Optimal Settlement Duration Under Holdout Threat

Süheyla Özyıldırım
Faculty of Business Administration, Bilkent University
06800 Bilkent, Ankara, Turkey. E-mail:suheyla@bilkent.edu.tr.

Abstract

In this paper, we introduce a model to examine the strategic actions of the union and the firm in the determination of the optimal settlement time for the new contracted wage. The holdout model is constructed as a dynamic game with optimal stopping time. Since the players cannot fully measure the bargaining power of their opponent, the system would have a stochastic nature. In the paper, the union that makes the wage offers, might create inefficiency such as slow-down of the production as a threat during holdout and tries to stop the game early with higher new wage contract. However the existence of accumulated inventory before the negotiation and close rivalry in the product market would also play crucial roles in the determination of the agreement time. Especially, we consider the impact of possible loss of customers or market share during the dispute period and the perception of this evolution by the union on the wage concession profile over time. In the numeric study, we analyze the effects of various strategic actions of the union and the firm on the settlement date and their respective discounted returns. We show that no accumulated inventory before the dispute, sufficient slow-down in production and increased noise or error in the estimation of the firm's bargaining power would expedite the resolution of the holdout.

Keywords: Stopping time; holdout; go-slow; accumulated inventory; noisy perceptions
JEL Classification: J52; C73

1. Introduction

In the empirical and theoretical literature on industrial disputes the main focus is on strikes. Little attention has been devoted to holdout option even though it is more frequently than strikes in some countries such as Canada, Netherland and United States.[1] A holdout is the period in between the expiration date of the old contract and the beginning of a new contract. During this period production continues under the terms of the old contract and in the meanwhile the parties negotiate. Although union may carry out strategic threats such as go-slow or work-to-rule holdout is less damaging than complete work stoppage under strike. Nevertheless in this paper, we will argue that long disputes[2] might be quite costly for the firms who have close rivals in the product market. As mentioned by Cramton and Tracy (1992, 2003) some of the firm's customers or suppliers may be reluctant to deal with firms of a holdout due to greater likelihood of an impending strike. Hence, we design a holdout model which can be considered as substitute for strikes in terms of creating inefficiencies to the disputing parties. The model examines the strategic actions of the union and the firm in the determination of the optimal settlement time for the new contracted wage. We introduce the holdout model as a dynamic game with optimal stopping time. Since the players cannot fully measure the bargaining power of their opponent, the system would have a stochastic nature.

Existing theoretical models investigate the factors affecting the duration of holdout within game theoretic bargaining framework. In Cramton and Tracy (1992), time of agreement and contract wage are specified depending on the threat (strike or holdout) before agreement. They argue that the bargaining problem under a holdout is simply a rescaling of the bargaining problem under strike. The main finding of the paper is that economic factors and policy changes determine the union's threat decision. In particular, decline in real wages during the prior contract due to uncompensated inflation

[1] It is striking that in Canada, the incidence of holdout is 80.8 percent compared to 21 percent for strikes between 1965-1988 (see Gu and Kuhn 1989).

[2] In Netherland, there are wage disputes that holdout takes 7-8 months (see van Ours and van de Wijngaert 1996 and Houba and Bolt 2000).

and workers' outside job opportunities because of tight labor market make holdout less attractive and strike more like to occur. Cramton and Tracy (1994a) test these predictions using US data during 1970-1989 and find empirical support for the theoretical model's result. Later, Gu and Kuhn (1998) model the holdout situation for more than one bargaining pair and explain the longer duration of holdout as a delaying tactic for unions to obtain bargaining information in their industry. They argue that wage dispute could be considered as a "waiting game" since more patient party will be the winner in the bargaining game of more than one pair. More specifically, each union's incentive is to delay its wage settlement in order to learn more on the firm's ability to pay over time. Recent paper by Houba and Bolt (2000) also studied the lengthy holdouts due to inefficiency such as work-to-rule, created by unions. Their model captures the backdated wage bargains which is different than the previous studies but strengthens the common wisdom that backdating is minor detail of wage negotiations (Cramton and Tracy 1992).

In this paper, the aim is to further explore how the duration of holdout is affected by the strategic behaviors of the parties before and during the dispute. The inefficiencies created by the union and the counter strategies by the firm will determine the stopping time for the holdout game. In particular, we will emphasize the impact of (i) inventory stock of the firm before the negotiations start, (ii) the expectations of the union on the possible market loss of the firm, and (iii) slowing down the production during the dispute period. Different than the previous studies, we will emphasize the outside effect or the existence of rivals in the product market on the determination of contract wage and the holdout period.

The paper is organized as follows. In Section 2, we set up the model and discuss the numerical experiments in Section 3. Section 4 summarizes the results and concludes with some extensions.

2. The Model

A union and a firm have dispute over wage during a holdout period. We use the definition that time between expiration of previous contract ($t = 0$) and the settlement of a new contract is the holdout period. We consider the situation as a dynamic game with optimal stopping time. In this dispute, union's problem is to choose the optimal settlement date, τ_u in order to maximize the expected return, J_u to its members over the contract period, T:

$$\max_{\tau_u} J_u(\tau_u, \tau_f) \quad = \quad E[\sum_{t=0}^{(\tau_u \wedge \tau_f)-1} \beta^t nw + \sum_{t=\tau_u \wedge \tau_f}^{T} \beta^t nw_{\tau_u \wedge \tau_f}]$$

where $0 < \beta < 1$ is the common discount factor, w is the previous contract wage, and n denotes the number of workers. In the game, stopping times are the strategies of a player to determine. So, unionized workers' expected return depends on the optimal settlement date, τ_f of the other player, firm. The intersection of the optimal times, $\tau_u \wedge \tau_f$ for both players finalize the new contract rate, $w_{\tau_u \wedge \tau_f}$ until T.

We assume that union only makes the contractual wage offers and each of these offers implicitly determines the agreement time. Due to transactional cost and technological reasons it is plausible to suppose discrete intervals between wage offers (see Hart (1989)). Thus we characterize the wage demand at each t as a difference equation,

$$w_t = (\mu - \Delta s_t)w_{t-1}, \quad t = 1, 2, \ldots, \tau_u \wedge \tau_f \tag{1}$$

where $w_0 = \bar{w}$ is the given acceptable wage at the point of contract expiration. Starting with $\bar{w}$ union reduces its acceptable wages by some fraction $0 < \mu < 1$ over time. In the dispute models, declining concession wage profiles of the unions are first rationalized in Hicks (1963) and, then in Ashenfelter and Johnson (1969). However, there are mixed empirical evidences on the negative, $(\mu - 1) < 0$ relationship between wages and the duration of work stoppage.[3] Yet we use the similar argument that union lowers its wage expectations as dispute continues. Moreover it is assumed that wage offer will

[3] McConnell (1989) using US manufacturing sector data find that wages decline on average 3 percent per 100-day of strike. Card (1990) using Canadian data finds no relation.

not decrease smoothly over time. Considering that the firm may lose market share during the holdout period, union's wage demand may decline less than μ. Cramton and Tracy (1992, 2003) mentioned an inefficiency faced by firm in the strike and holdout situations that customers and input suppliers may be reluctant to negotiate with the firm until a new labor agreement has been in effect. In the model, we describe the evolution in the firm's market share, Δs_t observed by the union as follows:

$$\Delta s_t = -\gamma[\frac{q_{t-1} - y_{t-1}}{q_{t-1}}] + \epsilon_t. \tag{2}$$

Since workers continue to work under the terms of the old contract in the holdout, we assume that they can observe the previous demand, q_{t-1} and the sales of the firm, y_{t-1} with some noise, ϵ_t and consider the loss of market share ($\Delta s_t < 0$) as a positive impact on their wage offer. As long as the product demand is more than sales, the firm might lose ground to competitors (Hart 1989; Clark 1996) and union interprets this as a decline in market share by $0 < \gamma < 1$.[4] Yet change in the market share will always be observed with some noise. Even if the firm sells the exact amount of demand, union's wage offer might also be affected by some uncontrollable factors such as tension due to dispute and the possibility of strike where we encounter all of them in ϵ_t.[5] Thus substituting (2) to (1), we may not have a smoothly declining wage offer over time.[6]

In this holdout game, firm's problem is to choose τ_f which maximizes the

Recent studies by Jimenez-Martin (1999) using Spanish data and Cramton, Gunderson and Tracy (1999) using Canadian data again provide evidences on the negatively sloped concession functions.

[4] γ normalizes the change in market share so that $|\Delta s_t| \in [0\ 1]$.

[5] In the study on 800 British manufacturing companies, Nickell, Vainiomaki and Wadhwani (1994) found that market share has a positive impact on wages. Increasing product market rents due to increase in market share raises workers share in wage bargaining. In our paper, we also study the influence of product market power on wage determination but this time union use this effect on her wage offers.

[6] The assumption that unsatisfied demands leading to loss of market share over time might be reasonable in the imperfectly competitive markets especially in the monopolistic competition where are there are many close substitutes.

expected discounted profit, J_f over T:

$$\max_{\tau_f} J_f(\tau_u, \tau_f) = E[\sum_{t=0}^{(\tau_u \wedge \tau_f)-1} \beta^t (py_t - nw - \theta_{I\geq 0} kI_t - \Theta_{I<0} b|I_t|) + \sum_{t=\tau_u \wedge \tau_f}^{T} \beta^{t-\tau_f} (py_t - nw_{\tau_u \wedge \tau_f} - kI_t)]$$

subject to

$$I_{t+1} = I_t + x_t - y_t, \quad I_0 \text{ is given.} \tag{3}$$

p is the price of the output produced, k is carrying or storing cost of current inventory stock, I_t and x_t is output produced. Equation (3) describes the evolution of firm's inventory stock. I_t has a strategic value to the firm since its exhaustion might cause firm to suffer loss of customers and market positions in the dispute period (see Hart 1989). We introduce a shortage cost, b to measure the impact of loss of sales on the discounted profit of the firm. Here we argue that as long as there are close providers or rivals in the product market, unsatisfied customers might switch to transact with another producer. So, permanent loss of customers would be more depressing than the unmet demand at each period. By the exhaustion of I_0, we consider the shortage of sales in accumulated amounts[7] using (3) as

$$I_{t+1} = I_t + x_t - q_t. \tag{3'}$$

θ and Θ are the indicator functions and equal to 1 when $I_t \geq 0$ and $I_t < 0$ respectively.

Usually due to switching costs as in Klemperer (1987) and brand loyalty as in Summer (1988) and in Nelson (1970), the customer loss may not be observed in most industries during holdout but long disputes might create tension on the customers. Hence by the existence of substitute products in the market, there is higher possibility that customers may switch to rival firms and this might prompt firm to compromise on some agreeable wage above the prior rate, w.

[7]In the profit function, negative I_t is in absolute value.

The output is produced by labor,

$$x_t = \begin{cases} a_H n^{\alpha} & 0 \le t < (\tau_u \wedge \tau_f), \\ a_N n^{\alpha} & (\tau_u \wedge \tau_f) \le t \le T \end{cases}$$

where the productivity during holdout, a_H is lower than the productivity during normal periods, a_N. Workers wish to slow down the production as much as possible during holdout as a strategic threat but regulations may keep them to stay within the rules of the contract to avoid being cited for an unfair labor practice.[8] Demand, q_t can be either high q_h or low q_l with probabilities π_h and π_l respectively. Thus, depending on the demand in the product market and the current inventory stock, sales during the holdout period will be

$$y_t = \begin{cases} q_l & \text{if } q_t = q_l, \\ q_h & \text{if } q_t = q_h,\ I_t \ge 0, \text{ and, } I_t + x_t \ge q_t, \\ I_t + x_t & \text{if } q_t = q_h\ , I_t \ge 0, \text{ and, } I_t + x_t < q_t, \\ x_t & \text{if } q_t = q_h \text{ and } I_t < 0, \end{cases}$$

where $x_t = q_l$ during holdout.

Finally, by the settlement of the new contract, the firm is faced with the problem of determining the new level of inventory for the future wage negotiations. As a simplifying assumption after $t \ge (\tau_u \wedge \tau_f)$ firm accumulates inventory up to I_0. Thereafter production is adjusted to the demand in the market and the accumulation of the inventory is stopped.

3. Numerical Simulations

A central assumption of the paper is that at each period the wage offer by union is affected by the proportion of unmet demand in the product market. Union has a noisy information about the change in the market share during the dispute which characterizes the stopping time in the game. Due to the existence of uncertainties on the wage offers and the product market demand, we use numerical analysis to study the impact of various factors on the duration of holdout.

[8]It is not allowed that $a_H = 0$ as in strike.

Game is assumed to take place from $t = 0$ until $t = \tau_u \wedge \tau_f$ and the contract is in effect from $t = \tau_u \wedge \tau_f$ until $t = T$ where $T = 2.3$ years.[9] Wage offers are be done in 3-day intervals hence there would be at most 276 interactions between the union and the firm over T.[10] For the rate of concession, we use the estimate by McConnell (1989) as the benchmark value[11] which is $\mu = 0.9991$ for 3-day period and then we further study μ for lower values. Price of the good, p is normalized to one. w and $\bar{w}$ are 0.25 and 0.3 (20 percent above the prior contract) respectively. Carrying cost, k is 0.3. Shortage cost, $b = 3$ is higher than the price of the good since we assume that customer loss will have long-term effect and it should be compensated.[12] Number of union members, n is 100. High and low production levels are $x_h = 300$ and $x_l = 282$ respectively for 3-day period. Therefore, workers' slow down parameter is $a_H = 0.94$ (see Cramton and Tracy 1992).[13] Initial inventory, $I_0 = 180$ which is equivalent to 30-day inventory stock before the dispute (see Cramton and Tracy 1994b). In a 3-day period, unsatisfied demand could be at most 18 units, hence, 30-day of high demand during holdout can be satisfied by 180 units. Moreover, the equal probability that the demand being high or low is generated randomly. Last set of parameters are related to noisy estimation of market share. The noise term is assumed to be normally distributed with mean zero and variance, $\sigma_\epsilon^2 = 0.0005$.[14] We assume that at most 6 percent of the demand can not be met during holdout and union considers this as a decline in the market share by 0.06 percent since it is assumed that $\gamma = 0.01$. Thus by the addition of noise (it could be positive or negative), perceived change in the market share will be reckoned before the next offer is made.

Table 1 summarizes the numerical results for various experiments.[15] In

[9] We use the mean duration of contract reported in Gu and Kuhn (1998).

[10] The interval between offers is arbitrary. In one year there are 360 days.

[11] She found that the real wages fall by about 3 percent for 100 days of strike.

[12] For instance, Moene (1988) in a similar setting showed that late delivery due to slow down can lead to a more than proportional reduction in profitability.

[13] Production, x is specified as Cobb-Douglas: $x = a_i n^\alpha$ where $a_i = N, H$. We assume that $\alpha = 0.75$, the normal productivity is $a_N = 9.486833$ and $a_H = 0.94 a_N$.

[14] We use Box-Muller method for generating random numbers with normal distribution (see Press et. al. (1988)).

[15] For each experiment, we run the simulation 1500 times.

Table 1

Numerical results

b	k	μ	γ	σ_ϵ	$\bar{w}$	I_0	a_H	τ	σ_τ	$\tau + \sigma_\tau$	$w_{\tau_u \wedge \tau_f}$	σ_w	J_f	σ_J
3.0	0.30	0.9991	0.01	0.0005	0.30	180	0.94	43.942	19.8732	63.8152	0.2934	0.0257	1634.26	19.8724
3.0	0.30	0.9991	0.01	0.0005	0.30	**0**	0.94	8.854	4.3027	13.1567	0.2986	0.0133	1728.44	64.9180
3.0	0.30	0.9991	0.01	0.0005	0.30	**90**	0.94	22.234	7.9856	30.2196	0.2950	0.0189	1753.22	19.0168
3.0	**0.35**	0.9991	0.01	0.0005	0.30	180	0.94	46.994	38.8496	85.8436	0.2932	0.0264	1593.19	21.7233
3.0	**0.25**	0.9991	0.01	0.0005	0.30	180	0.94	42.618	12.1035	54.7215	0.2932	0.0259	1675.51	17.9822
3.2	0.30	0.9991	0.01	0.0005	0.30	180	0.94	43.406	14.7897	58.1957	0.2933	0.0258	1633.97	19.9878
2.8	0.30	0.9991	0.01	0.0005	0.30	180	0.94	45.368	32.5728	77.9408	0.2933	0.0260	1634.59	19.7466
3.0	0.30	0.9991	0.01	0.0005	**0.32**	180	0.94	45.380	28.7079	74.0879	0.3125	0.0278	1632.77	19.8306
3.0	0.30	0.9991	0.01	0.0005	**0.28**	180	0.94	43.072	14.7716	57.8436	0.2740	0.0241	1635.80	19.9151
3.0	0.30	0.9991	0.01	0.0005	0.30	180	**0.96**	168.878	206.2685	375.1465	0.2853	0.0467	1631.43	10.8614
3.0	0.30	0.9991	0.01	0.0005	0.30	180	**0.92**	31.108	9.4040	40.5120	0.2948	0.0223	1620.29	24.6457
3.0	0.30	**0.9997**	0.01	0.0005	0.30	180	0.94	43.986	19.8659	63.8519	0.2962	0.0260	1634.08	19.8664
3.0	0.30	**0.9994**	0.01	0.0005	0.30	180	0.94	43.964	19.8697	63.8337	0.2948	0.0259	1634.17	19.8694
3.0	0.30	0.9991	0.01	**0.0001**	0.30	180	0.94	44.706	28.3276	73.0336	0.2952	0.0119	1634.18	19.7976
3.0	0.30	0.9991	0.01	**0.0010**	0.30	180	0.94	43.554	14.8114	58.3654	0.2912	0.0362	1634.36	19.9445
3.0	0.30	0.9991	**0.03**	0.0005	0.30	180	0.94	43.942	19.8732	63.8152	0.2935	0.0258	1634.26	19.8726
3.0	0.30	0.9991	**0.05**	0.0005	0.30	180	0.94	43.942	19.8732	63.8152	0.2936	0.0258	1634.26	19.8729

Note: First row is the benchmark. σ_w and σ_J are the standard deviations of $w_{\tau_u \wedge \tau_f}$ and J_f respectively. Since workers receive constant wage before and after holdout, we did not calculate the workers' discounted returns.

column 1-8, we describe the parameters used in each experiment. Column 9 and 10 present the mean, τ and the standard deviation, σ_τ of the duration of holdout respectively. Column 12 and 14 report the mean agreed wage and discounted profit for firm respectively where daily common discount factor, β is 0.95.

In the benchmark experiment, the mean holdout duration is 43.942 days. With standard deviation of 19.8732 days, the dispute can be at most 63.815 days long.[16] The first set of experiment is the effect of initial inventory accumulated before the holdout on the settlement duration. When the firm starts the negotiation with 15-day inventory stock, the mean duration for agreement decreases as compared to benchmark. On average, the duration is 22.234 days and at worst, $\tau + \sigma_\tau$, it continues for a month (30.2196 days). In the case that starting with no inventory, dispute ends even at a shorter period. For $I_0 = 0$, mean duration is 8.854 days and at most it takes 13.157 days. When we halve the inventory stock at each experiment, the dispute ends more rapidly.[17] In our holdout model, the accumulation of inventory before the game is strategic for firm but over accumulation of it might cause the dispute to continue for longer period and lower the expected firm profit. When we compare the profitability, J_f of the firm under different initial inventory stocks, the case of 15-day of I_0 yields the highest discounted profit. On the other hand union prefers the case that there is no inventory since the agreement terminates early with higher contracted wage rate. In Table 1, firm also enjoys high J_f when $I_0 = 0$ but due to high volatility, $\sigma_J = 64,918$, firm might be better off when negotiations start with certain amount of inventory.

Related to inventory strategy, experiments on carrying cost and shortage cost yield also interesting results. We found that if carrying cost, k declines to 0.25, both mean duration and the variation decrease. Especially by the decline in the variation, the dispute resolves within 54.721 ($\tau + \sigma_\tau$) days at worst which is 10 days early than the benchmark. Yet at $k = 0.35$, the mean duration is 46.994 days and the disagreement might continue up to 85.844

[16]Crampton and Tracy (1992) reports mean holdout duration of overall US industries is 63 days during 1970-1989.

[17]In the strike models inventory strategy of the firm is very crucial. See Clark 1991, 1997; Coles and Smith 1997; Coles and Hildreth 2000; Leach 1997.

days. We can conclude that if carrying cost is high, firm tries to bargain more with the expectation that union lowers wage offer over time. Even though new wage rate is lower, the long dispute results in lower discounted profit for the firm. On the other hand, with reduced carrying cost and the possibility of relatively early agreement, the firm benefit more in terms of its discounted returns. Another inventory related parameter in our model is the shortage or the backorder cost in the profit function of the firm. An increase or a decrease of shortage cost does not affect the mean agreement period whereas again volatility in the agreement process changes a lot. Especially with the decline in the shortage cost, negotiation might carry on for 77.34 days which is almost two weeks longer than the benchmark negotiation period. The variation on the settlement period decreases significantly (decrease by 25 percent) when shortage cost increases 6.67 percent more than the benchmark cost. Thus, at worst case scenario, $b = 3.2$ bargaining stops within 58.1957 days. Firm's discounted profit declines negligibly whereas union improves its discounted return.

The initial wage offer, $\bar{w}$ is also important in the determination of the duration of holdout. When $\bar{w} = 0.32$, it takes more time to come to an agreement on the new contract. At $\bar{w} = 0.28$, mean duration slightly changes but variation on the agreement decreases significantly (25 percent) and the dispute can be finalized in at most 57.844 days.

The threat of slowing down the production during holdout alters the results significantly. Especially further slowing down the production from 94 percent of the normal level of production to 92 percent decreases the mean holdout period to a month. With the addition of standard deviation of 9.248 days, the dispute terminates in at most 39.82 days. On the other hand, if workers cannot slow down the production sufficiently ($a_H = 0.96$), it may take longer than a year to make a new contract between the union and the firm. At $a_H = 0.92$, firm is worse off in terms of discounted profit ($J_f = 1620.29$ and $\sigma_J = 24.6457$). However union gets higher new contracted wage with early agreement and hence be better off when $a_H = 0.92$. However, at $a_H = 0.96$ both players are worse off since the dispute continues for an extended period of time. On average wage rate declines by 2.7 percent as compared to the benchmark. Thus without backdating, union's loss is relatively more than the loss of the firm over the contract period of 2.3 years.

As mentioned before, concession rate of 3 percent for 100-days of strike could be high for holdout period negotiations so we experiment for the cases that wage decreases by 1 percent ($\mu = 0.9997$) and 2 percent ($\mu = 0.9994$) for 100-day of dispute. As seen from Table 1, although there are relatively small changes in the settlement periods, union is better off by slowly decreasing its wage offers over the game since new contract wage is higher than the benchmark wage rate.

Finally we analyze the effect of the change in market share of the firm with noise during the negotiation process. The numerical experiment showed that by the decline in the noise, the negotiation takes little longer than the benchmark ($\tau = 44.7064$ days), however the volatility on the settlement period changes significantly. Thus, it might take 73.034 days to settle the dispute. Moreover with an increase in σ_ϵ^2 such as 0.001, union and the firm end the dispute early (at worst 58.365 days) as compared to the situations where there is less noise on the perceived information about the market share of the firm. In terms of discounted returns of both parties, especially union becomes worse off if the market share information is too noisy, $\sigma_\epsilon^2 = 0.001$. Although the holdout ends in a relatively short period of time, we observe further reduction in the agreed wage rate and consequently, the firm is better off when the information is more noisy.

4. Conclusion

In this paper we model the behavior of the union and the firm during holdout and examine the optimal settlement period for the dispute in a dynamic game framework. In the game, strategically accumulated inventory by the firm before the holdout and the existence of close rivalry in the product market play crucial roles in the determination of the agreement time. The union that makes the wage offers, may create inefficiency such as slow-down of the production as a threat during holdout and tries to stop the game early with higher new wage rate. In the paper, we numerically study the effects of various strategic actions of the union and the firm on the settlement time and their discounted returns. We show that no accumulated inventory before the dispute, sufficient slow-down in production during holdout and noisy observation of the firm's customers' satisfaction in terms of meeting demand ends the dispute situation as early as possible.

The main shortcoming of our model is that we do not allow the union to strike even if the dispute continues for a year. However, in the paper we argue that the union and the firm have credible threat strategies that end the dispute as early as possible. Nonetheless when the strike is allowed, the choice of time to strike would be another decision variable. The problem becomes three pieces where inventory strategy and union's perception of customer losses will be more crucial in the wage negotiations. The parameters used to measure the effects of various strategies will change during holdout and strike periods. Hence, the model would have more parameters. In the recent study by Lemke (1999), it is argued that wage gains do not offset the initial wage losses from the strike but holdout appear to be Pareto improving over striking since there would be no initial expense of forgone wages during strike. Also from the theory of bargaining under asymmetric information, we know that variables that increase the expected size of profits of the firm should decrease strike activity while increasing wage settlements (see Abowd and Tracy 1989). In our model there are sufficient variables that the firm's expected profit would be inversely affected due to work stoppage. Hence we argue that both players in wage negotiations find ways to avoid strike and extract as much benefit as possible.

In the paper, we introduced inventory stock as an exogenously determined strategic variable. Although existence of inventory stock during holdout period play a crucial role, we showed that even though there is no inventory before the negotiation, the firm would be better off. Hence endogenously chosen inventory stock before the game and during the game could be further studied in a framework other than optimal stopping time.

Finally we can play this game repeatedly for infinite horizon but more interesting extension may be the relaxation of the fixed contract period and the inclusion of the choice of contract period also by adding backdating.

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