ECONSTOR
Make Your Publications Visible.

A Service of

ZBW Leibniz-Informationszentrum Wirtschaft
Leibniz Information Centre for Economics

Baas, Timo; Belke, Ansgar

Working Paper

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

ROME Discussion Paper Series, No. 14-07

Provided in Cooperation with:
Research Network "Research on Money in the Economy" (ROME)

Suggested Citation: Baas, Timo; Belke, Ansgar (2014) : Labor market reforms and current account imbalances: Beggar-thy-neighbor policies in a currency union?, ROME Discussion Paper Series, No. 14-07, Research On Money in the Economy (ROME), s.l.

This Version is available at:
https://hdl.handle.net/10419/104786

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

WWW.ECONSTOR.EU

Mitglied der Leibniz-Gemeinschaft

R O M E
Research On Money in the Economy

No. 14-07 – September 2014

Labor Market Reforms and Current Account Imbalances – Beggar-thy-neighbor Policies in a Currency Union?

Timo Baas and Ansgar Belke

ROME Discussion Paper Series

"Research on Money in the Economy" (ROME) is a private non-profit-oriented research network of and for economists, who generally are interested in monetary economics and especially are interested in the interdependences between the financial sector and the real economy. Further information is available on www.rome-net.org.

ISSN 1865-7052

Research On Money in the Economy

Discussion Paper Series
ISSN 1865-7052

No 2014-07, September 2014

Labor Market Reforms and Current Account Imbalances - Beggar-thy-neighbor Policies in a Currency Union?

Timo Baas and Ansgar Belke

Prof. Dr. Timo Baas
University of Duisburg-Essen
Department of Economics

Universitaetsstr. 12
D-45117 Essen
e-mail: timo.baas@wiwinf.uni-due.de

Prof. Dr. Ansgar Belke
University of Duisburg-Essen
Jean Monnet Chair for Macroeconomics
Department of Economics
Universitaetsstr. 12
D-45117 Essen
e-mail: ansgar.belke@uni-due.de
and
Institute for the Study of Labor (IZA) Bonn
Schaumburg-Lippe-Str. 5 – 9
D-53113 Bonn

The discussion paper represent the authors' personal opinions and do not necessarily reflect the views of IZA Bonn.

NOTE: Working papers in the "Research On Money in the Economy" Discussion Paper Series are preliminary materials circulated to stimulate discussion and critical comment. The analysis and conclusions set forth are those of the author(s) and do not indicate concurrence by other members of the research network ROME. Any reproduction, publication and reprint in the form of a different publication, whether printed or produced electronically, in whole or in part, is permitted only with the explicit written authorisation of the author(s). References in publications to ROME Discussion Papers (other than an acknowledgment that the writer has had access to unpublished material) should be cleared with the author(s) to protect the tentative character of these papers. As a general rule, ROME Discussion Papers are not translated and are usually only available in the original language used by the contributor(s).

ROME Discussion Papers are published in PDF format at www.rome-net.org/publications/ .

Please direct any enquiries to the current ROME coordinator
Prof. Dr. Albrecht F. Michler,
Heinrich-Heine-University of Duesseldorf, Department of Economics, Universitaetsstr. 1,
Build. 24.31.01.01 (Oeconomicum), D-40225 Duesseldorf, Germany
Tel.: ++49(0)-211-81-15372
Fax: ++49(0)-211-81-15261
E-mail: helpdesk@rome-net.org
michler@uni-duesseldorf.de

Abstract

Member countries of the European Monetary Union (EMU) 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.

JEL-Classification: E24, E32, J64, F32

Keywords: Current account deficit, labor market reforms, DSGE models, search and matching labor market

Corresponding author
Timo Baas, University of Duisburg-Essen, Universitätsstr. 12, 45117 Essen, Germany.
E-Mail: timo.baas@wiwinf.uni-due.de

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, perceive reforms as the fastest way to restore competitiveness. Some observers, nevertheless, see labor market reforms embodying a beggar-thy-neighbor-policy[1] leaving non-reforming countries with reduced competitiveness and increasing foreign debt exacerbating 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 for steady state output, employment and average real wages but also for 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 embody a beggar-thy-neighbor policy or add to macroeconomic stability within the union.

The major problem faced by some of today's EMU member states in the 1990s was encompassed in the double-digit unemployment rates (Dreze and Malinvaud, 1994; Bean, 1994; Layard et al., 1994; Lindbeck, 1996; Phelps, 1994). Because of labor market inflexibility, an increase in growth no longer contributed to a strong increase in employment (Salvatore, 1998). Labor market reforms should, therefore, increase flexibility towards job-rich growth. By the mid 2000s, a number of the EMU members had begun implementing these reforms. Austria, Germany, Greece, France and Slovakia reduced the replacement rate[2] significantly (by between 12.7 and 22.3 percentage points). Some countries like Germany shifted resources from passive to active labor market policies, intending to increase the efficiency of the labor market matching process. Furthermore, a significant number of countries trimmed down regulations for temporary agency work, which then doubled in the following years in Austria, Germany and Denmark and tripled in Italy and Finland in the last decade.[3] As some countries that imposed reforms in the 2000s were now experiencing less unemployment, higher output stability and less foreign debt, as compared with their non-reforming counterparts, the contribution of labor market reforms to competitiveness and the current account was a controversial subject of discussion.

In principle, there are two different approaches which can be used to analyze the link between labor market reforms and the current account balance. Most

[1] Felbermayr et al. (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.

[2] The replacement rate is the percentage of a workers pre-unemployment income paid out by an unemployment insurance company or as welfare upon the transition from work to unemployment.

[3] Carone et al. (2009)provide an excellent overview of labor market reforms in Europe

papers follow a direct approach that treats structural reforms as macroeconomic shocks. There are at least three competing theories which explain why structural reforms, in particular labor market reforms, influence the current account directly. The first one sees structural reforms as to be painful today but to promise future gains (Obstfeld and Rogoff, 1995). It would, therefore, 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. However, since future gains of structural reforms will be used to pay back the loans in the future, we should observe a reversal and a positive change of the current account in the future. However, returns of reforms in the future are uncertain. Another argument concerning the impact of structural reforms on current account balances has been propagated by Kennedy and Slok (2005). They argue that, in a first step, wages and prices decline as result of structural reforms. Hence, the country receives a price advantage and 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 increases. Investment goes up and foreign capital is attracted which, in turn, tends to reduce capital exports and, therefore, goods exports. In the long run, the current account surplus should thus decline. 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 the same vein 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 because of higher uninsurable risk. Another explanation for rising current account balances is that purchasing power shifts towards individuals with higher saving propensities. Hence, the impact of structural reforms on the current account balance is a priori not clear and disputed in the empirical literature. In this context, Kennedy and Slok (2005) analyze the role of structural policy reforms for the solution of global current account imbalances for 14 OECD countries. They find a significant but small contribution of structural policy indicators to explain current account positions. Chen et al. (2013), however, doubts a strong contribution of labor market reforms, arguing that the presence of asymmetric shocks results in strong current account imbalances.

In this paper we follow an indirect approach that treats structural reforms as a change in institutional settings rather than a shock. This adds to an already growing literature analyzing the impact of labor markets reforms on macroeconomic stability. In a closed economy model, Zanetti (2011) shows the impact of decreasing replacement rates and firing costs on the stability of the economy and Krause and Uhlig (2012) discuss the effect of labor market reforms in the presence of shocks to the discount factor. Mussa (2005) argues that structural reforms affect the adjustment capacity of the currency union as a whole. Therefore, external balances will more easily readjust in the wake of shocks in general such as the introduction of the single currency or of asymmetric shocks manifesting themselves in diverging country-specific competitiveness positions. This view goes far back to the seminal paper by Mundell (1961) on

optimum currency areas as well as to more recent research, such as Pissarides (1997) or Blanchard (2007). In this context, the application of supply-side oriented measures (which directly lower the natural rate of unemployment) lowers the magnitude of the demand shock necessary to reverse the effect of an adverse shock in the past ("coercive power" in the language of ferromagnetics, Blanchard and Summers (1987)). Positive demand shocks lower the "remanence" of past shocks. In other words, institutions which can be modified by reforms serve as propagation mechanisms for shocks (Blanchard and Wolfers, 2000). While the impact of labor market reforms in the context of macroeconomic shocks receives increasing attention, up to now, research on the influence of labor market reforms on the current account is scarce. In this context and relating to EMU, we see essentially two open questions. Do labor market reforms, in the presence of macroeconomic shocks, raise the current account deficit of non-reforming countries, as a faster adjustment in some countries weakens the competitiveness of others? Or do flexible labor markets, in general, help to absorb shocks more swifty which benefits also non-reforming countries?

The contribution of this paper is to provide a two-county two-sector DSGE model with search and matching frictions. This allows us to identify the contribution of different labor market reform measures to the current account deficit of non-reforming countries. Naturally, our model is not the first one addressing 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 using a model with different skill groups to focus on the impact of labor market reforms on high versus low skilled workers. Krause and Lubik (2007), instead, 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 (2007) and Ferrero et al. (2008) and include trade, international borrowing and preferences for the consumption of home tradables into 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 next 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 different shocks and some robustness checks. The fifth section, finally, 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 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 perfect risk sharing of households in a given economy to be able to use a representative household setting. There are two sectors of production in each country. For each sector, firms can be separated into intermediate-goods producing firms and retailers. The trade specification of the model resembles that of Obstfeld and Rogoff (2007) and, more specifically, Ferrero et al. (2008), with the exception that we impose staggered price setting on the level of the retailers (Bernanke et al., 1999) rather than on the level of intermediate good firms and that we assume a search and matching labor market rather than staggered wage setting[4].

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 economy 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 (2007) call it, according to which a countries sees a deterioration in its terms of trade if national expenditures decline.

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 be, nevertheless, favorable for households of a given country to increase imports and to run up debt. Financial markets are assumed to be imperfect in the sense that only the bond of the domestic country is internationally tradable.

In our model, physical capital and labor are, at least in the short run, not mobile between the two countries. As a result, the imbalances shown in our model are more persistent than they would be in a model with factor mobility. Within the European Monetary Union, labor markets are by no means closed. We believe, nevertheless, that there is still a long road to go until we will have full factor mobility materialized (Krause et al., 2014) so that, given the scope of this paper, closed labor markets might be a not too bad approximation.

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 by den Haan et al. (2000) in a New Keynesian setting.

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

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 a idiosyncratic productivity below the threshold level[5], we assume that the productivity of a new worker is always higher than the threshold. After 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 due 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 decreases. This results in a reduction of the expected value of an open position. In equilibrium, free market entry ensures that the value of a vacancy is always zero.

In sum, 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 $i \in [0, 1]$ as well as a central bank for the monetary union.

2.1. The representative household

Our economy is inhabited by a large number of infinitive living identical households that are consuming Dixit and Stiglitz (1975) aggregates of domestic and imported goods. Due to labor markets with search frictions, a household is either employed or unemployed. In general, labor is supplied inelastically. As a second source of income, households own shares of domestic firms and receive dividends D_t from it. We assume that households in the domestic economy and in the foreign country have the same preferences and 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

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

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

where β with $0<\beta<1$ represents the discount factor and κ_m 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_{Tt} can be obtained from the domestic C_{Ht} or from the foreign economy C_{Ft} while non-tradables C_{Nt} are produced at home, only.

$$C_{Tt}=\left[(1-\alpha)^{\frac{1}{\gamma}}C_{Ht}+\alpha^{\frac{1}{\gamma}}C_{Ft}^{\frac{\gamma-1}{\gamma}}\right]^{\frac{\gamma}{\gamma-1}} \tag{3}$$

C_{Ht},C_{Ft},C_{Nt} are themselves consumption bundles containing varieties i produced by retailers at home or abroad.

$$C_{Ht}=\left(\int_0^1 C_{Ht}(i)^{\frac{\epsilon-1}{\epsilon}}di\right)^{\frac{\epsilon}{\epsilon-1}}\quad C_{Ft}=\left(\int_0^1 C_{Ft}(i)^{\frac{\epsilon-1}{\epsilon}}di\right)^{\frac{\epsilon}{\epsilon-1}} \tag{4}$$

$$C_{Nt}=\left(\int_0^1 C_{N,t}(i)^{\frac{\epsilon-1}{\epsilon}}di\right)^{\frac{\epsilon}{\epsilon-1}}$$

In this specification, γ measures the elasticity of substitution between home and foreign goods, while ϵ denotes the elasticity of substitution between varieties and τ stands for the elasticity of substitution between tradable and non-tradable goods. The household chooses consumption, nominal money and bond holdings, subject to the budget constraint

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

for $t=0,1,2...$, where P_t denotes the price of a bundle of domestic tradable and non-tradable and foreign tradable goods. 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 bonds mature providing additional B_{t-1} units of money which are used to purchase B_t new bonds at the nominal cost B_t/R_t. R_t denotes the nominal interest rate between t and $t+1$. Solving the intertemporal optimization problem we derive the following first-order conditions:

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

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

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

where $\beta_{t,t+1} = \mathring{\beta}_t \Lambda_{t+1}/\Lambda_t$ is the stochastic discount factor with $\mathring{\beta}_t = \frac{\varsigma_t}{\psi \beta C_{tt}}$ as an endogenous adjustment process that depends on consumption. The parameter ψ is assumed to be small, the steady state discount factor isβ and the shock term isς_t. 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, (6) and (7), yields the standard consumption Euler equation:

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

2.2. labor

We distinguish three different employment statuses of the representative household: Let U_t, W_t^N and $W_t(a_t)$ denote the present-discounted value of an unemployed, newly employed and continuously employed worker. In case of unemployment, the worker enjoys real return b and expects to move into employment with probability $\rho_j(\theta_{jt})$ and becomes employed either in the tradable or in the non-tradable sector. Therefore, the present-discounted income stream of an unemployed worker is

$$U_t = b + E_t \beta_{t,t+1} \left[\sum_{j=1}^{2} \rho_j(\theta_{jt}) W_{j,t+1}^N + (1 - \sum_{j=1}^{2} \rho_j(\theta_{jt})) U_{t+1} \right]. \tag{10}$$

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.

The worker's value from holding a job with match productivity a_t is given by

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

Equation (11) states that an employed worker is paid a sector-specific wage $w_{jt}(a_{jt})$ and that if the worker 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

$$W_{jt}^{N} = w_{jt}^{N} + E_{jt}\beta_{t,t+1}\left[(1-\rho^{x})\int_{\hat{a}_{j,t+1}}^{\infty} W_{j,t+1}(a_{j,t+1})dF(a_{j,t+1}) + \rho_{j,t+1}U_{j,t+1}\right]. \tag{12}$$

Please note, that equation (12) differs from (11) in the wage of new workers, only. The wage of new workers, w_t^N, will be different from the wage of continuing workers, $w_t(a_t)$ due 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 wage of new workers.

2.3. International risk sharing

Due to the assumption of complete securities markets, a first-order condition analogous to equation (9) must hold for the foreign country[6]

$$\beta E_t\left[\left(\frac{C_t^*}{C_{t+1}^*}\right)\frac{Q_t P_{t+1}^*}{Q_{t+1}P_t^*}\right] = R_t \tag{13}$$

with a star denoting foreign variables and the real exchange rate $Q_t \equiv \frac{P_t^*}{P_t}$ as the ratios of CPIs expressed in a common currency. Using this definition, we can combine equations (9) and (13) and express after iterating home consumption in terms of foreign consumption and the real exchange rate

$$C_t = \upsilon C_t^*. \tag{14}$$

2.4. Labor market flows and matching

During each period $t = 0, 1, 2, \ldots$, the representative intermediate goods-producing firm posts one vacancy and recruits one worker before production occurs. Each single job has the status filled or vacant. Due to 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.

---

[6] Please note that we assume that the law of one price holds throughout, implying that $P_{F,t}(i) = \varepsilon_t P_{F,t}^*(i)$ for all $i \in [0,1]$, where ϵ_t is the nominal exchange rate and $P_{F,t}^*(i)$ is the price of foreign produced good i in terms of the foreign currency. As the nominal exchange rate is fixed in a currency union, we get $P_{F,t}(i) = P_{F,t}^*(i)$. A similar relationship holds for goods produced in the domestic economy $P_{H,t}(i) = P_{H,t}^*(i)$. Integrating over all goods allows us to obtain $P_{F,t} = P_{F,t}^*$ and $P_{H,t} = P_{H,t}^*$. As we have preferences for the consumption of home goods in all countries, we define a real exchange rate as $Q_{tt} \equiv \frac{P_t^*}{P_t}$. Because of similar preferences, the equilibrium domestic price of a riskless bond issued in foreign currency is given by $R_t^{*-1} = E_t\{\beta_{t,t+1}, Q_t\}$. As we know from the first-order condition of household utility maximization, the domestic bond pricing equation is $R_t^{-1} = E_t\{\beta_{t,t+1}\}$. We can combine both equations to get a currency union version of the uncovered interest parity condition $E_t\{\beta_{t,t+1}[R_t - R_t^*(Q_t/Q_{t+1})]\} = 0$. For a paper on exchange rate volatility and labor markets see Belke and Kaas (2004).

If a firm finds a suitable worker, both form a match. The number of job matches depends on the matching function $m_{jt}(u_t, v_{jt})$, where v_{jt} denotes the number of vacancies in both sectors of the economy, tradable and non tradable goods $j = tr, nt$ and u_t is the number of unemployed workers. We assume a Cobb-Douglas matching function

$$m_{jt}(u_t, v_{jt}) = \chi u_t^{\xi} v_{jt}^{1-\xi}, \tag{15}$$

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

$$p(\theta_{jt}) = m_{jt}(u_t, v_{jt})/u_t = \chi \theta_{jt}^{\xi}, \tag{16}$$

and the probability that a searching firms will find a worker is given by

$$q(\theta_{it}) = m_{it}(u_{it}, v_{it})/v_{it} = \chi \theta_{it}^{1-\xi}. \tag{17}$$

The tighter the labor market, the easier it is for unemployed workers to find a job. Equation (17) implies that the higher the number of vacancies v_{jt} for a given number of unemployed workers, u_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. Firms may decide to dissolve a match endogenously if the realization of the worker's idiosyncratic productivity of a_{jt} is below a certain threshold productivity $\mathring{a}_{jt}$. The probability of endogenous job destruction is given by $\rho_{jt}^n = P(a_{jt} < \mathring{a}_{jt}) = F(\mathring{a}_{jt})$. The total job separation rate, therefore, is $\rho_{jt} = \rho_j^x + (1 - \rho_j^x)\rho_{jt}^n$. As in den Haan et al. (2000), the idiosyncratic productivity a_{jt} 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_{jt}^N which ensures that their productivity is always above the productivity threshold $\tilde{a}_{jt}$, and that all jobs produce before being destroyed. New matches in t, m_{jt}, become productive for the first time in $t+1$. Consequently, the employment in each sector evolves according to $n_{jt} = (1 - \rho_{jt})n_{jt-1} + m_{jt-1}(u_{t-1}, v_{jt-1})$. The number of unemployed persons is $u_t = \left(1 - \sum_{j=1}^{2} n_{jt}\right)$.

2.5. The representative intermediate goods-producing firm

In each period $t = 0, 1, 2, \ldots$, intermediate goods-producing firms post vacancies at cost c_j and hire workers. Labor is the only input in the production function. At the beginning of each period, old and new matches draw a idiosyncratic, job-specific productivity a_{jt}. Production in each sector is subject to an aggregate productivity shock, A_{jt}, common to all firms. If the realization of the worker's idiosyncratic productivity is above the reservation productivity $\mathring{a}_{jt}$, firms will produce output using labor $y_{jt} = A_{jt}a_{jt}$. The aggregate productivity A_{jt} follows an AR(1) process, $\ln(A_{jt}) = \rho_{jA} \ln(A_{jt-1}) + \epsilon_{jA_t}$, where ρ_{jA}

is the serial correlation coefficient with $0 < \rho_{jA} < 1$ and $\epsilon_{A_{jt}}$ follows a white noise process with standard deviation σ_{jA}.

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

$$V_{jt} = -c_j + E_t \beta_{t,t+1} \left[q_j(\theta_{jt}) J^N_{jt+1} + (1 - q_j(\theta_{jt})) V_{jt+1} \right]. \tag{18}$$

With probability of $q_j(\theta_{jt})$, the firms matches with a worker and the match yields a return of J^N_{jt+1}. With probability $1 - q_j(\theta_{jt})$, the job remains vacant with a return of V_{jt+1}. As long as the value of a vacancy is greater than zero, firms will post new vacancies. In equilibrium, free market entry drives the profit from opening a vacancy to zero, which implies $V_{jt} = 0$ for any t. This yields the vacancy posting condition

$$\frac{c_j}{q_j(\theta_{jt})} = E_t \beta_{t,t+1} J^N_{jt+1}, \tag{19}$$

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

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

$$\begin{aligned} J^N_{jt} = & \quad mc_{jt} A_{jt} a^N_{jt} - w^N_{jt} \\ & + E_t \beta_{t,t+1} (1 - \rho^x_j) \left[\int_{\mathring{a}_{jt+1}}^{\infty} J_{jt+1}(a_{jt+1}) dF_j(a_{jt+1}) - F_j(\mathring{a}_{jt+1}) T_j \right], \end{aligned} \tag{20}$$

where mc_j 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 $\mathring{a}_{jt+1}$ leads to endogenous separation and the firm incurs firing costs T_j.

Similarly, the present-discount value of a continuing job with productivity a_{jt} to the employer is

$$\begin{aligned} J_{jt}(a_{jt}) = & \quad mc_{jt} A_{jt} a_{jt} - w_{jt}(a_{jt}) \\ & + E_t \beta_{t,t+1} (1 - \rho^x_j) \left[\int_{\mathring{a}_{jt+1}}^{\infty} J_{jt+1}(a_{jt+1}) dF_j(a_{jt+1}) - F_j(\mathring{a}_{jt+1}) T_j \right] \end{aligned} \tag{21}$$

In equations (20) and (21) the term $mc_{jt} A_{jt} a_{jt} - w_{jt}(a_{jt})$ represents the net return of a match, and $J_{jt+1} - F_j(\mathring{a}_{jt+1}) T_j$ represents the present-discounted firm surplus, if the match is not destroyed.

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

$$mc_{jt} = \frac{1}{A_{jt}\mathring{a}_{jt}} \left(w_{jt}(\mathring{a}_{jt}) - E_t\beta_{t,t+1}\left[\int_{\mathring{a}_{jt+1}}^{\infty} J_{jt+1}(a_{jt+1})dF_j(a_{jt+1}) - F_j(\mathring{a}_{jt+1})T_j\right] - T_j\right) \tag{22}$$

From equation (22), it can be seen that the real marginal costs amount to the wage minus the expected future return generated by the match and the firing costs, weighted by the marginal product of labor. As pointed out by Trigari (2009), the real marginal costs are, in the presence 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.

2.6. Wage bargaining

In each period, firms and workers bargain over the real wage for the current 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 new and continuing matches are given by

$$\eta(J_{jt}(a_{jt}) + T_j) = (1 - \eta)(W_{jt}(a_{jt}) - U_{jt}) \tag{23}$$

and

$$\eta J_{jt}^N(a_{jt}) = (1 - \eta)(W_{jt}^N - U_{jt}), \tag{24}$$

respectively. The bargaining rule for continuing workers, represented by equation (23), 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_{jt}^N is assumed to be above the critical threshold $\mathring{a}_{jt}$.

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

$$w_{jt}(a_{jt}) = \eta\left[mc_{jt}A_{jt}a_{jt} + c\theta_t + (1 - \zeta_{jt})T_i\right] + (1 - \eta)b_j. \tag{25}$$

The agreed wage for new workers is equal to

$$w_{jt}^N = \eta\left[mc_{jt}A_{jt}a_{jt}^N + c\theta_t - \zeta_{jt}T_j\right] + (1 - \eta)b_j, \tag{26}$$

where $\zeta_{jt} = E_t\beta_{t,t+1}(1 - \rho_j^x)$.

The wage that new and continuing workers receive consists of two elements. First, if firms have complete bargaining power, the optimum wage would be the slightly above the benefits from unemployment b_j, 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 would be slightly less than the match revenue $mc_{jt}A_{jt}a_{jt}$, plus the saved hiring costs, $c_j\theta_{jt}$, minus the present-discounted firing costs, $\zeta_{jt}T_j$, and plus the savings on firing costs, T_j, in the case of continuing workers. In the case where the bargaining power of firms and workers is between those two extremes, the bargaining power of workers η attaches weight to the two elements. It follows from equation (26) that the wage of new workers does not include firing costs related to endogenous job separations in the initial period. Firing costs are assumed to be sunk. Lazear (1990) shows that any mandated severance payment can be offset by an efficient labor contract and, hence, firing costs do not impose no real effects.

2.7. Retail firms

We assume a continuum of monopolistic competitive retailers on the unit interval indexed by i. Each retailer purchases goods from the intermediate goods-producing firms and transforms it into a differentiated retail good using a linear production technology. During each period $t = 0, 1, 2, \ldots$ a retailer j of sector $i = H, F, N$ sells $Y_{it}(j)$ units of the retail goods, at the nominal price $P_{it}(j)$. Let Y_{it} denote the composite of individual retails goods which is described by the CES aggregator of Dixit and Stiglitz (1975):

$$Y_{it} = \left[\int_0^1 Y_{it}(j)^{(\gamma-1)/\gamma} dj\right]^{\gamma/(\gamma-1)}, \tag{27}$$

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

$$Y_{it}(j) = \left[\frac{P_{it}(j)}{P_{it}}\right]^{-\gamma} Y_{it}, \tag{28}$$

where P_{Hit} is the aggregate price index

$$P_{it} = \left[\int_0^1 P_{it}(j)^{1-\gamma} dj\right]^{1/(1-\gamma)} \tag{29}$$

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 is sector is allowed to set its prices optimally, whereas the remaining fraction ν adjust its prices by charging the previous period's price times the steady state inflation. Hence, a retail firm j, which can choose its price in period t, chooses the price $\hat{P}_{it}(j)$ to maximize

$$E_t \sum_{s=0}^{\infty} (\beta\nu)^j \beta_{t,t+s} \left[\left(\frac{\hat{P}_{it}(j)}{P_{it+s}}\right)^{-\gamma} Y_{it+j} \left(\frac{\hat{P}_{it}(j)}{P_{it+s}} - mc_{it+s}\right)\right], \tag{30}$$

where β_{t+s} is the discount factor used by the firms and mc_{it} is the real marginal costs. The first-order condition for this problem is

$$\hat{P}_{it}(j) = \frac{\gamma}{(\gamma-1)} \frac{\sum_{s=0}^{\infty} (\nu\beta)^j E_t(\lambda_{it+s} P_{it+s}^{\gamma} Y_{it+s} mc_{it+s})}{\sum_{s=0}^{\infty} (\nu\beta)^j E_t(\lambda_{it+s} P_{it+s}^{\gamma-1} Y_{it+s})}. \tag{31}$$

2.8. The central bank

The central bank conducts monetary policy according to a modified Taylor (1993) rule

$$\begin{aligned} \ln(R_t/\bar{R}) = \quad & \rho_r \ln(R_{t-1}/\bar{R}) + \rho_y \left(\delta \ln(Y_t/\bar{Y}) + (1-\delta)\ln(Y_t^*/\bar{Y}^*)\right), \\ & + \rho_\pi \left(\delta \ln(\pi_{H,t}/\bar{\pi}_H) + (1-\delta)\ln(\pi_{F,t}^*/\bar{\pi}_F^*)\right) + mp_{r_t} \end{aligned} \tag{32}$$

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 of the degree of interest rate smoothing ρ_r and the reaction coefficients to inflation and output, ρ_π and ρ_y, are positive.

2.9. Trade

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

$$\frac{B_t}{P_t} = \frac{R_{t-1}B_{t-1}}{P_t} + NX. \tag{33}$$

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 $X_t \equiv P_{Nt}/P_{Tt}$ and the terms of trade as $\top \equiv \mathrm{P_{Ft}/P_{Ht}}$. Using these definitions and their foreign counterparts gives us the expression of the real exchange rate in terms of the relative price of non-tradables to tradables and the terms of trade

$$Q_t = \left[\frac{\alpha \top^{1-\gamma} + (1-\alpha)}{\alpha + (1-\alpha)\top_t^{1-\gamma}}\right]^{\frac{1}{1-\gamma}} \left(\frac{X_t^*}{X_t}\right)^{1-\eta}. \tag{34}$$

2.10. Domestic equilibrium conditions

In equilibrium, the value of an open vacancy is zero in both sectors. Making use of the vacancy posting condition (19), combined with equations (20) and (26), yields the job creation condition

$$\frac{c_j}{q_j(\theta_{jt})} = (1-\eta) E_t \beta_{t,t+1} \left[mc_{jt+1} A_{jt+1} (a_{jt+1}^N - \mathring{a}_{jt+1}) - T_i\right]. \tag{35}$$

Equation (35) states that the expected hiring cost that the 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,

$$J_{jt}(\mathring{a}_{jt}) + T_j = 0. \tag{36}$$

The job destruction condition is derived using equations (21), (25) and (36) and is given by

$$\begin{aligned} mc_{jt}A_{jt}\mathring{a}_{jt} - b_j - \tfrac{\eta}{(1-\eta)}c\theta_t + (1-\zeta_{jt})T_j \qquad &= 0 \ . \\ +E_t\beta_{t,t+1}(1-\rho_j^x)mc_{jt+1}A_{jt+1}\textstyle\int_{\mathring{a}_{jt+1}}^{\infty}(a_{jt+1}-\mathring{a}_{jt+1})dF(a_{jt+1}) \qquad & \end{aligned} \tag{37}$$

with $c\theta_t$ representing the average hiring costs of all firms in the two sectors of the economy.

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

$$w_{jt} = \eta\left[mc_{jt}A_{jt}\overline{a}_{jt} + c\theta_t + (\omega_{jt}^c - \zeta_{jt})T_j\right] + (1-\eta_j)b, \tag{38}$$

where $\overline{a}_{jt} = \omega_{jt}^C H(\mathring{a}_{jt}) + (1-\omega_{jt}^C)a_{jt}^N$ is the average idiosyncratic productivity across jobs and $H(\mathring{a}_{jt}) = E(a_{jt}|a_{jt} > \mathring{a}_{jt}) = \int_{\mathring{a}_{jt}}^{\infty}\frac{af_j(a_j)}{1-F_j(\mathring{a}_j)}da$ represents the average productivity for continuing workers. The aggregate output, net of vacancy costs, amounts to

$$y_{jt} = n_{jt}A_{jt}\overline{a}_{jt} - c_{jt}v_{jt}. \tag{39}$$

Both, home and foreign non-tradable consumption must equal demand

$$Y_{Nt} = C_{Nt}\ Y_{Nt}^* = C_{Nt}^*,$$

as must home tradable production

$$Y_{Ht} = C_{Ht} + C_{Ht}^*,$$

with C_{Ht}^* as demand of home tradable goods from abroad. Combining this relation with equation (33) implies 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

$$Y_{Ht} = \alpha\left[\alpha + (1-\alpha)\top_t^{1-\gamma}\right]^{\frac{\gamma}{1-\gamma}}C_{Tt} + (1-\alpha)\left[\alpha\top_t^{1-\gamma} + (1-\alpha)\right]^{\frac{\gamma}{1-\gamma}}C_{Tt}^*. \tag{40}$$

For domestic and foreign non-tradables we get

$$Y_{Nt} = \frac{1-\eta}{\eta}\left(X_t\right)^{\eta-1} C_{Tt}\; Y^*_{Nt} = \frac{1-\eta}{\eta}\left(X^*_t\right)^{\eta-1} C^*_{Tt}.$$

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

$$NX_t = \left(X_t\right)^{\eta-1}\left\{\left[\alpha + (1-\alpha)\top_{\mathrm{t}}^{1-\gamma}\right]^{\frac{1}{1-\gamma}} Y_{Ht} - C_{Tt}\right\}$$

and

$$-\frac{NX_t}{Q_t} = \left(X_t\right)^{\eta-1}\left\{\left[\alpha + (1-\alpha)\top_{\mathrm{t}}^{1-\gamma}\right]^{\frac{1}{1-\gamma}} Y_{Ht} - C_{Tt}\right\}.$$

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 foreign country

$$C_{Tt} = \gamma\left(X_t\right)^{1-\gamma} C_t \; C^*_{Tt} = \gamma\left(X_t\right)^{1-\gamma} C^*_t.$$

In the steady state equilibrium, the household's bonds and money holdings are $B_t = B_{t+1} = 0$ and $M_t = M_{t+1} = 0$, 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 nominal bond holdings of domestic assets by foreign households.

2.11. 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)

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

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 $\hat{r}_t^m = \log(1 + \hat{r}_t^m / 1 + \bar{r}^m)$, 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

$$\tilde{y}_{Ht} = 2\alpha(1-\alpha)\gamma\tilde{\tau}_t + (1-\eta)\left[\alpha\tilde{x}_t + (1-\alpha)\tilde{x}_t^*\right] + \alpha\tilde{c}_t + (1-\alpha)\tilde{c}_t^*.$$

To derive this equation, we used the tradables consumption to aggregate consumption relation and the equations (14) and (40). 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

$$\tilde{y}_{Nt} = -\gamma\tilde{x}_t + \tilde{c}_t.$$

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

$$\tilde{\tau}_t = \tilde{\tau}_{t-1} + (\triangle\tilde{q}_t + \tilde{\pi}_{Ft}^* - \tilde{\pi}_t) - (\tilde{\pi}_{Ht} - \tilde{\pi}_t),$$

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

The price of domestically produced goods, nevertheless, is subject to labor market imperfections. If we now log-linearize equation (31) around the steady state, we can derive two New Keynesian Philips Curves

$$\tilde{\pi}_{Ht} = \beta E_t\tilde{\pi}_{Ht+1} + \frac{(1-\nu)(1-\nu\beta)}{\nu}\tilde{mc}_{Tt}, \tag{41}$$

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

where $\tilde{mc}_{jt}$ is defined as the log-deviation of marginal costs from their steady state value μ. Marginal costs $\tilde{mc}_{jt}$ are derived using a log-linear first-order approximation of (22). In general, CPI depends on home and foreign prices as well as the terms of trade

$$\tilde{\pi}_t = \mu\tilde{\pi}_{Ht} + (1-\mu)\tilde{\pi}_{Nt} + \mu(1-\alpha)\triangle\tilde{\tau}_t.$$

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

$$\tilde{nx}_t = (1-\alpha)\hat{\beta}_{R,t} - 2\alpha(1-\alpha)(\mu-1)E_t\triangle\tilde{\tau}_{t+1} + E_t\tilde{nx}_{t+1}.$$

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

$$\tilde{w}_{jt} = \frac{1}{\bar{w_j}}\left[\eta\bar{mc}_j\bar{A}_j\bar{a_j}\left(\tilde{mc}_{jt} + \tilde{A}_{jt} + \tilde{a}_{jt}\right) + c\bar{\theta}\tilde{\theta}_t + \tilde{T}_j\left(\bar{\omega_j}\tilde{\omega}_{jt} + \beta(1-\rho^x)\tilde{\beta}_{t,t+1}\right)\right]$$

with $\varrho = \frac{\eta\varepsilon Aa}{w}$, the job creation condition

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

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

and the job destruction condition

$$\tilde{\theta}_{jt} = \left(\frac{\eta}{1\text{-}\eta}\right)c\theta\tilde{\theta}_t\left[\bar{mc}_j\bar{A}_j\Omega_2 + \beta(1-\rho^x)\tilde{T}_jE_t\tilde{\beta}_{t,t+1}\right],$$

$$\Omega_2 = \left\{\begin{array}{c} \\ \bar{\mathring{g}}\left(\tilde{mc}_{jt} + \tilde{A}_{jt} + \tilde{\mathring{a}}_{jt}\right) + \beta(1-\rho^x)\left(H(\bar{\mathring{g}}) - \bar{\mathring{a}_j}\right) \\ E_t\left(\tilde{\beta}_{t,t+1} + \tilde{mc}_{jt+1} + \tilde{A}_{jt+1} + \frac{\bar{\mathring{g}}}{H(\bar{\mathring{g}}) - \bar{\mathring{g}}}\tilde{\mathring{a}}_{jt+1}\right) \end{array}\right\}$$

2.12. Monetary policy

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

$$\tilde{r}_t = \rho_r \tilde{r}_{t-1} + \rho_y \left[\delta \tilde{y}_t^* + (1-\delta)\tilde{y}_t\right] + \rho_\pi \left(\delta \tilde{\pi}_t^* + (1-\delta)\tilde{\pi}_t\right) + \epsilon_{r_t}, \qquad (42)$$

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.

3. Calibration

Household preferences are characterized by seven parameters, the steady state discount factor, the value of leisure, the partial elasticities for tradables and non-tradables, the elasticities of substitution between home and foreign-produced tradables, the home bias and the elasticities of substitution for varieties of a good. The periods of the model are calibrated to be quarters and we assume both countries and both sectors to be symmetric. Parameters, therefore, are the same if not indicated otherwise. The steady state discount factor, therefore, is assumed to have the value $\beta = .99$ which implies an annual steady state interest rate of 4 per cent. In the literature there exists a variety of definitions distinguishing tradables from non-tradables. We follow the traditional approach in assigning manufacturing, business services, financial services and tourism to the tradables sector. Given this definition, the size of the tradable sector for France is slightly higher than 41 per cent of GDP; for Italy the share is slightly higher than 45 per cent; while Germany has the highest tradable share of 49 per cent. Southern EMU countries, however, have much lower tradable shares. Given these values, we set the steady state share of the tradable sector to $\iota = .40$, which is roughly in-line with the share of tradables of EMU countries. We follow, furthermore, Ferrero et al. (2008) in setting the preference share parameter to $\alpha = 0.7$ and the elasticity of substitution between home and foreign tradables to $\gamma = 2.0$. Using a Cobb-Douglas specification, we impose a unit elasticity of substitution between tradables and non-tradables, which is the benchmark case in Obstfeld and Rogoff (2007).

We calibrate the labor market of the model to reproduce the structural characteristics of a typical EMU country. The unemployment rate is set to $u = 9.5$ per cent, which is the long-term average among EMU countries. We choose a job separation rate of $\rho = 1.2$ given estimates of between 0.7 per cent for Germany and 1.9 per cent for Denmark (Hobijn and Sahin, 2007). Given these two values, the probability of a worker finding a job in any period is $q_j = .37$ per cent. However, this figure varies significantly among countries within EMU. For German workers, the probability of finding the next job is 57 per cent while it is 18 per cent for Spain so we took a medium value. Using the calibrated

probabilities, we derive a exogenous separation rate of $\rho_x = 0.02$. Unfortunately, the data do 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 $\tilde{a} = 4.14$ is calculated at the steady state intersection of the job destruction and job creation curve. We follow den Haan et al. (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 $F(.)$, therefore, is calibrated to be $\mu_{ln} = 2.54$ 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 $a^n > \tilde{a}$ which implies that new matches never separate.

We follow Burgess and Turon (2010) in setting the matching rate of firms to $q_j(\theta_{jt}) = 0.9$. The elasticity of a match is calibrated to be $\xi = .7$ based on the estimates of Bean (1994) and in-line with Petrongolo and Pissarides (2001). We calibrate the level parameter of the matching function χ in a way that we replicate the steady state number of matches. As standard in the literature, the Nash bargaining coefficient used in the wage-setting equation is set to $\mu = 0.5$ such that workers and firms have the same bargaining power. The vacancy posting costs in the baseline scenario $c = 7.82$ and the unemployment benefits b are inferred from the steady state job destruction and cob-creation conditions. The parameter measuring leisure is calibrated to $h = 1.78$, a value calibrated using the calibrated realization of w and b. Firing costs T are set to .67 per cent, which is calculated as EMU average using the World Development Indicators (WDI) database, while the replacement rate is $\rho_u = .5$ cent of the mean wage. According to the dataset of Vliet and Caminada (2012), most EMU countries have a replacement rate between 0.5 and 0.6 per cent, while Portugal has the highest (78 per cent) and Malta the lowest value(30 per cent) .

As it is common in the literature, the parameter measuring the market power of intermediate good firms is set to $\varepsilon = 11$. This implies a mark-up over marginal costs of 10 per cent 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 common, we normalize steady state inflation to 1. The Taylor rule is calibrated following Taylor and Woodford (1999) implying 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 of European countries, which is on average 1.08. The standard deviation of the shock, consequently amounts to $\sigma_a = 0.0045$ and the shock persistence parameter is $\rho_a = 0.94$.

4. Results

In this section we present the results of our simulation exercise. In the first subsection, we show the impact of three reform measures, a reduction of vacancy posting costs, more efficient placement and a lower replacement rate on the four sectors of our two-economy model. In the second subsection, we will discuss the impulse response functions (IRF) showing the adjustment of the economy after a transitory shock and, finally, we assess the robustness of our results.

4.1. Steady state analysis

In section 3 we calibrated the model to reflect the structure of a typical EMU member state. In the benchmark scenario, both countries are symmetric. In our three policy scenarios, we changed the labor market framework to reproduce the impact of labor market reforms. The steady state values of the four scenarios are presented in Table 1. As labor market reforms are imposed in the domestic country, only, and due to zero net-exports and constant consumption preference parameters, the foreign country remains at the benchmark steady state values in all of our scenarios. In the first policy scenario, we decreased vacancy posting costs for the tradable goods sector. As mentioned earlier, a reduction in regulatory requirements for the posting of workers reduces the vacancy posting costs for firms. This affects primarily the tradable-goods sector, as two-thirds of posted workers are employed there. The second policy scenario discusses a situation in which the domestic country has a higher replacement ratio. Krause and Uhlig (2012), among others, consider the reduction of the replacement rate and the regime shift from earnings-dependent to an earnings-independent system as crucial for explaining the large drop in unemployment in Germany.[7] In our third policy scenario, we follow Fahr and Sunde (2009), who analyze the increase in matching efficiency related to the German labor market reforms.

The calibration of the model to the characteristics of a typical EMU member states results in a low threshold productivity of 0.25, which implies that there are nearly zero endogenous job-separations. In the model of Zanetti (2011) which reproduces the structural characteristics of the UK economy, the threshold productivity is much higher due to lower vacancy posting and firing costs.

In the first policy scenario, we decrease the vacancy posting costs by 25 per cent for the tradable goods sector. In the second column of Table 1, we see an increase in wages of both sectors which easily follows from equation (38) and an boost in the threshold productivity for job-separations which follows from equation (37). The increase in the threshold productivity is sizeable but, given the productivity distribution, has only minor effects on total job separations. The most important impact of a reduction in vacancy posting costs is on the job

[7] We assumed an increase in the replacement rate for technical reasons. This enables us to analyze the other labor market reform measures at a low endogenous separation steady state that the calibration of the "core" countries of EMU implies. This is important, as we believe that a reduction of the replacement rate has an immediate impact on the economy, while a change in regulations and an increase in the matching efficiency follows.

creation condition of the tradable sector (equation 35). Consequently, the number of matches increases for the tradable sector and unemployment decreases. Given that preferences do not change, the output of both sectors increases.

In our second policy scenario, we assume that the replacement rate of the domestic country increases by 5 percentage points compared to the benchmark replacement rate. The domestic country experiences higher wages following directly from the wage bargaining equation (38), an increase in the threshold productivity due to the job destruction condition and an increase in endogenous separations as the threshold productivity raises. An increase in separations, in general, increases the necessity for firms to post vacancies. The value of a vacancy, nevertheless, is decreasing, which results in an opposing effect, i.e. lowering the probability of firms to open new positions. In our model, the latter effect dominates, thereby, reducing the number of vacancies. The unemployment rate rises due to decreasing employment. Both a decreasing number of vacancies and an increase in the unemployment rate reduces labor market tightness.

In our third policy scenario we increase the matching efficiency by 5 percentage points which increases the number of matches given the number of vacancies and the number of unemployed workers. As it becomes more likely for a firm to fill a position, the costs for a match decrease. Given the job destruction condition, this implies an increase in the threshold productivity as the value of a match is constant while the costs of opening and filling positions decline. The total job destruction rate increases, which implies an increase in transitions to unemployment. But the latter is compensated as workers have a higher probability to find a job and spend less time in unemployment spells. As output increases, the real wage stays constant due to the fact that the bargaining position of workers is not affected by an increase in matching efficiency.

Table 1 on page 31 about here

4.2. Shock responses

In this section, we discuss the impulse responses to a positive domestic technology shock, a negative foreign technology shock, a monetary policy shock and a time-preference shock affecting households living in the domestic economy. In Figures 1 and 2, we see the response of the model to a positive technology shock on tradable good production of one standard deviation is visualized. On impact, output and employment in the tradable sector increases while inflation of home-produced tradables declines. As the value of a match increases, the threshold productivity declines and workers that used to be fired because their productivity is below the steady state threshold remain employed. This is exactly the reason why the average productivity of a worker and transitions from employment in the tradables sector to unemployment decline. As the technology shock affects the tradable sector of the economy, only, a price drop in tradables decreases the price relation of tradable to non-tradable goods and households

shift consumption towards tradables. Experiencing a drop in demand, the revenue of firms in the non-tradables sector declines, increasing the productivity threshold for continuing employment in this sector and boost transitions from non-tradable employment to unemployment.

In this model, wages are bargained in the second stage of a two-stage approach. Average wages in the non-tradable sector increase as costs stay constant and the average productivity of a worker is rising. The impact on average wages in the tradables sector, however, is not clear. As total factor productivity increases, there is a positive stimulus on the average wage. The marginal costs, nevertheless, decline, serving as a negative stimulus as does a decline in the average productivity so that we observe a tiny reduction in average wages of the tradable sector. A reduction in the average real wage does not affect the likelihood of accepting a position in the tradable sector. As vacancies of tradable firms increase and vacancies of non-tradable firms decline, the probability of becoming employed in the tradable sector increases. Households living in the foreign economy experience a drop in tradable good prices produced in the domestic economy. Given irrevocably fixed exchange rates in the currency union, they shift consumption towards these goods, increasing net imports and, therefore, the debt of their country. In sum, the production of tradables in the home country increases and the demand for these products in the home and foreign country. As overall prices decrease in the home country, households can consume more goods.

All of our four scenarios follow the pattern just sketched. In the scenario indicated by a dotted line where unemployment benefits are five percentage points higher than in the benchmark scenario, indicated by a continuous line, we observe a stronger increase in employment (Figures 1 and 2). This effect results from a stronger drop in endogenous job destruction. As we see in Table 1, the steady state of this scenario is characterized by a high job destruction rate, implying more endogenous job-separations than in the other scenarios. Given these steady state values, a drop in the threshold productivity results in a much stronger decline of endogenous job-separations than in the other scenarios. As a firm in the tradable sector is able to fill positions by reducing endogenous separations, it posts more positions in the first periods and keeps workers for a longer time which, in turn, results in reduced posting activities in later periods. Given that the impact on employment is stronger, and due to the fact that labor is the sole production factor, output in the tradable-sector is higher in this scenario. With a higher output, the impact on prices is greater. Both results in a stronger shift from non-tradable to tradable consumption and in an increase in demand for tradables from the foreign country resulting in higher debt there. We observe endogenous steady state job separations due to the calibration of our model. Decreasing the unemployment benefits further would be misleading as the impact of this institutional change works through the channel of net-separations. As net-separations are close to zero for any replacement rate equal or lower the the steady state value of 0.5, the impact of a decrease of the replacement rate would be minor. That is why we decided to present an increase in the replacement rate rather than a decrease observed in recent labor market

reforms.[8] The impact of a reduction in unemployment benefits can, therefore, easily dwarf the other labor market reforms if endogenous steady state job-separations strongly decline but may also be minor if endogenous steady state separations are already close to zero.

A second policy scenario, where we increased the matching efficiency by five percentage points, is indicated by a dotted / broken line (Figures 1 and 2). In this scenario, we record a smaller but still substantial increase in the tradable goods production compared to the scenario with an increase in the replacement rate. Gains in production are again caused by a stronger increase in employment compared to the benchmark scenario. The reason for this increase is a better matching of workers, which on the one hand, reduces the time workers spend searching for a job and, therefore, unemployment. On the other hand, the time span of an open vacancy is reduced, which raises the value of a vacancy as filled positions have a higher reward than open positions. As the value of a vacancy increases, firms open more positions. Again, the increase in output necessitates a stronger decrease in prices which, in turn, raises net exports and foreign debt.

Our third policy scenario, indicated by a broken line (Figures 1 and 2), shows a reduction in vacancy posting costs for vacancies posted by tradable goods producing firms. As in the scenario with an increase in matching efficiency, firms increase the posting of vacancies which increases employment. The increase, nevertheless, is much smaller than in the previous scenarios since the reduction affects tradable-goods-producing-firms, only. Vacancy posting costs, furthermore, have a smaller impact on average wages than a reduction of the replacement rate. Again we see an improvement in the terms of trade, an increase in net exports and an increase in foreign debt, but the impact is much smaller than in the other policy scenarios. However, a reduction of vacancy posting costs results in an increase in the number of posted workers. As labor market reforms diminish the regulations on this industry, the number of posted workers increased tremendously. From the literature on labor market reforms, we know, that posted workers are deployed mainly in tradable industries like manufacturing and business services, which is why we see decreased vacancy posting costs only for tradable firms.

Figure 1 on page 32 and Figure 2 on page 33 about here

As there are reasons to assume that some countries in the Eurozone were subject to positive technology shocks which mainly benefited the tradable goods sector (Krause and Uhlig, 2012), we are also interested in the impact of a negative technology shock that may hits the periphery of the Eurozone (Figures 3 and 4). In the benchmark scenario, the negative technology shock improves the terms of trade of the domestic economy. Alike the scenario with a positive

[8] This is in line with replacement rates of EMU countries that are, except those of the EU accession states of 2008 and 2010, all equal or greater than 0.5.

technology shock, net exports increase and, consequently, the foreign country experiences an increase in foreign debt. In the domestic economy, households shift consumption from foreign tradables, where prices tend to increase, to tradables of the domestic economy. In sum, the price of tradables increases, which is the reason why households shift from tradable to non-tradable consumption. The impact of the shock on home production is ambiguous. Demand of native households having a home preference is shrinking as households shift from tradables to non-tradables but also increases as households shift from foreign tradables to domestic produced tradables. Additionally, households living in the foreign country, increase their demand for tradables produced in the domestic economy. It is, therefore, likely that the demand for domestic produced tradable increases which induces an increase in production. If production increases, the demand for labor grows and the threshold productivity declines, reducing the number of endogenous job separations. In contrast to the previous shock, non tradable output is also growing and consumption has to decline because of an increase in the overall price index. In sum, the foreign negative technology shock increases prices and production in the home country and reduces production of tradables in the foreign country that was initially hit by the shock. As net imports from the domestic economy increase, foreign households increase debt.

Labor market reforms, again, affect the pattern of adjustment to a macroeconomic shock. Employment is falling with an increase in the replacement rate. If we consider that labor market reforms tend to reduce the replacement rate, a reduction in the replacement rate is the only reform measure reducing the debt of the foreign country. Again, like in the scenarios with a technology shock, an increase in the matching efficiency has a stronger effect than decreasing job creation costs. This is, however, true for the first 31 periods and turns around thereafter. From the 42nd period on, the increase in employment is higher in the vacancy cost reduction scenario than in all other scenarios. A similar pattern holds for unemployment, which turns round already in the 30nd period.

Given the tradable / non-tradable price relation, adjustment is faster in the vacancy posting scenario than in all other scenarios. The reason for this pattern is that firms in the tradable sector post more positions than in the other scenarios which, over time, turns into an increase in employment. The other sectors rely less on job separations than on a rising number of new matches. This holds especially for the scenario were we have an increase in the replacement rate. For the foreign country, a flexible adjustment in the tradable sector of the domestic economy comes at the cost of higher debt. While debt in the scenario of reduced vacancy posting costs was below that of the scenario with an increase in the replacement rate, this changes after 35 periods. Given that the increase in employment and production for the home tradable sector is ongoing and net exports stay above the value of all other scenarios, foreign debt will increase further. A deregulation of the posting of worker industry, therefore, is likely to result in increasing debt of non-reforming countries if those countries are subject to negative technology shocks. This effect overtakes the impact of a reduction in the replacement rate and will dominate the overall impact of labor market

reforms.

Figure 3 on page 34 and Figure 4 on page 35 about here

Figure 5 shows the impact of both, a time preference shock in the domestic country and of a monetary policy shock on the debt of the foreign country. As expected, a monetary policy shock has no impact on debt in the benchmark case. As monetary policy affects both countries in the monetary union, there is no reason for adjusting net exports, which also implies that debt of the foreign country remains unaffected. If the domestic country raises its matching efficiency, debt of the domestic country increases. As in the scenarios with technology shocks, a reduction in matching frictions amplifies the response of the economy to macroeconomic shocks. As the foreign country is more stable and does not adjust prices as the domestic country does, this induces a stronger demand for foreign tradable goods which increases net exports of the foreign country and increases the debt of the domestic country. The same holds true if the domestic country increases the replacement rate, as more endogenous job destruction makes the economy more sensitive with respect to macroeconomic shocks. As labor market reforms usually reduce the replacement rate, the reforming economy becomes more stable, which, in turn, might result in an increase of debt of the non-reforming countries.

Finally, we analyze the impact of a time preference shock on the domestic economy. Such a shock increases the share of income households save for the purpose of consumption smoothing (see equation 7). As foreign households have a higher preference for present consumption it is reasonable for them to increase net imports and repay the debt later on. For domestic households, net exports are treated as an riskless asset comparable to government bonds. In the wake of the time preference shock, domestic households have to cut consumption demand. As firms experience a drop in demand for their goods, those firms able to alter prices, adjust. In order to be able to stay in the market, firms have to reduce marginal costs by increasing the productivity threshold. The number of endogenous job separations, therefore, is rising. Additionally, firms post fewer vacancies as the value of a vacancy decreases. Both adds to an increase in unemployment and a reduction of labor market tightness. The drop in prices is stronger for non-tradables than for tradable goods as the prices of tradables from the foreign country remains unaltered. The tradable good firms, nevertheless, face an increasing demand by foreign households after the price drop. This raises net exports and foreign debt (Figure 5). The increase in debt is larger the scenario with an increase in the replacement rate since the productivity threshold in the steady state is much higher here than in the other scenarios. A further increase, therefore, affects more workers and decreases employment and production more sharply thereby enlarging the impact on debt.

Figure 5 on page 36 about here

4.2.1. 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 resulted in a low value of 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 should affect the threshold productivity, a driving force of the model.

Table 2 on page 37 about here

Reducing the standard deviation of the idiosyncratic productivity in all sectors of both countries raises the productivity threshold from 0.25 to 3. A new value of the equilibrium threshold productivity requires a full new set of calibrations. These new parameter values, yields higher steady state unemployment, lower average real wages and a lower output. The qualitative results of the previous section, nevertheless, stays the same. In general, the impact of labor market reforms turns out to be stronger. The scenario with a higher replacement rate (dotted line) is still the one with the highest impact on tradable production and consumption and and in which the foreign debt of the foreign country increases most strongly. The scenario with a higher matching efficiency (dotted / broken line) follows close behind. The impact of the scenario with an increase in vacancy posting costs (broken line), nevertheless, is gaining in size and is in its impact on output and net exports close to the scenario with an increase in matching efficiency. The previously gained clear result that the replacement rate scenario outperforms the other scenarios no longer holds. If we look at the combined effect, labor market reforms increase the debt of the foreign country compared to the baseline, while in the previous section, the reduction of the replacement rate had such a strong effect that labor market reforms reduced the impact of a domestic technology shock to the debt of the foreign country.

Figure 6 on page 38 about here

5. Conclusion

After the creation of the EMU, current account imbalances increased sharply as expectations regarding growth in the periphery of the union failed to materialize (Blanchard, 2007) and both the core and the periphery of the euro area

were hit by common and asymmetric macroeconomic shocks. In the economic literature, there is a discussion going on concerning to what extent labor market reforms contributed to these imbalances. In this paper, we examine the effects of three types of labor market reform measures, namely a decrease in the replacement rate, an increase in matching efficiency and a decrease of vacancy posting costs on the foreign debt of non-reforming countries. If the reforming country increases its current account surplus due to these reforms, some speak of a beggar-thy-neighbor policy.

The first reform measure, a decline in the replacement rate, reduces both, steady state unemployment and endogenous job-destruction, which is closely related to a lower impact of shocks on output, prices and, therefore, also on net exports and the level of foreign debt of non-reforming countries. The second reform measure, an increase in matching efficiency, in contrast, corresponds with a higher level of foreign debt of non-reformers, as endogenous job-destruction increases. This, in turn, amplifies the impact of a shock on employment, production and, therefore, 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 of output and prices, an increase in the impact of a shock on net exports and a stronger impact on the level of foreign debt of the non-reforming country. Finally, the third reform measure, a reduction in the costs of posting a vacancy, has an impact on the level of foreign debt on non-reformers, as the reforming country's tradable sector is able to alter employment at lower cost and, thus, more strongly. This in turn amplifies the impact of a shock on prices, production and, therefore, also on the foreign debt of the non-reformers.

In the case of a positive technology shock hitting a reforming country with the characteristics of a typical EMU member, fears about a beggar-thy-neighbor policy that leaves non-reforming countries with a loss in competitiveness and an increase in foreign debt cannot be corroborated by us for the specific bundle of reforms considered here. The positive effect of reduction in the replacement rate more than compensates negative spillovers from increases in matching efficiency and a decrease in vacancy posting costs. This does, however, not hold for a negative productivity shock in the non-reforming country, as the second reform measure, a reduction in vacancy posting costs in the tradable sectors, is dominating the overall impact of labor market reforms and, thus, increasing the foreign debt of the non-reforming country. As the impact of labor market reforms in the latter case are small compared to the impact of a positive technology shock in the reforming country, we do not see the danger of a beggar-thy-neighbor policy in the case of EMU member countries reforming their labor markets.

References

Andolfatto, D., 1996. Business cycles and labor-market search. American Economic Review 86 (1), 112–132.

Bean, C. R., 1994. European unemployment: a survey. Journal of Economic Literature 32 (2), 573–619.

Belke, A., Kaas, L., 2004. The impact of exchange rate volatility on labor markets: Europe versus United States. Journal of Economic Asymmetries 1 (2), 21–50.

Bernanke, B. S., Gertler, M., Gilchrist, S., 1999. The financial accelerator in a quantitative business cycle framework. In: Taylor, J. B., Woodford, M. (Eds.), Handbook of Macroeconomics. Volume 1C. Handbooks in Economics, vol. 15 and Amsterdam and New York and Oxford and Elsevier Science, North-Holland, pp. 1341–1393.

Bertola, G., Lo Prete, A., 2009. Reforms, finance, and current accounts. In: Paper presented at the IZA/CEPR 11th European Summer Symposium in Labour Economics. Institute for the Study of Labor, Bonn.

Blanchard, O., 2007. Adjustment within the Euro: the difficult case of Portugal. Portuguese Economic Journal 6 (1), 1–21.

Blanchard, O., Wolfers, J., 2000. The role of shocks and institutions in the rise of European unemployment: The aggregate evidence. Economic Journal 110 (462), C1–C33.

Blanchard, O. J., Summers, L. H., 1987. Hysteresis in unemployment. European Economic Review 31 (1–2), 288–295.

Burgess, S., Turon, H., 2010. Worker flows, job flows and unemployment in a matching model. European Economic Review 54 (3), 393–408.

Calvo, G. A., 1983. Staggered prices in a utility-maximizing framework. Journal of Monetary Economics 12 (3), 383–398.

Carone, G., Pierini, F., Stovicek, K., Sail, E., 2009. Recent reforms of the tax and benefit systems in the framework of flexicurity. European Economy. Occasional paper 43.

Chen, R., Milesi-Ferretti, G. M., Tressel, T., 2013. External imbalances in the Eurozone. Economic Policy (28), 101–142.

den Haan, W. J., Ramey, G., Watson, J., 2000. Job destruction and propagation of shocks. American Economic Review 90 (3), 482–498.

Dixit, A. K., Stiglitz, J. E., 1975. Monopolistic competition and optimum product diversity. American Economic Review 67 (3), 297–308.

Dreze, J. H., Malinvaud, E., 1994. Growth and employment: the scope of a European initiative. European Economic Review 38 (3-4), 489–504.

Fahr, R., Sunde, U., 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., Larch, M., Lechthaler, W., 2012. Labour market reforms in a globalised world. Intereconomics/Review of European Economic Policy 47 (5), 307–312.

Ferrero, A., Gertler, M., Svensson, Lars E. O., 2008. Current account dynamics and monetary policy. Working Paper, National Bureau of Economic Research (NBER) , Cambridge/MA 13906.

Hobijn, B., Sahin, A., 2007. Job-finding and separation rates in the OECD. Federal Reserve Bank of New York Staff Report 298.

Kennedy, M., Slok, T., 2005. Structural policy reforms and external imbalances. Organisation for Economic Co-operation and Development (OECD) Working Paper 415.

Krause, A., Rinne, U., Zimmermann, K. F., 2014. How far away is a single European labor market? Institute for the Study of Labor (IZA), Discussion Paper 2014 (8383).

Krause, M. U., Lubik, T. A., 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., Uhlig, H., 2012. Transitions in the German labor market: Structure and crisis. Journal of Monetary Economics 59 (1), 64–79.

Layard, R., Nickell, S., Jackman, R., 1994. The unemployment crisis. Oxford and New York and Oxford University Press.

Lazear, E. P., 1990. Job security provisions and employment. Quarterly Journal of Economics 105 (3), 699–726.

Lindbeck, A., 1996. The West European employment problem. Weltwirtschaftliches Archiv 132 (4), 609–637.

Merz, M., 1995. Search in the labor market and the real business cycle. Journal of Monetary Economics 36 (2), 269–300.

Mortensen, D. T., Pissarides, C. A., 1994. Job creation and job destruction in the theory of unemployment. Review of Economic Studies 61 (3), 397–415.

Mortensen, D. T., Pissarides, C. A., 2003. Taxes, subsidies and equilibrium labor market outcomes. In: Phelps, E. S. (Ed.), Designing inclusion: tools to raise low-end pay and employment in private enterprise. Cambridge University Press, Cambridge, New York and Melbourne, pp. 44–73.

Mundell, R. A., 1961. A theory of optimum currency areas. American Economic Review 51 (4), 657–665.

Mussa, M., 2005. Sustaining global growth while reducing external imbalances. In: Bergsten, C. F., Institute for International Economics (Eds.), The United States and the World Economy: Foreign Economic Policy for the Next Decade. Institute for International Economics, Washington, D.C., pp. 175–207.

Obstfeld, M., Rogoff, K., 1995. The intertemporal approach to the current account. In: Grossman, G. M., Rogoff, K. (Eds.), Handbook of International Economics. Volume 3. Elsevier, North-Holland, Amsterdam, New York and Oxford, pp. 1731–1799.

Obstfeld, M., Rogoff, K., 2007. The unsustainable u.s. current account position revisited. In: Clarida, R. H. (Ed.), G7 Current Account Imbalances: Sustainability and Adjustment. National Bureau of Economic Research Conference Report. Chicago and London: University of Chicago Press, pp. 339–366.

Petrongolo, B., Pissarides, C. A., 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, Cambridge and London, Harvard University Press.

Pissarides, C. A., 1997. The need for labor-market flexibility in a European Economic and Monetary Union. Swedish Economic Policy Review 4 (2), 513–545.

Salvatore, D., 1998. Europe's structural and competitiveness problems and the Euro. World Economy 21 (2), 189–205.

Taylor, J. B., 1993. Discretion versus policy rules in practice. Carnegie-Rochester Conference Series on Public Policy 39, 195–214.

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

Trigari, A., 2009. Equilibrium unemployment, job flows, and inflation dynamics. Journal of Money, Credit, and Banking 41 (1), 1–33.

Walsh, C. E., 2005. Labor market search, sticky prices, and interest rate policies. Review of Economic Dynamics 8 (4), 829–849.

Zanetti, F., 2011. Labor market institutions and aggregate fluctuations in a search and matching model. European Economic Review 55 (5), 644–658.

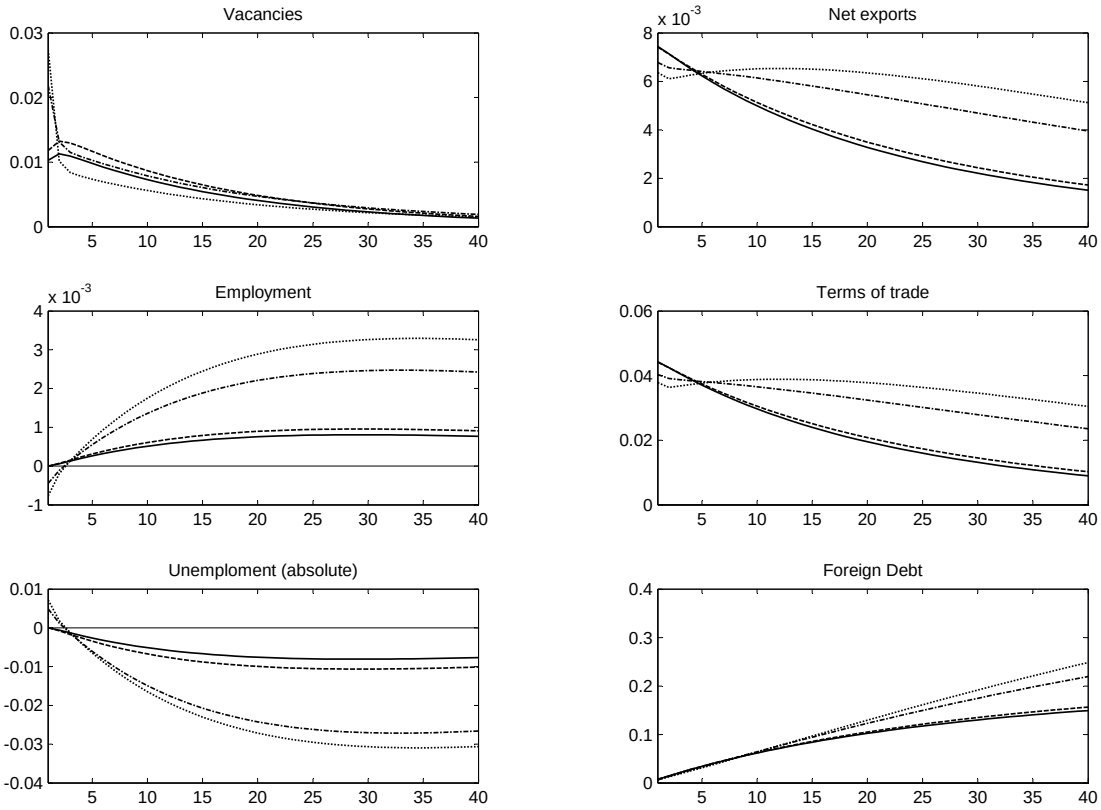
Tables and Graphs

Table 1: Steady state values

Variable	Benchmark	Decrease in vacancy posting costs	Increase in the replacement ratio	Increase in matching efficiency
Output	12.96	13.01	12.89	13.07
Unemployment rate	0.095	0.090	0.10	0.087
Real wages	12.96	12.97	12.99	12.96
Tightness	0.23	0.29	0.22	0.25
		Tradables		
Output tradables	5.13	5.15	5.11	5.18
Vacancies	0.009	0.012	0.009	0.009
Threshold productivity	0.25	1.03	2.53	2.27
Total job destruction rate	0.02	0.02	0.03	0.0202
		Non-tradables		
Output non-tradables	7.82	7.85	7.78	7.89
Vacancies	0.014	0.014	0.013	0.013
Threshold productivity	0.25	0.99	2.53	2.27
Total job destruction rate	0.0200	0.0200	0.0204	0.0202

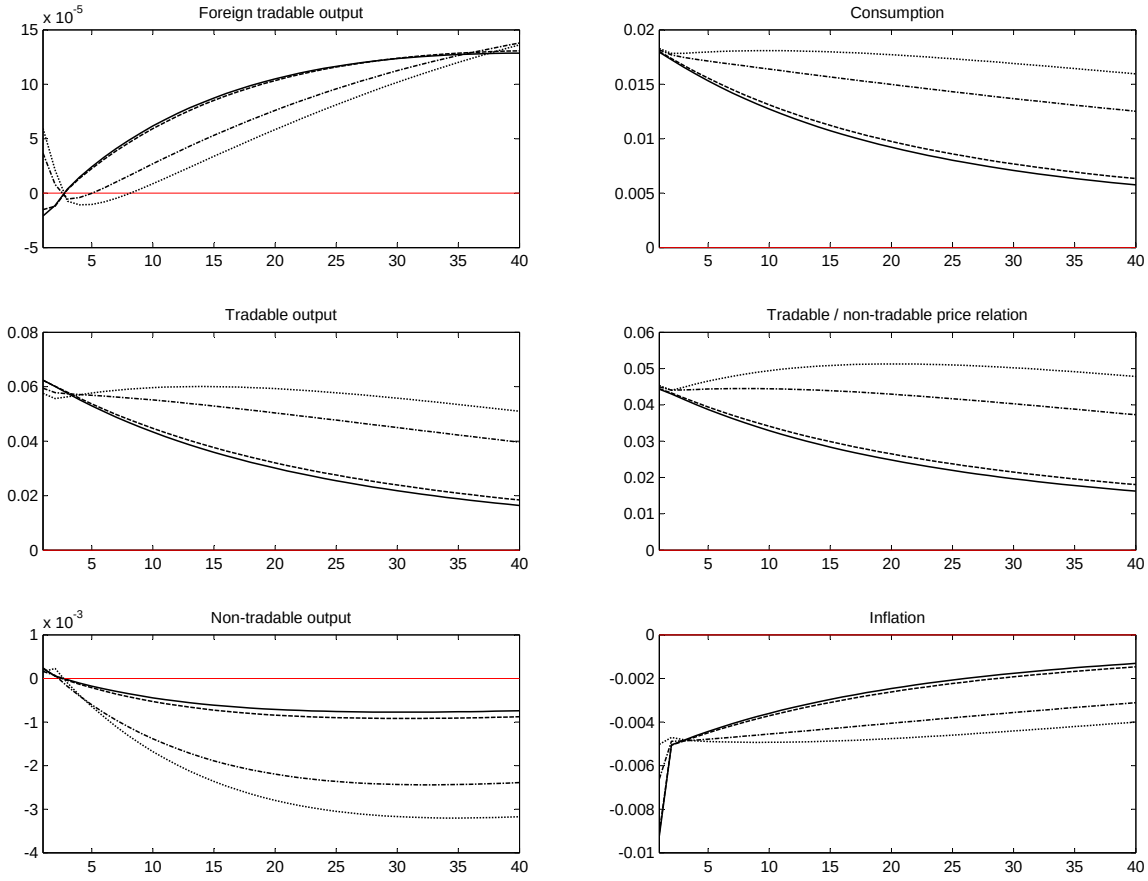
Notes: Entries in this table are computed using the calibration described in section (3)

Figure 1: Positive domestic technology shock



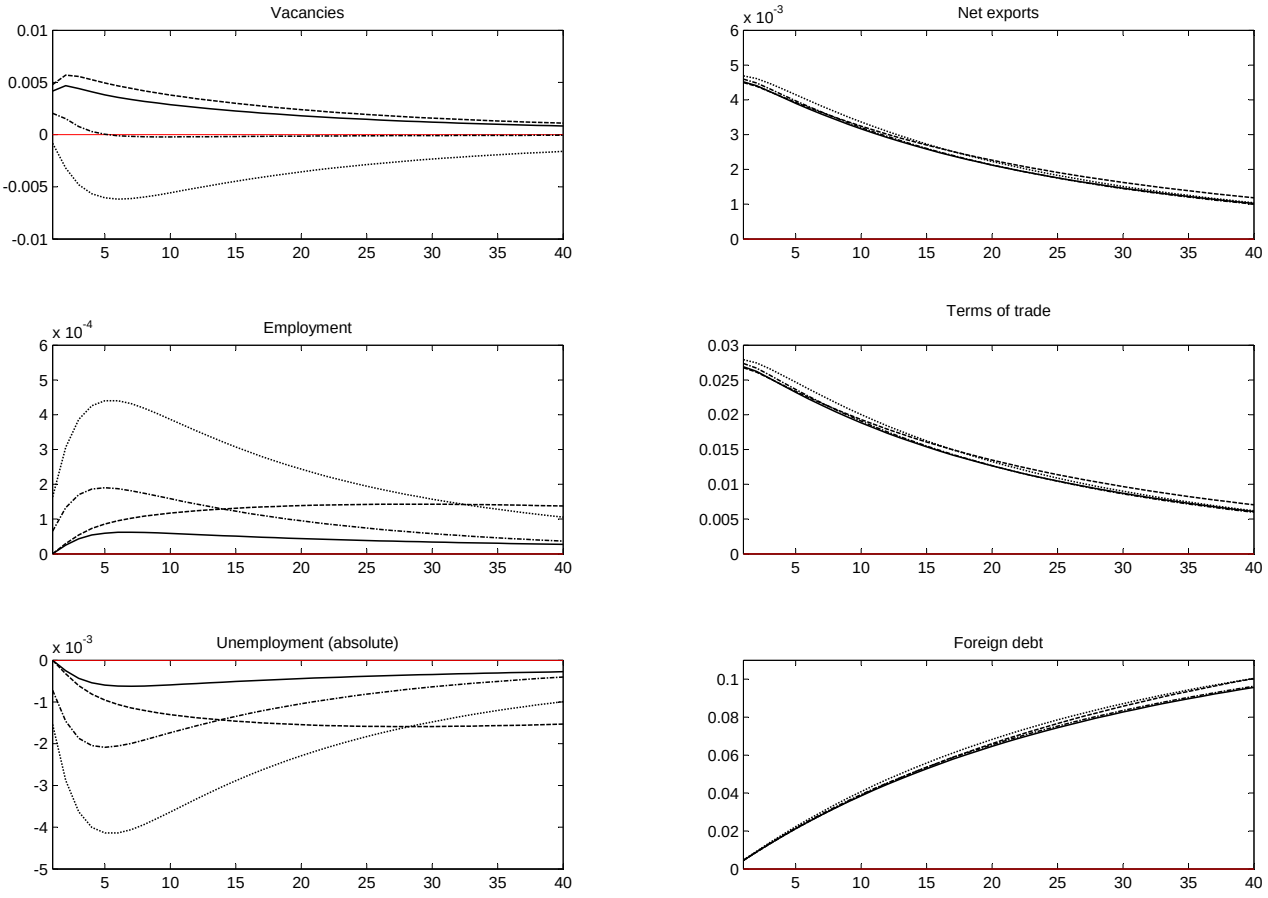
Impulse response functions to a positive technology shock in the domestic country.
Notes: Each panel shows the response of the models' variables to a technology shock of one standard deviation. The horizontal axes measure time, expressed in quarters.

Figure 2: Positive domestic technology shock



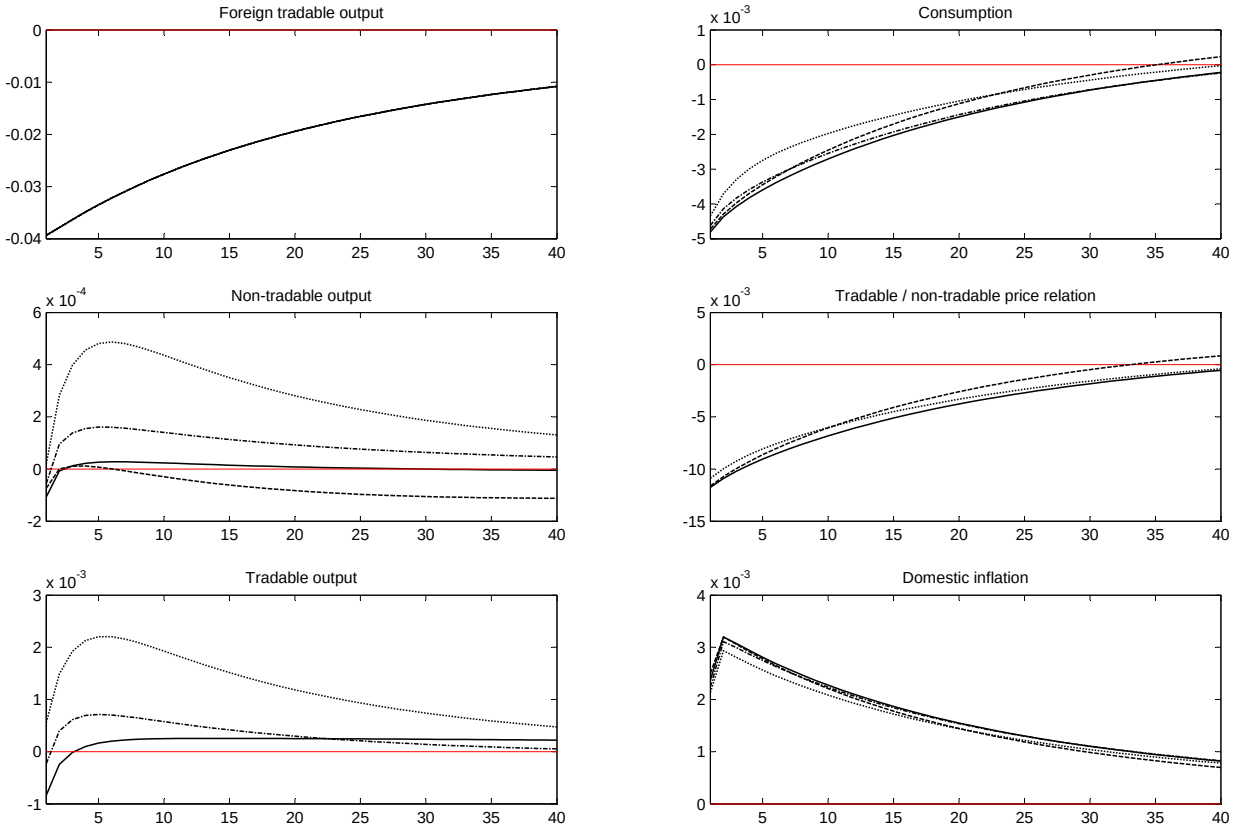
Impulse response functions to a positive technology shock in the domestic country.
Notes: Each panel shows the response of the models' variables to a technology shock of one standard deviation. The horizontal axes measure time, expressed in quarters.

Figure 3: Negative foreign technology shock



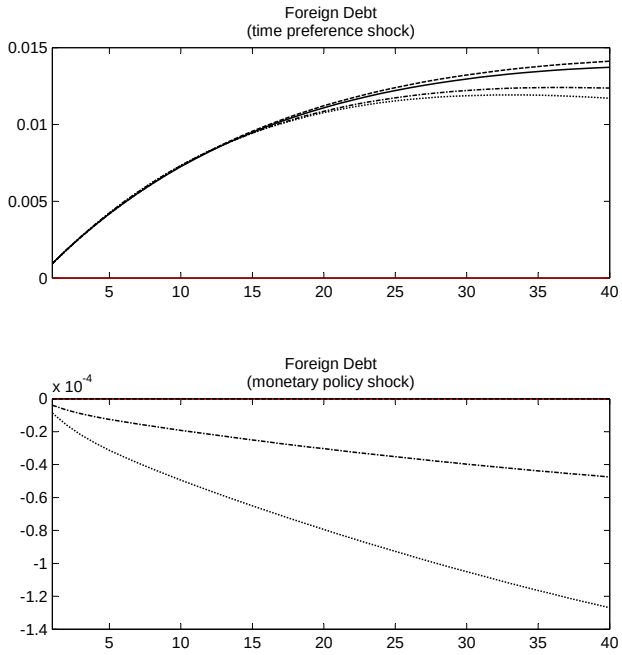
Impulse response functions to a negative technology shock in the foreign country. Notes: Each panel shows the response of the models' variables to a technology shock of one standard deviation. The horizontal axes measure time, expressed in quarters.

Figure 4: Negative foreign technology shock



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

Figure 5: Monetary policy shock



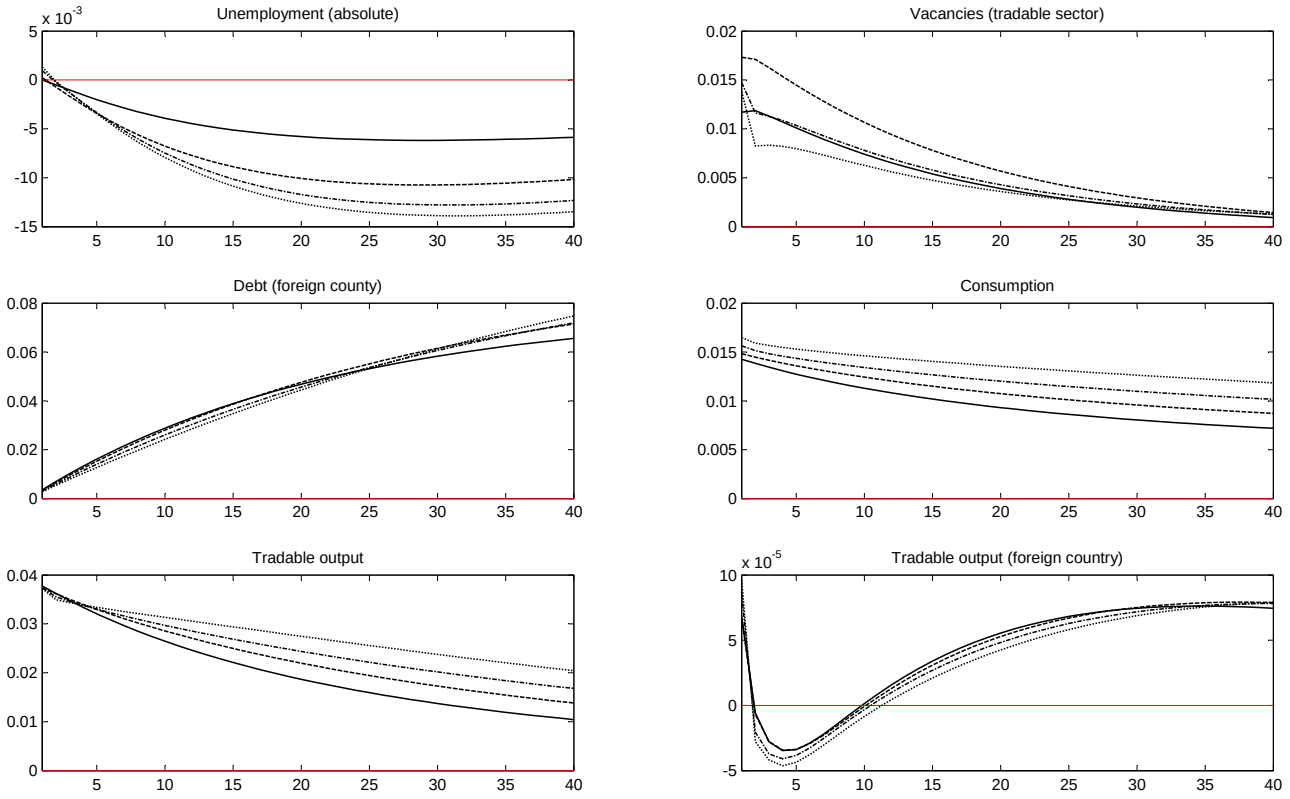
Impulse response functions to a monetary-policy and a time-preference shock in the union / domestic country.
Notes: Each panel shows the response of the models' variables to a technology shock of one standard deviation. The horizontal axes measure time, expressed in quarters.

Table 2: Steady state values sensitivity analysis

Variable	Benchmark	Decrease in vacancy posting costs	Increase in the matching efficiency	Increase in replacement ratio
Output	12.56	12.60	12.63	12.53
Unemployment rate	0.10	0.095	0.095	0.11
Real wages	12.03	12.04	12.04	12.05
Tightness	0.37	0.34	0.37	0.31
		Tradables		
Output tradables	4.91	4.92	4.94	4.90
Vacancies	0.008	0.011	0.007	0.007
Threshold productivity	3,00	3,66	4,16	4,41
Total job destruction rate	0.02	0.02	0.0201	0.0201
		Non-tradables		
Output non-tradables	7.65	7.67	7.69	7.64
Vacancies	0.012	0.011	0.011	0.011
Threshold productivity	3,00	3,66	4,16	4,41
Total job destruction rate	0.0200	0.0200	0.0201	0.0201

Notes: Entries in this table are computed using the calibration described in Section 4.

Figure 6: Sensitivity analysis



The following ROME Discussion Papers have been published since 2007:

1	2007	Quo vadis, Geldmenge? Zur Rolle der Geldmenge für eine moderne Geldpolitik	Egon Görgens Karlheinz Ruckriegel Franz Seitz
2	2007	Money and Inflation. Lessons from the US for ECB Monetary Policy	Ansgar Belke Thorsten Polleit
3	2007	Two-Pillar Monetary Policy and Bootstrap Expectations	Peter Spahn
4	2007	Money and Housing – Evidence for the Euro Area and the US	Claus Greiber Ralph Setzer
5	2007	Interest on Reserves and the Flexibility of Monetary Policy in the Euro Area	Ulrike Neyer
1	2008	Money: A Market Microstructure Approach	Malte Krueger
2	2008	Global Liquidity and House Prices: A VAR Analysis for OECD Countries	Ansgar Belke Walter Orth Ralph Setzer
3	2008	Measuring the Quality of Eligible Collateral	Philipp Lehmbecker Martin Missong
4	2008	The Quality of Eligible Collateral and Monetary Stability: An Empirical Analysis	Philipp Lehmbecker
5	2008	Interest Rate Pass-Through in Germany and the Euro Area	Julia von Borstel
1	2009	Interest Rate Rules and Monetary Targeting: What are the Links?	Christina Gerberding Franz Seitz Andreas Worms
2	2009	Current Account Imbalances and Structural Adjustment in the Euro Area: How to Rebalance Competitiveness	Ansgar Belke Gunther Schnabl Holger Zemanek
3	2009	A Simple Model of an Oil Based Global Savings Glut – The “China Factor” and the OPEC Cartel	Ansgar Belke Daniel Gros
4	2009	Die Auswirkungen der Geldmenge und des Kreditvolumens auf die Immobilienpreise – Ein ARDL-Ansatz für Deutschland	Ansgar Belke

5	2009	Does the ECB rely on a Taylor Rule? Comparing Ex-Post with Real Time Data	Ansgar Belke Jens Klose
6	2009	How Stable Are Monetary Models of the Dollar-Euro Exchange Rate? A Time-varying Coefficient Approach	Joscha Beckmann Ansgar Belke Michael Kühl
7	2009	The Importance of Global Shocks for National Policymakers – Rising Challenges for Central Banks	Ansgar Belke Andreas Rees
8	2009	Pricing of Payments	Malte Krüger
1	2010	(How) Do the ECB and the Fed React to Financial Market Uncertainty? The Taylor Rule in Times of Crisis	Ansgar Belke Jens Klose
2	2010	Monetary Policy, Global Liquidity and Commodity Price Dynamics	Ansgar Belke Ingo G. Bordon Torben W. Hendricks
3	2010	Is Euro Area Money Demand (Still) Stable? Cointegrated VAR versus Single Equation Techniques	Ansgar Belke Robert Czudaj
4	2010	European Monetary Policy and the ECB Rotation Model Voting Power of the Core versus the Periphery	Ansgar Belke Barbara von Schnurbein
5	2010	Short-term Oil Models before and during the Financial Market Crisis	Jörg Clostermann Nikolaus Keis Franz Seitz
6	2010	Financial Crisis, Global Liquidity and Monetary Exit Strategies	Ansgar Belke
7	2010	How much Fiscal Backing must the ECB have? The Euro Area is not the Philippines	Ansgar Belke
8	2010	Staatliche Schuldenkrisen – Das Beispiel Griechenland	Heinz-Dieter Smeets
9	2010	Heterogeneity in Money Holdings across Euro Area Countries: The Role of Housing	Ralph Setzer Paul van den Noord Guntram B. Wolff
10	2010	Driven by the Markets? ECB Sovereign Bond Purchases and the Securities Markets Programme	Ansgar Belke

11	2010	Asset Prices, Inflation and Monetary Control – Re-inventing Money as a Policy Tool	Peter Spahn
12	2010	The Euro Area Crisis Management Framework: Consequences and Institutional Follow-ups	Ansgar Belke
13	2010	Liquiditätspräferenz, endogenes Geld und Finanzmärkte	Peter Spahn
14	2010	Reinforcing EU Governance in Times of Crisis: The Commission Proposals and beyond	Ansgar Belke
01	2011	Current Account Imbalances in the Euro Area: Catching up or Competitiveness?	Ansgar Belke Christian Dreger
02	2011	Volatility Patterns of CDS, Bond and Stock Markets before and during the Financial Crisis: Evidence from Major Financial Institutions	Ansgar Belke Christian Gokus
03	2011	Cross-section Dependence and the Monetary Exchange Rate Model – A Panel Analysis	Joscha Beckmann Ansgar Belke Frauke Dobnik
04	2011	Ramifications of Debt Restructuring on the Euro Area – The Example of Large European Economies' Exposure to Greece	Ansgar Belke Christian Dreger
05	2011	Currency Movements Within and Outside a Currency Union: The Case of Germany and the Euro Area	Nikolaus Bartzsch Gerhard Rösl Franz Seitz
01	2012	Effects of Global Liquidity on Commodity and Food Prices	Ansgar Belke Ingo Bordon Ulrich Volz
02	2012	Exchange Rate Bands of Inaction and Play-Hysteresis in German Exports – Sectoral Evidence for Some OECD Destinations	Ansgar Belke Matthias Göcke Martin Günther
03	2012	Do Wealthier Households Save More? The Impact of the Demographic Factor	Ansgar Belke Christian Dreger Richard Ochmann
04	2012	Modifying Taylor Reaction Functions in Presence of the Zero-Lower-Bound – Evidence for the ECB and the Fed	Ansgar Belke Jens Klose

05	2012	Interest Rate Pass-Through in the EMU – New Evidence from Nonlinear Cointegration Techniques for Fully Harmonized Data	Joscha Beckmann Ansgar Belke Florian Verheyen
06	2012	Monetary Commitment and Structural Reforms: A Dynamic Panel Analysis for Transition Economies	Ansgar Belke Lukas Vogel
07	2012	The Credibility of Monetary Policy Announcements: Empirical Evidence for OECD Countries since the 1960s	Ansgar Belke Andreas Freytag Jonas Keil Friedrich Schneider
01	2013	The Role of Money in Modern Macro Models	Franz Seitz Markus A. Schmidt
02	2013	Sezession: Ein gefährliches Spiel	Malte Krüger
03	2013	A More Effective Euro Area Monetary Policy than OMTs – Gold Back Sovereign Debt	Ansgar Belke
04	2013	Towards a Genuine Economic and Monetary Union – Comments on a Roadmap	Ansgar Belke
05	2013	Impact of a Low Interest Rate Environment – Global Liquidity Spillovers and the Search-for-yield	Ansgar Belke
06	2013	Exchange Rate Pass-Through into German Import Prices – A Disaggregated Perspective	Joscha Beckmann Ansgar Belke Florian Verheyen
07	2013	Foreign Exchange Market Interventions and the $-¥ Exchange Rate in the Long Run	Joscha Beckmann Ansgar Belke Michael Kühl
08	2013	Money, Stock Prices and Central Banks – Cross-Country Comparisons of Cointegrated VAR Models	Ansgar Belke Marcel Wiedmann
09	2013	3-Year LTROs – A First Assessment of a Non-Standard Policy Measure	Ansgar Belke
10	2013	Finance Access of SMEs: What Role for the ECB?	Ansgar Belke
11	2013	Doomsday for the Euro Area – Causes, Variants and Consequences of Breakup	Ansgar Belke Florian Verheyen
12	2013	Portfolio Choice of Financial Investors and European Business Cycle Convergence – A Panel Analysis for EU Countries	Ansgar Belke Jennifer Schneider

13	2013	Exports and Capacity Constraints – A Smooth Transition Regression Model for Six Euro Area Countries	Ansgar Belke Anne Oeking Ralph Setzer
14	2013	The Transmission of Oil and Food Prices to Consumer Prices – Evidence for the MENA countries	Ansgar Belke Christian Dreger
15	2013	Target-balances: The Greek Example	Malte Krüger
16	2013	Competitiveness, Adjustment and Macroeconomic Risk Management in the Eurozone	Peter Spahn
17	2013	Contextualizing Systemic Risk	Lukas Scheffknecht
01	2014	Exit Strategies and Their Impact on the Euro Area – A Model Based View	Ansgar Belke
02	2014	Monetary Dialogue 2009-2014: Looking backward, looking forward	Ansgar Belke
03	2014	Non-Standard Monetary Policy Measures – Magic Wand or Tiger by the Tail?	Ansgar Belke
04	2014	Böhm-Bawerk und die Anfänge der monetären Zinstheorie	Peter Spahn
05	2014	State-of-play in Implementing Macroeconomic Adjustment Programmes in the Euro Area	Daniel Gros Cinzia Alcidi Ansgar Belke Leonor Coutinho Alessandro Giovannini
06	2014	Der Transaktionskassenbestand von Euro-Münzen in Deutschland	Markus Altmann Nikolaus Bartzsch
06e	2014	The Volume of Euro Coins held for Transaction Purposes in Germany	Markus Altmann Nikolaus Bartzsch
07	2014	Labor Market Reforms and Current Account Imbalances – Beggar-thy-neighbor Policies in a Currency Union?	Timo Baas Ansgar Belke