On the Design of a European Unemployment Insurance System *

Árpád Ábrahám[1], João Brogueira de Sousa[1], Ramon Marimon[1,2], and Lukas Mayr[3]

[1] *European University Institute*
[2] *UPF - Barcelona GSE,CEPR* and *NBER*
[3] *University of Essex*

April 9, 2019

Abstract

We study the introduction, and possible design, of a European Unemployment Insurance System (EUIS) using a multi-country dynamic general equilibrium model with labour market frictions. Our calibration provides a novel diagnosis of European labour markets, revealing the key parameters - in particular, job-separation and job-arrival rates - that explain their different performance in terms of unemployment (or employment) and its persistence. We show that there are small welfare gains from insuring against country-specific cyclical fluctuations in unemployment expenditures. However, we find that there are substantial gains from reforming currently suboptimal unemployment benefit systems. In spite of country differences, it is possible to unanimously agree on a (minimal) EUIS, which countries can complement by additional national benefits. The EUIS features an unlimited duration of eligibility, which eliminates the risk of not finding a job before the receipt of benefits ends, and a low replacement rate of 10%, which stabilizes incentives to work. Country-specific payroll taxes eliminate cross-country persistent transfers. The resulting tax differences across countries may be the best statistic of their structural labour market differences, in terms of job creation and destruction, providing clear incentives for reform.

*We would like to thank, for their comments, Juan Dolado, Mike Elsby, Juan F. Jimeno, Etienne Lalé, Rody Manuelli, Richard Rogerson and Pedro Teles, and, more generally, the participants in conferences and workshops where versions of this paper have been presented. Most of the research leading to this paper has been conducted within the Horizon2020 ADEMU project, "A Dynamic Economic and Monetary Union", funded by the European Union's Horizon 2020 Program under grant agreement No 649396.

1 Introduction

The recent financial and sovereign debt crises have affected European labour markets asymmetrically both in terms of duration and severity of unemployment. In particular, stressed countries - such as Greece, Portugal and Spain - have experienced high levels of unemployment, making it very difficult, if not impossible, to provide adequate insurance for the unemployed without violating the low-deficit (Fiscal Compact) commitments. This has raised interest in proposals for a Europe-wide – or, more specifically, Euro-Area-wide – unemployment insurance scheme.

As business cycles across Europe are not perfectly correlated[1], a European unemployment insurance system (EUIS) would provide risk-sharing by reducing the countercyclical impact of unemployment expenditures on national budgets, thereby also mitigating the long-lasting recessionary effects which follow severe crises. Proponents of an EUIS further emphasize its ability to strengthen cohesion and solidarity across Europe. Moreover, a harmonized system could improve labour mobility and market integration, since unemployment benefits, and the corresponding active policies of surveillance, do not need to be tied to a specific location.

However, implementing a European Unemployment Insurance may not be politically feasible. European countries differ in their unemployment rates not only because they are, at a given point in time, in different phases of the business cycle, but also because they have structurally different labour market institutions. As a consequence, long-term averages of unemployment rates vary substantially across Europe (see Figure 1). It is unlikely that national governments of countries with structurally low unemployment rates would agree to participate in an EUIS if their countries are persistent net contributors to the system, while others are persistent net receivers. Moreover, the differences in labour market institutions may imply very different optimal benefit schemes, making it potentially difficult to agree on one common system.

The goal of this paper is to provide an answer to the following related questions:

(i) Is there a design of a European Unemployment Insurance System which could achieve unanimous support among member states?

If there is such a system:

(ii) How is it characterised, in terms of replacement rate and duration of benefits?

[1] For an overview on business cycles in the Euro Area see, for example, Böwer and Catherine (2006), Giannone et al. (2009) and Saiki and Kim (2014).

(iii) What are its gains and costs, in terms of economic efficiency and welfare?

(iv) How can it be implemented?

To answer these questions, we develop and calibrate (to the Eurozone) a multi-country dynamic general equilibrium model, in which unemployment insurance affects agents' decisions along the dimensions that we would expect to be the most relevant in reality: the decision to accept job offers; to quit jobs; to search for new jobs; and to save (and thereby to self-insure against job-loss). These decisions in turn have aggregate consequences: on the aggregate stocks of employed, unemployed and inactive; on national budgets, in particular on taxes needed to finance unemployment insurance expenditures; on the aggregate capital stock; on wages; and on interest rates.

This model economy serves as our laboratory to analyse the impact of a set of potential reforms to the unemployment benefit system (and its financing), both at the national and at the Eurozone level. The results of these experiments enable us to answer the posed questions:

(i) Yes, it is possible to design an EUIS in a way that leads to positive welfare gains in all Eurozone countries[2].

(ii) This system features an unlimited duration of eligibility, which eliminates the risk of not finding a job before benefit receipt ends, and a low replacement rate of 10%, which stabilizes incentives to work. Importantly, it is financed by country-specific taxes, which ensure that no country is a net contributor, or recipient, to the system. Furthermore, countries are allowed to complement the EUIS by additional national benefits.

(iii) While a common EUIS insures against cyclical fluctuations in unemployment expenditures, we show that these (pure) insurance gains are relatively small in terms of life-time consumption equivalent welfare gains. The bigger gains arise from the reform of currently suboptimal national unemployment benefit policies. According to our results, the proposed basic EUIS (10% replacement rate, unlimited duration) would imply positive welfare gains in all the 18 countries studied. Several countries could further increase these gains by providing additional national benefits.

(iv) With the current European systems of unemployment benefits funds together with a central EIUS fund.

[2]To be precise we analysed all Eurozone countries except Cyprus for which we do not have the data on flows between employment, unemployment and inactivity that we require for our calibration.

In Section 3 we present the model we use to arrive at these conclusions, which is a multi-country version of the model in Krusell et al. (2011) and Krusell et al. (2017). In this model, agents can be employed, unemployed or inactive and they face idiosyncratic labour productivity shocks in all states. They transit between these three labour market states partially through their endogenous decisions (job acceptance, quitting, search effort) and partially through exogenous forces (job arrival and separation shocks). They can self-insure against these and against productivity shocks by saving in a risk-free asset.

In Section 4 we calibrate our model such that the equilibrium stocks of employed, unemployed and inactive, as well as the flows between these states, are in line with their empirical counterparts in each Eurozone country. More specifically, our model consists of three sets of parameters: (i) generic parameters of preferences and technologies common to all economies: agents' discount factors, idiosyncratic productivity processes, and so on; (ii) country-specific structural or institutional parameters of their economies: specifically, job-separation and job-arrival rates, which in turn are a summary of different factors determining job creation, destruction and matching; and (iii) the (current) country-specific unemployment insurance policies, summarized in two plus one parameters: the two are the replacement ratio (unemployment benefits to wages) and the duration of unemployment benefits, the third is the unemployment payroll tax rate needed to balance the budget. By allowing structural parameters to vary across European countries, our model accounts for the rich heterogeneity in European labour market institutions. At the same time it is parsimonious enough to allow for a meaningful comparison between countries revealing how different European labour market institutions are. We see our multi-country model and its flexible parametrization allowing for country-specific features of labour markets as a contribution itself because it can be adopted to study many other relevant research questions where asymmetries across European labour markets are important.

Our model and its calibration provide the framework for our policy experiments, the main goal and contribution of this paper. Perhaps the most frequently used argument in favour of an EUIS is that it may provide insurance against large fluctuations in unemployment, which - with limited fiscal capacity - result in fluctuations in the tax burden associated with its financing. Our first experiment, in Section 5, targets a quantitative evaluation of the potential pure risk-sharing benefits of an EUIS when one country suffers a severe negative shock. To this end, we compute the labour market and welfare consequences of a deep recession, under autarky and with an EUIS that can fully insure the fluctuations of the tax

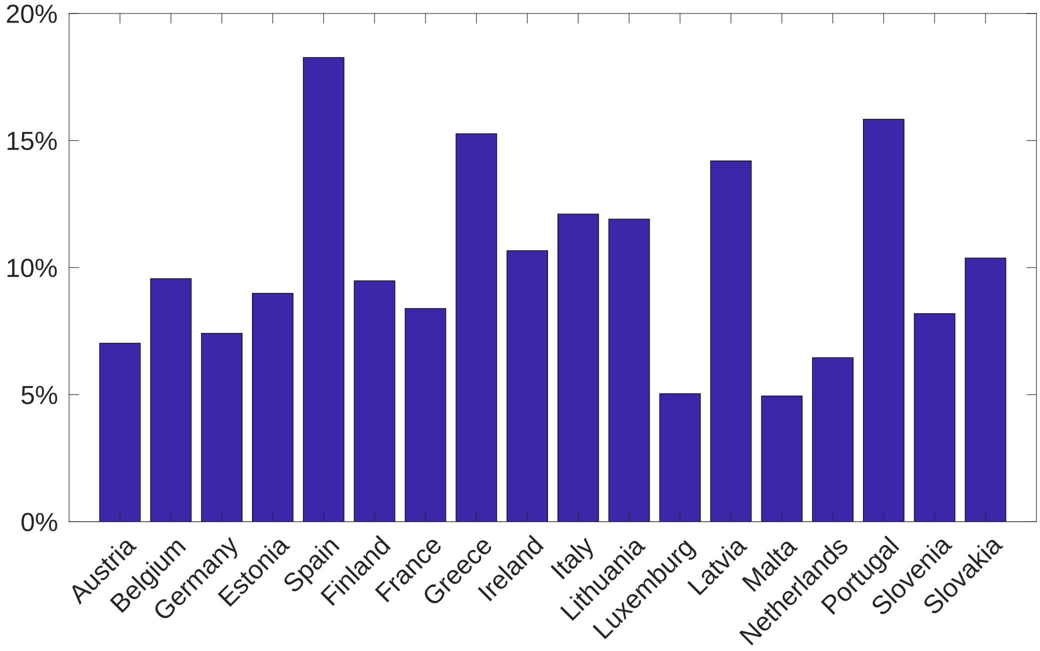

Figure 1: Average European Unemployment Rates: 2005-2015.

burden associated with the rise in unemployment benefits. We find that although the EUIS brings sizeable relief for those who keep their jobs during the crisis through reduced taxes in the short run, these welfare gains are relatively small from the perspective of an average consumption equivalent measure. Nevertheless, one of our findings is that for most EA countries there are more sizeable welfare gains from reforming their national EUIS system.

In light of this result, one may doubt the political feasibility, or desirability, of a European unemployment insurance system (EUIS). Even more so as the observed heterogeneity in labour market institutions suggests that the optimal benefit systems could differ substantially across European countries, making it potentially very difficult for governments to reach a common ground. To evaluate the feasibility, and desirability, of a EUIS, in Section 6 we compute the optimal unilateral reform of the unemployment benefit system in terms of a constant replacement rate and expected benefit eligibility duration (financed at the national level), separately for each country. We find that in most cases substantial welfare gains can be achieved by changing currently suboptimal benefit policies. A major risk for unemployed agents is the loss of unemployment benefits before finding a new job. Given search effort, this risk is not under the control of the agent, hence it is optimal in all Euro area countries to have unlimited duration. At the same time, it is necessary to adjust the replacement rate, such that incentives to take job opportunities are maintained, therefore optimal replacement rates are lower than existing ones, but still different across countries.[3]

Motivated by these results, we then move on to the analysis of harmonized European benefit systems. In Section 7, we compute the set of combinations (replacement rate, duration) that would achieve welfare improvements compared to the *status quo* in each single country of the Eurozone. Not surprisingly, this set is empty when the EUIS is financed with a common tax rate on wages that is the same in all countries, as several net contributors would suffer welfare losses in this case. Perhaps more surprising is the result that, even with this way of financing, some payers would gain from the reform, indicating that current unemployment benefit systems in these countries are far from optimal. However, such a system is unlikely to achieve unanimous support across member states as it would imply persistent transfers from countries with structurally low unemployment to high unemployment countries.

Our final contribution is to provide a better alternative, in which the EUIS is financed by country-specific contribution payments ensuring that no country runs a deficit or surplus. In this case there are several combinations of (common) replacement rates and duration that lead to welfare gains in every single country of the Eurozone. In particular, each country would gain from changing the current benefit system to one with a 10% replacement rate and an unlimited duration of benefit receipt. This low replacement rate (combined with the unlimited duration) provide a combination of sufficient amount of insurance with a minimal distortion on employment through low taxes and high incentives to accept job offers.[4] At the same time, in some countries, this reform will result in welfare losses among those who are unemployed at the time of the reform as they may face a dramatic decline in unemployment benefits. We show that, if national top-ups are available, in all countries the vast majority of unemployed agents would support such reform as well. A positive side effect of such a system is that the tax differences may still serve as an incentive device for individual countries to structurally reform weak labour market institutions in order to reduce their contribution payments.

[3]This result is in line with the results of Shimer and Werning (2008). In that paper, the key friction is also the rejection of offers. The authors show that constant benefits with infinite duration approximate very well the fully optimal unemployment insurance plan in terms of welfare.

[4]Abdulkadiroğlu et al. (2002) study the optimal design of unemployment insurance at a national level in a similar environment. They also show, in a general equilibrium model with incomplete asset markets similar to ours, that the optimal replacement rate can be very low (i.e. 5 percent).

2 EUIS Literature Review

There are a few recent papers that also study different aspects of the design of an EUIS coming both from academic scholars and from policy institutions. In this section, we review briefly some of the most recent and relevant papers on this issue.

On the one hand, Ignaszak et al. (2018) study the optimal provision of unemployment insurance in a federal state containing atomistic (and symmetric) regions. The focus of their paper is different from ours in three important dimensions. First, in their environment, the regions are *ex-ante* identical, hence they cannot study the asymmetric effect of an EUIS on the different participating nations as we do. Second, their model does not allow for an intertemporal saving technology for any agent (households, regions or the union altogether) and hence it abstracts from self-insurance as key mechanism of households' response to unemployment risk. Third, at the same time, their model allows for a rich interaction between federal and local policies as regional governments have a wide set of instruments, that they can use to respond to the introduction of new federal policies. Their main focus is indeed to study the crowding out of regional incentives due to generous federal insurance schemes. The main moral hazard problems arise from the ability of regional governments to use federal transfers for arbitrary purposes. These effects do not arise in our economies since there is a specific payroll tax to cover unemployment benefits. Furthermore, a well designed EUIS fund, isolating funds for unemployment benefits, should avoid this type of moral hazard problem.

On the other hand, Claveres and Clemens (2017) and Moyen et al. (2016) study unemployment insurance and international risk-sharing in a two-region DSGE model with frictional labour markets and calibrate their model to the core and the periphery of the Euro-zone. In both papers, a supranational agency runs an unemployment insurance scheme that triggers transfers to recessionary countries but has zero transfers in expectation. Such a scheme allows recessionary countries to maintain unemployment benefits and simultaneously reduce taxes, thus dampening recessionary effects similarly as in our experiment assessing the potential insurance gains of an EUIS. Our model differs in many dimensions from these papers. First, our model features a higher degree of heterogeneity both across and within countries. In particular, our policy experiments are performed with 18 countries of the Euro area instead of two regions. As we show, labour market institutions and consequently flows across employment, unemployment and inactivity are as heterogeneous across countries within the core (and the periphery) as across the core and the periphery. For example, we found that certain implementations of an EUIS have significantly different effects on Belgium and Germany, two core countries. Finally, our paper provides an extensive welfare evaluation (across and within countries) of different EUIS implementations both with business cycle fluctuations and by studying the transition to a new steady states after a policy reform.

In contrast to the previous papers, Dolls et al. (2015) and Beblavy and Lenaerts (2017) take into account the rich heterogeneity within the Euro area. They provide quantitative exercises that measure the possibilities for intertemporal and interregional smoothing of unemployment benefits and social security contributions under different versions of an EUIS as a 'rainy day fund'. Both papers present a set of counterfactual scenarios where household income and the evolution of labour markets are kept fixed during the period of study, and different specifications of an EUIS are considered. As in our paper, both studies find considerable interregional and intertemporal smoothing possibilities. In contrast to our paper, the lack of individual responses does not allow them to evaluate the effects of different insurance systems on labour markets, household consumption, individual savings and welfare. In addition, this implies that there are no equilibrium adjustments either and no effect on aggregate savings and capital accumulation.

Finally, Dullien et al. (2018) provide a concrete proposal, already discussed in the European Parliament, of a 'rainy day fund' structure for the EUIS, and a more detailed analysis of this idea can be found in Lenarčič and Kari (2018). In contrast with our work, they only focus on the fund-contract aspect, applying the self-insurance and the reinsurance principles to the design of an EUIS which operates national funds and a joint 'stormy day fund' that is operational only when the country is hit by a severe crisis. Similarly to ours, their scheme is intended to be implemented on a voluntary basis and it has interesting countercyclical features, likely an improvement upon the current situation. However, their national contracts are not based on a country-specific risk-assessment, the final destination of the funds is not guaranteed and, similarly to the papers cited above, their methodology does not allow to evaluate the impact on individual decisions and equilibrium outcomes.

3 Model

Our model economy consists of a union of $I \in \mathbb{N}$ countries. We assume that the population in each country $i \in \{1, ..., I\}$ is fixed and that there is no migration across countries. This implies that labour markets clear country by country. Capital, on the other hand, is perfectly mobile across countries. We assume that the union as a whole is a closed economy such that the (population weighted) sum of the capital stocks in all countries equals the savings of all citizens in the union.

Each country is modeled along the lines of Krusell et al. (2011) and Krusell et al. (2017). Their model captures key economic decisions of agents regarding their labour market behaviour and is therefore suited to think about unemployment policy. In particular, in the model, given labour income taxes and unemployment benefits, agents with an opportunity to work are able to choose whether or not they work and agents currently not employed are able to choose whether or not to actively search for a job.

Timing and Preferences. Time $t \in \{0, 1, 2, ...\}$ is discrete. Each country is populated by a continuum of agents of measure n^i, where $\sum_{i=1}^{N} n^i = 1$. Preferences over consumption, labour supply and job search are given by

$$\mathbb{E}_t \sum_{t=0}^{\infty} \beta^t \Big[\log(c_t) - \alpha w_t - \gamma^i s_t \Big]. \tag{1}$$

Agents derive utility from consumption c_t and disutility from employment w_t and job search s_t. The parameter α captures the disutility of work and is assumed to be the same in each country. The parameter γ^i denotes the disutility of active job search and varies across countries. In this way we capture that governments' assistance in the search for a job differs across countries. The time discount factor $\beta \in (0, 1)$ is the same for all citizens in the union. Workers can only choose to supply labour on the extensive margin, i.e. $w_t \in \{0, 1\}$. Additionally, the search decision is also discrete: $s_t \in \{0, 1\}$.

Markets and Technology. The production sector is competitive. Firms, who produce according to a constant returns to scale technology, hire labour from the domestic labour market and pay a wage per efficiency unit of labour that equals the marginal product of labour. They rent capital from the international capital market at a price r_t and pay for the depreciation of capital; the total rental price equals the marginal product of capital, which is the same across countries. Workers supply labour in the domestic market. This market is characterized by frictions that affect workers' separations from jobs, and workers' access to a job opportunity. In what follows, these frictions are described in detail.

At the beginning of every period, agents who were employed in the previous period can lose their job with probability σ^i. The probability of finding a job while not employed depends on the search effort. An agent who is actively searching during period t finds an employment opportunity for period $t+1$ with probability λ_u^i; an agent who is not actively searching, with probability $\lambda_n^i < \lambda_u^i$. After losing a job, agents who search may be eligible for unemployment benefits. The process that determines eligibility for unemployment benefits is described below. Note that the job arrival rates and the job separation rate are country specific. In this way we capture the heterogeneity in labour market institutions across the Eurozone.

Agents are heterogeneous with respect to their labour productivity, denoted by $z \in Z = \{\bar{z}_1, \bar{z}_2, ..., \bar{z}_{n_z}\}$. Idiosyncratic productivity follows a first order Markov chain with transition probabilities $p(z'|z)$. This process is assumed to be the same in each country.

Agents cannot directly insure themselves against the idiosyncratic productivity risk, however they can save using a risk-free bond. The risk-free return is given by the international real interest rate r_t.

Production is given by the Cobb-Douglas technology:

$$F^i(K_t^i, L_t^i) = A_t^i (K_t^i)^\theta (L_t^i)^{1-\theta}, \tag{2}$$

where A_t^i denotes total factor productivity in country i, K_t^i the aggregate capital stock in country i and θ the capital share of output. L_t^i is aggregate labour in country i, measured in efficiency units. In what follows, we generally assume no aggregate (country-specific) shocks, i.e. $A_t^i = A^i$.[5]

Individual Labour Market States. An agent can be employed, unemployed or inactive. The difference between unemployed and inactive agents is that the former exert search effort while the latter do not. Further, if an agent is unemployed he can either be eligible for unemployment benefits, in which case he receives a certain fraction of his potential income as a wage worker or he can be non-eligible, in which case he does not receive benefits and hence lives only from his savings. This gives a total of four possible individual labour market states that an agent can attain, $x_t \in \{e, u^e, u^n, n\}$: employed, unemployed eligible, unemployed non-eligible, non-participating;

Unemployment Benefits. Eligibility for unemployment benefits is partially determined by an agent's endogenous decisions, partially by exogenous shocks. Only agents who are

[5] We deviate from this assumption only in section 5.

exogenously separated from their job are eligible for unemployment benefits, while agents who quit their job are not eligible. All agents are eligible during the first period after a job loss. In order to maintain eligibility, agents have to continuously exert search effort. Once an agent stops searching, she is non-eligible even if at some later time she starts searching again. Finally, in every period with some probability μ^i agents lose eligibility even if they search for a job. This is a parsimonious way to capture limited (and country-specific) duration of unemployment benefit receipt.[6] Non-eligibility is an absorbing state. The only way to regain eligibility is to find a job, be employed for some time and then be exogenously separated again.

An eligible unemployed agent in country i receives unemployment benefits $b^i_t(z_t)$ according to

$$b^i_t(z_t) = \bar{b}^i_t \omega^i_t z_t, \tag{3}$$

where $\bar{b}^i_t$ is the replacement rate in country i, ω^i_t is the wage per efficiency unit of labour and z_t is the agent's current productivity level. The formula in (3) implies that an agent receives unemployment benefits according to his current labour market productivity. A more realistic assumption would be to have unemployment benefits depend on past labour earnings. We choose (3) to economize in the dimension of the state space of the model (avoiding the need to keep track of past productivity of currently unemployed agents), and because the process z_t is persistent, implying that current productivity is a good proxy for previous labour earnings.

Budget Sets. In every period t, each agent in country i chooses a pair of consumption and savings from a budget set $B^i_t(a, z, x)$ that depends on his current assets, productivity and employment state as well as on current prices r_t and ω^i_t. The budget set of an agent who is employed in period t ($x_t = e$) is given by

$$B^i_t(a, z, e) = \Big\{(c, a') \in \mathbb{R}^2_+ : c + a' \leq (1 + r_t)a + (1 - \tau^i_t)\omega^i_t z\Big\}. \tag{4}$$

An employed agent finances consumption c and savings a' with current period's asset a inclusive of interest income $r_t a$ and income from work, net of the tax rate τ^i_t. An unemployed

[6] In reality this duration is not stochastic but fixed. However, implementing a fixed duration is computationally expensive as it requires keeping track of the periods each unemployed agent already received benefits. To economize on the state space we use this stochastic process, as in Krusell et al. (2011) and Krusell et al. (2017).

agent who is eligible for unemployment benefits faces the budget set

$$B_t^i(a, z, u^e) = \Big\{(c, a') \in \mathbb{R}_+^2 : c + a' \leq (1 + r_t)a + b_t^i(z)\Big\}. \tag{5}$$

He does not have wage income but receives some fraction of his potential income as unemployment benefits.

Finally, both unemployed non-eligible and non-active agents finance consumption and next period's assets exclusively from savings:

$$B_t^i(a, z, u^n) = B_t^i(a, z, n) = \Big\{(c, a') \in \mathbb{R}_+^2 : c + a' \leq (1 + r_t)a\Big\}. \tag{6}$$

Labour Market Decisions and Value Functions. The individual optimization problem has a recursive representation. Denoting the value of an individual in country i, period t, and state (a, z, x), by $V_t^i(a, z, x)$. The time index of the value function captures in a simple way that the current value depends on current and future prices and government policies, which may vary over time in a deterministic way. Then the value of an agent in employment is given by

$$V_t^i(a, z, e) = \max_{(c,a') \in B_t^i(a,z,e)} \Bigg\{ \log(c) - \alpha + \beta \sum_{z' \in Z} p(z'|z) \Big[(1 - \sigma^i) \max_{x' \in \{e, u^n, n\}} V_{t+1}^i(a', z', x') + \sigma^i \Big(\lambda_u^i \max_{x' \in \{e, u^e, n\}} V_{t+1}^i(a', z', x') + (1 - \lambda_u^i) \max_{x' \in \{u^e, n\}} V_{t+1}^i(a', z', x') \Big) \Big] \Bigg\}. \tag{7}$$

The Bellman equation reflects the dynamics of the labour market. In the present period the worker derives utility from consumption but disutility of work. The continuation value takes into account that with probability $1 - \sigma^i$ the agent will not be separated from the job. In this case he can choose between staying employed or quiting the job. In the latter case he can choose to stay inactive or to search for a new job. He will, however, not be eligible for benefits as he decided to leave the job himself. Hence, if the worker does not get separated from his job he has three choices, $x' \in \{e, u^n, n\}$. With probability σ^i the worker is separated from his job. Then with probability λ_u^i he immediately gets matched with a new job, in which case he again can choose between employment, unemployment and inactivity. If he chooses unemployment he is eligible for benefits since he was exogenously separated from the job. With probability $1 - \lambda_u^i$ he does not immediately find a new job. In this case he can only choose between eligible unemployment and inactivity, i.e. $x' \in \{u^e, n\}$. Note that a worker who was separated from his job will get unemployment benefits for one period with certainty as long as he searches for a new job during this period.

Similarly, the value of an eligible unemployed agent in country i satisfies:

$$V_t^i(a,z,u^e) = \max_{(c,a')\in B_t^i(a,z,u^e)} \Bigg\{ \log(c) - \gamma^i + \beta \sum_{z'\in Z} p(z'|z) \Bigg[\lambda_u^i \Big((1-\mu^i) \max_{x'\in\{e,u^e,n\}} V_{t+1}^i(a',z',x') + \mu^i \max_{x'\in\{e,u^n,n\}} V_{t+1}^i(a',z',x') \Big) + (1-\lambda_u^i) \Big((1-\mu^i) \max_{x'\in\{u^e,n\}} V_{t+1}^i(a',z',x') + \mu^i \max_{x'\in\{u^n,n\}} V_{t+1}^i(a',z',x') \Big) \Bigg] \Bigg\}. \quad (8)$$

In the present period an unemployed agent incurs the utility cost of searching γ^i. While searching, a job offer for next period arrives with probability λ_u^i, in which case the agent can choose between employment, unemployment and inactivity. With the remaining probability $1-\lambda_u^i$ the agent does not receive a new offer and thus can only choose between unemployment and inactivity. An unemployed loses eligibility for benefits with probability μ^i and keeps eligibility with the remaining probability $1-\mu^i$.

The value of the non-eligible unemployed is very similar. The only exception is that he will not be eligible for benefits next period with certainty,

$$V_t^i(a,z,u^n) = \max_{(c,a')\in B_t^i(a,z,u^n)} \Bigg\{ \log(c) - \gamma^i + \beta \sum_{z'\in Z} p(z'|z) \Bigg[\lambda_u^i \max_{x'\in\{e,u^n,n\}} V_{t+1}^i(a',z',x') + (1-\lambda_u^i) \max_{x'\in\{u^n,n\}} V_{t+1}^i(a',z',x') \Bigg] \Bigg\}. \quad (9)$$

Finally, the value for non-active (i.e. not actively searching) agents in country i is given by

$$V_t^i(a,z,n) = \max_{(c,a')\in B_t^i(a,z,n)} \Bigg\{ \log(c) + \beta \sum_{z'\in Z} p(z'|z) \Big[\lambda_n^i \max_{x'\in\{e,u^n,n\}} V_{t+1}^i(a',z',x') + (1-\lambda_n^i) \max_{x'\in\{u^n,n\}} V_{t+1}^i(a',z',x') \Big] \Bigg\}. \quad (10)$$

The value of the non-active is similar to the non-eligible unemployed. The difference is that a non-active does not suffer the disutility of search and has a lower probability of a receiving a job offer next period, i.e. $\lambda_n^i < \lambda_u^i$.

Definition of Partial and General Equilibrium. We will now define two equilibria: (i) partial equilibrium for a specific country i, which takes the union interest rate r_t as given; (ii) general equilibrium for the union, for which the interest rate r_t is required to adjust such that aggregate savings equal aggregate capital in the union.

Individual state variables are assets $a \in \mathbb{R}_+$, idiosyncratic productivity $z \in Z$, and employment status $x \in \{e, u^e, u^n, n\}$. The aggregate state in country i is described by the joint measure ζ_t^i over assets, labour productivity status and employment status. Let $\mathcal{B}(\mathbb{R}_+)$ be the Borel σ-algebra of $\mathbb{R}_+$, $\mathcal{P}(Z)$ the power set over $Z = \{\bar{z}_1, \bar{z}_2, ..., \bar{z}_{n_z}\}$ and $\mathcal{P}(X)$ the power set over $X = \{e, u^e, u^n, n\}$. Further, let $\mathcal{M}$ be the set of all finite measures over the measurable space $\{(\mathbb{R}_+ \times Z \times X), \mathcal{B}(\mathbb{R}_+) \times \mathcal{P}(Z) \times \mathcal{P}(X)\}$.

Definition 1 *Partial equilibrium in country i: Given sequences of interest rates $\{r_t\}_{t=0}^{\infty}$ and unemployment benefit policies $\{(\bar{b}_t^i, \mu_t^i)\}_{t=0}^{\infty}$ and given an initial distribution ζ_0^i, a partial equilibrium in country i is defined by a sequence of value functions $\{V_t^i\}_{t=0}^{\infty}$, consumption and savings decisions $\{c_t^i, a_{t+1}^i\}_{t=0}^{\infty}$, firm production plans $\{K_t^i, L_t^i\}_{t=0}^{\infty}$, payroll taxes $\{\tau_t^i\}_{t=0}^{\infty}$, wages $\{\omega_t^i\}_{t=0}^{\infty}$ and measures $\{\zeta_t^i\}_{t=1}^{\infty}$, with $\zeta_t^i \in \mathcal{M}$ $\forall t$, such that:*

(i) Agents optimize: given prices, unemployment benefit policies and tax rates, the value function V_t^i and the policy functions for consumption c_t^i and savings a_{t+1}^i satisfy the Bellman equations (7), (8), (9) *and* (10) *for each $t \geq 0$.*

(ii) Firms optimize: $r_t = F_K^i(K_t^i, L_t^i) - \delta$ and $\omega_t^i = F_L^i(K_t^i, L_t^i)$ for each $t \geq 0$.

(iii) The labour market clears:

$$L_t^i = \sum_{z \in Z} z \int_0^{\infty} \zeta_t^i(a, z, e) da \quad \forall t \geq 0 \tag{11}$$

(iv) The government budget clears:

$$\tau_t^i \omega_t^i L_t^i = \sum_{z \in Z} b_t^i(z) \int_0^{\infty} \zeta_t^i(a, z, u^e) da \quad \forall t \geq 0 \tag{12}$$

(v) The law of motion $\zeta_{t+1}^i = H_t^i(\zeta_t^i)$ holds for each $t \geq 0$: the function $H_t^i : \mathcal{M} \to \mathcal{M}$ can be explicitly written as follows:

$$\zeta_{t+1}^i(\mathcal{A} \times \mathcal{Z} \times \mathcal{X}) = \sum_{x \in X} \sum_{z \in Z} \int_0^{\infty} T_t^i((a, z, x); \mathcal{A} \times \mathcal{Z} \times \mathcal{X}) \zeta_t^i(a, z, x) da,$$

where $T_t^i((a,z,x);\mathcal{A}\times\mathcal{Z}\times\mathcal{X})$ *describes the transition probability of moving from state* (a,z,x) *in period* t *to any state* (a',z',x') *such that* $a'\in\mathcal{A}\subset\mathbb{R}_+$, $z'\in\mathcal{Z}\subset Z$, $x'\in\mathcal{X}\subset X$ *in period* $t+1$.[7]

Definition 2 *General equilibrium in the union of countries: given a collection of sequences of unemployment benefit policies* $\{\{(\bar{b}_t^i,\mu_t^i)\}_{t=0}^{\infty}\}_{i=1}^{I}$ *and given a collection of initial distributions* $\{\zeta_0^i\}_{i=1}^{I}$, *a general equilibrium in the union of countries is defined by sequences of value functions* $\{\{V_t^i\}_{t=0}^{\infty}\}_{i=1}^{I}$, *policy functions* $\{\{c_t^i,a_{t+1}^i\}_{t=0}^{\infty}\}_{i=1}^{I}$, *firm production plans* $\{\{L_t^i,K_t^i\}_{t=0}^{\infty}\}_{i=1}^{I}$, *payroll taxes* $\{\{\tau_t^i\}_{t=0}^{\infty}\}_{i=1}^{I}$, *wages* $\{\{\omega_t^i\}_{t=0}^{\infty}\}_{i=1}^{I}$, *measures* $\{\{\zeta_t^i\}_{t=1}^{\infty}\}_{i=1}^{I}$, *with* $\zeta_t^i\in\mathcal{M}$, *and by a sequence of interest rates* $\{r_t\}_{t=0}^{\infty}$ *such that all conditions of definition 1 are satisfied for each country* $i\in\{1,2,...,I\}$ *and in addition the capital market clears at the union level, i.e.*

$$\sum_{i=1}^{I} n^i K_{t+1}^i=\sum_{i=1}^{I} n^i\sum_{x\in X}\sum_{z\in Z}\int_0^{\infty} a_{t+1}^i(a,z,x)\zeta_t^i(a,z,x)da \tag{13}$$

holds.

Definition 3 *Stationary general equilibrium: is a general equilibrium in which all government policies, decision rules, value functions, aggregate variables and prices are constant over time in all countries of the union.*

4 Calibration

We calibrate the model assuming that in $t=0$ the union of I countries is in a stationary general equilibrium (see Definition 3 above). Hence, we assume that the Eurozone as a whole is a closed economy with no net capital in- or outflows. However, we want to note here that the structural calibrated parameters are not sensitive to this choice. In particular, if we do not require capital market clearing at the union level and consider any world interest rate within a reasonable range, it does not affect the overall calibration much. We calibrate the model to Eurozone data. To be specific, we consider all Eurozone countries except Cyprus, for which we lack the flow data necessary for our calibration procedure.

Our model has three sets of parameters, which correspond to the three panels of Table 1. The upper panel describes technological and preference parameters that are common to

[7] The description of the transition function T_t^i is quite involved and therefore deferred to the appendix.

Parameter	Definition
θ	Capital share of output
δ	Capital depreciation rate
β	Discount factor
ρ_z	Persistence of productivity
σ_z^2	Variance of prod. shock
α	Utility cost of labour
A^i	Total factor productivity
γ^i	Utility cost of search
σ^i	Job separation rate
λ_u^i	Job finding rate for unemployed
λ_n^i	Job finding rate for inactive
μ^i	Prob. of losing UB eligibility
$\bar{b}^i$	UB replacement rate

Table 1: Model parameters.

all countries. In particular, we assume that in all countries the capital share of production θ, the depreciation of capital δ, the time discount factor β and the utility cost of work α are the same. Further, we assume that idiosyncratic productivity follows the same Markov process, for which we use a discretized version of an AR(1) process with persistence ρ_z and variance σ_z^2.

The middle and lower panels display parameters that are specific to each country. The middle panel includes parameters that capture - in a reduced form - different labour market institutions: total factor productivity A^i (which affects wage differences across countries), the cost of job search γ^i, the exogenous job separation rate σ^i, as well as the job arrival rates λ_u^i and λ_n^i. The lower panel contains parameters that define country specific unemployment benefit policies $(\mu^i, \bar{b}^i)$.

In total our model has $6 + I \times 7$ parameters. The three sets of parameters constitute a hierarchical structure in the degree to which policy can influence them. The unemployment benefit policy parameters $(\mu^i, \bar{b}^i)$ can be changed relatively easily by governments, while it takes more complex labour market reforms to change the institutional parameters $(A^i, \gamma^i, \sigma^i, \lambda_u^i, \lambda_n^i)$. Given the scope of this paper, in the policy experiments below we only vary unemployment benefit policies (and how these are financed). The institutional parameters can be potentially endogenized and/or can be changed through structural labour market reforms, but these experiments are beyond the scope of our paper.

A central aspect of our analysis is the transitions between employment, unemployment and inactivity. Flow statistics are a useful measure since they provide (indirect) information on job destruction and job creation (through job arrival rates) of these economies. In order to calibrate the model, we therefore use estimated quarterly transition probabilities, and the corresponding three average labour market stocks, generously provided by Etienne Lalé. Lalé and Tarasonis (2017) estimate these transition probabilities using quarterly data on prime-age workers (25-54) in the EU countries, from 2004 until 2013[8]. Data on unemployment benefits in EU Member States is taken from Esser et al. (2013), and data on population and average labour earnings from Eurostat.

4.1 Calibration strategy

We now describe in detail how the model is calibrated. First, we set the technological parameters θ, δ, ρ_z and σ_z to the quarterly counterparts of Krusell et al. (2017), who use monthly data for the US economy to estimate them. We discretize the AR(1) process for individual productivity process by 5 different productivity states using the Tauchen method. We set the discount factor β to 0.99, implying a subjective discount rate close to one percent per quarter.

The policy related parameters are chosen as follows. The parameter μ^i, which is the conditional probability of remaining eligible for UB in the next period, is also the inverse of the expected duration of unemployment benefits eligibility in the model. We therefore set $1/\mu^i$ to the maximum duration of eligibility according to the law in country i. As described above, we model the eligibility process in this way because it allows for a simpler representation and a reduction in the dimensionality of the state space. For the unemployment benefit replacement rates, we set $\bar{b}^i$ to the data equivalents in Esser et al. (2013).

The remaining five country specific parameters A^i, γ^i, σ^i, λ_u^i and λ_n^i are calibrated in order to match the following five data moments: the differentials of average wages across countries[9], the share of unemployed individuals in the population, the employment-to-employment, the unemployment-to-employment, and the non-active to employment flows. Finally, we set the common utility cost of work parameter α such that the population-weighted average of the fraction of employed agents in the union matches the data.

Table 2 lists the common parameters, and table 3 contains the country specific parameters for the calibrated European countries. We also report the tax rates τ^i that clear the government budget in each country.

[8]The underlying data is from the EU-SILC dataset, except Germany which comes from the GSOEP.

[9]We picked Germany, the largest country in the European Union, as our reference country. So TFP in Germany is equal to one and for the other countries it is calibrated in order to match wages relative to German wages.

Parameter	Definition	Value
θ	Cobb-Douglas capital weight	0.3
δ	Capital depreciation rate	0.01
ρ_z	Persistence of individual productivity	0.89
σ_z^2	Variance of individual productivity	0.08
α	Utility cost of work	0.90
β	Discount factor	0.99

Table 2: Common Parameters.

	A^i	γ^i	σ^i	λ_u^i	λ_n^i	$\bar{b}^i$	$1/\mu^i$	$\tau^i(\%)$
Austria	0.91	0.65	0.04	0.26	0.08	0.40	2	1.50
Belgium	1.01	0.65	0.02	0.10	0.06	0.50	20	4.82
Germany	1.00	0.01	0.01	0.10	0.10	0.42	4	1.07
Estonia	0.58	0.37	0.03	0.18	0.10	0.50	4	3.22
Spain	0.82	0.62	0.05	0.18	0.04	0.63	8	9.19
Finland	0.96	0.52	0.05	0.21	0.21	0.55	8	5.99
France	0.94	0.43	0.02	0.17	0.05	0.58	8	3.17
Greece	0.81	0.61	0.04	0.17	0.03	0.58	4	4.91
Ireland	1.04	0.37	0.03	0.13	0.06	0.48	4	2.99
Italy	0.91	0.43	0.03	0.13	0.04	0.50	3	2.40
Lithuania	0.47	0.22	0.03	0.16	0.07	0.34	2	1.18
Luxembourg	1.15	1.20	0.02	0.17	0.04	0.82	4	2.64
Latvia	0.45	0.34	0.04	0.17	0.07	0.56	3	4.04
Malta	0.72	1.00	0.01	0.10	0.03	0.20	2	0.07
Netherlands	0.87	0.09	0.01	0.17	0.13	0.75	4	2.59
Portugal	0.69	0.55	0.06	0.18	0.09	0.65	6	10.34
Slovenia	0.77	0.35	0.02	0.14	0.05	0.70	2	1.58
Slovakia	0.53	0.19	0.02	0.13	0.08	0.47	2	1.60

Table 3: Country specific parameters.

4.2 Quality of the Fit

In this section we investigate how well the model fits the European labour markets. In the calibration described above, several labour market moments were targeted. These are shown in Figures A.1 to A.4 in the Appendix. In Figure A.1 we observe that the average unemployment rate in Spain, Greece, Latvia and Portugal is much higher than the European average, while in Austria, Germany, Luxembourg and the Netherlands it is lower. The persistence of employment (Figure A.2) is high in almost all countries. The exceptions are Spain, Finland and Portugal which have substantial flows out of employment in each quarter. The flows from unemployment to employment (Figure A.3) are quite heterogeneous across European countries. Interestingly, it is the lowest in Germany, a country with rather low unemployment. By contrast, Austria, which has similar average unemployment rates as

Germany, has the highest flow from unemployment to employment. We observe substantial heterogeneity also in the flows from inactivity to employment (Figure A.4). For example, in Finland this flow is much higher than in the other countries. The latter three flows identify, to a large extent, the country specific separation rates, σ^i and the two job arrival rates, λ_u^i and λ_n^i, respectively.

The employment rates were not targeted country by country, but the union average was. At the country level, the comparison with the data is shown in Figure A.5. The model does very well in replicating the heterogeneity in stocks of employment that we observe in the data. Given that the model shares of employed and unemployed agents is in line with the data counterparts, the model unemployment rate is also as in the data (Figure 2).

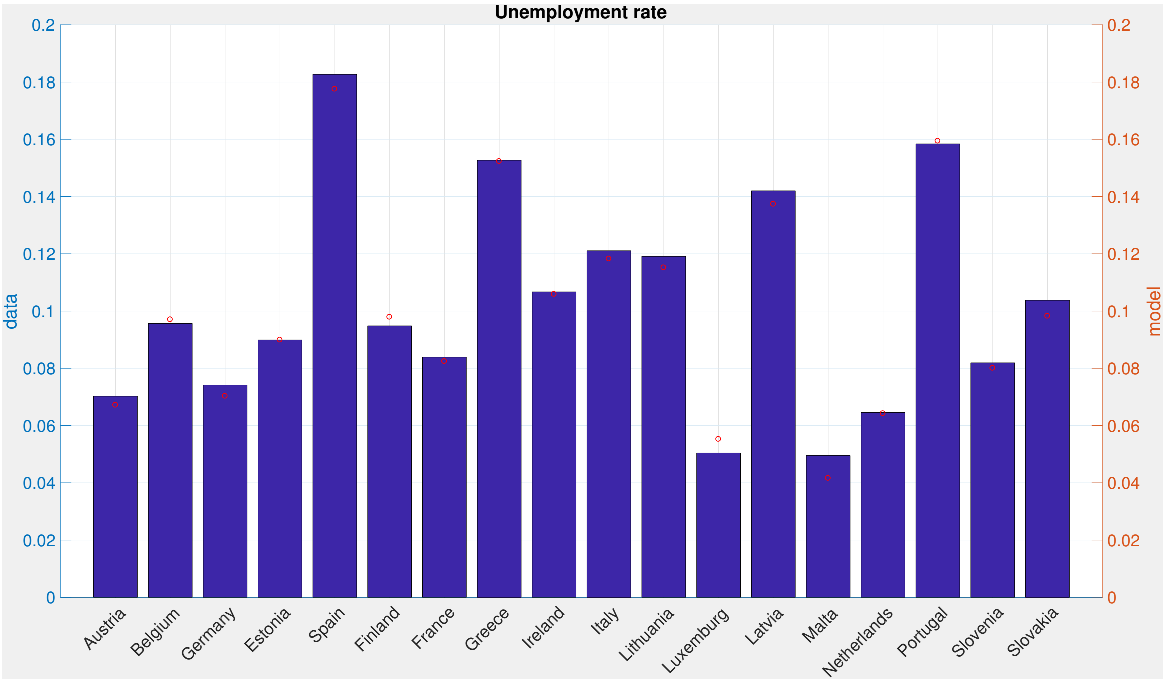

Figure 2: Unemployment Rate.

For completeness, the persistence of inactivity is shown in Figure A.6. Again, the model does a good job in replicating the data with only minor deviations.

4.3 Diversity of Labour Market Institutions

Our calibration provides a parsimonious map of the diversity of labour market institutions in Europe that generates diverse experiences both in terms of labour markets stocks and flows. We visualize this in Figures 3 to 5. Figure 3 shows the job arrival rate for non-searchers (λ_n^i, horizontal axis) and searchers (λ_u^i, vertical axis) for each of the calibrated economies. We observe that these two rates differ substantially across countries (λ_n^i ranges from 3 percent to 21 percent while λ_u^i ranges between 10 percent and 26 percent. Job arrival rates tend to be considerably higher for the unemployed with two notable exceptions, Finland and Germany, where the difference is negligible. This implies that, in these countries, there are no efficiency gains from making agents actively search. In equilibrium, they search mostly because it provides eligibility for unemployment benefits.

Figure 4 plots average the job arrival rate for the non-employed ($(\lambda_u^i + \lambda_n^i)/2$) on the x-axis, but this time against the job separation rate σ^i on the y-axis. It gives an idea of the rigidity of the respective labour markets. Here the correlation is stronger: countries with higher separation rates tend to have higher job arrival rates. For example, Malta is characterized by a very rigid labour market while Finland's high turnover in both dimensions implies a more dynamic market. However, this correlation is not perfect: for instance while Germany and Spain have similar job arrival rates for the non-employed, job destruction in Spain in roughly 5 times higher, contributing to higher unemployment in Spain.

Finally, Figure 5 shows that the countries also differ substantially with respect to their unemployment benefit system. It plots the replacement rate vs. the average duration for which unemployed are eligible to receive benefits. We find countries with unemployment benefits that provide little insurance both in terms of duration and replacement rates (Malta, Lithuania and Austria), others with generous replacement rates but short durations (Luxembourg, Netherlands and Slovenia) and others with longer durations but less generous replacement rates (Finland, Portugal and Spain). Given that the parameters are so different across countries, it is not necessarily surprising that they implement substantially different unemployment insurance schemes. However, there is no clear pattern across countries that would connect the dispersion of institutional parameters with the parameters of the UI policies. This indicates that national policies are not necessarily designed using the same welfare criterion. We come back to this issue in section 6.

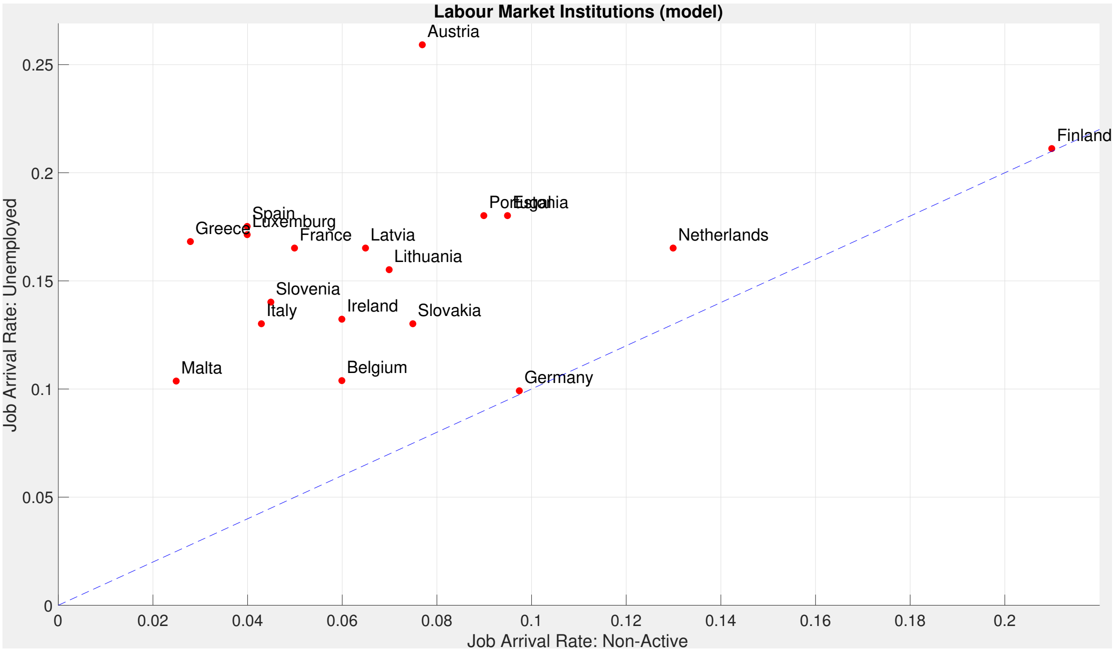

Figure 3: Job Arrival Rates.

This calibration, which initializes the economy in $t = 0$, allows to perform several experiments and analyze the evolution of countries' labour markets and other macroeconomic variables under different configurations of unemployment policy for $t \geq 1$, which we do in the following three sections.

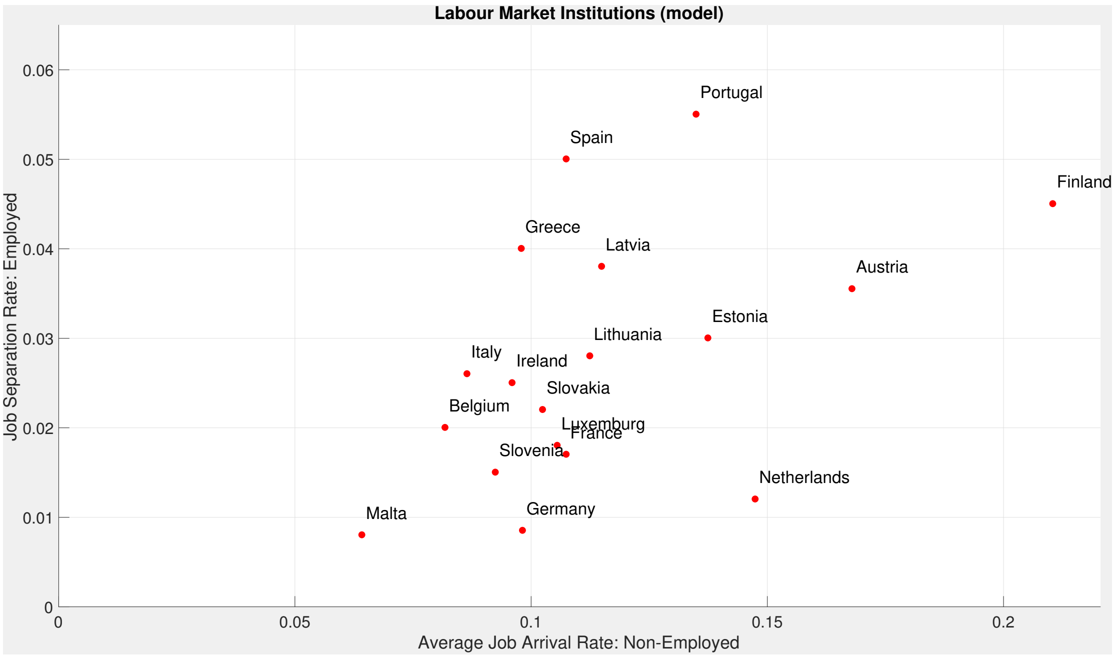

Figure 4: Labour Market Rigidity.

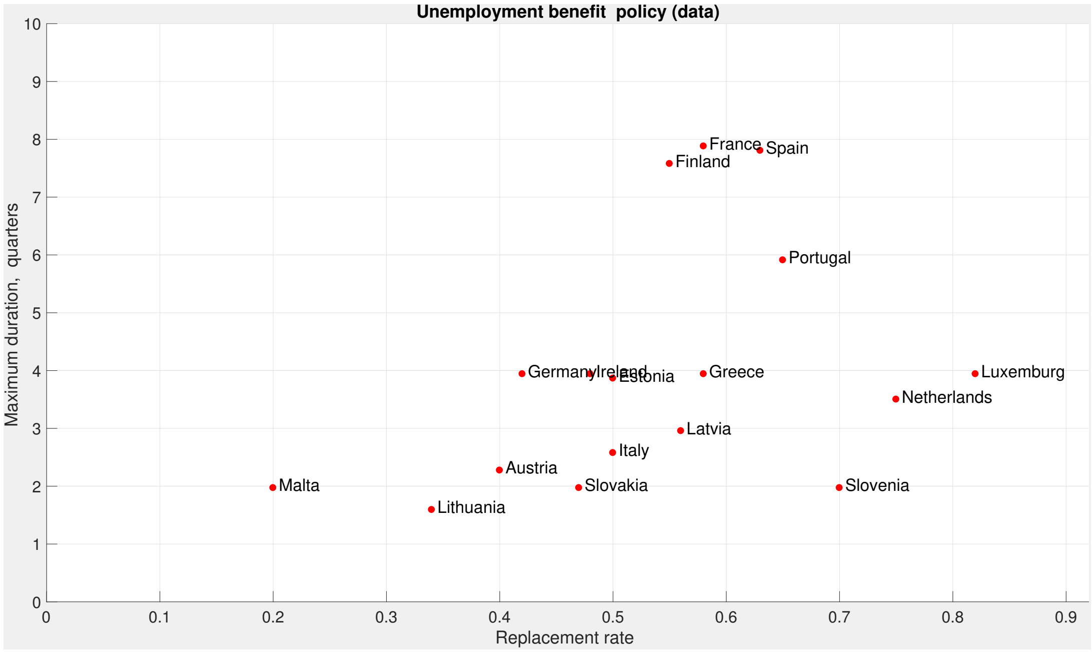

Figure 5: National Unemployment Benefit Systems.

5 Insuring Labour Market Recessions

One of the main arguments for an EUIS is its capacity to provide insurance against country level fluctuations in unemployment – in particular, severe economic downturns – through risk-sharing. In this section we quantitatively assess the insurance effects of having an EUIS on individual countries. In particular, we consider a benchmark which provides an upper bound on the gains of having an EUIS: individual countries are small with respect to the union. This small-country assumption allows the EUIS to insure countries against their specific fluctuations in unemployment, while keeping the rest of the union at the steady-state *status quo*. We show that the welfare benefits of such an insurance system are relatively small.

The experiment is constructed as follows. At time $t = 0$ the country is in its steady state. At the end of this period, when all decisions are already made, it becomes aware that at $t = 1$ it is hit by a completely unanticipated severe negative shock. After the shock hits the country returns to its steady state in a deterministic and gradual way. Given that it is a severe shock with relatively long-lasting effect, insurance is potentially very valuable.

Similarly to Krusell et al. (2017), we model shocks as hitting simultaneously TFP (A) and exogenous labour market flows (σ, λ_u and λ_n)[10]. In particular, a deep recession will be modelled as a drop in TFP and job arrival rates and a rise in the separation rate. We model

[10]Note that in order to economize on notation we suppressed the time subscript in these parameters in the description of our model. In most of our analysis these parameters are indeed treated as constant. Only in the present section we deviate from this assumption.

economic fluctuations in this way because it is well known that fluctuations of TFP alone are not able to generate large enough fluctuations of unemployment if output fluctuations are reasonable. This issue is amplified in our framework by the fact that job creation and job destruction are not modelled endogenously.

Given all these assumptions, note that, after the shock hits, the economy follows a deterministic pattern and eventually converges back to its steady state. Hence, along the transitions agents have perfect foresight when solving their dynamic optimisation problems. We consider two cases: financial autarky and insurance through the EUIS. In financial autarky, along the transition the tax rate needs to adjust to balance the government budget constraint every period. In the case of the EUIS, we assume that countries can get full insurance against the rise in unemployment expenditure and thus can leave the tax rate at its steady state value. We assume that the shock is a zero probability event and therefore comes as a complete surprise to agents.

We want to note here that the zero probability assumption serves one purpose: to calculate an upper bound for the actual welfare gains that a EUIS would achieve when its sole purpose was to insure country level fluctuations in unemployment expenditures. If we relax this assumption and assume that the shock happens with some positive probability, an actuarially fair EUIS would imply a higher tax rate than the steady state tax rate, i.e. countries would have to pay an insurance premium. This reduces consumption in normal times and thus welfare. It also would imply that agents would prepare for the possibility of such a shock through higher savings, in which case the smoothing of taxes is less helpful than in case of the fully unanticipated shock.

We calculate the welfare effect of the introduction of this EUIS by comparing the welfare of autarky and the EUIS of each individual at the end of period $t = 0$, i.e. after learning that shocks will occur next period. We calculate the welfare gains conditional on the negative shock happening, i.e. at the time when it is most desirable to be insured against increases in unemployment expenditures. The purpose is again to provide an upper bound for the actual insurance gains. For example, we neglect the possibility of an economic expansion during which under the EUIS taxes would be higher than in autarky and hence participation less desirable.

The argument that we make with this exercise is that, even in a highly stylized scenario which in several dimensions is constructed in a way to increase welfare gains of an EUIS (relative to what we could expect in reality), the gains of insuring country level fluctuations are small.

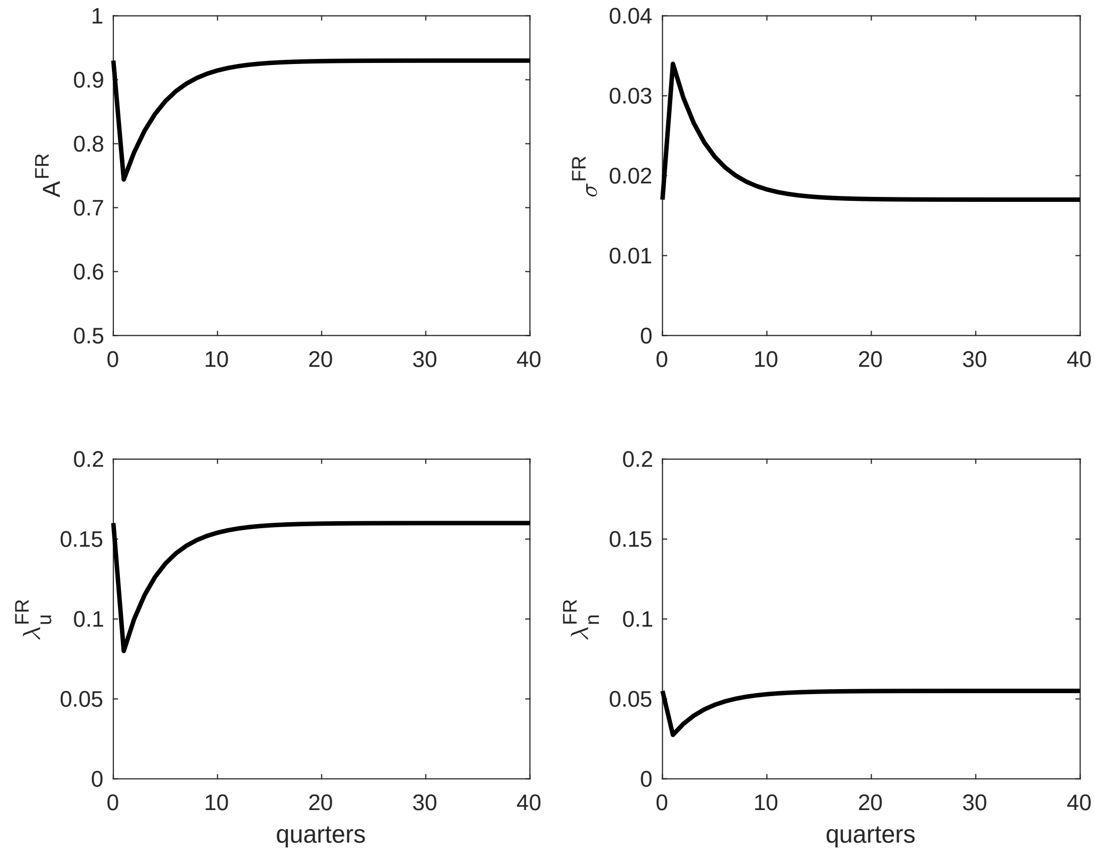

Figure 6: Shock process in France.

The Shocks. The combination of shocks has the following structure. Consider first total factor productivity in country i. At $t = 0$ the country is in steady state, i.e. $A_0^i = A^i$. At $t = 1$ a negative shock of size ϵ_A hits,

$$A_1^i = (1 - \epsilon_A)A^i.$$

The shock has persistence ρ_A and moves back to the steady state in a gradual and deterministic way,

$$\log(A_t^i) = \rho_A \log(A_{t-1}^i) + (1 - \rho_A) \log(A^i) \quad \text{for } t \geq 1.$$

Similarly, the job separation rate and the job arrival rates are hit in $t = 1$,

$$\sigma_1^i = (1 + \epsilon_\sigma)\sigma^i$$
$$\lambda_{u,1}^i = (1 - \epsilon_{\lambda_u})\lambda_u^i$$
$$\lambda_{n,1}^i = (1 - \epsilon_{\lambda_n})\lambda_n^i.$$

After that they gradually return back to their steady state values, i.e. for $t \geq 1$

$$\sigma_t^i = \rho_\sigma \sigma_{t-1}^i + (1 - \rho_\sigma)\sigma^i$$
$$\lambda_{u,t}^i = \rho_{\lambda_u} \lambda_{u,t-1}^i + (1 - \rho_{\lambda_u})\lambda_u^i$$
$$\lambda_{n,t}^i = \rho_{\lambda_n} \lambda_{n,t-1}^i) + (1 - \rho_{\lambda_n})\lambda_n^i$$

holds.

We consider a deep recession with TFP dropping by 10% ($\epsilon_A = 0.1$), the job separation rate doubling ($\epsilon_\sigma = 1$), and the job finding rates being reduced by half ($\epsilon_{\lambda_u} = \epsilon_{\lambda_n} = 0.5$). We further assume that $\rho_A = \rho_\sigma = \rho_{\lambda_u} = \rho_{\lambda_n} = 0.75$. Figure 6 depicts the evolution of the shock in the case of France.

The shock induces changes in labour markets, which are depicted in Figure 7. To some extent these responses are driven directly by the exogenous shock. For example a higher separation rate reduces employment by construction. But to a substantial degree they result from endogenous decisions of agents. For example, we observe that unemployment decreases at impact and only later rises above its steady state value (second panel) and that at the same time inactivity increases at impact and gradually decreases later (third panel). The reason is that because of lower wages and a lower likelihood to find a job even when searching, many agents are not willing to incur the utility loss of searching and instead decide not to participate. Only later, when economic conditions improved, they start searching for a job again. Furthermore, some not separated agents decide to quit working because of the reduction in wages.

If the country is in financial autarky, this mechanism is amplified through a rise in taxes, distorting incentives to (try to) work even more. Figure 8 shows how taxes in France would evolve under autarky (solid line) as opposed to the case in which the country is fully insured against fluctuations in benefit expenditures (dashed line). In France such a shock would result in a gradual increase in the payroll tax that is from 3.2% to about 6.6% at the peak of

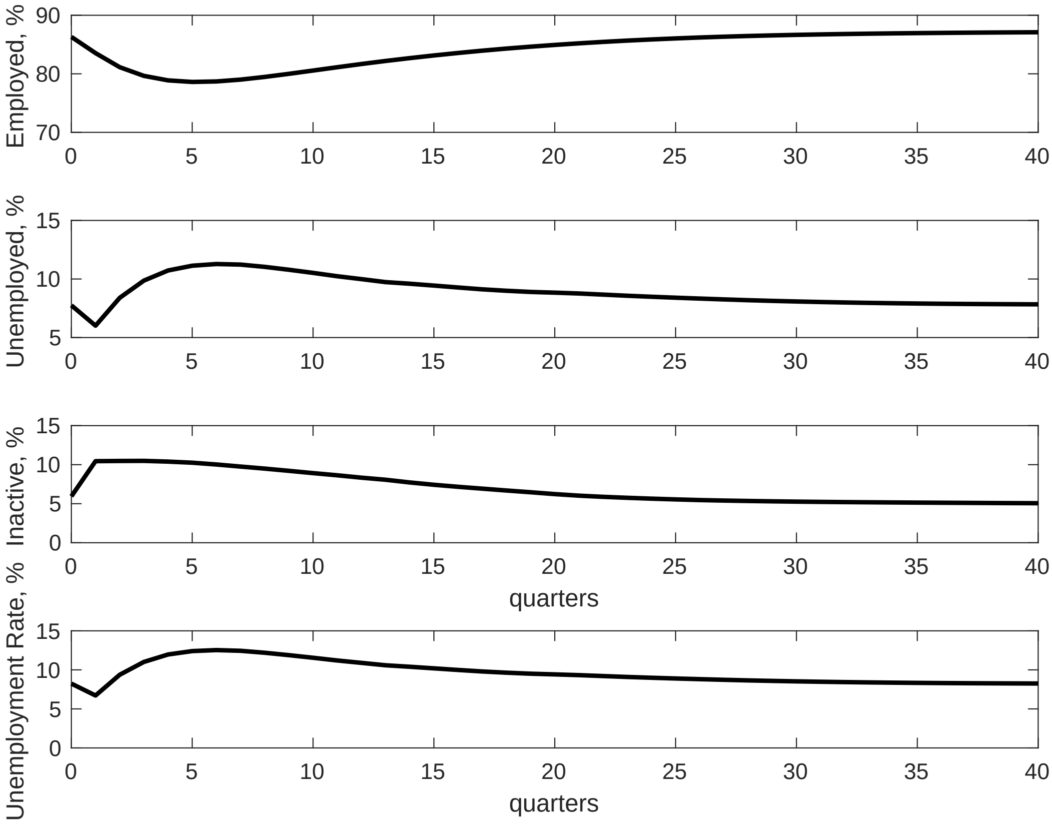

Figure 7: Labour Market in France.

the recession. Note that this reduction of taxes implies a very significant transfer from the EUIS to France. In particular, at the peak of the unemployment crisis (between quarters 3 and 6), France would receive between 2.8 and 3.4 percent of its total wage bill as a transfer, which is equivalent to 1.5% percent of its GDP during these periods. Five quarters after the shock hits, the average consumption of the employed is about 2.9% higher when taxes are constant compared to the case of financial autarky, implying significant welfare gains for the employed at the peak of the recession.

We performed this very same exercise for all 18 countries. Table 4 shows the average social welfare gains of insuring country level fluctuations in taxes. They are computed conditional on the shock happening using a consumption equivalent measure. Table 4 shows that many countries have a very modest welfare gain. At the same time, some countries like Portugal, Spain, Finland and Belgium have more significant gains. In the case of France, we have a modest but not negligible welfare gain of 0.18 percent of consumption equivalent variation. As we pointed out above, most of the welfare gains are coming from the consump-

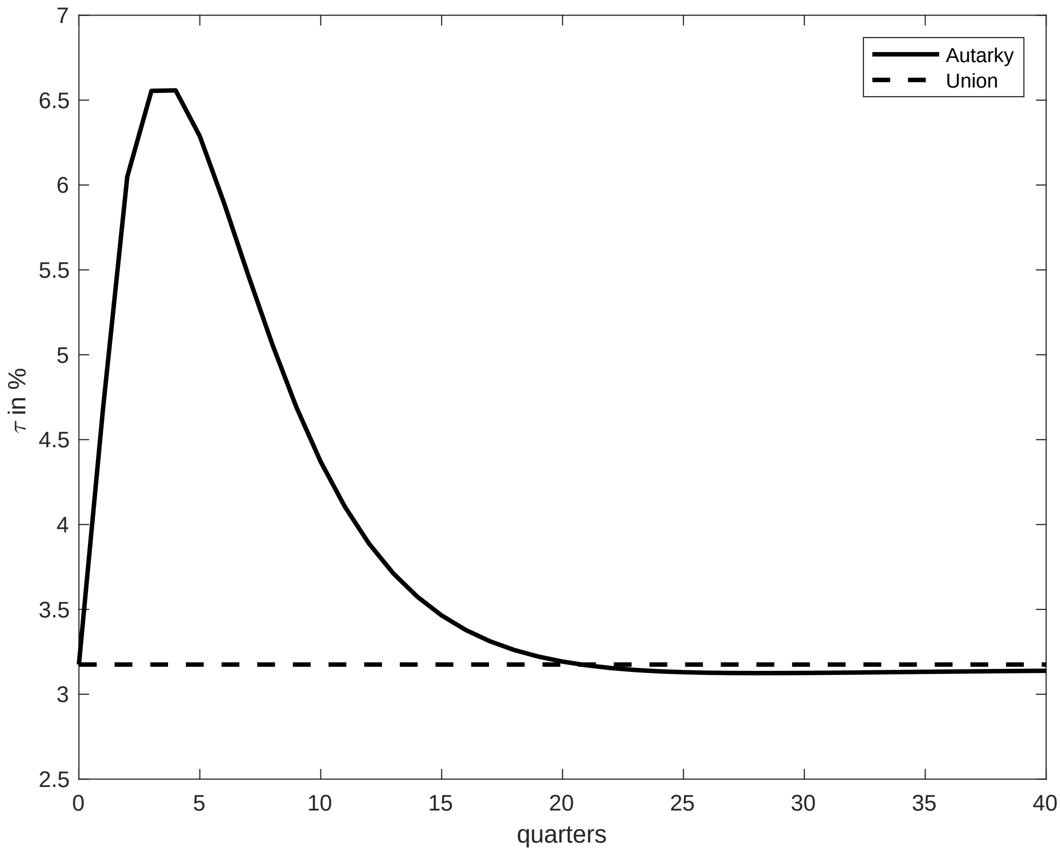

Figure 8: Taxes in France

tion smoothing benefits of lower taxes for the employed. In fact, the only reason why also unemployed and non-active have positive welfare gains is because they may be employed, and thus paying taxes, in the future.

Why don't the consumption gains described above translate to higher welfare benefits for France? Table 5 shows the drop of consumption (in net present value) in the first 10 years after the shock. Under the EU-UI system, which allows for taxes to stay constant during the recession, this drop is reduced by 0.38 percent. This is obviously lower then the reduction around the peak (2.9%). Hence, when we calculate the total welfare gain for the period we obtain smaller welfare gains. Not surprisingly, for those countries, where the consumption drop is reduced more (e.g. Finland by 2.63 percentage points, Spain 1.1 percentage points and Portugal 1.41 percentage points) we see the larger welfare gains in Table 4. In these countries, the increase of the tax burden in financial autarky is higher and more prolonged and for this reason they benefit more from risk sharing.

This exercise shows that risk-sharing by itself does not provide a strong rationale for the introduction of an EUIS, at least to some countries. In light of this result one may doubt the feasibility of a common European unemployment benefit scheme, especially since the observed heterogeneity in labour market institutions (see section 4) suggests that the optimal benefit system could differ substantially across countries, making it difficult to reach a consensus across Europe. In the next section we want to evaluate this claim and analyze how different optimal benefit systems are across countries.

	Employed	Un. Eligible.	Un. Non-Elig.	Non-Active	Total
Austria	0.10	0.07	0.09	0.04	0.09
Belgium	0.39	0.22	0.28	0.14	0.32
Germany	0.05	0.01	0.02	0.01	0.04
Estonia	0.19	0.07	0.11	0.04	0.16
Spain	0.68	0.32	0.39	0.11	0.55
Finland	0.65	0.26	-	0.24	0.55
France	0.20	0.09	0.11	0.02	0.18
Greece	0.31	0.14	0.17	0.05	0.23
Ireland	0.15	0.05	0.08	0.02	0.11
Italy	0.13	0.04	0.06	0.02	0.10
Lithuania	0.06	0.02	0.03	0.01	0.05
Luxembourg	0.18	0.10	0.13	0.05	0.15
Latvia	0.23	0.08	0.12	0.04	0.19
Malta	0.00	0.00	0.01	0.00	0.00
Netherlands	0.10	0.01	0.03	0.00	0.08
Portugal	0.63	0.06	0.36	0.00	0.41
Slovenia	0.08	0.02	0.03	0.01	0.07
Slovakia	0.08	0.02	0.03	0.01	0.06

Table 4: Welfare gains in percent CEV

	Autarky	Union	Difference
Austria	-3.00	-2.87	0.13
Belgium	-2.70	-2.17	0.53
Germany	-2.98	-2.83	0.15
Estonia	-3.94	-3.45	0.49
Spain	-3.96	-2.86	1.10
Finland	-5.99	-3.36	2.63
France	-3.08	-2.70	0.38
Greece	-0.83	-0.45	0.38
Ireland	-1.51	-1.24	0.27
Italy	-1.89	-1.58	0.32
Lithuania	-2.79	-2.68	0.11
Luxembourg	-2.36	-2.16	0.20
Latvia	-3.52	-2.92	0.60
Malta	-2.12	-2.11	0.00
Netherlands	-2.88	-2.65	0.23
Portugal	-2.05	-0.64	1.41
Slovenia	-2.77	-2.64	0.13
Slovakia	-1.83	-1.55	0.28

Table 5: Consumption drop (% of Steady State) in first 10 Years

6 National Reforms of the UB System

As we have seen in Section 4, European labour markets are very heterogeneous. We have also seen that although current national unemployment benefit systems, in terms of replacement rates and duration of benefits, vary across countries, these differences do not seem to mirror this underlying heterogeneity in institutions/parameters. Nevertheless, we could expect that the optimal (welfare maximizing) policies should reflect these differences. If this is the case, then it is unlikely that countries would agree on a common policy. In this section, we compute the (constrained) optimal unemployment insurance system individually for each country. We will show that there will be considerable heterogeneity in preferred replacement rates but that there will be full agreement on the duration of benefits.

More specifically, for each country i we ask the question: what is the optimal unilateral once-and-for-all change in $(\bar{b}^i, \mu^i)$? This analysis is done under the same atomistic country assumption as in the previous section, i.e. we assume that a single country does not affect the equilibrium interest rate when changing its unemployment benefit policy even though the savings decisions of its citizens change. This implies that the marginal product of capital and hence the capital-labour ratio is pinned down by the interest rate and as a consequence also wages are unaffected by the change in policy.

We assume that the government maximizes the utilitarian welfare of its citizens. Formally, the government in country i chooses a pair of policy parameters $(\bar{b}_1^i, \mu_1^i)$ with $\bar{b}_t^i = \bar{b}_1^i$ and $\mu_t^i = \mu_1^i$ for all $t \geq 1$ such that social welfare is maximized,[11]

$$\max_{(\bar{b}_1^i, \mu_1^i)} SW(\bar{b}_1^i, \mu_1^i) = \max_{(\bar{b}_1^i, \mu_1^i)} \sum_{x \in X} \sum_{z \in Z} \int_0^{\infty} V_0^i(a, z, x; \bar{b}_1^i, \mu_1^i) \zeta_0^i(a, z, x) da.$$

Thereby, individually optimal decision rules, firm production plans and taxes adjust such that all equilibrium conditions in Definition 1 are satisfied. Note that for each individual we compute the value in the initial period and therefore take into account the whole transitional dynamics to the new steady state.

In order to be able to interpret the welfare gains associated with the policy reform, we translate them into consumption equivalent variation. In particular, $\Delta^i(a, z, x)$ defines the per period percentage increase in consumption that would need to be given to an individual with initial state (a, z, x) when the benefit system is kept at the *status quo* such that he is indifferent between this *status quo* and the optimal reform. The aggregate welfare gain is then defined as

$$\Delta^i = \sum_{x \in X} \sum_{z \in Z} \int_0^{\infty} \Delta^i(a, z, x) \zeta^i(a, z, x) da.$$

Similarly, we define the aggregate welfare gain of the employed, unemployed eligible, unemployed non-eligible and inactive as

$$\Delta_x^i = \frac{\sum_{z \in Z} \int_0^{\infty} \Delta^i(a, z, x) \zeta^i(a, z, x) da}{\sum_{z \in Z} \int_0^{\infty} \zeta^i(a, z, x) da} \quad \text{for } x \in \{e, u^e, u^n, n\}.$$

Results. Table 6 shows the current benefit policy and the optimal reform in each country along with the taxes that finance this policy. For the optimal reform we report the new steady state taxes τ_{∞}^i. Note, however, that along the transition taxes vary in order to clear the government budget period by period.

[11] Here we add the policy parameters as arguments in the value function to make it explicit that the values depend on policy parameters.

Country	Status Quo			Optimal Reform			Δ
	$1/\mu_0^i$	$\bar{b}_0^i$	$\tau_0^i(\%)$	$1/\mu_1^i$	$\bar{b}_1^i$	$\tau_\infty^i(\%)$	
Austria	2	0.40	1.50	∞	0.10	0.42	0.41
Belgium	20	0.50	4.82	∞	0.15	0.47	1.85
Germany	4	0.42	1.07	∞	0.15	1.72	0.39
Estonia	4	0.50	3.22	∞	0.10	0.57	0.62
Spain	8	0.63	9.19	∞	0.20	3.50	1.05
Finland	8	0.55	5.99	∞	0.05	0.00	3.63
France	8	0.58	3.17	∞	0.35	2.99	0.73
Greece	4	0.58	4.91	∞	0.50	9.88	0.73
Ireland	4	0.48	2.99	∞	0.10	0.81	0.69
Italy	3	0.50	2.40	∞	0.30	5.15	0.67
Lithuania	2	0.34	1.18	∞	0.15	2.25	0.45
Luxembourg	4	0.82	2.64	∞	0.20	0.55	0.84
Latvia	3	0.56	4.04	∞	0.25	4.74	0.52
Malta	2	0.20	0.07	∞	0.40	2.50	0.46
Netherlands	4	0.75	2.59	∞	0.15	1.10	0.40
Portugal	6	0.65	10.34	∞	0.10	0.63	3.16
Slovenia	2	0.70	1.58	∞	0.30	2.81	0.69
Slovakia	2	0.47	1.60	∞	0.15	2.21	0.33

Table 6: Optimal National Reforms of the Benefit System

We see that despite the substantial heterogeneity in labour market institutions, optimal unemployment benefit policies are not so different from each other. In particular, in all countries an unlimited duration of eligibility is optimal. This policy eliminates the risk of not finding a job before losing eligibility. However, optimal replacement rates vary substantially between 5% and 50%[12]. In order to get more insights about these results, recall that our model features the usual insurance-incentive trade-off of transfer programmes. In particular, workers need insurance both for the income drop associated with job loss and for the contingency that they did not receive offers. At the same time, we need to provide them sufficient incentives to accept job offers instead of staying unemployed.[13] Note that both a higher replacement rate and longer duration provide more insurance and both reduce incentives to accept job offers. However, limiting the duration affects workers more on the margin which they cannot control (the probability of receiving offers), while reducing replacement rates affect them more on the margin which they can control (accepting or rejecting offers). Given

[12]Our optimization routine optimized over increments of 0.05 in the replacement rate dimension.

[13]There are two other potential moral hazard problems associated with unemployment insurance that are not present in our framework. The first is the issue of quitting and claiming unemployment benefits. In our environment, as in most European countries, quitters are not eligible for unemployment insurance. Second, in contrast to part of the literature (see e.g. Hopenhayn and Nicolini (1997)) search effort is observable in our environment. We motivate this assumption by the fact that unemployment agencies in all European countries devote significant resources to monitor the search effort of the unemployed.

this, it is not surprising that all countries would prefer an unlimited duration.

To understand better the differences between the welfare gains and the optimal levels of replacement rates across countries it is instructive to look at the welfare gains at a more disaggregated level. Table 7 shows the gains separately for agents in different labour market states. In line with the intuition above, we see that the eligible unemployed are the main beneficiaries in countries, which have a very short duration of benefit receipt in the *status quo* and relatively low arrival rates of job offers for the unemployed (Italy, Malta, Slovenia and Slovakia).

	Employed	Un. Eligible.	Un. Non-Elig.	Non-Active	Total
Austria	0.41	0.40	0.50	0.39	0.41
Belgium	2.07	0.11	1.38	1.67	1.85
Germany	0.36	1.91	0.56	0.29	0.39
Estonia	0.63	0.26	0.90	0.66	0.62
Spain	1.11	0.37	1.45	1.10	1.05
Finland	3.72	3.02	-	3.44	3.62
France	0.69	1.28	1.09	0.53	0.72
Greece	0.57	2.14	1.83	0.56	0.73
Ireland	0.69	0.42	1.16	0.64	0.69
Italy	0.53	2.07	2.10	0.54	0.67
Lithuania	0.38	1.27	0.99	0.36	0.45
Luxembourg	0.88	0.27	1.00	0.76	0.84
Latvia	0.40	1.12	1.32	0.52	0.52
Malta	0.31	7.42	2.65	0.57	0.46
Netherlands	0.40	0.11	0.65	0.36	0.40
Portugal	3.36	2.21	2.99	3.04	3.16
Slovenia	0.63	2.31	1.31	0.57	0.69
Slovakia	0.28	1.10	1.08	0.23	0.33

Table 7: Welfare gains in percent CEV.

It is also clear that the different levels of replacement rates combined with the different characteristics of labour markets imply large differences in the tax rates which finance the respective benefit systems (see table 6). For example, even though Luxembourg has the same optimal UI benefit system as Spain (unlimited duration, 20% replacement rate), its tax rate is less than one sixth of the Spanish tax rate (0.55% vs. 3.50%). Similarly, France provides more generous UI benefits than Italy, but its tax rate is lower. The reason for these are the structurally different labour market institutions. In particular, in section 4 we saw that in Spain the job separation rate is much higher and in Italy the job finding rates are much lower than in most other countries. These differences highlight that more generous UI systems make employment unattractive not only because the outside option (higher and/or longer duration of UI benefits) is improved, but also because taxes on the employed are higher, amplifying the incentive problem. This is another reason why in all countries (but Malta) the replacement rates are reduced. As a consequence, despite an extension of the duration of benefit receipt, in most countries taxes decline. Wherever the tax rate drops significantly (see for example Finland, Belgium and Portugal) the welfare gains are significant and highest among the employed.

The optimal level of the replacement rate is also affected by labour market parameters. In those countries where the job arrival rate λ_u^i is high, the reduction of replacement rates has lower costs to the unemployed (see Austria, Finland and Portugal for example). In contrast, in countries with lower job arrival rates, but where search has high benefits (i.e. $\lambda_u^i >> \lambda_n^i$) and the utility cost of search, γ^i, is relatively high, it is optimal to make sure that the unemployed keep searching and hence the replacement rates are higher (see for example Italy and France).

It may be surprising that in many countries non-eligible unemployed and inactive agents like the reform more than eligible unemployed. This is because these agents will earn wage income and pay lower taxes earlier than they will receive unemployment benefits. Remember that the only way to gain eligibility for benefits for these agents is by going through employment and being exogenously separated from the job.

Among all countries Finland has the lowest optimal replacement rate of only 5% (down from 55% in the *status quo*). The reason is that in Finland there is little benefit from incentivizing non-employed agents to search as the job arrival rate for the inactive is almost as high as the job arrival rate for the actively searching unemployed. Together with a considerable utility cost of search, the low replacement rate makes most non-employed agents in Finland stop searching. As a consequence there are basically no unemployment benefits to be paid in equilibrium and taxes can decrease to zero. We observe that the welfare gains in Finland are very high. The employed, who experience a tax decrease of six percentage points, gain about 3.7% in consumption equivalent terms. The gains for the non-employed are only slightly lower since non-employment spells are short due to high job arrival rates, and once employed these agents will experience the same tax cut.

Another interesting country is Germany, where unemployment duration is very long due to low job arrival rates and yet the original policy has a low duration of eligibility (four quarters). As a consequence, the eligible unemployed benefit the most from the reform, with a welfare gain of almost 2% in consumption equivalent terms, despite the fact that the replacement rate is reduced from 42% to only 15%. Furthermore, while the expenses of the government per eligible unemployed decrease by almost two thirds, the number of eligible unemployed increases so much due to the increase in duration of eligibility, that the total expenditures on UI benefits increase. As a consequence, the tax rate has to increase, dampening the welfare gains of all agents who are currently paying taxes (employed) or will pay taxes earlier than receive UI benefits (non-eligible unemployed and inactive).

7 A Proposal for a Constrained Efficient EUIS

In this section, we provide an answer to the question: can we find a harmonized European unemployment benefit system that is welfare improving in all countries of the euro area? Since the reform affects all the countries simultaneously, we compute the responses to the reform in general equilibrium[14].

We show that not only is it possible to find agreement on having benefits of unlimited duration, but also generalized agreement on a replacement rate of 10%. How much agreement is possible depends on how such a system is financed; in particular, there is majority support if the union payroll tax is harmonized (Subsection 7.1) and it is 'unanimous' - in the sense that utilitarian social welfare increases in every single country - if payroll taxes are experience based, as to eliminate cross-country transfers (Subsection 7.2). We take the latter as our benchmark proposal for a constrained efficient EUIS and we show how further welfare gains and more general support across the population within each country can be achieved by allowing countries to individually increase their replacement rates (Subsection 7.3); finally, we briefly discuss how it can be implemented together with an EUIS fund (Subsection 7.4).

7.1 Financing with a Common Tax Rate

Let us first consider jointly financed benefit systems. In this experiment, we replace individual countries' budget constraints with a common European one. Instead of I government budget constraints (equation (12)) which solve for I different tax rates, there is only one tax

[14] In particular, we solve for the path of interest rates that clears the total European capital market each period (See Definition 2). The assumption of the Eurozone as a closed economy is a simplification, since there are capital flows into and out of the Eurozone as a whole. Nevertheless, we found that the results under the other extreme assumption of the Eurozone as a small economy, are very similar. As we expect the truth to be somewhere between these two polar cases, our results should be robust to this assumption.

rate that clears the union budget constraint

$$\tau_t \sum_{i=1}^{I} n_t^i L_t^i = \bar{b} \sum_{i=1}^{I} n_t^i \sum_{z \in Z} z_t \int_0^{\infty} \zeta_t^i(a, z, u^e) da \quad \forall t \geq 1. \tag{14}$$

Note that both the tax rate and the replacement rate are independent of i but they may vary over time as we consider the joint transition of all countries to the new steady state.

It turns out that with this way of UI budget clearing the set of reforms that would achieve unanimous support across member states is empty. By contrast, we will show that when taxes are country specific in order to neutralize cross-country transfers, there are many combinations of replacement rate and duration which achieve welfare gains in every single country of the Eurozone. For reasons of comparability we pick one of these combinations, which we discuss in more detail in both sections. Specifically, we display the results for the benefit system with an unlimited duration of eligibility and a common replacement rate of 10%. This is the system which maximizes total utilitarian European social welfare when taxes are country specific. In table 8 we show the results when taxes instead satisfy equation (14).

Naturally, the net recipients of such a system are all beneficiaries of the reform. These countries are Germany (whose UI budget is almost balanced), Spain, Greece, Italy, Lithuania, Latvia and Slovakia. In terms of transfers Spain, which receives 0.37% of its GDP would be the biggest winner of such reform. It also has a very high welfare gain of almost 1.5% in consumption equivalent terms. However, one country, Portugal, has an even higher gain of almost 3% in consumption equivalent terms. Interestingly, this is the case even though Portugal is a net contributor into the system as it pays about 0.2% of its GDP. While it is the most extreme case of a country who is a net payer but gains from the reform, it is not the only one. The welfare gains in Austria, Belgium, Estonia, Finland, Ireland, Luxembourg, Netherlands, Portugal and Slovenia are positive even though these countries pay substantial transfers, between 0.1% and 0.6% of their respective GDP. This result can be understood when looking at the optimal national policies from the previous section. Most countries would prefer to reduce their replacement rate and consequently reduce the tax burden on the employed, especially if they can increase the duration of unemployment benefit eligibility. The welfare gains from this policy change are big enough to compensate for the transfers that the respective countries have to pay.

Overall, there are only two countries, France and Malta, that lose from the reform in terms of the average welfare gain. Both countries would be net payers into the system. France will oppose this reform because it already has a high duration of eligibility (8 quarters) and a high replacement rate (58%) at the *status quo*. Also its desired replacement rate (35%) is much higher than the 10% under the harmonized system. When the tax rate is harmonized, the reduction in taxes on the French employed is not big enough to compensate for the loss of benefits for the French unemployed. However, as we will see later, this conclusion changes once its tax rate can decrease further to eliminate the cross-country transfer. The same is true for Malta. Recall that Malta was the only country whose desired replacement rate (40%) was above the initial one (20%). If the tax rate is harmonized the reduction in taxes is not enough to compensate for the loss in benefits. Again, we will see that this changes once Malta can decrease taxes further such that it only finances the domestic unemployment benefit expenditures.

Country	Status Quo			Optimal Reform			Δ	Transfer/GDP
	$1/\mu_0^i$	$\bar{b}_0^i$	$\tau_0^i(\%)$	$1/\mu_1^i$	$\bar{b}_1^i$	$\tau_\infty^i(\%)$		
Austria	2	0.40	1.50	∞	0.10	0.92	0.03	-0.36
Belgium	20	0.50	4.82	∞	0.10	0.92	1.35	-0.49
Germany	4	0.42	1.07	∞	0.10	0.92	0.37	0.04
Estonia	4	0.50	3.22	∞	0.10	0.92	0.39	-0.25
Spain	8	0.63	9.19	∞	0.10	0.92	1.47	0.37
Finland	8	0.55	5.99	∞	0.10	0.92	2.87	-0.64
France	8	0.58	3.17	∞	0.10	0.92	-0.10	-0.14
Greece	4	0.58	4.91	∞	0.10	0.92	0.87	0.25
Ireland	4	0.48	2.99	∞	0.10	0.92	0.61	-0.08
Italy	3	0.50	2.40	∞	0.10	0.92	0.61	0.11
Lithuania	2	0.34	1.18	∞	0.10	0.92	0.64	0.33
Luxembourg	4	0.82	2.64	∞	0.10	0.92	0.27	-0.51
Latvia	3	0.56	4.04	∞	0.10	0.92	0.76	0.22
Malta	2	0.20	0.07	∞	0.10	0.92	-0.25	-0.38
Netherlands	4	0.75	2.59	∞	0.10	0.92	0.11	-0.19
Portugal	6	0.65	10.34	∞	0.10	0.92	2.99	-0.20
Slovenia	2	0.70	1.58	∞	0.10	0.92	0.12	-0.07
Slovakia	2	0.47	1.60	∞	0.10	0.92	0.50	0.28

Table 8: Harmonized Benefit System Financed With Common Tax Rate.

7.2 Financing with Country-Specific Tax Rates

Let us now consider the case of varying contribution payments across countries, which clear each country's government budget constraint separately. To be specific, in this experiment we require that condition (12) holds for each $i \in \{1, 2, ..., I\}$. Figure 9 depicts the set of combinations of replacement rates and expected duration that lead to an improvement in average welfare in every single country. This set has a few notable properties. First, all elements of the set are characterised by a very long duration of unemployment benefit eligibility of above 30 quarters. Second, there is a clear lower and upper limit in replacement rates given by 8 percent and 22 percent. The lower limit is determined by countries where lower replacement rates would hurt insurance significantly, while the upper limit is determined by countries where higher replacement rates will imply a very high tax burden on the employed. Third, there is some trade-off between the two instruments: decreasing the replacement rate requires increasing the duration of eligibility.

Also notice that the very same benefit system (unlimited duration, replacement rate of 10%) that we considered in the previous subsection is part of this set and hence welfare improving in all countries of the union. There are two reasons why we choose this particular combination for a deeper analysis. First, it delivers the highest gain if the objective is to maximize total - population weighted - utilitarian social welfare of the Eurozone[15]. Second, 10% is close to the lowest replacement rate that is acceptable for each country. Hence, once we allow countries to complement the EUIS with their own national top-ups (section 7.3), neither the countries who prefer more generous benefit systems, nor the countries for whom this low replacement rate is better in the first place (which will not desire to complement the EUIS) are harmed.

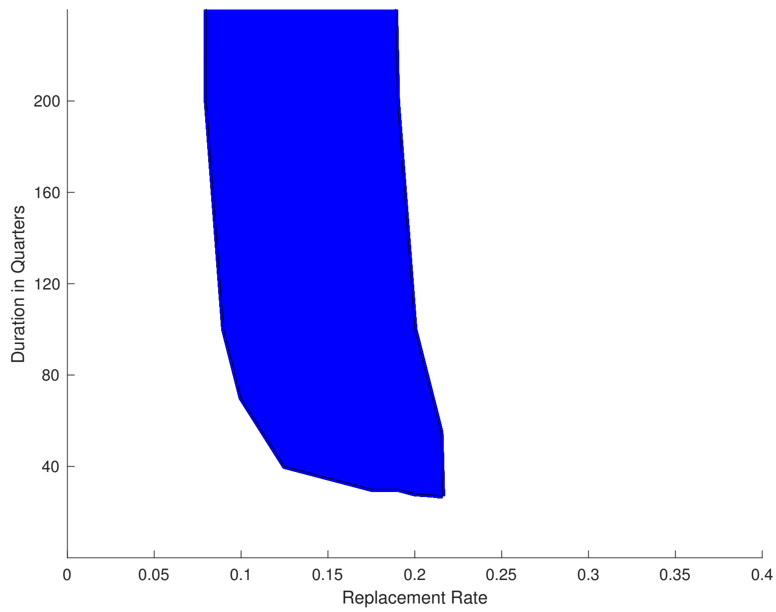

Figure 9: Set of welfare improving reforms.

[15]To be precise it does so when we optimize over a grid with 5% increments in the replacement rate dimension. The total European welfare gain with this policy reform is 0.62% CEV. It turned out that with a replacement rate of 12.5% the gain was slightly higher (0.66%).

Table 9 summarizes the results. In the previous subsection, we have seen that only two countries, France and Malta, have opposed this reform when a common tax rate (0.92%) cleared a European UI budget. Instead, with the country-specific taxes that eliminate cross-country transfers, France and Malta face smaller tax rates of 0.72% and 0.38%, respectively. This reduction makes the reform more attractive for them and overall leads to a (modest) welfare gain. Countries with high unemployment (like Greece and Spain) see significantly higher tax rates under this scenario than under harmonized taxes. However, these taxes are still much below the *status quo* taxes, resulting in reduced but still positive welfare gains.

Country	Status Quo			Optimal Reform			Δ
	$1/\mu_0^i$	$\overline{b}_0^i$	$\tau_0^i(\%)$	$1/\mu_1^i$	$\overline{b}_1^i$	$\tau_\infty^i(\%)$	
Austria	2	0.40	1.50	∞	0.10	0.41	0.42
Belgium	20	0.50	4.82	∞	0.10	0.21	1.85
Germany	4	0.42	1.07	∞	0.10	0.97	0.34
Estonia	4	0.50	3.22	∞	0.10	0.56	0.64
Spain	8	0.63	9.19	∞	0.10	1.46	0.96
Finland	8	0.55	5.99	∞	0.10	0.01	3.65
France	8	0.58	3.17	∞	0.10	0.72	0.05
Greece	4	0.58	4.91	∞	0.10	1.29	0.62
Ireland	4	0.48	2.99	∞	0.10	0.80	0.71
Italy	3	0.50	2.40	∞	0.10	1.08	0.55
Lithuania	2	0.34	1.18	∞	0.10	1.39	0.33
Luxembourg	4	0.82	2.64	∞	0.10	0.20	0.81
Latvia	3	0.56	4.04	∞	0.10	1.24	0.44
Malta	2	0.20	0.07	∞	0.10	0.38	0.20
Netherlands	4	0.75	2.59	∞	0.10	0.64	0.33
Portugal	6	0.65	10.34	∞	0.10	0.62	3.20
Slovenia	2	0.70	1.58	∞	0.10	0.82	0.23
Slovakia	2	0.47	1.60	∞	0.10	1.32	0.27

Table 9: Optimal Harmonized Benefit System Financed at the Country Level.

	Employed	Un. Eligible.	Un. Non-Elig.	Non-Active	Total
Austria	0.42	0.41	0.52	0.40	0.42
Belgium	2.13	-0.28	0.75	1.63	1.85
Germany	0.31	1.00	0.56	0.28	0.34
Estonia	0.65	0.28	0.92	0.67	0.64
Spain	1.14	-0.26	0.88	1.02	0.96
Finland	3.75	3.06	-	3.48	3.65
France	0.10	-0.95	0.10	0.11	0.05
Greece	0.66	0.14	0.74	0.56	0.62
Ireland	0.71	0.44	1.19	0.66	0.71
Italy	0.52	0.65	1.09	0.49	0.55
Lithuania	0.28	0.83	0.74	0.27	0.33
Luxembourg	0.89	-0.15	0.46	0.67	0.81
Latvia	0.42	0.26	0.83	0.48	0.44
Malta	0.16	2.35	0.93	0.22	0.20
Netherlands	0.34	-0.35	0.56	0.32	0.33
Portugal	3.41	2.26	3.05	3.09	3.20
Slovenia	0.21	0.48	0.50	0.20	0.23
Slovakia	0.22	0.65	0.84	0.21	0.27

Table 10: Welfare gains in percent CEV.

As before, the average welfare effects are not only heterogeneous across countries but also across different groups within each country. This is shown in table 10. We see that while the size varies, the sign is positive almost everywhere. In fact, only the unemployed eligible in Belgium, Spain, France, Luxembourg and Netherlands are against the reform. The reason is that the current benefit systems in those countries are rather generous. Belgium already has a rather high duration of eligibility in place together with a replacement rate of 50%. Spain and France currently have a duration of 8 quarters with a replacement rate of around 60%. Finally, Luxembourg and Netherlands have a duration of 4 quarters but very high replacement rates of about 80%. Those agents currently claiming these generous benefits are not happy when they are cut to 10%. In other countries, the cut in replacement rates is smaller and the negative direct effect of this cut is compensated by the increase in eligibility duration and by generally lower taxes that need to be paid once these agents find a job. In any case, as we will see in subsection 7.3, when national top-ups are available, the group of eligible unemployed will also agree to the reform (complemented with a national scheme) in each single country.

The reform induces only moderate effects on economic aggregates. Total European savings, and hence the capital stock, decreases slightly, by less than 1% over a time span of 40 years. Similarly, Figure A.7 in the Appendix shows that the total stocks of employed, unemployed and inactive agents in the Eurozone remain basically constant after the reform. As a consequence the capital-labour ratio and therefore equilibrium interest rates and wages are affected only slightly.

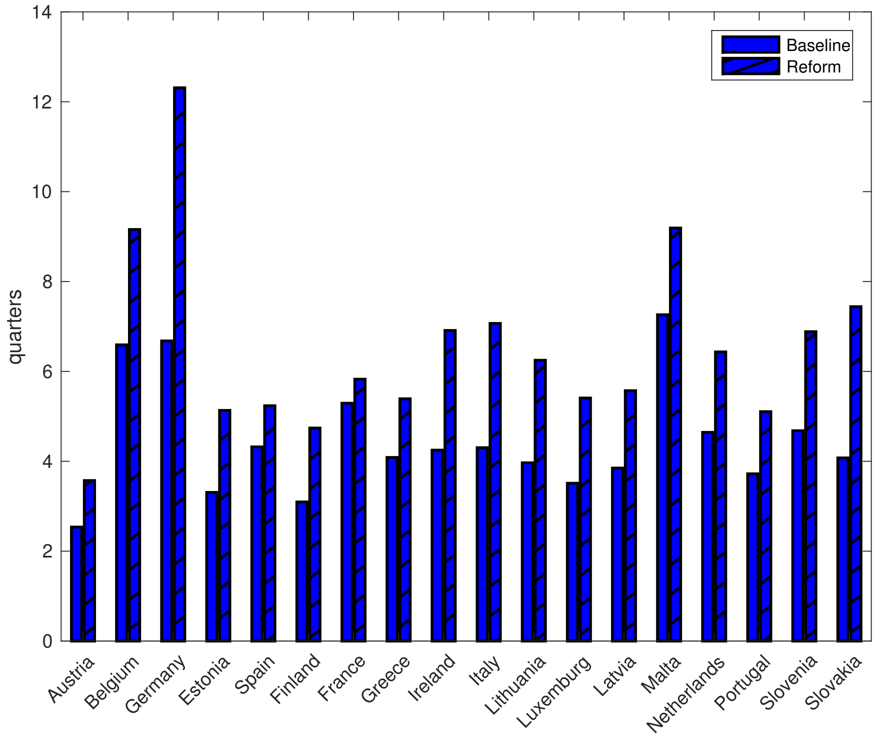

Figure 10: Unemployment duration before and after the reform.

What happens to the average duration of unemployment? In Figure 10 we see that it increases in every single country. This is due to two related reasons. First, as unlimited receipt of benefits eliminates the risk of losing eligibility, some unemployed workers who decided to accept job offers before the reform, now reject them. Second, workers who lost eligibility in the *status quo* often decided not to search actively and became inactive. Given unlimited eligibility these workers now keep searching to retain the eligibility of benefits.

7.3 Complementary National Benefits

The system proposed above would allow governments to complement the EUIS with additional, national, benefits. In this section we compute these optimal "top-ups" for each country separately. Specifically, for each country i, we compute the optimal increase of the national replacement rate $\tilde{b}^i$ and the corresponding tax rates to finance the increased UI expenditures $\tilde{\tau}^i$.[16]

[16]We do this analysis in partial equilibrium (Definition 1), assuming that the path of interest rates is fixed to the one implied by the EUIS system with 10% replacement rate and infinite duration, i.e. the one

Country	$\tilde{b}_0^i$	$\tilde{\tau}_0^i(\%)$	Δ	$\Delta + \tilde{\Delta}$
Austria	0.00	0.00	0.42	0.42
Belgium	0.05	0.26	1.85	1.86
Germany	0.05	0.75	0.34	0.39
Estonia	0.00	0.00	0.64	0.64
Spain	0.10	1.54	0.96	1.05
Finland	0.00	0.00	3.65	3.65
France	0.25	1.27	0.05	0.72
Greece	0.35	7.57	0.62	0.72
Ireland	0.00	0.00	0.71	0.71
Italy	0.20	4.07	0.55	0.67
Lithuania	0.05	0.86	0.33	0.44
Luxembourg	0.10	0.35	0.81	0.85
Latvia	0.15	3.23	0.44	0.51
Malta	0.30	2.12	0.20	0.46
Netherlands	0.05	0.51	0.33	0.36
Portugal	0.00	0.00	3.20	3.20
Slovenia	0.20	1.99	0.23	0.69
Slovakia	0.05	0.89	0.27	0.33

Table 11: Optimal National Top-Ups.

The results are summarized in table 11. The third column shows the welfare gains if only the basic EUIS was implemented, while the last column summarizes the gains if both, the EUIS and the optimal national top-ups, are in place. To have more intuition about these results we need to relate them to two sets of previous results. In table 6 we have the nationally optimal replacement rates. Obviously, for countries with high desirable replacement rates we expect significant top-ups (see for example France, Greece, Malta and Slovenia). At the same time, for countries where the individually desirable rate is close to 10 percent, we do not expect any benefit from complementing the EUIS (see Austria, Estonia, Finland, Ireland and Portugal)[17]. The second aspect can be seen by comparing table 10 with table 12, which shows the welfare gains for all labour market groups when optimal national top-ups are in place. We noticed before that, without national complementary insurance, in some countries the eligible unemployed would oppose the reform because they would suffer significant cuts in unemployment benefits. For all these countries (Belgium, France, Luxembourg, Netherlands and Spain), the government will optimally introduce top-ups to remedy this issue and the

computed in the previous subsection.

[17]Neither would these countries benefit from reducing the 10% replacement rate of the EUIS, if they were able to. For them, 10% replacement rate is optimal (at least with increments of 5% in the replacement rate dimension). Note that this is true even for Finland, which had an optimal national replacement rate of 5%. It turned out that once prices adjust after the EUIS is introduced, also Finland (slightly) prefers a replacement rate of 10% over 5%.

eligible unemployed will experience (very significant) welfare gains.

However, there are only three countries - France, Malta and Slovenia - where the additional welfare gains due to national top-up are significant (above 0.2% CEV) for the entire population. In all these countries the individually optimal replacement rate is high and at the same time, the tax increase to finance the top-up is not large. By contrast, in the case of Greece the large top-up indeed improves the welfare of the eligible unemployed substantially, but at the same time the increase in taxation of more than 7.5 percentage points reduces the welfare gains of the employed considerably. Hence the overall gain from the top-up is small.

The harmonised EUIS system with country-specific contribution payments and national top-ups can have many attractive features. Country specific contributions not only prevent cross-country transfers. They also provide a nice diagnostic test (experience rating) to evaluate labour market institutions in a given country. The common (minimal) policy would foster agreement and help to reform the national systems. Finally, the national top-ups allow flexibility to build stronger support within a given country and address differences across labour market characteristics. When we compare the welfare gains in table 11 with those associated with more risk sharing in table 4, we see that the welfare gains from jointly reforming the national unemployment systems are significantly larger than the welfare gains from risk sharing. Nevertheless, a successful EUIS should incorporate also the risk-sharing feature. Some basic ideas of implementation are discussed below.

	Employed	Un. Eligible.	Un. Non-Elig.	Non-Active	Total
Austria	0.42	0.41	0.52	0.40	0.42
Belgium	2.08	0.12	1.40	1.67	1.86
Germany	0.36	1.91	0.57	0.29	0.39
Estonia	0.65	0.28	0.92	0.67	0.64
Spain	1.11	0.37	1.46	1.10	1.05
Finland	3.75	3.06	-	3.48	3.65
France	0.69	1.27	1.09	0.52	0.72
Greece	0.57	1.92	1.78	0.55	0.72
Ireland	0.71	0.44	1.19	0.66	0.71
Italy	0.52	2.06	2.10	0.53	0.67
Lithuania	0.38	1.27	0.99	0.36	0.44
Luxembourg	0.88	0.28	1.01	0.76	0.85
Latvia	0.39	1.12	1.31	0.51	0.51
Malta	0.31	7.42	2.65	0.56	0.46
Netherlands	0.37	0.09	0.61	0.30	0.36
Portugal	3.41	2.26	3.05	3.09	3.20
Slovenia	0.62	2.31	1.31	0.56	0.69
Slovakia	0.27	1.10	1.09	0.23	0.33

Table 12: Welfare gains in (% CEV) with national top-ups.

7.4 Implementation

Although it is not the focus of this paper, we briefly consider how this EUIS proposal with a built-in risk-sharing function could be implemented. The basic idea is that it can be implemented through the existing national unemployment insurance systems. For this reason, we have only considered the common form of unemployment benefits defined by their 'replacement rate and duration'. If the national funds had enough borrowing capacity to provide the unemployment benefits without increasing the taxes in times of crisis, and enough commitment to properly accumulate funds in normal and good times, the EUIS would only require policy commitment to implement the policy through country specific EUIS funds. The fact that our proposal results in lower payroll taxes for all euro area countries makes this implementation easier. Nevertheless, the existence of a centralized euro area EUIS fund may facilitate the task of smoothing taxes, without ever having to use sovereign debt, even in severe country recessions, either because (not fully correlated) risks can be shared across the euro area, or because a centralised EUIS fund has more capacity to borrow from international markets than separate national EUIS funds. Furthermore, the establishment of a proper EUIS, with the centralised fund at its core is an institutional commitment to implement the common EUIS policy, which is a counter-cyclical stabilization policy.

The EUIS central fund can be hosted in the *European Stability Fund*[18] which would have contracts with participating countries stipulating countercyclical (unemployment) transfers between the national funds and the central fund. These contracts have three main features: *i*) they are based on country-risk assessments (an improved version of our calibration) to determine countries' stationary payroll tax rates and unemployment rates, and these assessments are periodically revised; *ii*) the national information regarding the costs of providing unemployment benefits and revenues from the corresponding payroll taxes is shared with the fund; *iii*) setting thresholds beyond which fluctuations of funds (revenues - costs) are absorbed by the central fund, guaranteeing that, with respect to every country contract, the fund breaks even in expectation.

While the design is thought as a euro area, or EU, system it can also be implemented with a subset of countries. Similarly, the specific implementation of the last two features can take different forms. A coherent design of an EUIS for the euro area would be to have an integrated EUIS in which the national funds become 'delegated' funds of the central fund and information is shared, and transfers are executed, in a similar fashion as done between the European System of Central Banks and the ECB. In this case, the central fund would absorb all fluctuations corresponding to the common minimal replacement rate. A more decentralised – possibly, transitional – design would be to have the central fund only absorbing extreme fluctuations. In this version, the contract can be a simple insurance contract, where above certain unemployment rate threshold, there is a fixed transfer from the central fund to the national unemployment funds (not to the governments for general purposes[19]), which is compensated in expected terms by a reverse transfer in normal times where the unemployment rate is below the threshold (i.e. a 'rainy day ' fund), but it can also be a more efficient contract by having more conditional transfers (e.g. the national fund transferring more funds in years where their net position is better), which would enhance the stabilization feature of the EUIS.

8 Conclusions

This paper is aimed at assessing the value of a European Unemployment Insurance System (EUIS) and, in particular, how it should be designed to deliver a Pareto improvement com-

[18]In the current setup, in the European Stability Mechanism. See the ESF ADEMU proposal (Chs. 2 and 12) in Marimon and Cooley (2018), based on the characterization of constrained efficient ESF contracts by Ábrahám et al. (2018).

[19]See the comment on Ignaszak et al. (2018) in Section 2.

pared to the current national systems. We take as a constraint the current labour market institutions which determine differences in job destruction and the likelihood of receiving job offers by the unemployed (searching for a job) and the inactive (not actively searching), we also limit the scope of unemployment insurance contracts to contracts defined by their coverage duration and their replacement rate. Our work provides a quantitative proof of the potential gains that market reforms – not just labour market reforms – can achieve in many European countries. In fact, the first contribution of this paper is to provide a novel diagnosis of European labour markets. The second, which is almost a corollary of the first, is to show quantitatively that country-specific structural parameters play a determinant role in explaining the different performances of labour markets across the EU.

Based on this calibration we perform a set of policy experiments. We show that the gains from pure risk-sharing (i.e. absent UI reforms) are limited but that substantial welfare gains can be achieved by reforming the existing UI systems within European countries. Even if, as we document, labour markets are very different, almost surprisingly the (parameterised) UI systems that maximise welfare are similar: unemployment benefits duration should be unlimited and replacement rates more similar across countries than how they are now. It should be noted that in our calibrated economies there are no 'minimum income' programmes that could partially absorb the risk of exhausting unemployment benefits, nor we consider the possibility of having unlimited duration with decreasing replacement rates. Nevertheless, these seem, at most, minor variations on our approach.

A harmonized benefit system with an unlimited duration and a replacement rate of 10% is welfare improving in all countries, when it is financed by country specific contribution payments. The welfare gains are large for most countries, almost unanimous within countries and, in fact, unanimous within countries if countries can top-up their replacement rates. Furthermore, these Pareto welfare improvements do not account for the risk-sharing gains that countries would have if, in addition to agents' idiosyncratic risk we also had aggregate country risks. That is, we require that each country runs a balanced budget, thereby eliminating permanent cross-country transfers. With country risks and no aggregate European risk, at the steady-state country-specific constant taxes would also provide risk-sharing, with short-run cross-country transfers across the EUIS, possibly with the support of a centralized fund as we discuss in the last section. Even with European aggregate risk the EUIS would play a major stabilising role: taxes would not be constant, unless the fund has borrowing capacity, but still provide risk-sharing across countries and agents; in fact, the EUIS central fund should have more borrowing capacity than the country funds. In any case, the resulting tax differences across countries reflect their structural labour market differences, in terms of job creation and destruction. These tax differences also provide clear incentives for labour market reforms.

In sum, by increasing welfare across European citizens the proposed EUIS can also be an important cohesive EU institution. There would be no need to wait for European labour markets to converge to implement the EUIS. In fact, it can promote national labour market reforms and European labour market integration.

References

Abdulkadiroğlu, A., B. Kuruşçu and A. Şahin (2002): Unemployment Insurance and the Role of Self-Insurance, *Review of Economic Dynamics (5)*, 681–703.

Ábrahám, A., E. Carceles-Poveda, Y. Liu and R. Marimon (2018): On the optimal design of a Financial Stability Fund, ADEMU Working Paper No. 2018/105.

Beblavy, M. and K. Lenaerts (2017): Feasibility and Added Value of a European Unemployment Benefits Scheme, CEPS Special Report.

Böwer, U. and G. Catherine (2006): Determinants of Business Cycle Synchronization across Euro Area Countries, ECB Working Paper No. 587.

Claveres, G. and M. Clemens (2017): Unemployment Insurance Union, Working Paper.

Dolls, M., C. Fuest, D. Neumann and A. Peichl (2015): An Unemployment Insurance Scheme for the Euro Area? A Comparison of Different Alternatives Using Micro Data, CESifo Working Paper No. 5581.

Dullien, S., J. Fernandez, M. López, G. Maass, D. del Prado and J. von Weizsäcker (2018): Fit for Purpose: German-Spanish proposal for a robust European Unemployment Insurance.

Esser, I., T. Ferrarini, K. Nelson, J. Palme and O. Sjöberg (2013): Unemployment Benefits in EU Member States, Technical report, Directorate-General for Employment, Social Affairs and Inclusion, EC.

Giannone, D., M. Lenza and L. Reichlin (2009): Business Cycles in the Euro Area, ECB Working Paper No. 1010.

Hopenhayn, H. and J. P. Nicolini (1997): Optimal Unemployment Insurance, *Journal of Politcal Economy 105 (2)*, 412–438.

Ignaszak, M., P. Jung and K. Kuester (2018): Federal Unemployment Insurance: Theory, and an Application to Europe, Working Paper.

Krusell, P., T. Mukoyama, R. Rogerson and A. Şahin (2011): A Three State Model of Worker Flows in General Equilibrium, *Journal of Economic Theory* 146, 1107–1133.

Krusell, P., T. Mukoyama, R. Rogerson and A. Şahin (2017): Gross Worker Flows over the Business Cycle, *American Economic Review (11)*, 3447–3476.

Lalé, E. and L. Tarasonis (2017): The Life-cycle Profile of Worker Flows in Europe, Working Paper.

Lenarčič, A. and K. Kari (2018): A Case for a European Rainy Day Fund, ESM Discussion Paper/5.

Marimon, R. and T. Cooley (Ed.) (2018): *The EMU after the Euro Crisis: Lessons and Possibilities - Findings and Proposals from the Horizon 2020 ADEMU Project.*

Moyen, S., N. Stähler and F. Winkler (2016): Optimal Unemployment Insurance and International Risk Sharing, Deutsche Bundesbank Discussion Paper No 33/2016.

Saiki, A. and S. H. Kim (2014): Business Cycle Synchronization and Vertical Trade Integration: A Case Study of the Eurozone and East Asia, DNB Working Paper No. 407.

Shimer, R. and I. Werning (2008): Liquidity and Insurance for the Unemployed, *American Economic Review 5 (98)*, 1922–1942.

A Appendix

A.1 Transition Function

The transition function $T_t^i((a,z,x);\mathcal{A}\times\mathcal{Z}\times\mathcal{X})$ describes the probability that an agent, who is in state (a,z,x) in period t, is in any state $\{(a',z',x') : a' \in \mathcal{A}, z' \in \mathcal{Z}, x' \in \mathcal{X}\}$ in period $t+1$. This function is quite involved as it captures exogenous shocks and endogenous decisions of the agent. Next period's assets $a'(a,z,x)$ are purely endogenous as they are chosen from the agent in period t and not subject to any shock. Next period's productivity level z' is purely exogenous and depends on the Markov transition probabilities. Next period's employment state $x' \in \{e, u^e, u^n, n\}$ depends on a combination of exogenous shocks (job separation, job finding) and endogenous decisions (work, search), which in turn depend on assets and individual productivity.

We can write the transition function as

$$
\begin{aligned}
&T_t((a,z,x);\mathcal{A}\times\mathcal{Z}\times\mathcal{X}) = \\
&\mathbb{1}_{a^i_{t+1}(a,z,x)\in\mathcal{A}} \cdot \sum_{z'\in\mathcal{Z}} p(z'|z)\Big\{\mathbb{1}_{e\in\mathcal{X}} \cdot xe\big(a^i_{t+1}(a,z,x),z'\big) + \mathbb{1}_{u^e\in\mathcal{X}} \cdot xu^e\big(a^i_{t+1}(a,z,x),z'\big) + \\
&\qquad\qquad \mathbb{1}_{u^n\in\mathcal{X}} \cdot xu^n\big(a^i_{t+1}(a,z,x),z'\big) + \mathbb{1}_{n\in\mathcal{X}} \cdot xn\big(a^i_{t+1}(a,z,x),z'\big)\Big\},
\end{aligned}
$$

where $xe\big(a^i_{t+1}(a,z,x),z'\big)$ describes the probability of moving from labour market state $x \in \{e, u^e, u^n, n\}$ into employment, conditional on saving $a^i_{t+1}(a,z,x)$ and on drawing productivity shock z'. Similarly, $xu^e(.)$ is the conditional probability of moving into unemployment and being eligible for benefits, and so on.

It is useful to define the decision to search for a job next period, conditional on being not eligible for unemployment benefits by

$$
s_{t+1}(a',z',0) = \begin{Bmatrix} 1 & \text{if arg} \max\limits_{x'\in\{u^n,n\}} V^i_{t+1}(a',z',x') = u^n \\ 0 & \text{else} \end{Bmatrix}
$$

and the decision to search for a job conditional on being eligible for unemployment benefits by

$$
s(_{t+1}a',z',1) = \begin{Bmatrix} 1 & \text{if arg} \max\limits_{x'\in\{u^e,n\}} V^i_{t+1}(a',z',x') = u^e \\ 0 & \text{else} \end{Bmatrix}
$$

Similarly, define the decision to work next period, conditional on being not eligible for unemployment benefits by

$$w_{t+1}(a', z', 0) = \begin{cases} 1 & \text{if } \arg \max_{x' \in \{,e,u^n,n\}} V^i_{t+1}(a', z', x') = e \\ 0 & \text{else} \end{cases}$$

and the decision to work conditional on being eligible for unemployment benefits by

$$w_{t+1}(a', z', 1) = \begin{cases} 1 & \text{if } \arg \max_{x' \in \{,e,u^e,n\}} V^i_{t+1}(a', z', x') = e \\ 0 & \text{else} \end{cases}$$

The conditional transition probability from employment into employment is then given by

$$ee\big(a^i_{t+1}(a, z, x), z'\big) = (1 - \sigma^i) w^i_{t+1}(a^i_{t+1}(a, z, e), z', 0) + \sigma^i \lambda^i_u w^i_{t+1}(a^i_{t+1}(a, z, e), z', 1).$$

There are two possibilities how an agent, who is employed in period t, is also employed in $t+1$: (i) the agent does not get separated, which happens with probability $1 - \sigma^i$ and does not quit his job, which is the case if the work decision $w^i_{t+1}(a^i_{t+1}(a, z, e), z', 0) = 1$. Since job quitters are not eligible for benefits the last entry of the work decision is zero; (ii) the agent gets separated from his job (with probability σ^i) but immediately finds a new job (with probability λ^i_u) and decides to work. In case of exogenous separation the agent would be eligible for unemployment benefits, therefore the last entry in the work decision is equal to one. One can observe that this conditional probability is a mixture of exogenous probabilities and endogenous decisions.

Similarly, we can define the other conditional probabilities: The probability of moving from employment to unemployment and being eligible for benefits is

$$eu^e\big(a^i_{t+1}(a, z, x), z'\big) = \sigma^i s^i_{t+1}(a^i_{t+1}(a, z, e), z', 1) \Big[(1 - \lambda^i_u) + \lambda^i_u \big(1 - w^i_{t+1}(a^i_{t+1}(a, z, e), z', 1)\big)\Big].$$

Eligibility next period requires that the worker is exogenously separated, which happens with probability σ^i and that the agent is actively searching for a job, i.e. $s^i_{t+1}(.) = 1$. There are again two possibilities to be unemployed next period: (i) With probability $1 - \lambda^i_u$ the agent does not immediately find a new job (ii) with probability λ^i_u the agent immediately finds a new job but he decides not to accept the offer ($w^i_t(.) = 0$).

The conditional probability of moving from employment into unemployment and being not eligible for benefits is equal to the probability of not being separated (once you are separated you are automatically eligible for benefits), given that the agent decides to quit $w(.) = 0$ and to search for a new job $s(.) = 1$:

$$eu^n\big(a^i_{t+1}(a,z,x),z'\big) = (1-\sigma^i)\big(1-w^i_{t+1}(a^i_{t+1}(a,z,e),z',0)\big)s^i_{t+1}(a'(a,z,e),z',0).$$

Finally, the conditional probability of moving from employment into inactivity is given by

$$\begin{aligned} eu^n\big(a^i_{t+1}(a,z,x),z'\big) = (1-\sigma^i)\big(1-w^i_{t+1}(a^i_{t+1}(a,z,e),z',0)\big)\big(1-s^i_{t+1}(a^i_{t+1}(a,z,e),z',0)\big)+ \\ \sigma^i\Bigg(1-\lambda^i_u+\lambda^i_u\big(1-w^i_{t+1}(a^i_{t+1}(a,z,e),z',1)\big)\Bigg)\big(1-s^i_{t+1}(a^i_{t+1}(a,z,e),z',1)\big). \end{aligned}$$

The agent can become inactive either if he does not get exogenously separated but decides to quit working and searching (first line) or if he gets separated and does not search for a new job (second line).

We now described all the possible cases for an agent who is employed in period t, i.e. $x_t = e$. In an analogous way this can be done for all other initial labour market states, i.e. for $x_t \in \{u^e, u^n, n\}$.

A.2 Figures

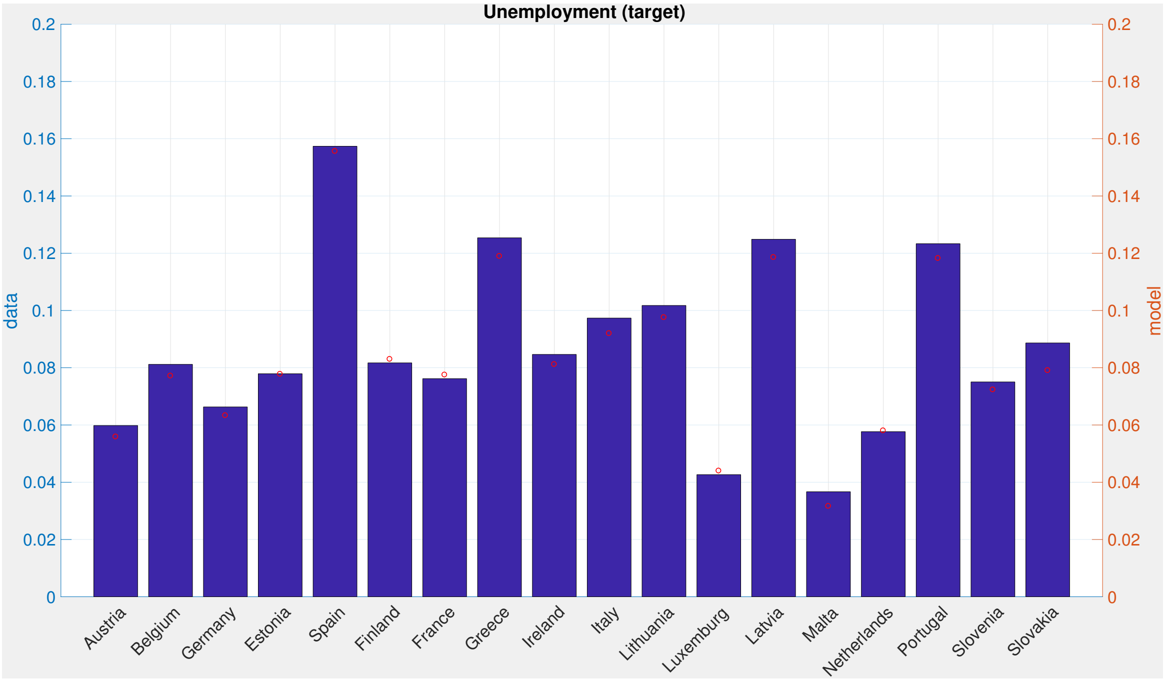

Figure A.1: Unemployment.

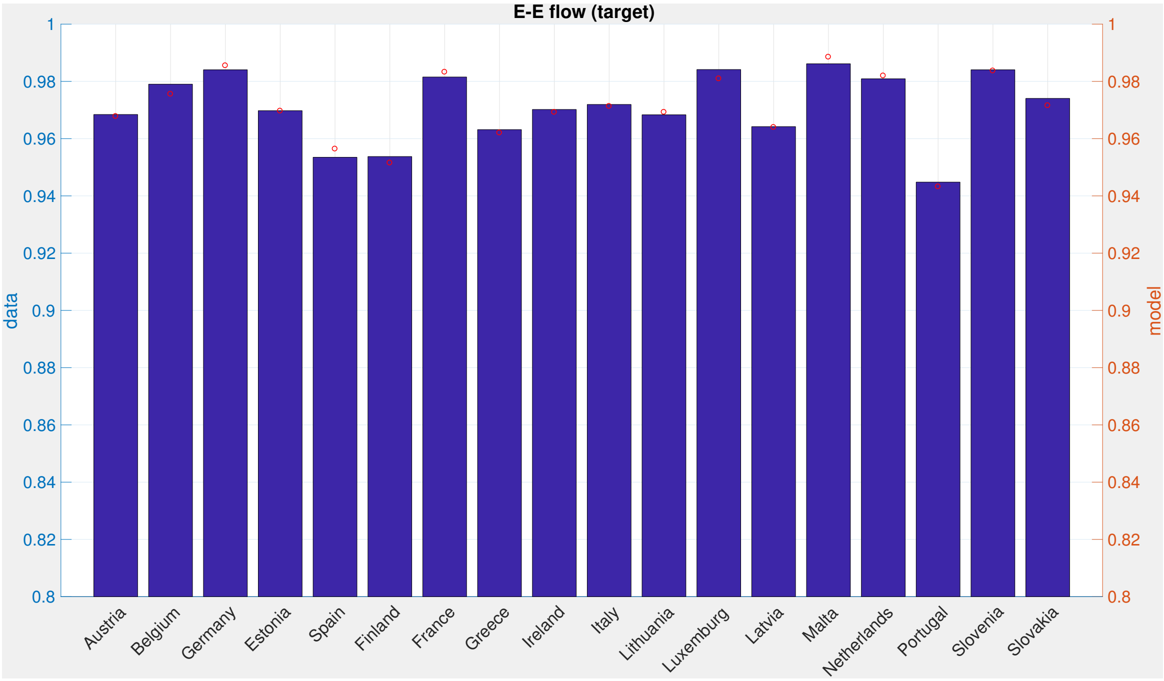

Figure A.2: Employment-Employment Flows.

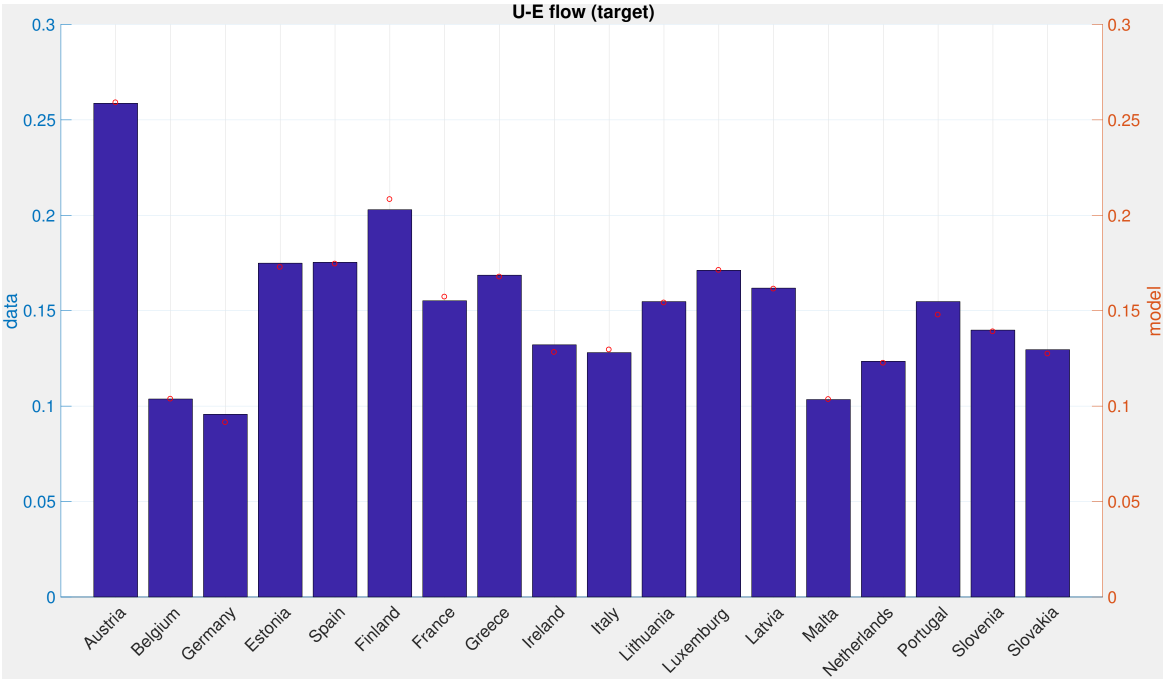

Figure A.3: Unemployment-Employment Flows.

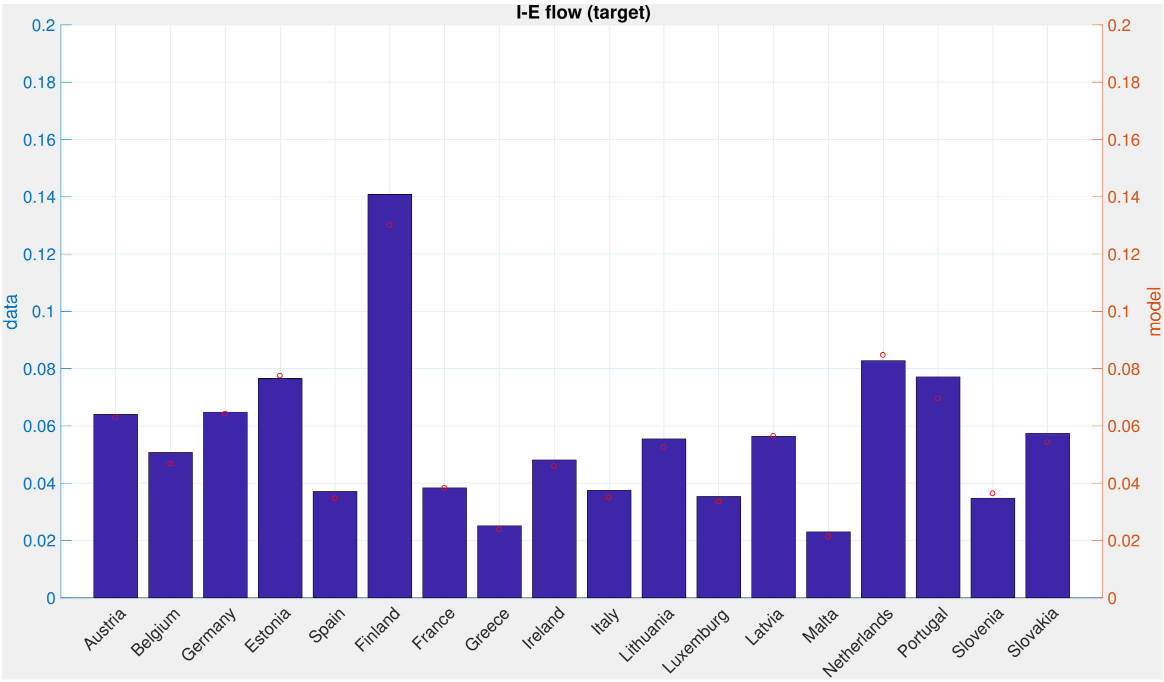

Figure A.4: Inactivity-Employment Flows.

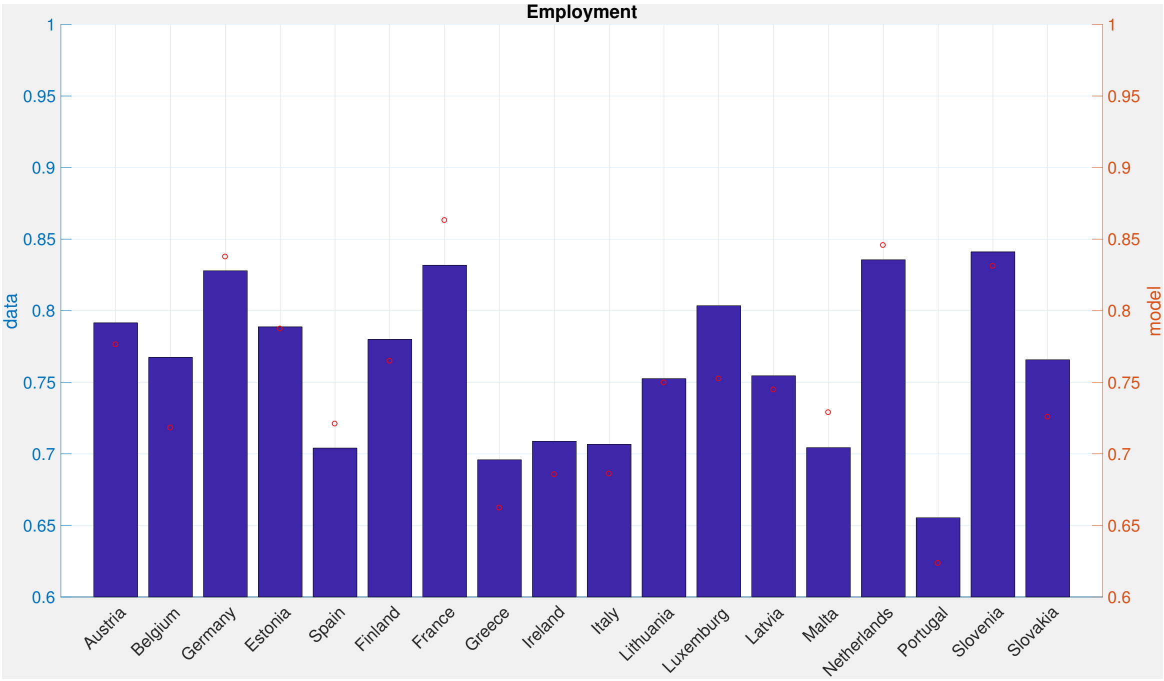

Figure A.5: Employment.

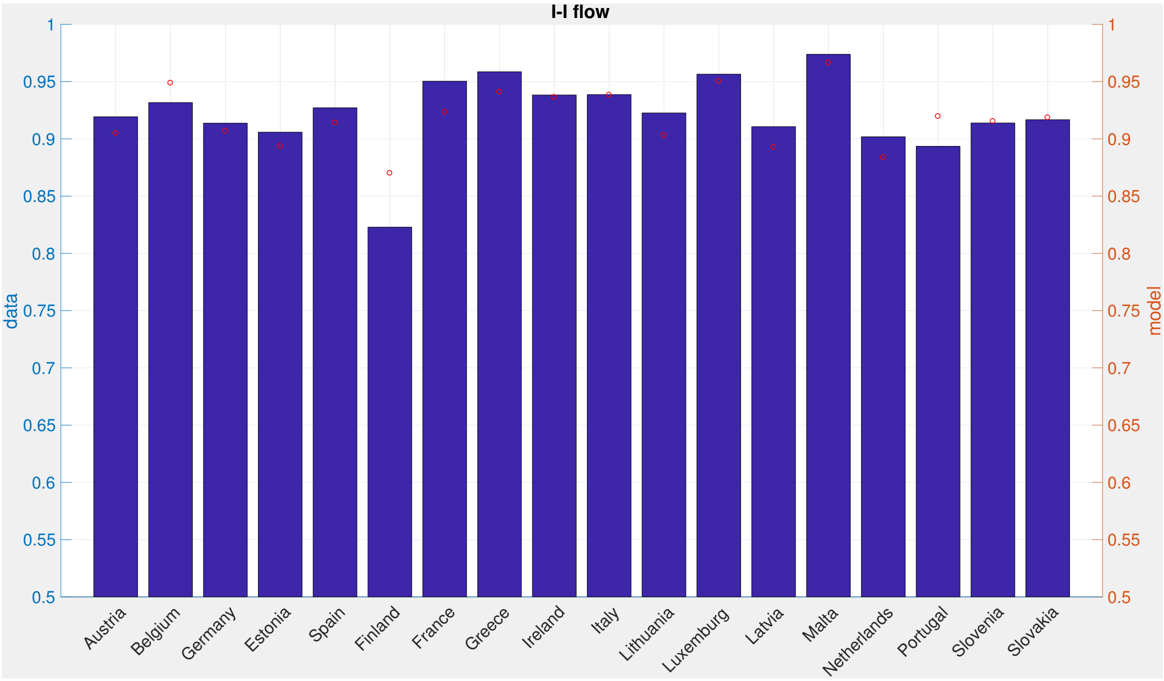

Figure A.6: Inactivity to Inactivity Flows.

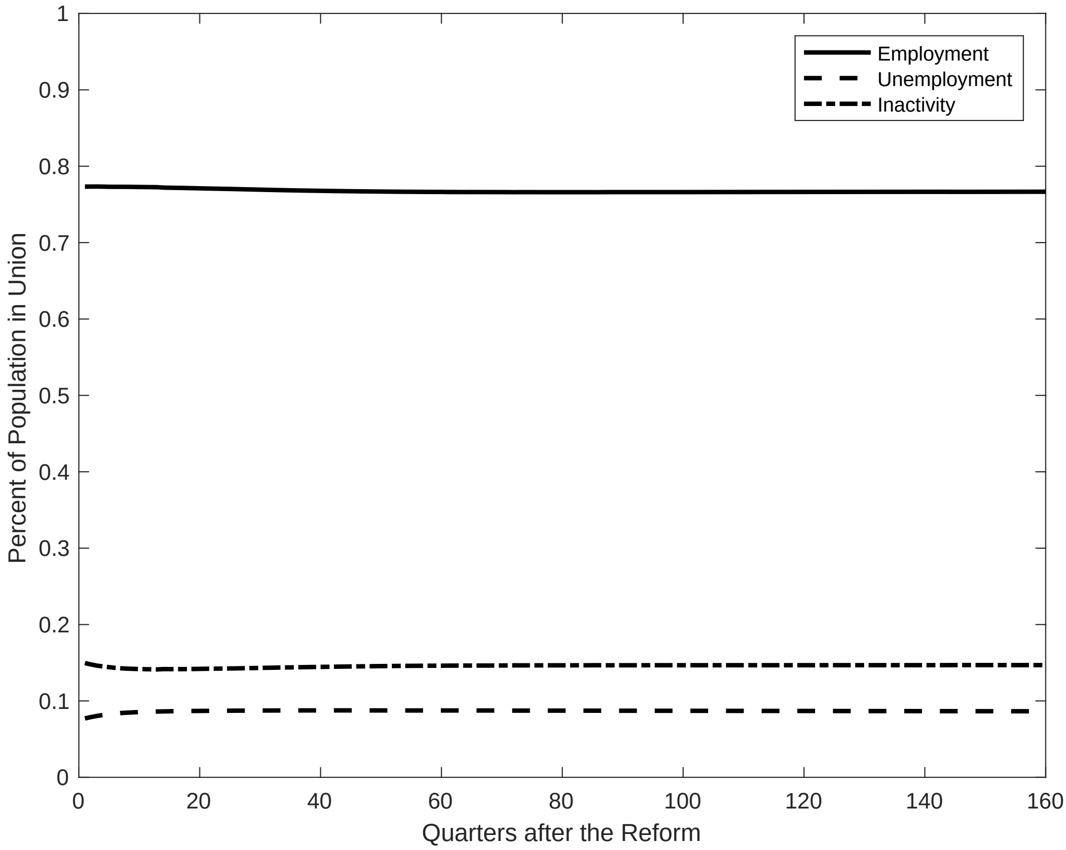

Figure A.7: Aggregate Labour Market States with Harmonized UI Benefit System.