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SFB 649 Discussion Paper 2007-034

# A Note on the Effect of Outsourcing on Union Wages

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# A Note on the Effect of Outsourcing on Union Wages

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We analyze the effect of outsourcing on union wages in a simple two-stage game between a firm and a union. In contrast to public perception the ease with which the firm can outsource parts of their production does not necessarily reduce the wage set by the union. Even in the simple model framework a surprisingly large number of conflicting effects is established.

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*Keywords:* Collective Bargaining; International Outsourcing; Union Wages

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# 1 Introduction

One of the most important phenomena of the recent wave of economic integration is the rush of firms to outsource an expanding range of activities abroad. In the public debate, the growing importance of international outsourcing has sparked concerns about detrimental effects on workers in industrialized countries. Trade unions in western countries fear that outsourcing will lead to job losses but also to downward pressures on domestic wages. In particular, the question arises whether the possibility to outsource deteriorates the bargaining outcome for unionized workers.

In the academic realm, a number of theoretical contributions has shed light on the labor market effects of international outsourcing (see, for instance, Feenstra and Hanson 1996, Arndt 1997, Jones and Kierzkowski 2001). However, the issue of trade unionism is barely mentioned in these studies. The present paper aims at filling this gap by providing a theoretical analysis of the effect of outsourcing on wages subjected to collective bargaining agreements. We develop a simple two-stage game between a monopoly union and a firm. The union sets wages before the firm decides on the degree of outsourcing and the level of production.

The framework is closely related to the setup proposed recently by Lommerud et al. (2005). In our approach firms adapt their outsourcing decision to the bargained wage. On contrary, Lommerud et al. (2005) assume that the degree of outsourcing is already fixed before the wage bargaining takes place. This assumption is of crucial importance for the results. While they find, among other things, outsourcing to actually increase union wages, we find that the bargained wage is subjected to various effects pulling into different directions. The analysis therefore shows that the issue is more complex than the public debate often suggests.

## 2 Basic Model

We analyze a two-stage game between a firm and a monopoly union with the stages given as follows:

1. The union sets wages to maximize its utility function depending on the union wage premium ( $w - \bar{w}$ ) and on employment  $n$ .
2. The firm chooses the level of output  $y$  and the degree of outsourcing  $k$  simultaneously.

In Lommerud et al. (2005) the two stages are exactly reversed. We believe that it is more reasonable to assume that the degree of outsourcing adapts to changing market conditions, such as the wage level. The setting implies that firms have the 'right to manage', i.e. they can choose the level of employment unilaterally. The game is solved by backward induction starting at the second stage.

## 2.1 Stage 2: Production and Outsourcing Decision

Consider a firm facing a linear demand function given by

$$p = a - by. \quad (1)$$

In order to produce the final good, the firm requires a continuum of intermediary inputs defined on the interval  $k \in [0, 1]$ . The firm can either produce an intermediate good at some wage  $w$  or import it from a foreign supplier at cost  $c$ . The unit costs of importing an intermediate good are assumed to be smaller than those of in-house production, i.e.  $c < w$ . The assumption can be thought of as reflecting, for instance, lower foreign wages. Total unit costs  $\omega$  are therefore given as

$$\omega = kc + (1 - k)w. \quad (2)$$

In addition, the firm incurs some fixed costs whenever it outsources a particular task along the value chain. These costs may include expenditures necessary to find an appropriate foreign supplier, costs for supervising the contract with the foreign firm etc. The fixed costs of outsourcing vary with the type of input and are assumed to increase over the interval. For simplicity, we postulate quadratic fixed costs

$$G(k) = \frac{1}{2} \varepsilon k^2, \quad (3)$$

with  $\varepsilon$  denoting an exogenous cost shift parameter. The firm maximizes profits by choosing output  $y$  and the degree of outsourcing  $k$  simultaneously. Yet, the maximization problem reads

$$\max_{y,k} \{ \Pi = (p - \omega) y - G(k) \}. \quad (4)$$

First-order conditions are then given by

$$k(y, w) = \frac{(w - c) y}{\varepsilon}, \quad (5)$$

$$y(k, w) = \frac{a - \omega}{2b}. \quad (6)$$

Equation (5) shows that the marginal benefits from outsourcing are determined by the product of output and the difference between domestic wages and foreign costs. Hence, the firm will find it more profitable to outsource the production of intermediate inputs if (i) sizable cost differences between home and foreign production exist and (ii) the production level is large. Equation (6) establishes the usual first-order condition for the optimal output given marginal cost  $\omega$ .

Solving the first-order conditions simultaneously yields explicit solutions for  $k$  and  $y$  depending on the wage level  $w$ :

$$k(w) = \frac{(a-w)(w-c)}{2b\varepsilon - (w-c)^2}, \quad (7)$$

$$y(w) = \frac{(a-w)\varepsilon}{2b\varepsilon - (w-c)^2}, \quad (8)$$

where  $2b\varepsilon > (w-c)^2$  for stability. Note that higher fixed costs of outsourcing not only diminish the degree of outsourcing  $k$ , but also reduce the output level  $y$  because marginal costs are higher with lower levels of outsourcing (as  $w > c$ ). We will now analyze the effect of union wage setting on the decision variables of the firm.

Consider first the effect of higher domestic wages on the degree of outsourcing. Differentiating the first-order condition (5) with respect to  $k$  yields

$$\frac{\partial k(y, w)}{\partial w} = \frac{1}{\varepsilon} \left[ y + (w-c) \frac{\partial y}{\partial w} \right]. \quad (9)$$

Hence, increasing the domestic wage will induce more outsourcing by the direct effect on the wage differential  $(w-c)$ . However, there is a second, potentially negative effect, which works through the effect of domestic wages on the production level. A potential decline in output following higher domestic wages will reduce the marginal benefit of importing intermediate goods and therefore lower  $k$ . The total effect of higher union wages on outsourcing is then, perhaps surprisingly, ambiguous.<sup>1</sup> From now on, we will assume that the positive effect prevails and higher domestic wages induce outsourcing.<sup>2</sup>

We now turn our attention to the effect of union wages on output. Taking the first derivative of equation (6) with respect to  $w$  gives

$$\frac{\partial y}{\partial w} = -\frac{1}{2b} \left[ (1-k) - (w-c) \frac{\partial k}{\partial w} \right]. \quad (10)$$

If outsourcing is not feasible (i.e.  $k = 0$ ), equation (10) reduces to  $-\frac{1}{2b}$ . Higher wages increase marginal costs and therefore lower output. With positive levels of outsourcing marginal costs are partly exogenous and are thus not influenced by union wage setting. Hence, the negative (direct) effect of higher union wages on output is dampened by the factor  $1-k$ . In addition, there is an (indirect) effect of wages on output working through the impact of wages on the outsourcing decision. A higher degree of outsourcing reduces marginal costs and therefore increases output. The total effect is indeterminate.

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<sup>1</sup>  $\frac{\partial k(w)}{\partial w} = \frac{2(a-w)(w-c)^2 + (2b\varepsilon - (w-c)^2)(a+c-2w)}{(2b\varepsilon - (w-c)^2)^2} \leq \geq 0$

<sup>2</sup> A necessary and sufficient condition for this assumption to hold is that  $a \geq c + \frac{4b\varepsilon(w-c)}{2b\varepsilon - (w-c)^2}$ , i.e. market size must exceed some threshold level. The main findings of the paper are not affected by this assumption. However, the effects of some channels identified in proposition 1 will change if the negative effect dominates. Detailed results for this case can be obtained from the authors upon request.

## 2.2 Stage 1: Wage Determination

At the first stage the monopoly union sets the wage as to maximize a standard utility function

$$\max_w \{U = n(w - \bar{w})\}, \quad (11)$$

where  $\bar{w}$  denotes the outside option of domestic workers. The domestic employment level is given by total output multiplied by the share of production remaining in-house

$$n = (1 - k)y. \quad (12)$$

Plugging equation (12) into (11) and differentiating with respect to  $w$  gives the following first-order condition:

$$\begin{aligned} n &= -(w - \bar{w}) \frac{\partial n}{\partial w} \\ \Leftrightarrow (1 - k)y &= -(w - \bar{w}) \left( (1 - k) \frac{\partial y}{\partial w} - \frac{\partial k}{\partial w} y \right). \end{aligned} \quad (13)$$

The marginal benefit of an increase in wages is equal to the employment level while the marginal costs are given by the wage premium multiplied by the resulting loss in employment. In contrast to a model without outsourcing the union also takes into account the effect of wages on the share of production that is produced domestically. This effect is not present in the paper by Lommerud et al. (2005), since their study assumes that the outsourcing decision has already been made when wage bargaining takes place.

We establish the main result of this paper by analyzing the effect of exogenous shifts in the cost parameter  $\varepsilon$  on the union's first-order condition. The higher  $\varepsilon$  is the lower  $k$  will be for any given wage level. For very large values of  $\varepsilon$  outsourcing is no credible option for the firm. Hence, we study to which extent the ease (in terms of costs) of the firm to outsource parts of its production influences union wages. Taking the first derivative of equation (13) with respect to  $\varepsilon$  gives

$$\underbrace{(1 - k) \frac{\partial y}{\partial \varepsilon}}_{(1)} - \underbrace{\frac{\partial k}{\partial \varepsilon} y}_{(2)} = (w - \bar{w}) \left[ \underbrace{\frac{\partial k}{\partial \varepsilon} \frac{\partial y}{\partial w}}_{(3)} - \underbrace{(1 - k) \frac{\partial^2 y}{\partial w \partial \varepsilon}}_{(4)} + \underbrace{\frac{\partial^2 k}{\partial w \partial \varepsilon} y}_{(5)} + \underbrace{\frac{\partial k}{\partial w} \frac{\partial y}{\partial \varepsilon}}_{(6)} \right]. \quad (14)$$

**Proposition 1** *Increasing the costs of outsourcing has an ambiguous effect on the wage set by the union. We can distinguish the following channels through which wages are affected:*

1. *Higher costs of outsourcing increase marginal cost of production thereby decreasing the level of output. This decreases employment and the marginal benefits of an increase*

- in wages. Consequently, the union tends to set lower wages.*
2. *Higher values of  $\varepsilon$  decrease  $k$ . For a given output level, domestic employment and marginal benefits increase. The union responds by increasing wage demands.*
  3. *Outsourcing partly exogenizes marginal production costs. With  $\frac{\partial y}{\partial w} < 0$  ( $\frac{\partial y}{\partial w} > 0$ ) higher union wages cause smaller decreases (increases) in the demand for domestic labor for high levels of outsourcing.<sup>3</sup> Higher outsourcing costs dampen this effect by lowering  $k$  and therefore induce the union to set lower (higher) wages.*
  4. *The negative effect of higher wages on output (and thus employment) is exacerbated by higher costs of outsourcing as it becomes more difficult for firms to resort to foreign suppliers. Marginal costs of demanding high wages increase and the union sets a lower wage rate.*
  5. *Higher outsourcing costs impede firm's ability to outsource when facing high domestic wage rates. Hence, the employment loss of a marginal increase in  $w$  shrinks and the union increases its wage demand.*
  6. *Parts of the marginal costs for unions implied by higher wages are caused by the resulting increase in  $k$ . These marginal costs are lower for a low level of output that results from high outsourcing costs. Hence, the union tends to set higher wages in the presence of higher outsourcing costs.*

**Proof 1** *See Appendix.*

### 3 Conclusion

In the present paper we have analyzed the effect of outsourcing on wages of unionized workers in a simple two-stage game between a firm and a monopoly union. In contrast to public perception the ease with which the firm can outsource parts of their production does not necessarily reduce the wage set by the monopoly union. In fact, even in the simple model framework a surprisingly large number of effects pulling into different directions are established. Hence, careful empirical research is needed to establish the net effect of outsourcing on union wages.

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<sup>3</sup>This is the effect driving the results of Lommerud et al. (2005).



## Appendix

### Proof of Proposition 1

The directions of channel one, two, five and six follow directly from equation (14) and the results of section 2.1. It remains to be shown that  $\frac{\partial^2 y}{\partial w \partial \varepsilon} < 0$  and  $\frac{\partial^2 k}{\partial w \partial \varepsilon} < 0$ . Calculating the latter derivative explicitly gives

$$\frac{\partial^2 k}{\partial w \partial \varepsilon} = \frac{2b(a+c-2w)}{(2b\varepsilon - (w-c)^2)^2} - \frac{4b[2(a-w)(w-c)^2 + (2b\varepsilon - (w-c)^2)(a+c-2w)]}{(2b\varepsilon - (w-c)^2)^3}. \quad (15)$$

The second term on the right hand side of equation (15) is positive by the assumption  $\frac{\partial k}{\partial w} > 0$ . In order to show that the total effect is indeed negative, we distinguish between two cases: 1.  $a+c-2w < 0$  and 2.  $a+c-2w > 0$ . In the first case the negativity of the derivative follows immediately. For the second case we have to show that the first term is smaller than the second one. Therefore,

$$\begin{aligned} & 2b(a+c-2w)(2b\varepsilon - (w-c)^2) \leq 4b[2(a-w)(w-c)^2 + (a+c-2w)(2b\varepsilon - (w-c)^2)], \\ \Leftrightarrow & (a+c-2w)(2b\varepsilon - (w-c)^2) \leq 4(a-w)(w-c)^2 + 2(a+c-2w)(2b\varepsilon - (w-c)^2) \\ \Leftrightarrow & -(a+c-2w)(2b\varepsilon - (w-c)^2) \leq 4(a-w)(w-c)^2 \end{aligned}$$

This condition is satisfied by assumption. The negativity of  $\frac{\partial^2 y}{\partial w \partial \varepsilon}$  can then be easily established by differentiating equation (10) with respect to  $\varepsilon$  and using  $\frac{\partial^2 k}{\partial w \partial \varepsilon} < 0$ .  $\square$

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