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Unions – The Role of Rent-Sharing  
Motives**

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# Firm-level versus Sector-level Trade Unions – The Role of Rent-Sharing Motives\*

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## Abstract

What are the effects of firm- and sector-level trade unions on unemployment and aggregate output if individuals have rent-sharing motives? To answer this question, we extend a Melitz-type model to unionized labor markets. Because individual rent-sharing motives are only taken into account and asserted by firm-level unions which capture a higher fraction of firms' rents via firm-specific wages, average profits are higher under sector-level trade unions. As a consequence, firm-selection increases (relative to firm-level unions), which causes average marginal costs to decline. At the general equilibrium, labor demand then, *ceteris paribus*, increases and unemployment falls. This new mechanism interacts with the negative employment effect due to higher wage markups of sector-level trade unions, as shown e.g. by Calmfors et al. (1988). Simulating our model indicates that the unemployment damping effect of rent-sharing motives mitigates but does not compensate for the unemployment increase caused by higher wage markups, while aggregate output is higher under sector-level agreements.

**Keywords:** Trade Unions, Rent-sharing Motives, Bargaining Level, Heterogeneous Firms, Unemployment

**JEL Classification:** J3, J51, J6

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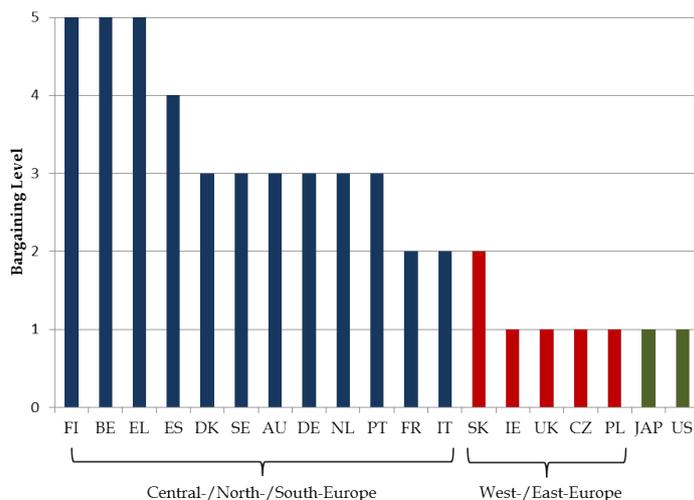
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# 1 Introduction

## 1.1 Bargaining Level and Rent-Sharing Motives

Despite decreasing union membership, trade unions are still one of the predominant labor market institutions in Europe and have a significant influence on labor market outcomes.<sup>1</sup> There are, however, structural differences with respect to the level at which bargaining takes place. As illustrated in Figure 1, bargaining at the sectoral- (or central-)level is mostly observed in Central-/North-/South-Europe, while firm-level bargaining is predominant in West-/East-Europe. These institutional differences feature in the public (and academic) discussion about how to reduce unemployment. One prevalent suggestion is that unemployment in countries with a sector-level wage-setting structure could be reduced if bargaining would be decentralized.

Figure 1: Bargaining Level in Selected Countries, 2011



Source: Visser (2013), own illustration. Notes: Bargaining level 1 and 2 indicate that bargaining takes place at the local/firm-level or that bargaining is alternating between sector- and firm-level, respectively. Bargaining level 3 and 4 indicate that bargaining takes place at the sector-level or that bargaining is alternating between central- and sector-level, respectively. Bargaining level 5 means that bargaining takes place at central- (or cross-sector)-level. European countries are categorized according to van Klaveren and Schulten (2015). Legend: FI=Finland, BE=Belgium, EL=Greece, ES=Spain, DK=Denmark, SE=Sweden, AU=Austria, DE=Germany, NL=Netherlands, PT=Portugal, FR=France, IT=Italy, SK=Slovakia, IE=Ireland, UK=United Kingdom, CZ=Czech Republic, PL=Poland, JAP=Japan, US= United States.

This argumentation is based on the highly influential paper by Calmfors et al. (1988), where the authors have theoretically shown that sector-level

<sup>1</sup>For instance, Venn (2009) shows that the average union coverage rate in Europe is about 66%.

bargaining leads to higher wages and higher unemployment relative to alternative bargaining levels. When it comes to the empirical test of this result, however, we obtain a converse picture. As put forward e.g. by Card and De La Rica (2006), Dahl et al. (2013) and Plasman et al. (2007), wages are *lower* in the case of sector-level bargaining (relative to firm-level agreements). This finding casts some doubt on the conventional wisdom that unemployment is higher under sector-level bargaining and has encouraged economists to (re-)investigate the impact of bargaining levels on wages and unemployment in different models; see section 1.2 for an overview.

The present paper contributes to this strand of literature by introducing rent-sharing motives as a new mechanism through which bargaining levels affect labor and goods market outcomes. More specifically, we analyze the effects of two bargaining regimes, namely firm-level and sector-level trade unions, on average productivity, unemployment and aggregate output if individuals have rent-sharing motives.<sup>2</sup> To that end, we assume that individuals have relative preferences, i.e. they compare their received wage payments, *inter alia*, with the profit of the firm at which they are employed.<sup>3</sup> These types of preferences imply that an increase in profits makes workers worse off (in terms of utility) if the wage rate remains unchanged. If, however, parts of the profit increase are shared with the worker, utility reduction could be mitigated. We incorporate this rent-sharing motive into a Melitz (2003)-type model with heterogeneous firms, monopolistic competition and CES demand functions. The latter two are implemented to rebuild the original finding of Calmfors et al. (1988), while the former establishes a link between rent-sharing motives and firm-selection. Moreover, we assume that monopoly trade unions unilaterally set wages while firms decide on prices, which in turn determines labor demand.<sup>4</sup>

As our main finding, we show that wages and thus unemployment could (but not necessarily have to) be lower under sector-level trade unions if individuals have rent-sharing motives. This can be explained as follows. Firm-

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<sup>2</sup>We focus on the analysis of firm- and sector-level trade unions because fully centralized bargaining is the exception rather than the rule (see Figure 1).

<sup>3</sup>This assumption finds strong empirical support. See Corneo and Grüner (2002), Glazer and Konrad (1996), Goerke (2013), Konrad and Lommerud (1993) for evidence on the existence of relative preferences and see Clark and Senik (2010), Friehe et al. (2014) for evidence that workers compare their income with the (expected) income of management. Note further that relative preferences are also (implicitly) assumed in models with fair wages (see, for instance, Egger and Kreickemeier, 2009a,b).

<sup>4</sup>The focus on monopoly trade unions is made for analytical simplification; a Nash-bargaining approach would not affect our qualitative results. This is because unions' bargaining power, which is set to one in the case of monopoly unions, is typically treated as exogenous and independent of the prevailing bargaining level.

level trade unions implement the rent-sharing which is desired by their members by capturing a higher fraction of firms' rents. In doing so, they set firm-specific wages where high-profit firms pay higher wages than low-profit firms. This leads to a wage differentiation between firms within one sector. In contrast, sector-level trade unions aggregate preferences over its members (which are employed at different firms within one sector) and thus do not take the rent-sharing motive at the individual level into account. Consequently, there is no wage differentiation across firms of one sector, but only potentially across sectors.<sup>5</sup> The more aggressive wage-setting of firm-level trade unions implies that average profits are higher under sector-level trade unions. More firms hence enter the market, competitions becomes more severe and some low-profit firms have to leave the market. This increase in firm-selection implies that average productivity of operating firms is higher under sector-level trade unions.

With respect unemployment, there are then two countervailing effects. On the one hand, unemployment is, *ceteris paribus*, higher under sector-level trade unions due to higher wage markups as also shown by Calmfors et al. (1988). On the other hand, unemployment is, *ceteris paribus*, *lower* under sector-level trade unions because higher average productivity of firms causes marginal costs to decline and labor demand hence increases. To quantify these countervailing effects, we solve our model numerically using standard parameters from the literature. Taking the estimated rent-sharing parameter by Egger et al. (2013) into account, which is relatively small, we find that the unemployment increasing effect due to higher wage markups still dominates the unemployment damping effect due to higher firm-selection. Hence, rent-sharing motives by themselves are not able to reverse the predictions of Calmfors et al. (1988). However, we find that aggregate output is higher under sector-level trade unions despite the negative employment reaction. This is because higher average productivity of operating firms raises aggregate output one-to-one and this additional effect dominates the output reduction due to higher unemployment.

## 1.2 Related Literature

How do different bargaining levels affect labor and goods market outcomes? This question is tackled by a large and still growing strand of literature. The basic procedure of the corresponding studies is to compare the impact of different bargaining levels, e.g. firm- and sector-level agreements, with each

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<sup>5</sup>This finding is also supported by the empirical evidence. For instance, Gørtzen (2009) finds that wages are more tightly linked to profits if firm-level trade unions bargain wages.

other. The modeling approach, however, varies substantially across these studies, e.g. with respect to competition at the goods market, (further) labor market frictions and trade openness. In the last years, some studies also take explicitly the role of firm heterogeneity into account and are thus closely related to our approach.

The paper by Braun (2011) is a study in this spirit. In his model, firms compete at markets characterized by monopolistic competition. Trade unions bargain wages either at the firm- or at the sectoral-level. As a result, he shows that sector-level bargaining enhances firm-selection relative to firm-level bargaining and thus increases average productivity. The driving mechanism behind this finding is that consumers' preferences lead to CES demand functions, i.e. the price elasticity of demand depends on the demanded quantity (and is thus not constant as in the CES case). This implies that firms set different price markups, which gives firm-level trade unions an incentive to bargain firm-specific wages while sector-level trade unions impose a uniform wage rate. Note that the effect on unemployment and aggregate output is not investigated by the author.<sup>6</sup> Firm heterogeneity is also taken into account by Jimeno and Thomas (2013). In this study, a Mortensen-Pissarides-type model with search and matching frictions is enriched by firm-specific productivity shocks. Within such a framework, unemployment is higher under sector-level bargaining compared to firm-level agreements because of a.) higher destruction of low-productive jobs and b.) lower vacancy posting.

In the present paper, we pursue a much simpler approach in order to highlight as clearly as possible the role of rent-sharing motives for the effects of different bargaining regimes. First, we stick to the assumption of CES demand functions to rule out the effect of variable price markups for firm-selection (and other equilibrium outcomes).<sup>7</sup> Second, we consider trade unions as the only labor market imperfection and hence do not allow for search and matching frictions. As such, we focus on the role of trade unions for the impact of rent-sharing motives and postpone the interaction with other labor market frictions to future research.

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<sup>6</sup>In similar study, Montagna and Nocco (2013) introduce different types of bargaining levels in a world with firm-specific price markups. They distinguish between bargaining at the firm-level and at the sub-firm or profit-center level, but additionally investigate the consequences of trade liberalization. As their key finding, a decentralization of wage bargaining to the profit-center level leads to a wage differentiation within firms. Trade unions then lower their export wage claims to improve the firm's access to markets abroad. Therefore, trade liberalization influences within firm intra-industry wage inequality.

<sup>7</sup>Note that both rent-sharing motives and variable price markups imply higher firm-selection under sector-level bargaining relative to firm-level bargaining. This is because both mechanisms lead to firm-specific wages in the presence of firm-level trade unions, while there is no wage differentiation under sector-level trade unions.

Our paper is also related to studies that investigate the effect of different bargaining levels but abstain from the incorporation of heterogeneous firms. For instance, Danthine and Hunt (1994) show that the predictions of Calmfors et al. (1988) are reversed if the economy is opened up to international trade. In a more complex study, Egger and Etzel (2014) point out that only product market integration (but not capital market integration) explains that unemployment could be lower in case of sector-level agreements. Back to a closed economy setting, Fitzenberger and Franz (1999) build an insider-outsider labor market model and show that decentralized wage bargaining regimes could lead to higher unemployment relative to more centralized wage-setting systems. In the paper by García and Sorolla (2014), the authors take the opposite strategy and derive conditions under which the results by Calmfors et al. (1988) are confirmed and find that this would be the case if the degree of product market power is sufficiently high.

The remainder of this paper is structured as follows. In section 2, we briefly present our model and in section 3 we determine the sectoral equilibrium. In section 4 and 5, we provide the derivation of the general equilibrium and the simulation exercise, respectively. Section 6 concludes.

## 2 Model

### 2.1 Market Structure

The economy consists of a final good sector producing a homogeneous good  $Y$  and  $N$  sectors indexed by  $j = 1, \dots, N$  in which horizontally differentiated intermediate goods are produced. The production technology of the final goods producer is assumed to be a (nested) CES aggregate of all the available intermediate goods (see Egger and Kreickemeier, 2009a,b for a similar approach):

$$Y = N^{\frac{1}{1-\eta}} \left( \sum_{j=1}^N Q_j^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}} \quad \text{and} \quad \Lambda = N^{\frac{1}{\eta-1}} \left( \sum_{j=1}^N P_j^{1-\eta} \right)^{\frac{1}{1-\eta}},$$

with  $\Lambda$  representing the price index of the final good.  $Q_j$  denotes the aggregate intermediate good of sector  $j$  and  $P_j$  measures its price level.  $\eta$  stands for the elasticity of substitution between any two aggregate intermediate goods of different sectors. Markets in the final good sector are perfectly competitive such that we suppose  $Y$  to be the numéraire, which allows the normalization of the price index:  $\Lambda \equiv 1$ .

The intermediate good of sector  $j$  is also a CES aggregate and defined by:

$$Q_j = M_j^{\frac{1}{1-\sigma}} \left[ \int_{i \in \Omega_j} q_{ji}^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}} \quad \text{and} \quad P_j = M_j^{\frac{1}{\sigma-1}} \left[ \int_{i \in \Omega_j} p_{ji}^{1-\sigma} di \right]^{\frac{1}{1-\sigma}},$$

with  $\Omega_j$  being the set of varieties (of the intermediate good) produced in sector  $j$  and its measure representing the mass of available varieties  $M_j$ . Since all firms produce one variety by assumption,  $M_j$  equals the mass of firms in sector  $j$ .  $q_{ji}$  denotes the demand for variety  $i$  in sector  $j$  and  $p_{ji}$  represents its price.  $\sigma > 1$  stands for the elasticity of substitution between any two varieties within one sector, where we assume that  $\sigma > \eta > 1$  holds (see Atkeson and Burstein, 2008 for the same assumption).

The demand for variety  $i$  in sector  $j$  and the demand for the (aggregate) intermediate good of sector  $j$  can be derived from the profit maximization of final goods producers. This yields, respectively:

$$q_{ji} = \left( \frac{p_{ji}}{P_j} \right)^{-\sigma} \frac{Q_j}{M_j}, \quad (1)$$

$$Q_j = P_j^{-\eta} \frac{Y}{N}. \quad (2)$$

The price elasticity of the demand for variety  $i$  is given by  $\sigma$  while the price elasticity of the demand for the aggregate intermediate good in sector  $j$  equals  $\eta$ . Our assumption  $\sigma > \eta$  ensures that competition within sectors is stronger (higher price elasticity) than across sectors (lower price elasticity). This is because varieties are closer substitutes within sectors than across sectors.

In the intermediate goods sectors, there is a continuum of ex-post heterogeneous firms. Each firm can enter the sector by paying sunk entry costs  $F_j^e > 0$  (measured in units of final goods).<sup>8</sup> Afterward, the firm observes its productivity  $\phi_j$ , which is drawn from a Pareto distribution  $G_j(\phi_j) = 1 - (\phi_{\min}/\phi_j)^{k_j}$  with  $\phi_j \geq \phi_{\min} \equiv 1$  and  $k_j > 1$ . Once the productivity is known, each firm decides whether to exit the sector or to start producing and selling its variety, which takes place under conditions of monopolistic competition.

## 2.2 Preferences

The economy is endowed with an exogenously given mass of homogeneous individuals  $L$ . As usual, utility of the individuals depends on their absolute

<sup>8</sup>For simplicity, we assume that firms are randomly allocated to sectors. Hence, we do not allow firms to optimally decide on which sector to enter.

income level. There is, however, a large strand of literature arguing that utility also depends on relative income terms because individuals compare their own income with the income of a certain reference group (see, for instance, Corneo and Grüner, 2002, Glazer and Konrad, 1996, Goerke, 2013, Konrad and Lommerud, 1993). The simplest way to formalize this fact is that the ratio between individuals own income and the average income in the economy enters their utility function.

Further empirical evidence suggests that individuals' business environment influences the reference group with which individuals compare themselves. For example, based on the European Social Survey and the German Socio-Economic Panel, Clark and Senik (2010) and Friehe et al. (2014) show that individuals compare their income more intensively with the income of individuals from the same occupation/firm, including the income of the firm's management. In models with heterogeneous firms, Egger and Kreickemeier (2009a,b) have already formalized this finding. They assume that a worker compares her/his received wage not only with the average income in the economy but also with the (firm-specific) profit of the firm at which s/he is employed. The authors interpret the resulting income as a wage rate that the individual considers as fair.

We take up their approach and assume that the utility of being employed, e.g. at firm  $i$  which produces in sector  $j$  and has drawn the productivity  $\phi_{ji}$ , is given by:

$$U_{ji} = \frac{w_{ji}}{\phi_{ji}^\omega I^{1-\omega}} \quad 0 \leq \omega \leq 1, \quad (3)$$

where  $w_{ji}$  denotes the wage that the firm pays,  $I$  stands for the average income in the economy and  $\phi_{ji}^\omega I^{1-\omega}$  represents the reference income. For simplicity, we use the firm's productivity as an approximation of its profit. This can be justified because the firm's profit increases in productivity (see section 3.1).<sup>9</sup>

To understand the intuition behind this utility concept, suppose (for the moment) that the firm's productivity rises. Holding everything else constant, the gap between the income of the firm, i.e. the profit, and the worker's own income, i.e. the wage, rises and the worker's utility hence declines. This reduction of utility indicates a rent-sharing motive of individuals. Each worker prefers if (parts of) the profit increase would be redistributed to their own wage bill because this would mitigate (or even avoid) the utility decline. The parameter  $\omega$  measures the extent of this rent-sharing motive. The higher  $\omega$  is, the higher the weight of the firm-specific variable in the reference income, and the more utility decreases in  $\phi$ .

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<sup>9</sup>Note that this assumption is also used by Egger and Kreickemeier (2009a,b).

If an individual is unemployed, s/he receives unemployment benefits  $B$  as income. In this case, the firm-specific variable plays no role for the utility, and the reference income consists only of the average income in the economy. However, consistency of preferences requires that  $I$  must be weighted by  $1 - \omega$ . Hence, the utility of being unemployed is given by:

$$U_B = \frac{B}{I^{1-\omega}}. \quad (4)$$

## 2.3 Trade Unions

Individuals are organized in (pre-entry) closed-shop monopoly trade unions, i.e. firms have to recruit individuals who are already union members. As usual in models with closed-shop trade unions, we do not endogenize individuals' decisions about which union to join. This implies that membership  $n$  of a trade union is exogenously given.

Trade unions maximize the utility of their members by setting the wage rate. However, they must take into account that firms unilaterally set prices which in turn determines the firms' labor demand. Thus, wage-setting is restricted by the firms' right to manage employment. Wage-setting can take place either at the firm-level or at the sectoral-level. To shed light on the different consequences of firm-level and sector-level trade unions, we analyze both wage-setting structures separately. For notational convenience, we index firm-level trade unions by  $FL$  and sector-level trade unions by  $SL$ .

## 3 Sectoral Equilibrium

At the sector-level, our model can be described as a three-stage game. Firms enter the sector and decide whether or not to produce in stage 1. In stage 2, monopoly trade unions set the wage rate taking into account that firms choose their profit-maximizing prices in stage 3. The three-stage game is solved by backward induction. Since we focus on sectoral equilibrium, we omit index  $j$  for notational simplicity.

### 3.1 Price and Employment

#### 3.1.1 Firm-level

Let us consider firm  $i$  with productivity  $\phi_i$ . The technology is given by:

$$q_i = \phi_i h_i, \quad (5)$$

where  $h_i$  denotes the number of workers employed at firm  $i$ . Firm  $i$  sets the price to maximize its profit  $\pi_i = r_i - w_i h_i - F$  subject to the final goods producers demand for variety  $i$  [see (1)], where  $r_i \equiv p_i q_i$  denotes the firm's revenue.  $F > 0$  are the fixed costs of production measured in units of the final good. As a standard result of models with monopolistic competition and CES demand functions, the optimal price is a constant markup,  $1/\kappa$ , over marginal costs:

$$p_i = \frac{1}{\kappa} \frac{w_i}{\phi_i} \quad \text{with} \quad \kappa \equiv 1 - \frac{1}{\sigma}, \quad 0 < \kappa < 1. \quad (6)$$

Using (1), (5), and (6), we can calculate the firm's labor demand as:

$$h_i = w_i^{-\sigma} \phi_i^{\sigma-1} (\kappa P)^\sigma \frac{Q}{M}, \quad (7)$$

which is decreasing in the wage rate,  $\partial h_i / \partial w_i < 0$ . The wage elasticity of labor demand equals  $\epsilon_{h,w} = -\sigma$ . Note that we can reformulate revenues and profits to  $r_i = p_i(\phi_i)^{1-\sigma} P^\sigma Q/M$  and  $\pi_i = r_i(\phi_i)/\sigma - F$ , respectively.

### 3.1.2 Sector-level

Since we analyze the effects of firm-level and sector-level trade unions later on, it is useful to calculate sector-level variables at this stage. For this purpose, we proceed in three steps. First, we anticipate that the ratio between any two firms' wages depends on the ratio of their productivities and the wage-setting structure (see section 3.2)<sup>10</sup>:

$$\frac{w(\phi_1)}{w(\phi_2)} = \left( \frac{\phi_1}{\phi_2} \right)^{\rho^s}, \quad \phi_1 > \phi_2, \quad (8)$$

where the superscript  $s = FL, SL$  is used if variables vary with the wage-setting structure. Using (6) and (8), the price ratio is given by:

$$\frac{p(\phi_1)}{p(\phi_2)} = \left( \frac{\phi_1}{\phi_2} \right)^{\rho^s - 1}.$$

For the revenue and employment ratio, we obtain:

$$\frac{r(\phi_1)}{r(\phi_2)} = \left( \frac{\phi_1}{\phi_2} \right)^{\beta^s}, \quad \frac{h(\phi_1)}{h(\phi_2)} = \left( \frac{\phi_1}{\phi_2} \right)^{\beta^s - \rho^s},$$

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<sup>10</sup>In our model, the functional form of the wage ratio is driven by the properties of CES demand functions and a well-behaved union's objective function. Notably, this functional form is also documented by papers that extend the original Melitz (2003) framework to trade unions or efficiency wages (see, for instance, de Pinto and Michaelis, 2014a,b, Egger and Kreckemeier, 2009a,b).

with  $\beta^s \equiv (\sigma - 1)(1 - \rho^s)$ .

Second, we calculate the average productivity of all firms in the sector,  $\tilde{\phi}$ . By definition, output of the firm with productivity  $\tilde{\phi}$  equals output per firm in the sector:  $q(\tilde{\phi}) \equiv Q/M$ . Using this condition, we obtain (for a step-by-step derivation see Egger and Kreickemeier, 2009a):

$$\tilde{\phi}^s = \left[ \int_{\phi^*}^{\infty} \phi^{\beta^s} dG(\phi) \right]^{\frac{1}{\beta^s}} = \left( \frac{k}{k - \beta^s} \right)^{\frac{1}{\beta^s}} \phi^{*s}, \quad k > \beta^s, \quad (9)$$

where  $\phi^{*s}$  stands for the productivity of the marginal firm in the sector, i.e. the firm with the lowest productivity operating in the market.

Finally, we derive the sector-level variables as a function of the average productivity and the mass of firms (for the same result, see Melitz, 2003, among others):  $Q^s = M^s q^s(\tilde{\phi}^s)$ ,  $P^s = p^s(\tilde{\phi}^s)$ ,  $R^s = M^s r^s(\tilde{\phi}^s)$  and  $\Pi^s = M^s \pi^s(\tilde{\phi}^s)$ , where  $R$  and  $\Pi$  denote aggregate revenues and profits in the sector, respectively. With regard to aggregate employment  $H^s$  of the sector, our result is in accordance with Egger and Kreickemeier (2009a):

$$H^s = \xi_1^s \xi_2^s M^s h^s(\tilde{\phi}^s) \quad \text{with} \quad \xi_1^s \equiv \left( \frac{k}{k - \beta^s} \right)^{\frac{\rho^s}{\beta^s}} \quad \text{and} \quad \xi_2^s \equiv \frac{k - \beta^s}{k + \rho^s - \beta^s}. \quad (10)$$

Note that the wage elasticity of aggregate sector-level employment is given by  $\epsilon_{H,w} = -\eta$ .

The sectoral variables have an important property independent of the prevailing wage-setting structure (see Melitz, 2003): the sector-levels of  $P$ ,  $Y$ ,  $R$ ,  $\Pi$ , and  $H$  are identical to what they would be if the sector were endowed with  $M$  identical firms with productivity  $\tilde{\phi}$ . Therefore, we can treat the firm with productivity  $\tilde{\phi}$  as the representative firm of the sector.

## 3.2 Wage-setting

### 3.2.1 Firm-level Trade Union

We assume that trade union  $i$ , which sets the wage rate of firm  $i$ , cares about the sum of the utilities of its members  $n_i$  (see Oswald, 1985). Therefore, the trade union's objective function is given by  $V_i = h_i U_i + (n_i - h_i) \bar{U}$ , where  $\bar{U}$  represents the fallback utility if the union member is not employed at firm  $i$ .<sup>11</sup> Note that  $n_i > h_i$  holds by assumption. Using (3), we can rewrite the

<sup>11</sup>We abstain from using the index  $s$  in section 3.2 because firm-level and sector-level trade unions are discussed separately here.

trade union's objective function and obtain:

$$V_i = h_i \frac{w_i}{\phi_i^\omega I^{1-\omega}} + (n_i - h_i) \bar{U}. \quad (11)$$

The trade union maximizes  $V_i$  by choosing  $w_i$  subject to the firm's price decision (respectively labor demand determination) of stage 3. However, due to the existence of a continuum of firms within each sector, the wage-setting of trade union  $i$  has no impact on macroeconomic variables, particularly on the unemployment rate. Therefore,  $\bar{U}$  and  $I$  are exogenously given for the firm-level trade union. Maximizing (11) subject to (7) then leads to:

$$w_i^{FL} = \theta^{FL} \phi_i^\omega I^{1-\omega} \bar{U}, \quad (12)$$

$$\theta^{FL} \equiv \frac{\epsilon_{h,w}}{1 + \epsilon_{h,w}} > 1. \quad (13)$$

Notably, we can use (8) and (12) and obtain:  $\rho^{FL} = \omega$ .

When maximizing  $V_i$  over  $w_i$ , the firm-level trade union balances two effects. On the one hand, a higher wage rate leads to a direct increase in members' utility. On the other hand, firms increase their prices and labor demand decreases, which in turn decreases members' utility. The latter effect can be interpreted as negative price externality measured by the wage elasticity of labor demand, which the union has to internalize in its decision (the wage markup  $\theta^{FL}$  depends on  $\epsilon_{h,w}$ ).

Moreover, we see from (12) that firm-level trade unions set firm-specific wages. The reason for this result is that trade unions respect the individuals' rent-sharing motive. Suppose that the firm's productivity and hence its profit increase. As explained in section 2.2, worker's utility c.p. declines. This gives firm-level trade unions an incentive to increase its wage demands. The rent-sharing motive hence implies that firm-level trade unions acquire (parts of) the higher profits and redistribute them to its members. As such, they pursue a relatively aggressive wage-setting strategy. This can be summarized in the following Lemma:

**Lemma 1** *If individuals have a rent-sharing motive, i.e.  $\omega \in (0, 1]$ , union wage-setting at the firm-level leads to a wage differentiation across firms within one sector, where high-productive firms pay higher wages than low-productive firms. If  $\omega = 0$ , individuals have no rent-sharing motive and wage differentiation is thus not present.*

### 3.2.2 Sector-level Trade Union

Sector-level trade unions also care about the sum of their members' utilities. However, two differences arise. First, the sector-level trade union aggregates

preferences of individuals (or equivalently union members) that are employed in the respective sector. From the union's perspective, it is thus irrelevant at which firm a member is employed as long as s/he works at a firm within the sector. Second, the sector-level trade union sets the wage rate for all firms within the sector (for the same assumption, see, for instance, Calmfors et al., 1988, Danthine and Hunt, 1994, Egger and Etzel, 2014). Consequently, it has to take into account that a wage variation influences the sector-level product and labor demand.

To formalize the unions' utility function, we use the property that the sector-levels can be described by a representative firm with productivity  $\tilde{\phi}$  at which all workers are employed. Therefore, we obtain:

$$V = H(\tilde{\phi}) \frac{w}{\tilde{\phi}^\omega I^{1-\omega}} + (\tilde{n} - H(\tilde{\phi})) \bar{U}, \quad (14)$$

with  $\tilde{n}$  ( $> H$ ) being the sector-level trade union membership. Before solving for the utility maximizing wage rate, three remarks are important. First, we assume a sufficiently large number of sectors  $N$  to ensure that the wage-setting of the sector-level trade union has a negligible impact on macroeconomic variables. Consequently, the fallback utility  $\bar{U}$  and average income  $I$  are treated as exogenous.<sup>12</sup> Second, due to the recursive structure of our model, the mass of firms  $M$  is predetermined at stage 1. Third, not only  $M$  but also the distribution of firms operating in the market, and thus, the average productivity  $\tilde{\phi}$  are predetermined at stage 1.

Then, maximizing (14) subject to (10) yields:

$$w^{SL} = \theta^{SL} \left( \tilde{\phi}^{SL} \right)^\omega I^{1-\omega} \bar{U}, \quad (15)$$

$$\theta^{SL} \equiv \frac{\epsilon_{H,w}}{1 + \epsilon_{H,w}} > 1. \quad (16)$$

As a result, the average productivity of all firms in the sector affects sector-level wage setting. This is in contrast to the firm-level wage setting where the firm's productivity enters the wage function. The reason for this finding is that sector-level trade unions aggregate preferences of all union members such that the rent-sharing motive at the individual level is not taken into account. Only if *aggregate* profits in the sector increase – mirrored by a rise of  $\tilde{\phi}$  –, the (aggregate) rent-sharing motive cause sector-level trade unions to set higher wages. This can be summarized in the following Lemma:

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<sup>12</sup>We implement this assumption to highlight two mechanisms: sector-level trade unions account for changes in sector variables and aggregate individuals' preferences over the sector. If repercussion effects on the macroeconomic variable would also be allowed, our model loses analytical tractability and the implications of the mentioned mechanisms would be more difficult to identify.

**Lemma 2** *If trade unions aggregate members' preferences, union wage-setting at the sector-level implies that there is no wage differentiation across firms within one sector. This result is independent of the individual's rent-sharing motive and implies that  $\rho^{SL} = 0$  [see (8)].*

### 3.3 Firm Entry and Exit

At stage 1, firms decide whether to produce in the sector or to leave the market. As in Melitz (2003), two conditions must be fulfilled for market entry. Before observing the productivity, expected profits must be equal to entry costs, i.e. the free-entry condition (FE):

$$\frac{1}{\delta} \int_0^{\infty} \pi^s(\phi) dG(\phi) = F^e,$$

with  $0 < \delta < 1$  representing the (exogenously given) death probability of firms. Using the Pareto distribution as well as  $\bar{\pi}^s \equiv \Pi^s/M^s = \pi^s(\tilde{\phi}^s)$ , we obtain:

$$\bar{\pi}^s = (\phi^{*s})^k \delta F^e. \quad (17)$$

After the productivity is revealed, the firm starts producing if and only if profits are at least equal to zero, i.e. the zero-profit-cutoff condition (ZPC). For the marginal firm, we obtain  $\pi^s(\phi^{*s}) = \frac{1}{\sigma} r^s(\phi^{*s}) - F = 0$ . Using the revenue ratio from above, we find:

$$\bar{\pi}^s = \frac{\beta^s F}{k - \beta^s}. \quad (18)$$

Since productivities are Pareto distributed, ZPC is independent of  $\phi^*$ .<sup>13</sup> The representative firm's revenue is given by:  $r^s(\tilde{\phi}^s) = k\sigma F/(k - \beta^s)$ .

Combining (17) and (18), we can explicitly calculate the cutoff productivity  $\phi^*$  as:

$$\phi^{*s} = \left( \frac{F}{\delta F^e} \frac{\beta^s}{k - \beta^s} \right)^{\frac{1}{k}}, \quad k > \beta^s. \quad (19)$$

For  $\phi \geq \phi^{*s}$ , firms will produce, otherwise they will exit the market.<sup>14</sup> Notably, we get  $\beta^{FL} = (\sigma - 1)(1 - \omega)$  and  $\beta^{SL} = \sigma - 1$ , which implies  $\beta^{SL} > \beta^{FL}$  if and only if  $\omega > 0$ . In the limiting case of  $\omega = 0$ ,  $\beta^{SL} = \beta^{FL}$  holds.

<sup>13</sup>The assumption of Pareto distributed productivities is commonly used in the literature and also finds empirical support (see Axtell, 2001, Del Gatto et al., 2006).

<sup>14</sup>Since  $\phi^{*s} \geq \phi_{\min} \equiv 1$  must hold by assumption, only parameter constellations are permitted that do not violate the condition  $\beta^s \geq k/(1 + F/(\delta F^e))$ .

## 3.4 Wage-setting Structures and their Implications

### 3.4.1 Wage markup

As mentioned above, there is a negative externality of the wage setting which trade unions must internalize: the firms' price reactions. However, the magnitude of the price externality differs with the considered wage-setting structure. In the case of firm-level trade unions, only the respective firm changes its price while all other firms within the sector leave their prices constant. The firm's variety demand declines sharply because competition within the sector is relatively strong.

In the case of sector-level trade unions, *all* firms within the sector increase their prices resulting in an increase in the sector's price index  $P$ . Therefore, the relative demand for each variety within the sector is unchanged. However, an increase in  $P$  causes a demand reduction of the aggregate sector good  $Q$  and all firms within the sector reduce their labor demand. Since competition between sectors is relatively low, the resulting decrease in the demand of each variety turns out to be moderate in comparison with the firm-level wage-setting.

Formally, the difference in the negative price externality is given by the difference in the wage markup. Inserting the respective wage elasticities of labor demand  $\epsilon_{h,w}$  and  $\epsilon_{H,w}$  into (13) and (16), respectively, yields:

$$\theta^{FL} = \frac{\sigma}{\sigma - 1} < \frac{\eta}{\eta - 1} = \theta^{SL} \quad \text{with } \sigma > \eta.$$

This shows that sector-level trade unions charge higher wage markups and set, *ceteris paribus*, higher wages. Note that this result was prominently introduced by Calmfors et al. (1988) and we thus denote it as the CF-effect in the following.

### 3.4.2 Rent-sharing Motives

In our framework, the considered wage-setting structures differ in a second dimension. Firm-level trade unions take the individual's rent-sharing motive into account, which leads to a wage differentiation across firms within one sector (see Lemma 1), while there is no wage differentiation in the case of sector-level trade unions (see Lemma 2). Comparing (12) and (15), we thus find:

$$\frac{w^{SL}}{w^{FL}(\phi)} = \underbrace{\frac{\theta^{SL}}{\theta^{FL}}}_{>1} \left( \frac{\tilde{\phi}^{SL}}{\phi} \right)^\omega, \quad (20)$$

where  $\theta^{SL} > \theta^{FL}$  holds due to the CF-effect.<sup>15</sup> This leads to the following Proposition:

**Proposition 1** *There is a firm with productivity  $\bar{\phi}$  for which firm-level and sector-level trade unions set the same wage rate:  $w^{SL}(\bar{\phi}) = w^{FL}(\bar{\phi})$ . For firms with productivities  $\phi > \bar{\phi} > \tilde{\phi}^{SL}$ , we obtain  $w^{SL} < w^{FL}$  if  $\omega \in (0, 1]$ . For firms with productivities  $\phi < \bar{\phi}$ , we find  $w^{SL} > w^{FL}$  if  $\omega \in (0, 1]$ . In the limiting case of  $\omega = 0$ , we find  $w^{SL} > w^{FL}$  irrespective of firms' productivities.*

**Proof 1** *We can use (20) to derive the productivity threshold  $\bar{\phi}$ :*

$$\frac{w^{SL}}{w^{FL}(\phi)} = 1 \Leftrightarrow \phi = \bar{\phi} \equiv \left( \frac{\theta^{SL}}{\theta^{FL}} \right)^{\frac{1}{\omega}} \tilde{\phi}^{SL}. \quad (21)$$

*For  $\phi > (<) \bar{\phi}$  and  $\omega > 0$ , we obtain  $w^{SL}/w^{FL} < 1$  ( $w^{SL}/w^{FL} > 1$ ), which proves the first and second part of Proposition. For the third part, note that the  $w^{SL}/w^{FL} = \theta^{SL}/\theta^{FL} > 1$  holds if  $\omega = 0$ .*

To explain the intuition behind this result, let us at first consider firms with relatively low productivities, i.e.  $\phi < \tilde{\phi}^{SL} < \bar{\phi}$ . If firm-level trade unions are present, the wage bill of these firms benefits from two effects: the wage markup is relatively low (CF-effect) and low-productive firms can pay lower wages (rent-sharing motive). However, if firm-level trade unions are replaced by sector-level trade unions, the effects are reversed: the wage markup increases and the advantage of (relatively low) firm-specific wages vanishes. Both lead to an unambiguous increase in the firm's wage rate.

For firms with productivities  $\tilde{\phi}^{SL} < \phi < \bar{\phi}$ , the rent-sharing motive implies that wages are relatively high under firm-level wage-setting. If firm-level trade unions are replaced by sector-level trade unions, the wage markup increases as before which, ceteris paribus, raises wage payments. However, there is also a wage decreasing effect because sector-level trade unions do not take the rent-sharing motive at the individual level into account. In sum, the latter effect mitigates but not compensates the former effect such that wages of these firms still increase. For firms with relatively high productivities, i.e.  $\phi > \bar{\phi} > \tilde{\phi}^{SL}$ , firm-level trade unions set even higher wages due to the rent-sharing motive. Switching to sector-level implies then, ceteris paribus, a relatively strong wage decreasing effect which dominates the CF-effect. As a result, wage payments of these firms decline.

Because optimal prices increase in  $w$  [see (6)], employment and revenues decrease in  $p$  as well as profits increase in  $r$ , we can conclude:

<sup>15</sup>Note that we ignore any consequences for macroeconomic variables at this stage because we analyze the sectoral equilibrium.

**Corollary 1** *If  $w^{SL} < w^{FL}$ , sector-level wage-setting leads to lower prices, higher employment, higher revenues and higher profits, relative to firm-level wage setting. If  $w^{SL} > w^{FL}$ , the reverse result holds.*

### 3.4.3 Firm-selection

In addition to our previous findings, the wage-setting structure influences firm-selection. As in Melitz (2003) and the corresponding literature, firm-selection implies that low-productive firms are forced to leave the market and is measured by an increase in the cutoff productivity  $\phi^*$ .

**Proposition 2** *For  $\omega \in (0, 1]$ , the cutoff productivity and the average productivity are higher under sector-level trade unions:  $\phi^{*SL} > \phi^{*FL}$  and  $\tilde{\phi}^{SL} > \tilde{\phi}^{FL}$ . In the limiting case of  $\omega = 0$ , we have  $\phi^{*SL} = \phi^{*FL}$  and  $\tilde{\phi}^{SL} = \tilde{\phi}^{FL}$ .*

**Proof 2** *Using (19) and noting  $\beta^{SL} > \beta^{FL}$ , we obtain:*

$$\frac{\phi^{*SL}}{\phi^{*FL}} = \left( \frac{\beta^{SL} k - \beta^{FL}}{\beta^{FL} k - \beta^{SL}} \right)^{\frac{1}{k}} > 1 \quad \text{for } 0 < \omega \leq 1, \quad (22)$$

*From (9) and (22), we can calculate:*

$$\frac{\tilde{\phi}^{SL}}{\tilde{\phi}^{FL}} = \frac{\left( \frac{k}{k - \beta^{SL}} \right)^{\frac{1}{\beta^{SL}}}}{\left( \frac{k}{k - \beta^{FL}} \right)^{\frac{1}{\beta^{FL}}}} \underbrace{\frac{\phi^{*SL}}{\phi^{*FL}}}_{\geq 1}. \quad (23)$$

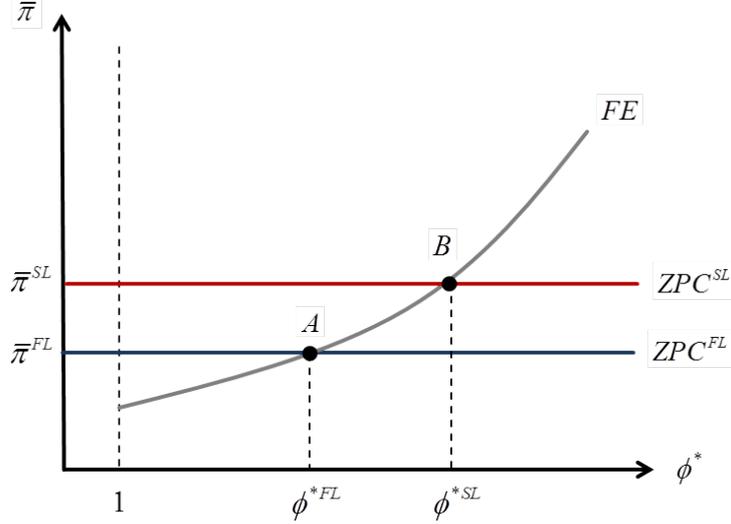
*Together with*

$$\frac{\partial}{\partial \beta^s} \left( \frac{k}{k - \beta^s} \right)^{\frac{1}{\beta^s}} > 0,$$

*this proves the first part of the Proposition. For the second part note that  $\beta^{SL} = \beta^{FL}$  holds if  $\omega = 0$ .*

To find an intuition for this result, we can use the FE and ZPC conditions, which are illustrated in Figure 2. If firm-level trade unions are fully replaced by sector-level trade unions, it is evident from Proposition 1 and Corollary 1 that high-productive firms receive higher profits while low-productive firms earn lower profits. How do the average profits of the sector change under these circumstances? Eq. (18) together with  $\beta^{SL} > \beta^{FL}$  show that  $\bar{\pi}$  unambiguously increases, i.e. the ZPC-curve goes up. Thus, the increase in profits of high-productive firms dominates the decrease in profits of low-productive firms, which is a direct consequence of the assumed Pareto distribution.

Figure 2: Cutoff Productivity



Consequently, market entry becomes more profitable such that more firms bear entry costs and the mass of firms producing in the market increases. However, an increasing mass of firms raises competition and reduces variety demand. Some low-productive firms are not able to compensate the implied reduction of their revenues and leave the market, which is mirrored by an increase in  $\phi^*$ . The economy moves from point A to point B, where  $\phi^{*SL} > \phi^{*FL}$  holds.<sup>16</sup> Notably, if individuals have no rent-sharing motive, i.e.  $\omega = 0$ , average profits are unaffected by the wage-setting structure and so the firm-selection remains unchanged as well.

## 4 General Equilibrium

In this section, we pin down the general equilibrium of the economy to analyze the effects of firm-level and sector-level wage-setting on unemployment and aggregate output.

### 4.1 Labor Market

By definition, the equilibrium unemployment rate  $u^*$  ensures that the unions' wage-setting schedules are in accordance with the firms' price-setting sched-

<sup>16</sup>This intuition is well in line with the literature investigating the determinants of different firm-selections, e.g. trade costs (Melitz, 2003) or tax rates (Egger and Kreickemeier, 2009b).

ules. The former visualizes the 'target' real wage, i.e. the wage intended by the trade unions. The latter represents the 'feasible' real wage, i.e. the wage firms are willing to concede to the workers. If the target real wage exceeds (falls short of) the feasible real wage, we observe an upward (downward) wage-price spiral implying an increase (decrease) in unemployment.<sup>17</sup> To ensure analytical tractability, we assume that all sectors are fully symmetric, thereby implying that  $\tilde{\phi}_j = \tilde{\phi} \forall j$  holds. Therefore, we can treat the firm with productivity  $\tilde{\phi}$  not only as representative for one sector (see above) but also as representative for the entire economy.

To derive the union's target real wage  $w_{WS}$ , an explicit description of the fallback utility  $\bar{U}$  is required. We assume that  $\bar{U}$  is a weighted average of utility in the case of unemployment,  $U_B$ , and of expected utility in case of employment,  $U_H$ . As discussed in section 2.2, the former is given by  $U_B = B/I^{1-\omega}$  [see (4)]. Regarding the latter, consistency with the individuals' preferences in Eq. (3) requires that  $U_H = \bar{w}/\tilde{\phi}^\omega I^{1-\omega}$  must hold, where  $\bar{w}$  stands for the expected wage rate in the economy. Using the (un-)employment rate as weights, we obtain:

$$\bar{U}^s = u \frac{B}{I^{1-\omega}} + (1-u) \frac{\bar{w}^s}{(\tilde{\phi}^s)^\omega I^{1-\omega}}. \quad (24)$$

Inserting (24) into (12) respectively (15) as well as using  $\phi_i = \tilde{\phi}^s$ , we obtain:<sup>18</sup>

$$w_{WS}^s(\tilde{\phi}^s) = \theta^s (\tilde{\phi}^s)^\omega \left( uB + (1-u)\bar{w}^s (\tilde{\phi}^s)^{-\omega} \right). \quad (25)$$

The representative firm's feasible real wage  $w_{PS}$  can be calculated by using (6),  $\phi_i = \tilde{\phi}$  and  $\Lambda = P = p(\tilde{\phi}) \equiv 1$ :

$$w_{PS}^s(\tilde{\phi}^s) = \tilde{\phi}^s \kappa. \quad (26)$$

The feasible real wage is independent of (un-)employment, which is a direct consequence of our assumptions on technology (output is linear in labor) and the CES variety demand and thus pins down the equilibrium wage rate,  $w^{*s} = w_{PS}^s$ , as well as the expected wage rate,  $\bar{w}^s = w_{PS}^s$ .

<sup>17</sup>For more information about the determination of the labor market equilibrium using the target and feasible real wage, see Layard et al. (2005) and Lindbeck (1993). See also de Pinto and Michaelis (2014a), de Pinto and Michaelis (2014b) and de Pinto (2015) who implement this approach in an open economy model with monopolistic competition and unionized labor markets.

<sup>18</sup>The union's target real wage and hence labor market equilibrium are independent of the average income in the economy  $I$ . Therefore, we abstain from calculating  $I$  explicitly.

In the general equilibrium,  $w_{WS}^s(\tilde{\phi}^s) = w_{PS}^s(\tilde{\phi}^s)$  must hold. Combining (25) and (26), we can calculate the equilibrium unemployment rate as:<sup>19</sup>

$$u^{*s} = \frac{1 - 1/\theta^s}{1 - B(\tilde{\phi}^s)^{-(1-\omega)}\kappa^{-1}}. \quad (27)$$

By definition, aggregate employment in the general equilibrium is given by:

$$H^{*s} = (1 - u^{*s})L. \quad (28)$$

With the labor market equilibrium at hand, we can show how the wage-setting level affects the equilibrium wage and unemployment rate.

**Proposition 3** *For  $\omega \in (0, 1]$ , the equilibrium wage rate is higher under sector-level trade unions:  $w^{*SL} > w^{*FL}$ . In the limiting case of  $\omega = 0$ , the equilibrium wage rate is not affected by changes in the wage-setting structure.*

**Proof 3** *Using (23),  $w^{*s} = w_{PS}^s$  and (26), we obtain:*

$$\frac{w^{*SL}}{w^{*FL}} = \frac{\tilde{\phi}^{SL}}{\tilde{\phi}^{FL}} > 1, \quad \text{if } \omega \in (0, 1], \quad (29)$$

*which immediately proves the first part of the Proposition. For the second part, note that  $\tilde{\phi}^{FL} = \tilde{\phi}^{SL}$  holds if  $\omega = 0$ .*

**Proposition 4** *For  $\omega \in (0, 1]$ , a switch from firm-level to sector-level trade unions has an ambiguous effect on the unemployment rate. In the limiting case of  $\omega = 0$ , the unemployment rate is higher under sector-level trade unions.*

**Proof 4** *From (27), we can calculate:*

$$\frac{u^{*SL}}{u^{*FL}} = \underbrace{\frac{1 - 1/\theta^{SL}}{1 - 1/\theta^{FL}}}_{>1 \text{ since } \theta^{SL} > \theta^{FL}} \underbrace{\frac{1 - B(\tilde{\phi}^{FL})^{-(1-\omega)}\kappa^{-1}}{1 - B(\tilde{\phi}^{SL})^{-(1-\omega)}\kappa^{-1}}}_{<1 \text{ since } \tilde{\phi}^{SL} > \tilde{\phi}^{FL}} \quad \text{if } \omega \in (0, 1], \quad (30)$$

*which proves the first part of the Proposition. For the second part, note that  $\tilde{\phi}^{FL} = \tilde{\phi}^{SL}$  holds if  $\omega = 0$ .*

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<sup>19</sup>Note that we only consider parameter constellations for which  $B < (\tilde{\phi}^s)^{1-\omega}\kappa(\theta^s)^{-1}$  is fulfilled to ensure  $0 < u^{*s} < 1$ .

In our framework with heterogeneous firms and rent-sharing motives of individuals, a switch from firm-level wage setting to sector-level wage setting has two countervailing effects (see also Figure 3). On the one hand, the CF-effect occurs due to the increase in the wage markups  $\theta$ . For any given level of unemployment, trade unions claim a higher income share and the target real wage goes up. Firms respond to such an increase in their marginal costs with a higher profit-maximizing price. Variety demand and labor demand decrease, and the unemployment rate, *ceteris paribus*, rises. In Figure 3, we move from point A to point B.<sup>20</sup>

On the other hand, firm-selection increases, which implies an increase in the firms' average productivity (see Proposition 2). The rise in  $\tilde{\phi}$  leads to a decrease in the marginal costs of the representative firm, thereby causing the profit-maximizing price to decline, i.e. the feasible real wage and thus the equilibrium wage increase. As a consequence, the variety demand and labor demand of the representative firm increase and the unemployment rate falls. We move from point B to C in Figure 3. This positive employment effect is mitigated (but never compensated) by a further increase in the unions' target real wage. With an increasing equilibrium wage rate and a higher average productivity, the union boosts their wage claims and the target real wage rises with respective negative implications for the unemployment rate, i.e. the transition from point C to D in Figure 3.

If the increase in firm-selection is sufficiently strong, i.e.  $\omega$  is relatively high, the shift in the feasible real wage is relatively strong as well. In this case, point D could even be located left from point A such that the unemployment rate would be lower under sector-level trade unions. However, if individuals have no rent-sharing motives, i.e.  $\omega = 0$ , firm-selection remains constant and we obtain the well-established Calmfors et al. (1988) result: the unemployment rate is higher under sector-level trade unions compared to that under firm-level trade unions, i.e. the new equilibrium is reached in point B.

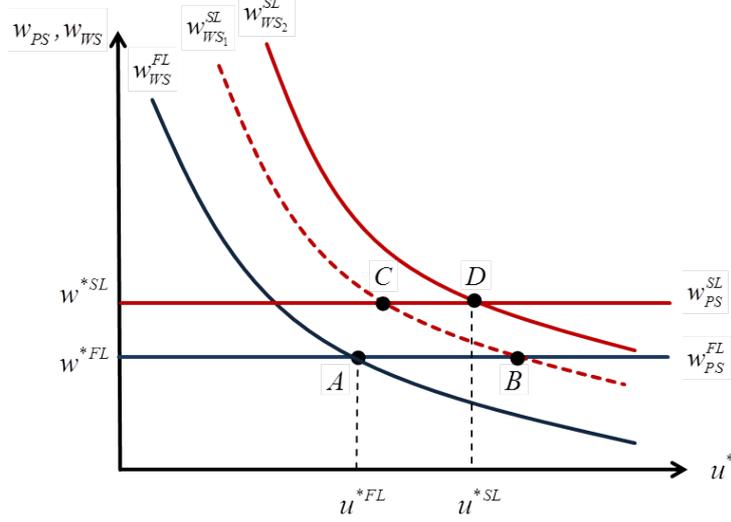
## 4.2 Goods Market

In a next step, we calculate aggregate output in the equilibrium. Using  $H^{*s} = (\xi_1 \xi_2)^\varrho NM^s h^s(\tilde{\phi}^s)$  [see (10)], with  $\varrho$  denoting an indicator variable that equals one in the presence of firm-level unions and zero otherwise, as

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<sup>20</sup>In the general equilibrium, the CF-effect has no impact on the wage rate. The increase in unemployment forces unions to lower their wage claims, i.e. the target real wage declines in  $u$ , up to the point where the wage rate equals the feasible real wage again. See Soskice (1990) for the same result.

Figure 3: Labor Market



well as  $Y^s = NQ^s = NM^s q^s(\tilde{\phi}^s)$  and  $q^s(\tilde{\phi}^s) = h^s(\tilde{\phi}^s)\tilde{\phi}^s$ , we have:

$$Y^{*s} = (\xi_1 \xi_2)^{-\varrho} H^{*s} \tilde{\phi}^s. \quad (31)$$

This leads to the following Proposition:

**Proposition 5** *For  $\omega \in (0, 1]$ , a switch from firm-level to sector-level trade unions has an ambiguous effect on aggregate output. In the limiting case of  $\omega = 0$ , aggregate output is lower under sector-level trade unions.*

**Proof 5** *Using (31), (28), (30), and (23), we obtain:*

$$\frac{Y^{*SL}}{Y^{*FL}} = \underbrace{\xi_1 \xi_2}_{>1 \text{ or } <1} \cdot \underbrace{\frac{H^{*SL}}{H^{*FL}}}_{>1 \text{ or } <1} \cdot \underbrace{\frac{\tilde{\phi}^{SL}}{\tilde{\phi}^{FL}}}_{>1} \quad \text{if } \omega \in (0, 1], \quad (32)$$

*which proves the first part of the Proposition. For the second part, note that  $\xi_1 \xi_2 = 1$ ,  $\tilde{\phi}^{FL} = \tilde{\phi}^{SL}$  and  $H^{SL} < H^{FL}$  hold if  $\omega = 0$ .*

The intuition is straightforward. If individuals have rent-sharing motives, i.e.  $\omega > 0$ , firm-selection and thus average productivity of operating firms increase under sector-level trade unions which, ceteris paribus, raise output, relative to firm-level wage-setting. This effect, however, interacts with the ambiguous employment effect (see Proposition 4). In addition, the factor  $\xi_1 \xi_2$  appears, where we have  $\xi_1 > 1$  and  $\xi_2 < 1$ . Both variables are relevant

due to the aggregation of firms' labor demand in the presence of firm-level trade unions, because the wage rate is then firm-specific (see Egger and Kreickemeier, 2009a,b for the same result). In general, we are unable to predict the sign of  $\xi_1\xi_2$ . If individuals have no rent-sharing motives, wages under firm-level trade unions are not firm-specific such that only the CF-effect is present. Then, employment and thus aggregate output decline.<sup>21</sup>

## 5 Numerical Solution

In the previous section, we have documented that the impact of the wage-setting level on unemployment and aggregate output is ambiguous. In the presence of rent-sharing motives, there are two countervailing forces: the CF-effect and the firm-selection effect. To quantify both mechanisms and to determine their net impact on unemployment and aggregate output, we solve our model numerically.

Our parameter choice is guided by the literature. In particular, we follow the calibration of Felbermayr et al. (2011) and set  $\sigma = 3.8$ ,  $k = 3.4$ ,  $F = 1.77$ ,  $F^e = 39.57$ , and  $\delta = 0.025$ . To ensure  $\sigma > \eta$ , we assume  $\eta = 3.4$ .<sup>22</sup> Without loss of generality, we normalize the labor force and number of sectors at unity:  $N \equiv 1$  and  $L \equiv 1$ . The independent variable in our simulations is the rent-sharing parameter  $\omega \in [0, \omega^{\max}]$ .<sup>23</sup>

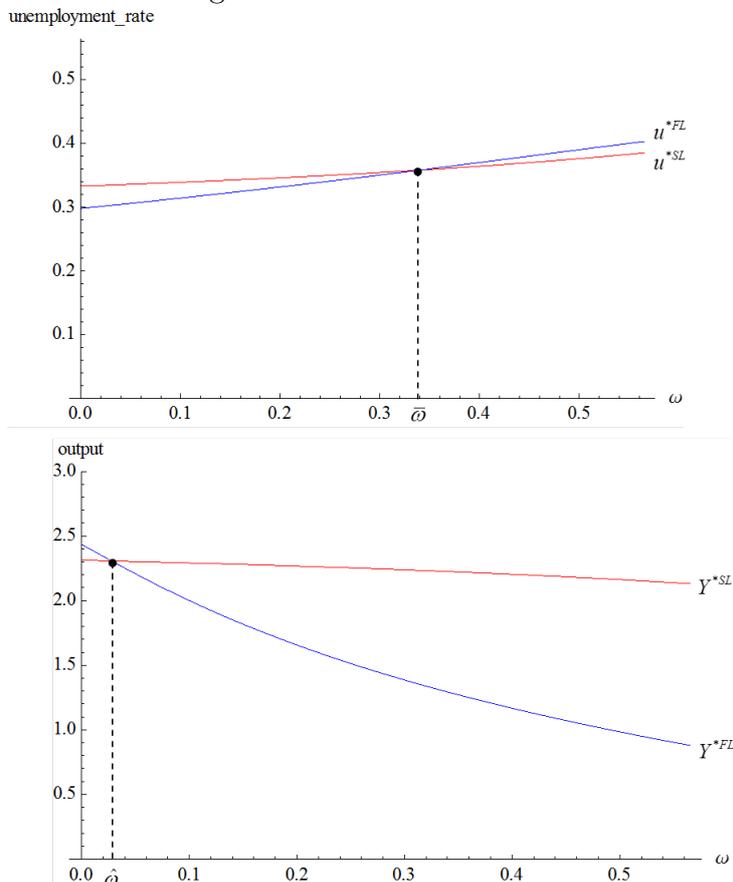
Our simulation results are illustrated in Figure 4. As proved analytically, the unemployment rate is unambiguously higher under sector-level trade unions if only the CF-effect is at work, i.e.  $\omega = 0$ . For  $0 < \omega < \bar{\omega}$ , the positive employment effect due to the increasing firm-selection reduces the negative impact of the CF-effect. For  $\omega > \bar{\omega}$ , the employment increase is sufficiently strong to overcompensate the CF-effect, thereby implying that the unemployment rate is even *lower* under sector-level trade unions. With regard to aggregate output, we find that  $Y^{*SL} < Y^{*FL}$  holds if individuals have no rent-sharing motive ( $\omega = 0$ ). In addition, we see that only a relatively low level of  $\omega$  is needed to outweigh the CF-effect such that aggregate output is higher under sector-level trade unions ( $\omega > \hat{\omega}$ ). The direct impact of the increasing firm-selection on aggregate output [see (32)] is sufficiently strong to imply  $Y^{*SL} < Y^{*FL}$  even if the employment effect is still negative.

<sup>21</sup>To complete the determination of the general equilibrium, we compute the mass of firms  $M$  from  $M^s = R^s/r^s(\tilde{\phi}^s)$  and  $r^s(\tilde{\phi}^s) = k\sigma F/(k - \beta^s)$ . Since  $\Lambda = P \equiv 1$  holds, we obtain  $R^s = Q^s = Y^{*s}/N$ . Therefore, the mass of firms reads:  $M^{*s} = \frac{Y^{*s}}{N} \frac{k - \beta^s}{k\sigma F}$ .

<sup>22</sup>Feenstra (2010) estimates the elasticity of substitution and find a median value of 3.7. The lower bound is estimated to 3, which indicates that our assumption on  $\eta$  is not at odds with the empirical literature.

<sup>23</sup>Note that  $\omega^{\max} = 0.56$  holds; for  $\omega > \omega^{\max}$ , the restriction  $\phi^{*FL} \geq 1$  is violated.

Figure 4: Simulation Results



Given our results, the final question might be: which is the relevant empirical value of the rent-sharing parameter  $\omega$ ? In a recent study, Egger et al. (2013) estimate country-specific rent-sharing parameters and find an average value of  $\omega = 0.101$  (in our notation). This leads to the following corollary:

**Corollary 2** *For  $\omega = 0.101$ , the unemployment rate is higher under sector-level trade unions (relative to firm-level trade unions), i.e.  $u^{*SL} > u^{*FL}$ . However, aggregate output increases in the case of sector-level wage-setting, i.e.  $Y^{*SL} > Y^{*FL}$ .*

Rent-sharing motives by themselves are, hence, not strong enough to explain why empirical studies do not support the findings of Calmfors et al. (1988). Aggregate output is higher under sector-level trade unions despite the output reducing negative employment effect because there is an additional (and sufficiently strong) output enhancing effect due to increasing firm-selection.

## 6 Conclusion

What are the effects of different bargaining regimes on labor and goods market outcomes? As shown by the related literature, the answer to this question depends crucially on the underlying modeling set-up, e.g. whether trade is allowed or whether price markups are endogenous. The contribution of this paper is to analyze rent-sharing motives of individuals as a new mechanism that affects the implications of different bargaining levels. To that end, we extend a Melitz (2003)-type model with heterogeneous firms, monopolistic competition and CES demand functions to unionized labor markets and individuals' rent-sharing motives. Wage-setting can take place either at the firm- or sectoral-level while firms unilaterally set their profit-maximizing prices, which in turn determines employment.

As our main result, we find that rent-sharing motives create a counter-vailing effect to the mechanism provided in the seminal paper by Calmfors et al. (1988), i.e. sector-level bargaining imply higher wage markups and thus higher unemployment. Because firm-level unions set firm-specific wages in response to the rent-sharing motives of their members, average profits are higher under sector-level trade unions. This raises firm-selection such that average productivity increases and average marginal costs decline. As a consequence, unemployment, *ceteris paribus*, decreases. If this channel would be sufficiently strong, it could dominate the negative employment effect due to higher wage markups and would thus imply that unemployment is lower under sector-level trade unions. Simulating our model with parameter values drawn from the corresponding literature, however, indicates that rent-sharing motives by themselves are too weak in order to reverse the prediction of Calmfors et al. (1988). Nevertheless, we find that aggregate output is higher under sector-level trade unions because the increase in firm-selection raises output one-to-one, which overcompensates the negative output effect of higher unemployment.

For future research, three modifications of the model appear to be interesting. First, we could analyze how our results change if the economy consists of only two (or a relatively low number of) sectors. Then, sector-level trade unions must internalize a second externality even at the sectoral equilibrium: their influence on the economy wide unemployment rate. Second, the assumption of fully symmetric sectors could be relaxed, e.g. by allowing differences in the Pareto distribution or entry costs between sectors. Third, as shown in Figure 1, wage-setting structures are relatively homogeneous within one country, but differ substantially between countries. Thus, it would be worthwhile to incorporate our approach into an open economy setting where, e.g. the home country is endowed with firm-level trade unions,

while the foreign country has sector-level trade unions. In such a setting, the impact of trade liberalization on wages and unemployment remains to be analyzed.

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