Institut for Nationaløkonomi

Handelshøjskolen i København

Working paper 4-98

THE ECONOMICS OF UNION CARTELIZATION

Niels Blomgren-Hansen

Department of Economics - Copenhagen Business School

Nansensgade 19, 5. DK - 1366 København K.

The Economics of Union Cartelization

Niels Blomgren-Hansen*
Department of Economics, Copenhagen Business School†

5 February 1998

Abstract

The present paper analyzes whether the way labor choose to organize can be explained as the result of rational (optimizing) behavior on the part of the unions. To do so, we set up a model in the tradition of Oswald (1979) and analyze the outcome under eight different organizational regimes. In general, there is no 'first best' solution' (as in the case of 'efficient bargaining'). In particular, there is no *a priori* reason to assume that 'more' cooperation is 'better'. Within this fairly simple model we establish (i) that both joint unions and industrial cartels may be preferred, (ii) that the choice depends on such factors as the number of skills, the elasticity of substitution among skills, and the members' attitude towards risk and an inegalitarian distribution of wages, (iii) that these parameters are likely to have developed in a way that has made industrial cartels more advantageous relative to joint unions, (iv) that loosely organized industrial cartels (contrary to joint unions) are incentive compatible if the cooperating unions organize workers with different skills and interests, and (v) that non-cooperative solutions appear to be unstable unless the intra-union competition is curtailed through the strict policing of demarcations.

JEL classification: D23; J5. *Keywords*: Labor market organization, Unions, Industrial Cartels, Demarcations

---

*I thank Thomas Blomgren-Hansen, Peter Møllgaard, Jeffrey Nilsen, Pascalis Raimondos-Møller, Steen Scheuer, Torsten Sløk and Dieter Urban for constructive comments on earlier versions of this paper. I am aware and regret that this, still preliminary, version of the paper does not fully reflects their valuable suggestions for improvements..

†Address: Nansensgade 19, DK-1366 Copenhagen K., Denmark. Tel. +(45) 38152588, E-mail: Blomgren.eco@cbs.dk

1 Introduction

Traditionally Danish workers were organized by craft and in two large general unions organizing unskilled workers and (mainly) low-level salaried employees. As a consequence, firms employing people of different skills/professions had to deal with a large number of unions, each of them defending their right to organize their specific group. In principle, each union might strike and thereby paralyzing production and hurting employees organized in other unions, if it wanted to put pressure on the employers to improve wages and working conditions.

Nevertheless, single-union strikes have not been a major problem in Denmark, mainly due to a long tradition for cooperation within the Danish Labor Movement, and the coordinating role of the Federation of Labor Unions (LO). This tradition of synchronized behavior is backed by the so-called Main Agreement (1899) which imposed a peace obligation on the parties during the term of the, usually two-year, wage agreements and established an industrial court and arbitration tribunals to settle disputes. On top of that the state mediator has an important role in avoiding open conflicts. Finally, there is a tradition for Parliamentary intervention, if necessary to avoid large scale conflicts.[1]

During the last decade or more the organizational structure of the Danish labor marked has been in the melting pot. Under the catchwords 'decentralization' and 'flexibility' there has been a gradual move from national multi-industry bargaining to national single-industry bargaining (Scheuer 1992). Finally, in 1996, after many years of discussions, the unions agreed to establish eight indutrial cartels. The decision-making power moved (further) away from the (head of) the previously predominant Federation of Labor Unions. The heirs were to the leaders of the cartels. This did not mean that the position of the heads of the individual unions were weakened. The heads of the (strongest) unions kept the deciding word, often as heads of the cartels. Whether, eventually, the cartels will gain the predominant position envisioned, is still to be seen.

Three aspects of the process are important. (1) The cartelization did not pass unchallenged; the unions organizing unskilled men and women vigorously fought proposals for a reorganization. (2) The cartelization is

[1] For a good description of the development of the Danish labour market, see Scheuer (1992).

not equally pervasive in all industries; it appears less pronounced in protected sectors than in sectors subject to international competition. (3) The cartelization was not opposed by the employers; on the contrary, the employers anticipated or, perhaps, even promoted the cartelization of unions by reorganizing themselves along similar lines.

The cartelization of the unions poses three questions: First, can the cartelization and the support of the employers be explained as the outcome of rational (optimizing) behavior on the part of both the unions and the employers? Second, can the timing be explained by the development in external conditions such as production technology, increased specialization of educations and skills, increased competition in the goods market, changes in labor's attitude towards risk and an inegalitarian distribution of income or the introduction of more 'generous' unemployment benefits in combination with increased taxation of wage income? Third, what are the macroeconomic consequences of the cartelization of the unions or, rather, what is the consequences for analyses of economic policy if the organization and the reaction of the labor market is endogenized?

The present paper makes some progress in answering the first of these questions, leaving the other questions (and a more elaborate answer to the first one) to further research.

The paper falls within the strand of literature initiated by Oswald (1979), i. e. we analyze the outcome of non-cooperation and cooperation in a game-theoretic, partial equilibrium, right-to-manage framework. More recent important contributions are Horn & Wolinsky (1988), Hoel (1989), Jun (1989) and Moene, Wallerstein & Hoel (1993).

The analysis is confined to a single industry; effects on other industries are disregarded. The industry consists of n firms each in a separate location. All firms have identical production functions and produce a homogeneous product. The only input is labor, having m different skills. Each skill group is of identical size, and the elasticity of substitution between any two is the same. Labor is immobile between locations and skills. Labor decides the organization of the labor market. The employers determine the level and composition of employment. The wage rates are determined jointly in bargaining process.

Within this setting we analyze the impact of four ways of organizing the labor market: (1) Non-cooperating local unions, (2) Local (firm-level) industrial cartels, (3) Joint unions organized by skill, and (4) A single national industrial cartel. In cases (1) and (3) we extend the analysis encompass the empirically important fact that unions may impose demarcations, which can reduce the feasible elasticity of substitution among skills below the one technically determined. The demarcations may be 'perfect' (if they reduce the feasible elasticity of substitution to its utility maximizing level) or 'imperfect' (if the utility maximizing elasticity of substitution is negative and, consequently, the best option is to impose rigid demarcations, thereby reducing the feasible elasticity to zero).

In general, there is no 'first best' solution (as in the case of 'efficient bargaining' where the parties determine the wage rate and the employment jointly). Metaphorically, we are at a point on the labor demand curve, not at a point on the contract curve. By cooperating, labor reduces negative externalities among workers belonging to competing skill groups or employed by competing firms. However, in this 'second best' world there is no *a priori* reason to believe that 'more' cooperation among workers is 'better'.

The structure of the paper is as follows: In part 2 we set up the model, solve it under the four (eight) alternative ways of organizing the labor market specified above, and derive existence and stability conditions. In part 3, we compare the results and discuss whether external conditions are likely to have developed in a way that has made it more attractive for unions to cooperate within cartels. In part 4, we address the incentive compatibility problem facing joint unions and establish the necessary conditions for cartels to be incentive compatible. Part 5 sums up the results of the analysis.

2 A model of labor market organization

2.1 The basic framework

The n firms in the industry produce a homogeneous product using identical CES production technology and, consequently, have identical CES unit cost functions,

$$q_i = m \cdot \left(\frac{1}{m} \cdot \sum L_{ij}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \quad (1)$$

$$c_i = \left(\frac{1}{m} \cdot \sum w_{ij}^{(1-\sigma)} \right)^{\frac{1}{1-\sigma}} \quad (2)$$

where

q_i = the production of the i'th firm

$$
\begin{aligned}
m &= \text{the number of skills (and local unions)} \\
L_{ij} &= \text{the employment of workers with skill } j \text{ in firm } i \\
c_i &= \text{the unit cost of the } i\text{'th firm} \\
w_{ij} &= \text{the wage rate of workers with skill } j \text{ in firm } i \\
\sigma &= \text{the elasticity of substitution between any two pairs of skills}
\end{aligned}
$$

Note that we have chosen a normalization such that $q_i = \sum L_{ij} = L_i$ if $L_{ij} = \frac{L_i}{m}$ for any skill j . $w_{ij} = c_i$ if all workers in the firm receive the same wage rate regardless of skill.

The cost minimizing labor demand functions of the i'th firm are

$$L_{ij} = \frac{q_i}{m} \cdot \left(\frac{c_i}{w_{ij}} \right)^{\sigma} \tag{3}$$

For simplicity we shall assume that the market (inverse) demand function is linear[2],

$$P = 1 - Q \tag{4}$$

where P is the market price and $Q = \sum q_i$, $i = 1, .., n$ is the market supply. The corresponding (inverse) demand curve facing the representative firm in a market characterized by Cournot competition is

$$p_i = P = 1 - Q = 1 - \sum q_j, \; j = 1, 2, , n \tag{5}$$

The representative firm's profit maximizing supply is

$$q_i = \frac{1 - c_i}{2} - \frac{\sum q_j}{2}, \; i \neq j \tag{6}$$

The solution to the corresponding n supply equations

$$\begin{bmatrix} q_1 \\ q_2 \\ \cdot \\ q_n \end{bmatrix} = \begin{bmatrix} 2 & 1 & \cdot & 1 \\ 1 & 2 & \cdot & 1 \\ \cdot & \cdot & \cdot & \cdot \\ 1 & 1 & \cdot & 2 \end{bmatrix}^{-1} \cdot \begin{bmatrix} 1 - c_1 \\ 1 - c_2 \\ \cdot \\ 1 - c_n \end{bmatrix} = \frac{1}{n+1} \cdot \begin{bmatrix} n & -1 & \cdot & -1 \\ -1 & n & \cdot & -1 \\ \cdot & \cdot & \cdot & \cdot \\ -1 & -1 & \cdot & n \end{bmatrix} \cdot \begin{bmatrix} 1 - c_1 \\ 1 - c_2 \\ \cdot \\ 1 - c_n \end{bmatrix} \tag{7}$$

[2]It might appear natural to assume an isoelastic demand function. However, some variable has to adjust. A model built on the assumptions of an isoelastic demand function, an isoelastic production function and an isoelastic union utility function has no stable non-cooperative equilibrium.

is

$$q_i = \frac{1}{n+1} \cdot \left(1 - n \cdot c_i + \sum c_j\right), \; j \neq i \tag{8}$$

from which market supply, market price, and profits of a representative firm are easily derived

$$Q = \frac{\sum (1 - c_j)}{n+1} \tag{9}$$

$$P = 1 - \frac{\sum (1 - c_j)}{n+1} \tag{10}$$

$$\Pi_i = (q_i)^2 = \left(\frac{1}{n+1}\right)^2 \cdot \left(1 - n \cdot c_i + \sum c_j\right)^2; \; j \neq i \tag{11}$$

Total labor force L is normalized to one. Labor is assumed immobile between locations (firms) and skills. The labor force in each location is $\frac{1}{n}$. Each local union organizes $\frac{1}{n \cdot m}$ of the labor force.

Unions are assumed to maximize the utility of a representative worker. For simplicity the utility function is isoelastic in the probability of being employed, gross income[3] and relative income:

$$V_{ij} = (L_{ij} \cdot n \cdot m)^{\gamma} \cdot w_{ij} \cdot \left(\frac{w_{ij}}{c_i}\right)^{\phi} \tag{12}$$

The utility function allows for two important psychological observations: (1) risk aversion and (2) 'envy'.

$L_{ij} \cdot n \cdot m$ is the employment rate of the workers organized by the j'th union at the i'th location $(= \frac{1}{n \cdot m})$. Consequently, $L_{ij} \cdot n \cdot m \leq 1$ is also the probability that a representative worker in location i and organized in union j becomes employed. If he is employed he receives the income w_{ij}; if not, he receives nothing. His expected income is $L_{ij} \cdot n \cdot m \cdot w_{ij}$. If he is risk averse, he prefers a somewhat smaller safe income to a given expected but risky income, i.e. $\gamma > 1$. $\gamma = 1$ corresponds to the case where the union maximizes expected or average income.

[3]It might appear an obvious extension to allow for taxes and unemployments benefits. However, we have abstained, because taxes have no effect in this model unless the tax function is non-linear, and the introduction of a non-zero reservation wage rate and a non-linear tax function seriously complicates the model and precludes the derivation of explicit solutions.

Income is an important measure of a person's position in society. Consequently, a wage hike is attractive not only because of the higher level of consumption it makes possible, but also because of the higher status it signals, provided, of course, that not everybody else in the neighborhood gets the same wage hike. The last term of the utility function is the relative wage rate of the representative worker compared to a (convenient) average of the wage rates of all workers in the same location (firm). The parameter $\phi \geq 0$ measures the extent to which income is considered a 'positional' good .

Substituting (8) into (3) and the resulting expression into (12) gives the utility of the representative worker in the (i, j)'th union as a function of his own wage rate, the unit costs in his own firm and the wage costs of competing firms,

$$V_{ij} = \left(\frac{n}{n+1}\right)^{\gamma} \cdot \left(1 - n \cdot c_i + \sum c_j\right)^{\gamma} \cdot c_i^{\gamma \cdot \sigma - \phi} \cdot w_{ij}^{1+\phi-\gamma \cdot \sigma}; \; j \neq i \qquad (13)$$

In symmetric equilibrium all wage rates are equal, $w_{ij} = c_i = c$, and the solution of the model as functions of c reduces to

$$q_i = \frac{1}{n+1} \cdot (1-c) \qquad (14)$$

$$L = Q = \frac{n}{n+1} \cdot (1-c) \qquad (15)$$

$$P = \frac{1 + n \cdot c}{1+n} \qquad (16)$$

$$\Pi_i = \left(\frac{1}{n+1}\right)^2 \cdot (1-c)^2 \qquad (17)$$

$$V_{ij} = \left(\frac{n}{n+1}\right)^{\gamma} \cdot (1-c)^{\gamma} \cdot c \qquad (18)$$

Notice that the number of firms, n, is the only parameter that influences production, employment and profits *directly* - and not through the impact on the wage rates and unit cost, c. Union utility is directly affected by the members' risk aversion, γ, as well as by the number of firms.

2.2 Non-cooperating local unions

2.2.1 No demarcations

In this subsection we shall assume that the individual local union engages in wage bargaining with its employer taking the wage level of all other unions - local as well as those organizing labor in competing firms - as given. Admittedly, this assumption is not very realistic. In particular, an employer might take into account that a wage hike given to one union has an effect on the wage demands of the other unions - positively or negatively depending on the slope of the reaction functions. However, the case is a natural and useful benchmark for evaluating the impact of union cooperation across skills and locations.

The wage rate w_{ij} is determined by maximizing (the logarithm of) the asymmetric Nash expression

$$\ln U_{LU} = \varepsilon \cdot \ln(V_{ij} - V_{ij}^*) + (1 - \varepsilon) \ln(\Pi_i - \Pi_i^*) \tag{19}$$

with respect to $\ln(w_{ij})$ assuming all other wage rates constant.

The definition of the disagreement points V_{ij}^* and Π_i^* is crucial (Binmore *et al.*1986). The terms denote, respectively, union utility and firm profits in case no agreement is reached. A realistic scenario is that the union calls a strike, which in a Danish setting is unlikely to be long, and that the firm attempt to continue production, although at a reduced scale and at higher costs.

To simplify the calculations we shall assume that both V_{ij}^* and Π_i^* are zero. $V_{ij}^* = 0$ is consistent with our assumption that labor is immobile between locations (firms) and skills. Consequently, the striking workers have no alternative income[4]. $\Pi_i^* = 0$ is strictly speaking consistent with the model set-up only if $\sigma \leq 1$ *and* the employer's right to manage includes the right to lay off non-striking workers[5]; if not the profits are negative. If $\sigma > 1$, a strike of one skill will not stop production completely; however, the profits may still not be positive, as the strike hurts efficiency and raises unit costs. In the analysis of existence and stability conditions below we find that the maksimum value of σ consistent with a stable non-cooperative solution is 1.33 in our reference case ($m = 3$, $n = 5$, $\gamma = 1.5$ and $\phi = 0.5$). For $\sigma = 1.33$,

[4] Striking workers may get financial support from the union, but as there is nobody to pay but the workers themselves, the support should rationally be considered a loan.

[5] The loss inflicted on non-striking workers is no argument in the non-cooperative game.

profits are reduced to about 15 per cent of the previous level. Consequently, we do not consider the simplification $V_{ij}^* = \Pi_i^* = 0$ inappropriate.

The parameter ε, $0 \leq \varepsilon \leq 1$, is interpreted as an exogenous measure the bargaining power of the union, and $1 - \varepsilon$ of that of the employer. It is convenient for expositional reasons. $\varepsilon = 1$ reduces the model to the familiar union-monopoly model. However, as pointed out by Binmore *et al.* (1986), it is not clear what kind of asymmetries $\varepsilon \neq 0.5$ is supposed to reflect. Ideally, asymmetries in preferences and outcomes in case of a breakdown of the bargaining process are already incorporated in the specification of, respectively, the utility functions and the disagreement points. What is left are difficult-to-model asymmetries in bargaining procedures and differing beliefs concerning the likelihood of a breakdown.

The first order condition is

$$\begin{aligned} \frac{\partial \ln U_{LU}}{\partial \ln w_{ij}} &= (\varepsilon \cdot \gamma + 2 \cdot (1 - \varepsilon)) \cdot \left(\frac{-n \cdot c_i}{1 - n \cdot c_i + \sum c_j} \right) \cdot E_{c_i, w_{ij}} \quad (20) \\ &\quad + (\varepsilon \cdot (\gamma \cdot \sigma - \phi)) \cdot E_{c_i, w_{ij}} + \varepsilon \cdot (1 + \phi - \gamma \cdot \sigma) \\ &= 0; \; j \neq i \\ E_{c_i, w_{ij}} &= \frac{\partial \ln c_i}{\partial \ln w_{ij}} = \frac{1}{m} \cdot \left(\frac{c_i}{w_{ij}} \right)^{\sigma - 1} \quad (21) \end{aligned}$$

Symmetric equilibrium requires that $w_{ij} = c_i = c$ for all unions and all firms. Imposing this restriction, (20) easily reduces to,

$$c_{LU} = \frac{m - (m-1) \cdot (\gamma \cdot \sigma - \phi)}{m - (m-1) \cdot (\gamma \cdot \sigma - \phi) + (\gamma + 2 \cdot (1/\varepsilon - 1)) \cdot n} \quad (22)$$

To simplify notation we introduce the ancillary variables a and b

$$\begin{aligned} a &= m - (m-1) \cdot (\gamma \cdot \sigma - \phi) \quad (23) \\ b &= \gamma + 2 \cdot (1/\varepsilon - 1) \quad (24) \end{aligned}$$

Inserting these in (22) and the resulting expression in (14) - (18) gives the following solution of the model,

$$c_{LU} = \frac{a}{a + b \cdot n} \quad (25)$$

$$q_{LU} = \frac{n}{n+1} \cdot \left(\frac{b}{a + b \cdot n} \right) \tag{26}$$

$$L_{LU} = Q_{LU} = \frac{n^2}{n+1} \cdot \left(\frac{b}{a + b \cdot n} \right) \tag{27}$$

$$P_{LU} = \frac{1}{1+n} + \frac{n}{n+1} \cdot \left(\frac{a}{a + b \cdot n} \right) \tag{28}$$

$$\Pi_{LU} = \left(\frac{n}{n+1} \right)^2 \cdot \left(\frac{b}{a + b \cdot n} \right)^2 \tag{29}$$

$$V_{LU} = \left(\frac{n^2}{n+1} \right)^{\gamma} \cdot \frac{a \cdot b^{\gamma}}{(a + b \cdot n)^{\gamma+1}} \tag{30}$$

V_{LU} as a function of a has a unique maximum at $a = \frac{b \cdot n}{\gamma}$ or in terms of σ at

$$\sigma_{opt,LU} = \left(\frac{m}{m-1} \cdot \frac{1}{\gamma} + \frac{\phi}{\gamma} \right) - \left(\frac{\gamma + 2 \cdot (1/\varepsilon - 1)}{\gamma^2} \right) \cdot \frac{n}{m-1} \tag{31}$$

$\sigma_{opt,LU}$ is positive if and only if

$$\frac{m + (m-1) \cdot \phi}{n} = \frac{a_{\sigma=0}}{n} > 1 + \frac{2 \cdot \left(\frac{1}{\varepsilon} - 1 \right)}{\gamma} \geq 1 \tag{32}$$

Consequently, if - as we shall assume in the following - $m \geq 2$ and $n \geq m + (m-1) \cdot \phi = a_{\sigma=0}$, then $\sigma_{opt,LU}$ is negative and V_{LU} a monotonically declining function of σ for any value of $\sigma \geq 0$.

2.2.2 Existence and stability conditions

The solution is only economically meaningful if $0 < c_{LU} < 1$ *and* the non-negative equilibrium is stable.

The non-negativity or existence condition follows directly from the numerator of (22),

$$\sigma < \left(\frac{m}{m-1} + \phi \right) \cdot \frac{1}{\gamma} \tag{33}$$

The non-negativity condition is binding for plausible values of the parameters[6]. For $m = 2$, $\phi = 0$ and $\gamma = 1$, σ may not exceed 2; for $m = 10$, $\phi = 0.5$, and $\gamma = 1.5$, a positive solution only exists if $\sigma < 1.07$. If condition (33) is not satisfied, the wage rates will be set at the union's reservation wage level which in our model is zero. $c = 0$ is an 'organizationally unstable' solution in the sense that labor has no incentive to organize (and pay to) unions unless the unions are able to raise the wage rate above the reservation wage level.

To derive the stability condition, we shall assume that the wage rates are determined in the following the wage adjustment process

$$\begin{aligned} w_{t+1} &= w_t + A \cdot \Delta w_t \\ &= w_0 + (A + A^2 + A^3 + +A^{t+1})\Delta w_0 \end{aligned}$$

where w is a vector of wage rates of length $m \cdot n$ and A is a corresponding square matrix. The first element of the first row of A is 0. The next $m-1$ elements are $\frac{\partial w_{11}}{\partial w_{1k}} \lesseqgtr 0$, $k = 2, .., m$. The remaining $(n-1) \cdot m$ elements are $\frac{\partial w_{11}}{\partial w_{hk}} \geq 0$, $h = 1, .., n$, $k = 1, .., m$. The symmetry assumption implies that all $\frac{\partial w_{11}}{\partial w_{1k}}$ are identical $(= \kappa_1)$ and all $\frac{\partial w_{11}}{\partial w_{hk}}$ are identical $(= \kappa_2)$. All rows have the same elements, although in differing order:

$$\Delta w_{ij,t+1} = \kappa_1 \cdot \sum_{h \neq j} \Delta w_{ih,t} + \ \kappa_2 \cdot \sum_{k \neq i} \sum_{j} \Delta w_{kj,t}$$

The adjustment process presupposes non-strategic behavior and static expectations. At the beginning of every period each union and its employer bargain and agree on a wage rate for that period, assuming that all other wage rates are unchanged.

It is a sufficient condition for stability the largest root of A is (numerically) less than one[7].

By inspection it is readily verified that A has three roots,

$$\lambda_1 = -\kappa_1 \text{ with multiplicity } m \cdot (n-1)$$

[6] On the basis of Danish data for the period 1948-88, Risager (1993) estimated the elasticity of substitution between skilled and unskilled workers to about 1.3 on the aggregate level. In (Risager 1992a) he estimated the elasticity of substitution to about 2.8 in the construction industry and to about 1.8 in the metal manufacturing industry.

[7] As A is symmetric, we have that $A = P^T(diag\ \lambda)P$, $P^T P = I$, where P is a matrix of eigenvectors corresponding to the $n \cdot m$ roots, λ_i, and $diag\ \lambda$ a corresponding matrix with the roots on the main diagonal. It follows directly that $A^n = P^T(diag\ \lambda)^n P$ vanishes if and only iff all roots are numerically less than one.

$$\lambda_2 = (m-1)\cdot\kappa_1 - m\cdot\kappa_2 \text{ with multiplicity } m-1$$
$$\lambda_3 = (m-1)\cdot\kappa_1 + m\cdot(n-1)\cdot\kappa_2 \text{ with multiplicity } 1$$

however, in general we cannot say which is numerically the largest one.

The symmetry condition implies that all elements in the vector Δw are identical. Utilizing this restriction, we can conclude that only the root associated with the eigenvector $v_3 = (1,..,1)^T$, that is λ_3 (hereafter$\lambda_{\max}$), is relevant for our purpose and establish the

Proposition 1 *Assuming symmetric, non-strategic behavior and static expectations the above described model has a stable, non-cooperative solution if and only if*
$$\lambda_{\max} = |(m-1)\cdot\kappa_1 + m\cdot(n-1)\cdot\kappa_2| < 1$$

$\lambda_{\max}$ is the analogue to the slope of the reaction functions in the simple two-union case. The interpretation of the stability condition is that the equilibrium is unstable if each union responds to a uniform increase in all other unions' wage rates by raising (or lowering) its wage rate by more than the other unions.

$\lambda_{\max}$ may be decomposed into an *intra-firm component,* $\lambda_{\max.1} \lesseqgtr 0$, indicating the response to a uniform wage raise obtained by skills employed in the same firm, and an *inter-firm component,* $\lambda_{\max.2} > 0$, indicating the response to a uniform wage raise obtained by wage earners employed in competing firms. The inter-firm component, $\lambda_{\max.2}$, is always positive; the utility maximizing response to improved competitiveness of the firm is to demand higher wages, regardless of the elasticity of substitution. The intra-firm component, $\lambda_{\max.1}$, reflects two opposing forces: a (positive) substitution effect and a (negative) scale effect. The scale effect dominates if the elasticity of substitution is 'low'; the substitution effect dominates, if the elasticity of substitution is 'high'(in our model, in fact, only if σ is very close to $\sigma_{\max}$)[8]

[8]Note that, in general and contrary to the impression Oswald (1979) and Gylfason and Lindbeck (1984) may leave, the reaction functions are not necessarily monotonic. Consequently, in general, skills cannot be categorized as gross substitutes (upward sloping reaction functions) nor gross complements (negatively sloping reaction functions).

A number of empirical labor market studies indicate that the reaction functions are upward sloping in equilibrium, e.g. Andersen and Risager (1990) and Risager (1992b). In our model the wage reaction of one skill to a wage increase in the other skills employed in the same firm, $\lambda_{\max.1}$, is only positive if the elasticity of substitution is pretty close to $\sigma_{\max}$. This discomforting discrepancy between our theoretical results and the empirical

To derive $\kappa_1 = \frac{\partial w_{ij}}{\partial w_{ik}}$ and $\kappa_2 = \frac{\partial w_{ij}}{\partial w_{hk}}$, take the total derivative of (20):

$$-\varepsilon \cdot b \cdot n \cdot \left(\frac{(1 - n \cdot c_i + \sum c_j) \cdot \Delta c_i - c_i \cdot (-n\Delta c_i + \sum \Delta c_j)}{(1 - n \cdot c_i + \sum c_j)^2} \right) \cdot E_{c_i, w_{ij}} \quad (34)$$
$$+ \left(\frac{-\varepsilon \cdot b \cdot n \cdot c_i}{1 - n \cdot c_i + \sum c_j} + \varepsilon \cdot (\gamma \cdot \sigma - \phi) \right) \cdot \Delta E_{c_i, w_{ij}} = 0$$

$$\Delta E_{c_i, w_{ij}} = \frac{\sigma - 1}{m} \cdot \left(\frac{c_i}{w_{ij}} \right)^{\sigma} \cdot \frac{w_{ij} \cdot \Delta c_i - c_i \cdot \Delta w_{ij}}{w_{ij}^2}; \ \Delta c_i = \frac{1}{m} \cdot \left(\frac{c_i}{w_{ij}} \right)^{\sigma} \cdot \sum \Delta w_{ij}$$

Substituting (25) for $w_{ij} = c_i = c_j$ in (34) and collecting terms gives

$$\kappa_1 = \frac{\partial w_{ij}}{\partial w_{ik}} = \frac{1 - \frac{(a+b) \cdot a}{m \cdot (1 - \gamma \cdot \sigma + \phi) \cdot (1 - \sigma) \cdot b}}{(m-1) + \frac{(a+b) \cdot a}{m \cdot (1 - \gamma \cdot \sigma + \phi) \cdot (1 - \sigma) \cdot b}} \lessgtr 0 \quad (35)$$

$$\kappa_2 = \frac{\partial w_{ij}}{\partial w_{hj}} = \frac{\frac{a^2}{n \cdot m \cdot (1 - \gamma \cdot \sigma + \phi) \cdot (1 - \sigma) \cdot b}}{(m-1) + \frac{(a+b) \cdot a}{m \cdot (1 - \gamma \cdot \sigma + \phi) \cdot (1 - \sigma) \cdot b}} \geq 0 \quad (36)$$

Note that $a = 0$ and $\lambda_{\max} = 1$ if $\sigma = \frac{m}{m-1} \cdot \frac{1}{\gamma}$. The *positive stability condition*, $\lambda_{\max} < 1$ is identical to the existence condition, $0 < \sigma < \frac{m}{m-1} \cdot \frac{1}{\gamma} = \sigma_{\max}$, and, consequently, imposes no additional restriction.

The *negative stability condition*, $\lambda_{\max} > -1$, has no similarly simple solution. For $m \geq 3$ it is clearly binding in the neighborhood of $\sigma = 1$ and $\sigma = \frac{1+\phi}{\gamma}$. To see that, notice that $\lambda_{\max.1} = -(m-1)$, $0 < \lambda_{\max.2} < 1$ and, consequently, $\lambda_{\max} < -(m-2)$, for $\sigma = 1$ *or* $\sigma = \frac{1+\phi}{\gamma}$. We cannot derive simple expressions for the width of the band around $\sigma = 1$ and $\sigma = \frac{1+\phi}{\gamma}$, within which the solution is unstable. However, numerical simulations reveals that instability seriously restricts the constellation of parameters for which *LU* is a viable organizational regime.

Insert figures 1a-b about here

analyses questions the interpretation of the empirical analyses as well as the practical relevance of our model. Do the empirical analyses reflect truly uncooperative behavior (as implicitly assumed) or do they reflect the outcome of some coordinated game?

Figures 1a-b show c_{LU}, V_{LU} and $\lambda_{\max}$ as functions of σ for $m = 3$, $n = 5$, $\gamma = 1.5$, $\varepsilon = 0.667$ and $\phi = 0.5$. For these parameter values the equilibrium solution is unstable in the range $0.87 < \sigma < 1.15$, and, consequently, only stable if σ is (considerably) less than 1 or falls within a narrow range close to $\sigma_{\max} = 1.33$. The width of the band within which the equilibrium in unstable is an increasing function of the number of separately organized skills, m, and labor's bargaining power, ε, and a decreasing function of the number of firms in the industry, n. If there is only one firm (effectively corresponding to the organizational regime JU discussed below), the *un*stable range *widens* to $0.45 < \sigma < 1.18$.

The above stability analysis is based on the assumptions of symmetric, non-strategic behavior and static expectations and is not readily generalized to encompass other adjustment processes. However, intuition does not support the hypothesis that strategic behavior or forward-looking expectations should make the non-cooperative solution more stable.

2.2.3 Optimal demarcations

So far we have considered the elasticity of substitution between skills as a technologically determined parameter measuring the degree to which a worker with one skill *can* substitute a worker with another skill. In doing so, we disregard the fact that unions may prevent the employer from substituting workers with different skills (and union membership) to the extent it is technically possible and economically profitable. It is a salient feature of the functioning of the labor market that unions define - unilaterally or by agreement - demarcations and defend these vigorously. Demarcations mean that the $feasible$ elasticity of substitution may be much lower than what differences in skills imply.

This poses the question: What is the optimal degree of flexibility (elasticity of substitution) from the point of view of the unions? To answer this question we may assume that each individual union maximizes V_{ij} as determined above with respect to σ or that the m local unions agree to maximize a joint utility function

$$V_i = \prod V_{ij}^{\beta_j}; \ \sum \beta_j = 1 \tag{37}$$

with respect to σ. As derived above, the first order condition is $a = \frac{b \cdot n}{\gamma}$ or $\sigma = \sigma_{opt,LU}$ (independently of the weights β_j).

Obviously, demarcations are imprecise instruments of controlling the elasticity of substitution. Nevertheless, it is illustrative to see how the solution of the model is affected if $\sigma_{opt,LU} > 0$ and the unions succeed in pegging $\sigma = \sigma_{opt,LU}$:

$$c_{LUPD} = \frac{1}{1+\gamma} \tag{38}$$

$$q_{LUPD} = \frac{1}{n+1} \cdot \frac{\gamma}{1+\gamma} \tag{39}$$

$$L_{LUPD} = Q = \frac{n}{n+1} \cdot \frac{\gamma}{1+\gamma} \tag{40}$$

$$P_{LUPD} = \frac{n+1+\gamma}{(n+1)\cdot(\gamma+1)} \tag{41}$$

$$\Pi_{LUPD} = \left(\frac{1}{n+1}\right)^2 \cdot \left(\frac{\gamma}{1+\gamma}\right)^2 \tag{42}$$

$$V_{LUPD} = \left(\frac{n}{n+1}\right)^\gamma \cdot \frac{\gamma^\gamma}{(1+\gamma)^{\gamma+1}} \tag{43}$$

The effects are striking. By comparing (22) - 30) and (38) - (43) it is seen that perfect demarcations eliminate the employer's influence on the wage setting process and any negative externality that may derive from 'envy' or competition between unions. It also eliminates the *negative* effects (from the point of view of labor) of competition in the goods market (the indirect competition for the jobs with 'colleagues' at other locations increases with the number of competing firms), leaving the *positive* effect of increased competition on total production and employment unaffected. The resulting welfare increases for unions comes, however, at the cost of reduced profits to the employers and increasing prices to the consumers[9].

Notice that perfect demarcations are not inflexible. (31) implies that the unions become more flexible (increases $\sigma_{opt,LU}$) if the number of skills and unions, m, grows, or the members of the unions become more risk adverse or 'envious', and that they become less flexible, if the employer gains more

[9]This is an illustration of the important point made by Binmore *et al* (1986) that any change in the utility functions of the parties or their disagreement points affect the outcome of the game as does a shift in the distribution of the bargaining power as measured by the exoegneous parameter ε. The unions' capture of the control of some parameter, say σ, is a substitute to an increase in ε. n the case of perfect demarcation it is a perfect sub

bargaining power or the competition in the goods market becomes more fierce.

However, as explained above, except for a very narrow range of parameter constellations this story is too good to be true (from the point of view of labor). Outside this range, $\sigma_{opt,LU}$ is negative and the best labor can do is to apply '*imperfect demarcations'*, (denoted ID) that is to reduce the feasible elasticity of substitution to zero. The solution in this case is readily derived by substituting $a_{\sigma=0} = m + (m-1) \cdot \phi$ for a in (22) - (30). It always holds that $V_{LUID} > V_{LU}$ if $\sigma_{opt,LU} < 0$.

2.3 Local industrial cartels

The most obvious way to eliminate the negative externalities of inexpedient competition on the local labor market is to form local industrial cartels. For simplicity we shall here assume that the governing body of the local industrial cartel attaches equal weight[10] to the utility of the representative member of each of the m cooperating local unions, i.e. $\beta_j = \frac{1}{m}$. In this case we have $w_{ij} = c_i$ for all j. The substitution and 'envy' terms vanish and the objective function of the local industrial cartel reduces to

$$V_{LIC} = (L_{i*} \cdot n \cdot m)^{\gamma} \cdot c_i = (q_{i*} \cdot n)^{\gamma} \cdot c_i \tag{44}$$

As above - and here with no reservation for the case $1 < \sigma < \sigma_{\max}$ where the employer may earn some profits during a strike - we shall assume the disagreement points $V_{LIC}^* = \Pi_i^* = 0$ and determine the wage rates by maximizing the resulting asymmetric Nash expression

$$\ln U_{LIC} = \varepsilon \cdot \ln(V_{LIC}) + (1-\varepsilon)\ln(\Pi_i) \tag{45}$$

with respect to $\ln(c_i)$ assuming the unit costs in all other firms are constant.

The first order condition is

$$\frac{\partial \ln U_{LIC}}{\partial \ln c_i} = (\varepsilon \cdot \gamma + 2 \cdot (1-\varepsilon)) \cdot \left(\frac{-n \cdot c_i}{1 - n \cdot c_i + \sum c_j} \right) + \varepsilon = 0 \tag{46}$$

[10] In part 3 we argue that a wage setting cartel is incentive incompatible if it does not attach equal weights to the welfare of the representative member of all cooperating unions.

Substituting c for c_i and c_j in (46) gives the symmetric equilibrium solution for the wage rates and the unit cost

$$c_{LIC} = \frac{1}{1+(\gamma+2\cdot(1/\varepsilon-1))\cdot n} \tag{47}$$
$$= \frac{1}{1+b\cdot n} \tag{48}$$

Substituting this expression in (14) - (18) gives

$$q_{LIC} = \frac{n}{n+1}\cdot\frac{b}{1+b\cdot n} \tag{49}$$
$$L_{LIC} = Q_{LIC} = \frac{n^2}{n+1}\cdot\frac{b}{1+b\cdot n} \tag{50}$$
$$P_{LIC} = \frac{1}{1+n}+\frac{n}{1+n}\cdot\frac{1}{1+b\cdot n} \tag{51}$$
$$\Pi_{LIC} = \left(\frac{n}{n+1}\right)^2\cdot\left(\frac{b}{1+b\cdot n}\right)^2 \tag{52}$$
$$V_{LIC} = \left(\frac{n^2}{n+1}\right)^\gamma\cdot\frac{b^\gamma}{(1+b\cdot n)^{1+\gamma}} \tag{53}$$

The equilibrium wage rate - as determined in (47) - is always positive, and the equilibrium solution always stable[11].

The equilibrium solution for c_{LIC} and V_{LU} is shown in figure 1a.

From the analysis in the preceding section we have that V_{LU} is a monotonically declining function of σ (for $n \geq m+(m-1)\cdot\phi = a_{\sigma=0}$. By comparing (53) and (30) we also have that $V_{LIC} = V_{LU}$ at $a = 1$. The two observations allow us to conclude, that

$$V_{LIC} > V_{LU} \text{ if } \sigma > \frac{1+\phi}{\gamma} \equiv \sigma_2 \tag{54}$$

[11]To verify that the equilibrium is stable, take the total derivative of equation first order condition and derive as in the preceding section the largest root of the corresponding $(n\cdot n)$ transformation matrix:

$$0 < \lambda_{\max} = \frac{n-1}{n\cdot(1+b)} < 1$$

The largets root in case of LIC is identical with the intra-firm component $\lambda_{\max.2}$ in case of JU for $m=1$ and $\sigma=\phi=0$.

It may sound odd that cooperative wage setting may actually make labor worse off. The reason is that labor only cooperates locally. Firms compete and, consequently, so do workers employed in separate firms, although indirectly. Between-firm competition will make the unions go for wage rates that are 'too low'. Within-firm competition among skills will make the unions go for wage rates that are 'too high' if the skills are complements (σ is 'low') and vice versa if they are substitutes. Consequently, the negative externalities due to lack of cooperation across firms may be reduced or increased through the formation of local cartels. Even though the local unions have a clear incentive to cooperate there is no *a priori* reason to believe that cooperation makes labor better off if all local unions react in the same way.

If (54) is satisfied and, hence, coordinated wage setting within local industrial cartels improves the welfare of labor, then - as seen by comparing (47) and (**??**) - the result is detrimental to the interests of the employers (and consumers): higher wage costs, reduced profits and higher prices. Consequently, the parties have opposing interests: if the formation of local industrial cartels is good for labor, then it is bad for the employers and vice versa.

If demarcations (although imperfect) are practicable, then non-cooperating local unions is always preferable to local industrial cartels from the point of view of labor[12].

2.4 Joint unions

2.4.1 No demarcations

Typically, wage earners identify themselves more by their profession or skill than by the firm in which they are employed, and supposedly more so in former times than today. Consequently, workers traditionally organized in skill specific joint unions, whereas coordination across skills within the individual firms was limited, if at all existing.

As above we shall assume that the wage rate is determined in a bargaining process, that the parties take the wages of the other skills as given, and that their relative bargaining power is unaffected.

A joint union organizing all employees with skill j maximizes

$$V_{JU} = \left(\prod V_{ij}\right)^{\alpha_i}; \ \sum \alpha_i = 1$$

[12] $V_{LU}/V_{LIC} = a$, which in case of imperfect demarcations ($\sigma = 0$) reduces to $m + (m - 1) \cdot \phi > 1$, as $(m-1) \cdot (1+\phi) > 0$.

For simplicity we shall further assume that the governing body of the joint union attaches equal weight to the welfare of all members, regardless of where they are employed, $\alpha_i = \frac{1}{n}$. This reduces the utility function of the joint union to $V_{JU} = V_{ij}$, and the utility function of the employers to that of a representative firm, Π_i. As under the *LU*-regime we shall assume $V_{ij}^* = \Pi_i^* = 0$, in fact, with a slightly better justification as the *stable* range of σ above 1 and below $\sigma_{\max}$ is even narrower under the *JU*-regime.

The Nash expression is

$$\begin{aligned}
\ln U_{JU} &= \varepsilon \cdot \ln(V_{ij}) + (1-\varepsilon) \cdot \ln(\Pi_i) \qquad (55)\\
&= \varepsilon \cdot \left(\gamma \cdot \left(\ln(q_i \cdot n) + \sigma \cdot \ln(\frac{c_i}{w_{*j}}) \right) + \ln(w_{*j}) + \phi \cdot \ln(\frac{w_{*j}}{c_i}) \right) \\
&\quad +(1-\varepsilon) \cdot 2 \cdot \ln(q_i) \\
&= (\varepsilon \cdot \gamma + 2 \cdot (1-\varepsilon)) \cdot \ln(1 - c_i + \sum c_j) + \varepsilon \cdot (\gamma \cdot \sigma - \phi) \cdot \ln(c_i) \\
&\quad +\varepsilon \cdot (1 - \gamma \cdot \sigma + \phi) \cdot \ln(w_{*j}) + \varepsilon \cdot \gamma \cdot \ln(n) \qquad (56)\\
&\quad -(\varepsilon \cdot \gamma + 2 \cdot (1-\varepsilon)) \cdot \ln(n+1)
\end{aligned}$$

from which we derive the first order condition

$$\left((\varepsilon \cdot \gamma + 2 \cdot (1-\varepsilon)) \cdot \frac{-c_i}{1 - c_i + \sum c_j} + \varepsilon \cdot (\gamma \cdot \sigma - \phi) \right) \cdot E_{c_i, w_{*j}} + \varepsilon \cdot (1 - \gamma \cdot \sigma + \phi) = 0 \qquad (57)$$

and the unit cost and wage rate in symmetric equilibrium

$$\begin{aligned}
c_{JU} &= \frac{m - (m-1) \cdot (\gamma \cdot \sigma - \phi)}{m - (m-1) \cdot (\gamma \cdot \sigma - \phi) + \gamma + 2 \cdot (\frac{1}{\varepsilon} - 1)} \qquad (58)\\
&= \frac{a}{a+b} \qquad (59)
\end{aligned}$$

By substituting this expression for c in (14) - (18) we get

$$\begin{aligned}
q_{JU} &= \frac{1}{n+1} \cdot \left(\frac{b}{a+b} \right) \qquad (60)\\
L_{JU} &= Q_{JU} = \frac{n}{n+1} \cdot \left(\frac{b}{a+b} \right) \qquad (61)
\end{aligned}$$

$$P_{JU} = \frac{1}{1+n} + \frac{n}{n+1} \cdot \left(\frac{a}{a+b} \right) \tag{62}$$

$$\Pi_{JU} = \left(\frac{1}{n+1} \right)^2 \cdot \left(\frac{b}{a+b} \right)^2 \tag{63}$$

$$V_{JU} = \left(\frac{n}{n+1} \right)^\gamma \cdot \frac{a \cdot b^\gamma}{(a+b)^{\gamma+1}} \tag{64}$$

Comparing (25) and (59) shows that the effect on the wage rate of forming joint unions organized by skill is to eliminate the effect of indirect competition between workers with identical skill employed at different firms. The wage rate increases to the level that would have been the outcome of the bargaining if the unions had faced only one employer. The positive employment effect (and a welfare gain to the consumers) from competition in the goods market is reduced, but not eliminated.

The non-negativity condition is independent of the number of firms and, thus, unaffected by a shift from a merger of local unions to industry-wide joint unions.

The stability condition in case of joint unions corresponds to the intra-firm component of $\lambda_{\max}$,

$$\lambda_{\max.1} = \frac{1 - \frac{(a+b)\cdot a}{m\cdot(1-\gamma\cdot\sigma+\phi)\cdot(1-\sigma)\cdot b}}{(m-1) + \frac{(a+b)\cdot a}{m\cdot(1-\gamma\cdot\sigma+\phi)\cdot(1-\sigma)\cdot b}} \cdot (m-1) \tag{65}$$

derived above.

As explained above and illustrated in figure 1b, the range within which the equilibrium solution is *un*stable is broader in JU than in LU. The widening of the unstable range by shifting from LU to JU is illustrated in figure 1b.

V_{JU} as a function of σ has a unique maximum at

$$\sigma_{opt,JU} = \left(\frac{m}{m-1} \cdot \frac{1}{\gamma} + \frac{\phi}{\gamma} \right) - \left(\frac{\gamma + 2 \cdot (1/\varepsilon - 1)}{\gamma^2 \cdot (m-1)} \right) \tag{66}$$

Contrary to $\sigma_{opt,LU}$, $\sigma_{opt,JU}$ may be positive. In fact, that will be the case unless both m and ε are 'small',

$$\sigma_{opt,JU} > 0 \text{ if } m + (m-1) \cdot \phi > \frac{2 \cdot \left(\frac{1}{\varepsilon} - 1\right)}{\gamma} \tag{67}$$

Consequently, V_{JU} is likely to have an increasing branch (in the range $0 < \sigma < \sigma_{opt,JU}$) and a decreasing branch (in the range $\sigma_{opt,JU} < \sigma < \sigma_{\max}$)

There is no unambiguous ranking among JU, LU and LIC. For certain parameter constellations, V_{JU} is larger (smaller) than both V_{LU} and $V_{LIC.}$

2.4.2 Optimal demarcations

The solutions in this case is given by (38) - (43) above.

Perfect demarcations will improve union welfare if $0 < \sigma_{opt,JU} < \sigma < \sigma_{\max}$. In the range $0 < \sigma < \sigma_{opt,JU}$ the imposition of perfect demarcation is not possible (as demarcations can only reduce the feasible elasticity of substitution); *im*perfect demarcations are irrelevant as V_{JU} is a declining function of σ. .

σ_{opt} may fall with in the unstable range. If so, the best alternative is to combine JU with stricter demarcations, thereby reducing the feasible elasticity of substitution, σ, to the highest possible value consistent with stability ($\sigma_{lb} \equiv$ the lower bound of the unstable range). In the following, we shall denote the organizational regime in which the unions succeed to restrict σ to $\min(\sigma_{opt}, \sigma_{lb})$ $JUPD^{*}$ provided $\sigma_{opt,LU} > 0$. *Imperfect demarcations* are only relevant - the inequality $V_{JUID} > V_{JU}$ only applies - if $\sigma_{opt,LU} < 0$.

2.5 A single national industrial cartel

The utility function of a single industrial cartel comprising all firms in the industry is

$$V_{NIC} = \prod \left(\prod V_{ij}^{\beta_j} \right)^{a_i}; \; \sum \alpha_i = 1; \; \sum \beta_j = 1 \tag{68}$$

For simplicity we shall assume that the cartel attaches an equal weight to the welfare of the representative member of each local union regardless of their skill and the firm in which they are employed, i.e.$\alpha_i = \frac{1}{n}$ and $\beta_j = \frac{1}{m}$. In this case the joint utility function reduces to that of a representative local union $V_{NIC} = V_{ij}$ for $w_{ij} = c$. The Nash expression to be maximized with respect to $\ln(c)$ reduces to

$$\begin{aligned} \ln U_{NIC} &= \varepsilon \cdot \left(\gamma \cdot \left(\ln \left(\frac{n}{n+1} \right) + \ln (1-c) \right) + \ln (c) \right) \\ &\quad + (1-\varepsilon) \cdot 2 \cdot \left(\ln \left(\frac{1}{n+1} \right) + \ln (1-c) \right) \end{aligned} \tag{69}$$

and the first order condition to

$$c_{NIC} = \frac{1}{1+\gamma+2\cdot(\frac{1}{\varepsilon}-1)} \tag{70}$$
$$= \frac{1}{1+b} \tag{71}$$

Substituting the latter expression for c in (14) -(18) gives

$$q_{NIC} = \frac{1}{n+1}\cdot\frac{b}{1+b} \tag{72}$$
$$L_{NIC} = Q_{NIC} = \frac{n}{n+1}\cdot\frac{b}{1+b} \tag{73}$$
$$P_{NIC} = \frac{1}{1+n}+\frac{n}{1+n}\cdot\frac{1}{1+b} \tag{74}$$
$$\Pi_{NIC} = \left(\frac{1}{n+1}\right)^2\cdot\left(\frac{b}{1+b}\right)^2 \tag{75}$$
$$V_{NIC} = \left(\frac{n}{n+1}\right)^{\gamma}\cdot\frac{b^{\gamma}}{(1+b)^{1+\gamma}} \tag{76}$$

One might conjecture that cooperating within the framework of one comprehensive industrial cartel is always at least as good as any alternative organizational regime, at least if - as here - there is perfect information and no transaction cost. However, this is not the case. NIC is unconditionally superior to JU only in the limiting case, $\sigma_1 = \sigma_{opt,JU} = \sigma_2$, that is if the employers have no bargaining power at all and the unions can dictate the wage rates $(\varepsilon = 1)$[13].

For $\varepsilon < 1$, $V_{JU} > V_{NIC}$ within a certain range of σ.To determine that range, define the ancillary function $G(\sigma) = V_{JU} - V_{NIC}$. $G(\sigma)$ has a maximum at $\sigma = \sigma_{opt,JU} = \frac{1+\phi}{\gamma} - \frac{2\cdot(1/\varepsilon-1)}{\gamma^2\cdot(m-1)}$ and two roots. The larger root - corresponding to $a = 1$ - is $\sigma_2 = \frac{1+\phi}{\gamma} \geq \sigma_{opt,JU}$. The smaller root, $\sigma_1 \leq \sigma_{opt,JU}$, has no explicit solution. $V_{JU} > V_{NIC}$ if $\sigma_1 < \sigma < \sigma_2$. Consequently, cooperating within a single comprehensive industrial cartel is preferable to non-cooperating joint unions only if there is either 'too little' competition between the skills $(\sigma < \sigma_1)$ or 'too much' competition between skills $(\sigma > \sigma_2)$.

[13] $V_{JU} = V_{NIC}$ at $\sigma = \sigma_2$ as illustrated in figure 2d. However, the equilibrium solution is unstable at $\sigma = \sigma_2$ in case of JU.

The intuitive explanation is that individual unions do not take the negative employment effect on other unions into account. They will therefore be more 'militant' in their wage demands than an all-encompassing industrial cartel. This is reflected in the compromise wage rate which results from the bargaining process. The result resembles the one derived by Calmfors and Drifill (19xx): A fully decentralized and a fully centralized labor marked are likely to result in lower wages rates and higher employment than a labor market dominated by a few independent unions. However, as this analysis stresses: This does not mean that a such an organization of the labor market is irrational from the point of labor; the increased 'militancy' may make up for an insufficient bargaining power.

3 The optimal choice of organization

3.1 Review of results

Of the eight organizational regimes analyzed above, four can be ruled out as inferior from the point of view of labor. $LUPD$ was found not feasible, as $\sigma_{opt,LU} < 0$ for relevant values of m and n. By comparing (76) with (53) and (30) we can readily establish[14] that $V_{NIC} > V_{LUID} \geq V_{LU}$ and $V_{NIC} > V_{LIC}$. This reduces the field of candidates to four, JU, $JUPD^* \equiv JU(\min(\sigma_{opt.JU}, \sigma_{lb}))$, $JUID$, and NIC, all of which may be preferred depending on the constellation of the parameters m, γ, ε, σ, and ϕ.

This leaves us with the following possibilities:

(a) $\sigma_{opt,JU} < 0$. - V_{JU} is a monotonically declining function of σ intersecting V_{NIC} from above at $\sigma = \sigma_2 = \frac{1+\phi}{\gamma}$. Perfect demarcations are not feasible. If imperfect demarcations are feasible, the best choice is $JUID$ regardless of the value of σ. If imperfect demarcations are *not* feasible, the best choice is JU if $0 < \sigma < \sigma_{lb}$, and NIC if $\sigma_{lb} < \sigma < \sigma_{\max}$.

(b) $\sigma_1 < 0 < \sigma_{opt,JU}$. - V_{JU} is an increasing function of σ in the range $0 < \sigma < \sigma_{opt}$ and a declining function in the range $\sigma_{opt} < \sigma < \sigma_{\max}$. $JUID$ is irrelevant for all values of σ. If $\sigma < \min(\sigma_{opt}, \sigma_{lb})$, then the best choice is JU. If $\sigma > \min(\sigma_{opt}, \sigma_{lb})$ and perfect demarcations are feasible, then $JUPD^*$ is preferable for any value of $\sigma > \min(\sigma_{opt}, \sigma_{lb})$. If perfect demarcations are *not* feasible, the best choice is JU if $\sigma < \sigma_{lb}$, and NIC if $\sigma > \sigma_{lb}$.

[14] To see that $V_{NIC} > V_{LUID}$ substitute $a(\sigma = 0) \cdot \theta$, $\theta > 1$, for n and derive the limit of $F(\theta) = \frac{V_{NIC}}{V_{LUID}} = \frac{(1+b\cdot\theta)^{1+\gamma}}{\theta^{\gamma}\cdot(1+b)^{1+\gamma}}$ for $\theta \Rightarrow \infty$. $Lim(F(\theta)) > 1$ as $b > \gamma$ for $\varepsilon < 1$.