FRIEDRICH-ALEXANDER-UNIVERSITÄT ERLANGEN-NÜRNBERG

Lehrstuhl für VWL, insbes. Arbeitsmarkt- und Regionalpolitik
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Diskussionspapiere
Discussion Papers

NO. 12

On Strike Insurance

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JUNE 2002

ISSN 1615-5831

Editor: Prof. Dr. Claus Schnabel, Friedrich-Alexander-Universität Erlangen-Nürnberg

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ABSTRACT: A strike insurance is integrated into a model based on one-sided private information of the firm. It is shown that the strike insurance will increase the dispute level if payments to the insurance are lump-sum or if payments from the insurance are proportional to wages. However, if wages affect contributions or if firms receive lump-sum transfers in the case of a dispute, strike activity will fall. Information on the extent of employer strike funds and union strike pay in 16 OECD countries is used to test whether their existence influences strike volume. Regression analyses for the period 1970 to 1996 and for three sub-periods show that while the existence of union strike pay schemes tends to reduce strike volume, countries with strike funds provided by employers' peak confederations are characterised by more strike activity.

ZUSAMMENFASSUNG: Ein Streikmodell mit privater Information eines Unternehmens wird um eine Streikversicherung ergänzt. Es wird gezeigt, dass eine Streikversicherung zu mehr Arbeitskämpfen führt, wenn die Beiträge an die Versicherung eine Pauschale darstellen oder die Leistungen von der Versicherung lohnbezogen sind. Sind jedoch die Beiträge lohnbezogen oder die Leistungen der Versicherung pauschal ausgestaltet, so wird die Streikaktivität geringer. Informationen über unternehmerische Streikversicherungen und gewerkschaftliches Streikgeld für 16 OECD Länder werden genutzt, um den Einfluss dieser Institutionen auf das Streikvolumen zu testen. Die Regressionsergebnisse für den Zeitraum 1970 bis 1996 und für drei Teilperioden zeigen, dass Länder mit unternehmerischen Streikversicherungen auf der obersten Verbandsebene durch mehr Streikaktivität gekennzeichnet sind, während die Existenz von gewerkschaftlichem Streikgeld das Streikvolumen reduziert.

KEYWORDS: Asymmetric information, employer strike insurance, OECD, strike pay

JEL-CLASSIFICATION: D 74, G 22, J 52

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1. Introduction

In many industrialised countries, employers' confederations or unions have set up strike insurance schemes. Since such institutions increase the payoff during a dispute, a strike becomes more attractive relative to its alternatives. However, if for example the union is aware of the impact of an employers' strike fund, it might alter its wage demands. This alteration of demands will, in turn, change the probability of a dispute. Moreover, contributions to the fund lower the firm's ability to pay higher wages. Similar effects are likely to occur for union strike pay. A priori, the impact of strike insurance schemes on dispute activity is, therefore, uncertain.

In this paper, we analyse the consequences of strike insurance funds on labour disputes. After a survey of the relevant literature in Section 2, a model of strikes is developed which is based on the assumption of private information of the firm about its revenues (Section 3). In particular, a standard two-period screening model is augmented by an employers' strike insurance, to derive theoretical predictions about the impact of this insurance on the probability and extent of disputes. If the bargaining relationship which the model depicts is representative for the economy, the results can be generalised and yield predictions for the determinants of strike volume on an aggregate level. However, as indicated above, employees can also receive payments from trade union strike insurance funds. Moreover, private information models of strikes can be theoretically convincing but there might be other real world factors influencing labour disputes than the existence of asymmetric information. In addition, private information models do not always fare well in comparative econometric analyses (Kramer/Hyclak 2002). Accordingly, the theoretical predictions should be taken with a pinch of salt. In Section 4, we, therefore, supplement our theoretical analysis and investigate empirically for 16 OECD countries whether the existence of a union or employer strike insurance has an impact on aggregate dispute activity. In the first investigation of this kind, we find that while the existence of union strike pay schemes tends to reduce strike volume, the effect of employer strike funds seems to depend on the level at which they are set up. In Section 5 we evaluate our findings and sketch perspectives for further research.

2. Survey of the Literature

Information on strike insurance funds by employers or trade unions is usually hard to obtain and although their impact is often discussed in public when disputes

occur, there are few thorough analyses. This scarcity of hard evidence is reflected by the lack of theoretical investigations. As an exception, Goerke (2000) sets up a private information model of strikes. In this model, contributions to and payments from an employer strike insurance are related to a variable which is private information of the firm. However, this assumption is clearly questionable and will, therefore, not be upheld in the present paper. The empirical literature on strike insurance funds is somewhat more extensive. However, it mostly focuses on American institutions. For example, Levine/Helly (1977) and Unterberger/Koziara (1975, 1980) argue that the Mutual Aid Pact of American airlines, which was effectively outlawed in 1978, caused a rise in strike activity (see, however, Northrup (1977) for the contrary assessment). Hirsch (1969) and Foster (1971) analyse further instances of employer strike insurance systems in the United States and also tentatively diagnose a positive relationship between the existence of strike insurance funds and strike activity.

The impact of union strike pay on dispute activity has not been the subject of intensive investigations either. As one exception, Farber (1978) includes a measure of the union's financial strength as a proxy for its ability to pay out benefits into an Ashenfelter/Johnson (1969) type of strike model. However, this proxy does not significantly explain the rate of wage concessions. Skeels/McGrath (1997) find that the union's liquid assets per member significantly reduce the strike probability. In a signalling model with private information of the firm, Cramton/Tracy (1994a) show that a union strike fund – interpreted as a source of additional income during a dispute – will raise strike activity. The prediction of a positive relationship between union strike pay and strike activity is also consistent with the total or joint cost theory of strikes (Kennan 1980a, Neumann/Reder 1980) according to which any rise in strike costs increases strike activity.

Statements about the impact of strike pay and strike insurance funds on strike activity are usually based on the additional payments in the case of a dispute. However, the additional income which strike funds or insurance systems are assumed to generate needs to be financed, as well. The above survey indicates that such contributions have not figured prominently in the literature.

In addition to research which focuses directly on employer and union strike insurance funds, there are a number of related strands of literature. For example, the impact of inventories on strikes has been investigated. In general, it is argued that the existence of inventories reduces strike costs for firms and, therefore,

contributes to a rise in strike activity (Clark 1997).[1] Moreover, other means of income replacement than strike funds have been looked at. Instead of strike pay, workers might receive unemployment benefits. Higher unemployment compensation during strikes or more lenient eligibility rules are argued to raise strike activity (Cramton/Tracy 1994a, Kennan 1980b). Empirical evidence for the United States indicates that more liberal eligibility rules for workers on strike can increase dispute activity (Kennan 1980b, Hutchens et al. 1992), a claim, however, which has not gone undisputed (Skeels/McGrath 1997). Finally, attention especially in the United States and Canada has focussed on strike replacements (see, for example, Cramton et al. 1999 or Budd 2000). However, Sing and Jain (2001) conclude in their survey that strike replacements generally do not seem to have robust effects on strike activity.

3. A Model of Strikes with an Employer's Strike Insurance

3.1 Framework

Let two parties, say a union and a firm, bargain over wage increases in a two-period framework. Both parties are risk-neutral, maximise expected income and discount payoffs occurring in period two with a common factor f, $0 < f \leq 1$.[2] The union represents all workers within the firm. Each worker receives a wage $\overline{w}$ during the period before bargaining starts. Before bargaining commences the firm alone learns about the earnings which are available for wage increases. The union only has a limited knowledge about the exact financial situation of the firm. This constitutes the private or asymmetric information assumption underlying the model.[3] Due to its restricted knowledge about the firm's revenues, a wage demand by the union might be too high and, thus, be rejected by the firm.

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[1] Kiander (1991) analyses the impact of union strike funds and firm inventories on bargaining outcomes. However, in his model strikes never occur. See also the comment by Ståhl (1994) and Kiander's reply (1994). Jones/McKenna (1988) analyse a bargaining model in which strike funds are included, but which does not allow for disputes either.

[2] Given risk-neutrality and the assumption of actuarial fairness, the potential impact of an insurance might be questioned. However, in the present setting an insurance can credibly transfer income from period 1 into period 2. Since such transfers over time alter wage demands, the usual irrelevance finding does not hold.

[3] For a survey of bargaining models of strikes, see Kennan (1986) and Kennan/Wilson (1993). Strike models based on the assumption of informational asymmetries include those by Booth/Cressy (1990), Card (1990), Goerke (1998), Hayes (1984) and Tracy (1987). The model presented here is similar in spirit, though not in its implementation, to that of Cheung/Davidson (1991).

All variables are defined per employee to facilitate the calculation of explicit solutions. At the beginning of period one, the union demands a wage increase w_1, which the firm can either reject or accept. If it accepts, ($\overline{w} + w_1$) will be the wage paid for the remainder of the game. If it rejects, the union will call a strike in period one and ask for a wage increase w_2 at the beginning of period two.[4] This demand can again either be accepted or declined, an acceptance being followed by the resumption of work and the payment of ($\overline{w} + w_2$) in the second period, after which bargaining ends. Should the firm reject not only the first but also the second demand w_2, employees leave the firm and receive the wage $\overline{w}$ elsewhere in the economy. The firm will not find new employees and close down. This behaviour is interpreted as a strike. If no production takes place, the firm will not obtain any revenues and neither incur wage payments.

The firm's sole variable costs are wages and strike insurance contributions. Its outlays for factors of production other than labour are normalised to zero. The firm's strike insurance requires contributions and can generate additional revenues in the case of a dispute. Empirically, there is no clear evidence for the basis of contributions to or payments by employer strike insurance systems (cf. Crémieux 1996, Foster 1971, Hirsch 1969, Koziara et al. 1989). Hence, we will allow for two potential sources of contributions and payments, respectively. Contributions can either be a fixed proportion z, $z \geq 0$, of the wage. Alternatively, contributions are modelled as a constant amount k per worker, $k \geq 0$. Analogously, insurance payments can either be a fixed amount K per worker, $K \geq 0$, or be a mark-up Z, $0 \leq Z < 1$, on wages subsequent to a strike. Contributions to the strike insurance are only incurred in periods without strikes. To rule out the possibility that a firm with a low realisation of the revenues which are available for wage increases raises its profitability by rejecting all wage demands, it will not receive strike insurance payments if the dispute lasts two periods.

Since there are no costs other than from the use of labour – apart from insurance contributions – the trade union's uncertainty about the firm's revenues translates into uncertainty about the rent which is available for wage increases. This 'pre-wage increase' rent per employee V, referred to as potential profits for simplicity, is distributed uniformly on the interval $[V_l, V_h]$. The lower boundary of the interval is given by $V_l = a - r > k + \overline{w}$, where a is the average value of potential profits in the

[4] The rejection of a wage demand might not be followed by a strike but by a holdout, that is, a continuation of work under the conditions of the old contract. To provide an incentive for the firm to agree to a wage increase, the productivity might fall during a holdout (see, for example, Cramton/Tracy (1992, 1994b), Cramton et al. (1999), Holden (1997), and van Ours/van de Wijngaert (1996)).

absence of an employer's strike insurance. A value of V_l in excess of the fixed contribution k and the going wage $\overline{w}$ ensures that the firm can always pay the contribution without incurring losses and the union never agrees to wage reductions. The upper boundary of the support of is given by $V_h = a + r$. Therefore, the parameter r, $r > 0$, is an indicator of the width of the interval from which potential profits stem and can be interpreted as a measure of uncertainty in screening models of strikes (Tracy 1987). Since the firm knows the realisation of V, which is invariant over time, the uncertainty of the trade union captures the idea that the firm is better informed than the union about its potential profits. In that spirit, the interval $[V_l, V_h]$ can be understood as describing the amount of uncertainty that the union still faces after having taken into account all information it can get a hand on.

Employees are assumed not to care about employment. This is equivalent to being sheltered against a job loss and could be the case if, for example, the firm operated a seniority rule in which the employee determining wage demands of the union in a voting process could do so without fear of losing his or her work (Oswald 1993). For simplicity, it is, thus, assumed that the number of employees in the firm is given exogenously and constant. The union maximises the expected income W of a risk-neutral employee over two periods. The wage demands w_1 and w_2 will be accepted with the respective probabilities $\alpha(w_1)$ and $\beta(w_2)$. Accordingly, the employees' expected income W is given by:

$$W = \alpha(1+f)(\overline{w} + w_1) + (1-\alpha)f\left[\beta(\overline{w} + w_2) + (1-\beta)\overline{w}\right] \qquad (1)$$

This definition of expected income W implies that the union can commit itself to wage demands and to a strike lasting for period one in response to a rejection of w_1, by, for example, a prior strike ballot which it cannot renege on. The model will be solved recursively. The rejection of the first period demand provides the union with information about the true state of potential profits enabling it to update its wage demands for period two. Given w_2, the optimal first period demand can be determined. The loss of profits arising from a labour dispute provides an incentive for the firm to accept wage demands it would not give in to otherwise. For simplicity, the wage $\overline{w}$ is normalised to zero and can be ignored in the subsequent analysis.

3.2 Optimal Wage Demands and Strike Activity

Let us denote by $\hat{V}$ the cut-off level of potential profits which makes the firm indifferent between accepting a wage w_1 on the one hand and, on the other hand, rejecting the first wage demand, incurring a strike and then accepting the second

demand w_2. If the firm accepts the first wage demand, it incurs a wage payment w_1, plus the wage-related strike insurance contribution. Moreover, its payoff is reduced by the fixed insurance contribution k. Profits which result from an acceptance of w_1 will be obtained for two periods, of which those which occur in the second are discounted. Alternatively, the firm might reject the demand w_1, giving rise to a strike in period one, which generates fixed insurance payments K (for simplicity discounted) and additional wage-related transfers to the firm. These wage-related transfers are a fraction Z of the wage w_2 agreed upon if the first demand is rejected while the second is accepted. Since it is assumed that a firm which does not incur a strike has to make insurance contributions k, the variable Z might alternatively be interpreted as the net (wage-related) payment from the insurance in period 2. Accordingly, $\hat{V}$ is defined by:

$$(1+f)\left(\hat{V} - w_1(1+z) - k\right) = f\left(\hat{V} - w_2(1-Z) - k + K\right) \qquad (2)$$

Should the firm be characterised by a true value of V of potential profits which is higher than the indifference level $\hat{V}$, it will accept w_1 because the resulting profits are larger than those arising due to a rejection. If the firm is characterised by a value of V less than $\hat{V}$ but larger than $w_2(1 - Z) - k + K$, the firm will reject w_1 and accept w_2. If the realised level of V is less than $w_2(1 - Z) - k + K$, the firm will also reject the second demand and close down since it would otherwise experience losses.

The optimal second period wage demand is independent of $\alpha(w_1)$, since its calculation is based on the rejection of w_1. The union's expected (conditional) payoff in period two is given by βw_2. A rejection of w_1 implies $V < \hat{V}$. Thus, the interval $[V_l, \hat{V}]$ represents the set of rational wage demands, given the information originating from the rejection of the first demand. Taking into account that the rent is distributed uniformly on this interval, and that an acceptance of the second demand implies wage payments and transfers from the insurance, $\beta(w_2)$ is given by the following ratio:

$$\beta(w_2) = \frac{\hat{V} - w_2(1-Z) - k + K}{\hat{V} - (a-r)} \qquad (3)$$

Using this value and maximising $\beta(w_2)w_2$ with respect to the second demand, yields $w_2 = (\hat{V} - k + K)/(2(1 - Z))$. In combination with equation (2), it is then possible to define w_2 as a function of w_1. For a given first demand, the second period wage demand rises with the transfers K and Z to the firm, since it becomes more likely that a firm accepts a given wage request. Moreover, the wage w_2 also

increases with wage-related contributions z since such payments make the rejection of a given first period demand more likely and enhance the likelihood that a firm with a high value of potential profits is confronted by a strike and, thus, by a demand w_2.

$$w_2 = \frac{(1+f)(w_1(1+z)+K)}{(2+f)(1-Z)} \tag{4}$$

Turning to the acceptance probability $\alpha(w_1)$ for the first period demand, it is known that a firm with potential profits V above $\hat{V}$ accepts w_1. The interval of theoretically acceptable wage demands is defined by $[V_l, V_h]$ and the acceptance probability is given by $\alpha = (V_h - \hat{V})/2r$.[5] Using $\overline{w} = 0$, substituting for w_2, α, and β, and noting that $(1 - \alpha)\beta = w_2(1 - Z)/(2r)$, the union's objective is found to be:

$$W = \left(\frac{(2+f)(a+r-k) - 2(1+z)(1+f)w_1 - Kf}{2r(2+f)} \right)(1+f)w_1 + \frac{(w_1(1+z)+K)^2}{((1-Z)(2+f))^2}\frac{1-Z}{2r}f \tag{5}$$

Maximising W with respect to w_1 and solving this expression for the first demand, the unconstrained optimal value w_1^* for the first demand can be obtained.

$$w_1^* = \frac{(a+r-k)(2+f)^2(1-Z) - Kf[(1-Z)(2+f) - 2(1+f)(1+z)]}{2(1+f)(1+z)[2(2+f)(1-Z) - f(1+z)]} \tag{6}$$

Since the rejection of the first demand is equivalent to the occurrence of a strike, $1 - \alpha$ depicts the probability of a dispute. For a positive first demand defined by (6), the respective rejection probability is given by:

$$1 - \alpha(w_1^*)) = 1 - \frac{(a+r-k)[(2+f)(1-Z) - f(1+z)] - Kf(2-Z+z)}{[2(2+f)(1-Z) - f(1+z)]2r} \tag{7}$$

The probability that the second demand is rejected, given a rejection of the first, equals $1 - \beta(w_2^*)$. Since in our empirical work below we will focus on strike volume as the dependent variable, it seems desirable to construct a comparable measure for the theoretical model. Strike volume Ψ is defined as the product of the number of strikes, their duration, and the number of employees involved. In our theoretical framework, the number of employees is fixed. The expected length of a strike is given by $1 + (1 - \beta)$, since – conditional on taking place – a strike will last for one period at least, and for another period with the probability that a dispute occurs in

[5] While the probability β is calculated for a given cut-off level of potential profits and expresses the likelihood that a wage demand w_2 is accepted, including all the insurance contributions or payments from the strike insurance, the probability α describes the likelihood that profits exceed the cut-off level of potential profits. Thus, the probability α is unaffected by the insurance parameters, for a given cut-off level.

period two, that is $1 - \beta(w_2^*)$. For a given number of firms, expected strike volume Ψ^e is, therefore, equivalent to the product of expected strike incidence $1 - \alpha$ and expected strike length $1 + (1 - \beta)$. Substitution in accordance with (4) and (7) yields:

$$\Psi^e = (1-\alpha)(1+(1-\beta)) = 2 - 2\alpha(w_1^*) - (1-\alpha(w_1^*))\beta(w_2^*)$$

$$= 2 - 2\frac{(a+r-k)[(2+f)(1-Z)-f(1+z)]-Kf(2-Z+z)}{[2(2+f)(1-Z)-f(1+z)]2r}$$

$$- \frac{(a+r-k)(2+f)(1-Z)+K(1-Z)(4+3f)]}{4r[2(2+f)(1-Z)-f(1+z)]}$$

$$= 2 - \frac{(a+r-k)[5(2+f)(1-Z)-4f(1+z)]-K[4f(1+z)-(1-Z)(4-f)]}{4r[2(2+f)(1-Z)-f(1+z)]} \qquad (8)$$

For the subsequent analysis of the impact of an employer's strike insurance fund on expected strike volume it is assumed that the strike probability $1 - \alpha$ and the probability of the rejection of the second demand $1 - \beta$ are positive.

3.3 Impact of an Employer's Strike Insurance

From inspection of equation (7) it is immediately obvious that the probability of a strike $1 - \alpha$ increases with lump-sum contribution k, while it varies with higher levels of wage-related contributions z or transfers Z and the fixed insurance premium K in a potentially ambiguous manner. Moreover, even if the impact of variations in the parameters of the strike insurance fund on the strike probability can be determined, the impact on the expected duration of a strike tends to be of the opposite direction. This finding may be summarised as:

Proposition 1
In a model of strikes with private information by the firm, predictable effects of an employer's strike insurance on expected strike volume require restrictions on the institutional set-up of the insurance system.

Accordingly, to analyse the consequences of the strike insurance on strike activity we focus, first, on a setting in which there are only payments to and from the insurance which are unrelated to wages ($z = Z = 0$, $k, K > 0$) and, second, on a set-up in which there are only wage-related payments ($k = K = 0$, $z, Z > 0$). As a special case of the latter model we look at wage-related contributions which have to be made for two periods, while the transfers in the case of a strike exceed the contributions, such that net transfers to the firm are positive. This implies

$Z = \gamma - z > 0$, $\gamma > 0$. An increase in contributions is then equivalent to a rise in z, while a higher level of insurance payments amounts to a rise in γ.

Expected strike volume in the absence of wage-related payments and transfers is:

$$\Psi^{e}_{|z=Z=0} = 2 - \frac{(a + r - k)(10 + f) + K(4 - 5f)}{4r(4 + f)} \qquad (9)$$

Inspection of equation (9) reveals that an increase in the lump-sum contribution k to the strike insurance fund raises expected strike volume while higher lump-sum payments will have the opposite effect if the discount factor f does not exceed a critical value of 0.8. Higher contributions k reduce the first wage demand (cf. equation (6)). However, this reduction is not sufficient to leave the expected strike probability constant. Equation (7) reveals that the probability of a strike increases. Moreover, the expected length of a strike goes up.[6] Thus, strikes become more likely and more extensive. This is the effect which was hypothesised to cause an increase in strike activity in the Introduction. The outcome occurs because the second wage demand is rejected with a higher probability. Accordingly, the reduction in the ability of the firm to pay for wages should there be an agreement – that is lump-sum contributions to the strike insurance – enhance strike activity.

An increase in the lump-sum transfer K has potentially ambiguous effects on expected strike volume. If there is hardly any discounting of the future (f close to unity), higher lump-sum contributions will raise strike activity, while a comparatively strong degree of discounting can induce the opposite impact. For $z = Z = 0$, the first period wage demand rises with K and the rejection probability for this demand also increases (cf. equations (6) and (7)). If the future is strongly discounted, the gain in the firm's payoff due to the lump-sum payment will only represent a small incentive to reject the first wage demand, in order to obtain a lower second demand. The increase in the rejection probability for the first demand might, therefore, be compensated by the higher acceptance probability for the second demand. In such a situation, expected strike volume declines with lump-sum transfers K. However, if the future is not discounted strongly, the firm will gain to a greater extent from the rejection of the first demand than in a situation with a lower discount factor. Since the behaviour in the second period is unaffected by the rate of time preference, for a given first wage demand, the greater probability of a strike dominates the duration effect of a strike, and

[6] From equation (8) it can be observed that $(1 - \alpha)\beta$ declines with k. Since the strike probability increases with k, the probability β of an agreement in period 2 must fall and the expected length of a strike $2 - \beta$ has to rise.

expected strike volume rises with lump-sum transfers K for f > 0.8. The results are summarised in:

Proposition 2
In the absence of wage-related payments, lump-sum contributions to an employer's strike insurance fund lower wage demands but also the respective acceptance probabilities, while expected strike volume increases in a model with private information by the firm. Lump-sum transfers in the case of a strike raise wages but may also increase acceptance probabilities such that these transfers will reduce expected strike volume if the future is discounted sufficiently strongly.

Focussing next on a situation in which only wage-related contributions and transfers exist (k = K = 0), expected strike volume Ψ^e is given by:

$$\Psi^e_{|k=K=0} = 2 - \frac{(a+r)[5(2+f)(1-Z) - 4f(1+z)]}{4r[2(2+f)(1-Z) - f(1+z)]} \qquad (10)$$

Differentiation of Ψ^e with respect to wage-related contributions or payments demonstrates that both types of payments raise expected strike volume.

$$\frac{\partial \Psi^e}{\partial z}_{|k=K=0} = \frac{3(a+r)(1-Z)(2+f)f}{4r\left(2(2+f)(1-Z) - f(1+z)\right)^2} = \frac{1-Z}{1+z}\frac{\partial \Psi^e}{\partial Z}_{|k=K=0} > 0 \qquad (11)$$

Wage-related contributions z to the strike fund raise the rejection probability for the first wage demand and, hence, increase the probability of a strike. Moreover, such contributions leave the acceptance probability for the second period wage unaffected for a given demand. Since the second demand increases, also the expected duration of a strike goes up. A higher probability of a strike and a greater duration imply a larger expected strike volume.

Wage-related transfers Z from the strike insurance fund which are only obtained in period 2 increase both wage demands and lower the respective acceptance probabilities. This is the case since a rejection of the first demand becomes more attractive to the union ceteris paribus, since it can only benefit from the firm's ability to pay higher wages in period two if the first demand is rejected. This unambiguous effect for the wage-related transfers from the insurance fund contrasts with the impact of lump-sum transfers for f < 0.8. This is the case because a wage-relation of transfers implies that any increase in wages also raises transfers. This kind of multiplier effect ensures the unambiguously positive effect of wage-related transfers on expected strike volume, irrespective of the rate of time preference. The results may be summarised in:

Proposition 3

In the absence of lump-sum payments, wage-related contributions to an employer's strike insurance fund which will only be incurred if no strike takes place raise the second wage demand and affect the first in an ambiguous manner, while they reduce the respective acceptance probabilities and increase expected strike volume in a model with private information by the firm. Wage-related transfers in the case of a strike raise wages, lower acceptance probabilities and increase expected strike volume.

Propositions 2 and 3 suggest that an employer's strike insurance will generally contribute to a rise in expected strike volume unless the discount factor is sufficiently low. However, it has been presumed that wage-related contributions z will only be levied in period one if a strike occurs. An equally reasonable hypothesis is that firms have to pay wage-related contributions in *every* period without a strike and that Z represents the *net* transfer in period two, given a strike in the first period. The variable Z can then be modelled as $Z = \gamma - z$, where $\gamma > z$ represents the gross transfer. Substitution in equation (10) and taking the derivative with respect to z yields:

$$\frac{\partial \Psi^e}{\partial z}\Big|_{\substack{k=K=0,\\ Z=\gamma-z}} = -\frac{(a+r)\gamma(2+f)(3+f)}{4r\big(2(2+f)(1-Z)-f(1+z)\big)^2} < 0 \qquad (12)$$

Proposition 4

In the absence of lump-sum payments, wage-related contributions to an employer's strike insurance fund which have to be made in every period without a strike lower wage demand and raise the respective acceptance probabilities such that expected strike volume declines in a model with private information by the firm.

If wage-related contributions to the strike insurance fund have to be made in every period without a strike, there is no incentive for the firm to postpone an agreement by incurring a strike. While lump-sum contributions k reduce wage demands and acceptance probabilities, wage-related contributions have the same qualitative but a stronger quantitative wage effect. This is the case because by lowering wages, the acceptance probability cannot only be raised directly but also indirectly via lower contributions to the strike fund. The union substitutes a greater probability of its demands being accepted for a higher payment in the case of an acceptance. Expected strike volume declines. This effect is akin to the impact of payroll taxes in according models of strikes which have also be shown to reduce the probability

of strikes (Goerke 1998). The above analysis has shown that payments by strike insurance funds indeed tend to raise strike activity, as conjectured in the Introduction. However, contributions may have the opposite impact. This is especially the case for wage-related contributions which occur in every period without a strike. The analysis of revenues and the expenditure of the employer strike insurance funds demonstrates that the way in which the insurance distributes payments or obtains its income can have a decisive influence on the impact of a strike insurance on expected strike incidence and volume.

3.4 Consequences for Empirical Work

Since the impact of an employers' strike insurance on strike activity will depend on the institutional details of the insurance, in an ideal set-up the implications of the model would be tested by using information on differential contribution and payment mechanisms of strike insurance schemes. However, employer strike insurance funds are extremely reluctant to reveal the sources of their revenues or the extent of their payments. Moreover, on the basis of aggregate data on OECD countries which we employ for the empirical analysis, a potential diversity of institutional features of insurance funds within countries cannot be utilised. We will, therefore, have to be content to test directly whether the existence of employer strike insurance funds has an impact on strike activity.

In the model outlined above, only the firm was insured against the consequences of a strike. However, strike pay for employees is a well-known feature in many industrialised economies. It is, therefore, desirable to include the impact of a union strike insurance into the analysis. This is all the more so the case since our data set contains the existence of information on union strike funds as well. Theoretically, reversing the informational assumptions and attributing private information to the union instead of the firm does not fundamentally alter the features of the model. Thus, it can be conjectured that – depending on how contributions and payments are determined – there is basically the same ambiguity with respect to the impact of union strike pay on strike activity. Since it cannot be ascertained, a priori, which side of the labour market possesses private information, or whether perhaps both sides have information which the other side does not possess but which is relevant for the bargaining outcome, it could be argued that the appropriate model for the analysis would be an approach based on two-sided private information. However, such models (cf., for example, Cramton (1984), or Kreps/Wilson (1982)) yield no precise predictions with respect to the occurrence of disputes which can be employed for the analysis of union and employer strike insurance. We, therefore, refrain from modelling their existence in

a two-sided private information setting, since already the simpler one-sided asymmetric information set-up shows that the theoretical predictions about the impact of strike insurance funds are ambiguous. Introducing additional uncertainties will tend to aggravate this problem.

4. Testing the Impact of Strike Insurance on Strike Activity

Since the impact of employers' or unions' strike insurance funds on strike activity is theoretically ambiguous, an empirical cross-section analysis may shed some light on this relationship. To the best of our knowledge, no according analysis has been carried out yet. While information on differential contribution and payment mechanisms of strike insurance is generally not available, there exist some data on the existence or non-existence of strike funds. According to the Golden/Lange/Wallerstein (1997) dataset, in three out of 16 OECD countries (Finland, Norway, Sweden) employers' peak confederations have their own conflict funds.[7] In six countries (Denmark, Finland, France, Germany, Sweden, Switzerland) employer affiliates have own conflict funds whereas in two of these countries employers' funds exist on both levels. On the union side, peak organisations have own strike funds in five countries (Austria, Belgium, the Netherlands, Norway, Sweden). Their affiliates even have such funds in ten countries (Canada, Denmark, Finland, Germany, the Netherlands, Norway, Sweden, Switzerland, UK, US).

In order to see whether and how the existence of strike funds affects strike activity, a simple regression analysis for the OECD countries is conducted. In principle, aggregate strike activity can be measured by the number of labour disputes, the number of workers involved or by the number of working-days lost (i.e. strike volume). Since the latter indicator is the most encompassing and since the number of labour disputes is not recorded in all countries (e.g. in Germany), the dependent variable in the following analysis is the average number of working-days lost due to strikes and lockouts per 1,000 employees. The strike data for the OECD countries in the period 1970 to 1996 are based on statistics by ILO and Eurostat as well as national sources and have been compiled and analysed by Schnabel (1998).

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[7] The Golden/Lange/Wallerstein (1997) dataset contains information on unions, employers, labour relations and collective bargaining in 16 OECD countries. An obvious coding error concerning strike funds of employers' peak organisations in Germany was corrected by using the information published in Wallerstein et al. (1997, Table 5).

The explanatory variables are four dummy variables for the existence of employers' and unions' strike funds in each country taken from the Golden/Lange/Wallerstein (1997) dataset: Two variables (named EMCONV4 and EMAFV1 in this dataset) indicate whether employers' peak confederations or their affiliates have own conflict funds. For the union side, two other variables (called CON14 and NAT11, respectively) show whether first confederations or their affiliates have own strike funds. In order to control for labour market conditions, whose impact on labour disputes is, however, a priori ambiguous,[8] another explanatory variable is included in the empirical analysis. This is the average standardised unemployment rate for the period under consideration (SUR for short), which is taken from the OECD Quarterly Labour Force Statistics. Since long-term data for this variable are not available for three of the 16 OECD countries, the sample shrinks to 13 countries.[9]

The results of estimating cross-section OLS regressions for different periods are presented in Table 1. It can be seen that the strike volume is significantly higher in countries with higher standardised unemployment rates. The existence of employers' conflict funds also affects strike activity, albeit in two different ways: While the existence of a conflict fund at the employers' peak association is associated with significantly higher strike activity, affiliates' conflict funds tend to reduce strike activity. The latter effect, however, is weaker, and not statistically significant in all periods. The magnitude of estimated coefficients indicate that if employers' conflict funds exist at both levels, the positive effect on strike activity dominates. In contrast, the existence of strike funds in union peak organisations significantly reduces strike activity. The estimated coefficients of union affiliates' strike funds are also negative but never statistically significant.

[8] On the one hand, higher unemployment might be argued to reduce strike activity because the employees' expected alternative income is lower, replacement workers are more easily available, and the unions will be reluctant to strike due to their lower bargaining power. On the other hand, higher unemployment might make employers less willing to compromise, reduce the rent available for distribution, and increase uncertainty, so that strike activity rises. This theoretical ambiguity is also reflected in empirical studies which distinguish between strike duration and strike incidence: While duration is often positively related to unemployment, incidence falls with unemployment (cf. Kennan/Wilson 1993), and hence the relationship between strike volume (which combines duration and incidence effects) and unemployment is uncertain.

[9] These 13 countries are Australia, Belgium, Canada, Germany, Finland, France, Italy, Japan, the Netherlands, Norway, Sweden, the United Kingdom and the United States.

Table 1: Strike insurance and strike activity in 13 OECD countries
OLS regressions; dependent variable is the period average of the number of working-days lost due to strikes and lockouts per 1,000 employees

explanatory variables	1970-96	1970-79	1980-89	1990-96
constant	-137.31 (-2.20)*	-112.99 (-0.77)	-95.66 (-1.17)	-57.05 (-2.16)*
standardised unemployment rate SUR	85.48 (4.36)***	194.56 (3.59)***	55.48 (3.54)***	20.49 (4.92)***
employers' funds:				
– EMCONV4	412.52 (3.49)***	502.33 (2.94)**	550.45 (4.19)***	106.30 (4.69)***
– EMAFV1	-214.54 (-2.12)*	-165.48 (-1.33)	-171.48 (-1.68)	-79.36 (-2.53)**
unions' funds:				
– CON14	-305.96 (-3.85)***	-392.96 (-3.43)***	-359.72 (-3.49)***	-54.88 (-2.74)**
– NAT11	-93.61 (-1.01)	-255.16 (-1.43)	-57.20 (-0.61)	-5.07 (-0.14)
$\bar{R}^2$	0.67	0.71	0.46	0.62

Notes: Heteroscedastic-consistent t-values in parentheses, */**/*** denotes statistical significance at 0.10/0.05/0.01 levels

In terms of the above theoretical model, the differential impact of conflict funds by employers' peak confederations and affiliate organisations may be explained as follows: the existence of wage-related contributions to an employer's strike insurance fund can lower strike activity. This will be the case if wage demands are adjusted to the alteration in the firm's ability to pay. The theoretical model explicitly assumes a firm- or industry-specific bargaining relationship and might, thus, be a good approximation of the behavioural impact of a strike fund at the level of an affiliate organisation. However, if strike funds are encompassing, the wage

adjustments may be limited due to the more pronounced heterogeneity of firms. Hence, the model can be argued to describe the consequences of encompassing employer strike funds less adequately than of funds at the firm or industry level. Alternatively, it can be speculated whether the different effects for strike funds at the peak and affiliate level reflect alternative possibilities of avoiding moral hazard and internalising external financing effects from using strike insurance.

With respect to unions, the negative effect of strike funds runs counter to a priori intuitive arguments but is consistent with findings by Skeels/McGrath (1997) for US unions. While it is not feasible to interpret our findings with respect to union strike pay in terms of the theoretical model, it should be noted that strike pay, in contrast, for example, to unemployment benefits, is financed from union membership dues. Any strike, accordingly, reduces union wealth. This may explain why the existence of union strike funds tends to lower strike activity.

Estimating this simple empirical model for the entire period 1970 to 1996 and for three sub-periods shows that is relatively stable over time, although its explanatory power is lower in the 1980s. The estimations should be interpreted very cautiously, however, due to the aggregate nature of the data as well as the limited sample size of only 13 observations and five explanatory variables.[10] They can be seen as a sort of exploratory data analysis and they seem to indicate that the existence of strike funds matters, but in order to obtain definite answers on the effects of strike funds on strike activity, better, more disaggregated data and further research are necessary.

5. Conclusions

The impact of employers' strike insurance schemes on labour disputes has not been the subject of intensive investigations, perhaps because it seems obvious that by increasing the payoff during a dispute such institutions raise dispute activity. In contrast to this intuitive reasoning, our theoretical analysis shows that the relationship between an employer's strike insurance fund and strike activity depends on the institutional details of such an insurance. The general insight that the influence of strike insurance on strike activity is ambiguous prompted an exploratory analysis of aggregate strike data in the OECD using information on the

[10] Due to better availability of data, the same model can be estimated for all 16 countries in the 1990s, and the estimation results for the extended sample confirm the insights obtained from Table 1.

existence of employer strike funds and union strike pay in 16 countries from a new dataset. Regression analyses for the period 1970 to 1996 and for three sub-periods confirmed that the relationship between strike funds and strike activity is quite complex. While the existence of union strike pay schemes tends to reduce strike volume, the effect of employers' strike funds depends on the level at which they are set up: funds provided by employers' peak confederations are associated with higher strike activity, whereas funds at employer affiliates tend to reduce strike activity.

Due to the aggregate nature of the data and the limited sample size of only 13 countries for which long-term data were available, the empirical results must be taken with a pinch of salt, and they should merely be seen as a starting point for further research. In order to obtain more definite answers on the effects of strike funds on strike activity, larger samples and more information on the financing and the payments of strike insurance schemes are necessary. Since international data of this sort are currently not available, a more promising approach might be to compare labour disputes of companies with and without strike insurance within one country. According to our knowledge, however, even the industrial relations surveys and the large sets of establishment data collected recently in many countries do not contain such data yet.

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