.02
		Tradable goods sector		
Output	6,70	0.05	0.05	0.16
Employment	0.46	0.17	0.01	0.01
Vacancies	0.038	1.26	1.83	-0.13
Real wages	13.14	-0.11	0.03	0.12
Threshold productivity	2.74	-14.03	3.74	12.77
Job destruction rate	0.05	-0.9	0.4	1.74
		Non-tradable goods sector		
Output	6.36	0.07	0.07	0.21
Employment	0.44	0.18	0.03	0.06
Vacancies	0.036	1.28	1.84	-0.08
Real wages	13.14	-0.11	0.03	0.12
Threshold productivity	2.74	-14.03	3.74	12.77
Job destruction rate	0.05	-0.9	0.4	1.74
		Foreign economy		
Output tradables	5.27	0.02	0.02	0.07
Output non-tradables	7.79	-0.02	-0.01	-0.05

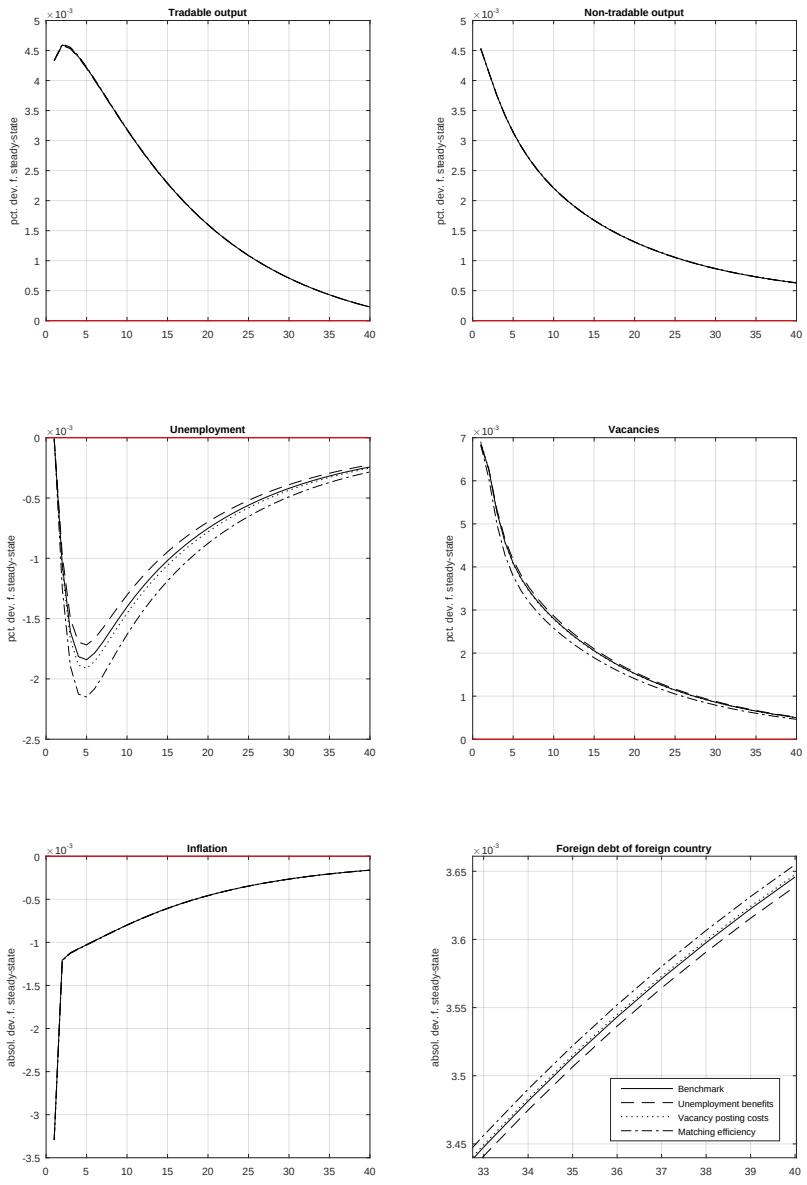
Notes: Entries in this table are computed using the calibration described in section (3). The reduction in the replacement rate is one percentage point, the increase in matching efficiency and the reduction in vacancy posting costs is two percent.

Table 2: Business cycle properties, all shocks

Variable	Euro Area	Benchmark	Decrease in the replacement ratio	Decrease in vacancy posting costs	Increase in matching efficiency
		Standard deviations			
GDP	0.0164	0.0164	0.0164	0.0165	0.0165
Vacancies	0.1079	0.0485	0.0479	0.0494	0.0515
Unemployment	0.0712	0.0126	0.0123	0.0130	0.0150
Employment		0.0013	0.0013	0.0014	0.0016
Inflation	0.0069	0.0497	0.0497	0.0496	0.0494
		Tradable goods sector			
Production	0.0241	0.0365	0.0365	0.0365	0.0366
Employment	0.0057	0.0276	0.0276	0.0276	0.0277
Vacancies		0.2104	0.2108	0.2107	0.2102
Job searchers		0.1642	0.1640	0.1643	0.1650
Real wage	0.0135	0.0889	0.0884	0.0887	0.0885
Labor market tightness	0.1573	0.0531	0.0535	0.0534	0.0523
		Non-tradable goods sector			
Production	0.0109	0.0319	0.0320	0.0319	0.0319
Employment	0.0072	0.0277	0.0278	0.0277	0.0275
Vacancies		0.1412	0.1425	0.1399	0.1358
Job searcher		0.1834	0.1854	0.1823	0.1770
Real wage	0.0101	0.6656	0.6674	0.6644	0.6604
Labor market tightness	0.1573	0.0531	0.0535	0.0534	0.0523
		Cross correlations			
Output, real wages T	0.8622	0.1666	0.1659	0.1692	0.1761
Output, real wages NT	0.4381	0.0969	0.0951	0.0991	0.1071
Output, Inflation	0.5433	0.0128	0.0111	0.0147	0.0215
Real wages T, Inflation	0.3226	0.9738	0.9735	0.9736	0.9735
Real wages NT, Inflation	-0.4357	0.9777	0.9778	0.9777	0.9775
Unemployment, vacancies	-0.5766	-0.2511	-0.3559	-0.1848	-0.0876

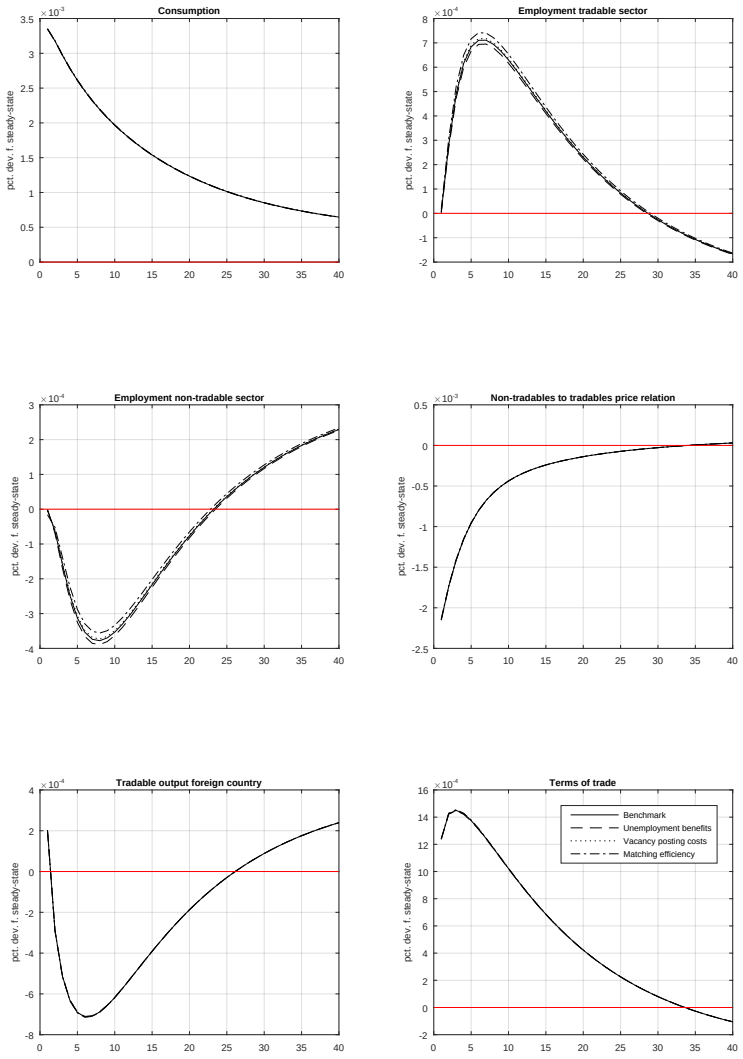
Notes: Observed and simulated business cycle properties for the Eurozone (EA-12). The observed statistics are based on seasonally adjusted quarterly data from 2006:Q1 to 2012:Q2. Variables, except inflation, are transformed into logarithms. All the series are HP filtered (frequency 1600), so that only the cyclical component remains. The simulated business cycle statistics are based on 1000 simulations over 100 quarter horizon and are HP filtered for comparison purposes. Simulated figures are averages across simulations. The reduction in the replacement rate is one percentage point, the increase in matching efficiency and the reduction in vacancy posting costs is two percent.

Figure 1: Positive domestic technology shock



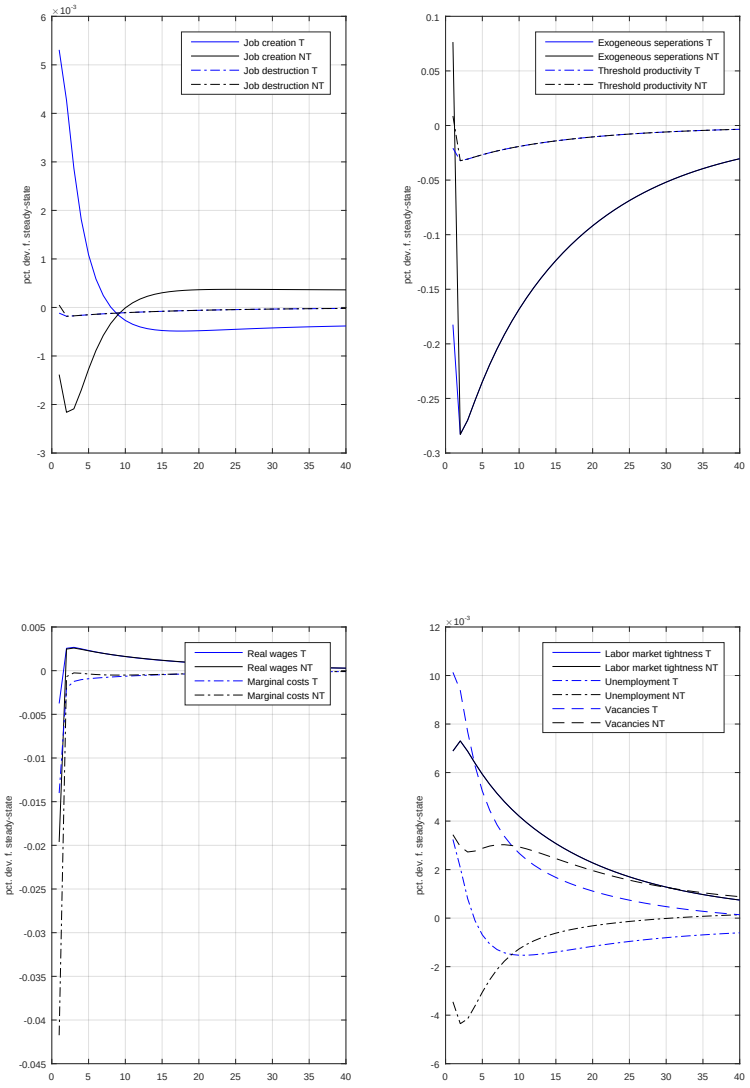
Impulse response functions to a positive technology shock in the domestic country. Notes: Each panel shows the response of the model variables to a technology shock of one standard deviation. The horizontal axes measure time, expressed in quarters.

Figure 2: Positive domestic technology shock



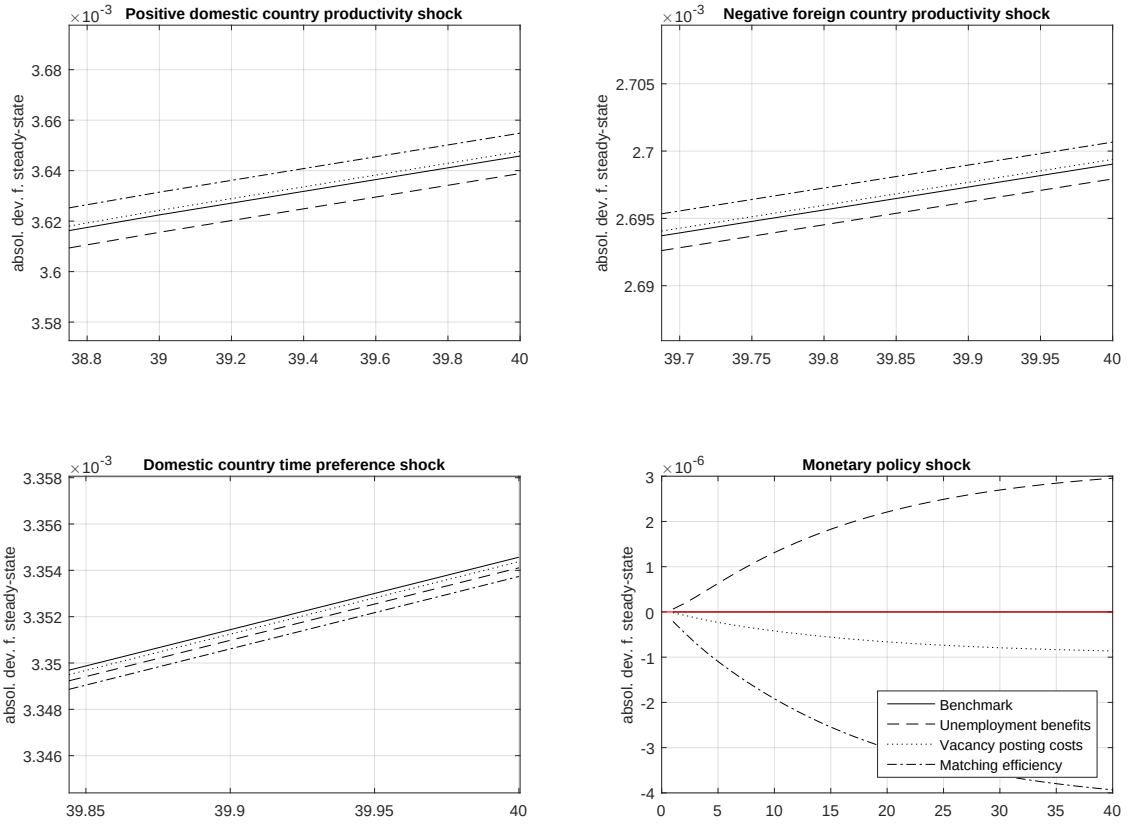
Impulse response functions to a positive technology shock in the domestic country. Notes: Each panel shows the response of the model variables to a technology shock of one standard deviation. The horizontal axes measure time, expressed in quarters.

Figure 3: Positive domestic productivity shock: labor market adjustment, benchmark case



Impulse response functions in the domestic country for the benchmark scenario. Notes: Each panel shows the response of the model variables to a technology shock of one standard deviation. The horizontal axes measure time, expressed in quarters.

Figure 4: Foreign debt of foreign country



Impulse response functions of the debt of the foreign country to various shocks. Notes: Each panel shows the response of the model variables to a technology shock of one standard deviation. The horizontal axes measure time, expressed in quarters.

7. Appendix (not for publication)

7.1. The log-linearized model

We now derive the log-linear equations for the domestic economy. A symmetric set of equations specifies the economy of the foreign country. The log-linearized version of the model is derived through a first-order Taylor approximation, while variables with a tilde denote the log-deviations from a deterministic steady-state. From the household's utility maximization, we can derive a log-linearized Euler equation

$$\tilde{c}_t = E_t\left\{\tilde{c}_{t+1}\right\} - \left(\tilde{r}_t - E_t\left\{\tilde{\pi}_{t+1}\right\} - \hat{\beta}_t\right),$$

and money demand from equation (8)

$$\tilde{m}_{Ht} - \tilde{p}_t = \sigma_m \tilde{y}_t + \left(\frac{1-\bar{\triangle}}{\bar{\triangle}}\right)\sigma_m\left(\hat{r}_t - \hat{r}_t^m\right),$$

where $\hat{\beta}_t$ denotes the log of the endogenous time-discount rate, $\tilde{\pi}_t \equiv \tilde{p}_t - \tilde{p}_{t-1}$ represents the log CPI inflation and the log differential in interest rates on assets and money is given by $\bar{\triangle} = 1 - \beta\left(1 - \bar{r}^m\right)$. The price of a consumption good bundle $\tilde{p}_t$ consists of prices for home-produced goods $\tilde{p}_{Ht}$ and goods produced in the rest of the currency union $\tilde{p}_{F,t}$. The log interest rate differential is given by $\hat{r}_t^m = \log\left(1 + \hat{r}_t^m / 1 + \bar{r}^m\right)$, with $\bar{r}^m$ being the steady-state zero inflation interest rate.

The endogenous discount factor depends negatively on consumption according to

$$\hat{\beta}_t = \varsigma_t - \psi\beta\tilde{c}_t,$$

where ς_t denotes an exogenous shock to the discount factor that obeys an autoregressive process. We, nevertheless, assume that ψ is small so that the effect is negligible on medium-term dynamics.

The demand of home tradables depends on the non-tradable to tradable price relation and on the terms of trade

$$\tilde{y}_{H,t} = \alpha(1-\alpha)\gamma\tilde{\tau}_t\Phi_1 + (1-\eta)\left[\alpha\tilde{x}_t\bar{\tau}^{\gamma-1} + (1-\alpha)\tilde{x}_t^*\bar{\tau}\right] + \alpha\tilde{c}_t\bar{\tau}^{\gamma-1} + (1-\alpha)\tilde{c}_t^*\bar{\tau}.$$

with $\Phi_1 \equiv \frac{1+\bar{\tau}^2}{\alpha+(1-\alpha)\bar{\tau}^{(1-\gamma)}}$. To derive this equation, we used the tradables consumption to aggregate consumption relation and equation (38). We derive the demand for non-tradables using the market clearing condition and the relation of non-tradables to aggregate consumption, which also depends on the non-tradables to tradables price relation

$$\tilde{y}_{N,t} = -\gamma\tilde{x}_t + \tilde{c}_t.$$

We now relate the terms of trade and the non-tradable to tradable price relation to CPI inflation and home prices for both domestic as well as foreign-produced tradable goods

$$\tilde{\tau}_t = \tilde{\tau}_{t-1} + \left(\triangle\tilde{q}_t + \pi\tilde{_{F,t}}^* - \tilde{\pi}_t\right) - \left(\tilde{\pi}_{H,t} - \tilde{\pi}_t\right),$$

$$\tilde{x}_t = \tilde{x}_{t-1} + \tilde{\pi}_{Nt} - \tilde{\pi}_{H,t} - \eta(1-\alpha)\triangle\tilde{\tau}_t.$$

The price of domestically produced goods, nevertheless, is subject to labor market imperfections. If we now log-linearize equation (29) around the steady-state, we can derive two New Keynesian Philips Curves

$$\tilde{\pi}_{H,t} = \beta E_t \tilde{\pi}_{H,t+1} + \frac{(1-\nu)(1-\nu\beta)}{\nu} \tilde{mc}_{T,t}, \tag{39}$$

$$\tilde{\pi}_{N,t} = \beta E_t \tilde{\pi}_{N,t+1} + \frac{(1-\nu)(1-\nu\beta)}{\nu} \tilde{mc}_{N,t}.$$

where $\tilde{mc}_{j,t}$ is defined as the log-deviation of marginal costs from their steady-state value μ. Marginal costs $\tilde{mc}_{j,t}$ are derived using a log-linear first-order approximation of Equation (35). In general, CPI depends on home and foreign prices as well as the terms of trade

$$\tilde{\pi}_t = \mu \tilde{\pi}_{H,t} + (1-\mu)\tilde{\pi}_{N,t} + \mu(1-\alpha)\triangle\tilde{\tau}_t.$$

Net exports depend on the difference of time-varying discount factors, the terms of trade and expected future net exports

$$\tilde{nx}_t = \frac{\bar{P}_F \bar{C}_F}{(1-\alpha)\bar{C}} \left[(1-\alpha)\hat{\beta}_{R,t} - 2\alpha(1-\alpha)(\mu-1)E_t\triangle\tilde{\tau}_{t+1}\right] + E_t\tilde{nx}_{t+1}.$$

Net indebtedness evolves from previous trade imbalances and net exports in the current period

$$\tilde{b}_t = \frac{1}{\beta}\tilde{b}_{t-1} + \tilde{nx}_t.$$

Given the indebtedness of the economy, we can express the current account as

$$\tilde{ca}_t = \tilde{b}_t - \frac{1}{1+g}\tilde{b}_{t-1},$$

with ca_t denoting the current account normalized by steady-state growth.

From the labor market equilibrium, we get the log-linear average real wage per sector

$$\tilde{w}_{j,t} = \frac{1}{\bar{w}_j}\left[\begin{array}{c} \eta\bar{mc}_j\bar{A}_j\frac{\bar{P}_j}{\bar{P}}\bar{a}_j\left(\tilde{mc}_{j,t} + \tilde{p}_{j,t} - \tilde{p}_t + \tilde{A}_{j,t} + \tilde{a}_{j,t}\right) \\ +c\bar{\theta}\tilde{\theta}_t + \tilde{T}_j\left((1-\tilde{\rho}_t)\left(\tilde{n}_t - \tilde{n}_{t-1}\right) - \tilde{\rho}_t\bar{\rho}_t - \beta(1-\rho^x)\sigma E_t\left(\tilde{y}_{j,t} - \tilde{y}_{j,t-1}\right)\right) \end{array}\right]$$

with the job creation condition

$$\tilde{\theta}_{j,t} = \frac{1}{\xi}\left[(1-\eta)\beta\bar{mc}_j(\bar{a_j}^N - \mathring{\bar{a}}_j)\left(\frac{\chi_j}{c_j\bar{\theta_j}^{\xi}}\right)E_t\Omega_1 + \sigma E_t\left(\tilde{y}_{j,t} - \tilde{y}_{j,t-1}\right)\right],.$$

$$\Omega_1 = \left(\tilde{mc}_{jt+1} + p_{j,t} - p_t + \tilde{A}_{jt+1} - \frac{\bar{a_i}}{\bar{a}_j^N - \mathring{\bar{a}}_j}\mathring{\tilde{a}}_{jt+1}\right)$$

and the job destruction condition

$$\tilde{\theta}_{j,t} = \left(\frac{1-\eta}{\eta c\bar{\theta}}\right)\left[m\bar{c}_j\bar{A}_j\frac{\bar{P}_j}{\bar{P}}\Omega_2 + \beta(1-\rho^x)\tilde{T}_j\sigma E_t\left(\tilde{y}_{j,t}-\tilde{y}_{j,t-1}\right)\right],$$

$$\Omega_2 = \left\{ \begin{array}{l} \mathring{\bar{a}}_j\left(\tilde{mc}_{j,t}+p_{j,t}-p_t+\tilde{A}_{j,t}+\mathring{\tilde{a}}_{j,t}\right)+\beta(1-\rho^x)\left(H(\mathring{\bar{a}}_j)-\mathring{\bar{a}}_j\right) \\ E_t\left(\sigma E_t\left(\tilde{y}_{j,t}-\tilde{y}_{j,t-1}\right)+\tilde{mc}_{j,t+1}+\tilde{A}_{j,t+1}+\frac{\mathring{\bar{a}}_j}{H(\mathring{\bar{a}}_j)-\mathring{\bar{a}}_j}\mathring{\tilde{a}}_{j,t+1}\right) \end{array} \right\}$$

In our model, we assumed a currency union with a common monetary policy. In this case, the central bank targets inflation and output stability for the whole currency union

$$\tilde{r}_t = \rho_r\tilde{r}_{t-1}+\rho_y\left[\delta\tilde{y}_t^*+(1-\delta)\tilde{y}_t\right]+\rho_\pi\left(\delta\tilde{\pi}_t^*+(1-\delta)\tilde{\pi}_t\right)+\epsilon_{r_t}, \qquad (40)$$

where δ attaches weights to the importance of the economy in the monetary policy function and $\epsilon_{r_t} \overset{i.i.d.}{\sim} N(0,\sigma_{r_t}^2)$ is a shock to monetary policy. The degree of interest rate smoothing ρ_r and the reaction coefficients to inflation and output, ρ_π and ρ_y, are all positive.

7.2. Tables supplement

Table 3: Business cycle properties, all shocks

Variable	Euro Area	Benchmark		
		Standard	H-M	Sensitivity
GDP	0.0164	0.0164	0.0164	0.0164
Vacancies	0.1079	0.0485	0.0416	0.0478
Unemployment	0.0712	0.0126	0.0617	0.0117
Employment		0.0013	0.0371	0.0014
Inflation	0.0069	0.0497	0.0029	0.0495
Production	0.0241	0.0365	0.0155	0.0364
Employment	0.0057	0.0276	0.0265	0.0281
Vacancies		0.2104	0.0348	0.2153
Job searchers		0.1642	0.0739	0.1716
Real wage	0.0135	0.0889	0.0032	0.0902
Labor market tightness	0.1573	0.0531	0.1018	0.0517
Production	0.0109	0.0319	0.0276	0.0318
Employment	0.0072	0.0277	0.0514	0.0281
Vacancies		0.1412	0.0524	0.1491
Job searcher		0.1834	0.0502	0.1888
Real wage	0.0101	0.6656	0.0054	0.6604
Labor market tightness	0.1573	0.0531	0.1018	0.0517
Output, real wages T	0.8622	0.1666	0.9684	0.1444
Output, real wages NT	0.4381	0.0969	0.8992	0.0841
Output, Inflation	0.5433	0.0128	0.3349	0.0026
Real wages T, Inflation	0.3226	0.9738	0.4709	0.9746
Real wages NT, Inflation	-0.4357	0.9777	0.6105	0.9774
Unemployment, vacancies	-0.5766	-0.2511	-0.9408	-0.2273

Notes: Observed and simulated business cycle properties for the Eurozone (EA-12). The observed statistics are based on seasonally adjusted quarterly data from 2006:Q1 to 2012:Q2. Variables, except inflation, are transformed into logarithms. All the series are HP filtered (frequency 1600), so that only the cyclical component remains. The simulated business cycle statistics are based on 1000 simulations over 100 quarter horizon and are HP filtered for comparison purposes. Simulated figures are averages across simulations.

7.3. Figures supplement

Figure 11: Sensitivity analysis (Income distribution)

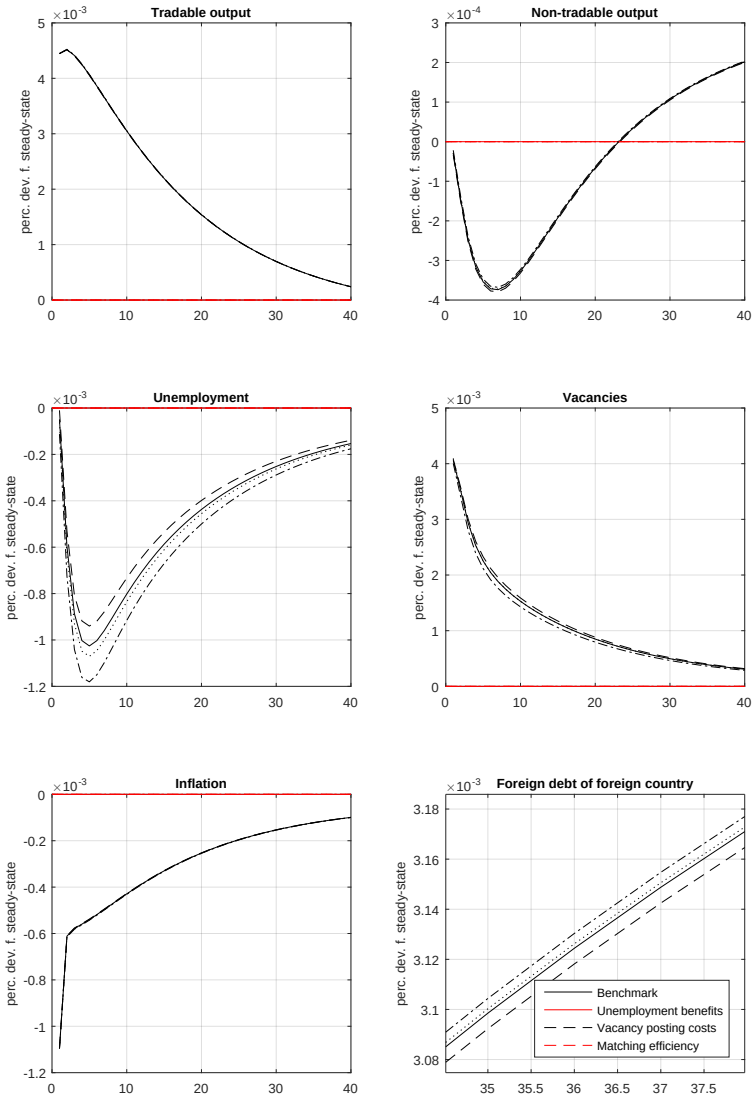
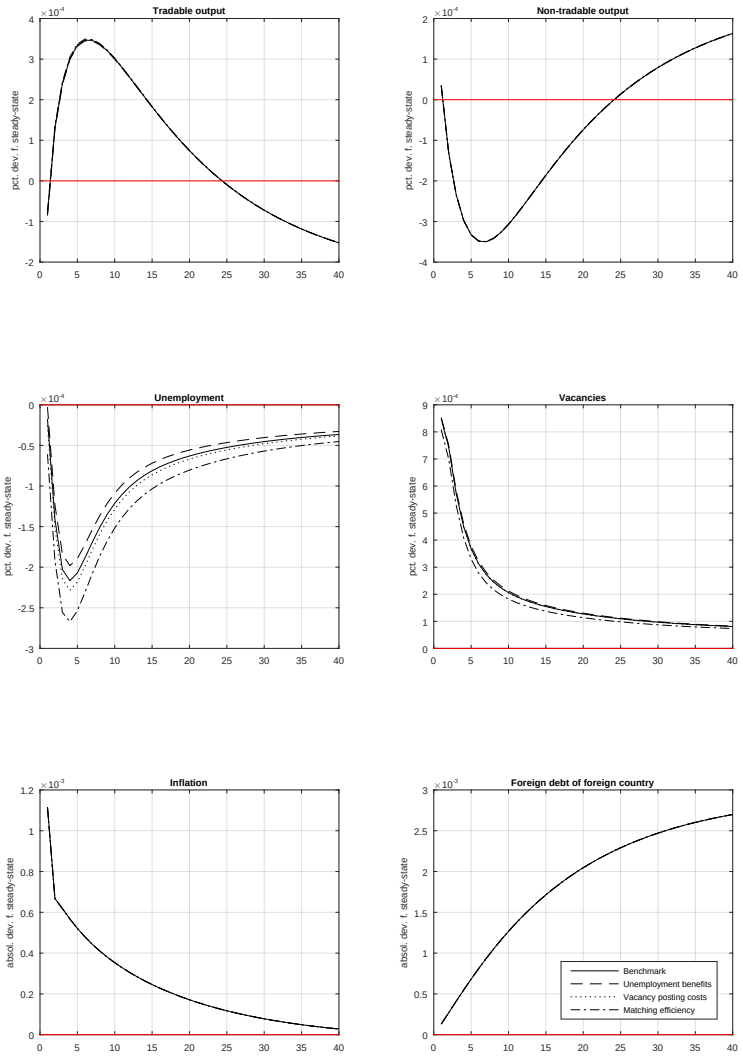
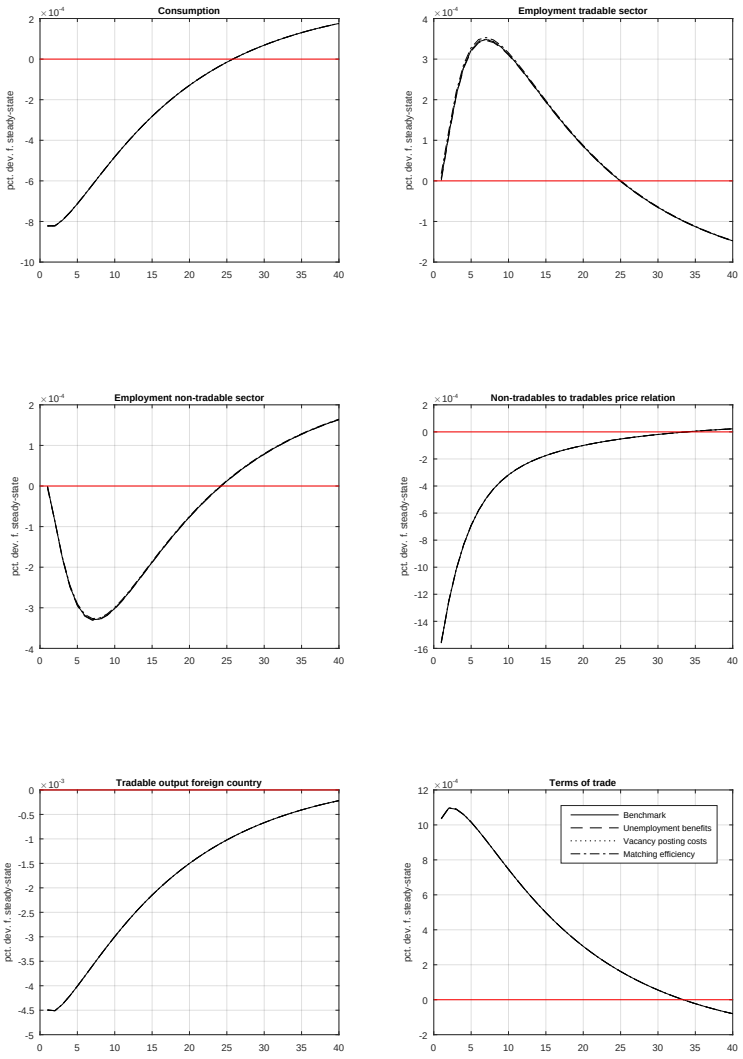


Figure 5: Negative foreign technology shock



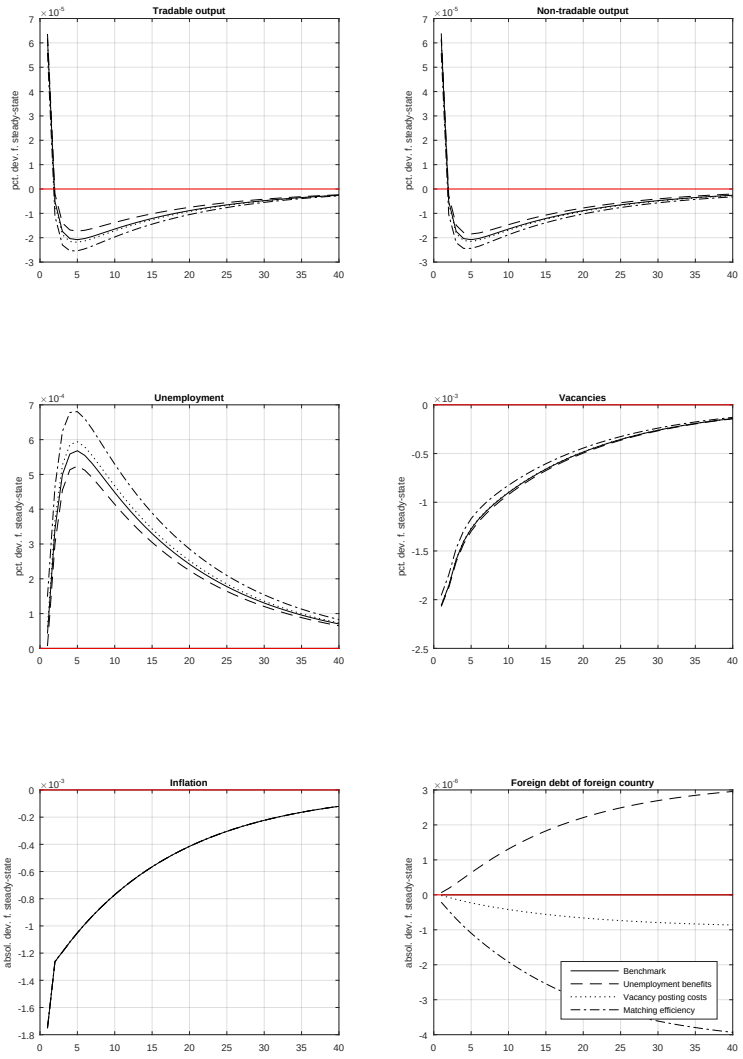
Impulse response functions to a negative technology shock in the foreign country. Notes: Each panel shows the response of the model variables to a technology shock of one standard deviation. The horizontal axes measure time, expressed in quarters.

Figure 6: Negative foreign technology shock



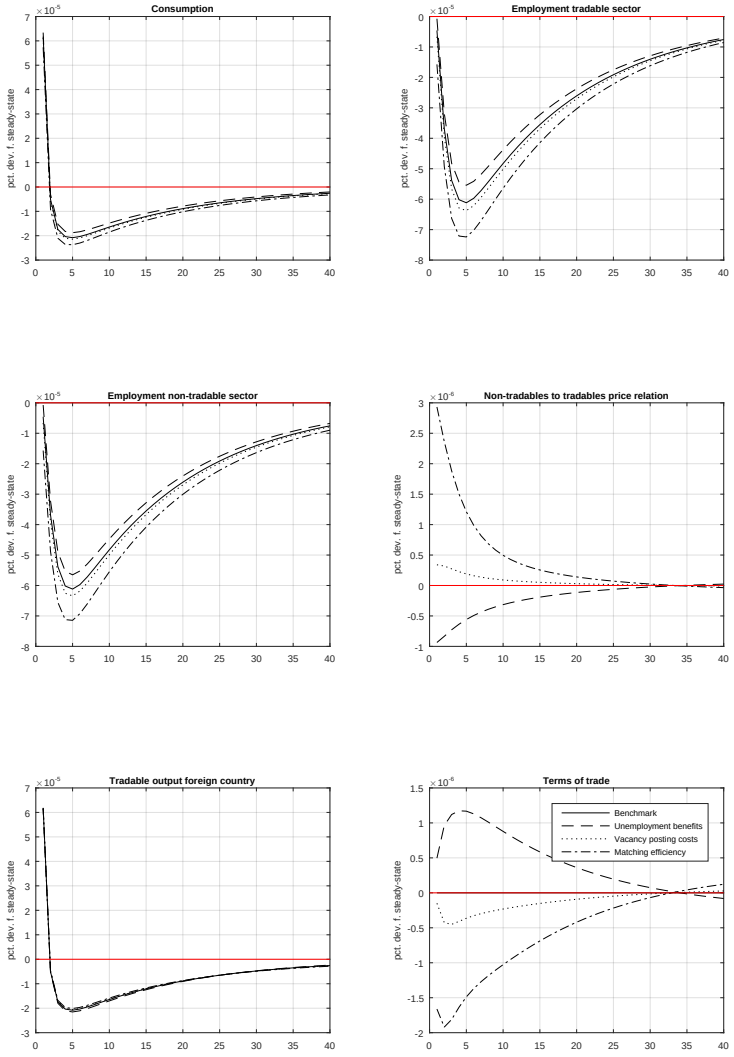
Impulse response functions to a negative technology shock in the foreign country. Notes: Each panel shows the response of the model variables to a technology shock of one standard deviation. The horizontal axes measure time, expressed in quarters.

Figure 7: Monetary policy shock



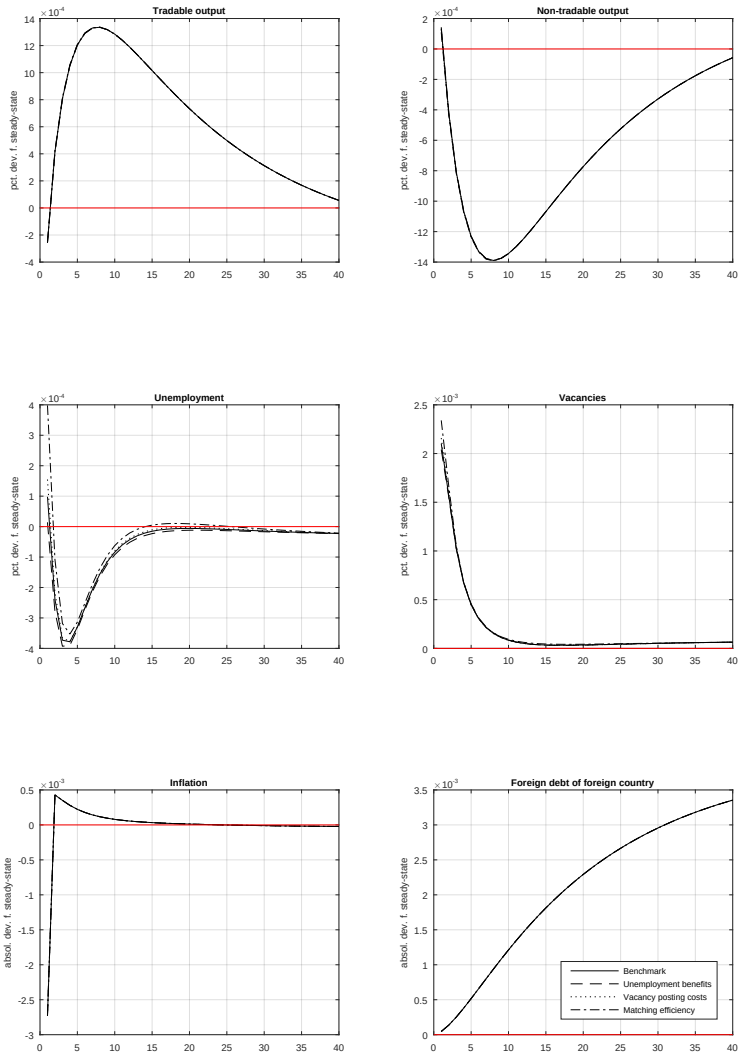
Impulse response functions to a monetary-policy and a time-preference shock in the union / domestic country.
Notes: Each panel shows the response of the model variables to a technology shock of one standard deviation. The horizontal axes measure time, expressed in quarters.

Figure 8: Monetary policy shock



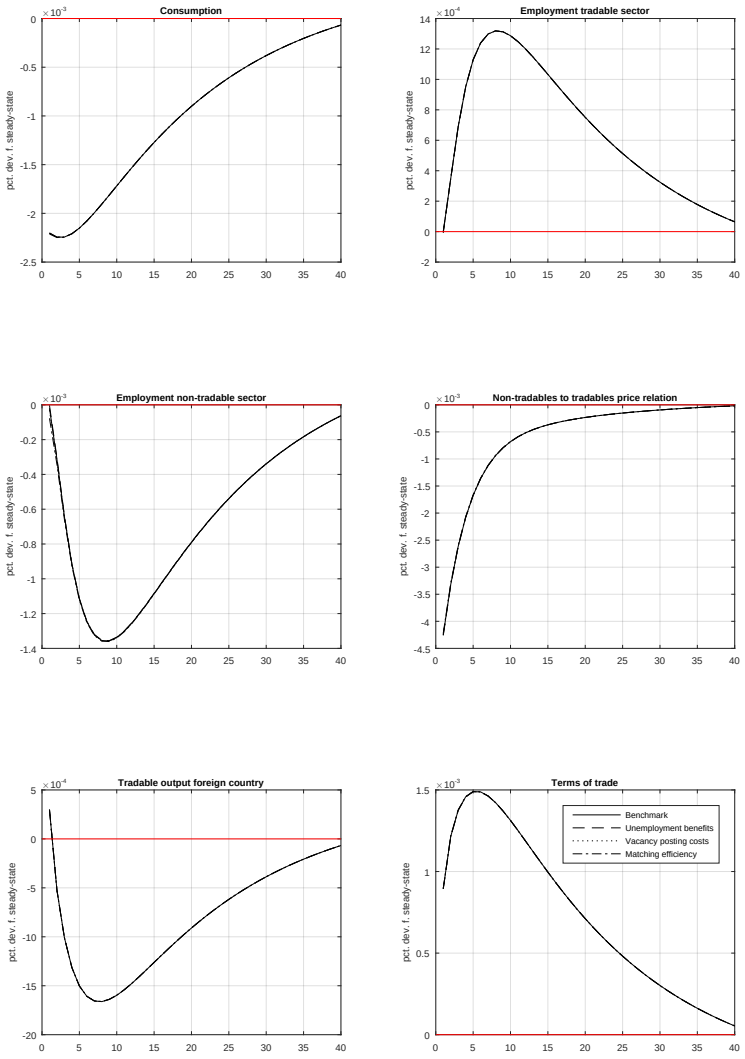
Impulse response functions to a monetary-policy and a time-preference shock in the union / domestic country.
Notes: Each panel shows the response of the model variables to a technology shock of one standard deviation. The horizontal axes measure time, expressed in quarters.

Figure 9: Time preference shock



Impulse response functions to a monetary-policy and a time-preference shock in the union / domestic country.
Notes: Each panel shows the response of the model variables to a technology shock of one standard deviation. The horizontal axes measure time, expressed in quarters.

Figure 10: Time preference shock



Impulse response functions to a monetary-policy and a time-preference shock in the union / domestic country.
Notes: Each panel shows the response of the model variables to a technology shock of one standard deviation. The horizontal axes measure time, expressed in quarters.

Figure 12: Sensitivity analysis (Income distribution)

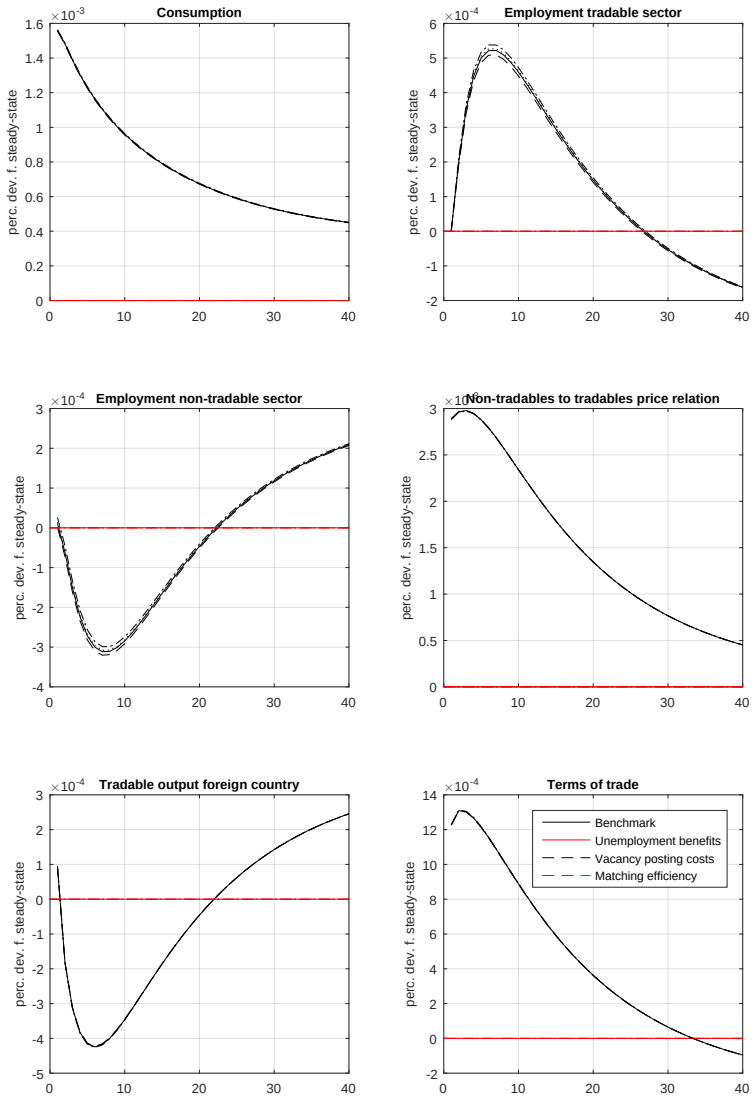


Figure 13: Sensitivity analysis (Low bargaining power)

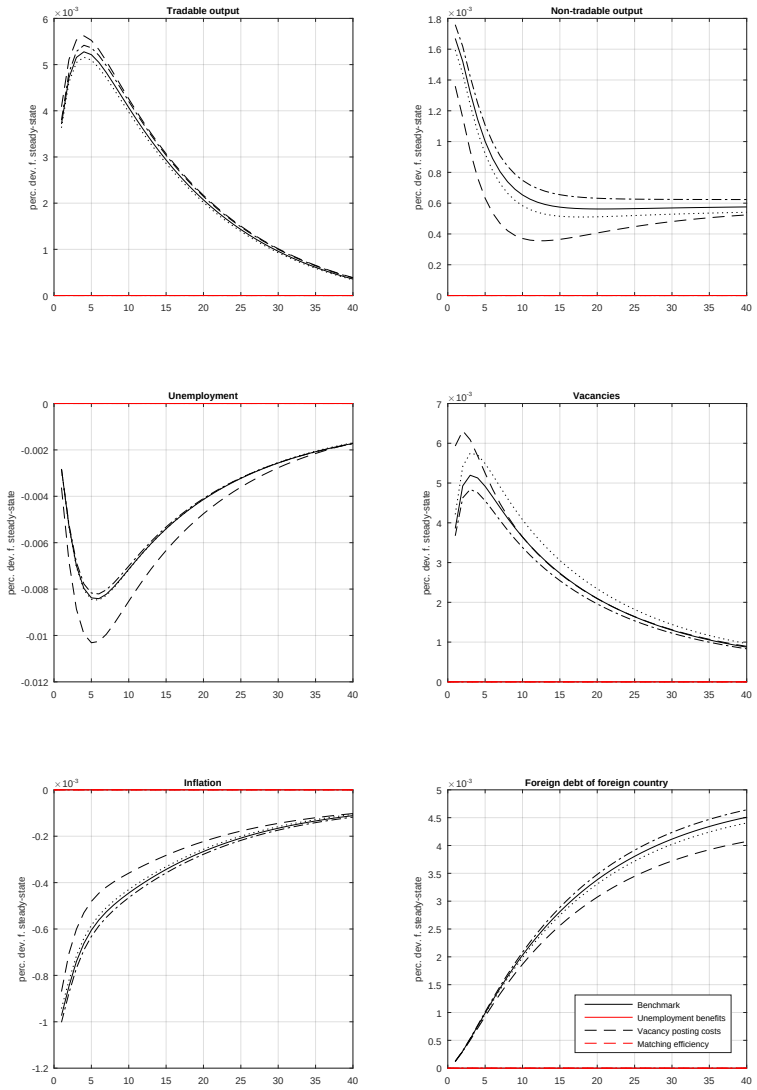


Figure 14: Sensitivity analysis (Low bargaining power)