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Should unemployment insurance be centralized in a state union?

by

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2019
Should unemployment insurance be centralized in a state union?
Unearthing a principle of efficient federation building∗

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Abstract

Our study compares the efficiency of centralized and decentralized unemployment insurance programs in a state union. We use a model of two countries with collective bargaining for regional gross wages. The labor force and the firms are partially mobile across the member states of the state union, which gives rise to distortive migration incentives. If unemployment insurance is organized centrally, trade unions negotiate inefficiently high wages due to a vertical fiscal externality. The central government generally cannot provide the second-best unemployment insurance as long as migration is costly. In contrast, decentralized unemployment insurance in the member states is second-best irrespective of the degree of mobility and regional asymmetries. Furthermore, efficiency depends on the federal context. If the wage bargaining process on the labor markets is decentralized, then decisions about unemployment insurance made at the state level are superior to centralized public insurance. For the efficiency of a centralized unemployment insurance, it matters whether decisions in related institutions like cooperative wage bargaining are also centralized.

Keywords: unemployment insurance, imperfect labor markets, federal state union, centralization, migration, vertical fiscal externality

JEL codes: F22, F66, H77, J65

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1 Introduction

Should the social security systems of member states be centralized in a state union or remain in the single country’s competence? In the European Union, the concept of a centralized European unemployment insurance system has often been proposed and discussed (Beblavý and Lenaerts, 2017, Andor et al., 2014). Recently, the French prime minister argued in favor of a common European unemployment insurance in order to redistribute resources from more economically successful countries to less successful ones. Typically, this debate deals with the stabilizing function of a common unemployment insurance program, where centralization serves as mutual interstate insurance against asymmetric economic shocks on the labor markets of individual member states. However, another perspective on such centralization is the allocational effects on migration and the labor market, and the optimality of unemployment insurance.

In this paper we compare the efficiency of a centrally organized unemployment insurance program at the state union’s level with the decentralized organization of individual countries. In the model, two countries form a state union. In both countries, labor markets are governed by collective bargaining between trade unions and firms to set the rate of gross wages. An individual within the labor force can be employed or unemployed with a probability expressed by the relation of the number of workers or unemployed to the total size of the labor force (Harris and Todaro, 1970). The labor force is insured against unemployment through a public insurance system. Under both types of unemployment insurance, decentralized or centralized, the government determines the contribution rate of wages in order to finance the insurance budget. The labor force as well as the firms in both countries may travel across state lines. The cost of migration is reflected in the shares of both groups’ mobility.

Our benchmark for the efficiency of governmental behavior is a second-best scenario where the social planner faces collective bargaining on the labor market and has to take account of wages negotiated by trade unions and firms. This constrained social planner sets the contribution rate such that workers are fully insured against unemployment. The result arises from the full alignment of the planner’s objectives and those of the parties involved in wage bargaining.

Having defined this second-best allocation as a benchmark, we study the decentralized organization of public unemployment insurance programs. Again, trade unions and firms in each state determine the local wage through collective bargaining. The local government chooses the parameters of unemployment insurance, taking account of negotiated gross wages. In this regime, the migration of individuals and relocation of firms affects the agreed-upon wage chosen by collective bargaining in each state and the decision of the local government regarding unemployment insurance. Distortive relocation and migration incentives arise, and their severity depends on the cost of migration. In this decentralized regime we obtain the following results.

The contribution rate of the government is second-best irrespective of firms’ and workers’ mobility costs. The government provides full unemployment insurance, because the effects of migration at the governmental and the labor market level provide the same incentives. Furthermore, if regions are symmetric and both groups, the labor force and the firms, have the same degree of mobility then relocation and migration incentives outweigh each other, and the wages are also second-best. If mobility differs between workers and firms, whichever is more immobile causes a relatively less severe externality and is therefore favored in wage bargaining. For example, if the labor force is more immobile, the negotiated wages will be higher than the second-best wages. However, this does not affect
the efficiency of unemployment insurance, where the contribution rate is second-best with symmetric as well as asymmetric states.

Next we analyze the centralized organization of unemployment insurance at the state union level. A central government determines the common insurance for all states. The individuals of both states pay contributions into a common budget of unemployment insurance. The unemployment benefit is the same for all unemployed individuals in the state union. However, trade unions and the firms still negotiate the wage separately for each state. For symmetric regions, we find the following results.

At the level of regional wage negotiations, government decisions about unemployment insurance no longer induce labor force migration. However, there are effects on migration due to different net wages and employment levels in the states. For firms, similar relocation incentives occur as in the decentralized case. Furthermore, due to the common budget, trade unions are able to externalize part of their cost from negotiating a higher wage level. However, the vertical fiscal externality and the migration effect may force the wage level into opposite direction. The migration effect partially crowds out the negative vertical externality. In general, the wages negotiated are too high. While the vertical fiscal externality operates independent of mobility, the compensating migration effect increases with mobility. With perfect mobility the latter effect outweighs the former and wages are second-best. Only in this special case of full mobility of firms and labor force does the centralized contribution rate approach the second-best level. Otherwise, centralized unemployment insurance is generically inefficient.

Governmental behavior in both scenarios essentially hinges on our assumption of imperfect labor markets. A change in the contribution rate affects the negotiated gross wage. This factor is essential for all results and serves as an important difference to interregional models with mobile workers in integrated perfect labor markets (see Wildasin, 1991, Kolmar, 1999, Wellisch, 2000 for similar questions about the optimal allocation of redistributive governmental functions in a federal setting).

Another important finding is that the inefficiency of centralized unemployment insurance depends on the degree of centralization of the wage bargaining process within the state union. The vertical fiscal externality which distorts the central government’s decision about unemployment insurance, even in the case of symmetric states, arises only if wage negotiations are decentralized in the states. If the labor markets were integrated, in the sense of implementing a centralized wage bargaining process, a centralized unemployment insurance program could also be efficient. This gives rise to the consideration of a more general question regarding institution building within a federal system of states. One principle of efficient implementation of institutions in a federation could be the following: institutions connected by a common federal budget should be regulated at the same federal level.

The paper proceeds as follows: section 2 reviews the relevant literature; section 3 introduces the model; section 4 determines the social optima in the first-best and second-best cases; section 5 analyzes optimal labor demand for both cases of unemployment insurance; section 6 discusses the behavior of the trade union, the firm association and the government in a decentralized setting; section 7 proceeds with the centralized organization of unemployment insurance; and section 8 concludes.

2 Literature review

The issue of centralizing unemployment insurance in a state union is currently discussed from two perspectives. First, it is advocated as an instrument to cushion adverse macroe-
conomic shocks on individual states in a state union (see Dolls et al., 2018 or Moyen et al., 2019 and their discussion of the related literature). In this case, national governments pay into a common supra-national budget. Then, if a member state is adversely affected by an unexpected increase in the unemployment rate, this common unemployment insurance supports the respective state with transfer payments to the national social security budget. Thus, the implementation of a mechanism of international risk-sharing levels out the business cycle.

A second body of literature focuses on the efficiency of the insurance itself, asking for example whether full insurance against the risk of unemployment can be provided in the case that a common unemployment insurance system is introduced among several sectors or regions. In the context of collective wage bargaining on the labor market, unemployment insurance may be organized either by the government or by trade unions themselves. In the latter case, the so-called Ghent system, trade unions determine the parameters of unemployment insurance. If the government subsidizes local insurance funds, Holmlund and Lundborg (1988) show that trade unions partially externalize the cost of bargaining for higher wages to other trade unions or sectors. Then, wages and unemployment are inefficiently high. A similar reasoning applies if several trade unions share a common insurance budget with uniform contributions and benefit levels. Similar to our findings, Saha and Schöb (2019) identify a fiscal externality in such centralized unemployment insurance setting. At the labor-rent maximizing wage rate, full unemployment insurance cannot be provided. However, in contrast to our paper, governmental decision making is exogenous, and no migration incentives emerge for unemployed workers, the only group with partial mobility. We in turn allow for the mobility of firms and the full labor force, which then reveals an interesting interplay of migration effects and the fiscal externality. Under certain conditions, wage setting as well as governmental behavior are second-best.

Inefficiently high wages may be set if trade unions do not see through the unemployment insurance budget. As shown by Dur (2001), in a partial equilibrium framework without migration, trade unions do not take account of the costs they impose on the federal insurance budget. Then, if a government can persuasively commit to their policies, it will aim at internalizing the fiscal externality via the effect of the contribution rate on the negotiated wage level. Thus, the generosity of unemployment insurance is moderated. If the trade union were to take account of the fiscal externality, governmental decision making would not be distorted. In our paper trade unions take account of the wage effect on the common budget. However, the costs of a wage increase are still partially externalized to other trade unions or states, because the respective trade union considers only the wage effect on its own members. We can then show that as the mobility of the labor force increases, the adverse effect of the fiscal externality on the provision of full unemployment insurance is cushioned.

In a theoretical model with minimum wages, Lozachmeur (2003) shows that decentralized governments strategically set contribution rates too low. This result is driven by the full mobility of low skilled workers, which provides distortive incentives for governmental contribution rate setting. A decentralized setting is also considered by Saha and Schöb (2019), who consider unemployment insurance in a Ghent system with pure welfare migration between sectors. To prevent welfare from decreasing immigration, the sector specific unions limit the generosity of unemployment insurance. Even though similar migration effects occur in our setting, we can show that the mobility of businesses and the labor force does not affect the provision of full unemployment insurance, even in the cases of different degrees of mobility and potential asymmetries between states. Furthermore, in our paper we consider unemployment insurance organized by state governments, where
the trade unions only engage in wage negotiations. As noted by Boeri et al. (2001), the majority of unemployment insurance systems in European countries is organized by the government, but collective bargaining bears relevance on each of them.

Horizontal inter-jurisdictional externalities or effects are well understood in the literature on fiscal federalism (see Zodrow and Mieszkowski, 1986, Wildasin, 1991 and Dahlby, 1996, among others). To maximize social welfare, governments set inefficiently low tax rates in order to attract a mobile tax base. In our paper, similar relocation effects occur with both types of unemployment insurance and with respect to wage and contribution rate setting. The interplay of horizontal and vertical fiscal externalities, in turn, were initially and extensively elaborated by Keen and Kotsogiannis (2002). For the case of local public goods and federal tax spending, they showed that each externality drives the local tax rates in opposite directions. Under certain conditions one externality may dominate the other such that the total effect on tax rate setting is ambiguous. In our paper, similar results are obtained in the noticeably different case of centralized unemployment insurance organization. Surprisingly, all externalities cancel each other out in the special case of full mobility and symmetric regions. Then, a centralized unemployment insurance system approaches the second-best solution, defined as full insurance against the risk of unemployment.

Novel results of our paper include the following: (i) decentralized wage setting may be second-best irrespective of the degree of mobility, even in the case of asymmetric regions; (ii) centralized unemployment insurance is generically inefficient but may approach the second-best solution in the case of full mobility and symmetric regions; and (iii) the efficiency of centralized unemployment insurance can be achieved by centralizing all related economic policy decisions.

3 The model

The state union consists of two states, $i = 1, 2$. $N$ identical individuals live and $M$ identical firms produce in the state union. All individuals and firms are allocated to one of the two states such that

$$M = m^1 + m^2$$

$$N = n^1 + n^2$$

with $n^i$ for the number of individuals and $m^i$ for the number of firms in either state.

3.1 Firms

All firms located in one of the two states are organized in a regional firm association. Each receives $\pi^i$ share of the total regional profit, which is given by $\Pi^i = f(l^i) - w^i l^i$. The aggregate production function $f(l^i)$ is assumed to be continuous, monotonically increasing and strictly concave, implying $f_{l^i} > 0$ and $f_{l^i l^i} < 0$. Furthermore, $f(0) = 0$. The objective of the firm association, however, is the maximization of profit per firm

$$\pi^i = \frac{\Pi^i}{m^i}, \quad i = 1, 2$$

by setting optimal regional labor demand $l^i$ for a given gross wage level $w^i$.  

\[\text{The partial derivative of the variable } x \text{ with respect the variable } y \text{ is denoted by } x_y := \frac{\partial x}{\partial y}, \text{ and the second partial derivative by } x_{yy}.\]
3.2 Labor force

Each individual is endowed with one unit of labor supplied inelastically in the state of residence. The number of individuals \( n^i \) in either state is divided into the subgroups employed \( l^i \) and unemployed \( u^i \):

\[
n^i = l^i + u^i, \quad i = 1, 2
\]

(4)

Following Harris and Todaro (1970), the probability of being employed is defined by \( \frac{l^i}{n^i} \) and the probability of being unemployed by \( \frac{u^i}{n^i} = \frac{w^i - t^i}{n^i} \). Ex ante, individuals do not know their labor market status. If they are employed they receive a net wage \( \tilde{w}^i = w^i (1 - t^i) \), where \( w^i \) represents the gross wage and \( t^i \) denotes the contribution rate of their unemployment insurance. If the individuals are unemployed, they receive an unemployment benefit \( b^i \). Through their income, either the net wage or benefit, individuals finance consumption. The utility they draw from consumption is represented by a monotonically increasing and strictly concave utility function \( U(\cdot) \). Individuals are assumed to be risk averse and in favor of insurance against the risk of unemployment. The expected utility \( EU^i \) of an individual living in either state is given by

\[
EU^i = \frac{l^i}{n^i} U(\tilde{w}^i) + \frac{n^i - l^i}{n^i} U(b^i), \quad i = 1, 2
\]

(5)

3.3 Migration

Mobile individuals and firms relocate as long as their expected utilities or profits differ between the respective states. Individuals move to the state in which they have a higher expected utility (5). Firms locate to the state where the profit (3) is higher. The migration equilibrium is given when expected utilities as well as profits are equalized across states. With full mobility of all individuals and firms, the migration equilibria are given by

\[
\pi^1 - \pi^2 = 0
\]

(6)

\[
EU^1 - EU^2 = 0
\]

(7)

Now assume that only a fraction \( 0 \leq \alpha \leq 1 \) of firms and a fraction \( 0 \leq \beta \leq 1 \) of individuals can freely migrate. We thus incorporate migration and location costs into the model by assuming a certain share of individuals and firms in each state, \( i = 1, 2 \), to be immobile. The higher the degree of immobility, the larger the migration costs. The number of firms in either state can be divided into mobile and immobile firms: \( m^i = m^i_{mob} + m^i_{immob} \) and the same division holds for individuals: \( n^i = n^i_{mob} + n^i_{immob} \). Obviously, only the mobile firms and individuals can respond with migration to changes in the unemployment insurance of a state, i.e. the contribution rate \( t^i \), \( m^i_{mob} (t^i) \) and \( n^i_{mob} (t^i) \), while the number of immobile persons and businesses is constant. In either country, the share of mobile firms is the ratio of \( m^i_{mob} \) to the number of all firms \( m^i \). Equivalently, the share of mobile households is defined as the ratio of \( n^i_{mob} \) to \( n^i \), which is identical to the ratio of mobile employed persons \( l^i_{mob} \) to all employed persons \( l^i \):

\[
\alpha^i = \frac{m^i_{mob}}{m^i} = 1 - \frac{m^i_{immob}}{m^i}
\]

(8)

\[
\beta^i = \frac{n^i_{mob}}{n^i} = \frac{l^i_{mob}}{l^i} = 1 - \frac{l^i_{immob}}{l^i} = 1 - \frac{n^i_{immob}}{n^i}
\]

(9)
Now assuming that the share of mobile firms and individuals is identical in both states: \( \alpha_1 = \alpha_2 = \alpha \) and \( \beta_1 = \beta_2 = \beta \), the total number of mobile firms or individuals in the state union is given by

\[
\begin{align*}
\alpha M &= \alpha m_1 + \alpha m_2 \\
\beta N &= \beta n_1 + \beta n_2
\end{align*}
\]  
(10)

All firms, mobile and immobile, receive the same share of total profit \( \Pi^i \). The share of total profit assigned to mobile firms is given by \( \Pi^{i \text{ mob}} = \alpha \Pi^i \). Then the migration equilibrium of mobile firms determines how many companies will relocate to each country:

\[
\frac{\Pi^{1 \text{ mob}}}{\alpha m_1} - \frac{\Pi^{2 \text{ mob}}}{\alpha M - \alpha m_1} = 0
\]  
(12)

Similarly, the utility of mobile individuals is given by \( U^{i \text{ mob}} = \beta l^i U(w^i(1-t^i)) + (\beta n^i - \beta l^i)U(b^i) \). Their migration equilibrium is determined by

\[
\frac{U^{1 \text{ mob}}}{\beta n_1} - \frac{U^{2 \text{ mob}}}{\beta N - \beta n_1} = 0
\]  
(13)

which shows the allocation of mobile individuals between countries.

### 3.4 Unemployment insurance

Unemployment insurance may be organized either regionally in each state or centrally for the whole state union. In the case of the former, the budget constraint reads as

\[
b^i(n^i - l^i) = t^i w^i l^i, \quad i = 1, 2
\]  
(14)

where \( t^i \) is the policy instrument of the regional government and \( b^i \) is determined as residual from the balanced budget. The left-hand side represents the total expenditure on unemployment benefits while the right-hand side shows the tax revenues paid by the employed. In the case of a centralized budget, a uniform benefit \( b^c \) and a uniform contribution rate \( t^c \) apply to both regions. The budget constraint is given by

\[
b^c (N - l^1 - l^2) = t^c (w^1 l^1 + w^2 l^2)
\]  
(15)

The central government chooses the contribution rate of unemployment insurance \( t^c \) in order to maximize social welfare.

### 3.5 Wage negotiations

The labor market is characterized by unemployment. This enters the model by implementing symmetric Nash bargaining about the regional gross wage \( w^i \).\(^2\) It is assumed that membership in the trade union or the firm association in either country encompasses all resident individuals \( n^i \) and firms \( m^i \). If the migration of individuals and relocation of firms is possible, any change of residence implies a change of membership, which is non-exclusive. Furthermore, both negotiating parties consider how their wage setting affects the relocation of mobile firms \( \alpha m^i(w^i) \) and the migration of mobile households \( \beta n^i(w^i) \). The negotiators consider the budgets (14) or (15) of each government, take as given the

\(^2\)Symmetric bargaining powers in the negotiations are assumed, because it eases the calculus without affecting the general results of the paper.
contribution rates and account for optimal labor demand. The objective function of the bargaining parties is given by the logarithmized Nash-product

\[ \ln B^i = \ln \pi^i + \ln EU^i, \quad i = 1, 2 \]  

(16)

where \( \pi^i \) is given by (3) and \( EU^i \) by (5). Without loss of generality, outside options are normalized to zero.\(^4\)

### 3.6 Social optimum and governmental regimes

In the following parts of the paper we analyze and compare decentralized and centralized governmental decisions about unemployment insurance with respect to efficiency. First, we determine the social optimum where a social planner (sp) makes all decisions, subject only to the total number of firms and individuals, operating under country-specific production technologies. She allocates the labor force and firms in a state union with a perfect labor market and without border constraints.

Second, a constrained social planner faces collective bargaining in the labor market and must account for unemployment. In this second-best economy, the constrained social planner chooses the unemployment insurance program. However, like the unconstrained social planner she takes into account a state union where policy instruments may not induce migration or relocation. We use this second-best allocation as a benchmark for efficiency in a world with unemployment and collective bargaining on labor markets.\(^5\)

Then we analyze the following two regimes of unemployment insurance. The first regime is characterized by decentralization (dc) where each government of a member state decides autonomously and independently on the state unemployment insurance program. Borders between the states are open and the economies are integrated in a common labor market where individuals and firms are partially mobile. The second regime is characterized by a centralized (c) organization with a common unemployment insurance pool for all states within the state union. The central government sets the unitary parameters of the common unemployment insurance system, accounting for open borders and the partial migration of individuals and firms.

In both regimes, each of the governments is a Stackelberg leader with respect to wage setting and takes into account the effect of the contribution rate on the gross wage level. The objective of the different governments as well as the social planner is to maximize the logarithmized Nash-Bernoulli social welfare function

\[ \ln V^i = \ln \pi^i + \ln EU^i, \quad i = 1, 2 \]  

(17)

The governments’ objectives are in line with the welfare objectives of the social groups. In particular, they do not follow their own redistributive goals. This implies that the welfare of both social groups is equally weighted.\(^6\)

\(^3\)With a large trade union and a sizeable firm association in each state, it is reasonable to assume that both negotiators recognize the impact of their decisions on the social security budget.

\(^4\)Positive values of the outside options could be implemented but would only add redistributive effects, which is not a focus of this paper. For reasonable outside options under open borders, it can be shown that both parties prefer to take part in negotiations (see Lemma 1).

\(^5\)We take the second-best allocation as the benchmark for the welfare optimum since we focus on the problem of whether centralized or decentralized unemployment insurance is closer to the optimum in an economic world with unemployment and cooperative wage bargaining.

\(^6\)The welfare function exhibits the same weights for the social groups of the labor force and the firms as the bargaining function. We have checked the implications of setting different weights. An additional
3.7 Sequence of decisions

At the first stage, the government decides on the contribution rate, which maximizes a social welfare function. All other endogenous variables are considered by the government, including possible responses to migration. At the second stage, the negotiators of the wage bargain take as given the contribution rate. Like the government, they contemplate the effects of their wage setting on migration and relocation. If the wage is determined, the firm association decides at the third stage what number of workers it wishes to employ in the sector. Finally, at the fourth stage, workers decide whether to migrate between countries by comparing net wages and benefits, and firms decide on their location by balancing profits. The model is solved backwards. Table 1 summarizes the sequence of decisions.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Decision variable</th>
<th>Decision maker</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Contribution rate: $t$</td>
<td>Governments</td>
</tr>
<tr>
<td>2</td>
<td>Wage level: $w$</td>
<td>Trade union/Firm association</td>
</tr>
<tr>
<td>3</td>
<td>Employment: $l$</td>
<td>Firm association</td>
</tr>
<tr>
<td>4</td>
<td>Migration: $n, m$</td>
<td>Work force and firms</td>
</tr>
</tbody>
</table>

4 Social optimum

Two social optima are considered in the following: a first-best solution implemented by an unconstrained social planner, and a second-best solution implemented by a constrained social planner. The latter faces the same institutional framework of the labor market as the governments with centralized and decentralized unemployment insurance, i.e., she is bound by the imperfections of the labor market.

4.1 First-best allocation

The social planner maximizes social welfare by deciding simultaneously about the contribution rate $t^i$, the gross wage $w^i$, the level of employment $l^i$ and the number of individuals $n^i$ and firms $m^i$ in each state. Her maximization problem is given by

$$
\max_{t^i, w^i, l^i, m^i, n^i} \sum_{i=1}^{2} \ln V^i = \sum_{i=1}^{2} \left[ \ln \left( \frac{f^i(l^i) - w^i l^i}{m^i} \right) + \ln \left( \frac{t^i}{n^i U(w^i(1 - t^i))} + \frac{n^i - l^i}{n^i U(t^i w^i l^i)} \right) \right]
$$

subject to the total number of firms (1) and individuals (2) in the state union.\(^\text{7}\) The first-order condition regarding the contribution rate $t^i$ in either state reads as

\(^\text{7}\)To ensure interior solutions of the different maximization problems throughout the paper, we generally assume the fulfillment of second-order conditions.
Because yields of an adjusted level of employment on the benefit level. Applying the envelope theorem with EU and between the labor force and firms, the social planner maximizes production and social welfare.

The first-order condition regarding the gross wage \( w^i \) in either state is given by

\[
\frac{d \ln V^i}{dw^i} = \frac{1}{\pi^i} \pi_{w^i}^i + \frac{1}{EU^i} EU_{w^i}^i \tilde{w}_{l^i}^i + \frac{1}{EU^i} EU_{b^i}^i b_{w^i}^i = 0
\]

or:

\[
\frac{U_{\tilde{w}^i}}{EU^i} \frac{1}{m^i} - \frac{1}{\pi^i} m^i = 0
\]

with \( EU_{w^i}^i = \frac{\lambda^i}{m^i} U_{\tilde{w}^i}^i, \tilde{w}_{l^i}^i = -w^i, \) \( EU_{b^i}^i = \frac{w^i}{\pi^i} U_{b^i}^i \) and \( b_{w^i}^i = \frac{w^i}{w^i - r} \). By changing the value of \( t^i \), the social planner redistributes income between employment statuses within the labor force, i.e., between employment and unemployment. The first term in condition (19) denotes the marginal effect on the expected utility for an employed individual and the second term for an unemployed person. Condition (20) outlines full insurance against unemployment and reveals that the optimal contribution rate balances the marginal utilities of the employed and unemployed. This is realized at the actuarial fair contribution rate: \( t^i = \frac{w^i - r}{\pi^i} \) which is equal to the unemployment probability.

The third first-order condition concerns the decision regarding the level of employment \( l^i \) and is given by

\[
\frac{d \ln V}{dl^i} = \frac{1}{\pi^i} \pi_{l^i}^i + \frac{1}{EU^i} EU_{l^i}^i \tilde{w}_{l^i}^i + \frac{1}{EU^i} EU_{b^i}^i b_{l^i}^i = 0
\]

or:

\[
U_{\tilde{w}^i}^1 \frac{1}{EU^i} \frac{1}{m^i} - \frac{1}{\pi^i} m^i = 0
\]

with \( \pi_{l^i}^i = -\frac{\lambda^i}{m^i}, \tilde{w}_{l^i}^i = (1 - t^i) \) and \( b_{l^i}^i = t^i \frac{\lambda^i}{m^i - r} \). When deciding about the gross wage, the social planner optimally redistributes between the labor force and the firms by profit and income allocation. Three effects are taken into account: the labor cost effect depicts the effect of a gross wage adjustment on the cost of employing labor, the net wage effect the change on the expected utility of the employed and the benefit effect via wage the impact on the unemployed. By the envelope theorem, condition (21) implies (22). The gross wage \( w^i \) is chosen optimally, if it balances the relative gain of workers from a gross wage increase (a higher net wage and unemployment benefit) with the relative loss of firms.

The third first-order condition concerns the decision regarding the level of employment \( l^i \) and is given by

\[
\frac{d \ln V}{dl^i} = \frac{1}{\pi^i} \pi_{l^i}^i + \frac{1}{EU^i} EU_{l^i}^i \tilde{w}_{l^i}^i + \frac{1}{EU^i} EU_{b^i}^i b_{l^i}^i = 0
\]

with \( \pi_{l^i}^i = \frac{1}{m^i} (f^i - w^i), \) \( EU_{l^i}^i = \frac{1}{m^i} [U(\tilde{w}^i) - U(b^i)] \) and \( b_{l^i}^i = t^i \frac{w^i}{m^i - r} \). The first term conveys the effect of an adjusted employment level on the producers’ surplus while the status effect denotes its impact on expected utility via the number of households that change their labor market status. The benefit effect via employment illustrates the effect of an adjusted level of employment on the benefit level. Applying the envelope theorem yields \( f^i = 0 \), and the social planner chooses full employment of the labor force, \( l^i = n^i \), because \( l^i \leq n^i \) must hold. Conditional on optimal redistribution within the labor force and between the labor force and firms, the social planner maximizes production and social welfare.
The first-order condition regarding the number of firms, say in state 1, \( m^1 \) is given by

\[
d \ln V \frac{d}{dm^1} = \frac{1}{\pi^1_m} \pi^1_m - \frac{1}{\pi^2_m} \pi^2_m = 0 \tag{24}
\]

or:

\[
\frac{1}{2} M = m^1 \tag{25}
\]

with \( \pi^i_m = -\frac{f^i - w^i m^i}{(m^i)^2}, \ i = 1, 2 \). The social planner balances the marginal costs and benefits that result from a change of the number of firms in state 1. An efficient allocation of firms is achieved once they are equally distributed among states, as asserted by (25). This result holds true for symmetric as well as asymmetric states.

The fifth first-order condition concerns the number of individuals, say in state 1, \( n^1 \) and is given by

\[
d \ln V \frac{d}{dn^1} = -\frac{1}{EU^1} EU^1 n^1 + \frac{1}{EU^1} EU^1 b^1 n^1 + \frac{1}{EU^2} EU^2 b^2 n^2 + \frac{1}{EU^2} EU^2 b^2 n^2 = 0 \tag{26}
\]

or:

\[
\frac{dU^1}{db^1} \frac{w^1}{U^1} \frac{dU^2}{db^2} \frac{w^2}{U^2} N = n^1 \tag{27}
\]

with \( EU^i_n = \frac{v^i}{(w^i)^2} (U^i(\tilde{w}^i) - U^i(b^i)) \) and \( b^i_n = \frac{v^i w^i}{(w^i)^2} \), \( i = 1, 2 \). A change in the number of households in state 1 affects the expected utility in both regions directly via its impact on the likelihood of unemployment. Furthermore, the adjustment of the unemployment benefit level produces an indirect effect. The social planner then chooses an allocation, which balances the respective costs and benefits within the state union from an additional inhabitant in region 1. Applying the envelope theorem yields (27), which states that the social planner allocates relatively more individuals to the region with a higher elasticity of utility with respect to income.\(^8\) For symmetric regions an equally distributed allocation of individuals results: \( n^i = \frac{1}{2} N \).

### 4.2 Second-best allocation

In contrast to the first-best optimum, the social planner is restricted by collective wage bargaining and profit-maximizing labor demand on the labor market, i.e., she cannot set \( l^i \) and \( w^i \) directly. Wage negotiators are constrained by profit-maximizing labor demand and do not take account of mobility. There are no migration decisions because the social planner allocates households and firms across the states.

#### 4.2.1 Labor demand

Optimal labor demand in either state is determined by the firm association, which faces the maximization problem

\[
\max_{l^i} \pi^i = \frac{f^i(l^i) - w^i l^i}{m^i}, \ i = 1, 2 \tag{28}
\]

yielding the first-order condition

\[
\pi^i_l = \frac{1}{m^i} (f^i - w^i) = 0 \tag{29}
\]

\(^8\) Note that due to the envelope theorem \( b^i = w^i \).
with the implicit derivative \( dl^i/dw^i < 0 \), because \( f_{\ell^i} < 0 \). The firm association weighs the marginal product against the marginal cost of an additional unit of labor. In general, second-best labor demand is not first-best, because the status effect and the benefit effect evaluated by the unconstrained social planner in first-order condition (23) are not considered by the firm association.

### 4.2.2 Wage bargaining

The bargaining parties, both the firm association and the trade union, maximize the Nash-product (16) subject to optimal labor demand given by condition (29):

\[
\max_{w^i} \ln B^i = \ln \left( \frac{f^i(l^i(w^i)) - w^i l^i(w^i)}{n^i} \right) + \ln \left( \frac{l^i(w^i)}{n^i} U \left( \frac{w^i(1 - t^i)}{l^i(w^i)} \right) \right), \quad i = 1, 2 \quad (30)
\]

With the envelope theorem the first-order condition of the Nash bargaining problem is given by\(^9\)

\[
\frac{d \ln B^i}{dw^i} = \frac{1}{n^i} \pi^i_{w^i} + \frac{1}{EU^i} \left( E U^i_{w^i} \tilde{w}^i + E U^i_{l^i} \frac{dl^i}{dw^i} + E U^i_{\ell^i} \left[ b^i_{w^i} + b^i_{l^i} \frac{dl^i}{dw^i} \right] \right) \stackrel{!}{=} 0 \quad (31)
\]

The negotiated gross wage balances the marginal benefits from a wage increase with the marginal costs. While the firm association considers the effect on the unit cost of employment, the trade union considers the net wage effect, the status effect, the sum of the benefit effect via wage and the benefit effect via employment. Rewriting condition (31) yields:

\[
\frac{d \ln B^i}{dw^i} = -\frac{1}{n^i} l^i + \frac{1}{EU^i} \left( \frac{l^i}{n^i} U^i_{l^i} (1 - t^i) + \frac{1}{n^i} \left[ U^i(\tilde{w}^i) - U^i(b^i) \right] \right) \frac{dl^i}{dw^i} + \frac{1}{n^i} b^i_{l^i} \frac{dl^i}{dw^i} \left( \frac{n^i - l^i}{n^i} + \frac{dl^i}{dw^i} \frac{d^l}{d^i} \right) \stackrel{!}{=} 0 \quad (32)
\]

Condition (32) shows that the sign of the benefit effect depends on the unemployment ratio and the elasticity of profit-maximizing labor demand with respect to the gross wage. There are two effects of a wage adjustment on the benefit level. On the one hand, it affects the taxable base, which decreases due to a wage increase, if \( 1 < -\frac{dl^i}{dw^i} \frac{w^i}{l^i} \), and vice versa. Lower employment outweighs the higher wage level. On the other hand, a higher wage increases the number of beneficiaries, because employment decreases. Thus, expenditures increase. Accounting for both effects yields the total benefit effect in first-order condition (32). The total effect of a higher gross wage on the benefit level is negative, if \( \frac{n^i - l^i}{n^i} < -\frac{dl^i}{dw^i} \frac{w^i}{l^i} \), and vice versa. In the following this effect is assumed to be negative for empirical reasons.\(^10\) Generally, the second-best wage level is not first-best, because the bargaining parties are bound to profit-maximizing labor demand in contrast to an unconstrained social planner.

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\(^9\)We exclude corner solutions by assuming that \( dEU^i/dw^i > 0 \).

\(^10\)The value of the elasticity of labor demand with respect to the wage level, \( d\ell^i/dw^i \), measures approximately between \(-0.3\) and \(-0.8\) (Hamermesh, 1993). A more recent study of Lichter et al. (2015) finds a mean value of \(-0.197\) in a meta-regression analysis. As unemployment rates typically have lower absolute values, the sum of the benefit effects is assumed to be negative.
4.2.3 Constrained social planner

The constrained social planner maximizes the social welfare function (17) by setting the contribution rate $t^i$ subject to condition (32) as well as the number of firms (1) and individuals (2) in the state union. She faces the following optimization problem:

$$\max_{t^i,m^i,n^i} \sum_{i=1}^{2} \ln V^i = \sum_{i=1}^{2} \left[ \ln \left( \frac{f^i(l^i(w^i(t^i))-w^i(t^i)l^i(w^i(t^i))}{m^i} \right) + \ln \left( \frac{l^i(w^i(t^i))}{n^i}U \left( w^i(t^i)(1-t^i) \right) + \frac{n^i-l^i(w^i(t^i))}{n^i}U \left( \frac{t^i w^i(t^i)l^i(w^i(t^i))}{n^i-l^i(w^i(t^i))} \right) \right) \right]$$

(33)

The first-order condition regarding $t^i$ is given by

$$\frac{d \ln V^i}{dt^i} = \frac{1}{EU^i} \left( EU^i_w \tilde{w}_t^i + EU^i_b b_t^i \right) + \frac{1}{\sigma^i_w^2} \frac{dw^i}{dt^i} + \frac{1}{EU^i} \left( EU^i_w \tilde{w}_t^i + EU^i_b \frac{dl^i}{dw^i} + EU^i_b b_t^i \frac{dt^i}{dw^i} \right) \frac{dw^i}{dt^i} = 0$$

(34)

where $\frac{dw^i}{dt^2} = -\frac{\partial^2 \ln B^i}{\partial \omega \partial t} / \frac{\partial^2 \ln B^i}{\partial \omega \partial w} > 0$ is assumed to be positive without loss of generality.\(^{11}\)

The first and second term in condition (34) exhibit effects which do not appear in the respective first-order condition (19) of the unconstrained social planner. These effects express the limitation of the constrained social planner, who is unable to adjust the level of redistribution between firms and households directly. This means, to maximize social welfare, the contribution rate must serve two purposes. First, it should aim for optimal intra-group redistribution within the labor force, and second, it must provide optimal inter-group redistribution between the labor force and the firms. Applying the envelope theorem reveals that the redistribution between the employed and the unemployed is optimal from a social welfare perspective:

$$\frac{d \ln V^i}{dt^i} = \frac{1}{EU^i} \frac{l^i}{n^i} \tilde{w}_t^i \left( U^i_t - U^i_t \right) \equiv 0$$

(35)

The constrained social planner determines the contribution rate so that the marginal utility of the unemployment benefit balances against the marginal utility loss of the net wage. The indirect effects via the wage level $w^i(t^i)$ cancel out, because the planner’s objective function $V^i$ is identical to the wage Nash bargaining function $B^i$. Therefore, for any given value of the contribution rate $t^i$, the resulting wage level $w^i(t^i)$ maximizes social welfare on decision stage two and no indirect intervention by the constrained social planner is necessary. The contribution rate is only needed to solve the problem of optimal intra-group redistribution within the labor force. Thus, first-order condition (35) is equivalent to the first-best solution, condition (20).

Equal to the unconstrained social planner, the constrained social planner weighs the costs and benefits of allocating firms and individuals between states. Thereby the constrained social planner must additionally consider the indirect effects of an adjustment of the number of firms and individuals on labor demand and the negotiated gross wage. However, for symmetric regions, the allocations of $m^i$ and $n^i$ are first-best.\(^{12}\)

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\(^{11}\)Because $\frac{\partial^2 \ln B^i}{\partial \omega \partial t} < 0$ must hold to ensure an interior optimum of the Nash bargain, $\frac{\partial^2 \ln B^i}{\partial \omega \partial w} > 0$ is assumed.

\(^{12}\)The assumption of symmetry implies that firms and individuals are equally allocated between states:
5 Labor demand

Wages and employment are determined separately by each state. This means the labor market integrates both states in the sense that the labor force and firms can move between them. However, the labor market is still separated due to localized wage bargaining in each state, though it takes mobility into account.

The firm association in either region maximizes profit per firm (3) subject to the migration equilibrium (12) of mobile firms:

$$\max_i \pi_i = \frac{f_i(l^i) - w^i l^i}{(1 - \alpha) m^i + \alpha m^i(l^i)}, \quad i = 1, 2$$

(36)

The maximization problem is the same for both organizational regimes of unemployment insurance. The first-order condition is given by

$$\frac{d\pi_i}{dl^i} = \frac{f_i^i}{m^i} - \frac{w^i}{m^i} \left(1 - \alpha \frac{dx^i}{dm^i} + \frac{dx^i}{dm^i} \frac{dx^i}{dm^i}\right) = 0$$

(37)

with $\frac{dx^i}{dm^i} = \frac{\Pi^i}{(m^i)^2}$ describing the effect of the number of firms on profit per firm.\(^{14}\)

Condition (37) shows that firms choose profit-maximizing employment by equalizing labor cost and productivity, $f_i^i - w^i = 0$. However, there is an opposing effect due to the firm mobility induced by employment decisions.

The mobility of firms impacts profit per firm, say in state 1, in two respects. On the one hand, there is an incentive for the firm association to employ less workers. Lower employment decreases production, because $f_1^1 > 0$, and thereby total profit, $\Pi^1$. This in turn encourages firms to relocate from country 1 to country 2 such that profit per firm in country 1 increases. On the other hand, there is an incentive to increase employment. A higher level of employment increases the total cost of labor such that the total profit, $\Pi^1$, shrinks. Then firms relocate from country 1 to country 2 such that profit $\pi^1$ per firm in country 1 increases, too. The same reasoning applies to state 2.

The firm mobility effect consists of the parameter $\alpha$ and the mobility-profit factor \(\frac{dx^i}{dm^i} / \left(\frac{dx^i}{dm^i} + \frac{dx^i}{dm^i}\right), \quad i = 1, 2\).\(^\text{15}\) The higher the value of $\alpha$, the greater the inclination of the firm association to increase profit per firm, say in state 1 by taking advantage of the mobility effects explained above. The mobility-profit factor indicates, in which state the level of profit per firm is affected relatively stronger by the relocation of firms. Any migration policy that endeavors to increase profit per firm in state 1 implies ceteris paribus that profit per firm in state 2 will decrease. This reciprocity cushions the induced migration flow between regions and thereby the firm association’s intended effect on profit per firm in state 1. If the impact of relocation on profit per firm is relatively stronger in state 1 than in state 2, the ratio takes a value between one and one half. This means that the firm association in state 1 can exploit firm mobility more efficiently, because the allocations $m^i = \frac{1}{2} M$ and $n^i = \frac{1}{2} N$. These specific allocations are efficient as they represent valid solutions to the respective first-order conditions $\frac{d\ln \Pi^i}{dm^i} = 0$ and $\frac{d\ln \Pi^i}{dm^i} = 0$. For the following cases of decentralized and centralized unemployment insurance schemes, the symmetry assumption implies that the allocation of firms and individuals among the states is also second-best.

\(^{13}\)See Lemmata 2 and 3 for the derivation of the implicit derivative $\frac{dx^i}{dm^i}$ regarding decentralized and centralized unemployment insurance.

\(^{14}\)A stable relocation equilibrium requires $\frac{dx^i}{dm^i} < 0$, which we assume to be satisfied in both scenarios.

\(^{15}\)The effect on migration here constitutes a horizontal relocation externality.
The maximization problem is given by

$$\max w^* \ln B^i = \ln \left( \frac{l^i (l^i (w^i)) - w^i l^i (w^i)}{(1 - \alpha) m^i + \alpha m^i (w^i)} \right) + \ln \left( \frac{l^i (w^i)}{(1 - \beta)n^i + \beta n^i (w^i)} U \left( w^i (1 - t^i) \right) \right)$$

$$+ \frac{(1 - \beta)n^i + \beta n^i (w^i) - l^i (w^i)}{(1 - \beta)n^i + \beta n^i (w^i)} U \left( \frac{t^i w^i l^i (w^i)}{(1 - \beta)n^i + \beta n^i (w^i) - l^i (w^i)} \right)$$

(38)

The following first-order condition results

$$\frac{d \ln B^i}{dw^i} = \frac{1}{\pi^i w^i} \left( 1 - \alpha \frac{dn^i}{dw^i} + \frac{dw^i}{dw^i} \right) + \frac{1}{EU^i} \left( EU^i_{\tilde{w}^i} \tilde{w}^i + EU^i_{\tilde{b}^i} \frac{dl^i}{dw^i} \right) + \frac{EU^i_{\tilde{w}^i} \tilde{w}^i + EU^i_{\tilde{b}^i} \frac{dl^i}{dw^i}}{(1 - \beta \frac{dn^i}{dw^i} + \frac{dw^i}{dw^i})} = 0$$

(39)

6 Decentralized unemployment insurance

This section considers collective wage bargaining and governmental contribution rate setting within a decentralized system of unemployment insurance. The firms and the labor force actively move between states, which is taken into account by the negotiating parties as well as the government. Furthermore, each state government organizes its own unemployment insurance, whose budget is known to local decision makers.

6.1 Wage bargaining

The firm association and the trade union in both states, $i = 1, 2$, negotiate the gross wage level $w^i$ to maximize the Nash bargaining function (16) subject to optimal labor demand (37), the decentralized budget (14), and the migration equilibria (12) and (13). The maximization problem is given by

$$\max w^i \ln B^i = \ln \left( \frac{f^i (l^i (w^i)) - w^i l^i (w^i)}{(1 - \alpha) m^i + \alpha m^i (w^i)} \right) + \ln \left( \frac{l^i (w^i)}{(1 - \beta)n^i + \beta n^i (w^i)} U \left( w^i (1 - t^i) \right) \right)$$

$$+ \frac{(1 - \beta)n^i + \beta n^i (w^i) - l^i (w^i)}{(1 - \beta)n^i + \beta n^i (w^i)} U \left( \frac{t^i w^i l^i (w^i)}{(1 - \beta)n^i + \beta n^i (w^i) - l^i (w^i)} \right)$$

with $EU^i_{\tilde{w}^i} = -\frac{U^i (\tilde{w}^i) - U^i (w^i)}{(\tilde{w}^i - w^i)} - \frac{1}{\tilde{w}^i - w^i} U^i_{\tilde{w}^i} \tilde{w}^i$ delineating the effect of a change of the number of inhabitants on their expected utility for the respective state. Like the constrained social planner, the bargaining parties in the decentralized case take into consideration all direct and indirect wage effects: the labor cost effect of the firms and the net wage, status and benefit effects of the labor force (compare first-order condition (31)). Additionally, open borders cause migration and relocation effects. Each wage effect is accompanied by an opposing but not necessarily countervailing migration effect. For the strength of the household migration effect, the parameter $\beta$ and the mobility-utility factor $\frac{dEU^i_{\tilde{w}^i}}{dn^i} / \left( \frac{dEU^i_{\tilde{w}^i}}{dn^i} + \frac{dEU^i_{\tilde{b}^i}}{dn^i} \right)$ are decisive. The mobility-utility factor can be analogized to the mobility-profit

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16See Lemmata 2 and 4 for the derivation of the implicit derivatives $\frac{d\alpha m^i}{dw^i}$ and $\frac{d\beta w^i}{dw^i}$.

17A stable migration equilibrium requires $\frac{dEU^i_{\tilde{w}^i}}{dn^i} < 0$, which we assume to be satisfied in both scenarios.

18The following holds: $\frac{dEU^i_{\tilde{w}^i}}{dn^i} < 0$ while $\frac{dEU^i_{\tilde{b}^i}}{dn^i} > 0$. 
The wage effect on firms and the opposite migration effect due to their relocation is given by $\pi_i = \left(1 - \alpha \frac{d\pi_i}{dm^1} / \left(\frac{d\pi_i}{dm^1} + \frac{d\pi_i}{dm^2}\right)\right)$. Firms in both states negotiate for a lower gross wage rate in order to increase profits (labor cost effect). With mobility, however, due to firm relocation there is an opposite incentive not to overly decrease the wage. A higher wage rate presents firms, say in state 1, with a reason to relocate from country 1 to country 2 such that the profit per firm in country 1 increases. Therefore, the possible relocation of firms attenuates the preference for lower wages.

Also the effects of wage setting by the trade union in favor of the labor force are cushioned by the migration of households: $EU_i = \left(\frac{EU_{wi}}{EU_{w1}} \frac{dEU_{l1}}{d\pi_{1}} + \frac{EU_{bl}}{EU_{b1}} \left[b_{wi} + b_{l1} \frac{d\pi_{1}}{dm^1}\right]\right) \times \left(1 - \beta \frac{dEU_{wi}}{d\pi_{1}} / \left(\frac{dEU_{l1}}{dm^1} + \frac{dEU_{l2}}{dm^2}\right)\right)$. The net wage effect shows that trade unions in both states negotiate a higher gross wage to increase expected utility. With household mobility this incentive is partially reversed because a lower gross wage, say in state 1, prompts households to migrate to state 2, implying a higher probability of being employed in state 1 and a higher expected utility.

The status effect may be negative ($t_i < n_i - l_i$) such that trade unions seek a lower gross wage rate. A higher number of individuals thus become employed and find themselves in the more favorable income status. However, mobile households will migrate from state 2 to state 1. This in turn lowers the prospect of employment (the employment probability), decreasing expected utility. Hence, due to migration trade unions are incentivized to negotiate higher wages. Overall their preference for lower wages is curbed by mobility. If the status effect is positive, the reverse reasoning applies.

The benefit effect is negative (by assumption) and trade unions bargain for a lower gross wage. A lower wage increases employment and the unemployment benefit. The utility of the unemployed population and its expected utility will increase. But again, migration curbs the trade union preference for lower wages.

Now, consider the case that the incentives given by firm mobility are stronger than that of the labor force: $\alpha \frac{d\pi_i}{dm^1} / \left(\frac{d\pi_i}{dm^1} + \frac{d\pi_i}{dm^2}\right) > \beta \frac{dEU_{wi}}{d\pi_{1}} / \left(\frac{dEU_{l1}}{dm^1} + \frac{dEU_{l2}}{dm^2}\right)$. How does a wage rate increase affect both negotiating parties? First, note that without migration a higher wage increases expected household utility, and lowers firms’ profits. Wage bargaining leads to a gross wage where the marginal benefit of households is equal to the marginal cost of the firm in terms of lower profit (see condition (3)). Allowing for migration reduces both the utility increase of the households and the decrease of the firms’ profits. As a wage increase clearly benefits the labor force and harms the firms, this incentivizes workers to emigrate to one state and encourages firms to relocate to the other. Hence, the expected utility increases and the profit per firm increases. Since households are more immobile than firms, the share by which the labor force increases due to immigration is relatively lower than the share of firms that leave the state. As a consequence of migration, the expected utility of households decreases by less than the increase of profits per firm. Thus, the dampening effect of migration on the increasing expected utility of households is smaller than its impact on the decreasing profit of firms. Generally, a higher degree of immobility improves the respective bargaining position of the negotiator, which we call the advantage of relative immobility.

In the case of symmetric states, the absolute impact of migration on expected utility is equally strong, such that the trade union in state 1 can realize exactly one half of its intended effect on expected utility in region 1. If regions are symmetric the first-order
condition (39) becomes

\[
\frac{d \ln B}{dw} = -\frac{1}{\pi m} \left( 1 - \alpha \frac{1}{2} \right) + \frac{1}{EU} \left( \frac{l}{n} U_\varphi (1-t) + \frac{1}{n} [U(\tilde{w}) - U(b)] \frac{d l}{dw} \right) + U_b \frac{b}{W} \left( \frac{n-l}{n} + \frac{d l}{dw} \frac{W}{l} \right) \left( 1 - \beta \frac{1}{2} \right) = 0 \tag{40}
\]

The total effect of combining the direct wage and migration effects is as follows. The marginal benefit of households due to a higher wage becomes larger than the marginal cost of firms if \( \alpha > \beta \) in condition (40). This implies that the optimal wage must be higher if firms are more mobile than households. Since the total beneficial effect of higher wages for households is larger than the total cost effect on firms, households receive a higher weight in the bargaining process: \( 1 - \alpha \frac{1}{2} < 1 - \beta \frac{1}{2} \). As result of wage negotiations, the gross wage will be higher due to the advantage of the relative immobility of the labor force.

If both firms and the labor force are equally mobile (\( \alpha = \beta \)), the bargaining position of the firm association and the trade union driven by this mobility outweigh each other as migration exerts the same relative strength on gains and losses from a wage increase. Comparing the first-order condition (32) to condition (40) then implies that wage setting in the decentralized scenario is second-best as long as firms and the labor force have the same degree of mobility: \( \alpha = \beta \). With symmetry the following proposition holds.

**Proposition 1.** In symmetric states, (a) the negotiated gross wage level in each state with decentralized unemployment insurance is second-best, if firms and workers are equally mobile: \( 1 \geq \alpha = \beta \geq 0 \). Furthermore, (b) firms that are more mobile than workers will produce a wage level that is higher than the second-best level: \( 1 \geq \alpha > \beta \geq 0 \), and vice versa.

**Proof.** See appendix. \( \square \)

### 6.2 Decentralized governments

Each government in the state union sets a contribution rate \( t_i \) to maximize social welfare (17) in its region, \( i = 1, 2 \), subject to optimal wage bargaining (39), optimal labor demand (37), the decentralized budget (14) and the migration equilibria (12) and (13):\(^{19}\)

\[
\max_c \ln V^i = \ln \left( \frac{f^i(l^i(w^i(t^i)) - w^i(t^i)l^i(w^i(t^i)))}{(1 - \alpha) m^i + \alpha m^i(t^i)} \right) + \ln \left( \frac{l^i(w^i(t^i))}{(1 - \beta) n^i + \beta n^i(t^i)} U \left( w^i(t^i)(1 - t^i) \right) \right) + \frac{(1 - \beta) n^i + \beta n^i(t^i) - l^i(w^i(t^i))}{(1 - \beta) n^i + \beta n^i(t^i)} U \left( \frac{t^i w^i(t^i) l^i(w^i(t^i))}{(1 - \beta) n^i + \beta n^i(t^i) - l^i(w^i(t^i))} \right) \tag{41}
\]

Applying the envelope theorem with respect to optimal wage setting (39), the decentralized government’s first-order condition is given by

\[
\frac{d \ln V^i}{dt^i} = -\frac{1}{EU^i} \frac{t^i}{n^i} w^i \left( U_\varphi^i - U_{\tilde{w}}^i \right) \left( 1 - \beta - \frac{dU_\varphi^i}{dn^i} + \frac{dU_\tilde{w}^i}{dn^2} \right) = 0 \tag{42}
\]

\(^{19}\) See Lemmata 2 and 4 for the derivations of the implicit derivatives \( \frac{d \ln V^i}{dt^i} \) and \( \frac{d U_\varphi^i}{dn^i} \).
All indirect effects of the contribution rate via wage and employment are internalized by wage negotiations, and the bargaining objective is aligned with the government’s welfare objective. Hence, the government only considers the direct effect of the contribution rate on expected utility of the household.

Migration incentives due to the contribution rate concern only the labor force. With respect to unemployment, the government has an incentive to set a lower contribution rate, because a lower contribution rate decreases the unemployment benefit such that the unemployed population is induced to migrate from, for example, region 1 to region 2. Due to the lower number of inhabitants in region 1, expected utility rises. With respect to the employed, the government aims for a higher contribution rate. A higher contribution rate decreases the net wage such that the employed will emigrate to region 2. Then, expected utility in region 1 increases because $\frac{dE[U]}{dn} < 0$. However, since the household migration affects the employed and unemployed population to the same degree, the chosen contribution rate is not distorted and second-best. The following proposition for symmetric and asymmetric states results:

**Proposition 2.** The decentralized decision of the government in either state, $i = 1, 2$, yields the second-best contribution rate which provides full insurance against the risk of unemployment, irrespective of firms’ and households’ degrees of mobility.

**Proof.** Consider condition (42) with symmetric regions ($i = 1 = 2$) and divide by $(1 - \beta \frac{1}{2})$ where $0 \leq \beta \leq 1$. For any degree of household mobility then, (42) is equivalent to the second-best condition (35).

Just like the constrained social planner, the decentralized government balances the effect of the contribution rate on the marginal utility of the unemployment benefit with the marginal loss of utility derived from the net wage. This describes optimal intra-group redistribution within the labor force, and the first-order condition (42) is equivalent to the second-best solution, condition (35).

### 7 Centralized unemployment insurance

The following sections consider collective wage bargaining and government rate setting within a centralized unemployment insurance system. While collective wage bargaining is still decentralized in each state, unemployment insurance is now determined by a single institution: the central government. This means that for both states a uniform contribution rate applies and a uniform unemployment benefit is granted. A centralized budget balances contributions and expenditures from both states simultaneously. Similar to the above scenarios, all decision makers take into account the mobility of firms and the labor force, and are privy to the central government’s budget.

#### 7.1 Wage bargaining

The bargaining parties in each state, $i = 1, 2$, negotiate independently the gross wage rate $w^i$ in order to maximize the local Nash bargaining function (16) subject to optimal labor demand (37), the central budget (15) and the migration equilibria (12) and (13).
The maximization problem is given by:

$$\max_{w^i} \ln B^i = \ln \left( \frac{f^i(l^i(w^i)) - w^i l^i(w^i)}{(1 - \alpha) n^i + \alpha m^i} \right) + \ln \left( \frac{l^i(w^i)}{(1 - \beta) n^i + \beta m^i} U \left( w^i(1 - t^i) \right) \right)$$

$$+ \frac{(1 - \beta) n^i + \beta m^i}{(1 - \beta) n^i + \beta m^i} U \left( \frac{t^c(w^i l^i + w^i l^i(w^i))}{N - \beta - t^i(w^i)} \right), \quad j = 1, 2, j \neq i$$

The first-order condition is as follows:

$$\frac{d \ln B^i}{d w^i} = \frac{1}{\pi^i_{\alpha \omega}} \left( 1 - \alpha \frac{d w^i}{d w^i} \right) + \frac{1}{EU^i_{\omega}} \left( EU^i_{\omega} b^i_{c_{\omega}} + EU^i_{\omega} \frac{d l^i}{d w^i} \right)$$

$$+ \frac{1}{EU^i_{\omega}} \left( b^i_{c_{\omega}} + b^i_{\pi} \frac{d l^i}{d w^i} \right) \beta \frac{d EU^i_{\omega}}{d n^i} + \frac{d EU^i_{\omega}}{d n^i} = 0$$

with $b^c_{\omega} = \frac{\theta^c}{N - \theta^c - \beta^D}$, $b^p_{\pi} = \frac{\theta^p(N - \theta^p) + \theta^p \theta^D}{(N - \theta^c - \beta^D)^2}$ and $d EU^i_{\omega} = -\frac{\theta^i(U^i(\omega^i) - U^i(\beta^c))}{(n^i)^2}$. Negotiators consider the same wage effects – including the indirect effects via migration – as those with decentralized unemployment insurance programs. In particular, the labor cost effect on firms and the effects on the expected utility of households are accompanied by opposing migration effects. Whether these migration effects lead to higher or lower gross wages in the bargain depends again on the relative advantage of immobility: if firms are more immobile the negotiated wage decreases, and if households are more immobile the wage increases.

However, compared to the case of decentralized unemployment insurance systems, there are two additional effects on the wage bargaining outcome. First, centralized unemployment insurance is now characterized by a common pool, which gives rise to a bottom-up vertical fiscal externality (compare Keen and Kotsogiannis, 2002) that induces excessive wages. Note that a higher wage in region 1 reduces employment and increases unemployment: the number who receive the unemployment benefit grows and the number of contributors to the insurance program diminishes. If the effect of the direct wage increase on the basis of contributions is smaller than the negative effect via lower employment (as is assumed here) the contribution base shrinks. The higher the number of the unemployed and the subsequent reduction of total contributions causes an additional burden for unemployment insurance in state 1, which leads to lower benefits. This negative benefit effect constrains the ability of the wage bargaining parties in state 1 to negotiate higher wages. However, in a framework with centralized unemployment insurance this loss of benefits as a result of higher negotiated wages is now co-financed by the payments of contributors from the other state 2. State 1 no longer has to bear the full cost of lower benefits if it increases the gross wage. Hence, the expected utility reduction of the unemployed due to a higher wage is smaller than in the case of decentralized insurance:

$$\left| EU^i_{\omega} \left[ b^c_{\omega} + b^p_{\pi} \frac{d l^i}{d w^i} \right] \right| < \left| EU^i_{\omega} \left[ b^c_{\omega} + b^p_{\pi} \frac{d l^i}{d w^i} \right] \right|.$$  

The vertical fiscal externality is the difference of both terms. In the special case of symmetric states the loss in benefit is half the loss in the decentralized
case: $EU^\nu \left[ b^\nu_{w^1} + b^\nu_{l^1} \frac{dl^1}{dw^1} \right] = \frac{1}{2} EU^\nu \left[ b^\nu_{w^1} + b^\nu_{l^1} \frac{dl^1}{dw^1} \right]$. Therefore, with centralized unemployment insurance the benefit effect of reducing the negotiated wage rate is not as strong as in the decentralized case. Due to this effect, the trade union will reduce the wage level but since the effect is smaller the reduction is not quite as high as under the decentralized regime. In fact, the wage rate will be too high compared to the second-best wage rate in the scenario with decentralized unemployment insurance (compare also Saha and Schöb, 2019).

Second, the migration from state 1 to state 2 has a reverse counterpart because the centralized unemployment benefit decreases in both states if the wage in state 1 increases. Due to the lower benefit, households in state 2 also migrate to state 1, again reducing the probability of employment and the expected utility in state 1:

$$EU^\nu \left[ b^\nu_{w^1} + b^\nu_{l^1} \frac{dl^1}{dw^1} \right] \times \beta \frac{dEU^1}{dw^1} \times \left( \frac{dEU^1}{dn^1} + \frac{dEU^2}{dn^2} \right).$$

Vice versa the same reasoning applies for region 2. However, if both states are symmetric, migration flows cancel each other out. For symmetric states the first-order condition (44) becomes

$$\frac{d \ln B}{dw} = -\frac{1}{\pi n} \ln \left( 1 - \alpha \frac{1}{2} \right) + \frac{1}{EU} \left( \frac{1}{n} U_{\tilde{w}}(1-t) + \frac{1}{n} [U(\tilde{w}) - U(b)] \frac{dl}{dw} \right) \left( 1 - \beta \frac{1}{2} \right)$$

What remains is a vertical externality described above that leads to unduly high negotiated gross wages in each state. Wage negotiators undervalue the negative effect of higher wages on the centralized unemployment benefit insofar as its reduction is shared by other states. Hence, in contrast to decentralized unemployment insurance, the gross wage with centralized unemployment insurance is too high and generically not second-best with the exception of two special cases:

**Proposition 3.** In symmetric states, the negotiated gross wage level in each state with centrally organized unemployment insurance is second-best only in two special cases: (a) the share of mobile firms and workers approaches unity, $\alpha = \beta \rightarrow 1$ or, (b) in the case of $0 \leq \alpha < \beta \leq 1$, if the advantage of greater firm immobility compared to the cost of labor is outweighed by the trade union’s incentive to increase labor costs by externalizing the cost of a higher wage rate on unemployment benefits. In all other cases, the wage bargaining in the states under a centralized unemployment insurance system is not second-best.

**Proof.** See appendix.

Assume the full immobility of firms and households, that is $\alpha = \beta = 0$, and compare condition (45) to the corresponding second-best condition (32). In this special case, the only difference between both first-order conditions consists of the effect of a wage increase on the utility derived from the common unemployment benefit $b^\nu$. The cost of a wage increase in terms of the centralized unemployment benefit is halved in comparison to the second-best solution. The total benefit effect is multiplied by $\frac{1}{2}$. This means that, in comparison to second-best wage setting, the costs related to a wage increase are lowered such that the negotiated wage in the centralized scenario is higher than the second-best wage. This additionally holds true for all degrees of firm and household mobility, satisfying $0 \leq \beta \leq \alpha < 1$.

However, the difference between the higher centralized wage level and the second-best wage level, say in state 1, melts down with an increasing degree of household mobility.
The gains for the trade union from the exploitation of the vertical externality decrease because mobile households in state 2 react to this policy and are induced to migrate to state 1 due to the higher local wage level. The higher the degree of mobility, the greater the exodus from state 2 to state 1. Ceteris paribus, social welfare in state 1 then decreases due to the higher number of households among which the gains from the wage increase have to be distributed. This explains why a higher reverse migration further reduces the advantage of the cost externalization arising from higher wages in a centralized unemployment insurance system. At the limit $\alpha = \beta \to 1$, the reverse migration effect completely offsets this advantage, the vertical externality dissolves and wage setting in the centralized scenario approaches the second-best optimum.

7.2 Central government

The central government sets the uniform contribution rate $t^c$ to maximize the sum of social welfare in the state union. In particular, its objective is to maximize the sum of the social welfare (17) of the states subject to optimal local wage bargaining (44) with centralized unemployment insurance, optimal labor demand (37), the central budget (15) and the migration equilibria (12) and (13):\footnote{See Lemmata 3 and 5 for the derivation of the implicit derivatives $\frac{d\alpha m^i}{dt^c}$ and $\frac{d\beta n^i}{dt^c}$. The implicit derivative $\frac{dw^i}{dt^c} > 0$ is assumed to be positive.}

\[
\begin{align*}
\max_{t^c} \sum_{i=1}^{2} \ln V^i &= \sum_{i=1}^{2} \left[ \ln \left( \frac{f^i(l^i(w^i(t^c))) - w^i(t^c)l^i(w^i(t^c))}{(1 - \alpha)m^i + \alpha m^i(t^c)} \right) \\
&\quad + \ln \left( \frac{l^i(w^i(t^c))}{(1 - \beta)n^i + \beta n^i(t^c)} U \left( w^i(t^c)(1 - t^c) \right) \\
&\quad + \frac{(1 - \beta)n^i + \beta n^i(t^c) - l^i(w^i(t^c))}{(1 - \beta)n^i + \beta n^i(t^c)} U \left( t^c w^1(t^c)l^1(w^1(t^c)) - l^1(w^1(t^c)) \right) \right] \\
&\quad + \ln \left( \frac{w^2(t^c)}{N - l^2(w^2(t^c))} \right) \\
&\quad - l^2(w^2(t^c)) \right)
\end{align*}
\]

By setting the common contribution rate in order to maximize the sum of welfare functions, all first-order effects of the welfare in one state (1 or 2) cancel out those which run via the wage rate of another state, because these effects are already internalized by wage bargaining in the respective state (envelope theorem via (44)). The central government still must observe the effects via the wage rate in either state (2 or 1), the
direct effects of the contribution rate and the migration responses, respectively:

\[
\sum_{i=1}^{2} \frac{d \ln V^i}{dt} = \sum_{i,j=1}^{2} \frac{1}{EU^i} \left( \text{envelope in state } i \right) \left( \frac{d \text{EU}^i}{d \omega^i} + \frac{d \text{EU}^j}{d \omega^j} \right) + \frac{1}{EU^i} \left( \text{migration in state } j \right) \left( \frac{d \text{EU}^j}{d \omega^j} \right) + \frac{1}{EU^i} \left( \text{relocation of firms due to labor cost effect in state } j \right) \left( \frac{d \text{EU}^j}{d \omega^j} \right)
\]

\[
\left( EU^j w_j^j \omega_j^j + EU^j w_j^j \frac{dw_j}{d \omega^j} + EU^j \left( b_j^j + b_j^j \frac{dl_j}{d \omega^j} \right) \right) \left( 1 - \beta \frac{d \text{EU}^j}{d \omega^j} + \frac{d \text{EU}^j}{d \omega^j} \right) \equiv 0 \quad (47)
\]

with \( b_c^i = \frac{w^{i}_c + w^{j}_c}{1 - \beta} \) and \( \omega_c^i = -w^i \). The central government provides common unemployment insurance in order to optimally redistribute between the employed and the unemployed populations of each state. Furthermore, the government attempts to internalize welfare-reducing distortions on the wage bargaining level: first, the externalities of the migration of firms and households; and secondly, the trade union’s exploitation of the vertical fiscal externality. Disposing of one instrument to achieve these three goals causes the following distortions.

The central government aims at full insurance (the second-best solution) in setting the contribution rate of unemployment insurance. This means incomes in both statuses on the labor market, employed and unemployed, must be equal. However, the central government can only set a common benefit level in both member states. With a common contribution rate the government cannot take full account of asymmetric state specific conditions. Since the net wages of both states remain unequal due to the separated wage bargaining in their labor markets, incomes cannot be matched using a single instrument. From condition \( EU^j w_j^j \omega_j^j + EU^j w_j^j \frac{dw_j}{d \omega^j} = 0 \) it can be shown that such a policy leads to a loss in welfare benefits. This effect of a common policy for asymmetric states in a state union is well-known. In a federal setting, the deadweight loss from centralization has been shown by Oates (1972). Hence, the central government cannot succeed in providing full insurance unless both states are symmetric and have, in equilibrium, the same probability of unemployment. Furthermore, the insurance, or the setting of the contribution rate to provide full insurance, is distorted by migration between the states (see first two terms in (47)). If the states are symmetric, the migration responses to the insurance effect cancel each other out.

But even with symmetric states there are further distortions due to centralized decisions about unemployment insurance, preventing full insurance. Maximizing the welfare of one state (say state 1) by setting a common contribution rate must account for changes in the wage rate of the other state 2 as a result of its local wage bargaining.

First, the advantage of relative immobility distorts the wages in both states and a central government has to consider the repercussions of migration in both states on their welfare. In the decision about the common contribution rate, the central government already accounts for the effects of migration on wage bargaining in state 1 (envelope the-
orem). However, there are also migration externalities of both firms and households in state 2, which are not yet internalized. From the viewpoint of welfare in state 1, the central government addresses those migration externalities by using the common contribution rate. A higher contribution rate increases the wage in state 2 as a result of wage bargaining, and a lower contribution rate induces the opposite result. Contingent on the relative immobility of firms and households, the wage bargaining in state 2 generates higher or lower wages and the contribution rate must be adjusted accordingly. If households are more immobile than firms, \[ \alpha \frac{d\pi^d}{dm^d} / \left( \frac{d\pi^1}{dm^1} + \frac{d\pi^2}{dm^2} \right) > \beta \frac{dEU^i}{dn^i} / \left( \frac{dEU^1}{dn^1} + \frac{dEU^2}{dn^2} \right), \] the wage in state 2 increases due to the advantage of relative immobility. This migration externality can be internalized by the government if the contribution rate is reduced, which diminishes the wage rate in state 2. In this case, the share of households that migrate to state 1 is smaller than the share of firms that leave state 1. Thus, expected utility will decrease by less than the increase of profits per firm so that the welfare in state 1 increases with a lower contribution rate. If firms are more immobile, state 1 improves its welfare if it increases the common contribution rate. This is the internalization of the externalities of migration on welfare in state 1 which arise due to the advantage of relative immobility in state 2. The same reasoning applies when maximizing the welfare of state 2.

Second, there is the effort of the central government to internalize the vertical fiscal externality that – as we have shown – arises at the level of wage bargaining under a centralized unemployment insurance program. Due to the common budget, the trade union in state 2 negotiates a wage level that is inefficiently high such that the level of the common unemployment benefit is inefficiently low. Thereby, the welfare in state 1 is adversely affected. In order to decrease wages, the central government uses the common contribution rate:

\[
1 \frac{dEU^i}{EU^c} \left( b_w^c + b_l^c \frac{dV}{d\omega} \right) \frac{dw}{dc} \left( 1 - \beta \frac{dEU^1}{dn^1} / \left( \frac{dEU^1}{dn^1} + \frac{dEU^2}{dn^2} \right) \right). \]

Since the common contribution rate affects the wage rate in state 2, the central government sets a lower contribution rate to decrease wages in state 2. This increases employment in state 2 and, hence, the common unemployment benefit in both states and the welfare in state 1. However, there is again an opposing migration effect because lowering the wage in state 2 and increasing the benefit raises the expected utility in state 1 and generates migration of households to state 1. This in turn reduces employment probability and expected utility so that the increase in welfare is cushioned. This restrain any impulse to lower the contribution rate by too much. The more mobile the labor force, the stronger the migration induced by a wage increase in state 2. Ceteris paribus, this migration enhances the welfare of region 1 and diminishes it in region 2. Thus, the trade union’s intent to increase the wage level in state 2 is mitigated and the internalized distortion is weaker. Indeed, if work force mobility \( \beta \) approaches unity, the gains of the trade union in region 2 from a wage increase induced by the common budget are completely offset by the welfare effects of the inflow of workers from state 1, and the vertical externality is completely outweighed.

The overall incentives show that the central government sets an overly reduced contribution rate compared to the second-best rate due to the internalization of the vertical externality. In addition, the contribution rate may be distorted downwards or upwards depending on the relative immobility of households and firms. If the states are symmetric, the insurance condition yields full insurance against unemployment and these two distorting effects remain, impeding a second-best decision on the contribution rate with
centralized unemployment insurance. With symmetry first-order condition (47) becomes

$$\frac{d \ln V}{dt^c} = \frac{1}{EU} \frac{l}{n} (U_b - U_\tilde{b}) \left( -\frac{1}{2} \frac{\alpha - \beta}{\pi m} \right) - \frac{1}{2 - \beta} \frac{dw}{dt^c}$$

full insurance advantage of relative immobility

$$+ \frac{1}{EU} \frac{b^c}{w} \left( \frac{n - l}{n} + \frac{w \, dl}{l \, dw} \right) \frac{1 - \beta}{2 - \beta} \frac{dw}{dt^c} = 0$$

(48)

and the following proposition holds

**Proposition 4.** In symmetric states, a centrally organized unemployment insurance program is second-best in two special cases: (a) the share of mobile firms and households in the state union approaches unity, \( \alpha = \beta \to 1 \), or (b) in the case of \( 0 \leq \alpha < \beta \leq 1 \), the effects of the migration externalities on the contribution rate have the same absolute strength as the effect of the vertical externality. In all other cases, the central government cannot provide full insurance against the risk of unemployment.

**Proof.** See appendix.

The first-order condition with symmetric regions (48) shows that in order to internalize the vertical fiscal externality the central government adjusts the contribution rate less strong if the share \( \beta \) of mobile worker increases. In the special case that worker mobility approaches unity, \( \beta \to 1 \), no vertical externality occurs. Open borders and migration prevent the trade union from externalizing cost from state 2 to state 1, and no governmental intervention is required to maximize social welfare. If in addition the share of mobile firms approaches unity, then neither firms nor workers can take advantage of relative immobility. The migration externalities, which originate from wage bargaining in state 2 and adversely affect welfare in state 1, have the same relative strength such that the wage level in state 2 is not distorted and no inefficient migration of either firms or workers is induced. For \( \alpha = \beta \to 1 \) the common contribution rate \( t^c \) then needs to serve only a single purpose: optimal labor force insurance. First-order condition (48) approaches the second-best condition (35).

To this point, we have shown that a centralized unemployment insurance system induces a vertical fiscal externality at the level of wage bargaining in the states because negotiators can partly externalize the cost of higher wages and therefore increase them above efficient levels. As a consequence, the central government attempts to internalize the vertical externality and sets the contribution rate lower than would be optimal in order to bring down excessive wages. In addition, the contribution is distorted by the advantage of relative immobility. These distorting effects arise because of the common pool character of the insurance market, which allows for the externalization of costs via the indirect effects of wages in the other state. The asymmetric federal design of centralized unemployment insurance mixed with decentralized wage bargaining within states

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22 If a persistent subsidization and therefore ex ante redistribution is to be avoided with centralized unemployment insurance, a certain degree of symmetry is required across the participating countries. Otherwise, the insurance aspects will be diluted with distributional considerations.

23 Due to stability requirements the special case of \( \alpha = \beta = 1 \) cannot be considered. For full mobility of firms and workers the migration equilibria had either no solution or an infinite number of solutions, because with full mobility the central government was induced to set a fair contribution rate such that \( dEU^1/dn^1 = 0 \), which is excluded. However, valid migration equilibria are defined for values of \( t^c \) around the fair contribution rate.
is the reason for the vertical fiscal externality and the advantage of relative immobility. Both effects vanish if the symmetry of centralization (or decentralization) of institutions on all federal levels is restored. In our setting the distortion of governmental behavior can be healed by centralizing the wage negotiations in the state union. Then, the trade unions and firm associations of both states determine a common wage level for the state union. All indirect effects via wages are internalized from the viewpoint of the central government because they are taken care of in a centralized wage bargaining system. What remains is the insurance condition. With asymmetric states the central government cannot provide full insurance in both because the employment probabilities of the labor force are still conditional on the place of residence. Therefore, unless regions merge, centralized government behavior is second-best only in the symmetric case:

**Proposition 5.** In symmetric states, a centrally organized unemployment insurance system is second-best, if collective wage bargaining is also centralized and yields a common wage level for the whole state union.

**Proof.** See appendix.

The centralization of unemployment insurance is accompanied by several distortions which make it generically inefficient. A main reason for this result is the non-alignment of the levels on which decision making takes place. Decentralized wage determination and centralized contribution rate setting causes migration and fiscal externalities. Aligning the decision-making process eliminates these distortions. However, the asymmetry of states ultimately prevents the accomplishment of a second-best solution via a single governmental policy instrument.

**8 Conclusion**

Should unemployment insurance be centralized in a state union? This paper presents two answers. The first answer is that it depends on the degree of mobility of households and firms between the member states of the state union. Only with perfect mobility is the centralized organization of unemployment insurance second-best and equivalent to the decentralized organization of the states. In this case migration offsets the vertical fiscal externality that arises from centralized unemployment insurance. In all other cases, if there are any costs of migration, like administrative obstacles, language barriers, cultural distinctions, etc., the decentralized insurance systems of the states are superior in terms of efficiency to centralized insurance at the union level.

The second answer is that centralized unemployment insurance is only inferior to decentralized state insurance if wage bargaining within state labor markets remains decentralized. This setting creates the vertical fiscal externality and all included migration effects that would vanish if wage bargaining took place centrally and a uniform wage were negotiated for the whole state union. In this case centralized unemployment insurance would become second-best. This may explain why a centralized unemployment insurance system in a federal nation can be justified for reasons of efficiency if a nation’s internal mobility is very high or if wage setting is also centralized with binding standard wages nationwide. At the same time, a supranational organization could be rejected on the same grounds if those conditions are not satisfied.

This gives rise to a wider perspective on efficient fiscal-federal structures of a state union. As long as collective decisions in economic institutions (like unemployment insurance and cooperative wage bargaining within labor markets) are connected by a common
budget and organized at different levels of the federation, vertical externalities may arise which distort the central decision. Thus, a principle of efficient federal systems for further investigation might be that fiscally linked economic institutions should be ruled on the same federative layer: centrally or decentrally.
Appendix

Wage bargaining - outside options:

In each state the firm association and the trade union take part in the gross wage negotiations, if the payoff from successful negotiations is positive for firms and workers. The payoffs are positive if the profit per firm and the expected utility are higher with a wage agreement than the respective outside options for both parties. First, consider the second-best as well as the decentralized scenario. For immobile subjects, the outside option in state 1 is clearly zero as no production takes place if negotiations break down. However, mobile firms and workers can move to state 2, where the total profit, the wage, the unemployment benefit and the employment level take positive values in the case of successful gross wage negotiations there. Note that firm relocation and worker emigration implies a change of union membership and that the labor market conditions are pre-determined. Then, outside options in state 1 are defined as follows:

\[
\pi_{sb,dc}^1 = \Pi^2 - \alpha \frac{m^1}{m} \text{ for firms}
\]

and

\[
EU_{sb,dc}^1 = U\left(\frac{tw^2l^2}{n^2} - l\right) - U\left(\frac{tl(n+\beta)}{n(1+\beta)} - l\right) + \frac{l}{n} \left(U(w(1-t)) - U\left(\frac{tw}{n-l}\right)\right) \text{ for workers.}
\]

The mobile firms and workers from state 1 each claim a share of given total profit and tax revenues from state 2. If membership is non-exclusive, pure welfare migration emerges. In the case of centralized unemployment insurance, mobile as well as immobile workers receive an alternative income via the common unemployment benefit and no worker emigration takes place if negotiations break down in state 1. Then, the workers’ outside option is defined as

\[
EU_{c}^1 = U\left(\frac{tw^2l^2}{N^2} - l\right).
\]

For firms, \(\pi_{c}^1 = \pi_{sb,dc}^1\) holds.

**Lemma 1.** For symmetric states and the defined outside options, (a) in each state the local firm association always prefers negotiation, and (b) the local trade union prefers participation in wage negotiations if the sum of utility gains (from entering negotiations) for the complete labor force is higher than the losses for the employed.

**Proof.** Define the payoffs in the Nash bargaining problem (16) with positive outside options as follows: \(S_{F}^i = \pi_{i}^1 - \pi_{i}^1\) for the firm association and \(S_{TU}^i = EU_{i}^1 - \tilde{EU}_{i}^1\) for the trade union. Both parties prefer to take part in the negotiations, if \(S_{F}^i \geq 0\) and \(S_{TU}^i \geq 0\).

Part (a): The firms’ payoff is given by

\[
SP_{F}^i = \frac{\Pi}{m} - \frac{\Pi}{m + \alpha m} \frac{\alpha m}{m} = \frac{\Pi}{m} \left(1 - \frac{\alpha}{1+\alpha}\right) > 0
\]

Part (b): The workers’ payoff in the decentralized case is given by

\[
S_{TU,dc}^i = U\left(\frac{twl}{n-l}\right) - U\left(\frac{twl}{n(1+\beta)} - l\right) + \beta \frac{n}{n} \left(U(w(1-t)) - U\left(\frac{twl}{n-l}\right)\right) \text{ for workers.}
\]

The sum of the first and second term is positive for any value of \(0 < t^i < 1\). For \(t^i \leq \frac{w^i-l^i}{n^i}\), the third term is non-negative such that \(S_{TU}^i > 0\). For \(t^i > \frac{w^i-l^i}{n^i}\), the third term is negative. Then, \(S_{TU,dc}^i > 0\), if and only if the utility loss from being employed is lower than the utility gain for the complete labor force.
The trade union’s surplus from successful negotiations in the centralized case is given by

\[ S_{TU,c} = U \left( \frac{twl}{n-l} \right) - U \left( \frac{twl}{2n-l} \right) + \frac{l}{n} \left( U(w(1-t)) - U \left( \frac{twl}{n-l} \right) \right) \]  

(51)

and the same reasoning as in the decentralized case applies.

\[ \blacksquare \]

Migration equilibria - implicit derivatives:

**Lemma 2.** With decentralized unemployment insurance, the relocation responses of the firms, \( \frac{\partial \alpha_i}{\partial l_i}, \frac{\partial \alpha_i}{\partial w_i} \) and \( \frac{\partial \alpha_i}{\partial t_i} \) are obtained as follows.

Define the relocation equilibrium of firms, given by equation (11), as an implicit function

\[ \phi \equiv \frac{\alpha(f(l) - w l)}{\alpha m_i} - \frac{\alpha(f(l) - w j l)}{\alpha M - \alpha m_j} = 0 \]  

(52)

The partial derivative with respect to the number of mobile firms is given by

\[ \frac{\partial \phi}{\partial \alpha_m} = -\frac{\alpha \Pi_i}{(\alpha m_i)^2} - \frac{\alpha \Pi_j}{(\alpha m_j)^2} = -\left( \frac{\Pi_i}{(m_i)^2} + \frac{\Pi_j}{(m_j)^2} \right) \frac{1}{\alpha} \]

and the partial derivative with respect to the number of employed by

\[ \frac{\partial \phi}{\partial l_i} = \frac{\alpha(f(l) - w_i l)}{(\alpha m_i)^2} = \frac{f(l) - w_i l}{m_i} \]

By the envelope theorem and optimal employment \( l(w) \), the partial derivative with respect to the wage level \( w \) is given by

\[ \frac{\partial \phi}{\partial w} = \frac{\alpha(-l)\alpha m_i}{(\alpha m_i)^2} = \frac{m_i}{(m_i)^2} (-l) = -\frac{l}{m_i} \]

Taking into account \( w(t) \) and \( l(w(t)) \), the partial derivative with respect to the contribution rate level \( t \) is given by

\[ \frac{\partial \phi}{\partial t} = \frac{\alpha(-l)\alpha m_i}{(\alpha m_i)^2} \frac{d\alpha m_i}{dt} = \frac{m_i}{(m_i)^2} (-l) \frac{d\alpha m_i}{dt} = -\frac{l}{m_i} \frac{d\alpha m_i}{dt} \]

The firms’ relocation responses are then given by \( \frac{\partial \alpha_i}{\partial l_i} = -\frac{\phi_i}{\phi_{\alpha_m}}, \frac{\partial \alpha_i}{\partial w_i} = -\frac{\phi_i}{\phi_{\alpha_m}} \) and \( \frac{\partial \alpha_i}{\partial t_i} = -\frac{\phi_i}{\phi_{\alpha_m}} \).
Lemma 3. With centralized unemployment insurance, the relocation responses of the firms, \( \frac{d\alpha m}{dl^i} \), \( \frac{d\alpha m}{dw^i} \) and \( \frac{d\alpha m}{dt_c} \) are obtained as follows.

Define the relocation equilibrium (12) of firms as an implicit function

\[
\phi \equiv \frac{\alpha(f(l^i) - w^i l^i)}{\alpha m^i} - \frac{\alpha(f(l^j) - w^j l^j)}{\alpha M - \alpha m^i} = 0
\]

the partial derivative with respect to the number of mobile firms is given by

\[
\frac{\partial \phi}{\partial \alpha m^i} = -\frac{\alpha \Pi^i}{(\alpha m^i)^2} - \frac{\alpha \Pi^j}{(\alpha m^j)^2} = -\left(\frac{\Pi^i}{(m^i)^2} + \frac{\Pi^j}{(m^j)^2}\right) \frac{1}{\alpha}
\]

and the partial derivative with respect to the number of employed by

\[
\frac{\partial \phi}{\partial l^i} = \frac{\alpha (f_{l^i} - w^i) \alpha m^i}{(\alpha m^i)^2} = m^i \frac{f_{l^i} - w^i}{m^i}
\]

By the envelope theorem and optimal employment \( l^i(w^i) \), the partial derivative with respect to the wage level \( w^i \) is given by

\[
\frac{\partial \phi}{\partial w^i} = \frac{\alpha (-l^i) \alpha m^i}{(\alpha m^i)^2} = m^i \frac{-l^i}{(m^i)^2} = -l^i m^i
\]

Taking into account \( w^i(t^i) \) and \( l^i(w^i(t^i)) \), the partial derivative with respect to the common contribution rate level \( t^c \) is given by

\[
\frac{\partial \phi}{\partial t^c} = \frac{\alpha (-l^i) \alpha m^i \frac{d w^i}{dt^c}}{(\alpha m^i)^2 \frac{dt^c}{dt^c}} - \frac{\alpha (-l^j) \alpha m^j \frac{d w^j}{dt^c}}{(\alpha m^j)^2 \frac{dt^c}{dt^c}} = -\left(\frac{l^i}{m^i} \frac{dw^i}{dt^c} - \frac{l^j}{m^j} \frac{dw^j}{dt^c}\right)
\]

The firms’ relocation responses are then given by \( \frac{d\alpha m}{dl^i} = -\frac{\phi_{l^i}}{\phi_{\alpha m^i}} \), \( \frac{d\alpha m}{dw^i} = -\frac{\phi_{w^i}}{\phi_{\alpha m^i}} \) and \( \frac{d\alpha m}{dt^c} = -\frac{\phi_{t^c}}{\phi_{\alpha m^i}} \).
Lemma 4. With decentralized unemployment insurance, the migration responses of the work force, $\frac{d\beta_{n}}{dw}$ and $\frac{d\beta_{n}}{dt}$ are obtained as follows.

Define the migration equilibrium of firms, given by equation (12), as an implicit function

$$\phi \equiv \frac{\beta_{l}^{i}}{\beta_{n}^{i}}U^{i}(w^{i}(1 - t^{i})) + \frac{\beta_{n}^{i} - \beta_{l}^{i}}{\beta_{n}^{i}}U^{i} \left( t^{i} \frac{w^{i}}{\beta_{l}^{i}} \right)$$

$$- \frac{\beta_{l}^{j}}{\beta_{N}^{j} - \beta_{n}^{i}}U^{j}(w^{j}(1 - t^{j})) - \frac{\beta_{N}^{j} - \beta_{n}^{i} - \beta_{l}^{j}}{\beta_{N}^{j} - \beta_{n}^{i}}U^{j} \left( t^{j} \frac{w^{j}}{\beta_{l}^{j}} \right) = 0$$

The partial derivative with respect to the mobile workforce $\beta_{n}^{i}$ is given by

$$\frac{\partial \phi}{\partial \beta_{n}^{i}} = - \left( \frac{\partial}{\partial \beta_{n}^{i}} \left[ \frac{U^{i}(\tilde{w}^{i}) - U^{i}(b^{i})}{(n^{i})^{2}} \right] + \frac{1}{n^{i}} \frac{\partial}{\partial w^{i}} U^{i}_{t^{i}} \right) \frac{1}{\beta_{l}^{i}}$$

Taking into account $\beta_{l}^{i}(w^{i})$, the partial derivative with respect to the wage level $w^{i}$ is given by

$$\frac{\partial \phi}{\partial w^{i}} = \frac{1}{n^{i}} \left[ U^{i}(\tilde{w}^{i}) - U^{i}(b^{i}) \right] \frac{d\beta_{l}^{i}}{dw^{i}} + \frac{1}{n^{i}} U^{i}_{w^{i}}(1 - t^{i}) + \frac{1}{n^{i}} U^{i}_{b^{i}} \left( \frac{n^{i}}{n^{i} - \beta_{l}^{i} w^{i}} \right) t^{i}$$

Taking into account $w^{i}(t^{i})$ and $\beta_{l}^{i}(w^{i}(t^{i}))$, the partial derivative with respect to the contribution rate level $t^{i}$ is given by

$$\frac{\partial \phi}{\partial t^{i}} = \frac{1}{n^{i}} w^{i} \left( U^{i}_{b^{i}} - U^{i}_{\tilde{w}^{i}} \right)$$

$$+ \left( \frac{1}{n^{i}} \left[ U(\tilde{w}^{j}) - U(b^{j}) \right] \frac{d\beta_{l}^{j}}{dw^{j}} + \frac{1}{n^{j}} U^{j}_{w^{j}}(1 - t^{j}) + \frac{1}{n^{j}} U^{j}_{b^{j}} \left( \frac{n^{j}}{n^{j} - \beta_{l}^{j} w^{j}} \right) t^{j} \right) \frac{dw^{j}}{dt^{j}}$$

The work force’s migration responses are then given by $\frac{d\beta_{n}^{i}}{dw^{i}} = - \frac{\phi_{w^{i}}}{\phi_{\beta_{n}^{i}}}$ and $\frac{d\beta_{n}^{i}}{dt^{i}} = - \frac{\phi_{t^{i}}}{\phi_{\beta_{n}^{i}}}$.
Lemma 5. With centralized unemployment insurance, the migration responses of the work force, \( \frac{\partial \phi}{\partial w} \) and \( \frac{\partial \phi}{\partial t} \) are obtained as follows.

Define the migration equilibrium (13) of the work force as an implicit function

\[
\phi \equiv \frac{\beta l}{\beta n} U^i(w^i(1 - t^c)) + \frac{\beta n - \beta l}{\beta n} U^i \left( t^c \frac{w^i \beta l + w^j \beta l}{\beta N - \beta l - \beta l} \right) - \frac{\beta l}{\beta N - \beta n} U^j(w^j(1 - t^c)) - \frac{\beta N - \beta n - \beta l}{\beta N - \beta n} U^j \left( t^c \frac{w^i \beta l + w^j \beta l}{\beta N - \beta l - \beta l} \right) = 0
\]

The partial derivative with respect to the mobile workforce \( \beta n \) is given by

\[
\frac{\partial \phi}{\partial \beta n} = - \left( \frac{U^i(\tilde{w}^i) - U^i(b^c)}{(n^i)^2} + \frac{U^j(\tilde{w}^j) - U^j(b^c)}{(n^j)^2} \right) \frac{1}{\beta}
\]

Taking into account \( \beta l(w^i) \), the partial derivative with respect to the wage level \( w^i \) is given by

\[
\frac{\partial \phi}{\partial w^i} = \frac{1}{n^i} \left( U^i(\tilde{w}^i) - U^i(b^c) \right) \frac{d^i}{dw^i} + \frac{1}{n^i} U_{\tilde{w}^i}(1 - t^c)
\]

Taking into account \( w^i(t^c) \) and \( \beta l(\tilde{w}^i(t^c)) \) as well as \( w^i(t^c) \) and \( \beta l(\tilde{w}^i(t^c)) \), the partial derivative with respect to the common contribution rate level \( t^c \) is given by

\[
\frac{\partial \phi}{\partial t^c} = - \frac{1}{n^i} U_{\tilde{w}^i} w^i + \frac{n^i - l^i}{n^i} U_{\tilde{w}^i} \left( \frac{w^i l^i + w^j l^j}{N - l^i - l^j} \right) + \left( \frac{1}{n^i} U^i(\tilde{w}^i) - U^i(b^c) \right) \frac{d^i}{dw^i} + \frac{1}{n^i} U_{\tilde{w}^i}(1 - t^c)
\]

The work force’s migration responses are then given by \( \frac{\partial \phi}{\partial w} = - \frac{\phi w}{\phi_{\beta n}} \) and \( \frac{\partial \phi}{\partial t} = - \frac{\phi t}{\phi_{\beta n}} \)
Proof of Proposition 1
Part (a): Consider condition (40) and evaluate at $0 \leq \alpha = \beta \leq 1$. Dividing by $(1 - \beta \frac{1}{2})$ then yields the second-best condition (32). Part (b): Consider condition (40) and evaluate at $0 \leq \alpha < \beta \leq 1$. In comparison to second-best condition (32) then, costs from a wage increase related to profit per firm are always evaluated higher than the gains for expected utility, because $1 - \alpha \frac{1}{2} > 1 - \beta \frac{1}{2}$. Thus the negotiated wage level is lower than in the second-best case.

Proof of Proposition 3
Part (a): Consider condition (45) and evaluate at $\alpha = \beta \rightarrow 1$. Dividing by $\frac{1}{2}$ then yields the second-best condition (32). Part (b): Consider condition (45) and evaluate at $0 \leq \beta \leq \alpha < 1$ such that $1 - \alpha \frac{1}{2} \leq 1 - \beta \frac{1}{2}$. Dividing by $1 - \beta \frac{1}{2}$ then shows that in the case with centrally organized unemployment insurance, the costs of a wage increase related to the benefits and the profit per firm are evaluated lower than in the second-best case. Thus, the negotiated wage level is higher than the second-best case. Now evaluate at $0 \leq \alpha < \beta < 1$ such that $1 - \alpha \frac{1}{2} > 1 - \beta \frac{1}{2}$. Dividing by $1 - \beta \frac{1}{2}$ and comparing to the second-best first-order condition (32) shows that the effect of a wage adjustment on the profit per firm is evaluated at a higher level, while the effect on the unemployment benefit is evaluated at a lower one. Effects on the net wage and the labor market status are weighed equally. Then, any combination of mobility degrees $0 \leq \alpha < \beta \leq 1$, which yields a relative advantage of firm immobility whose negative effect on the negotiated wage rate outweighs the positive trade union’s intent to negotiate a higher wage, implies that centralized wage bargaining is second-best.

Proof of Proposition 4
Part (a): Evaluate condition (48) at $\alpha = \beta \rightarrow 1$. Then, $\frac{d \ln V}{d \omega} = \frac{1}{\epsilon \ell \bar{w}} \left( U_{\bar{w}} - U_{\bar{w}} \right) \frac{1}{\epsilon} = 0$, which is equivalent to the second-best condition for providing unemployment insurance. Part (b): In the case of $0 \leq \alpha < \beta \leq 1$, the second term in condition (48) has the opposite sign of the third term in condition (48). Any combination of mobility degrees $0 \leq \alpha < \beta \leq 1$, which equalizes the absolute strength of both terms, implies that the central government provides full insurance against the risk of unemployment.

Proof of Proposition 5
Consider the maximization problem (46) of the central government and assume $w^1 = w^2$. Under the condition of symmetric objective functions in collective wage bargaining and social welfare maximization, the envelope theorem states that no indirect effect of the contribution rate on the common wage level enters the first-order condition of the central government. Then, only the government’s direct effects remain. Due to different budgetary conditions, it follows directly that only in the case of symmetry the governmental first-order condition coincides with that of the constrained social planner.
References


