Discussion Paper No. 03-28

Revisiting the Impact of Union Structures on Wages – Integrating Different Dimensions of Centralisation

Nicole Gürtzgen

ZEW

Zentrum für Europäische Wirtschaftsforschung GmbH

Centre for European Economic Research

Discussion Paper No. 03-28

Revisiting the Impact of Union Structures on Wages – Integrating Different Dimensions of Centralisation

Nicole Gürtzgen

Non-technical summary

The degree of bargaining centralisation is widely perceived as an important determinant of macroeconomic performance and economic competitiveness. The economic rationale behind the idea that the bargaining or union structure has considerable impact on the behaviour of real wages and unemployment is primarily rooted in the work of Calmfors and Driffill (1988). According to their line of reasoning, countries with decentralised bargaining structures are generally expected to out-perform countries with intermediate centralised industry-level bargaining in terms of real wages and unemployment. A core assumption of the Calmfors-Driffill model is that union cooperation takes place between firms or industries producing substitutable goods and that workers are organised by either firm- or industry-specific unions. However, there is another relevant dimension of centralisation which refers to the professional line since workers of different professions may be organised in separate craft unions. This type of (de)centralisation is commonly labelled as 'horizontal' (de)centralisation, whereas cooperation across firms or industries is usually referred to as 'vertical' centralisation. Although it has been widely recognised in the literature that the effects of the two types of centralisation are likely to work into opposite directions, no comprehensive analysis has been undertaken yet so as to combine vertical and horizontal centralisation. The present analysis attempts to fill this gap and integrates the two dimensions along which centralisation may occur into one modelling framework. As country-specific bargaining structures typically vary along horizontal as well as vertical lines, such an analysis proves to be particularly important in order to evaluate the relative wage performance of different bargaining structures in an international context. In an international context, the fact that cooperation may take place across crafts, firms/industries, or both raises for

example the interesting question whether completely decentralised bargaining structures with firm-specific craft unions (like in the UK) still out-perform sectoral centralised bargaining, e.g. in Germany, where industry unions typically encompass all workers of a particular industry. It will be shown that, when taking into account the different centralisation dimensions, wage outcomes of different bargaining regimes cannot simply be ranked according to the degree of bargaining centralisation. The argument will be that negotiated wages rather depend on the technical relationship between different groups of labour and goods, the dimension along which cooperation takes place and finally on the number of externalities being taken into account under different union structures.

Revisiting the impact of union structures on wages – integrating different dimensions of centralisation

Nicole Gürtzgen[*)]

April 2003

Abstract: In a framework of a unionised oligopoly, this paper reconsiders the impact of the bargaining structure on union wages. In particular, two dimensions along which centralisation may occur, namely the professional and firm line, are integrated into one modelling framework. It will be shown that, when taking into account different centralisation dimensions, wage outcomes of different bargaining regimes cannot simply be ranked according to the degree of bargaining centralisation. The argument will be that negotiated wages rather depend on the technical relationship between different groups of labour and goods as well as upon the dimension along which centralisation takes place.

JEL-Classification: J 51, L 13

Keywords: Unions, Bargaining Structure, Oligopoly

[*)] ZEW, Center for European Economic Research, Labour Markets, Human Resources and Social Policy, L 7,1, 68161 Mannheim, Germany, Tel.: +49(0)621/1235-155, Fax: +49(0)621/1235-225, E-mail: Guertzgen@zew.de.

This paper is based on a chapter of my doctoral dissertation prepared at the University of Rostock, Germany. I am grateful to my supervisor Michael Rauscher and to Bernhard Boockmann and Jochen Michaelis for helpful comments.

Introduction

The degree of bargaining centralisation is widely perceived as an important determinant of macroeconomic performance and economic competitiveness. In Germany, for example, wage negotiations on sectoral and regional levels (*Flächentarifverhandlungen*) recently have come under severe pressure. Considered as responsible for wages being too inflexible with respect to their level and dispersion, *centralised* industry-level bargaining is often blamed for the deterioration of German firms' international competitive position (see e.g. Hassel and Schulten, 1998, Berthold, 2001). Recent *decentralisation* tendencies at the professional lines, on the other hand, have also been heavily criticised for being responsible for excessive wage demands undermining wage solidarity within the German union movement. The most prominent example are separate collective bargaining agreements being negotiated by the pilots' trade union at German air carriers. Until 1999 pilots had been represented by the German public sector union DAG. In 1999, their professional association Vereinigung Cockpit (VC) decided to negotiate a collective bargaining agreement on its own, which resulted in major pay increases (see EIROnline, 2001).

The economic rationale behind the idea that the bargaining or union structure has a considerable impact on the behaviour of real wages and unemployment is primarily rooted in the work of Calmfors and Driffill (1988). Inspired by some empirical stylised facts, the authors argue that there is a 'hump-shaped' (i.e. inverse U-shaped) relationship between the degree of bargaining centralisation and unemployment, with low unemployment and low real wages being associated with the most decentralised and centralised systems, and high unemployment and high real wages being associated

with intermediate levels of centralisation. In particular, the hump-shape arises from two conflicting forces: on the one hand, as bargaining becomes more centralised, unions are able to secure higher wages since they internalise positive externalities arising from demand spill-over effects across firms (or industries) producing substitutable goods. On the other hand, unions progressively take into account negative externalities since the impact of the negotiated wage on the general consumption price-level becomes larger as centralisation increases. Assuming that the elasticities of substitution between goods become smaller at higher levels of aggregation, it is straightforward to see that at higher levels of centralisation the internalisation of the negative price externality is likely to dominate the positive externalities arising from demand spill-overs. This essentially produces the 'hump-shape' since complete centralisation implies lower wages than intermediate centralised wage bargaining. Other authors who developed similar models to examine the impact of union cooperation on wage outcomes are Davidson (1988), Dowrick (1989), Cahuc and Zylberberg (1991), and Hoel (1991).

As a consequence, according to the Calmfors-Driffill hypothesis, countries with completely decentralised bargaining structures are generally expected to out-perform countries with centralised industry-level bargaining in terms of real wages and unemployment. However, the view that decentralised bargaining produces favourable wage outcomes as compared to intermediate industry-level bargaining has been challenged by several authors, who argue for a monotonic and negative relationship between bargaining centralisation and wage outcomes. Their main argument is that negative externalities are likely to be internalised even with intermediate bargaining structures[1]: Soskice (1990), for example, questions the superiority of decentralised

[1] For an overview of externalities being internalised by centralised unions, see Calmfors (1993).

bargaining in emphasising wage envy effects. He argues that workers in low profitable firms are likely to use wage increases in high profitable firms to achieve higher wage increases than they would have received with reference to their own firm's profit level. Another frequently invoked argument favouring industry-level bargaining asserts that *insider* power may be more relevant at the firm level and that industry unions are more likely to take into account adverse employment prospects for unemployed *outsiders* when setting too high wages (see e.g. Moene et al., 1993, Fitzenberger and Franz, 1999). These critics are confirmed by recent empirical studies which are not able to support the superiority of decentralised as compared to intermediate industry-level bargaining (see e.g. OECD, 1997), and which present evidence in favour of a negative monotonic instead of a non-monotonic relationship between centralisation and wage outcomes (see e.g. Soskice, 1990, Blanchard and Wolfers, 2000)[2].

Apart from the objections raised above, another argument against the superiority of decentralised bargaining refers to the dimensions along which centralisation occurs. A core assumption of the Calmfors-Driffill model is that union cooperation takes place between firms or industries producing substitutable goods and that workers are organised by either firm- or industry-specific unions. However, as already mentioned at the outset, there is another relevant dimension of centralisation which refers to the professional line since workers of different professions may be organised in separate craft unions. This type of (de)centralisation is commonly labelled as 'horizontal' (de)centralisation, whereas cooperation across firms or industries is usually referred to as 'vertical' centralisation (Calmfors, 1993, Moene et al., 1993). Bargaining fragments along craft lines mainly in the UK, in the Scandinavian countries, and in Australia. In

[2] For a brief summary of the most recent studies, see Calmfors (2001).

Australia, craft-specific bargaining tended to be coordinated across different firms and industrial sectors until the late 1980s. However, since the beginning of the 1990s there has been an increasing trend towards decentralisation of bargaining across firms and towards centralisation across crafts (see e.g. Dowrick, 1993, Katz, 1993). In Scandinavia, there are separate union federations for blue collar, white collar and professional workers which negotiate industry- or nation-wide collective bargaining agreements (see e.g. Flanagan, 1999). Firm-specific craft unions, in contrast, are prevalent in the UK. Craft-specific bargaining in the UK is generally uncoordinated across different firms or industries, but may either be coordinated or uncoordinated across different craft unions on the firm level. Although the extent of uncoordinated bargaining within one workplace has been decreasing during the last decades in the UK, there is still a significant proportion of firms with multiple unions being engaged in separate bargains (Pencavel, 2002). While in many continental European countries professional unions traditionally play no major role, there are yet some sector-specific tendencies for wage bargaining to fragment along professional lines, as for example in the German air carriers industry. In response to separate wage bargains struck by the pilots' union VC (Vereinigung Cockpit), several other split-ups of employee associations are being discussed, notably by the Independent Association of Flight Attendants (Unabhängige Flugbegleiter Organisation) and by the Association of Ground Crew (Vereinigung Boden) (see EIROnline, 2001).

The economic implications of craft-unionism have already been analysed by Horn and Wolinsky (1988) and Dowrick (1993). These authors show that cooperation between unions representing different work groups which are complements in production leads to lower wages. Horn and Wolinsky (1988), who assume an

exogenously given labour demand, argue that complementary work groups bargaining separately over wages are able to inflict substantial harm on the firm and do not take into account losses inflicted on other work groups in case of a strike. Assuming variable labour demand, Dowrick (1993) additionally emphasises that cooperating craft unions internalise the fact that higher wages for one professional work group will reduce labour demand for the other work group[3]. Although it has been widely recognised in the literature that the effects of the two types of centralisation are likely to work into opposite directions (Calmfors and Driffill, 1988, Calmfors, 1993, Moene et al., 1993), no comprehensive analysis has been undertaken yet so as to combine vertical and horizontal centralisation. The present analysis attempts to fill this gap and integrates the two dimensions along which centralisation may occur into one modelling framework. As country-specific bargaining structures typically vary along horizontal as well as vertical lines, such an analysis proves to be particularly important in order to evaluate the relative wage performance of different bargaining structures in an international context. In an international context, the fact that cooperation may take place across crafts, firms/industries, or both raises for example the interesting question whether completely decentralised bargaining structures with firm-specific craft unions (like in the UK) still out-perform sectoral centralised bargaining, e.g. in Germany, where industry unions typically encompass all workers of a particular industry. It will be shown that, when taking into account the different centralisation dimensions, wage outcomes of different bargaining regimes cannot simply be ranked according to the degree of bargaining centralisation. The argument will be that negotiated wages rather

[3] Empirical evidence for these results is found by Machin et al. (1993). The authors report that UK firms bargaining separately with multiple unions pay higher wages than firms bargaining either with one single union or with multiple unions which are cooperating.

depend on the technical relationship between different groups of labour and goods as well as upon the dimension along which cooperation takes place.

The modelling framework which is used to integrate the different dimensions of centralisation is borrowed from Dowrick (1993), who analyses different bargaining structures in the presence of craft unions in an oligopolistic product market. More specifically, Dowrick confines his attention to the consequences of cooperation between craft unions either at the firm level or at the industry level, but neglects complete centralisation of unions along craft *and* firm lines. The latter case would be relevant in order to assess the relative wage performance of bargaining regimes in the UK and e.g. in Germany. The purpose of the present paper is therefore to establish a complete ranking of different bargaining scenarios. Moreover, in contrast to Dowrick (1993), who considers the 2×2-case of a duopoly with two firms and crafts, we will extend the analysis to the more general case of n firms and m crafts, since intuitively one might suppose that there are generally more firms than crafts within an industry. In what follows, the focus will be on the comparison of decentralised and intermediate union structures. This appears to be justifiable when analysing sector-specific union structures in industries whose unions neglect macroeconomic externalities. The remainder of the analysis will be organised as follows: Section 1 investigates the case of two firms and two crafts and analyses different bargaining structures for general demand, utility and production functions. Section 2 considers the case of specific functional forms and extends the analysis to the more general case of n firms and m crafts. The analysis then enables us to highlight the importance of the number of positive and negative externalities being internalised by unions, when assessing the relative wage

performance of alternative centralisation scenarios. Finally, Section 3 provides some conclusions.

1. Integrating vertical and horizontal centralisation– the case of general utility, demand and production functions

Following Dowrick (1993), consider a duopoly with firm 1 and 2, each employing two types of workers or crafts, 1 and 2. Both groups are assumed to be complements in production, i.e. an increase in the employment of one group raises the marginal product of the other group. This seems to be a reasonable assumption, with type 1 and 2, for example, representing production and non-production workers. For the time being, the analysis shall be conducted for general utility, demand and production functions. Moreover, firms behave either according to Cournot or Bertrand conjectures in the product market. Each firm's labour demand can be written as

$$L^{ik} = L^{ik}(w_{11}, w_{21}, w_{12}, w_{22}), \;\; i, k = 1, 2, \tag{1}$$

with L^{ik} denoting labour demand of firm k for labour of type i and w_{ik} denoting type i workers' remuneration in firm k. Assuming homogeneous production technologies and regular product demand functions, L^{11}, for example, can be shown to exhibit the following properties[4]:

$$L^{11}_{11} < 0, L^{11}_{21} < 0, L^{11}_{12} > (<) 0, L^{11}_{22} > (<) 0, \tag{2}$$

where L^{ik}_{jl} denotes the partial derivative of L^{ik} with respect to w_{jl}, $i, j, k, l = 1, 2$. L^{11} decreases with w_{11} and w_{21} since workers are assumed to be complements in production. Moreover, L^{11} increases with w_{12} and w_{22} if the firms' products are substitutes. Conversely, the signs in brackets apply if firms produce complementary products.

For the time being, workers in each firm are assumed to be organised in craft- and firm-specific unions *ik*. Each union is assumed to maximise a general utility function U^{ik}, which is increasing in both wages and employment (see Oswald, 1982) and which represents the preferences of type i workers in firm k. According to eq. (1), union preferences can then be rewritten as

$$U^{ik} = U^{ik}(w_{11}, w_{21}, w_{12}, w_{22}), \quad i, k = 1, 2. \tag{3}$$

Due to the cross-employment effects, as given by ineqs. (2), we have, for example, for U^{11}:

$$U^{11}_{21} < 0, U^{11}_{12} > (<) 0, U^{11}_{22} > (<) 0, \tag{4}$$

where U^{ik}_{jl} denotes the partial derivative of U^{ik} with respect to w_{jl}, $i, j, k, l = 1, 2$. Analogous to ineqs. (2), the terms in brackets apply if the firms produce goods that are complements. The present model with two firms and two types of workers gives rise to a variety of bargaining structures:

---

[4] Let P_i be the price and x_i the output of firm i, with $i = 1, 2$. It can easily be verified that with Cournot competition and general product demand $P_i = P_i(x_1, x_2)$, a sufficient condition for each firm's output to increase (decrease) in the rival's wage is that $P_{ij} < (>) 0$ if the products are substitutes (complements), where $i, j = 1,2$ and $i \neq j$. Moreover, with Bertrand competition and a general demand function $x_i = d(P_1,P_2)$, a sufficient condition for each firm's output to increase with the rival's wage is that d_{ii} and d_{ij} be negative if products are substitutes. Conversely, a sufficient condition for each firm's output to decrease with the rival's wage is that $d_{ii} < 0$ and $d_{ij} > 0$ if products are complements.

- Completely decentralised bargaining takes place with 4 firm- and craft-specific unions, each bargaining independently of the other unions, henceforth denoted as (*FC*).
- Intermediate centralisation would be represented either by two firm-specific unions (*F*), each of which organises workers of type 1 and 2, or, alternatively, by two industry-craft unions (*IC*), each of which organises one type of workers across the industry.
- The completely centralised case occurs if all unions amalgamate into one encompassing industry union, which organises both type 1 and 2 workers in firm 1 and 2, denoted as case (*I*).

While Dowrick (1993) confines his attention to the comparison between (*FC*) and (*F*) as well as between (*FC*) and (*IC*), the purpose of the present analysis is to establish a complete ranking between the aforementioned bargaining scenarios. According to the monopoly-union and right-to-manage approach (see Nickell and Andrews, 1983), it is assumed that unions unilaterally set wages and firms unilaterally decide on the employment level[5]. As will be seen, a relative ranking of the wage outcomes associated with the different bargaining structures then simply requires a comparison of the unions' first order conditions. In the following analysis the focus will be on wage outcomes of type 1 workers in firm 1. Under the assumption that the two type of workers as well as unions and firms are symmetric, involving that unions and firms

[5] A straightforward extension of the monopoly-union approach would be to consider a bargaining model, which entails a variety of possible bargaining structures concerning cooperation on the employers' side. Moreover, in a bargaining model, different bargaining structures give rise to different disagreement utilities of the bargaining parties. For a detailed discussion, see Dowrick (1993).

maximise symmetric objective functions, analogous results may be derived for type 2 workers and workers in firm 2.

1.1. 4 firm- and craft-specific unions (FC)

Consider as a benchmark scenario the case of completely decentralised, uncoordinated bargaining with 4 firm- and craft-specific unions. Each union sets its wage independently of the other unions. The first-order condition for union 11 solves

$$U_{11}^{11} = 0\,, \tag{5}$$

which defines implicitly $w_{11}^{FC}(w_{21}, w_{12}, w_{22})$. Symmetric conditions represent the reaction functions of the other unions, whose intersection yields the (symmetric) equilibrium wage vector $\boldsymbol{w}^{FC} = (w_{11}^{FC}, w_{21}^{FC}, w_{12}^{FC}, w_{22}^{FC})$[6]. To compare $\boldsymbol{w}^{FC}$ with the outcome of an alternative bargaining scenario β, where $\beta = F, IC, I$, evaluate the first-order condition U_{11}^{β} at the wage vector, $\boldsymbol{w}^{FC}$, which solves condition (5). Given the second-order condition that U_{11}^{β} is decreasing in w_{11}, $U_{11}^{\beta}(\boldsymbol{w}^{FC}) < 0$ would imply that $w_{11}^{FC}(w_{21}, w_{12}, w_{22}) > w_{11}^{\beta}(w_{21}, w_{12}, w_{22})$, i.e the reaction functions as compared to the case (FC) shift inwards. Conversely, $U_{11}^{\beta}(\boldsymbol{w}^{FC}) > 0$ would imply that the reaction functions shift outwards. An inward shift of the reaction functions is illustrated in Figure 1 for the two-dimensional case with two craft unions within one firm, where the subscript referring to the firm is suppressed for convenience:

[6] In what follows, bold print letters will be used to represent equilibrium wage vectors.

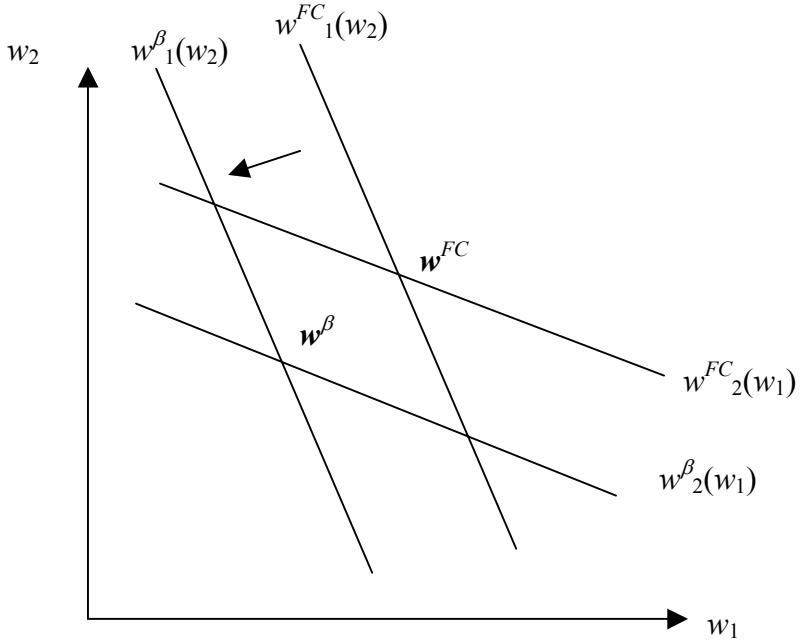

Figure 1: Shift of the reaction functions and new equilibrium wage vector

From Figure 1 it can be seen that the inward shift of the reaction functions involves that in equilibrium $\boldsymbol{w}^{\beta} < \boldsymbol{w}^{FC}$. The Appendix discusses sufficient conditions guaranteeing that an inward (outward) shift of the reaction functions leads to a lower (higher) equilibrium wage vector. More specifically, it is shown that this is the case, as long as the stability conditions for a symmetric equilibrium hold. As a consequence, when comparing two bargaining scenarios, the sign of the change in $\boldsymbol{w}$ is generally determined by the sign of the change in the first-order condition evaluated at the reference wage vector.

1.2. 2 firm-specific unions (F)

In this scenario, the craft-specific unions in each firm amalgamate into two encompassing firm-specific unions $F1$ and $F2$. The utility function of union $F1$ is given by $U^{F1} = U^{11} + U^{21}$. Due to the symmetry assumption, union 1 sets a common wage $w^{F}{}_1 = w_{11} = w_{21}$. The first-order condition of union $F1$ is given by

$$U_{11}^{F1} = U_{11}^{11} + U_{11}^{21} = 0\,, \tag{6}$$

implicitly defining $w_{11}^{F}(w_{21}, w_{12}, w_{22})$. Symmetric expressions hold for union *F*2, yielding $\boldsymbol{w}^{F}$ as the equilibrium wage vector associated with firm-specific bargaining. To compare $\boldsymbol{w}^{F}$ with $\boldsymbol{w}^{FC}$, evaluate the first-order condition (6) at the wage vector, $\boldsymbol{w}^{FC}$, which solves condition (5). Using eq. (5) together with expression (4), one obtains $U_{11}^{F1}(\boldsymbol{w}^{FC}) = U_{11}^{21} < 0$. Given the second-order condition that U_{11}^{F1} is decreasing in w_{11}, this implies that $w_{11}^{FC}(w_{21}, w_{12}, w_{22}) > w_{11}^{F}(w_{21}, w_{12}, w_{22})$, i.e the reaction functions as compared to the case (*FC*) shift inwards. Hence, if the workers are complements in production, the cooperation of two craft-specific unions gives rise to a lower wage since the encompassing union internalises the fact that any wage rise obtained for one group of workers reduces employment for the other group (see Dowrick, 1993).

1.3. 2 craft-specific industry unions (IC)

Now consider the case if the craft-specific unions in firm 1 and 2 merge to form two encompassing industry-craft unions *IC*1 and *IC*2. Union *IC*1's utility is given by $U^{IC1} = U^{11} + U^{12}$. Setting a symmetric wage $w^{IC}{}_{1} = w_{11} = w_{12}$, union *IC*1's optimal wage solves

$$U_{11}^{IC1} = U_{11}^{11} + U_{11}^{12} = 0. \tag{7}$$

A symmetric condition holds for union *IC*2. Evaluating eq. (7) at $\boldsymbol{w}^{FC}$, it is straightforward to see that, by virtue of eqs. (5) and (4), $U_{11}^{IC1}(\boldsymbol{w}^{FC}) = U_{11}^{12} > (<) 0$. That is, an industry-craft union takes into account cross effects on labour demand, the direction of which depends on whether the firms produce goods that are substitutes or complements. With the products being substitutes, a wage rise in firm 1 leads to increased employment in firm 2. An industry craft union internalises this positive

demand spill-over effect, so that $\boldsymbol{w}^{IC} > \boldsymbol{w}^{FC}$. Conversely, with the products being complements, a wage rise in firm 1 reduces employment in firm 2, thereby inducing the industry-craft union to set a lower wage, so that $\boldsymbol{w}^{IC} < \boldsymbol{w}^{FC}$ (see Dowrick, 1993).

To compare $\boldsymbol{w}^{IC}$ with $\boldsymbol{w}^{F}$, evaluation of eq. (7) at $\boldsymbol{w}^{F}$ yields, by virtue of eq. (6) $U_{11}^{IC1}(\boldsymbol{w}^{F}) = -U_{11}^{21} + U_{11}^{12}$, which is unambiguously positive if the products are substitutes, so that $\boldsymbol{w}^{IC} > \boldsymbol{w}^{F}$. The reason is that, unlike the firm-specific union *F*1, industry-craft union *IC*1 disregards adverse employment effects of a wage rise for type 2 workers in firm 1, but internalises the positive demand spill-over effect of a wage rise in firm 1, benefiting type 1 workers in firm 2.

However, if the products are complements, $U_{11}^{IC1}(\boldsymbol{w}^{F}) = -U_{11}^{21} + U_{11}^{12}$ cannot be signed unambiguously. This is because industry-craft union *IC*1 on the one hand disregards adverse employment effects of a wage rise for type 2 workers in firm 1, but simultaneously takes into account negative employment effects of a wage rise in firm 1 for type 1 workers in firm 2. The relationship between $\boldsymbol{w}^{IC}$ and $\boldsymbol{w}^{F}$ therefore depends on which of the two effects is the dominating one.

1.4. One encompassing industry union (I)

As a last scenario, consider the case of one industry-specific union *I*, representing the interests of all crafts 1 and 2 in firm 1 and 2. The encompassing union's utility function is given by $U^{I} = U^{11} + U^{21} + U^{12} + U^{22}$. The first-order condition solves

$$U_{11}^{I} = U_{11}^{11} + U_{11}^{21} + U_{11}^{12} + U_{11}^{22} = 0. \tag{8}$$

Evaluating eq. (8) at $\boldsymbol{w}^F$ yields with eq. (6) that $U_{11}^I(\boldsymbol{w}^F) = U_{11}^{12} + U_{11}^{22} > (<) 0$. I.e., whether one encompassing industry union sets a higher industry wage than two firm-specific unions depends on the nature of product rivalry. With the products being substitutes, one obtains $\boldsymbol{w}^I > \boldsymbol{w}^F$ since the industry union internalises positive demand spill-over effects across firms[7]. Conversely, with the products being complements, an industry union moderates its wage demand as compared to firm-specific unions due to negative demand spill-overs across firms.

In order to rank $\boldsymbol{w}^I$ and $\boldsymbol{w}^{IC}$, evaluate eq. (8) at $\boldsymbol{w}^{IC}$ by means of eq. (7): from $U_{11}^I(\boldsymbol{w}^{IC}) = U_{11}^{21} + U_{11}^{22} < 0$ it follows that, if the products are complements, an industry union unambiguously settles for a lower wage than an industry craft union, i.e. $\boldsymbol{w}^I < \boldsymbol{w}^{IC}$. The mechanism behind this result is that an industry-wide union additionally takes into account that a rise in w_{11} has negative employment consequences for type 2 workers in firm 1 as well as in firm 2. In contrast, if the products are substitutes, $U_{11}^I(\boldsymbol{w}^{IC}) = U_{11}^{21} + U_{11}^{22}$ is ambiguous in sign. While an industry union internalises negative employment effects across crafts, it simultaneously takes into account positive demand spill-over effects of a rise in w_{11} for type 2 workers in firm 2.

To compare $\boldsymbol{w}^I$ with $\boldsymbol{w}^{FC}$, consider expression (8) evaluated at $\boldsymbol{w}^{FC}$ (see eq. (5)): from $U_{11}^I(\boldsymbol{w}^{FC}) = U_{11}^{21} + U_{11}^{12} + U_{11}^{22} < 0$ it follows that an industry union unambiguously moderates its wage demand as compared to firm-specific craft unions if the products are complements. The rationale behind this result is that an industry union simultaneously

[7] Note that this is actually the line of reasoning of Calmfors and Driffill (1988). A similar result has been derived independently by Davidson (1988).

takes into account negative employment effects across crafts as well as firms. If, however, the products are substitutes, $\boldsymbol{w}^I$ and $\boldsymbol{w}^{FC}$ cannot be ranked unambiguously since the industry union now internalises negative cross-employment effects across crafts, but positive employment effects across firms. Finally, the results of the present section are summarised in the following proposition:

Proposition 1*: Comparing the four different bargaining scenarios (FC), (F), (IC) and (I), the following rankings with respect to the wage outcomes can be established:*

(i) With the products being substitutes, it follows that

$$\boldsymbol{w}^{IC} > \boldsymbol{w}^{FC} > \boldsymbol{w}^{F}.$$

The only conclusion that can be drawn with respect to $\boldsymbol{w}^I$ *is that*

$$\boldsymbol{w}^{I} > \boldsymbol{w}^{F}.$$

(ii) With the products being complements, the following ranking unambiguously holds

$$\boldsymbol{w}^{FC} > \boldsymbol{w}^{F} > \boldsymbol{w}^{I}.$$

The only conclusion that can be drawn with respect to $\boldsymbol{w}^{IC}$ *is that*

$$\boldsymbol{w}^{FC} > \boldsymbol{w}^{IC} > \boldsymbol{w}^{I}.$$

2. Integrating vertical and horizontal centralisation – the case of specific functional forms

Proposition 1 highlights that with two dimensions of cooperation, only the case of complementary products suggests a simple ranking of wage outcomes. More specifically, if one identifies the degree of centralisation with the number of unions that are cooperating, part (ii) provides support for a monotonic relationship between centralisation and wage outcomes. Increased centralisation leads to lower wages since with increased cooperation unions progressively take into account negative employment effects across crafts and firms. With substitute goods, however, no simple ranking is possible. As wage outcomes generally depend on the specific technical relationship between the two types of workers and goods, the purpose of the present section is to illustrate the results of the preceding section by means of an example with specific functional forms. Restricting the attention to specific functional forms with no doubt involves a considerable loss of generality. However, the gain is that the analysis can be extended to the more general case of n firms and m crafts employed by each firm without obtaining non-interpretable results. This appears to be a reasonable extension since intuitively one might suppose that there are generally more firms than crafts within an industry. The analysis then enables us to highlight the importance of the number of positive and negative externalities being internalised by unions, when assessing the relative wage performance of alternative centralisation scenarios.

Consider now an oligopoly, with n firms, each employing m types of workers or crafts, and producing differentiated products $x_{1, \ldots,} x_n$. The production function shall be given by a simple Leontief technology, i.e.

$$x_k = min\ \{L^{1k},..., L^{mk}\},\ k = 1, \ldots, n. \tag{9}$$

Product demand is assumed to be linear, with

$$P_k = 1 - x_k - c \sum_{l \neq k} x_l\ , k, l = 1, \ldots, n. \tag{10}$$

with $c \in \left]-1;1\right[$ representing the degree of product rivalry. If c is negative, the following restriction is required to guarantee strict concavity in the firms' optimisation problems:

$$|c| < 1/(n\text{-}1) \tag{11}$$

The firms' profit functions take the form

$$\pi_k = (1 - x_k - c \sum_{l \neq k} x_l\ )\ x_k - \sum_{j=1}^{m} w_{jk} L^{jk}\ , k, l = 1, \ldots, n. \tag{12}$$

Assuming that firms compete in quantities, maximising each firm's profit function with respect to x_k, taking x_l as given, yields the following $m \cdot n$ labour demand functions:

$$x_k = L^{1k} = ... = L^{mk} = \frac{2 - c + c\sum_{l \neq k}^{n} \sum_{j=1}^{m} w_{jl} - (2 + c(n-2))\sum_{j=1}^{m} w_{jk}}{(2 + c(n-1))(2 - c)},\ k = 1,..., n. \tag{13}$$

Eq. (13) reveals that each firm's output depends positively (negatively) on wages prevailing in the rival firms if $c > (<) 0$.

Moreover, each firm's output depends negatively on its own wages since by virtue of eq. (11) the expression $(2 + c(n - 2))/((2 + c(n - 1))(2 - c))$ can be shown to be positive.

Unions are assumed to maximise the wage bill, i.e. each firm- and craft-specific union's *ik* preferences are given by:

$$U^{ik} = w_{ik} L^{ik}, \;\; i = 1,\ldots, m; \; k = 1,\ldots, n. \tag{14}$$

2.1. m · n firm- and craft-specific unions

The first-order condition of union *ik*, setting its wage independently of the other $(m{\cdot}n - 1)$ unions is given by

$$U^{ik}_{ik} = L^{ik} - \frac{(2 + c(n-2))w_{ik}}{(2 + c(n-1))(2-c)} = 0, \;\; i = 1,\ldots, m; \; k = 1,\ldots, n, \tag{15}$$

which gives rise to the following $m{\cdot}n$ reaction functions[8]:

$$w_{ik}(\underline{\boldsymbol{w}}) = \frac{2 - c + c\sum_{l \neq k}^{n} \sum_{j=1}^{m} w_{jl} - (2 + c(n-2))\sum_{j \neq i}^{m} w_{jk}}{2(2 + c(n-2))}, \tag{16}$$

where $\underline{\boldsymbol{w}}$ denotes the wage vector of $(m{\cdot}n - 1)$ wages set by the rival firm-specific craft unions. Symmetric reaction functions hold for the other unions. Solving the $m{\cdot}n$ first-order conditions for a symmetric equilibrium yields the following equilibrium wage:

$$w^{FC} = \frac{2 - c}{m(2-c) + c(n-2) + 2}. \tag{17}$$

[8] In the following, the superscripts *FC*, *F*, *IC* and *I* will be dropped for convenience.

Eq. (17) reveals that w^{FC} depends negatively on the number of crafts, m. The intuition here is that the more crafts are necessary to produce one unit of output, the higher the firms' marginal costs and the lower the output level. This reduces the marginal benefit to raise the wage and therefore leads to wage moderation on behalf of unions. Moreover, as expected, w^{FC} is decreasing (increasing) in the number of firms, n, if $c >$ (<) 0, which represents the number of positive (negative) externalities not being taken into account by completely decentralised firm-specific unions.

2.2. n firm-specific unions (Fk)

The first-order condition of union Fk, $k = 1,\ldots,n$, setting its wage independently of the other (n - 1) firm-specific unions solves

$$\begin{aligned} & U_{ik}^{Fk} = U_{ik}^{ik} + \sum_{j \neq i} U_{ik}^{jk} = \\ & L^{ik} - \frac{(2 + c(n-2))w_{ik}}{(2 + c(n-1))(2-c)} - \sum_{j \neq i}^{m} (m-1) \frac{(2 + c(n-2))w_{jk}}{(2 + c(n-1))(2-c)} = 0. \end{aligned} \tag{18}$$

Imposing a symmetric wage outcome $w_k = w_{1k} = \ldots = w_{mk}$, eq. (18) defines the following n reaction functions

$$w_k(\underline{\boldsymbol{w}}) = \frac{2 - c + cm \sum_{l \neq k}^{n} w_l}{2m(2 + c(n-2))}, \; k, l = 1,\ldots, n, \tag{19}$$

where $\underline{\boldsymbol{w}}$ denotes the wage vector of (n – 1) wages set by the rival firm unions. Solving eq. (19) and imposing symmetric reaction functions for the (n - 1) rival unions Fl, $l \neq k$, one obtains the following equilibrium wage vector:

$$w^F = w_1 = \ldots = w_n = \frac{2 - c}{m(4 + c(n-3))}. \tag{20}$$

2.3. m craft-specific industry unions (ICi)

The first-order condition of union *ICi*, $i = 1,\ldots, m$, setting its wage independently of the (m - 1) rival industry-craft unions *ICj*, $j \neq i$, is given by

$$U_{ik}^{ICi} = U_{ik}^{ik} + \sum_{l \neq k}^{n} U_{ik}^{il} = \\ L^{ik} - \frac{(2 + c(n-2))w_{ik}}{(2 + c(n-1))(2-c)} + c\sum_{l \neq k}^{n} \frac{w_{il}}{(2 + c(n-1))(2-c)} = 0. \tag{21}$$

Imposing a symmetric wage outcome $w_i = w_{i1} = \ldots = w_{in}$, eq. (21) defines the following m reaction functions

$$w_i(\underline{\boldsymbol{w}}) = \frac{1}{2} - \frac{1}{2} \cdot \sum_{j \neq i}^{m} w_j \ , \ i, \ j = 1,\ldots, m, \tag{22}$$

where $\underline{\boldsymbol{w}}$ denotes the wage vector of (m – 1) wages set by the rival industry-craft unions. Solving eq. (22) and imposing symmetric reaction functions for unions j, $j \neq i$, one obtains the following equilibrium wage vector

$$w^{IC} = w_1 = \ldots = w_m = \frac{1}{m+1}. \tag{23}$$

Note that with craft-specific industry unions, the equilibrium wage is independent of the number of firms in the industry, n, and the degree of product rivalry, c. The rationale behind this result is that an industry-craft union sets a uniform craft-specific wage for

all firms in the industry, so that the number of firms, n, and the degree of product rivalry, c, do not affect the unions' trade-off between wages and employment[9].

2.4. One encompassing industry union (I)

The first-order condition of the encompassing industry union, setting a uniform wage for all firms and crafts is given by

$$\begin{aligned} & U_{ik}^{I} = \sum_{j=1}^{m} \sum_{l=1}^{n} U_{ik}^{jl} = \\ & L^{ik} - \frac{(2+c(n-2))w_{ik}}{(2+c(n-1))(2-c)} \\ & - \sum_{j\neq i}^{m} \frac{(2+c(n-2))w_{jk}}{(2+c(n-1))(2-c)} + c\sum_{j=1}^{m} \sum_{l\neq k}^{n} \frac{w_{jl}}{(2+c(n-1))(2-c)} = 0. \end{aligned} \tag{24}$$

Imposing a symmetric wage outcome w^I for all $i = 1,\ldots, m$; $k = 1,\ldots, n$, one obtains the following equilibrium wage vector

$$w^I = \frac{1}{2m}. \tag{25}$$

As with industry-craft unions, the industry wage does not depend on n and c since the industry-union sets a uniform wage for all firms. Finally, closer inspection of the equilibrium wage outcomes establishes the following proposition:

[9] For the homogeneous good case and for only one type of craft, this result has already been derived by Dowrick (1989).

Proposition 2*: Comparing the four different bargaining scenarios (FC), (F), (IC) and (I) and assuming linear demand functions and a Leontief technology, the following rankings with respect to the wage outcomes can be established: with the products being imperfect substitutes (0 < c < 1) , it follows that*

(i) $$\boldsymbol{w}^{IC} > \boldsymbol{w}^{FC} > \boldsymbol{w}^{I} > \boldsymbol{w}^{F}, \quad \text{if } m > \frac{2 + c(n-2)}{2 - c},$$

(ii) $$\boldsymbol{w}^{IC} > \boldsymbol{w}^{I} > \boldsymbol{w}^{FC} > \boldsymbol{w}^{F}, \quad \text{if } m < \frac{2 + c(n-2)}{2 - c},$$

With the products being imperfect complements (-1/(n-1) < c < 0), the following ranking unambiguously holds

(iii) $$\boldsymbol{w}^{FC} > \boldsymbol{w}^{IC} > \boldsymbol{w}^{F} > \boldsymbol{w}^{I}, \quad \text{if } m > \frac{2 - c}{2 + c(n-2)},$$

(iv) $$\boldsymbol{w}^{FC} > \boldsymbol{w}^{F} > \boldsymbol{w}^{IC} > \boldsymbol{w}^{I}, \quad \text{if } m < \frac{2 - c}{2 + c(n-2)}.$$

Proof: See the Appendix.

For general demand functions and technologies, the results of the previous section have shown that $\boldsymbol{w}^{I}$ and $\boldsymbol{w}^{FC}$ cannot be ranked unambiguously if the products are substitutes. The reason is that an industry union simultaneously internalises negative cross-employment effects across crafts and positive employment effects across firms. Hence, which of the two effects dominates essentially depends on the relationship between the number of negative externalities, m, and the number of positive externalities, n, whose extent is strongly affected by the degree of product substitutability, c. Intuitively, the difference between $\boldsymbol{w}^{FC}$ and $\boldsymbol{w}^{I}$ may be expected to be the larger, the less positive externalities and the more negative externalities are internalised by an industry-wide union. Part (i) and (ii) of Proposition 2 establish some

critical level for m above which $\boldsymbol{w}^{FC}$ exceeds $\boldsymbol{w}^{I}$. Indeed, it may easily be checked that the smaller n and c, the more likely is m to exceed this critical level. With respect to an international comparison, this result therefore suggests that countries with completely decentralised bargaining structures, as represented by firm-specific craft unions, need not necessarily out-perform countries with sectoral centralised bargaining if the negative cross-employment effect across crafts dominates positive demand spill-over effects across firms or industries. Whether this will be the case depends strongly on the number of firms in the industry, the number of crafts being employed by each firm, and the degree of craft-/product substitutability or complementarity. While the fact that there are usually more firms than crafts within one industry tends to favour the superiority of decentralised bargaining, the case for the superiority of centralised bargaining ought to be the stronger, the more firms in a particular industry produce complementary goods[10]. This ambiguity is particularly reinforced by the argument that an industry union encompassing firms producing complementary goods becomes particularly likely at very high levels of centralisation[11]. I.e., a large number of firms, n, will generally involve an increasing number of firms generating negative cross-employment effects owing to complementary products.

[10] However, this is not explicitly incorporated into the model since the degree of product rivalry, c, has been assumed to be identical for all n firms. Moreover, at this point it is worthy to note that the coexistence of intermediate input goods and final goods generates a similar cross-employment externality. If labour and intermediate inputs are complements in production, a wage rise in firms producing final (intermediate input) goods imposes a negative cross-employment effect on firms producing intermediate input (final) goods (see e.g. Calmfors, 1993). However, this externality works through the production technology, which is not explicitly modelled here.

[11] This argument has also been made by Calmfors and Driffill in favour of their hump-shape hypothesis (Calmfors and Driffill, 1988, p. 45).

With the product being substitutes and general demand functions and technologies, a further ambiguous ranking has been derived for $\boldsymbol{w}^{IC}$ and $\boldsymbol{w}^{I}$. The rationale is that an industry-wide union, as compared to an industry-craft union, additionally internalises negative employment effects across crafts, but simultaneously takes into account positive demand spill-over effects of a wage rise for all type of workers in the rest of the industry. Here, with products being imperfect substitutes and a Leontief-technology, cross-employment effects arising from the strong complementary factor relationship dominate any positive demand spill-over effects across firms, so that an industry-wide union unambiguously sets a lower wage than craft-specific industry unions. Note that the comparison between an industry-wide union wage and industry-wide craft-specific wages would be relevant for the evaluation of the decentralisation process being observed at German air carriers if the emerging professional unions encompassed all workers of a given profession across the whole industry. The present results therefore suggest that the current split-up of employee associations is the more likely to lead to higher wage outcomes the stronger the complementary factor relationship between different professional groups.

Moreover, with the products being complements, a further ambiguous ranking has been shown to hold for $\boldsymbol{w}^{F}$ and $\boldsymbol{w}^{IC}$. The reason is that industry-craft unions take into account negative employment effects of a wage rise for workers in the rest of the industry, whereas firm-specific unions internalise adverse employment effects of a wage rise for all types of crafts employed in the firm. Hence, which of the two effects dominates again depends on the relationship between the number of negative externalities, m, being internalised by firm-specific unions and the number of negative externalities, n, which are affected by the degree of product complementarity, c, and are

internalised by industry-craft unions. Intuitively, the difference between $\boldsymbol{w}^{IC}$ and $\boldsymbol{w}^{F}$ may be expected to be the larger, the less negative externalities are internalised by industry-craft unions and the more negative externalities are taken into account by firm-specific unions. Part (iii) and (iv) of Proposition 2 establish some critical level for m above which $\boldsymbol{w}^{IC}$ exceeds $\boldsymbol{w}^{F}$. It may easily be verified that the smaller n and the smaller the absolute value of c, the more likely is m to exceed this critical level.

3. Conclusions

The present paper has demonstrated the importance of different dimensions of centralisation, when assessing the relative wage performance of decentralised and centralised bargaining structures. In particular, it has been shown that wage outcomes of different bargaining regimes cannot simply be ranked according to the degree of bargaining centralisation since wage outcomes depend on the specific technical relationship between different groups of labour and goods as well as upon the dimension along which cooperation takes place. With respect to an international comparison, it has been shown that countries with completely decentralised bargaining structures, as represented by firm-specific craft unions, need not necessarily out-perform countries with sectoral centralised bargaining if the negative cross-employment effect across crafts dominates positive demand spill-over effects across firms or industries. Whether this will be the case depends strongly on the number of firms in the industry, the number of crafts being employed by each firm, and the degree of craft-/product substitutability or complementarity. When comparing country-specific union structures it should be emphasised that the present analysis has neglected union centralisation on the national level. However, since the ranking of different union structures turns out to be ambiguous even when confining the attention to decentralised and intermediate

structures, the only gain of the internalisation of macroeconomic externalities would be to add further ambiguities to the results. In any case, the present analysis suggests that with different dimensions of centralisation, particular caution is necessary when classifying countries with respect to their bargaining structures and that the focus on vertical centralisation may provide an imperfect guide to the assessment of the relative wage performance of different bargaining structures. In light of the limited numbers of observations being used in empirical cross-country analyses, this may help to explain the difficulties of recent empirical studies in revealing a clear pattern of correlations between measures of macroeconomic performance and the degree of bargaining centralisation.

Appendix

Let the bargaining structure be parameterised by a shift-parameter β, determining the movement of the unions' reaction functions. This defines the unions' first-order conditions as

$$U_{ik}^{ik}(w_{11}, w_{21}, w_{12}, w_{22}, \beta) = 0,\ i,\ k = 1, 2. \tag{A.1}$$

Totally differentiating the four first-order conditions yields

$$\begin{pmatrix} U_{11,11}^{11} & U_{11,21}^{11} & U_{11,12}^{11} & U_{11,22}^{11} \\ U_{21,11}^{21} & U_{21,21}^{21} & U_{21,12}^{21} & U_{21,22}^{21} \\ U_{12,11}^{12} & U_{12,21}^{12} & U_{12,12}^{12} & U_{12,22}^{12} \\ U_{22,11}^{22} & U_{22,21}^{22} & U_{22,12}^{22} & U_{22,22}^{22} \end{pmatrix} \begin{pmatrix} dw_{11} \\ dw_{21} \\ dw_{12} \\ dw_{22} \end{pmatrix} = \begin{pmatrix} -U_{11,\beta}^{11} \\ -U_{21,\beta}^{21} \\ -U_{12,\beta}^{12} \\ -U_{22,\beta}^{22} \end{pmatrix} d\beta. \tag{A.2}$$

$U_{ik,jl}^{ik}$ denotes the partial derivative of U_{ik}^{ik} with respect to w_{jl} and $U_{ik,\beta}^{ik}$ denotes the partial derivative of U_{ik}^{ik} with respect to β, where $i, j, k, l = 1, 2$. Imposing $U_{ik,jl}^{ik} = U_{jl,ik}^{jl}$, $i, j, k, l = 1, 2$, we obtain a symmetric matrix, denoted as A, on the left-hand side of eq. (A.2). For a symmetric matrix, sufficient and necessary conditions for the equilibrium to be stable are that the upper left-hand principal minors of the above system alternate in sign (see e.g. Gandolfo, 1997, p. 252). In particular, stability conditions then require

$$U_{11,11}^{11} < 0,\ \begin{vmatrix} U_{11,11}^{11} & U_{11,21}^{11} \\ U_{21,11}^{21} & U_{21,21}^{21} \end{vmatrix} > 0,\ \begin{vmatrix} U_{11,11}^{11} & U_{11,21}^{11} & U_{11,12}^{11} \\ U_{21,11}^{21} & U_{21,21}^{21} & U_{21,12}^{21} \\ U_{12,11}^{12} & U_{12,21}^{12} & U_{12,12}^{12} \end{vmatrix} < 0,\ DET(A) > 0. \tag{A.3}$$

Comparative static effects of a change in β on w_{ik} may be derived by applying Cramer's rule. For example, for w_{11} it follows that

$$\frac{dw_{11}}{d\beta} = \frac{1}{DET(A)} \begin{vmatrix} -U^{11}_{11,\beta} & U^{11}_{11,21} & U^{11}_{11,12} & U^{11}_{11,22} \\ -U^{21}_{21,\beta} & U^{21}_{21,21} & U^{21}_{21,12} & U^{21}_{21,22} \\ -U^{12}_{12,\beta} & U^{12}_{12,21} & U^{12}_{12,12} & U^{12}_{12,22} \\ -U^{22}_{22,\beta} & U^{22}_{22,21} & U^{22}_{22,12} & U^{22}_{22,22} \end{vmatrix}. \tag{A.4}$$

Imposing additional symmetry assumptions

$$U^{ik}_{ik,\beta} = U^{jl}_{jl,\beta},\ i, j, k, l = 1, 2, \tag{A.5}$$

$$U^{ik}_{ik,ik} = U^{jl}_{jl,jl},\ i,\ j, k, l = 1, 2, \tag{A.6}$$

$$U^{11}_{11,21} = U^{21}_{21,11} = U^{12}_{12,22} = U^{22}_{22,12}, \tag{A.7}$$

$$U^{11}_{11,12} = U^{12}_{12,11} = U^{11}_{11,22} = U^{22}_{22,11} = U^{21}_{21,12} = U^{12}_{12,21} = U^{21}_{21,22} = U^{22}_{22,21}, \tag{A.8}$$

eq. (A.4) may be simplified to

$$\frac{dw_{11}}{d\beta} = \frac{1}{DET(A)} \begin{vmatrix} -U^{11}_{11,\beta} & U^{11}_{11,21} & U^{11}_{11,12} & U^{11}_{11,12} \\ -U^{11}_{11,\beta} & U^{11}_{11,11} & U^{11}_{11,12} & U^{11}_{11,12} \\ -U^{11}_{11,\beta} & U^{11}_{11,12} & U^{11}_{11,11} & U^{11}_{11,21} \\ -U^{11}_{11,\beta} & U^{11}_{11,12} & U^{11}_{11,21} & U^{11}_{11,11} \end{vmatrix}. \tag{A.9}$$

Condition (A.7) imposes symmetric second-order effects across different crafts within one firm, whereas condition (A.8) imposes symmetric second-order effects across wages in different firms, independent of the relevant craft. From eq. (A.9) it follows that

$$\frac{dw_{11}}{d\beta} = -\frac{1}{DET(A)} U^{11}_{11,\beta} \cdot (U^{11}_{11,11} + U^{11}_{11,21}) \cdot (U^{11}_{11,11} - U^{11}_{11,21})^2, \tag{A.10}$$

which, by virtue of eqs. (A.3), unambiguously takes the sign of $U^{11}_{11,\beta}$.

Proposition 2:

The following comparison of the equilibrium wage outcomes is derived for $n > 1$, $m > 1$ and relies on the following restriction for the parameter c:

$$c \in \left]-1;1\right[\text{ and } |c| < \frac{1}{n-1} \text{ for } c < 0. \tag{A.11}$$

In particular, from (A.11) it follows that $(2 + c(n - 2)) > 0$ and $(4 + c(n - 3)) > 0$.

1) Comparison of w^{IC} and w^{FC} :

$$w^{IC} - w^{FC} = \frac{c(n-1)}{(m+1)((2-c)m+2+c(n-2))} \gtreqless 0, \text{ for } c \gtreqless 0. \tag{A.12}$$

2) Comparison of w^{F} and w^{FC} :

$$w^{F} - w^{FC} = -\frac{(2-c)(m-1)(2+c(n-2))}{m(4+c(n-3))((2-c)m+2+c(n-2))} < 0. \tag{A.13}$$

3) Comparison of w^{I} and w^{FC} :

$$w^{I} - w^{FC} = \frac{2-(2-c)m+c(n-2)}{2m((2-c)m+2+c(n-2))} \gtreqless 0, \tag{A.14}$$

$$\text{for } m \lessgtr \frac{2+c(n-2)}{2-c}.$$

From (A.14) it follows that, for $c \leq 0$, $w^{I} < w^{FC}$ for all m, $n > 1$, since

$$\frac{2+c(n-2)}{2-c} \leq 1 \text{ for } c \leq 0.$$

4) Comparison of w^I and w^F :

$$w^I - w^F = \frac{c(n-1)}{2m(4+c(n-3))} \gtreqless 0, \text{ for } c \gtreqless 0. \tag{A.15}$$

5) Comparison of w^{IC} and w^F :

$$w^{IC} - w^F = \frac{mc(n-2)+2(m-1)+c}{m(m+1)(4+c(n-3))} \tag{A.16}$$

From (A.16) it can be seen that $w^{IC} > w^F$ for $c \geq 0$. For $c < 0$ it follows that $w^{IC} \gtreqless w^F$, if

$$m \gtreqless \frac{2-c}{2+c(n-2)}. \tag{A.17}$$

6) Comparison of w^I and w^{IC}:

$$w^{IC} - w^I = \frac{m-1}{2m(m+1)} > 0. \tag{A.18}$$

References

Berthold, N. (2001), Das Bündnis für Arbeit – Ein Weg aus der institutionellen Verflechtungsfalle?, *Perspektiven der Wirtschaftspolitik* 2, 383-406,

Blanchard, O. and Wolfers, J. (2000), The role of shocks and institutions in the rise of European unemployment: the aggregate evidence, *The Economic Journal* 110, C1-C33,

Cahuc, P. and Zylberberg, A. (1991), Niveaux de négociations salariales et performances macroéconomiques, *Annales d'Economie et de Statistique*, 23, 1-12,

Calmfors, L. and Driffill, J. (1988), Centralization of wage bargaining, *Economic Policy*, 6, 12-61,

Calmfors, L. (1993), Centralisation of wage bargaining and macroeconomic performance: a survey, *OECD Economic Studies*, 21, 161-191,

Calmfors, L. (2001), Wages and wage-bargaining institutions in the EMU – a survey of the issues, *Empirica* 28, 325-351,

Davidson, C. (1988), Multiunit bargaining in oligopolistic industries, *Journal of Labor Economics*, 6, 397-422,

Dobson, J. **(**1997), The effects of multi-unionism: a survey of large manufacturing establishments, *British Journal of Industrial Relations*, 35, 547-566,

Dowrick, S. (1989), Union-oligopoly bargaining, *The Economic Journal*, 99, 1123-1142,

Dowrick, S. (1993), Enterprise bargaining, union structure and wages, *The Economic Record*, 69, 393-404,

EIROnline (European Industrial Relations Observatory online) (2001), Lufthansa pilots pay dispute draws to close, http://www.eiro.eurofound.ie/2001/06/features/,

Fitzenberger, B. and Franz, W. (1999), Industry-level wage bargaining: A partial rehabilitation – the German experience, *Scottish Journal of Political Economy*, 46, 437-457,

Flanagan, R.J. (1999), Macroeconomic performance and collective bargaining: An international perspective, *Journal of Economic Literature*, 37, 1150-1175,

Gandolfo, G. (1997), Economic dynamics. Berlin and Heidelberg: Springer-Verlag,

Hassel, A. und Schulten, T. (1998), Globalization and the future of central collective bargaining: The example of the German metal industry, *Economy and Society* 27, 486-522,

Hoel, M. (1991), Union wage policy: The importance of labour mobility and the degree of centralization, *Economica*, 58, 139-153,

Horn, H. and Wolinsky, A. (1988), Worker substitutability and patterns of unionisation, *The Economic Journal*, 98, 484-497,

Katz, H.C. (1993), The decentralization of collective bargaining: A literature review and comparative analysis, *Industrial and Labor Relations Review*, 47, 3-20,

Machin, S., Stewart, M.B. and van Reenen, J. (1993)**,** The economic effects of multiple unionism: evidence from the 1984 Work Place Industrial Relations Survey, *Scandinavian Journal of Economics*, 95, 279-296,

Moene, K.O., Wallerstein, M. and Hoel, M. (1993), Bargaining structure and economic performance, in: *Trade union behaviour, pay-bargaining and economic performance*, eds. Flanagan, R.J., Moene, K.O. and Wallerstein, M. Oxford: Clarendon Press,

Nickell, S. J. and Andrews, M. (1983), Unions, real wages and employment in Britain, 1951-1979, *Oxford Economic Papers*, 35, 183-206,

OECD (1997), *Employment Outlook* 1997. Paris,

Oswald, A.J. (1982), The microeconomic theory of the trade union, *The Economic Journal*, 92, 576-595,

Pencavel, John H. (2002), The surprising retreat of Union Britain, in: *Seeking a premier league economy*, eds. Blundell, R., Card, D. and Freeman, R.B. Chicago: University of Chicago Press for NBER,

Soskice, D. (1990), Wage determination: The changing role of institutions in advanced industrialized countries, *Oxford Review of Economic Policy*, 6, 36-61.