Cyclical Fluctuations in Strike Incidence and Duration*

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This paper explains procyclical strike incidence and countercyclical strike duration in an asymmetric information bargaining model by focusing on the distinction between the cyclical and noncyclical parts of bargaining cost. Strike duration is inversely related to the interest rate which is the marginal cost of a strike continuing for one more period relative to the size of the rent to be shared by the firm and the union. Therefore, countercyclical strike duration can be explained by the procyclical variations in the interest rate. If there exist noncyclical fixed costs of strikes independent of strike duration, then an increase in the rent reduces fixed cost of a strike relative to the size of the rent and hence increases strike incidence. Therefore, procyclical strike incidence can be explained by the existence of noncyclical fixed costs of strikes.

I. Introduction

After Pigou (1927) noticed a negative correlation between unemployment rates and strike activity, many studies have provided convincing evidence of procyclical fluctuations in strike incidence.[1] By comparision with the procyclical variations in strike incidence, some recently developed evidence, started by Horvath (1968), shows that strike duration is negatively related to the business cycle.

Though some early theories offered some insights into explaining the occurrence of strikes[2], a theoretically complete model of strikes has been recently developed with the use of asymmetric informa-

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[1]Kennan (1986) contains surveys of some of the empirical studies on strike incidence and the empirical studies on strike duration.

[2]See, e.g., Cross (1965, 1969), Ashenfelter and Johnson (1969), Kennan (1980) and Reder and Neumann (1980).

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tion.[3] Despite the bilateral monopoly situation, if both the firms and the unions are fully informed, then the bargaining should not lead to a strike. However, in the presence of asymmetric information, bargaining serves as a learning process and a strike takes place whenever the process continues beyond the expiration of the current contract. Standard asymmetric-information models of strikes predict that the probability of a strike's occurring and the probability of its continuing, conditional on its having begun, both vary in the same way with the business cycle.

The empirical findings seem therefore to pose a problem for these models. This issue is addressed by Kennan and Wilson (1989, 1990), who propose what they refer to as the Coase property as a resolution of the problem. Novel as this suggestion may be it hinges rather critically on the proposition that a union's ability to commit to infrequent high offers weakens when economic conditions improve. We need a theory of strikes that can provide stronger a priori grounds for the opposite cyclical properties of strike incidence and duration.

This paper explains the opposite cyclical properties of strike incidence and duration by focusing on the distinction between the cyclical and noncyclical parts of bargaining cost in an asymmetric information bargaining model. In the asymmetric information bargaining model of Sobel and Takahashi (1983), we find that expected strike duration is inversely related to the interest rate which is the marginal cost of a strike continuing for one more period relative to the size of the rent to be shared by the firm and the union.[4] Therefore, countercyclical strike duration can be (partly) explained by the procyclical variations in the interest rate.

To explain the opposite cyclical properties of strike incidence and duration, we need to identify some factors which affect the bargaining before the occurrence of a strike but do not affect the bargaining after its occurrence or vice versa. We propose that the fixed cost of a strike is one such factor. Recovery cost is incurred when the firm resumes operation after a strike. We assume that the recovery cost is independent of strike duration to focus on its role as a fixed cost. The recovery cost is less than proportionally increasing in the rent

[3]See, e.g., Sobel and Takahashi (1983), Hayes (1984), Tracy (1987) and Card (1990). Asymmetric information was first suggested by Hicks (1963) as a possible explanation for strikes.

[4]Kennan (1980) and Reder and Neumann (1980) proposed that strike activity is inversely related to the sum of the costs to both of the bargaining parties.

to be shared by the firm and the union, because it is related more closely to technical aspects of the firm than to demand-side factors in the market. We assume that the recovery cost is constant over the business cycle to focus on its noncyclical part. Therefore, the fixed cost of a strike relative to the rent to be shared is countercyclical. Then, strike incidence can be procyclical because, ceteris paribus, it is inversely related to the fixed cost of a strike relative to the rent to be shared.

The paper is organized as follows. Section II introduces the model and shows that strike shows that strike duration is countercyclical. In section III, we analyze cyclical properties of strike incidence. Finally, section IV concludes the paper.

II. Strike Duration under Asymmetric Information

To illustrate the implications outlined in the introduction, we analyze a simple bargaining model in which the firm and the union bargain over a wage contract with the level of employment fixed. The current contract expires at date zero. Bargaining for a new contract, which will be effective from the next period to date T, takes place from date zero.[5] The union offers a wage contract once each date either until the firm accepts an offer or by date $T-1$. At each date, the firm either accepts or rejects the contract offered at the date.

A strike takes place if the firm rejects the union's offer at date zero. After a strike occurs, the firm must pay the recovery cost F to resume its operation. Let r denote the interest rate and π denote the per period revenue of the firm net of non-labor cost and the opportunity cost of labor. Without loss of generality, we assume that the firm and the union bargain over the union's share of the rent, whose present value at date t discounted to date t is $\sum_{s=1}^{T} \delta^{s-1}\pi$ if $t=0$ and $\sum_{s=t+1}^{T} \delta^{s-t-1}\pi - F$ if $1 \leq t \leq T-1$, where $\delta \equiv 1/(1+r)$. To avoid complexity in calculation, let $T=\infty$. Then, the rent is $v \equiv \pi/r$ at date zero and $v-F$ after date zero.

The union is assumed to believe that v is uniformly distributed between L and H with

$$L \leq F < H/2. \tag{1}$$

[5]Bargaining before date zero does not affect the bargaining outcome because it does not incur any cost when the firm and the union fail to agree upon a new contract.

If $H/2 \leq F$ or $H/2 \leq L$, then there will be zero strike incidence in the equilibrium. The inequality, $L \leq F$, is assumed in order to avoid complexity in calculation by making the lower bound of the rent zero after a strike occurs.

Suppose that at date zero, the union makes an offer w_0 for its share of the rent and the firm accepts it if the rent v is greater than or equal to the cut-off value V, which depends on w_0, and reject it otherwise. In the next section, we will see that there exists the equilibrium offer w_0^* at date zero and the equilibrium cut-off value V^*. The equilibrium employed in this paper is Kreps and Wilson's (1982) sequential equilibrium. The beliefs in the equilibrium can be specified directly from the equilibrium strategies because there is no unreached information set in the equilibrium in our model.

If $V \leq F$, then the firm exits the market when $v < V$, because resuming operation is not profitable with any nonnegative offer of the union. When $V > F$, the firm exits if $v \in [L, F)$ and continues bargaining if $v \in [F, V)$. Let $z \equiv v - F$ and $Z \equiv V - F$. Then, z is the rent to be shared between the firm and the union after the occurrence of a strike and Z is the upper bound of the rent at date one.

When $F \leq v < V$, a strike takes place and the bargaining after date zero is a simple example of Sobel and Takahashi's (1983) infinite horizon bargaining with uniformly distributed rent between 0 and Z. Let w_t^* denote the equilibrium offer at date t and Z_t^* be the value of z such that the firm accepts the offer w_t^* at date t if and only if $z \geq Z_t^*$.[6] Finally, let

$$Y(Z) \equiv \sum_{t=1}^{\infty} \delta^{t-1} w_t^* (Z_{t-1}^* - Z_t^*)/Z, \tag{2}$$

where $Z_0^* = Z$. Then, $Y(Z)$ is the expected present value of the union's share of the rent, in the equilibrium, discounted to date one, conditional on the occurrence of a strike with the rent uniformly distributed between 0 and Z. Now, the Proposition follows.

Proposition (Sobel and Takahashi 1983)
For $t > 1$, $w_t^* = (1-b)b^{t-1}Z$, $Z_t^* = b^t Z$ and $Y(Z) = (1-b)Z/2$, where $b = (1 - \sqrt{1-\delta})/\delta$.

[6]Though w_t^* and Z_t^* are functions of Z, their dependence on Z is not expressed to simplify the exposition. In the proposition that follows, we will see that $Z_t^* \leq Z_{t-1}^*$ for all $t > 1$.

By the Proposition, the expected strike duration conditional on the occurrence of a strike is

$$\begin{aligned} D(\delta) &= \sum_{t=1}^{\infty} t(Z_{t-1}^* - Z_t^*)/Z \\ &= 1/(1-b). \end{aligned} \tag{3}$$

From (3), $D'(\delta) > 0$ because $db/d\delta > 0$. Therefore, procyclical interest rate variation is responsible for the countercyclical strike duration.

III. Cyclical Properties of Strike Incidence

In this section, we analyze cyclical properties of strike incidence. For this purpose, we derive the bargaining equilibrium at date zero. In the equilibrium at date zero, the union makes offer w_0^* which solves the problem

$$\begin{aligned} &\max_{L \le w \le H} w(H-V)/(H-L) + \delta Y(Z)Z/(H-L), \\ &\text{subject to } V - w = \delta \max\{0, V - F - w_1^*(Z)\} \\ &\qquad \text{and } Z = \max\{0, V - F\}. \end{aligned} \tag{4}$$

The objective function in the problem (4) is the expected present value of the union's share of the rent discounted to date zero when the union offers w at date zero, assuming that it and the firm behave optimally in the future. There is a cut-off value V (depending on w) such that the firm accepts the offer w at date zero if and only if the rent is greater than or equal to the cut-off value. The first constraint in the problem (4) says that when the rent is equal to the cut-off value, the firm is indifferent between accepting and rejecting the offer w at date zero.[7] The second constraint implies that if the cut-off value is less than the recovery cost, then the bargaining will not continue after date zero because the firm which rejected the offer w at date zero exists the market at the end of date zero.

Let V^* denote the equilibrium cut-off value. Using the constraints to eliminate w and Z in the objective function of (4), V^* is the value of V which solves

$$\max_{L \le V \le H} X(V), \tag{5}$$

[7]For the optimality of the firm's decision of accepting and rejecting the union's offer with a cut-off value on the rent, see Sobel and Takahashi (1983).

where

$$X(V) = \begin{cases} [(1-b)V + bF](H-V)/(H-L) \\ + \delta(1-b)(V-F)^2/2(H-L) & \text{if } V \geq F \\ V(H-V)/(H-L) & \text{otherwise.} \end{cases}$$

Then, by the assumption (1),

$$V^* = \begin{cases} H/2 & \text{if } H \leq 2[b + \delta(1-b)]F/\delta(1-b) \\ H/2 + \{\delta(1-b)H - 2[b + \delta(1-b)]F\}/(4 - 2\delta) & \\ \quad \text{otherwise.} \end{cases} \tag{6}$$

Now, we can calculate the exit rate and the strike incidence. The exit rate is

$$ER = (F-L)/(H-L), \tag{7}$$

and the strike incidence is

$$SI = \max\{0, V^* - F\}/(H-L)$$
$$= \begin{cases} (H/2 - F)/(H-L) \\ \quad \text{if } H \leq 2[b + \delta(1-b)F]/\delta(1-b) \\ [(2 - b\delta)H/(4 - 2\delta) - F]/(H-L) \text{ otherwise.} \end{cases} \tag{8}$$

From (7), we have

$$\partial ER/\partial L < 0 \text{ and } \partial ER/\partial H < 0. \tag{9}$$

We also have, from (8),

$$\partial SI/\partial L > 0 \text{ and } \partial SI/\partial H > 0. \tag{10}$$

It is natural to assume that the lower and the upper bounds of π are procyclical. We further assume that L and H, which are the lower and upper bounds of $v \equiv \pi/r$, are procyclical. Then, by (9), we can conclude that exit rate is countercyclical. We derive mixed cyclical properties of strike incidence from (10). Strike incidence is positively related to the upper and lower bounds of the rent. An increase in the interest rate may reduce strike incidence. But strike incidence is procyclical if the effect of procyclical changes in the distribution of the rent dominates the effect of procyclical variations in the interest rate. In sum, procyclical strike incidence can be explained by the existence of noncyclical fixed costs of strikes.

To analyze whether the procyclical effect of the change in the distribution of the rent on strike incidence is due to the countercy-

clical exit rate, we derive cyclical properties of $(ER + SI)$. From (7) and (8),

$$\partial(ER + SI)/\partial L < 0 \text{ and } \partial(ER + SI)/\partial H > 0. \quad (11)$$

The inequalities in (9), (10) and (11) show that an increase in the lower bound of the rent increases both the strike incidence and the rate of successful bargaining without a strike by reducing the exit rate. An increase in the upper bound of the rent increases strike incidence by reducing the rate of successful bargaining and the exit rate.

IV. Conclusions

This paper explains procyclical strike incidence and countercyclical strike duration by focusing on the distinction between the cyclical and noncyclical parts of bargaining cost in an asymmetric information bargaining model. The expected strike duration conditional on the occurrence of a strike is inversely related to the interest rate, which is the marginal cost of a strike continuing for one more period relative to the size of the rent to be shared by the firm and the union. Therefore, countercyclical strike duration is due to the procyclical interest rate.

If there exist noncyclical fixed costs of strikes independent of strike duration, for example the recovery cost of resuming operation after a strike, then an increase in the distribution of the rent reduces the fixed cost of a strike relative to the rent and hence increases strike incidence. An increase in the interest rate may reduce strike incidence. But strike incidence is procyclical if the effect of procyclical changes in the distribution of the rent dominates the effect of procyclical variations in the interest rate. In sum, procyclical strike incidence can be explained by the existence of noncyclical fixed costs of strikes. An increase in the upper bound of the rent increases strike incidence by reducing the exit rate and the rate of successful bargaining without a strike. However, an increase in the lower bound of the rent increases both the strike incidence and the rate of successful bargaining by reducing the exit rate.

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