A note on the impact of procedures in strike models. The case of bargaining structure

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1 The Importance of Procedures

Strikes have increasingly been interpreted as rational means of eliciting information from a better informed party. Unfortunately, in models of strikes based on private information, specific propositions often depend on somewhat arbitrary assumptions. Well known examples for screening models include: (1) the negative relation between wage demands and strike duration with private information of the firm and a positive association if the union is better informed, (2) the importance of exogenous delay times and, (3) the feature that no strikes will occur if the better informed party proposes a wage(1). The specific procedural bases required for meaningful interpretations of strike models have led to a multiplicity of predictions, many of which are only applicable to a particular model.

> "[...] each hypothesis is actually a joint hypothesis about the assumed economic and information structure, the procedure, a strong form of rationality, and the equilibrium refinement."(2)

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(1) See Cramton and Tracy [1994a] and McConnell [1989] for the relation between wages and strike duration. A positively sloped resistance curve —the firm having private information— can also exist in signalling models with time-dependent strike costs (Cramton and Tracy [1994b], Cramton *et al.* [1995]) or in screening models with a strike insurance (Goerke [1996], pp.170f). For the relevance of delay times owing to the Coase conjecture, see Hart [1989] and Kennan and Wilson [1989, 1993]. Bagnoli *et al.* [1989] and von der Fehr and Kühn [1995] discuss limitations. Kennan [1986] and Kennan and Wilson [1989] analyse wage offers by a better informed firm.

(2) Kennan and Wilson [1993], p.54.

In this note, it is shown that this multitude of joint hypotheses can be reduced when investigating alterations of the bargaining structure. Hence, procedures might be less important than Kennan and Wilson suggest.

More specifically, it is demonstrated that results derived by Cheung and Davidson [1991] concerning the impact of joint or industry-wide bargaining in a screening model will also hold if the informational distribution is altered. Cheung and Davidson assume that a union has private information about its reservation utility and negotiates with two firms making wage offers. They show that a coalition of unions implies more strike activity than enterprise negotiations. This effect of joint bargaining can also be found in a model in which firms have private information and the union presents wage demands. In Section 2, a simple two-period bargaining model of strikes is outlined[3]. Measures of strike activity are calculated for enterprise bargaining and for joint negotiations between two firms and the union. In Section 3, results are discussed.

2 A Simple Bargaining Model of Strikes

2.1 Overview

In the model outlined below, strikes serve as a mechanism to elicit information. The starting point for the analysis is the assumption that the companies possess private information about a variable relevant for the bargaining outcome which they cannot convey credibly to the union. Hence, a policy of "book-opening" to prevent disputes is not feasible (see Wang [1995]). Suppose, the variable unknown to the union is the size of the rent available for distribution between employers and employees in the form of either wages or profits. If the company does not yield to a wage demand by the union but prefers a strike, this will imply that the payoff resulting from a strike is higher than that ensuing from an acceptance of a demand. This, in turn, allows the union to infer a critical level of the rent that cannot be exceeded. By allowing a strike to occur the firm therefore credibly conveys (a limited amount of) information to the union.

Assume a two-period wage-negotiation game in which two equal-sized companies A and B bargain with a union about wages. Before negotiations start, each company learns the precise value of its fixed

[3] Similar approaches to the explanation of strikes can, for example, be found in Hayes [1984], Tracy [1987], Booth and Cressy [1990], Hart [1989], Card [1990], Manning [1993] and Goerke [1998]. See Kennan [1986] for a survey of strike models.

rent per employee. The union, representing the entire workforce of fixed size, however, only knows that the rent r is distributed uniformly on an interval $[0, 1]$. The realisation of r in firm A is independent of that in B. Hence, the union cannot infer the value of the rent in one company from an agreement with the other. Side-payments between companies are not feasible. In the case of enterprise negotiations, the union presents each company with a wage demand at the beginning of period one which the company can either accept or reject. If a company accepts the wage, the contract will be valid until the end of period two. If the first demand d_1 is rejected, the union will call a strike in the respective company[4]. At the beginning of period two, a demand d_2 will be presented. If the company concedes, the wage d_2 will be paid in period two. If the company rejects d_2, the strike will continue. The game ends after two periods.

A dispute is costly since no production takes place during a strike such that the rent is zero. Furthermore, in the case of a strike, the firm incurs no expenditure and employees do not have an income from other sources. Both parties are characterised by a common discount factor δ, $0 < \delta \leqslant 1$. The union is assumed to maximise expected income E of an employee,

$$E = \alpha (1 + \delta) d_1 + (1 - \alpha) \delta \beta d_2 , \tag{1}$$

where (d_1) and (d_2) characterise the probabilities that the respective wage demands are accepted. This definition of E implies that the union can commit itself and does not try to renegotiate. The model will be solved recursively, yielding a Perfect Bayesian Equilibrium.

Assuming that d_1 has been rejected, the union only knows at the beginning of period two that the firm is characterised by a rent which does not exceed a critical level r^*. This cut-off level of the rent r^* makes the firm just indifferent between accepting and rejecting d_1, given wage demands, and is defined by:

$$(1 + \delta) (r^* - d_1) = (r^* - d_2) \delta . \tag{2}$$

If the rent of the firm exceeds the cut-off level r^*, it will accept a demand d_1. If the rent is less than r^* but greater than the second demand, d_1 will be rejected and the firm will wait a period to accept d_2. If the rent is less than d_2, no wage contract will be agreed upon.

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[4] Holdouts, *i.e.*, the continuation of production —albeit with reduced productivity— under the terms of the old contract although no agreement has been reached by the beginning of period one, have been analysed, *inter alia*, by Cramton and Tracy [1992, 1994a] and Holden [1997].

2.2 Enterprise Bargaining

If the union bargains with each company individually, this procedure can formally be treated as if it negotiates with just one firm because the rents in company A and B are independent of each other. Optimal wage demands are given by (see appendix A):

$$d_1^* = \frac{(2+\delta)^2}{2(1+\delta)(4+\delta)} \tag{3}$$

$$d_2^* = \frac{2+\delta}{2(4+\delta)}. \tag{4}$$

Expected strike incidence SI per company is defined by the rejection probability for the first wage demand:

$$SI = 1-\alpha(d_1^*) = \frac{2(1+\delta)d_1^*}{2+\delta} = \frac{2+\delta}{4+\delta}. \tag{5}$$

A strike continues with probability $\beta = 0.5$ for another period as the second demand $d_2{}^*$ will exactly be half the cut-off level of the rent r^*. The expected duration of a strike is given by $ST = 1.5$ periods. The expected number of working days lost due to strikes in the two companies WL is defined by the product of strike incidence, the number of firms, the fixed number of employees and expected strike duration.

2.3 Joint Bargaining

Assume the two firms can credibly convince the union that they will only accept a demand both firms can agree to. This type of negotiations, in which a contract requires both companies to be able to pay the wage agreed upon, can be understood as joining an employers' association which bargains on behalf of the firms. Despite representing employees in both firms, Cheung and Davidson [1991] allow for the possibility that the union strikes different deals with each firm. In contrast, it is supposed in this model that joint bargaining implies a common wage rate. As before, no side-payments are feasible. These two assumptions are crucial for the subsequent results. They mirror the nature of collective negotiations in many European countries, insofar as agreements between unions and employers' associations are binding for all their members and since —with the exception perhaps of a strike insurance— companies do not share wages or other costs. Moreover, the consent of national and industry level employers' associations for firm-specific strike and lock-out decisions is required in many European countries (cf. Wallerstein *et al.* [1997]). To focus on the impact of a change in the bargaining procedure, firms are therefore required to communicate

the true value of the rent to each other or their representatives before negotiations start. They cannot convey this information to the union, however. Hence, the notion of private information on the employers' side is retained but the possibility of strategic behaviour amongst them is disregarded.

All variables in the case of joint, coalition or industry-wide bargaining will be indexed with a subscript c. If both companies agree to the first wage demand d_{1c} at the beginning of period one, negotiations will terminate and d_{1c} will be paid until the end of the wage game in both companies. If either company prefers to reject the demand, the employers' association will do so and there will be a strike in period one. At the beginning of period two, the union will present a demand d_{2c} which can again either be accepted or rejected, jointly by both companies. The former implies a contract, the latter a continuation of the strike. The optimal wage demands are given by (see appendix B):

$$d_{1c}^{*} = \frac{3+\delta}{9(1+\delta)}(2 - z(\delta)) \tag{6}$$

and

$$d_{2c}^{*} = \frac{2 - z(\delta)}{9}, \tag{7}$$

where

$$z(\delta) = \sqrt{\frac{27 - 7\delta}{27 + 5\delta}}.$$

The second wage demand will be accepted with probability $\beta_c = 4/9 < \beta$. Comparing the wage demands in the case of enterprise and joint bargaining establishes Proposition 1:

Proposition 1 *Wage demands will fall if there is joint bargaining, since* $d_1^{*} > d_{1c}^{*}$ *and* $d_2^{*} > d_{2c}^{*}$.

Proof Subtract, for example, d_{1c}^{*} from d_1^{*}. Assuming $z(\delta)$ to be minimal, $(d_1^{*} - d_{1c}^{*})$ is positive for all δ, $0 \leqslant \delta \leqslant 1$. Using the same procedure, it can be shown that $d_2^{*} > d_{2c}^{*}$.

Expected strike incidence is given by:

$$\begin{aligned} SI_c &= 1 - \alpha_c(d_{1c}^{*}) \\ &= 1 - \left(1 - \frac{3(1+\delta)d_{1c}^{*}}{(3+\delta)}\right)^2 \\ &= \frac{1}{9}(2 - z(\delta))(4 + z(\delta)). \end{aligned} \tag{8}$$

A strike having started in period one will continue with probability $5/9$, such that the expected duration of a dispute amounts to $ST_c = 14/9$. Lastly, the amount of working days lost WL_c can be calculated as twice the product of SI_c and ST_c and the number of employees. Contrasting expected strike measures gives rise to Proposition 2.

Proposition 2 *Joint negotiations increase the strike probability per bargaining pair, strike duration and working days lost due to strikes in comparison to enterprise bargaining.*

Outline of Proof Strike duration in the case of enterprise bargaining is given by $ST = 27/18$ while joint negotiations imply $ST_c = 28/18$. The comparison of SI and SI_c (as well as WL and WL_c) proceeds as follows[5]: First, show that the strike measures increase in δ. As $SI_c(WL_c) > SI(WL)$ for $\delta = 0$ and for $\delta = 1$, assume a maximum slope for $SI_c(WL_c)$ and a minimum slope for $SI(WL)$. It can then be seen that $SI(WL)$ will never be larger than $SI_c(WL_c)$ for $0 < \delta \leqslant 1$.

The intuition for the results summarised in Propositions 1 and 2 is as follows: Joint bargaining implies a credible change in the probability distribution of acceptable wage demands. When there is enterprise bargaining, α is decreasing linearly in d_1. But when the union faces two firms, both of which have to accept a given demand, α_c is convex d_{1c} (cf. equation (8)). As the acceptance probability has to be zero for $d_1 = 1$ (or $d_{1c} = 1$) and is unity for a wage demand of zero, this feature implies that α_c shrinks quicker for low values of wage demands than α. Therefore, the expected gain from a low wage demand relative to the gain from a higher demand rises relative to the case of enterprise negotiations and, thus, lower wage demands become more attractive to the union. Despite the reduction in the first demand, the probability of rejection increases ($SI_c > SI$), because the alteration in the acceptance probability for a given demand is not fully compensated for by the decline in wage demands from d_1^* to d_{1c}^*. The change in the probability distribution of acceptable wage demands also implies a lower second wage demand ($d_{2c}^* < d_2^*$). Again, the reduction in the demand is not sufficient to keep the rejection probability constant; it increases ($\beta_c < \beta$). Expected strike duration rises ($ST_c > ST$) because its magnitude is determined by the (conditional) strike probability in period two. Since a strike will always affect both companies when they bargain jointly, the expected number of working days lost in the bargaining relationship will be higher than for two separate bargains.

[5] A detailed derivation is available from the author upon request.

It can also be shown that expected profits —the product of acceptance probability and the difference between rent and wage payment— increase when the firms decide to bargain jointly with the union[6]. This result comes about because the lower expected wage costs more than compensate the firm for the higher expected loss of working time due to strikes. The model therefore provides an endogenous rationale for the formation of employers' associations.

3 Comparison of Results

The model of this paper and the one by Cheung and Davidson [1991] differ in two main respects: Firstly, Cheung and Davidson assume private information by employees, whereas in this paper the employer(s) are supposed to be better informed. This implies, in the context of a screening model, that wage offers are presented by the firm(s) in Cheung and Davidson, while the union makes demands here. Secondly, in this paper, joint bargaining is interpreted as a mechanism whereby the firms credibly commit themselves to only accept demands which guarantee positive profits for both companies but which ensures uniform wages across firms. In Cheung and Davidson, each firm can negotiate a different contract with the single union. The impact of joint bargaining on wage demands and measures of strike activity in both strike models is summarised in table 1.

Table 1

Changes in wage demands and measures of strike activity due to joint negotiations

	wage demands	incidence	duration	days lost
this model	–	+	+	+
Cheung/Davidson	–	+	0	+

All strike measures refer to expected values.

The above results have been derived assuming that the rents in the two firms are independent. If, instead, it is supposed that the rents in firms A and B are identical but not affected by a strike in the other firm, joint bargaining will also increase strike activity. The intuition for this outcome is as follows: With a perfect correlation of rents, joint bargaining does not alter the acceptance probabilities in comparison to negotiations with a single enterprise and no correlation. However,

[6] The proof is rather tedious and thus omitted. It can also be obtained upon request.

enterprise bargaining allows the union to derive information about the true level of the rent from the behaviour of firm A when presenting a demand to B. Hence, the private information of firm B shrinks. A reduction in asymmetric information diminishes expected strike activity and raises the expected utility of the union in a model with private information of the firm (cf. Card [1990], Goerke [1996], p. 66 or Tracy [1987]). Thus, enterprise bargaining implies lower strike activity. If the correlation of rents is less than perfect, this will be tantamount to less private information such that the strike enhancing impact of joint bargaining can be conjectured to hold in such a setting, as well. However, if a correlation of rents implies that firm B's rent rises in the case of a strike in company A, and vice versa, the above argument will not necessarily hold.

From the results summarised in table 1 it can be concluded that screening models of strikes imply more strike activity and lower wages when there is a move from enterprise bargaining to more centralised negotiations, irrespective of the distribution of private information. Whereas the slope of the wage - strike duration schedule, for example, depends on the assumptions with respect to the information distribution, the theoretical predictions concerning the effects of a change in the bargaining structure are not affected. Moreover, the strike enhancing impact of joint negotiations has also been diagnosed empirically (cf. Booth and Cressy [1990], Blanchflower and Cubbin [1986] or Dickerson and Stewart [1993]).

APPENDIX A

Optimal Wage Demands in the Case of Enterprise Bargaining

The objective function of the union and the indifference condition of the firm are given by equations (1) and (2). The optimal second period wage demand is independent of $\alpha(d_1)$ since its calculation is solely based on the assumption that d_1 was rejected. Let $E2$ be the expected (conditional) discounted payoff for the union in period two, given no agreement in the first.

$$E2 = \beta d_2 \delta . \tag{A1}$$

The union maximises $E2$ with respect to d_2, taking into account that this demand must not be negative. As the rent is distributed uniformly, $\beta(d_2)$ is

given by the following ratio:

$$\beta(d_2) = \frac{r^* - d_2}{r^*}. \tag{A2}$$

Plugging this value for β into (A1) and maximising $E2$, d_2 is found to be:

$$d_2 = \frac{r^*}{2}. \tag{A3}$$

Combining (A3) and equation (2) yields.

$$d_2 = \frac{(1+\delta)d_1}{2+\delta}. \tag{A4}$$

The acceptance probability (d_1) for the first demand is defined by $\alpha = 1 - r^*$, since the interval from which the rent can result is given by $[0, 1]$. Substituting for d_2, α, and β, E is found to be:

$$E = \left(\frac{(2+\delta) - 2(1+\delta)d_1}{2+\delta}\right)(1+\delta)d_1 + \frac{2(1+\delta)d_1}{2+\delta}\left[\frac{\delta(1+\delta)d_1}{2(2+\delta)}\right]. \tag{A5}$$

Maximising (A5) with respect to d_1 and also using (A3) and (A4), the optimal values d_1^* and d_2^* and the probabilities for a rejection of the respective demands can be determined, as defined by equations (3) to (5) in the main text and by $\beta = 0.5$.

APPENDIX B

Optimal Wage Demands in the Case of Joint Negotiations

Expected income $E2_c$ resulting from the second wage demand d_{2c} is given by:

$$\begin{aligned} E2_c &= \beta_c \delta d_{2c} \\ &= \left[1 - \frac{d_{2c}}{r_c^*}\right]^2 \delta d_{2c} \\ &= \left[d_{2c} - \frac{2(d_{2c})^2}{r_c^*} + \frac{(d_{2c})^3}{r_c^{*2}}\right]\delta. \end{aligned} \tag{B1}$$

The probability β_c is defined as the product of the individual firm's probability of acceptance, as is α_c, because both companies have to agree to a demand

and their rents are not correlated, while side payments are not feasible. The optimal second demand then amounts to:

$$d_{2c} = \frac{r_c^*}{3}. \tag{B2}$$

The cut-off level r_c^* is the same for both companies as they are confronted with identical wage demands. From (B2) and the firm's indifference condition (2), which has not changed in comparison to enterprise bargaining, one obtains the following expression:

$$d_{2c} = \frac{1+\delta}{3+\delta} d_{1c}. \tag{B3}$$

Combining (B1) and (B2), β_c is found to be:

$$\beta_c = \frac{4}{9}. \tag{B4}$$

The acceptance probability of the first demand, α_c is defined by:

$$\alpha_c = (1 - r_c^*)^2 = \left(1 - \frac{3(1+\delta)d_{1c}}{(3+\delta)}\right)^2. \tag{B5}$$

Substituting into the union's objective function the FOC for a maximum of E_c is given by:

$$\begin{aligned} \frac{dE_c}{d(d_{1c})} &= (1+\delta) - d_{1c}(1+\delta)^2 \\ &\quad \times \left[\frac{12}{(3+\delta)} - \frac{27(1+\delta)d_{1c}}{(3+\delta)^2} - \frac{16\delta}{3(3+\delta)^2} + \frac{12(1+\delta)\delta d_{1c}}{(3+\delta)^3}\right] \\ &= 0. \end{aligned} \tag{B6}$$

The SOC is found to be:

$$\frac{d^2E_c}{d(d_{1c})^2} = \left[2(27+5\delta)\left(\frac{(1+\delta)}{(3+\delta)}\right)\right]\left(\frac{3(1+\delta)d_{1c}}{(3+\delta)} - \frac{2}{3}\right). \tag{B7}$$

Manipulating the quadratic equation resulting from (B6) and taking into account the SOC, the value of d_{1c} maximising E_c is given by equation (6) in the main text. In conjunction with (B2) to (B5), d_{2c}^* and the strike measures can be derived.

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