Should unemployment insurance be centralized in a state union?

Unearthing a principle of efficient federation building

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Abstract

From the perspective of efficiency we compare a central with a decentral unemployment insurance in a state union. We use a model of two countries with collective bargaining about the regional gross wages and partial mobility of the labor force and the firms between the states, which gives rise to distortive migration incentives. Additionally, 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, a decentral unemployment insurance in the states is second-best irrespective of the degree of mobility and regional asymmetries. Furthermore, efficiency depends on the federal setting. If the wage bargaining on the labor markets is decentral, then decentral decisions about the unemployment insurances in the states are superior to a central insurance and second-best. In general, for the efficiency of a central unemployment insurance it matters whether decisions in related institutions like the 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
1 Introduction

Should social security systems of member states in a state union be centralized or remain in the single country’s competence? In the European Union once and again the centralization of a European unemployment insurance has 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 transfers from economically more successful countries to less successful ones. Usually this debate deals with the stabilization function of a common unemployment insurance. Here the centralization serves as a mutual interstate insurance against asymmetric economic shocks on the labor markets. However, another perspective of such a centralization are the allocational effects on migration and on the labor market, and the optimality of the unemployment insurance.

In this paper we compare the efficiency of a central organization of the unemployment insurance at the state union’s level with a decentral organization in the countries. In the model, two countries form a state union. In both countries, labor markets are governed by the bargaining of trade unions and firms about the gross wage rate. An individual of the labor force can be employed or unemployed with a probability which is given 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 by a public insurance. Under both types of unemployment insurance, decentralized or centralized, the government determines the contribution rate on wages in order to finance the insurance budget. The labor force as well as the firms in both countries may migrate between the states. They face migration costs which is reflected in the shares of both groups being mobile and immobile.

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 wage bargaining parties.

Having defined this second-best allocation as benchmark, we study the decentral organization of unemployment insurance. Again trade unions and firms in each state determine the local wage by collective bargaining. The local government chooses the parameters of the unemployment insurance taking account of the negotiated gross wages. In this regime, migration of individuals and relocation of firms between the countries affect the wage chosen by collective bargaining in each state and the decision of the local government about the unemployment insurance. Distortive relocation and migration incentives arise and their severity depends on cost of migration. In this decentral regime we get the following results.

The contribution rate of the government is second-best irrespective of firms’ and workers’ mobility cost. The government provides full unemployment insurance, because migration effects on 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 second-best, too. If mobility differs between workers and firms, the group which is more immobile causes a relatively less severe externality and is therefore favored in the wage bargaining. For example, if the labor force is more immobile than firms, the negotiated wages are higher than the second-best wages. However, this does
not affect the efficiency of the unemployment insurance, where the contribution rate is second-best with symmetric as well as asymmetric states.

Next we analyze the central 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 the contributions into a common budget of unemployment insurance. The unemployment benefit is the same for all unemployed individuals in the state union. However, the trade unions and the firms still negotiate about the wage separately in each state. For symmetric regions, we find the following results.

On the level of regional wage negotiations, decisions of the governments about unemployment insurance do not induce labor force migration anymore. However, there are migrational effects 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, this vertical fiscal externality and the migration effects force the wage level into opposite directions. The migration effect partially crowds out the negative vertical externality. In general, wages are negotiated too high. While the vertical fiscal externality is independent of mobility, the compensating migration effect increases with mobility. With perfect mobility the latter effect outweighs the former one and wages are second-best. Only in this special case of full mobility of firms and labor force, the central contribution rate approaches the second-best level, too. Otherwise, central unemployment insurance is generically inefficient.

Governmental behavior in both scenarios hinges essentially on our assumption of imperfect labor markets. Since the effect that in a labor market with trade unions a change in the contribution rate affects the negotiated gross wage is essential for all results. This is an important difference to inter-regional models with mobile workers in integrated perfect labor markets (see e.g. 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 the central unemployment insurance depends on the degree of centralization of the wage bargaining in the state union. The vertical fiscal externality which distorts the central government’s decision about the unemployment insurance even in the case of symmetric states arises only if the wage negotiations are decentralized in the states. If the labor markets were integrated in the sense of implementing a central wage bargaining, a centralized unemployment insurance could also be efficient. This gives rise to consider a more general question of building institutions in a federal system of states. A principle of efficient implementation of institutions in a federation could be the following: institutions connected by a common federal budget should be regulated on 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 the second-best case. Section 5 analyzes optimal labor demand for both cases of unemployment insurance. Then section 6 discusses the behavior of the trade union and the firm association as well as government behavior in the decentralized setting. Section 7 proceeds with central organization of unemployment insurance. Section 8 concludes.

2 Literature review

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

The second strand of literature focuses on the efficiency of the insurance itself. E.g. it is asked whether full insurance against the risk of unemployment can be provided, if a common unemployment insurance 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 the trade unions themselves. In the latter case, the so-called Ghent-system, trade unions determine the parameters of the unemployment insurance. If the government subsidizes the local insurance funds, Holmlund and Lundborg (1988) show that trade unions partially externalize the cost of bargaining 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. In the context of collective wage bargaining on the labor market, unemployment insurance may be organized either by the government or by the trade unions themselves. In the latter case, the so-called Ghent-system, trade unions determine the parameters of the unemployment insurance. If the government subsidizes the local insurance funds, Holmlund and Lundborg (1988) show that trade unions partially externalize the cost of bargaining 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 a setting with centralized unemployment insurance. 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 mobility of firms and the complete 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 wage setting may also occur if trade unions do not see through the budget of the unemployment insurance. 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 in this case. Then, if governments can persuasively commit to their policies, the government aims 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 took 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 with increasing mobility of the labor force, 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 set contribution rates strategically too low. This result is driven by 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 decreasing immigration, the sector specific unions limit the generosity of the unemployment insurance. Even though similar migration effects occur in our setting, we can show that the mobility of firms 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 the state governments while the trade unions do only engage in wage negotiations. As noted by Boeri et al. (2001), the
majority of unemployment insurance systems in most European countries is organized by
the government but collective wage bargaining is of relevance in each of them.

Horizontal inter-jurisdictional externalities or effects are well understood in the litera-
ture on fiscal federalism (see Zodrow and Mieszkowski, 1986, Wildasin, 1991 or Dahlby,
1996 among others). E.g. 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 contribu-
tion rate setting. The interplay of horizontal and vertical fiscal externalities, in turn,
were elaborated firstly and extensively by Keen and Kotsogiannis (2002). For the case
of local public goods and federal tax spending they showed that both externalities drive
the local tax rates into 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 much different case of central unemployment
insurance organization. Surprisingly, all externalities outweigh each other in the special
case of full mobility and symmetric regions. Then, a central unemployment insurance
approaches the second-best solution, which means full insurance against the risk of being
unemployed.

Novel results of our paper include that (i) decentral wage setting may be second-
best irrespective of the degree of mobility even in the case of asymmetric regions, (ii)
central 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 central unemployment insurance can be achieved by centralizing all related economic
policy decisions as well.

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 and
receive each the share \( \pi^i \) of the regional total 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 \( f_{l^i l^i} < 0 \).\(^1\) 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 \( w^i \).

\(^1\)The partial derivative of the variable \( x \) with respect the variable \( y \) is denoted by \( x_y \) and
the second partial derivative by \( x_{yy} \).
3.2 Labor force

Each individual is endowed with one unit of labor inelastically supplied in the state of residence. The number of individuals $n_i$ in either state are divided in the subgroups of the employed $l_i$ and the unemployed $u_i$:

$$n_i = l_i + u_i, \quad i = 1, 2$$  \hspace{1cm} (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 $\frac{u_i}{n_i} = \frac{n_i - l_i}{n_i}$. Ex ante, the individuals do not know their labor market status. If they are employed they receive a net wage $\tilde{w}_i \equiv w_i(1 - t_i)$ where $w_i$ represents the gross wage and $t_i$ denotes the contribution rate of the unemployment insurance. If the individuals are unemployed they receive an unemployment benefit $b_i$. With their income, either the net wage or the 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 being insured against the risk of unemployment. The expected utility $EU_i$ of an individual living in either of both states is given by:

$$EU_i = \frac{l_i}{n_i} U(\tilde{w}_i) + \frac{n_i - l_i}{n_i} U(b_i), \quad i = 1, 2$$  \hspace{1cm} (5)

3.3 Migration

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

$$\pi^1 - \pi^2 = 0$$  \hspace{1cm} (6)

$$EU^1 - EU^2 = 0$$  \hspace{1cm} (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. Thus we incorporate migration and location costs in 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 are the migration costs. The number of firms in either state divides 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 the immobile 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 $l^i_{mob}$ to all employed $l^i$:

$$\alpha^i = \frac{m^i_{mob}}{m^i} = 1 - \frac{m^i_{immob}}{m^i}$$  \hspace{1cm} (8)

$$\beta^i = \frac{n^i_{mob}}{n^i} = \frac{l^i_{mob}}{l^i} = 1 - \frac{l^i_{immob}}{l^i} = 1 - \frac{n^i_{immob}}{n^i}$$  \hspace{1cm} (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

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

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

All firms, mobile and immobile, receive the same share of total profit $\Pi^i$. The share of total profit which is assigned to the mobile firms is given by $\Pi_{mob}^i = \alpha \Pi^i$. Then the migration equilibrium of mobile firms determines how many firms locate in each of both countries:

$$\frac{\Pi_{mob}^1}{\alpha m^1} - \frac{\Pi_{mob}^2}{\alpha M - \alpha m^1} = 0$$

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

$$\frac{U_{mob}^1}{\beta n^1} - \frac{U_{mob}^2}{\beta N - \beta n^1} = 0$$

which shows the division of the mobile individuals to both countries.

### 3.4 Unemployment insurance

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

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

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 to 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

$$b^c (N - t^1 - t^2) = t^c (w^1 l^1 + w^2 l^2)$$

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 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 $\beta n^i(w^i)$.

\(^2\)Symmetric bargaining powers in the negotiations are assumed, because it eases the calculus without affecting the general results of the paper.
The negotiators consider the budgets (14) or (15) of the governments, take as given the contribution rates and take into account 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.

3.6 Social optimum and governmental regimes

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

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

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 about the unemployment insurance in the state. 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 of a common unemployment insurance for all states of the state union. The central government sets the unitary parameters of the common unemployment insurance, taking account of open borders and partial migration of individuals and firms.

Each of the governments in the different regimes 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 of 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 own redistributive goals. This implies that the welfare of both social groups is equally weighted.

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

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

5We take the second-best allocation as benchmark for the welfare optimum since we focus on the problem whether a central or a decentral unemployment insurance is closer to the optimum in an economic world with unemployment and cooperative wage-bargaining.

6The welfare function exhibits the same weights for the social groups of the labor force and the firms.
### 3.7 Sequence of decisions

At the first stage, the government decides about the contribution rate which maximizes a social welfare function. All other endogenous variables are taken into account by the government, including migration responses. At the second stage, the negotiators of the wage bargain take as given the contribution rate. Like the government, they take into account the effects of their wage setting on migration and relocation. If the wage is determined, the firm association decides at the third stage about the number of workers it wishes to employ in the sector. Finally, at the fourth stage, workers decide whether to migrate to the other country by comparing net wages and benefits between both countries, and firms decide about their location by comparing 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 on the labor market as the governments with decentral and central unemployment insurance, i.e. she is bound by imperfections on 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

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

(18)

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

\(^7\)As the bargaining function. We have checked the implications of having different weights. An additional effect arises (the so-called misrepresentation effect, see Fenge and Friese, 2018) both in the decentral and in the central decision about unemployment insurance which does not affect the comparative results of both regimes.

\(^7\)To ensure interior solutions of the different maximization problems throughout the paper, we generally assume that second-order conditions are fulfilled.
\[
\frac{d \ln V^i}{dt^i} = \frac{1}{EU^i}EU_{\bar{w}^i}\tilde{w}^i + \frac{1}{EU^i}EU_{b^i}b^i = 0
\]

(19)

\text{insurance condition}

or: \(U_{\bar{w}^i} - U_{\tilde{w}^i} = 0\) \(20\)

with \(EU_{\bar{w}^i} = \frac{\partial U_i}{\partial \bar{w}^i}, \tilde{w}^i = -w^i, EU_{\tilde{w}^i} = \frac{n-i}{m}U_{\bar{w}^i}\) and \(b^i = \frac{w^i - \bar{w}^i}{n-i}\). By changing the value of \(t^i\), the social planner redistributes income between the two 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 as an employed and the second term as an unemployed. Condition (20) describes full insurance against unemployment and reveals that the optimal contribution rate balances the marginal utilities of the employed and the unemployed. This is realized at the actuarial fair contribution rate: \(t^i = \frac{n-i}{m}\) which is equal to the unemployment probability.

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

\[
\frac{d \ln V^i}{dw^i} = \frac{1}{\pi^i}\pi^i_{\bar{w}^i} + \frac{1}{EU^i}EU_{\tilde{w}^i}\tilde{w}^i + \frac{1}{EU^i}EU_{b^i}b^i = 0
\]

(21)

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

(22)

with \(\pi^i_{\bar{w}^i} = -\frac{\bar{w}^i}{m}, \tilde{w}^i = (1 - t^i)\) and \(b^i = t^i\frac{w^i - \bar{w}^i}{n-i}\). With the decision about the gross wage the social planner optimally redistributes between the labor force and the firms by allocating profits and income. Three effects are taken into account. The labor cost effect describes the effect of a gross wage adjustment on the cost of employing labor, the net wage effect the effect 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 (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

\[
\frac{d \ln V}{dl^i} = \frac{1}{\pi^i}\pi^i_{\tilde{u}^i} + \frac{1}{EU^i}EU_{\tilde{u}^i}\tilde{u}^i + \frac{1}{EU^i}EU_{b^i}b^i = 0
\]

(23)

with \(\pi^i_{\tilde{u}^i} = \frac{1}{m}(f^i - w^i), EU_{\tilde{u}^i} = \frac{1}{m}[U(\tilde{w}^i) - U(b^i)]\) and \(b^i = t^i\frac{w^i - \bar{w}^i}{m - l^i}\). The first term describes the effect of an adjusted employment level on the producers’ surplus while the status effect denotes the impact on expected utility via the number of households which change their labor market status. The benefit effect via employment describes 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 amount of firms, say in state 1, \( m^1 \) is given by

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

(24)

or: \( \frac{1}{2} M = m^1 \)  

(25)

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

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

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

(26)

or:

\[
\frac{dU^1_{b^1}}{db^1} \frac{w^1}{U^1} dU^2_{b^2} \frac{w^2}{U^2} \frac{1}{N} = \frac{1}{2} N
\]  

(27)

with \( EU^i_{n^i} = \frac{U^i}{(\sigma^i)^2} (U^i(\tilde{w}^i) - U^i(b^i)) \) and \( b^i = \frac{\tilde{w}^i w^i}{(w^i - \tilde{w}^i)}, \ i = 1, 2 \). A change of the number of households in state 1 affects the expected utility in both regions directly via its impact on the probability to be employed. Furthermore, an indirect effect appears via the adjustment of the unemployment benefit level. The social planner then chooses an allocation which balances the respective cost 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 the 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 profit-maximizing labor demand and collective wage bargaining on the labor market, i.e. she cannot set \( l^i \) and \( w^i \) directly. Wage negotiators are restricted by profit-maximizing labor demand and do not take account of mobile firms or labor force. There are no migration decisions since the social planner allocates households and firms across the states.

#### 4.2.1 Labor demand

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

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

(28)

yielding the first-order condition

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

(29)

\(^8\)Note that due to the envelope theorem \( b^i = w^i \).
with the implicit derivative \( dl_i/dw_i < 0 \), because \( f_{U^i} < 0 \). 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 taken into account 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):

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

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

\[
\frac{d \ln B^i}{dw^i} = \frac{1}{\pi^i \sigma_{w^i}^i} \left( E U^i_{w^i} \tilde{w}_{w^i}^i + E U^i_{l^i} \frac{dl^i}{dw^i} + E U^i_{t^i} \left[ b^i_{w^i} + b^i_{l^i} \frac{dl^i}{dw^i} \right] \right) \overset{!}{=} 0 \tag{31}
\]

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

\[
\frac{d \ln B^i}{dw^i} = -\frac{1}{\pi^i \sigma_{w^i}^i} \frac{l^i}{n^i} \frac{1}{U^i} \left( \frac{l^i}{n^i} U^i_{w^i}(1 - t^i) + \frac{1}{n^i} \left[ U^i(\tilde{w}^i) - U^i(b^i) \right] \frac{dl^i}{dw^i} \right) + \underbrace{U^i_{\tilde{w}^i} \left( \frac{n^i - l^i}{n^i} + \frac{dl^i}{dw^i} \frac{w^i}{l^i} \right)}_{\text{total benefit effect via wage and employment}} \overset{!}{=} 0 \tag{32}
\]

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 e.g. 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 the 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, \( \frac{dl^i}{dw^i} \frac{w^i}{l^i} \), takes values 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 have usually 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:

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

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

$$
\frac{d \ln V^i}{d t^i} = \frac{1}{E U^i} \left( E U^i_{\tilde{w}^i} \tilde{w}^i \tilde{t}^i + E U^i_{b^i} b^i \tilde{t}^i \right) + \frac{1}{\pi^i} \pi^i_i \frac{d w^i}{d t^i} \left( E U^i_{\tilde{w}^i} \tilde{w}^i \tilde{t}^i + E U^i_{b^i} b^i \tilde{t}^i \right) + E U^i \left[ b^i \tilde{w}^i + b^i \frac{d t^i}{d w^i} \right] \frac{d w^i}{d t^i} = 0
$$

where $\frac{d w^i}{d t^i} = - \frac{\partial^2 \ln B^i}{\partial w^i \partial t^i} / \frac{\partial^2 \ln B^i}{\partial w^i \partial w^i} > 0$ is assumed to be positive without loss of generality. 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 of being not able 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 aims at 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 employed and unemployed is optimal from a social welfare perspective:

$$
\frac{d \ln V^i}{d t^i} = \frac{1}{E U^i} \frac{b^i}{n^i} \left( U_{\tilde{w}^i} - U_{\tilde{w}^i} \right) \frac{d t^i}{d w^i} = 0
$$

The constrained social planner determines the contribution rate so that the marginal utility of the unemployment benefit balances with 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 2 and no indirect intervention of 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).

Likewise the unconstrained social planner, the constrained social planner weighs the cost and benefits of allocating firms and individuals between both states. Thereby the constrained social planner must additionally take into account the indirect effects of an adjustment of the number of firms and individuals on labor demand and the negotiated utility of the unemployment benefit balances with 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 2 and no indirect intervention of 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).

Likewise the unconstrained social planner, the constrained social planner weighs the cost and benefits of allocating firms and individuals between both states. The constrained social planner must additionally take into account the indirect effects of an adjustment of the number of firms and individuals on labor demand and the negotiated

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11Because $\frac{\partial^2 \ln B^i}{\partial w^i \partial t^i} < 0$ must hold to ensure an interior optimum of the Nash-bargain, $\frac{\partial^2 \ln B^i}{\partial w^i \partial w^i} > 0$ is assumed.
gross wage. However, for symmetric regions then, the allocations of $m^i$ and $n^i$ are first-best.\textsuperscript{12}

5 Labor demand

Wages and employment are determined separately in the states. This means the labor market integrates both states in the sense that labor force and firms are mobile between the states. However, the labor market is still separated due to the local wage bargaining in each state which takes mobility into account.

The firm association in either region maximizes profit per firm (3) subject to the migration equilibrium (12) of mobile firms: \textsuperscript{13}

$$\max_{\tilde{\nu}} \pi^i = \frac{f^i(l^i) - w^i l^i}{(1 - \alpha)m^i + \alpha m^i l^i}, \quad i = 1, 2$$ (36)

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

$$\frac{d\pi^i}{dl^i} = \frac{f^i l^i - w^i}{m^i} \left( 1 - \alpha \frac{dm^i}{dm^i} + \frac{dm^i}{dm^i} + \frac{dm^i}{dm^i} \right) = 0$$ (37)

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

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

The mobility of firms affects profit per firm, say in state 1, by two channels. On the one hand, there is an incentive for the firm association to employ less workers. Lower employment decreases production, because $f^1 l^1 > 0$, and thereby total profit, $\Pi^1$. This in turn induces 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 labor cost 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 vice versa for state 2.

The firm mobility effect consists of the parameter $\alpha$ and the mobility-profit factor $\frac{dm^i}{dm^i} \left( \frac{dm^1}{dm^1} + \frac{dm^2}{dm^2} \right)$, $i = 1, 2$.\textsuperscript{15} The higher the value of $\alpha$, the stronger the firm association is inclined to increase profit per firm, say in state 1 by taking advantage of the firm 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

\textsuperscript{12} The assumption of symmetry implies that firms and individuals are equally allocated among both states: $m^i = \frac{1}{2} M$ and $n^i = \frac{1}{2} N$. These specific allocations are efficient as they represent valid solutions of the respective first-order conditions $\frac{d\ln V^i}{dm^i} = 0$ and $\frac{d\ln V^i}{dn^i} = 0$. For the following cases of decentral and central unemployment insurance, the symmetry assumption implies that the allocation of firms and individuals among the states is second-best, too.

\textsuperscript{13} See Lemmata 2 and 3 for the derivation of the implicit derivative $\frac{dm^i}{dm^i}$ with decentral and central unemployment insurance.

\textsuperscript{14} A stable relocation equilibrium requires $\frac{dm^i}{dm^i} < 0$, which we assume to be satisfied in the decentral as well as in the central scenario.

\textsuperscript{15} The migrational effect here constitutes a horizontal relocation externality.
The maximization problem is given by:

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

\[
+ \frac{(1 - \beta)n^i + \beta n^i(w^i) - l^i(w^i)}{(1 - \beta)n^i + \beta n^i(w^i)} \frac{l^i(w^i)}{U(w^i(1 - l^i))}
\]

The following first-order condition results

\[
\frac{d \ln B_i^i}{dw^i} = \frac{1}{\pi^i m^i w^i} \left( 1 - \alpha \frac{dn^i}{dm^i} + \frac{dw^i}{dm^i} \right) + \frac{1}{EU_i} \left( EU_i^i b^i_{w^i} + EU_i^i \frac{dl^i}{dw^i} \right)
\]

\[
+ EU^i_{b^i} \left[ b^i_{w^i} + b^i_{l^i} \frac{dl^i}{dw^i} \right] \left( 1 - \beta \frac{dEU_i^i}{dn^i} + \frac{dEU_i^i}{dn^i} \right) = 0
\]

with \( \frac{dEU_i}{dn^i} = -\frac{U^i(l^i(w^i) - U^i(l^i))}{(n^i)^2} + \frac{1}{n^i} U^i b^i \) describing the effect of a change in the number of inhabitants on the expected utility in the respective state.\(^{17}\) Like the constrained social

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\(^{16}\)See Lemmata 2 and 4 for the derivation of the implicit derivatives \( \frac{dn^i}{dm^i} \) and \( \frac{dw^i}{dm^i} \).

\(^{17}\)A stable migration equilibrium requires \( \frac{dEU_i}{dn^i} < 0 \), which we assume to be satisfied in the decentral as well as in the central scenario.
planner the bargaining parties in the decentral case take into consideration all direct and indirect wage effects: the labor cost effect of the firms as well as the net wage effect, the status effect and the benefit effects of the labor force (compare first-order condition (3)).

Additionally, due to open borders migration and relocation effects occur. Each wage effect is accompanied by an opposing but not countervailing migration effect. For the strength of the migrational effect of households, the parameter $\beta$ and the mobility-utility factor $\frac{dEU^i}{dn^i}/\left(\frac{dEU^i}{dn^i} + \frac{dEU^2}{dn^2}\right)$ are decisive. The mobility-utility factor can be interpreted by analogy to the mobility-profit factor.

The wage effect on firms and the opposite migration effect due to the relocation of firms is given by: $\frac{1}{\pi} \pi^i w_i \left(1 - \alpha \frac{dn^i}{dn} / \left(\frac{dn^1}{dn^1} + \frac{dn^2}{dn^2}\right)\right)$. Firms in both states negotiate for a lower gross wage rate in order to increase the profit (labor cost effect). With mobility of firms, however, there is an opposite incentive due to firm relocation to decrease the wage not too much. A higher wage rate gives reason to firms, say in state 1, 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: $\frac{1}{\pi} \pi^i w_i \left(1 - \beta \frac{dEU^i}{dn} / \left(\frac{dEU^i}{dn} + \frac{dEU^2}{dn^2}\right)\right) \times \left(1 - \beta \frac{dEU^i}{dn^i} / \left(\frac{dEU^i}{dn^i} + \frac{dEU^2}{dn^2}\right)\right)$. 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, induces households to migrate to state 2 which implies a higher probability of being employed in state 1 and a higher expected utility.

The status effect may be negative $\left(t^i < \frac{w^i}{w^j}\right)$ such that trade unions aim at a lower gross wage rate. A higher number of individuals become employed and find themselves in the more favorable income status. However, mobile households are attracted from state 2 to migrate to state 1. This in turn lowers the prospects of being employed (the employment probability). Expected utility decreases. Hence, due to migration trade unions have an opposite incentive 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 a lower gross wage. A lower wage increases employment and the unemployment benefit. The utility of the unemployed and expected utility will increase. But again migration curbs trade union’s preference for lower wages due to the same reason mentioned above.

Now, consider the case that the incentives given by firm mobility are stronger than that of the labor force: $\alpha \frac{dn^i}{dn} / \left(\frac{dn^1}{dn^1} + \frac{dn^2}{dn^2}\right) > \beta \frac{dEU^i}{dn} / \left(\frac{dEU^i}{dn} + \frac{dEU^2}{dn^2}\right)$. How does an increase of the wage rate affect both negotiating parties? First note that without migration a higher wage increases expected utility of the households, and lowers the profit of firms. 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 the lower profit (see condition (3)). Allowing for migration reduces both the utility increase of the households and the decrease of firms’ profit. As a wage increase clearly benefits the labor force and harms the firms this gives an incentive for workers to immigrate into the state and for firms to relocate to the other state. Hence, the expected utility decreases and the profit per firm increases. Since households are more immobile than firms the share by which the labor force increases

\[\text{The following holds: } \frac{dEU^i}{dn^i} < 0 \text{ while } \frac{dEU^j}{dn^j} > 0.\]
due to immigration is relatively lower than the share of firms that leave the state. As a consequence of migration expected utility of households decreases by less than the profit per firm increases. Thus the dampening effect of migration on the increasing expected utility of households is smaller than 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 in both states 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

$$\frac{d\ln B}{dw} = -\frac{1}{2} \ln \left(1 - \alpha \beta \frac{1}{2}\right) + \frac{1}{EU} \left(\frac{1}{n} U(\bar{w}(1 - t)) + \frac{1}{n} [U(\bar{w}) - U(b)] \right) \frac{dl}{dw} + U_b \frac{b}{w} \left(\frac{n - t}{n} + \frac{dl}{dw} \right) \left(1 - \beta \frac{1}{2}\right) = 0$$

(40)

The total effect combining the direct wage effect and the migration effect is as follows. The marginal benefit of households due to a higher wage becomes larger than the marginal cost of firms if $\alpha$ gets larger than $\beta$ 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 to households is larger than the total cost effect to firms, households receive a higher weight in the bargaining process: $1 - \alpha \beta < 1 - \beta \frac{1}{2}$. As result of the wage negotiation the gross wage will be higher due to the advantage of relative immobility of the labor force.

If both firms and labor force are equally mobile ($\alpha = \beta$) the bargaining position of the firm association and the trade union driven by the mobility of firms and workers 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 decentral 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 decentrally organized unemployment insurance is second-best, if firms and workers are equally mobile: $1 \geq \alpha = \beta \geq 0$. Furthermore, (b) it is higher than the second-best wage level, if firms are more mobile than workers: $1 \geq \alpha > \beta \geq 0$, and vice versa.

*Proof.* See appendix.

6.2 Decentral 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 decentral budget (14), and the migration equilibria (12) and (13):\(^{19}\)

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

(41)

\(^{19}\)See Lemmata 2 and 4 for the derivations of the implicit derivatives $\frac{dm^i}{dt^i}$ and $\frac{dn^i}{dt^i}$.
Applying the envelope theorem with respect to optimal wage setting (39), the decentral government’s first-order condition is given by

$$\frac{d\ln V_i}{dt} = \frac{1}{EU_i n_i} w_i \left(U_{ib} - U_{\tilde{w}i}\right) \left(1 - \beta \frac{dEU_1}{dn_i} + \beta \frac{dEU_2}{dn_i}\right) = 0$$

(42)

All indirect effects of the contribution rate via wage and employment are internalized by wage negotiations and the bargaining objective is aligned with the welfare objective of the government. 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 the unemployed, the government has an incentive to set a lower contribution rate, because a lower contribution rate decreases the unemployment benefit such that the unemployed are induced to migrate from e.g. 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 at 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 increases because $\frac{dEU_1}{dn_i} < 0$. However, since the household migration affects the employed and unemployed 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 of both states, $i = 1, 2$, 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 $(1 - \beta)$ 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 decentral 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 first-order condition (42) is equivalent to the second-best solution, condition (35).

### 7 Central unemployment insurance

The following sections consider collective wage bargaining and governmental contribution rate setting with a central organization of unemployment insurance. While collective wage bargaining still takes place 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. As before all decision makers take into account the mobility of firms and the labor force, and know the central government’s budget.

#### 7.1 Wage bargaining

The bargaining parties in each of both states, $i = 1, 2$, negotiate independently from the other state 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:

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

The first-order condition is as follows

$$\frac{d \ln B^i}{dw^i} = \frac{1}{\pi^i} \pi^i \left( 1 - \alpha \frac{dn^i}{dn^i} + \frac{\pi^i}{dx^i} \right) + \frac{1}{EU^i} \left( EU^i \left[ b_w^i + b_l^i \frac{dl^i}{dw^i} \right] \left( 1 - \beta \frac{dEU^i}{dn^i} + \frac{dEU^i}{dx^i} \right) \right)$$

$$+ \frac{1}{EU^i} \left[ b_w^i + b_l^i \frac{dl^i}{dw^i} \right] \beta \frac{dEU^i}{dn^i} + \frac{dEU^i}{dx^i} = 0$$

with \( b_w^i = t^c \frac{N - \beta^i}{(N - \beta^i - \beta^i)^2} \), \( b_l^i = t^c \frac{w^i(1 - t^i)}{(N - \beta^i - \beta^i)^2} \) and \( \frac{dEU^i}{dn^i} = -\frac{t^i U^i(w^i) - U^i(b^i)}{(\pi^i)^2} \). Negotiators consider the same wage effects - including the indirect effects via migration - like negotiators with decentral unemployment insurance do. Especially 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 decentral unemployment insurance, there are two additional effects on the outcome of the wage bargaining. First, the central unemployment insurance has a common pool character now, which gives rise to a bottom-up vertical fiscal externality (compare Keen and Kotsogiannis, 2002) which induces too high wages. Note that a higher wage e.g. in region 1 reduces employment and increases unemployment: the number of receivers of the unemployment benefit grows and the number of contributors to the insurance diminishes. If the effect of the direct wage increase on the basis of contributions is smaller than the negative effect via a lower employment (as is assumed here) the contribution basis shrinks. The higher number of unemployed and the 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 wage bargaining parties in state 1 to negotiate higher wages. However, in a framework with central unemployment insurance this loss in benefit as a result of higher negotiated wages is now co-financed by the payments of contributors in the other state 2. State 1 has not to bear the full cost in terms of lower benefits if it increases the gross wage. Hence, the expected utility reduction of unemployed due to a higher wage is smaller than in the case of decentral insurance: \( EU^i \left[ b_w^i + b_l^i \frac{dl^i}{dw^i} \right] < EU^i \left[ b_w^i + b_l^i \frac{dl^i}{dw^i} + \frac{d\pi^i}{dw^i} \right] \). 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 decentral case: \( EU^i \left[ b_w^i + b_l^i \frac{dl^i}{dw^i} + \frac{d\pi^i}{dw^i} \right] = \frac{1}{2} EU^i \left[ b_w^i + b_l^i \frac{dl^i}{dw^i} \right] \).

\(^{20}\)See Lemmata 3 and 5 for the derivation of the implicit derivatives \( \frac{d\pi^i}{dw^i} \) and \( \frac{d\pi^i}{dx^i} \).
Therefore, with central unemployment insurance the benefit effect reducing the negotiated wage rate is not as strong as in the decentral 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 decentral regime. In fact, the wage rate will be too high compared to the second-best wage rate in the scenario with decentral unemployment insurance (compare also Saha and Schöb, 2019).

Second, the migration from e.g. state 1 to state 2 has a counterpart in the reverse direction because the central 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 which reduces again employment probability and the expected utility in state 1:

$$\frac{d \ln B}{d w} = -\frac{1}{\pi m} \left( 1 - \alpha \frac{1}{2} \right) + \frac{1}{EU} \left( \frac{1}{n} U(\bar{w})(1-t) \right) \left( 1 - \beta \frac{1}{2} \right)$$

What remains is a vertical externality described above that leads to too high negotiated gross wages in the states. Wage negotiators in each state underrate the negative effect of higher wages on the central unemployment benefit insofar as the reduction of the benefit is shared by the other state. Hence, in contrast to decentral unemployment insurance the gross wage with central unemployment insurance is too high and generically not second-best unless in 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, $\alpha = \beta \to 1$ or, (b) in the case of $0 \leq \alpha < \beta \leq 1$, if the advantage of higher firm immobility on labor cost is outweighed by the trade union’s incentive to increase labor cost by externalizing the cost of a higher wage rate on unemployment benefits. In all other cases, the wage bargaining in the states under a central unemployment insurance is not second-best.

**Proof.** See appendix. ■

Assume 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 $b'$. The cost of a wage increase in terms of the central 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 lower such that the negotiated wage in the central scenario is higher than the second-best wage. This holds also true for all degrees of firm and household mobility satisfying $0 \leq \beta \leq \alpha < 1$.

However, the difference between the higher central 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 decreases, because mobile workers in state 2 react to this policy and are induced to migrate to
state 1 due to the higher local wage level there. The higher the degree of mobility, the stronger 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 reversed migration reduces more and more the advantage of the cost externalization which arises with higher wages in a centralized unemployment insurance. At the limit $\alpha = \beta \rightarrow 1$, the reversed migration effect completely offsets this advantage, the vertical externality dissolves, and the wage setting in the central 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).

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

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 which run via the wage rate of this state, because these effects are already internalized by the wage bargaining in the respective state (envelope theorem via (44)). The central government still has to observe the effects via the wage rate in the other state (2 or 1), the direct effects of the contribution rate and the migration responses, respectively:

$$\sum_{i=1}^{2} \frac{d\ln V^i}{dt^c} = \sum_{i,j=1}^{2} \left[ \frac{1}{EU^i} \left( EU^i_{w^i} \tilde{w}^i_{w^i} + EU^i_{b^i} b^i_{w^i} \right) \left( 1 - \beta \frac{dEU^i}{dn^i} + \frac{dEU^i}{d\alpha^2} \right) \right]_{\text{insurance in state } i \text{ net of migration}}$$

$$+ \frac{1}{EU^i} \left( EU^i_{w^i} \tilde{w}^i_{w^i} + EU^i_{b^i} b^i_{w^i} \right) \beta \frac{dEU^i}{dn^i} + \frac{dEU^i}{d\alpha^2} \right]_{\text{migration in state } j \text{ due to common insurance}}$$

$$+ \frac{1}{EU^i} \left( EU^i_{w^i} \tilde{w}^i_{w^i} + EU^i_{b^i} b^i_{w^i} \right) \frac{1}{\pi} \tilde{n}^{j}_{w^i} \frac{d\tilde{n}^{j}_{w^i}}{dt^c} \frac{dn^i}{dt^c} \frac{dn^i}{d\alpha^2}$$

$$+ \left( EU^j_{w^i} \tilde{w}^j_{w^i} + EU^j_{b^i} b^j_{w^i} \right) \left( \frac{dEU^j}{dn^i} + \frac{dEU^j}{d\alpha^2} \right) \right]_{\text{relocation of firms due to labor cost effect in state } j}$$

$$+ \left( EU^i_{w^i} \tilde{w}^i_{w^i} + EU^i_{b^i} b^i_{w^i} \right) \beta \frac{dEU^i}{dn^i} + \frac{dEU^i}{d\alpha^2} \right] = 0 \quad \text{(47)}$$

---

$\beta$ is assumed to be positive.
with \( b_c = \frac{w^1_{\text{t}} + w^1_{\text{w}}}{N - 1} \) and \( \tilde{w}_c = -w^1_{\text{w}} \). The central government provides the common unemployment insurance in order to redistribute optimally between the employed and the unemployed in each state. Furthermore, the government aims at the internalization of welfare reducing distortions on the wage bargaining level: firstly, migrational externalities of the firms and the households, and secondly, the trade union’s exploitation of the vertical fiscal externality. Disposing of one instrument to achieve 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, have to be equalized. However, the central government can only set a common benefit level in both member states of the union. 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 on the labor markets, incomes cannot be matched with a single instrument. From condition \( EU^i_{w} \tilde{w}_c + EU^i_{b} b_c = 0 \) it can be shown that such a policy leads to a welfare loss. 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 which goes in both directions (see first two terms in (47)). If states are symmetric the migration responses to the insurance effect cancel each other out.

But even with symmetric states there are further distortions of a central decision about unemployment insurance which prevent full insurance. Maximizing the welfare of one state (say state 1) by setting a common contribution rate has to take account of changes in the wage rate of the other state 2 as a result of the local wage bargaining there.

First, the advantage of relative immobility distorts the wages in both states and a central government has to consider the effect of the repercussions of migration in both states on welfare of each other state. In the decision about the common contribution rate the central government already takes account of the migrational effects on the wage bargaining in state 1 (envelope theorem). 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 the wage bargaining and a lower contribution rate induces the opposite. Contingent on the relative immobility of firms and households the wage bargaining in state 2 generates higher or lower wages and the contribution rate has to be adjusted accordingly. If households are more immobile than firms, \( \alpha \frac{d\pi^i_{w}}{dm^i_{w}} / \left( \frac{d\pi^1_{w}}{dm^1_{w}} + \frac{d\pi^2_{w}}{dm^2_{w}} \right) > \beta \frac{dEU^i_{w}}{dm^i_{w}} / \left( \frac{dEU^1_{w}}{dm^1_{w}} + \frac{dEU^2_{w}}{dm^2_{w}} \right) \), 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. Hereupon 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 profits per firm will increase so that the welfare in state 1 increases with a lower contribution rate. If firms are more immobile it is welfare improving for state 1 to increase the common contribution rate. This is the internalization of the migrational externalities on welfare in state 1 which arise due to the advantage of relative immobility in state 2. Vice versa 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 the wage bargaining under a central unemployment insurance. 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 affected adversely. In order to decrease the wages the central government uses the common contribution rate: \[ \frac{1}{\pi} \left( b_c w_c + b_c \frac{dU}{dn} \right) \frac{dw}{dt} \left( 1 - \beta \frac{dEU}{dn} / \left( \frac{dEU}{dn} + \frac{dEU}{dn} \right) \right). \] Since the common contribution rate affects the wage rate in state 2 the central government sets a lower contribution rate to decrease the wage 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 restrains the intention to lower the contribution rate by too much. The more mobile the labor force is, the stronger is the migration induced by a wage increase in state 2. Ceteris paribus this migration is welfare enhancing in region 1 and welfare decreasing in region 2. Thus, the trade union’s intent to increase the wage level in state 2 is mitigated and the distortion to be internalized 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 a too low 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 a full insurance against unemployment and these two distorting effects remain which impede a second-best decision on the contribution rate with a central unemployment insurance.\(^{22}\) With symmetry first-order condition (47) becomes

\[ \frac{d\ln V}{dt^c} = \frac{1}{\pi} \frac{l}{n} w \left( U_b - U_w \right) - \frac{1}{\pi} \frac{l}{m} 2 - \frac{\alpha}{\beta} \frac{dw}{dt^c} \]  

\[ + \frac{1}{\pi} \frac{l}{w} \left( n - l \right) + \frac{dU}{dn} \frac{1 - \beta}{\beta} \frac{dw}{dt^c} \]  

and the following proposition holds

**Proposition 4.** In symmetric states, a centrally organized unemployment insurance is second-best in two special cases only: (a) the share of mobile firms and households in the state union approaches unity, \( \alpha = \beta \rightarrow 1 \), 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 does not provide full insurance against the risk of unemployment.

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

\(^{22}\)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.
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 e.g. 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 affecting welfare in state 1 adversely, 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 between both states. 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).

So far we have shown that a central unemployment insurance induces a vertical fiscal externality at the level of wage bargaining in the states because the negotiators can externalize partly the cost of higher wages and therefore increase wages above the efficient level. As a consequence of this the central government tries to internalize the vertical externality and sets the contribution rate lower than would be optimal in order to bring down the too high 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 which allows to externalize costs via the indirect effects of wages in the other state. The asymmetric federal design of having a central unemployment insurance mixed with decentral wage bargaining in the states is the reason why the vertical fiscal externality and the advantage of relative immobility can occur. 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 the central wage bargaining. What remains is the insurance condition. With asymmetric states the central government cannot provide full insurance in either of both states, because employment probabilities of the labor force are still conditional on the place of residence. Therefore, unless regions merge, central government behavior is second-best only in the symmetric case:

**Proposition 5.** In symmetric states, a centrally organized unemployment insurance 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. Decentral wage determination and central contribution rate setting causes migrational and fiscal externalities. Aligning the decision making eliminates these distortions. However, the asymmetry of states ultimately...

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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 $dEU^s/dn^s = 0$, which is excluded. However, valid migration equilibria are defined for values of $t^c$ around the fair contribution rate.
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 gives two answers to this question. 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 a central organization of unemployment insurance is second-best and equivalent to a decentral organization in the states. In this case migration offsets the vertical fiscal externality arising with a central unemployment insurance. In all other cases if there are any costs of migration, like e.g. administrative obstacles, language barriers, cultural distinctions etc., the decentral insurances in the states are superior in terms of efficiency to a central insurance on the union’s level.

The second answer is that the central unemployment insurance is only inferior to decentral state insurances if the wage bargaining on the labor markets in the states remains decentralized. This setting creates the vertical fiscal externality and all included migration effects that would vanish if wage bargaining took place centrally and negotiated a uniform wage for the whole state union. In this case central unemployment insurance would become second-best. This may explain why a central unemployment insurance in a federal nation can be vindicated by efficiency reasons if the mobility within the nation is very high or if wage setting is also centralized with binding standard wages nationwide. At the same time a supranational organization can 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 on labor markets) are connected by a common pool budget and organized on different levels of the federation, vertical externalities may arise which distort the central decision. Thus a principle of efficient federal systems further to be investigated might be that fiscally linked economic institutions should be ruled on the same federative layer i.e. either 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 of both parties. Firstly, consider the second-best as well as the decentral scenario. For immobile subjects, the outside option e.g. in state 1 is clearly zero as no production takes place, if negotiations break down. However, mobile firms and mobile 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: \( \pi_{1, sb, dc} = \Pi_m + \alpha m \) for firms and \( EU_{1, sb} = U \left( \frac{\ell w^2}{n^2 + \beta n^2 - \ell} \right) \beta n \) for workers. The mobile firms and workers from state 1 claim each a share of given total profit and tax revenues in state 2. If membership is non-exclusive, pure welfare migration emerges. In the case of a central 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 \( EU_c = U \left( \frac{tw l}{n - l} \right) \). For firms, \( \pi_{1} = \pi_{sb, dc} \) holds.

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

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

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

\[
SP_F = \frac{\Pi}{m} - \frac{\Pi}{m + \alpha m} \frac{\alpha m}{m} = \frac{\Pi}{m} \left( 1 - \frac{\alpha}{1 + \alpha} \right) > 0 \tag{49}
\]

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

\[
S_{TU, dc}^i = U \left( \frac{tw l}{n - l} \right) - U \left( \frac{tw l}{n (1 + \beta) - l} \right) \beta n \frac{l}{n} + U \left( \frac{tw l}{n - l} \right) - U \left( \frac{tw l}{n - l} \right) \tag{50}
\]

The sum of the first and second term is positive for any value of \( 0 < t^i < 1 \). For \( t^i \leq \frac{n^i - l^i}{n^i} \), the third term is non-negative such that \( S_{TU}^i > 0 \). For \( t^i > \frac{n^i - l^i}{n^i} \), 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 to the complete labor force.
The trade union’s surplus from successful negotiations in the central case is given by

\[ S_{TU,c}^i = U \left( \frac{tw_i}{n-l} \right) - U \left( \frac{tw_i}{2n-l} \right) + \frac{l}{n} \left( U(w(1-t)) - U \left( \frac{tw_i}{n-l} \right) \right) \quad (51) \]

and the same reasoning as in the decentral case applies.

Migration equilibria - implicit derivatives:

Lemma 2. With decentral unemployment insurance, the relocation responses of the firms, \( \frac{da_m^i}{dt} \), \( \frac{da_m^i}{dw} \) and \( \frac{da_m^i}{dt} \) are obtained as follows.

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

\[ \phi \equiv \frac{\alpha(f(l^i) - w^i l^i)}{\alpha m^i} - \frac{\alpha(f(l^j) - w^j l^j)}{\alpha M - \alpha m^i} = 0 \quad (52) \]

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

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

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

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

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

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

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

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

The firms’ relocation responses are then given by \( \frac{da_m^i}{dt} = - \frac{\phi_{l^i}}{\phi_{m^i}} \), \( \frac{da_m^i}{dw} = - \frac{\phi_{w^i}}{\phi_{m^i}} \) and \( \frac{da_m^i}{dt} = - \frac{\phi_{t^i}}{\phi_{m^i}} \).
**Lemma 3.** With central unemployment insurance, the relocation responses of the firms, \( \frac{d\alpha_m}{dt^c} \), \( \frac{d\alpha_m}{dw^i} \) 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
\[
\frac{\partial \phi}{\partial m^i} = -\frac{\alpha \Pi^i}{(\alpha m^i)^2} - \frac{\alpha \Pi^j}{(\alpha m^j)^2} = -\left( \frac{\Pi^i}{(m^i)^2} + \frac{\Pi^j}{(m^j)^2} \right) \frac{1}{\alpha}
\]
and the partial derivative with respect to the number of employed by
\[
\frac{\partial \phi}{\partial l^i} = \frac{\alpha(f(l^i) - w^i)}{(\alpha m^i)^2} = \frac{f(l^i) - w^i}{m^i}
\]
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
\[
\frac{\partial \phi}{\partial w^i} = \frac{\alpha(-l^i)\alpha m^i}{(\alpha m^i)^2} = \frac{m^i}{(m^i)^2} (-l^i) = -\frac{l^i}{m^i}
\]
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
\[
\frac{\partial \phi}{\partial t^c} = \frac{\alpha(-l^i)\alpha m^i}{(\alpha m^i)^2} \frac{dw^i}{dt^c} - \frac{\alpha(-l^j)\alpha m^j}{(\alpha m^j)^2} \frac{dw^j}{dt^c} = -\left( \frac{l^i}{m^i} \frac{dw^i}{dt^c} - \frac{l^j}{m^j} \frac{dw^j}{dt^c} \right)
\]
The firms’ relocation responses are then given by \( \frac{d\alpha_m}{dt^c} = -\frac{\phi_{\alpha m^i}}{\phi_{\alpha m^i}} \), \( \frac{d\alpha_m}{dw^i} = -\frac{\phi_{\alpha w^i}}{\phi_{\alpha m^i}} \) and \( \frac{d\alpha_m}{dt^c} = -\frac{\phi_{\alpha t^c}}{\phi_{\alpha m^i}} \).
Lemma 4. With decentral 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

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

The partial derivative with respect to the mobile workforce $\beta n^i$ is given by:

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

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

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

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

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

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

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

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

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

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

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

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

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

\[
\frac{\partial \phi}{\partial t^c} = -\frac{l^i}{n^i} U_{\tilde{w}^i} w^i + \frac{n^i - l^i}{n^i} U_{b^c} \left( \frac{w^i l^i + w^i l^j}{N - l^i - l^j} \right) + \left( \frac{1}{n^i} \left( U^i(\tilde{w}^i) - U^i(b^c) \right) \cdot \frac{d l^i}{d w^i} + \frac{l^i}{n^i} U_{\tilde{w}^i} (1 - t^c) \right) + \left( \frac{n^i - l^i}{n^i} U_{b^c} \left( \frac{l^i}{N - l^i - l^j} + \left[ \frac{w^i (N - l^i) + w^j l^j}{(N - l^i - l^j)^2} \right] \frac{d l^i}{d w^i} \right) t^c \right) \frac{d w^i}{d t^c}
\]

The work force’s migration responses are then given by \( \frac{\partial n^i}{\partial w} = \frac{\phi_{w^i}}{\phi_{\beta n^i}} \) and \( \frac{\partial n^i}{\partial t^c} = \frac{\phi_{t^c}}{\phi_{\beta n^i}} \).
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 $0 < \alpha < \beta \leq 1$. 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, costs of a wage increase related to the benefit effects and the profit per firm are evaluated lower than in the second-best case. Thus the negotiated wage level is higher than in the second-best case. Now evaluate at $0 < \alpha < \beta < 1$ 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 level. Effects on the net wage and the labor market status are equally weighed. 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 central wage bargaining is second-best. ■

Proof of Proposition 4
Part (a): Evaluate condition (48) at $\alpha = \beta \rightarrow 1$. Then, $\frac{d \ln V}{d \nu} = \frac{1}{\kappa l} \ln w (U_{w*} - U_{\tilde{w}}) \frac{1}{2} = 0$, 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


