Evaluating Recent Proposals For A Common European Unemployment Insurance[☆]

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Abstract

Using a two-country New Keynesian model with frictional labor markets, we evaluate recent proposals to establish a common European unemployment insurance (UI): a supranational UI system that covers short-term unemployment benefits. Such a system generates structural transfers between regions. Because of increasing (decreasing) the total labor tax burden, the donor (recipient) region will face lower (higher) structural GDP, consumption and employment as well as a deterioration (improvement) in the terms of trade. International risk sharing cannot be improved. If anything, volatility of key macroeconomic variables increases because an additional channel for spillovers from one region to the other is established. Union-wide welfare can be improved, however, because the structural gains in the recipient region may outweigh losses in the donor region and increases in the costs of business cycles as long as the donor region and/or differences in steady-state unemployment rates are not too large.

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1. Introduction

The Eurozone debt crisis has renewed the debate about deeper fiscal integration in the European Economic and Monetary Union (EMU). It is argued that fiscal risk sharing is necessary to make the Eurozone more resilient to macroeconomic shocks. The 2012 Four and 2015 Five Presidents' Reports suggest that fiscal integration could include a common unemployment insurance (UI) system (see van Rompuy, 2012; Juncker, 2015). Such an UI system is also proposed by, among others, the former EU Commissioner for Employment, László Andor, the International Monetary Fund, the German Institute for

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Economic Research, the French Advisory Council, the Centre for European Economic Research and the Banca d'Italia (see Artus et al., 2013; Bernoth and Engler, 2013; Andor, 2014; Blanchard et al., 2014; Dolls et al., 2014; Brandolini et al., 2016; Bénassy-Quéré et al., 2016; Enderlein et al., 2017).

From an academic perspective it can indeed be shown that, if designed optimally, a common UI improves international risk sharing which cannot be replicated by debt-financed national policies (see Moyen et al., 2016). However, the optimal design calls for time-varying and country-specific replacement and contribution rates depending on each member state's relative cyclical position. In practical terms, it seems extremely difficult – if not impossible – to operate such an insurance scheme given that one would have to be able to correctly identify the cyclical situation of each EMU member state (or, even better, the exact shocks each country is hit by) and, then, modify contribution and replacement rates in each country accordingly.

In the literature mentioned above, it is therefore suggested that the an EMU-wide UI system should cover short-term unemployment by providing a basic insurance level, say, a replacement rate of 50% of net wages, and by partly replacing the national systems. According to the the proposals, long-term unemployment should not be covered to limit the risk of permanent redistribution while, at the same time, not dampening the incentives for national policy-makers for structural reforms. In order to allow for diversity across member states in terms of replacement rates and entitlement duration in line with national preferences, the supranational scheme could be supplemented by additional payments from national systems if desired. The supranational UI then directly provides payments to the short-term unemployed and collects contributions.[1] In this paper, we assess the macroeconomic and welfare implications of such a supranational UI scheme by means of a dynamic New Keynesian two-country business cycle model with frictional labor markets calibrated to core and periphery Europe. Core is characterized by lower short and long-term unemployment rates as well as a higher per-capita GDP.

We find that choosing short-term unemployment as a proxy for measuring the cyclical situation of an economy is not innocuous because short-term unemployment itself has a structural component and is, therefore, larger in some countries than in others. This implies that a supranational UI system that covers short-term unemployment will entail transfers between regions. As these transfers are channeled through the UI system, they increase effective labor taxation in regions with relatively low structural short-term unemployment rates generating a negative income effect and, ultimately, structural GDP and consumption losses in that region (amounting to -0.14% and -0.42%

[1] Alternatively, it is suggested that a common UI scheme could kick in after a large shock designed as a reinsurance scheme where the national UI systems stay in place and receive transfers from the other national systems after, for example, unemployment or negative GDP developments have exceeded some threshold (see Dolls et al., 2016; Gros, 2014). In such a system, transfers would be paid between the fiscal entities and not directly to workers, which relates more to a "true" fiscal union. We discuss related literature below.

relative to initial steady state values in Core in our baseline calibration). Unemployment, including long-term unemployment, will only rise slightly in the long-run (by 0.01 percentage points) because the loss in net labor income resulting from the higher tax burden (by -0.73%) increases the share of workers not participating in the labor market (by 0.08 percentage points). The opposite holds in regions characterized by below average short-term unemployment rates in the initial steady state. In our baseline calibration, Periphery faces GDP and consumption gains amounting to 0.46% and 1.10%, respectively, a decrease in unemployment by -0.02 percentage points and an increase in net labor income by 1.91%; labor market participation increases by 0.19 percentage points. For the union as a whole, we can observe small GDP and consumption gains which, taken together, also translates in to aggregate steady-state welfare gains for the union as a whole. This result, however, is sensitive to the calibrated size of the donor and the transfer recipient region as well as structural labor market differences in the initial steady state.[2]

Given this finding, one could still argue that the gains of international risk sharing may potentially outweigh the weaker long-run situation of donor regions, at least in the aggregate, because sharing the burden of negative (and gains of positive) shocks is what the supranational UI system is actually aiming at. However, we find that business cycle statistics and welfare costs of business cycles between the two regimes do not differ much. If anything, welfare costs of business cycles increase slightly because the supranational UI system increases the spillovers between the two regions. Therefore, our analysis suggests that one should expect to gain much by simply shifting part of the UI for short-term unemployed at a supranational level. On the contrary, one may even face the risk of long-term losses, at least for some union members.

[To be done: *Still, motivated by the findings of Moyen et al. (2016), who show that welfare gains from a common UI scheme that has no structural transfers in expectations can be significant, we ask the question whether or not there may be a potentially feasible way to implement a similar scheme here, too. In order to avoid structural transfers, regions with above-average short-term unemployment rates could pay a higher contribution rate the the supranational insurance scheme, similar to experience rating in the UI system in some US state (see XX for this literature). Again motivated by the UI system in the USA and by the fact that the EU Commissions calculates the cyclical stance for each member state for monitoring the compliance with the Stability and Growth Pact, unemployment benefits could then be extended for countries facing a recession relative to the other member states. Moyen and Stähler (2014) discuss the effects of cyclical entitlement duration in a standard RBC model. We probably find that such a system*

[2]As will be detailed in the calibration section, we calibrate the model to six Eurozone core countries (Austria, Belgium, Germany, Finland, France, Luxembourg, Netherlands) and six periphery countries (Spain, Greece, Ireland, Italy, Portugal). Core's size is, therefore, about 60% and the difference in the initial steady-state unemployment rates amounts to 4 percentage points. Increasing Core's relative population size or the differences in unemployment worsens our welfare results for the union as a whole until union-wide welfare eventually turns negative. This also holds for aggregate union-wide output and consumption.

indeed fosters international risk sharing while, at the same time, avoiding structural transfers. However, welfare gains in the Periphery would probably be lower relative to the situation with permanent transfers.]

Our analysis relates to the literature on international risk sharing and fiscal unions. Leduc et al. (2009) show that, when asset markets are incomplete, country-specific productivity disturbances can have large uninsurable effects on wealth and consumption paths. Farhi and Werning (2012) find that such uninsurable effects may be especially large in a currency union with nominal rigidities and suggest forming a transfer union to insure against this risk. Many economists and policy-makers follow the view that, in federal unions, a (fiscal) transfer mechanism may be desirable. Nevertheless, there is still some debate on how to ideally establish such a transfer mechanism (see Bargain et al., 2013 and Bordo et al., 2011 for a discussion). Evers (2012) provides a quantitative assessment of federal transfer rules and finds that targeting regional differences in labor income generates highest welfare gains, which primarily stem from reducing the allocative inefficiencies of factor inputs caused by nominal rigidities. Dmitriev and Hoddenbagh (2013), however, find that a tax union, in which the steady state income taxes are harmonized, seems preferable to cross countries fiscal transfers if the elasticity of substitution between domestic and foreign goods is low. Evers (2015) shows that a fiscal revenue equalization system that shares nominal tax revenues destabilizes business cycles and worsens welfare while a fully centralized fiscal authority does the opposite. This is confirmed in an estimated large-scale model of the Eurozone by Gadatsch et al. (2016a). Moyen et al. (2016) show that a welfare-improving transfer mechanism can also be designed via a common UI scheme. Our paper contributes to the discussion by also focussing on the design of a supranational UI system. We show that, when shifting part of the UI system for short-term unemployment at a supranational level, there may be the risk of long-term losses and short-term welfare gains are negligible. The former can be avoided and the latter increased whenever regions characterized by high unemployment pay higher contributions to the supranational UI system and when entitlement duration depends on the cycle.

The remainder of the paper is organized as follows. In Section 2, we lay out the dynamic model that we use for quantitative analysis and calibrate it to the Euro area. Section 3 shows the long-run effects of establishing a common EMU-wide UI system including the transition. In Section 4, we assess business cycle and welfare implications of the common UI scheme discussed above, while Section 5 is supposed to discuss an implementable scheme that avoids structural transfers. Section 6 concludes.

2. Model setup

The model we use for our analysis is a two-country monetary union DSGE model with frictional labor markets. Households, firms, policymakers and the external sector interact each period by trading final goods, financial assets and factors of production. We also include short and long-term unemployment. For what follows, we normalize the population size of the entire monetary union to unity, of which $\omega \in (0,1)$ live in

Core, while the remaining $(1-\omega)$ live in the Periphery. Throughout the paper, quantity variables will be expressed in per capita terms, unless otherwise indicated. Both regions are modeled analogously, while we allow structural parameters to differ. Hence, we restrict ourselves to explaining the core country in detail only. If the explicit description of the foreign country is necessary, we use asterisks to denote decisions made by the corresponding foreign agents as well as the structural parameters.

2.1. Households

Assuming that the utility of household members positively depends on consumption and leisure, the welfare function of the representative household at time $t = 0$ is given by

$$E_0 \left\{ \sum_{t=0}^{\infty} \beta^t \cdot \frac{\left(\left(c_t - h \cdot c_{t-1} \right)^{\sigma_l} \cdot leis_t{}^{1-\sigma_l} \right)^{(1-\sigma_c)}}{(1-\sigma_c)} \right\}, \tag{1}$$

where E_t is the expectations operator conditional on time-t information, c_t denotes household consumption of final goods. h denotes the degree of habit formation in consumption. Furthermore, the household obtains utility from leisure, $leis_t$, when not participating in the labor market. Hence, we assume that, when participating in the labor market, the household always forgoes leisure because being unemployed also entails search costs. σ_l relates consumption and leisure utilities, while σ_c is the coefficient of relative risk aversion (equal to the inverse of the intertemporal elasticity of substitution).

Household members may be enjoying leisure (denoted by $leis_t$), be employed (denoted by n_t^p) or be unemployed (denoted by u_t). Given that we assume that unemployment is split into short and long-term unemployment, it holds that $1 = n_t^p + u_t + leis_t$, with $u_t = u_t^s + u_t^l$. The superscripts s and l indicate the fraction of household members being short and long-term unemployed, respectively. As inAndolfatto (1996) or Merz (1995), we will assume full consumption insurance within each household.

Households in both countries trade consumption and investment goods as well as international nominal bonds. The consumption and investment baskets, c_t and I_t, respectively, in the home country are given by

$$x_t = \left(\frac{x_{At}}{\psi} \right)^{\psi} \left(\frac{x_{Bt}}{1-\psi} \right)^{1-\psi},$$

with $x_t = \{c_t, I_t\}$, where c_{At}, I_{At} and c_{Bt}, I_{Bt} represent consumption/investment demand of goods produced in Core (country A) and Periphery (region B), respectively, and ψ is a parameter capturing the degree of home bias in consumption (as long as $\Psi > \omega$). From now onwards, let $p_{Bt} \equiv P_{Bt}/P_{At}$ denote the *terms of trade*, where P_{At} and P_{Bt} are the *producer price indexes* (PPI) in countries A and B, respectively. Cost minimization by the household then implies $x_{At}/x_{Bt} = \psi/(1-\psi) \cdot p_{Bt}$. Nominal expenditure in consumption and investment goods equals $P_{At}(c_{At} + I_{At}) + P_{Bt}(c_{Bt} + I_{Bt}) =$

$P_t\left(c_t + I_t\right)$, where $P_t = \left(P_{At}\right)^{\psi}\left(P_{Bt}\right)^{1-\psi}$ is the corresponding *consumer price index* (CPI). Notice that $P_t = P_{At} \cdot p_{Bt}^{1-\psi}$. Therefore, CPI inflation, $\pi_t \equiv P_t / P_{t-1}$, evolves according to $\pi_t = \pi_{At}\left(p_{Bt}/p_{Bt-1}\right)^{1-\psi}$, where $\pi_{At} \equiv P_{At}/P_{At-1}$ is PPI inflation in region A.

The household's real labor income (gross of taxes) is given by $w_t^p n_t^p$, where w_t^p is the real wage paid in the private sector (to be derived later), and n_t^p is the number of employed household members. The national labor income tax rate is denoted by τ_t^w, and $\tau_t^{w,EU}$ denotes the supranational one. Household members who are short-term unemployed receive unemployment benefits κ_t^{Bs}, while long-term unemployed members receive a fixed amount κ^{Bl} (which can also be interpreted as social assistance). τ^c denotes the consumption tax rate and T are lump-sum taxes (or, if negative, subsidies).

Households can further invest in physical capital, domestic government bonds or international assets. Investments in physical capital k_t earn a real rental rate r_t^k, while the capital depreciates at rate δ^k. Returns on physical capital net of depreciation allowances are taxed at rate τ^k. Nominal government bonds B_t pay a gross nominal interest rate R_t. Finally, D_t denote holdings of international nominal bonds, which pay the gross nominal interest rate R_t^{ecb}.[3] Π_t are nominal per capita profits generated by firms net of vacancy posting costs. We assume that profits are redistributed in a lump-sum manner. Summarizing, the budget constraint of the representative household in real terms is

$$\begin{aligned}(1+\tau^c)c_t + I_t + \frac{B_t + D_t}{P_t} + T = \frac{\Pi_t}{P_t} + \left((1-\tau^k)r_t^k + \tau^k\delta^k\right)k_{t-1} + \frac{R_{t-1}B_{t-1}}{P_t} \\ + \frac{R_{t-1}^{ecb}D_{t-1}}{P_t} - \frac{\psi_d}{2}\cdot\left(\frac{D_t}{P_t} - \frac{\bar{D}}{\bar{P}}\right)^2 + \left(1-\tau_t^w - \tau_t^{w,EU}\right)w_t^p n_t^p + u_t^s\kappa_t^{Bs} + u_t^l\kappa^{Bl}. \quad (2)\end{aligned}$$

The law of motion of physical capital is given by

$$k_t = (1-\delta^k)k_{t-1} + \left[1 - S\left(I_t/I_{t-1}\right)\right]I_t, \quad (3)$$

where $S\left(I_t/I_{t-1}\right) = \frac{\kappa_I}{2}\left(I_t/I_{t-1} - 1\right)^2$ represents investment adjustment costs (see Christiano et al., 2005). Maximizing (1) subject to equations (2) and (3) yields standard first-order conditions. For the labor-market participation decision, we get

$$\frac{\sigma_l}{1-\sigma_l}\frac{leis_t}{c_t} = \frac{1+\tau_t^c}{\Xi_t^p}, \quad (4)$$

which states that, when deciding whether or not to participate in the labor market, the household equates the relative marginal utilities of consumption and leisure with the

[3] In order to ensure stationarity of international bond holdings, we follow Schmitt-Grohé and Uribe (2003) and assume that there exist portfolio adjustment costs of the form $\psi_d/2\left(d_t - \bar{d}\right)^2$, with $\psi_d > 0$ and $d_t \equiv D_t/P_t$. We assume for simplicity that trading in domestic government and in international bonds is not taxed.

expected gain of participating in the labor market. In case the household participates in the labor market, he gets income that he can use for consumption. The income consists unemployment benefits plus the expected probability-weighted income of finding a job in the next period, Ξ_t^p, which we derive in the labor market section below. If the household does not participate, he enjoys utility from leisure, which he has to compare to the "forgone" consumption utility due to lower income.

2.2. Production

The retail and intermediate goods sectors of the economy are similar to Smets and Wouters (2003, 2007) or Christiano et al. (2005), with the exception that labor services are not hired directly from the households but from a sector of firms that produce homogenous labor services in the manner of Christoffel et al. (2009). In this subsection, we focus on the retail and intermediate goods sectors, postponing the description of the labor market to the next subsection.

2.2.1. Final goods producer

There is a measure-ω continuum of firms in the final goods sector, in which firms purchase a variety of differentiated intermediate goods and bundle these into a final good, which is sold under perfect competition. Assuming the law of one price within the union, the price of the home country's final good is the same in both countries, equal to P_{At}. The problem of the representative retail firm reads $\max_{\{\tilde{y}_t(j):j\in[0,\omega]\}} P_{At}Y_t - \int_0^\omega P_{At}(j)\tilde{y}_t(j)dj$, where $Y_t = \left(\int_0^\omega \left(\frac{1}{\omega}\right)^{1/\epsilon} \tilde{y}_t(j)^{(\epsilon-1)/\epsilon}dj\right)^{\epsilon/(\epsilon-1)}$, with $\epsilon > 1$, is the retailer's production function, $\tilde{y}_t(j)$ is the retailer's demand for each differentiated input $j \in [0,\omega]$, and $P_{At}(j)$ is the nominal price of each input. The standard first-order condition for the problem is given by $\tilde{y}_t(j) = (P_{At}(j)/P_{At})^{-\epsilon}\frac{Y_t}{\omega}$. Combining the latter with the firms' maximization problem and the zero profit condition, we obtain that the producer price index in the home country must equal $P_{At} = \left(\int_0^\omega \frac{1}{\omega}P_{At}(j)^{1-\epsilon}dj\right)^{1/(1-\epsilon)}$. Because there are ω retail firms, total demand for each intermediate input equals

$$\omega\tilde{y}_t(j) \equiv y_t(j) = \left(\frac{P_{At}(j)}{P_{At}}\right)^{-\epsilon} Y_t. \tag{5}$$

2.2.2. Intermediate goods and price setting

Each intermediate goods producer $j \in [0,\omega]$ faces the technology

$$y_t(j) = \epsilon_t^a \cdot \left[\tilde{k}_t(j)\right]^{\alpha} \cdot \left[lab_t(j)\right]^{(1-\alpha)}, \tag{6}$$

where $\alpha \in [0,1]$ is the elasticity of output with respect to private capital, $lab_t(j)$ denotes the demand for labor services, $\tilde{k}_t(j)$ is the demand for capital services and ϵ_t^a is total factor productivity, which is subject to an iid normally distributed shock. Intermediate goods firms acquire labor and capital services in perfectly competitive factor markets

at real (CPI-deflated) prices x_t and r_t^k, respectively. Cost minimization subject to (6) implies the factor demand conditions for capital and labor $r_t^k = mc_t \cdot \alpha \cdot y_t(j)/\tilde{k}_t(j)$ and $x_t = mc_t \cdot (1-\alpha) \cdot y_t(j)/lab_t(j)$, where mc_t is the real (CPI-deflated) marginal cost common to all intermediate good producers. The ratios $y_t(j)/\tilde{k}_t(j)$ and $y_t(j)/lab_t(j)$ are equalized across firms because of constant returns to scale in private capital and labor and perfectly competitive input prices.

As is standard in the literature, intermediate goods firms set nominal prices à la Calvo (1983). This implies that a randomly chosen fraction $\theta_P \in [0,1)$ of firms cannot re-optimize their price in each period. A firm that has the chance to re-optimize its price in period t chooses the nominal price $P_{At}(j)$ that maximizes $E_t \sum_{z=0}^{\infty} (\beta\theta_P)^z \frac{\lambda_{t+z}^o}{\lambda_t^o} \left[\frac{P_{At}(j)}{P_{t+z}} - mc_{t+z}\right] y_{t+z}(j)$, subject to $y_{t+z}(j) = (P_{At}(j)/P_{At+z})^{-\epsilon} Y_{t+z}$. The first-order condition is standard implying the law of motion of the price level $1 = \theta_P \left(\frac{1}{\pi_{At}}\right)^{1-\epsilon} + (1-\theta_P)\tilde{p}_t^{1-\epsilon}$, where $\tilde{p}_t \equiv \tilde{P}_{At}/P_{At}$ is the relative (PPI-deflated) optimal price and $\tilde{P}_{At}$ is the optimal price chosen by all period-t price setters. Following Christoffel et al. (2009), we assume that labor firms hire workers from the household sector in order to produce homogeneous labor services, which they sell to intermediate goods producers at the perfectly competitive price x_t. λ_t^o is the household's marginal consumption utility, which also affects the firm's discounting.

2.3. The labor market

The production function of each labor firm is linear in the number of hours worked by its employee, which is fixed at the level $\bar{h} \equiv 1$. With n_t^p being the fraction of the total labor force employed in the private sector, the total per-capita supply of labor services is given by $Lab_t = n_t^p$. Equilibrium in the market for labor services requires that $\omega Lab_t = \int_0^\omega lab_t(j)dj$.

Using equations (5) and (6) and the fact that the capital-labor ratio is equalized across intermediate goods firms, this yields $Y_t D_t = \epsilon^a k_{t-1}^\alpha Lab_t^{1-\alpha}$, where $D_t \equiv \int_0^\omega \omega^{-1} (P_{At}(j)/P_{At})^{-\epsilon} dj$ is a measure of price dispersion. Below, we will specify the matching process, flows in the labor market, private-sector vacancy creation and the corresponding wage determination.

2.3.1. Matching process and labor market flows

As stated already, a household member can be in one of four states: (i) employed, (ii) short-term unemployed, (iii) long-term unemployed and (iv) not participating in the labor market. Long-term unemployment is the residual state in the sense that a worker whose employment relationship ends and who does not find a job while being short-term unemployed flows into long-term unemployment. All unemployed workers participating in the labor market look for job opportunities.

The aggregate unemployment rate is given by $U_t = 1 - n_t^p - leis_t$. Following Blanchard and Galí (2014), we assume that the hiring round takes place at the beginning of each period, and that new hires start producing immediately. We also assume that

workers dismissed at the end of period $t-1$ start searching for a new job at the beginning of period t. Therefore, the pool of searching workers at the beginning of period t is given by

$$\tilde{U}_t = U_{t-1} + s^p n^p_{t-1} - leis_{t-1} = 1 - (1 - s^p) n^p_{t-1} - leis_{t-1},$$

where s^p represents the constant job-separation rate. The matching process is governed by a standard Cobb-Douglas aggregate matching function,

$$M^p_t = \kappa^p_e \cdot \left(\tilde{U}_t\right)^{\varphi^p} \cdot \left(v^p_t\right)^{(1-\varphi^p)}, \tag{7}$$

where $\kappa^p_e > 0$ is the matching efficiency parameter, $\varphi^p \in (0,1)$ the matching elasticity and M^p_t the number of new matches formed in period t resulting from the total number of searchers and the number of vacancies v^p_t. The probability for an unemployed worker to find a job can thus be stated as $p^p_t = M^p_t / \tilde{U}_t$, while the probability of filling a vacancy is given by $q^p_t = M^p_t / v^p_t$. The law of motion for the employment rate is therefore given by

$$n^p_t = (1 - s^p) \cdot n^p_{t-1} + p^p_t \cdot \left(u^s_{t-1} + u^l_{t-1} + s^p n^p_{t-1}\right). \tag{8}$$

Employment today is given by yesterday's employment that has not been destroyed plus newly created matches. Notice that we have to take into account that unemployed workers are divided into short and long-term unemployment. Following Moyen and Stähler (2014), we assume that, when dismissed, a workers flows into the pool of short-term unemployment. With (a fixed) probability ϑ, workers in this pool become long-term unemployed unless they find a job (which happens at probability p^p_t). When in the pool of long-term unemployment, a worker only flows out when finding a job at probability p^p_t. This can be summarized by the following two equations:

$$u^s_t = \left(1 - \vartheta - p^p_t -\right) u^s_{t-1} + s^p n^p_{t-1} \tag{9}$$

$$u^l_t = \left(1 - p^p_t\right) u^s_{t-1} + \vartheta u^s_{t-1}, \tag{10}$$

where we have to bear in mind that $u_t = u^s + u^l_t$ holds. For further reference, we define $\gamma_t = u^s_t / u_t$ as the fraction of short-term unemployment (or premium benefit recipients, respectively) to total unemployment.

2.3.2. Asset value of jobs, wage bargaining and job creation

As is standard in the literature, we assume that firms and workers bargain about their share of the overall match surplus to determine wages following Boscá et al. (2009, 2010, 2011) and Stähler and Thomas (2012). Furthermore, we assume staggered bargaining of nominal wages similar to Gertler et al. (2008). This implies that, each period, a randomly chosen fraction θ_w of continuing firms cannot renegotiate wages, while a fraction θ^n_w of newly created firms does not bargain over wages and simply pays the average nominal wage of the previous period. Letting $J_t\left(\tilde{W}^p_t\right)$ be the value function of

employment for firms that are allowed to bargain over wages and $H_t^p\left(\tilde{W}_t^p\right)$ that of the worker, the Nash problem is given by

$$\max_{\tilde{W}_t^p} \left[H_t^p\left(\tilde{W}_t^p\right)\right]^{\xi}\left[J_t\left(\tilde{W}_t^p\right)\right]^{1-\xi}, \tag{11}$$

where $\xi \in [0,1)$ is the workers' bargaining power and $\tilde{W}_t^p$ denotes the nominal wage negotiated in period t. The value function of a firm that renegotiates in that period is given by

$$\begin{aligned} J_t\left(\tilde{W}_t^p\right) &= E_t \sum_{z=0}^{\infty}\left\{\left[\beta\cdot(1-s^p)\cdot\theta_w\right]^z\cdot\frac{\lambda_{t+z}^o}{\lambda_t^o}\cdot\left[\bar{h}\cdot x_{t+z}-(1+\tau_{t+z}^{sc}+\tau_{t+z}^{sc,EU})\cdot\frac{\tilde{W}_t^p}{P_{t+z}}\right]\right\} \\ &\quad +(1-\theta_w)\cdot E_t\sum_{z=1}^{\infty}\left\{\left[\beta\cdot(1-s^p)\right]^z\cdot\theta_w^{z-1}\cdot\frac{\lambda_{t+z}^o}{\lambda_t^o}\cdot J_{t+z}\left(\tilde{W}_{t+z}^p\right)\right\}, \end{aligned} \tag{12}$$

where τ_t^{sc} is the national social security contribution rate, while $\tau_t^{sc,EU}$ characterizes the supranational one.[4] The value of the firm is the discounted profit flow in those future states in which it is not allowed to renegotiate plus its continuation value should it have the chance to reoptimize in the next period. For new jobs where firm and worker do not bargain, the nominal wage equals last period's average nominal wage, W_{t-1}^p, and the value of the job equals

$$J_t\left(W_{t-1}^p\right) = J_t\left(\tilde{W}_t^p\right) - E_t\sum_{z=0}^{\infty}\left\{\left[\beta\cdot(1-s^p)\cdot\theta_w\right]^z\cdot\frac{\lambda_{t+z}^o}{\lambda_t^o}\cdot(1+\tau_{t+z}^{sc}+\tau_{t+z}^{sc,EU})\cdot\frac{W_{t-1}^p-\tilde{W}_t^p}{P_{t+z}}\right\}.$$

Analogously, we can derive how workers value a match surplus. The surplus value of a job in a renegotiating firm is given by

$$\begin{aligned} H_t^p\left(\tilde{W}_t^p\right) &= E_t \sum_{z=0}^{\infty}\left\{\left[\beta\cdot(1-s^p)\cdot\theta_w\right]^z\cdot\frac{\lambda_{t+z}^o}{\lambda_t^o}\cdot\left[(1-\tau_{t+z}^{w}-\tau_{t+z}^{w,EU})\cdot\frac{\tilde{W}_t^p}{P_{t+z}}-\Xi_{t+z}^p\right]\right\} \\ &\quad +(1-\theta_w)\cdot E_t\sum_{z=1}^{\infty}\left\{\left[\beta\cdot(1-s^p)\right]^z\cdot\theta_w^{z-1}\cdot\frac{\lambda_{t+z}^o}{\lambda_t^o}\cdot H_{t+z}^p(\tilde{W}_{t+z}^p)\right\}, \end{aligned} \tag{13}$$

[4]Given that contributions to the UI system are paid in parity by firms and workers in many EMU member states, we differentiate between contribution rates levied to households, $\tau_t^{w,EU}$, and firms, $\tau_t^{sc,EU}$, in order to check if it makes a differences whether contributions to the supranational authority will have to be paid by firms or workers as a robustness analysis below.

where

$$\begin{aligned}\Xi_t^p \equiv\ & \gamma_t\kappa_t^{Bs} + (1-\gamma_t)\kappa^{Bl} - \beta(1-s^p)E_t\frac{\lambda_{t+1}^o}{\lambda_t^o}\left\{\vartheta\cdot\gamma_{t+1}\cdot\mathcal{V}_{t+1}\right\} \\ & +\beta(1-s^p)E_t\frac{\lambda_{t+1}^o}{\lambda_t^o}\left\{p_{t+1}^p\left[(1-\theta_w^n)H_{t+1}^p\left(\tilde{W}_{t+1}^p\right)+\theta_w^n H_{t+1}^p\left(W_t^p\right)\right]\right\},\end{aligned}$$

represents the outside option of an employed worker at time t. The latter is the sum of the household's average unemployment benefits, $\gamma_t\kappa_t^{Bs} + (1-\gamma_t)\kappa^{Bl}$, the expected value of searching for a job in the following period,[5] and the expected utility difference of being in the short-term unemployment pool and the long-term unemployment pool. The latter is given by

$$\mathcal{V}_t = \kappa_t^{Bs} - \kappa^{Bl} + \beta E_t\frac{\lambda_{t+1}^o}{\lambda_t^o}\left\{\left(1-p_{t+1}^p-p_{t+1}^g-\vartheta\right)\mathcal{V}_{t+1}\right\}. \tag{14}$$

In new jobs where the wage is not optimally bargained, the surplus value enjoyed by workers is given by

$$H_t^p\left(W_{t-1}^p\right) = H_t^p\left(\tilde{W}_t^p\right) + E_t\sum_{z=0}^{\infty}\left\{\left[\beta\cdot(1-s^p)\cdot\theta_w\right]^z\cdot\frac{\lambda_{t+z}^o}{\lambda_t^o}\cdot(1-\tau_{t+z}^w-\tau_{t+z}^{w,EU})\cdot\frac{W_{t-1}^p-\tilde{W}_t^p}{P_{t+z}}\right\}.$$

Given the asset value functions of firms and workers, equations (12) to (13), we are now in a position to solve the wage bargaining problem (11). The resulting sharing rule is given by

$$H_t^p\left(\tilde{W}_t^p\right) = \frac{\xi}{1-\xi}\cdot\frac{E_t\sum_{z=0}^{\infty}\left\{\left((1-\mu)\frac{\lambda_{t+z}^o}{\lambda_t^o}+\mu\frac{\lambda_{t+z}^r}{\lambda_t^r}\right)\left[\beta(1-s^p)\theta_w\right]^z\frac{(1-\tau_{t+z}^w-\tau_{t+z}^{w,EU})}{P_{t+z}}\right\}}{E_t\sum_{z=0}^{\infty}\left\{\frac{\lambda_{t+z}^o}{\lambda_t^o}\left[\beta(1-s^p)\theta_w\right]^z\frac{(1+\tau_{t+z}^{sc}+\tau_{t+z}^{sc,EU})}{P_{t+z}}\right\}}\cdot J_t\left(\tilde{W}_t^p\right). \tag{15}$$

Solving equation (15) for $\tilde{W}_t^p$ by using the corresponding asset value functions gives the optimal wage bargained in period t. The average real wage in the private sector, $w_t^p \equiv W_t^p/P_t$, hence evolves according to

$$w_t^p = \frac{(1-s^p)N_{t-1}^p}{N_t^p}\left[(1-\theta_w)\tilde{w}_t^p+\theta_w\cdot\frac{w_{t-1}^p}{\pi_t}\right] + \frac{M_t^p}{N_t^p}\left[(1-\theta_w^n)\tilde{w}_t^p+\theta_w^n\cdot\frac{w_{t-1}^p}{\pi_t}\right], \tag{16}$$

[5]Here, we have to take into account that the surplus value for the worker is contingent on whether the firm is allowed to bargain (in which case the worker receives $\tilde{W}_{t+1}^p$) or not (in which case she receives today's average wage, W_t^p).

where $\tilde{w}_t^p \equiv \tilde{W}_t^p / P_t$ is the real optimally bargained wage and $w_{t-1}^p / \pi_t = W_{t-1}^p / P_t$ is the real value of yesterday's average nominal wage at today's prices. We have also taken into account the fact that new and continuing jobs pay the optimally bargained wage with probabilities $1 - \theta_w^n$ and $1 - \theta_w$, respectively.

It remains to determine how jobs are created. As is standard in the literature, we assume that opening a vacancy has a real (CPI-deflated) flow cost of κ_v^p. Following Pissarides (2009), we further assume that free entry into the vacancy posting market drives the expected value of a vacancy to zero. Under our assumption of instantaneous hiring, real vacancy posting costs, κ_v^p, must equal the time-t vacancy filling probability, q_t^p, times the expected value of a filled job in period t net of training costs. The latter condition can be expressed as

$$\frac{\kappa_v^p}{q_t^p} = (1 - \theta_w^n) \cdot J_t\left(\tilde{W}_t^p\right) + \theta_w^n \cdot J_t\left(W_{t-1}^p\right), \tag{17}$$

where we take into account that the wage of the newly-created job may be optimally bargained with probability $1 - \theta_w^n$.

2.4. Fiscal authorities

Defining the (CPI-deflated) per capita value of national end-of-period government debt as $b_t \equiv B_t / P_t$, we can state that it evolves according to a standard debt accumulation equation, $b_t = \frac{R_{t-1}}{\pi_t} b_{t-1} + PD_t$, where PD_t denotes real (CPI-deflated) per capita primary deficit. The latter is given by per capita fiscal expenditures minus per capita fiscal revenues,

$$\begin{aligned} PD_t \;=\; & \left[\frac{G_t}{p_{Bt}^{1-\psi}} + \left(\gamma_t\left[\kappa_t^{Bs} - on \cdot \kappa_t^{Bs,EU}\right] + (1-\gamma_t)\kappa^{Bl}\right) U_t + \kappa_v^g v_t^g\right] \\ & - \left[\left(\tau_t^w + \tau_t^{sc}\right) w_t^p N_t^P + \tau_t^c C_t + \tau_t^k (r_t^k - \delta^k) k_{t-1} + (1-\mu) T^o + \mu T^r\right], \end{aligned} \tag{18}$$

where G_t denotes per capita government consumption. Following Stähler and Thomas (2012), we assume that government consumption entails a full home bias and is, therefore, expressed in PPI terms (hence, the correction for the CPI-to-PPI ratio, $P_t / P_{At} = p_{Bt}^{1-\psi}$). Furthermore, $\kappa_t^{Bs} = rrs(1 - \tau_{t-1}^w - \tau_{t-1}^{w,EU}) w_{t-1}^p$, where rrs is the national replacement rate tying short-term unemployment benefits to last period's average wages. This analogously holds for the supranational benefit $\kappa_t^{Bs,EU}$ containing a replacement rate rrs^{EU}. The parameter $on \in \{0,1\}$ determines whether or not there exists a supranational UI system. In the initial steady state, we will assume that it does not (ie $on = 0$) and we will, then, simulate what happens if we set $on = 1$.

To guarantee stationarity of national public debt, for *at least* one fiscal instrument

$X \in \{\tau^w, \tau^{sc}\}$, the government must follow a fiscal rule of the form

$$X_t = \bar{X} + \rho_X \left(X_{t-1} - \bar{X}\right) + \left(1 - \rho_X\right) \phi_X \cdot \left(\frac{b_{t-1}}{Y_{t-1}^{tot}} p_{Bt-1}^{1-\psi} - \omega^b \right) + \epsilon_t^X, \tag{19}$$

in which the coefficient ϕ_X, i.e. the fiscal policy stance on debt deviations from target, is non-zero (positive for revenue instruments, negative for expenditure instruments). ρ_X is a smoothing parameter (see Schmitt-Grohé and Uribe, 2007, for a discussion). Theoretically, any fiscal instrument could be adjusted in line with (19). However, as we exclusively focus on (financing) the UI system, we restrict ourselves to the controbution rates associated to labor income.

The supranational UI agency can administer a component of UI and has to balance its budget every period. It collects contributions per employed worker at rate $\tau_t^{w,EU}$ or $\tau_t^{sc,EU}$, respectively, and pays out unemployment benefits to the short-term unemployed. The agency's budget constraint (in terms of region A's CPI) writes

$$\begin{aligned} & on \cdot \left[\omega \gamma_t U_t \kappa_t^{Bs,EU} + \left(1 - \omega\right) \gamma_t^* U_t^* \kappa_t^{Bs,EU,*} \right] \\ & = \omega N_t^P (\tau_t^{w,EU} + \tau_t^{sc,EU}) w_t^p + \left(1 - \omega\right) N_t^{P,*} (\tau_t^{w,EU} + \tau_t^{sc,EU}) w_t^{p,*}. \end{aligned} \tag{20}$$

It is obvious that, as long as $on = 0$, $\tau_t^{w,EU} = \tau_t^{sc,EU} = 0$ and all UI benefits κ_t^{Bs} and $\kappa_t^{Bs,*}$ have to be financed by the national authorities.

2.5. Monetary authority

We assume that the area-wide monetary authority has its nominal interest rate, R_t^{ecb}, and responds to deviations of area-wide inflation from its long-run target, $\bar{\pi}$, and to area-wide GDP growth, according to a simple Taylor rule,

$$\frac{R_t^{ecb}}{\bar{R}^{ecb}} = \left(\frac{R_{t-1}^{ecb}}{\bar{R}^{ecb}} \right)^{\rho_R} \left\{ \left[\left(\frac{\pi_t}{\bar{\pi}} \right)^{\omega} \left(\frac{\pi_t^*}{\bar{\pi}^*} \right)^{1-\omega} \right]^{\phi_\pi} \left[\left(\frac{Y_t}{\bar{Y}} \right)^{\omega} \left(\frac{Y_t^*}{\bar{Y}*} \right)^{1-\omega} \right]^{\phi_y} \right\}^{(1-\rho_R)},$$

where ρ_R is a smoothing parameter, and ϕ_π and ϕ_y are the monetary policy's stance on inflation and output growth, respectively.

2.6. International linkages

International linkages between the two countries are given by trade in goods and services as well as in international bonds. The home country's per-capita net foreign asset position, expressed in terms of PPI, evolves according to

$$d_t = \frac{R_{t-1}^{ecb} \cdot d_{t-1}}{\pi_{At}} + \frac{1 - \omega}{\omega} \left(C_{At}^* + I_{At}^*\right) - p_{Bt} \left(C_{Bt} + I_{Bt}\right)$$

$$+ \underbrace{p_{Bt}^{(1-\psi)} \left(on \cdot \gamma_t U_t \kappa_t^{Bs,EU} - (\tau_t^{w,EU} + \tau_t^{w,EU}) N_t^p w_t^p \right)}_{Trans_t}, \tag{21}$$

where $(1-\omega)\left(C_{At}^* + I_{At}^*\right)/\omega$ are real per capita exports and $p_{Bt}\left(C_{Bt} + I_{Bt}\right)$ are real per capita imports. Zero net supply of international bonds implies $\omega d_t + (1-\omega)\, p_{Bt} d_t^* = 0$. Terms of trade $p_{Bt} = P_{Bt}/P_{At}$ evolve according to $p_{Bt} = (\pi_{Bt}/\pi_{At})\, p_{Bt-1}$. In case there exists a supranational UI system, ie $on = 1$, the home country receives (pays) a transfer $Trans_t$ to the foreign country if the UI benefits it gets are larger (smaller) than the contributions paid to the system.

2.7. Equilibrium in goods markets and GDP

Market clearing implies that private per capita production in the home and foreign country, Y_t and Y_t^* respectively, is used for private and public consumption investment demand,

$$Y_t = C_{At} + I_{At} + C_t^g + I_t^g + \frac{1-\omega}{\omega}\left(C_{At}^* + I_{At}^*\right) + p_{Bt}^{(1-\Psi)} \kappa_v^p v_t^p, \tag{22}$$

$$Y_t^* = C_{Bt}^* + I_{Bt}^* + C_t^{g*} + I_t^{g*} + \frac{\omega}{1-\omega}\left(C_{Bt} + I_{Bt}\right) + p_{Bt}^{-\Psi^*} \kappa_v^{p,*} v_t^{p,*}, \tag{23}$$

where we have to take into account that (CPI deflated real) vacancy positing costs must also be covered. This completes the model description. We now turn to the model calibration.

2.8. Calibration [to be improved...!]

Following Moyen et al. (2016), we calibrate the model to the Eurozone, where we identify the Home country with six Eurozone core countries (Austria, Belgium, Germany, Finland, France, Luxembourg, Netherlands) and the Foreign country with six periphery countries (Spain, Greece, Ireland, Italy, Portugal). In what follows, we use the term "country" in the model sense and use the words "Home"/"Foreign" and "Core"/"Periphery" interchangeably. In the initial steady state, we assume that there exists no supranational UI, which implies $on = 0$. Steady-state targets are given in Table 1, while parameter values are summarized in Table 2.

The number of workers in the Home country is set to 60 percent, which corresponds to the relative size of the labor force in the Core. We set the discount factor β in both countries to the standard value of 0.99 which yields an annual real interest rate of 4 per cent. Risk aversion $\sigma_c = 2$ as well as habits in consumption $h = 0.6$ are set close to the mode estimates in Smets and Wouters (2003). Given this, we calculate values for domestic good preferences $\psi, (1-\psi^*)$ to match a GDP-weighted average of domestic expenditure shares in Core of 85 percent as estimated in Balta and Delgado (2009), and ensuring that the relative price of foreign goods in steady state equals $\bar{p}_B = 1$, while the steady-state net foreign asset position is zero.

In order to determine per capita GDP and productivity in Core and Periphery, we use OECD data which states that the real GDP share in Core makes up 65.3% (given the

Table 1: Targeted moments

Moment	Core	Periphery	Source
Labor force share; ω and $(1-\omega)$	60.1%	39.9%	OECD
Real GDP share	65.3%	34.7%	OECD
Labor market participation rate; $(1-\bar{lei}s)$	80.0%	80.0%	OECD
Mean unemployment rate	8.38%	12.23%	OECD
Government share in GDP	21.3%	22.5%	Gadatsch et al. (2016b)
Labor tax rate	30.4%	27.7%	Gadatsch et al. (2016b)
Capital tax rate	21.4%	31.6%	Gadatsch et al. (2016b)
Consumption tax rate	18.3%	19.6%	Gadatsch et al. (2016b)
Social security contribution rate	16.7%	24.6%	Gadatsch et al. (2016b)
Net replacement rate, short-term unemployment	60.0%	59.0%	Gadatsch et al. (2016c)
Net replacement rate, long-term unemployment	43.0%	43.0%	Gadatsch et al. (2016c)
SS job finding rate	30%		Balta and Delgado (2009)
SS vacancy filling rate	70%		Christoffel et al. (2009)
Consumption home bias	85%		Corbo and Osbat (2013)

OECD data is taken in the range 1984Q1–2014Q4. GDP in this table is defined as the sum of final private and government expenditure.

population share of only 60%, this implies higher per capita GDP in Core). From this, we can deribe the steady-state level of TFP, $\bar{\epsilon}^a$.

Monetary policy parameters are standard values of a conventional Taylor rule, while the price mark-up and the Calvo parameters for prices are set in line with estimates from the New Area Wide Model (see Christoffel et al., 2008, for a discussion). For nominal wage rigidities, Christoffel et al. (2009) find a rather high degree of stickiness, too, which we set to $\theta_w = \theta_w^n = 0.83$. Capital depreciation is the standard value of $\delta^p = 0.025$, and the capital share in production is set to one third (Cooley and Prescott, 1995), while capital adjustment costs are set to a standard value close to 5. According to Schmitt-Grohé and Uribe (2003) and Benigno (2009), it is sufficient to choose a rather small value for the risk premium parameter on international bonds in order to generate a stable equilibrium. So we opt for $\Psi_d = \Psi_d^* = 0.01$.

We set the matching elasticity φ^p to the conventional value 0.5 according to estimates by Burda and Wyplosz (1994). Following Moyen et al. (2016), the bargaining power of workers ξ is set at 0.9.[6] The matching efficiencies κ_m, separation rates s, vacancy costs

[6]As observed by Hagedorn and Manovskii (2008), workers need to capture a high share of the match surplus for a search model to more closely match the volatility of unemployment in the data. Many ways have been proposed to address the fact that the standard search and matching model fails, for a standard calibration, to account for the cyclical properties of unemployment and vacancies, the so called "Shimer puzzle" (Shimer, 2005). Contributing to this debate is beyond the scope of our paper, however. Nevertheless, this implies that, in our framework, the Hosios condition (see Hosios, 1990) is not fulfilled. Running robustness checks on this parameter shows that it is not crucial for our qualitative results.

Table 2: Calibrated parameter values

Parameter	Symbol	Core	Periphery
Discount factor	β	0.99	
Risk aversion	σ_c	2	
Habits in consumption	h	0.6	
Consumption weight in utility	σ_l	0.896	0.900
Utility weight on domestic goods	ψ, $(1-\psi^*)$	0.804	0.619
Matching elasticity	φ^p	0.5	
Worker bargaining power	ξ	0.9	
Matching efficiency	κ_m	0.4583	0.4583
Separation rate	s	0.0488	0.0764
Vacancy costs	κ_v	0.0837	0.0669
Per-period probability to become long-term unemployed	ϑ	0.25	
Calvo parameter on prices	θ_P	0.9	
Calvo parameter on wages	$\theta_w = \theta_w^n$	0.83	
Price markup	$\epsilon/(\epsilon-1)$	1.30	
Capital share in production	α	0.33	
Capital depreciation	δ^p	0.025	
Investment adjustment costs	κ_I	4.94	
Portfolio adjustment cost	Ψ_d	0.01	
Coefficient on inflation	ϕ_π	1.5	
Coefficient on output growth	ϕ_y	0.5	
Interest rate smoothing	ρ_R	0.85	
Steady-state TFP level	$\bar{\epsilon}^a$	0.6667	0.6054
Autocorrelation of TFP	ρ_A	0.95	
Autocorrelation of fiscal instrument	ρ_X	0.5	
Debt sensitivity of fiscal instrument	ϕ_X	0.1	

κ_v and the utility weight of leisure $(1 - \sigma_l)$ are set in each country to jointly match an average quarterly vacancy-filling probability of 70 percent (Christoffel et al., 2009), a quarterly job finding rate of 30% (Elsby et al., 2013), average labor market participation rates of 80% over the last decades and unemployment rates of 8.4 percent in the Core and 12.1 percent in the Periphery. For the replacement rates of the unemployment insurance system, *rrs* and rrs^l, we follow Gadatsch et al. (2016c), where we assume that it holds that $\kappa^{Bl} = rrs^l(1 - \bar{\tau}^w - \bar{\tau}^{EU,w})\bar{w}^p$; analogously in Foreign. Given that short-term unemployment is defined to be an unemployment spell of one year, $\vartheta = 0.25$.

For the fiscal variables, especially tax and social security rates, we rely on data presented in Gadatsch et al. (2016b). This implies that tax rates on labor income, capital interest, consumption and social security rates finance government spending, unemployment benefits, public-sector vacancy costs as well as interest on outstanding debt. In the initial steady-state, the budget is closed by a lump-sum tax. This tax is kept constant in the analyses to follow. In the long-run and for business cycle dynamics, the government's budget is either closed by time-varying labor income tax or social security contribution rates, following the rule of equation (19). In the former case, $\phi_{\tau^{sc}} = 0$ and $\phi_{\tau^w} = \phi$ as indicated in Table 2, while $\phi_{\tau^{sc}} = \phi$ and $\phi_{\tau^w} = 0$ in the latter case. Autocorrelation of the fiscal instrument is assumed to be 0.1. The replacement rate for the common EMU-wide UI system is set to $rrs^{EU} = 0.5$. However, as $on = 0$ in the initial steady state, it does not affect its derivation.

For the business cycle analyses, we set the technology shock persistence to $\rho_a = 0.95$ in both countries. The standard deviation of the shocks in Home and Foreign are chosen to be 1%.

3. Effects of establishing a common UI system

Figure 1 to 3 give the transition results of establishing a supranational UI at the EMU level. Installing a common EMU-wide UI insurance that pays benefits to short-term unemployed workers will entail a transfer from the Core to the Periphery because the short-term unemployment rate is structurally lower in Core (see Figure 1).

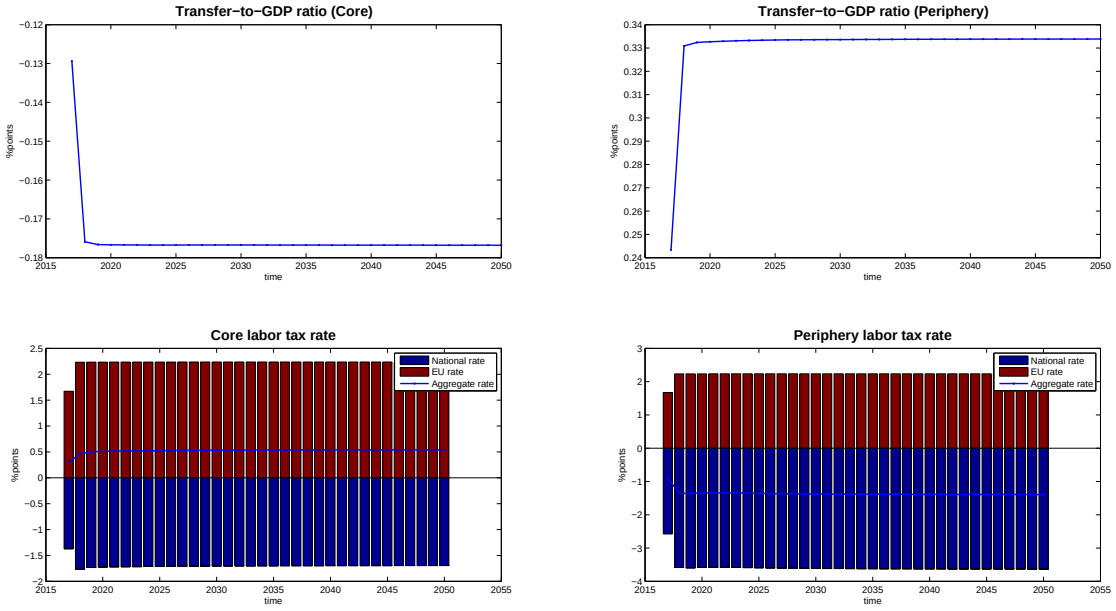
The reason for this is that short-term unemployment is not equal to cyclical unemployment. To understand this better, note that, in terms of the model presented above, the steady-state short-term unemployment rate is given by

$$\bar{u}^s = \frac{s^p \cdot \bar{n}^P}{\bar{p}^p + \vartheta}.$$

It is obvious that structurally different levels of employment, $\bar{n}^p$, or different dismissal and job finding rates, s^p and $\bar{p}^p$, respectively, will result in structurally different levels of short-term unemployment. Dismissal and re-employment probabilities are certainly driven by differences in national labor market institutions (other than UI) and, were we to disaggregate the production sector further by allowing for different industries (eg a tradable and non-tradable sector), the production structure of the economy would also

matter. For example, an economy with a relatively large service sector may face different aggregate dismissal and employment probabilities relative to an economy with a large industry sector. Given that all this is not equal across EMU member states, it seems natural that also short-term unemployment will not only measure cyclical but also structural differences. Hence, a common UI paying benefits to short-term unemployed will naturally benefit countries with higher (short-term) unemployment rates.

Figure 1: Transfers and tax developments



The facts that (i.) transfers from Core to Periphery will have to be financed by Core and that (ii.) these transfers are channeled through the UI system imply that, relative to the status quo of fully national UI systems, the overall labor tax burden will raise in Core, while it can be reduced in Periphery (see Figure 1). It is indeed true that the national tax rates fall in both regions given the fact that lower benefits to the short-term unemployed have to be financed nationally. However, from the Core's perspective, the average number of short-term unemployed to be financed has increased (while it has fallen from the Periphery's perspective) such that the total tax burden including contributions to the common UI system rises (falls) in Core (Periphery) as Figure 1 reveals.

A higher (lower) labor tax burden in Core (Periphery) induces households to demand higher (lower) gross wages on impact because what they care about in the bargaining process is their net wage income, see Figure 2. This dampens (fosters) job creation and, thus, private employment in Core (Periphery) ceteris paribus. Unemploy-

Table 3: Long-run effects of a common EMU-wide UI system

Variable	Core	Periphery	Whole union
GDP	-0.14	0.46	0.10
Consumption	-0.42	1.10	0.19
Wages	0.05	-0.02	0.02
Net labor income	-0.73	1.91	0.32
Unemployment	0.01	-0.05	-0.01
Leisure	0.08	-0.19	-0.03
Effective labor tax rate	0.54	-1.39	-0.23

Long-run effects of a common EMU-wide UI system financing contributions to the short-term unemployed relative to the initial steady state (in per cent/percentage point deviations).

ment increases (decreases) in Core (Periphery). However, the reaction of the unemployment rate is only very small in both regions. The reason for this is that the increase (cut) in the tax burden in Core (Periphery) increases (decreases) net wage income of employed workers as well as the expected income of those who are unemployed. Lower (higher) expected labor income will induce less (more) household members to participate in the labor market and, thus, labor supply falls (increases) over-proportionately.[7] This ultimately dampens the movements in unemployment. Private employment in Core (Periphery) falls (rises) due to the wage effects just described.

The transfers from Core to Periphery immediately increases the income for Periphery households and, as expected, they consume more. This boosts GDP and private investment demand in Periphery (see Figure 3). However, households in Core consume and invest less due to the fact that some of their income is transferred to Periphery. As part of private consumption/investment is spend on foreign goods, this implies that Periphery's gains are dampened slightly (so Core's losses are alleviated by Periphery's additional demand). The transfer related changes in demand and GDP, however, cannot be compensated for by this effect. The long-run results for selected macroeconomic variables are summarized in Table 3. In the table, we also provide the effects for the union as a whole, measured as a population-weighted average of the effects in Core and Periphery. We can see that the positive effects in Periphery outweigh the losses in Core in our baseline calibration. This, however, is sensitive to Core's size and the difference in the steady-state levels of the unemployment rates. If Core's size or the differences in unemployment increase, union-wide gains become smaller and may turn negative.

There are two things worth mentioning. First, when conducting analogous simulations but, instead of using the workers' labor income tax rates as the stabilizing fiscal

[7] Also note that, because of the relatively sharp reaction of labor market participation, movements in unemployment peak on impact and move in opposite direction during the first period(s). This will, however, be dominated eventually by the effects described above

instrument, take the firms' social security contribution rates, the results do not change qualitatively. This may be noteworthy because financing the UI system is done on the basis of parity in many member countries. Hence, a policy mix here would not alter the overall qualitative findings. The major difference can be observed in the wage evolution. Given that firms and workers in our model bargain over the match surplus and the fact that higher (lower) social security contribution rates decrease (increase) firms' profits, a higher (lower) contribution rate will lead to lower (higher) gross wages, dampening the wage increase (decrease) in Core (Periphery) relative to using labor income tax rates as the fiscal instrument. We provide the results of this simulation in the appendix.

Second, in the policy discussions, it is often claimed that a common EMU-wide UI system, in which the supranational level finances part of the unemployment benefits, is also useful to foster harmonization of social standards within EMU. For example, regions characterized by ungenerous UI system could be lifted to some minimum standards by a supranational scheme. Using our model and assuming that, in Periphery, unemployment replacement rates are only 30%, we can show that, if the supranational UI system still entails replacement rates of 50% (as in our baseline calibration), it can happen that, after the introduction of a common UI, GDP in Core *and* Periphery will fall, while unemployment rates rise. The reason for this is that, in Periphery, the workers' outside option and, thus, wage claims increase (which cannot be compensated for by the tax decrease) and, thus, production costs rise. Hence, in this case, the transfer scheme may worsen the economic situation for both, Core and Periphery. Again, we relegate more details of this analysis to the appendix.

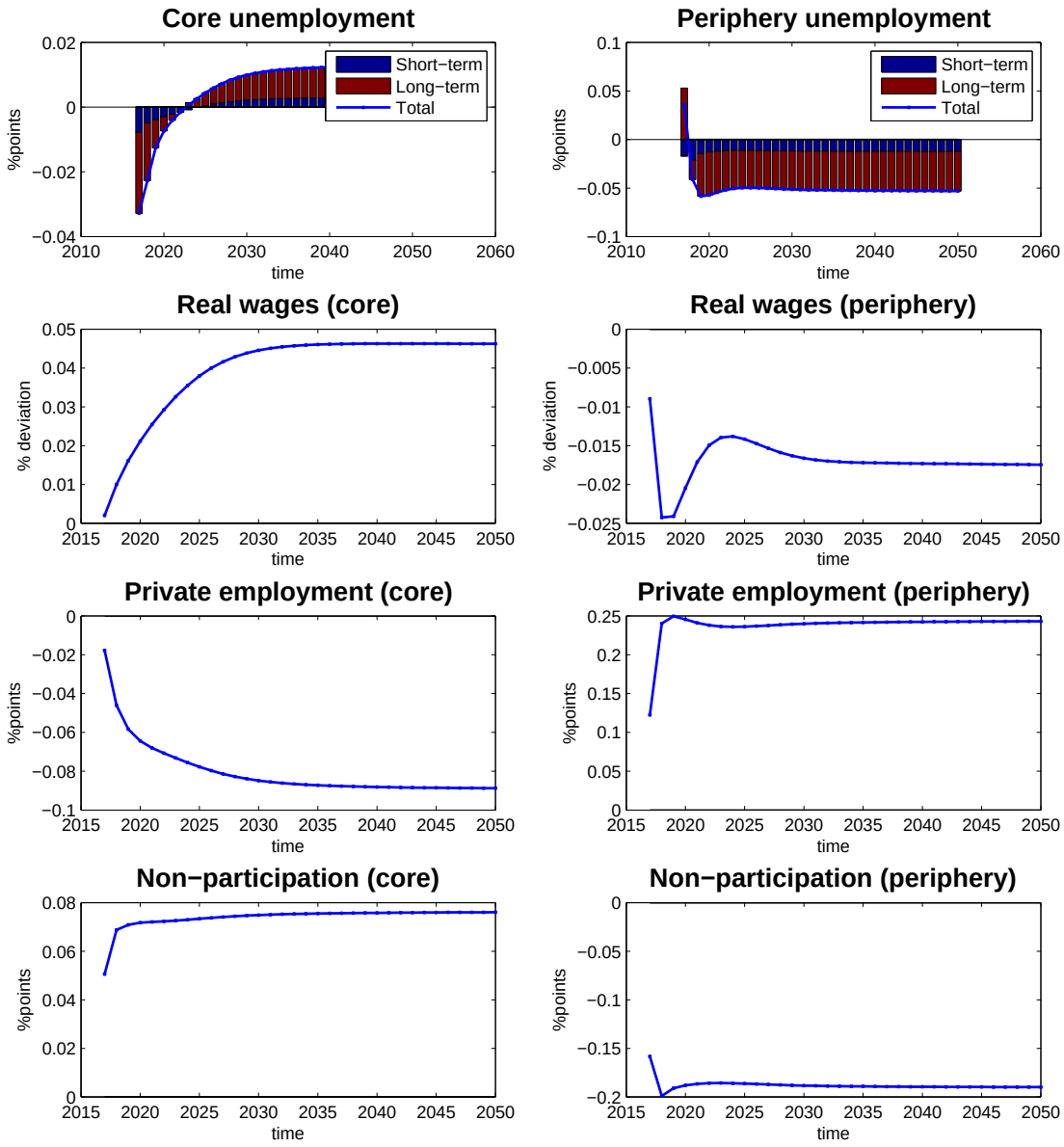
4. Business cycle and welfare effects of a common UI system

In order to evaluate a common EMU-wide UI system further, we will also have to check the business cycle and welfare effects of both regimes because it may be possible that, while Core faces losses in the new steady state (as described in the previous section), risk sharing aspects could theoretically outweigh these losses.[8] As we will see in this section, this is not the case.

Table 4 summarizes the business cycle statistics of selected macroeconomic variables. We present standard deviations, autocorrelations and cross-correlations. Standard deviations show how much the corresponding variables fluctuate due to business cycle

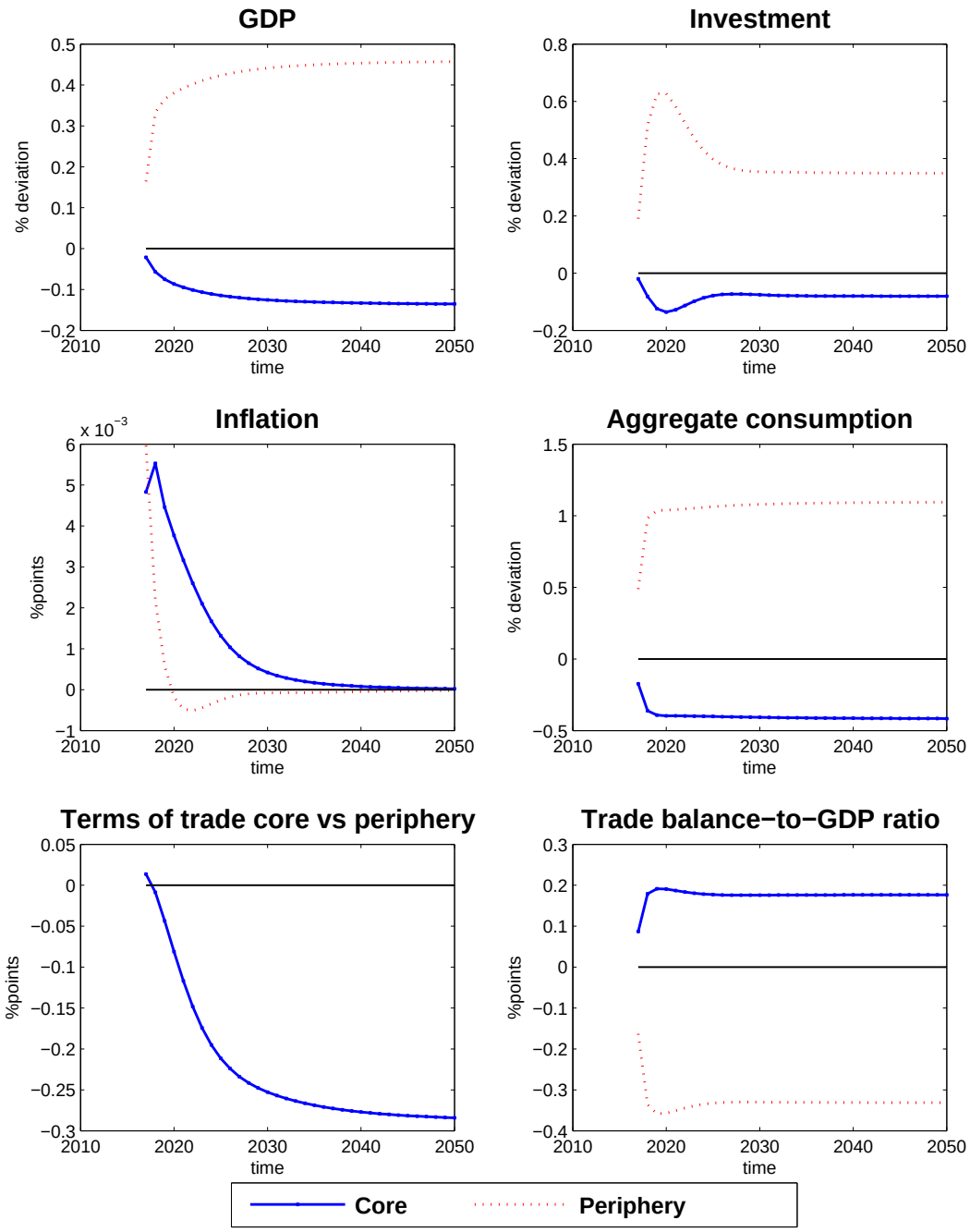
[8]From the literature, it is known that, in a model with incomplete financial markets, transfers between regions improve international risk sharing and are at least weakly better than debt-financing national policies. However, it is not clear whether the gains from transfers are *quantitatively* sizeable. Indeed, there exist well-known theoretical examples where the gains from having even full risk sharing in the form of complete markets are either zero (Cole and Obstfeld, 1991) or very small (Levine and Zame, 2002). In what follows, we also assess what happens in our model regarding this issue.

Figure 2: Developments of unemployment rates



shocks, autocorrelations measure the persistence of these fluctuations, and the cross-correlation is a measure for how synchronized business cycles. [Note that, given that we only have a technology shock for now, the values presented below should be handled with care (by improving the calibration, we aim at bringing the status quo closer

Figure 3: Developments of selected macro variables



to the data); what matters is the relative size of the values between the scenarios with and without a supranational UI system, not the values themselves].

Table 4: Business cycle statistics with and without a common EMU-wide UI system

	National UI only		Common UI	
Variable	Core	Periphery	Core	Periphery
Standard deviations				
GDP	0.3159	0.3311	0.3184	0.3370
Consumption	0.1227	0.0862	0.1253	0.0927
Wages	0.1798	0.1687	0.1809	0.1675
Unemployment	0.2315	0.2543	0.2319	0.2540
Leisure	0.0680	0.0667	0.0681	0.0647
Autocorrelations				
GDP	0.9926	0.9942	0.9926	0.9942
Consumption	0.9926	0.9952	0.9929	0.9956
Wages	0.9926	0.9938	0.9926	0.9937
Unemployment	0.6768	0.8061	0.6832	0.8135
Cross-correlations				
GDP	0.9183		0.9195	
Consumption	0.6815		0.6963	
Unemployment	0.6768		0.6851	

Business cycle statistics of simulating the model with and without a common EMU-wide UI system for selected variables. Cross-correlations in absolute values.

Table 5: Welfare effects

	Core	Periphery	Whole union
Long-run welfare gains (Δ_{LR})	-0.3725	0.9874	0.1706
Costs of business cycles (Δ_{BC})	-0.0289	-0.0265	-0.0279
Total welfare gains	-0.4014	0.9609	0.1435

All welfare changes are expressed in consumption equivalent. Long-run welfare gains (Δ_{LR}) represent a steady-state comparison, without aggregate uncertainty and excluding transition costs. Costs of business cycles calculate the gain from one regime to the other (ie $\Delta_{BC} > 0$ implies a reduction in the welfare costs of business cycles). Total welfare gains are given by the sum of the steady-state welfare changes and the differences in the costs of business cycles.

In a regime with a supranational UI system, the standard deviations of GDP and consumption increase in both, Core and Periphery. For unemployment, wages and labor market participation, standard deviations increase in Core but decrease in Periphery. Autocorrelation of shocks is hardly affected, which also holds for cross-correlations (if anything, the increase). The reason for an increase in volatility in GDP, consumption and wages can be found by the fact that, in a regime with a supranational UI scheme, spillovers from one region to the other increase. With only national UI schemes, these spillovers are primarily driven by the regions' trade in goods and assets as well as monetary policy. Within each region, changes in unemployment will have to be financed nationally. The spillovers are increased with a supranational UI system. In this case, a shock hitting one region will additionally affect the other region through changes in the supranational tax rate which, in turn, will affect the labor market there. Hence, net income and therefore consumption becomes slightly more volatile. On the contrary, unemployment and labor market participation are stabilized a bit more in Periphery which, in our baseline calibration, has the somewhat less efficient labor market. In a regime with a supranational UI system, a negative shock hitting the Periphery will induce a lower changes in the overall labor income tax rate households face. Therefore, wages, employment and labor market participation decisions will be affected less. Hence, the slight increase in business cycle synchronization is, in the end, achieved by increasing the overall amount of volatility in the system.

In calculating welfare, we follow Cacciatore and Fiori (2016) and differentiate between long-run welfare implications and welfare effects resulting from business cycle fluctuations. Table 5 summarizes the welfare gains/losses for each region and the union as a whole. Changes in welfare are, as is standard, expressed in consumption equivalent, ie how much of the initial steady-state consumption would a household in each region be willing to give up (or how much would he have to be paid, if negative) in order to be indifferent to live in one regime or the other. As expected, Core loses from shifting to a supranational UI system that pays out benefits to short-term unemployed workers, while Periphery gains. Both regions lose in terms of business cycle costs, es-

pecially because consumption volatility has increased (the reduction in the volatility of leisure cannot compensate for this effect in the Periphery). The union as a whole faces welfare gains, but this is not a Pareto improvement given that the Core will lose.

5. A feasible way to establish a common UI system

In this section, we ask the equation what would be a feasible way to establish a common EMU-wide UI system that avoids transfers and improves risk sharing. Here is the idea:

1. Make the steady-state tax rates to the EMU-wide system country-specific such that there will be no steady-state transfers. Argument: in the EMU-wide system, every country should take care of its own structural unemployment. Could "practically" be done as follows: one calculates a tax rate that covers past (short-term) unemployment benefits of the regions.
2. Following the findings of Moyen et al. (2016) or Moyen and Stähler (2014), make rrs^{EU} time-varying and country-specific.
3. As a rule, one could have rrs^{EU} react to home output deviations relative to foreign ones (ie the relative cyclical position). Argument: cyclical output is calculated for the Stability and Growth Pact anyway, so it is available; relative cyclical position due to the findings of mentioned papers – whoever is worse off, may receive a transfer
4. To get the "optimal" welfare-improving rule, run a grid search to determine how strongly rrs^{EU} should react to the relative cyclical position.
5. This could hopefully improve risk sharing (which the above system may not) while, at the same time, avoid structural transfers (which the above system implies).

6. Conclusions

Using a two-country New Keynesian model with frictional labor markets, we evaluate recent proposals to establish a common European unemployment insurance (UI): a supranational UI system that covers short-term unemployment benefits. Such a system generates structural transfers between regions. Because of increasing (decreasing) the total labor tax burden, the donor (recipient) region will face lower (higher) structural GDP, consumption and employment as well as a deterioration (improvement) in the terms of trade. International risk sharing cannot be improved. If anything, volatility of key macroeconomic variables increases because an additional channel for spillovers from one region to the other is established. Union-wide welfare can be improved, however, because the structural gains in the recipient region may outweigh losses in the donor region and increases in the costs of business cycles as long as the donor region and/or differences in steady-state unemployment rates are not too large.

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Appendix A. Using social security contribution rates as the fiscal instrument

To be included...

Appendix B. Increasing minimum UI standards in the Periphery

To be included...

Appendix C. Robustness

To be included...