Efficiency Wages, Union-Firm Bargaining, and Strikes[*]

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We consider efficiency wage effects in a union-firm bargaining model with private information. We show that efficiency wage effects do not necessarily increase the wage level at equilibrium. However, if it is commonly known that the union is stronger than the firm and the productivity enhancing effects of paying higher wages are sufficiently large, then efficiency wage effects still increase the wage at equilibrium. More surprisingly, we show that efficiency wage effects increase the strike activity.

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1 Introduction

Clearly, it is likely that when firms bargain with workers over wages they are also influenced by efficiency wage considerations (see e.g. Campbell, 1993). Models of union bargaining with efficiency wages have been used to inquire into several considerations. Layard et al. (1991) have shown in a general equilibrium framework that unionization aggravates the unemployment due to efficiency wages. Recently, Garino and Martin (2000) have confirmed an original insight of Summers (1988) that efficiency wage effects lead to higher wages and result in lower employment. But all the previous studies have considered a complete information framework so that strikes cannot occur in equilibrium.[1]

The aim of this note is to study the relationship among wages, strikes and efficiency wage effects in a union-firm bargaining model with private information. To describe the wage bargaining process, we adopt Rubinstein's (1982) alternating-offer bargaining model with two-sided incomplete information, which allows the occurrence of strikes at equilibrium. We show that efficiency wage effects do not necessarily increase the wage level at equilibrium. However, if it is commonly known that the union is stronger than the firm and the productivity enhancing effects of paying higher wages are sufficiently large, then efficiency wage effects still increase the equilibrium wage.

With respect to the strike activity, one might expect at first that efficiency wage effects would reduce the strike activity. Indeed, efficiency wages offset the cost of higher wages through higher productivity or lower turnover, and so, make profits less sensitive to the wage, which might induce more concessions and less conflicts in wage bargains. In the words of Summers (1998, p386): "... in any plausible bargaining environment ... [efficiency wage effects] ... make it easier to extract concessions". But, contrary to this conjecture, we find that efficiency wage effects increase the strike activity. The intuition behind this result is the following one. Efficiency wage considerations make the wage objective of the firm less obvious. Now, a wage rise not only increases the marginal cost of labor, but also increases the marginal product of labor. As a consequence, the firm has plenty of scope to hide her type, which is private information, in order to reach a more favorable agreement. Therefore, longer strikes may be needed for the union to screen the private information.

[1] Strikes data seem to have a significant impact on the wage-employment relationship for collective negotiations [see e.g. Kennan and Wilson (1989), Vannetelbosch (1996)].

2 The Union-Firm Bargaining Model

We consider a wage determination model with incomplete information between a firm and a union. The firm is risk neutral and profit-maximizer. Firm's technology is characterized by a production function $Q = (EL)^{\alpha}$ with $0 < \alpha < 1$, where L is the level of employment and E is the effort per worker. The firm faces a demand function $Q = P^{-\varepsilon}$ with constant elasticity of demand ε, where P is output price. Firm's profits are given by $\Pi = P \cdot (EL)^{\alpha} - WL$, where W is the wage level. There is a continuum of identical risk-neutral workers who supply each one unit of labor with no disutility. We denote by $\overline{W}$ the expected income of a worker who loses his job. It may be interpreted as the unemployment benefit or the wage elsewhere. Workers are represented in the wage bargaining process by a utilitarian union. The continuum of workers who supply labor is normalized to unity. Hence, the union's utility is given by $U = L \cdot W + (1 - L) \cdot \overline{W}$.

We adopt Summers (1988) and Layard et al. (1991) functional form of efficiency wage effects,

$$E = \left(\frac{W - \overline{W}}{\overline{W}} \right)^{\lambda}, \text{ with } \lambda < 1 \tag{1}$$

where E measures the effort put forth by workers which depends of the wage paid by the firm relative to the wage workers expect to earn elsewhere, and λ measures the productivity enhancing effects of paying higher wages. If $\lambda = 0$, efficiency wage considerations are absent. As λ increases, they become more important. Interactions between the output and price decision, and the wage level are analyzed according to the following structure. First, wages are determined by negotiations between the firm and the union. Second, the firm chooses employment, output and price. The model is solved backwards.

Taking as given the wage level, the output and the employment levels that maximize the profits of the firm are

$$Q^{*} = \left[\left(\frac{\varepsilon}{\varepsilon - 1} \right) \frac{W}{\alpha E} \right]^{\frac{-\varepsilon\alpha}{\alpha + \varepsilon(1-\alpha)}} \text{ and } L^{*} = \frac{1}{E} \left[\left(\frac{\varepsilon}{\varepsilon - 1} \right) \frac{W}{\alpha E} \right]^{\frac{-\varepsilon}{\alpha + \varepsilon(1-\alpha)}}, \tag{2}$$

respectively. The firm and the union negotiate the wage level foreseeing perfectly the effect of wages on output and employment levels. The negotiation proceeds as in Rubinstein's (1982) alternating-offer bargaining model. The firm and the union make alternatively wage offers, with the firm making offers in odd-numbered periods and the union making offers in even-numbered periods. The negotiation ends when one of the negotiators accepts an offer. No limit is placed on the time that may be expended in bargaining and perpetual disagreement is a possible outcome. The union is on strike in every period until an agreement is reached. Both negotiators are assumed to be impatient: the firm and the union have time preferences with constant discount rates $r_f > 0$ and $r_u > 0$, respectively.

As the interval between offers and counteroffers is short and shrinks to zero, the alternating-offer model has a unique limiting subgame perfect equilibrium, which approximates the Nash bargaining solution to the bargaining problem (see Binmore et al., 1986). Thus the predicted wage is given by

$$W^* = \arg\max [U - U_0]^{\gamma} \cdot [\Pi - \Pi_0]^{1-\gamma} \tag{3}$$

where $U_0 = \overline{W}$ and $\Pi_0 = 0$ are, respectively, the disagreement payoffs of the union and the firm, and $\gamma \in (0;1)$ is the union bargaining power which is equal to $\frac{r_f}{r_u + r_f}$. Simple computation gives us

$$W^* = \overline{W} \cdot \left[\frac{\alpha(\varepsilon - 1)(1-\gamma) + \varepsilon\gamma}{\alpha(\varepsilon - 1)(1-\lambda)}\right]. \tag{4}$$

This is the wage expression Garino and Martin (2000) obtained and it tells us that, in complete information, the wage is increasing with the union bargaining power (γ), the elasticity of demand (ε), and the efficiency wage effects (λ). Then, one can easily obtain the equilibrium employment level as well as the equilibrium payoffs, which are denoted by $U^*(\gamma)$ and $\Pi^*(\gamma)$. However, both the asymmetric Nash bargaining solution and the Rubinstein's model predict efficient outcomes of the bargaining process (in particular agreement is settled immediately). This is not the case once we introduce incomplete information into the wage bargaining, in which the first rounds of negotiation are used for information transmission between the two negotiators.

3 Private Information

The main feature of the negotiation is that both negotiators have private information. Each negotiator does not know the impatience (or discount rate) of the other party. It is common knowledge that the firm's discount rate is included in the set $[r_f^P; r_f^I]$, where $0 < r_f^P \leq r_f^I$, and that the union's discount rate is included in the set $[r_u^P; r_u^I]$, where $0 < r_u^P \leq r_u^I$. The superscripts "I" and "P" identify the most impatient and most patient types, respectively. The types are independently drawn from the set $[r_i^P; r_i^I]$ according to the probability distribution p_i, for $i = u,f$. We allow for general distributions over discount rates. This uncertainty implies bounds on the union bargaining power which are denoted by $\underline{\gamma} = r_f^P \cdot \left[r_u^I + r_f^P\right]$ and $\overline{\gamma} = r_f^I \cdot \left[r_u^P + r_f^I\right]$.

Lemma 1 Consider the wage bargaining with incomplete information in which the distributions p_f and p_u are common knowledge, and in which the period length shrinks to zero. For any perfect Bayesian equilibria (PBE), the payoff of the union belongs to $\left[U^*(\underline{\gamma}); U^*(\overline{\gamma})\right]$ and the payoff of the firm belongs to $\left[\Pi^*(\overline{\gamma}); \Pi^*(\underline{\gamma})\right]$.

This lemma follows from Watson's (1998) analysis of Rubinstein's alternating-offer bargaining model with two-sided incomplete information.[2] As Watson (1998) stated, Lemma 1 establishes that "each player will be no worse than he would be in equilibrium if it were common knowledge that he were his least patient type and the opponent were his most patient type. Furthermore, each player will be no better than he would be in equilibrium with the roles reversed".[3] From Lemma 1 we have that wage outcome, $W^*(\underline{\gamma}, \bar{\gamma})$, satisfies the following inequalities:

$$\bar{W} \cdot \left[\frac{\alpha(\varepsilon - 1)(1 - \underline{\gamma}) + \varepsilon\underline{\gamma}}{\alpha(\varepsilon - 1)(1 - \lambda)}\right] \le W^*(\underline{\gamma}, \bar{\gamma}) \le \bar{W} \cdot \left[\frac{\alpha(\varepsilon - 1)(1 - \bar{\gamma}) + \varepsilon\bar{\gamma}}{\alpha(\varepsilon - 1)(1 - \lambda)}\right]. \quad (5)$$

Notice that each wage satisfying these bounds can be the outcome by choosing appropriately the distribution over types. The lower (upper) bound is the wage outcome of the complete information game, when it is common knowledge that the union's type is r_u^l (r_u^p) and the firm's type is r_f^p (r_f^l) (and the union bargaining power is $\underline{\gamma}$ ($\bar{\gamma}$)). Expression (5) implies bounds on the firm's employment level, as well as on the firm's output, at equilibrium.

In complete information, the efficiency wage effects increase the equilibrium wage level. But once the union and the firm have private information, this complete information result does not necessarily hold. The necessary and sufficient condition to recover the complete information result is

$$\lambda \ge 1 - \frac{\alpha(\varepsilon - 1)(1 - \underline{\gamma}) + \varepsilon\underline{\gamma}}{\alpha(\varepsilon - 1)(1 - \bar{\gamma}) + \varepsilon\bar{\gamma}} \quad (6)$$

That is, the larger the amount of private information $\bar{\gamma} - \underline{\gamma}$ the larger λ should be in order to get for sure that efficiency wage effects increase the wage at equilibrium in case of union-firm bargaining with private information. However, if it is commonly known that the union is stronger than the firm (i.e. $\underline{\gamma} \ge \frac{1}{2}$) and the productivity enhancing effects of paying higher wages are sufficiently large (i.e. $\lambda \ge \frac{1}{2}$), then efficiency wage effects still increase the wage at equilibrium.

[2] Watson (1998) characterized the set of PBE payoffs which may arise in Rubinstein's alternating-offer bargaining game and constructed bounds (which are met) on the agreements that may be made. The bounds and the PBE payoffs set are determined by the range of incomplete information and are easy to compute because they correspond to the SPE payoffs of two bargaining games of complete information. These two games are defined by matching one player's most impatient type with the opponent's most patient type.

[3] Lemma 1 is not a direct corollary to Watson (1998) Theorem 1 because Watson's work focuses on linear preferences, but the analysis can be modified to handle the present case. Translating Watson (1998) Theorem 2 to our framework completes the characterization of the PBE payoffs. For any $\hat{U} \in [U^*(\underline{\gamma}); U^*(\bar{\gamma})]$, $\hat{\Pi} \in [\Pi^*(\bar{\gamma}); \Pi^*(\underline{\gamma})]$, there exists distributions p_u and p_f, and a PBE such that the PBE payoffs are $\hat{U}$ and $\hat{\Pi}$. In other words, whether or not all payoffs within the intervals given in Lemma 1 are possible depends on the distributions over types.

Lemma 1 and Expression (5) also tell us that inefficient outcomes are possible, even as the period length shrinks to zero. The wage bargaining game may involve delay (strikes or lockouts), but not perpetual disagreement, at equilibrium. Indeed, Watson (1998) has constructed a bound on delay in equilibrium which shows that an agreement is reached in finite time and that delay time equals zero as incomplete information vanishes.

In the literature on strikes (see e.g. Kennan and Wilson, 1989), three different measures of strike activity are usually proposed: the strike incidence, the strike duration, and the number of work days lost due to work stoppages. Since we allow for general distributions over types and we may encounter a multiplicity of PBE, we are unable to compute measures of strike activity as the ones just mentioned.[4] However, we propose to identify the strike activity with the maximal delay in reaching a wage agreement. Following Watson (1998) Theorem 3, the larger is the difference between the upper bound and lower bound on the bargaining outcome, the larger is the potential delay for obtaining an agreement. Therefore, the strike activity is given by the difference between the upper bound and the lower bound on the wage outcome.[5] So, the strike activity, $\Psi(\lambda)$, is given by the following expression.

$$\Psi(\lambda) = \left[\bar{\gamma} - \underline{\gamma}\right] \cdot \overline{W} \cdot \left[\frac{\alpha + (1-\alpha)\varepsilon}{\alpha(\varepsilon - 1)(1-\lambda)}\right], \tag{7}$$

where

$$\bar{\gamma} - \underline{\gamma} = \frac{\left[r_f^I r_u^I - r_f^P r_u^P\right]}{\left[r_f^P + r_u^I\right]\left[r_f^I + r_u^P\right]}$$

From expression (7) it is immediate that the strike activity is always increasing with the efficiency wage effects: $\frac{\partial \Psi}{\partial \lambda} > 0$. The intuition behind this result has to do with the time needed to screen or to learn each other's type. The incorporation of efficiency wage effects makes the wage objective of the firm less obvious. Indeed, the firm may still be interested in reaching low wages, but low wages reduce the effort produced by the workers (hence, their productivity). As a consequence, the firm has plenty of scope to hide her type, which is private information, in order to reach a more favorable wage outcome. Therefore, the union (who still claims higher wages) may need more time, during the negotiation, to screen the firm's type. Finally, notice that the strike activity is decreasing with the elasticity of substitution between the demand and the price: $\frac{\partial \Psi}{\partial \varepsilon} < 0$.

The next proposition summarizes our main results.

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[4] In order to compute an expected strike duration one would need to fix some parameters of the model such as the distribution over types but it would imply a substantial loss of generality.

[5] Our measure of strike activity gives the scope each player has for screening his opponent by making wage proposals satisfying the expression (5), and hence, for delaying the wage agreement. Only in average this measure is a good proxy of actual strike activity.

Proposition 1 In case of union-firm bargaining with private information, efficiency wage effects increase the strike activity but do not necessarily increase the wage outcome. However, if it is commonly known that the union is stronger than the firm ($\gamma \geq \frac{1}{2}$) and the productivity enhancing effects of paying higher wages are sufficiently large ($\lambda \geq \frac{1}{2}$), then efficiency wage effects still increase the wage at equilibrium.

References

[1] Binmore, K.G., A. Rubinstein, and A. Wolinsky, 1986, "The Nash Bargaining Solution in Economic Modelling," Rand Journal of Economics 17, 176-188.

[2] Campbell, C.M., 1993, "Do Firms Pay Efficiency Wages? Evidence with Data at the Firm Level," Journal of Labor Economics 11, 442-470.

[3] Garino, G. and C. Martin, 2000, "Efficiency Wages and Union-Firm Bargaining," Economics Letters 69, 181-185.

[4] Kennan, J. and R. Wilson, 1989, "Strategic Bargaining Models and Interpretation of Strike Data," Journal of Applied Econometrics 4, S87-S130.

[5] Layard, R., S. Nickell and R. Jackman, 1991, Unemployment: Macroeconomic Performance and the Labour Market, Oxford University Press (Oxford).

[6] Rubinstein, A., 1982, "Perfect Equilibrium in a Bargaining Model," Econometrica 50, 97-109.

[7] Summers, L.H., 1988, "Relative Wages, Efficiency Wages and Keynesian Unemployment," American Economic Review 78, 383-388.

[8] Vannetelbosch, V.J., 1996, "Testing Between Alternative Wage-Employment Bargaining Models Using Belgian Aggregate Data," Labour Economics 3, 43-64.

[9] Watson, J., 1998, "Alternating-Offer Bargaining with Two-Sided Incomplete Information," Review of Economic Studies 65, 573-594.