Strategic Disclosure of Firm-Specific Skills in Wage Bargaining

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We study the bargaining relationship between a firm and its incumbent worker who possesses firm-specific human capital. We show that the worker's ability to disclose his skills strategically increases his bargaining power. The game may have inefficient equilibria where delays occur in real time. With the addition of outside options for both the firm and the worker, delays are shortened whenever outside options are credible threats. Our model also predicts that wages are procyclical, and there can be a variation in wages for a given job level.

1 Introduction

Employment contracts are inherently incomplete. In a typical employment contract the worker agrees to carry out the instructions of the employer, within broad limits, in return of a prespecified wage. In the absence of comprehensive contracts, productive efficiency requires that successive adaptations to the changing job and market conditions take place. In the implementation of these adaptations, parties may find it profitable to bargain ex-post over the terms of the contract within the contract period as well as in the contract renewal stage. If the labor market is competitive, the ex-post bargaining between the firm and its employees results in an efficient allocation, as the firm can replace its employees costlessly without any disruption in production. However, most jobs involve non-trivial firm-specific skills and information which develop during the course of the worker's employment. Employees such as, high level managers, sales representatives, key product

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engineers, and members of the production teams possess firm-specific human capital, and the firm cannot replace them with new inexperienced workers at the spot labor market. As pointed out by Williamson et. al. (1975), although the firm's initial hiring decision takes place in a competitive labor market, once the worker's skills are developed as a result of experience, the employment relationship resembles a bilateral monopoly. Therefore, in the ex-post bargaining game the hold-up problem may arise.[2] This, in turn, may create inefficiencies both ex-ante and ex-post.

In this paper, we study the bargaining relationship between a firm and its incumbent worker who possesses firm-specific human capital. We show that, in the contract renewal stage, the worker's ability to strategically disclose his skills increases his bargaining power vis-à-vis the firm. The firm can threaten to fire the worker and hire a new inexperienced worker or the worker can also quit and work elsewhere, but these threats are not always credible. Even though the bargaining game takes place in an environment with perfect information, there exist inefficient equilibria in which delays occur in real time. The wage bargaining between the firm and its skilled workers results in ex-post inefficiency in the production. This supports the arguments in Williamson et. al. (1975) that sequential spot contracting in the labor market is not efficient when firm-specific human capital is important. Instead, hierarchical organization of labor such as internal labor markets promotes efficiency by avoiding individual bargaining.[3]

The specialized skills and information which we call firm-specific human capital, develop either as a part of on-the-job training or accrue naturally during the course of employment.[4] In most jobs, especially those involving

[2]There is an extensive literature on the hold-up problem in bilateral relationships and its remedies. Among these, Grossman and Hart (1986) studied the incentives to invest in relationship-specific investment when there is contractual incompleteness. Rogerson (1992), Chung (1991), MacLeod and Malcomson (1993) are among those who studied the contractual solutions to ex-ante inefficiency that is created by ex-post hold-up problem.

[3]The internal labor markets paradigm which is pioneered by Doeringer and Piore (1971), argues that there are hierarchical carrer structure within a firm. The wages are attached to jobs rather than workers which eliminates the inefficient bargaining between the firm and its incumbent workers. In fact, recent empirical analysis of personnel data of large firms (See Baker et. al, 1994; Gibbs and Hendricks, 2004; Dohmen, 2004) reveal that formal salary systems mainly determine the wage policy within the firm. In a formal salary system, the employees' seniority wage profiles are largely independent from idiosyncratic employee characteristics but rather wage raises are centerally administered.

[4]According to Green and Montogomery (1998) more than one in six young people

"idiosyncratic tasks" the firm-specific human capital is an important input for the firm. Familiarity with the physical environment (Doeringer and Piore 1971), customer relationships (Anderson and Schimittlein 1984), the ability to communicate and work effectively with the members of a team (Mailath and Postlewaite 1990, and Klein 1988) are examples of firm-specific human capital. When the firm-specific skills develop as a result of on-the-job training that is, an investment in human capital, the possibility of ex-post bargaining creates both ex-ante and ex-post inefficiencies. The ex-ante inefficiency arises because the parties' incentives to invest in specific human capital are distorted.[5] The ex-post inefficiency, on the other hand, arises because the worker may strategically disclose his specialized skills during the ex-post bargaining, causing delays in bargaining. In this model we focus on the firm-specific human capital that accrues naturally to the worker during the course of his employment without a significant cost to either him or the firm. In this way, we isolate the effects of the ex-ante investment decisions and study only the ex-post inefficiencies that may arise in the relationship.

The paper borrows ideas from and is related to the non-cooperative bargaining literature. It is a well known result in the bargaining literature that if there is an informational asymmetry between the negotiating parties, then in equilibrium delays occur in real time (for example, see Admati and Perry, 1987). In these models, the delay serves as a signalling device. In contrast, the works of Fernandez and Glazer (1991), Haller and Holden (1990), and Busch and Wen (1995) show that delays can also be observed in equilibrium in bargaining games with perfect information. The alternating offers bargaining game with constant disagreement payoffs (see Rubinstein, 1982) has a unique equilibrium. If the disagreement payoffs are endogenous, that is, if the value of disagreement payoffs depend on the actions taken by players in each period, then the players' offers in the bargaining game depend not only on the past rejected offers, but also on the actions taken in the disagreement stage. As in repeated games, multiple equilibria exist because the history-dependent strategies can be used to punish the players for deviations from the proposed equilibrium actions, thus deterring deviations. If the game has multiple equilibria, inefficient equilibrium where delays occur can easily be constructed.

This paper contributes to the literature on non-Walrasian wage bargain-

acquired only firm-specific skills in their first substantial job.

[5]Becker (1962) is the first who considered incentives to invest in specific human capital.

ing where the existence of wage differentials in labor market is attributed to the higher bargaining power of insiders compared to outsiders. In these models, however, the way in which the worker's firm-specific skills increases his bargaining power is not explicitly modelled. In Shaked and Sutton (1984) this bargaining power is characterized by the firm's inability to replace its current workforce on the spot. The firm's current workforce enjoys a bargaining advantage because it is time-consuming for the firm to replace them. During the wage bargaining, the firm bargains with the incumbent worker for a number of periods before it makes an offer to an outsider. The game has a unique equilibrium. If the time period during which the firm is forced to bargain with the insider decreases, the equilibrium approaches a Walrasian solution. If the time period increases, then the outsider does not represent a threat to the insider and the equilibrium is similar to the one in bilateral monopoly. Stole and Zwiebel (1996a, 1996b) developed a model of intra-firm bargaining between the firm and its skilled employees in order to explain the firm's input and organizational design decisions. In their model of intra-firm bargaining, the firm has many employees but it bargains with each one individually. The worker's bargaining power stems from his threat to quit. This threat is credible insofar as it deprives the firm from the worker's contribution, thus, weakens its position against the remaining workers. The bargaining game has a unique subgame perfect equilibrium. An extension of this model is studied in Wolinsky (2000) where the firm has the opportunity to replace the existing workers.

All of these models of bargaining between the firm and the incumbent workers assume that the production takes place after a new agreement is reached. Hence, both the firm and worker receives zero as their disagreement payoffs. In contrast, in our model the bargaining game takes place concurrently with production. The worker's decision in the disagreement stage involves how much effort to exert. In our model, if the worker always strike in the disagreement stage, hence, produce nothing, both players' disagreement payoffs would also be zero.

The rest of the paper is organized as follows. Section 2 presents the basic model. Section 3 charcterizes the equilibrium of the basic model. Section 4 extends the basic model by introducing outside options for both players. Finally, Section 3 concludes.

2 The Model

A firm is randomly matched with a worker from a competitive market of identical workers. They sign a contract that specifies the wage that the agent will be paid for a day's work. This wage is equal to the competitive wage which is denoted by w_c. This relationship produces one unit of output in each production period. We assume that initially the worker is unskilled and he does not need to exert effort to perform the job. However, as the worker continues to work in the same firm, his productivity increases as he acquires both general and firm-specific human capital. He develops these skills without exerting any effort. We assume that, after some time, the worker is able to produce $\theta > 1$ units of output when he combines his skills with high levels of effort. The parameter θ can be thought of as the skill-weighted productivity of the worker in this firm as in Lazear (2003). High effort levels impose disutility c to the worker. Although the incumbent worker was drawn from a pool of identical workers before the initial contract was signed, he gradually becomes more productive than the outsiders. Hence the employment relationship resembles a bilateral monopoly. Once the initial contract expires, the worker can negotiate with the firm to raise his wage above the competitive wage.[6] The incumbent worker's ability to increase his salary depends on his ability to strategically disclose his firm-specific skills during the contract negotiation.

We characterize the wage negotiation as an alternating offers bargaining game between the firm and the incumbent worker which takes place concurrently with the production. We first consider the game in which neither the firm nor the worker has outside option. Let this game be called G_0 game. The structure of the game is as follows. In each odd-numbered period, the worker proposes a new wage contract w_t. The firm then responds by either accepting or rejecting the offer. If the firm accepts the offer, the negotiation game ends. In the new wage contract the worker is paid w_t, and the firm retains $\theta - w_t$, thereafter. If the firm rejects the offer, then the players receive their disagreement payoffs which depend on the action taken by the worker. The worker can either work hard and produce the output θ, or shirk and produce 1. If the worker works hard he incurs disutility c. Therefore, his utility when he works hard, is $w_c - c$. If he shirks, he does not expend any

[6] If there is no breach penalties, the worker could also ask for the raise before the initial contract has expired.

effort; hence his utility is w_c.[7] The worker's decision is observed by the firm, and time advances one period.

In every even-numbered period, the firm offers a wage contract, w_t, to the worker. The worker then responds by either accepting or rejecting the offer. The acceptance of the offer implements a binding contract between the firm and the agent that holds forever. If the worker rejects the offer, then the worker chooses between shirking and not shirking. The same rules as described above govern the consequences of the worker's decision. We make the following two assumptions to guarantee a non-degenerate solution to the wage bargaining game.

Assumption 1. $\theta - c > 1$.

Assumption 2. $\theta > w_c + c$.

Assumption 1 implies that agreement is strictly preferred to disagreement. Assumption 2 implies that the total output is sufficiently large so that the firm can afford to pay the worker his disutility of work above the competitive wage. If this condition does not hold, then the production is not efficient and an agreement between the incumbent worker and the firm is never reached. In the unique equilibrium of the game, the worker produces 1 unit of output in return of wage w_c. We also assume that both the firm and the worker have the same discount factor, $0 < \delta < 1$. Both players maximize their lifetime utility. Let $u_i(e_t)$ be the disagreement payoff of player i in period t, where $i = w, f$, denoting worker and firm, respectively and $e_t = s, ns$, denoting whether the worker has shirked or not in period t.[8] If the agreement is reached at period $T < \infty$, then the worker's payoff is

$$(1-\delta)\sum_{t=1}^{T}\delta^{t-1}u_w(e_t) + \delta^T(w_T - c) \tag{1}$$

and the firm's payoff is,

[7] Since the unskilled worker does not choose his effort level, the initial contract does not specify payments contingent on effort. Once the worker becomes skilled, he can choose whether or not to work hard. Regardless of his decision, however he is paid w_c.

[8] The worker's disagreement payoff, $u_w(e_t)$, is defined net of disutility of effort.

$$(1-\delta)\sum_{t=1}^{T}\delta^{t-1}u_f\left(e_t\right)+\delta^T\left(\theta-w_T\right). \tag{2}$$

3 Equilibrium

The following proposition characterizes the set of subgame perfect equilibria of the game. Let $\underline{w}=w_c+c$ denote the minimum wage contract and $\overline{w}=w_c+[(\theta-1+\delta c)/(1+\delta)]$ denote the maximum wage contract.

Proposition 1. *In the G_0 game, any wage contract w such that, $\underline{w}\leq w\leq\overline{w}$ can be generated as a subgame perfect equilibrium wage contract with agreement reached in the first period.*

Proof. By Proposition 1 of Busch and Wen (1995). ∎

The subgame perfect equilibrium strategies that generate $\overline{w}$ as an equilibrium are the following. The worker's strategy is to shirk after every rejection, offer $\overline{w}$ in every odd-numbered period, and in every even-numbered period accept an offer w_t such that, $w_t\geq\widehat{w}$, where $\widehat{w}=w_c+[(\delta\left(\theta-1\right)+c)/(1+\delta)]$, and reject otherwise. The firm's corresponding subgame perfect equilibrium strategy is to propose $\widehat{w}$ in every even-numbered period and accept any offer that pays $w_t\leq\overline{w}$ in every odd-numbered period. Essentially, if the worker commits himself to shirking in every period following a rejection, then the game resembles a Rubinstein's bargaining game (Rubinstein 1982) with disagreement payoffs $(w_c,1-w_c)$ and $\overline{w}$ is the unique equilibrium of this game.

The minimum wage equilibrium, $\underline{w}$, is generated by the following pair of strategies. The firm proposes $\underline{w}+[(1-\delta)\,c/\delta]$ in every even-numbered period if the worker did not shirk in the previous period and proposes $\underline{w}$ otherwise. The firm accepts any offer that pays $w_t\leq\underline{w}$ in every odd-numbered period. If the firm deviates from its strategy, it is punished by the maximum wage equilibrium, $\overline{w}$. The worker's strategy is to offer at least $\underline{w}$ in every odd-numbered periods and accept any offer $w_t\geq\underline{w}$ in every even–numbered period. In every even-numbered period he shirks if he is not offered at least $\underline{w}$ or he does not accept an acceptable offer and in every odd-numbered period he shirks if he asks more than $\underline{w}$ or his proposal of $\underline{w}$ is rejected.[9]

[9]The equilibrium strategy that we propose calls for the worker to shirk in every even-

The construction of the minimum wage contract relies on the firm's ability to compensate the worker for not shirking in the disagreement stage. The firm is willing to offer this additional payment because its per period payoff if the worker does not shirk, $(\theta - w_c - c)(1-\delta) + \delta\ w_{t+1}$, is greater than its per period payoff if the worker shirks, $(1 - w_c)(1-\delta) + \delta\ w_{t+1}$ due to Assumption 1.

Any wage contract w such that $\underline{w} < w < \overline{w}$ can be supported by subgame perfect equilibrium strategies by punishing the worker with the minimum wage equilibrium if he deviates and the firm with the maximum wage equilibrium if it deviates. The wage increase the worker can capture from the bargaining game ranges between c and $(\theta - 1 + \delta c)/(1+\delta)$. The minimum wage contract equalizes the worker's utility to his reservation utility. Thus, the worker is indifferent between working in this firm or elsewhere at competitive salary w_c. The maximum wage contract is increasing in worker's disutility of effort, c, and marginal productivity of his firm-specific skills, $\theta - 1$. Proposition 1 shows that even when there are no outside options for players, the worker can sometimes capture substantial part of the rent created by his firm-specific skills.

Besides the efficient subgame perfect equilibria in which the agreement is reached at the first period, the bargaining game also have inefficient equilibria in which there is a delay in agreement. The following proposition characterizes these inefficient equilibria.

Proposition 2. *If $\widetilde{w}$ is such that*

$$w_c + c \leq \widetilde{w} \leq \frac{\delta^T - 1}{\delta^T}(\theta - 1 + c) + \frac{1}{\delta^T}\overline{w} \tag{3}$$

then there is a subgame perfect equilibrium in which the worker shirks for T periods followed by an agreement of $\widetilde{w}$.

Proof. For a formal proof see Busch and Wen (1995). ∎

We provide conditions that are sufficient for deviations not to occur. Along the equilibrium path, the players' strategies are as follows. In every

numbered period and not to shirk in the odd-numbered periods. A strategy that calls for the worker not to shirk in every period generates the same result. (For a detailed discussion on this see Busch and Wen 1995.)

odd-numbered period up to period $T+1$, the worker makes a non-serious offer to the firm and the firm rejects his offer. In every period up to the period $T+1$, the worker shirks. In period $T+1$, the worker offers $\widetilde{w}$ if it is an odd-numbered period, and accepts any offer that pays him at least $\widetilde{w}$, if it is an even-numbered period. The firm makes a non-serious offer to the worker in every even-numbered period up to $T+1$. In $T+1$, the firm offers $\widetilde{w}$, if it is even numbered period, and accepts any offer that pays at least $\widetilde{w}$, if it is an odd-numbered period.

The worker can always obtain $\underline{w}$ in the first period. In order for the worker to be willing to shirk for T periods and receive $\widetilde{w}$ in period $T+1$, he should prefer to receive w_c for T periods and $\widetilde{w}$ thereafter. Hence,

$$\sum_{t=1}^{\infty} \delta^{t-1} (\underline{w} - c) \leq \sum_{t=1}^{T} \delta^{t-1} w_c + \sum_{t=T+1}^{\infty} \delta^{t-1} (\widetilde{w} - c) \tag{4}$$

or, equivalently

$$w_c + c \leq \widetilde{w}. \tag{5}$$

In the same manner, the firm can obtain its lowest equilibrium payoff, $\theta - \overline{w}$ in the first period. In order for the firm not to deviate from the equilibrium strategy, it should prefer to receive $(1 - w_c)$ for T periods and $\theta - \widetilde{w}$ thereafter. Hence,

$$\sum_{t=1}^{\infty} \delta^{t-1} (\theta - \overline{w}) \leq \sum_{t=1}^{T} \delta^{t-1} (1 - w_c) + \sum_{t=T+1}^{\infty} \delta^{t-1} (\theta - \widetilde{w}) \tag{6}$$

which is equivalent to

$$\widetilde{w} \leq \frac{\delta^T - 1}{\delta^T} (\theta - 1 + w_c) + \frac{1}{\delta^T} \overline{w}. \tag{7}$$

In order for $\widetilde{w}$ to exist, $w_c + c$ has to be smaller than $[(\delta^T - 1)(\theta - 1 + w_c) + \overline{w}] / \delta^T$ which always holds under Assumption 1. The players' deviations from the strategies described above is eliminated by "equilibrium switching". If the worker deviates, he is punished with the minimum wage contract. If the firm deviates, then it is punished with the maximum wage contract.

4 Bargaining with Outside Options

Now we introduce outside option to both players. In every odd-numbered period, the rejection of the worker's proposal leaves the firm with the choice of firing the incumbent worker and hiring a new worker, or continuing to bargain with the incumbent worker. In the former case, the firm matches with a worker from the external labor market. This match yields the payoff $\phi_f = 1 - w_c + \beta(\theta - 1)$, thereafter, where $0 \leq \beta < 1$. The new worker's productivity may be lower than the incumbent worker's productivity because the new worker's skills may not be a perfect match to the firm's need. In this sense, β is a measure of market thickness and firm's search cost.

In every even-numbered period, the rejection of the firm's offer leaves the worker with the choice of quitting or staying with the firm. If the incumbent worker quits, he matches with a new firm where he can utilize some of his skills and receives wage $\phi_w = w_c + \alpha(\theta - 1)$, where $0 \leq \alpha < 1$. Here we interpret α, similar to β, to measure the market thickness and the worker's search cost. We assume that the worker's disutility of effort in the new firm is c despite the mismatch of skills. We make the following assumption which guarantees that $\phi_f + \phi_w < \theta$, that is the sum of the firm's and worker's outside options does not exceed the surplus generated within the relationship.

Assumption 3: $\alpha + \beta < 1$.

We call the game with outside option as the G_1 game. In an alternating offers bargaining game, the outside option changes the equilibrium of the game if and only if the players obtain a higher payoff by exercising this option than by continuing to bargain with each other.[10] Let $\varepsilon = c/(\theta - 1)$ be the measure of efficiency of the incumbent worker. The following proposition characterizes the set of all possible equilibria.

Proposition 3. *(i) If $\alpha \leq \varepsilon$ and $1 - \varepsilon \leq \beta < 1 - \alpha$ then $w = \theta - \phi_f$ is the unique subgame perfect equilibrium of the G_1 game. (ii) If $\alpha \leq \varepsilon$ and $\delta(1-\varepsilon)/(1+\delta) \leq \beta \leq 1-\varepsilon$ then any w such that $\underline{w} \leq w \leq \theta - \phi_f$ is a subgame perfect equilibrium of the G_1 game. (iii) If $\alpha \leq \varepsilon$ and $\beta < \delta(1-\varepsilon)/(1+\delta)$, then any w such that $\underline{w} \leq w < \overline{w}$ is a subgame perfect equilibrium of the*

[10] See Shaked and Sutton (1984) more on this. Note that we only allow the player to opt out after responding an offer to simplify the analysis.

G_1 game. (iv) If $\varepsilon \leq \alpha \leq (1-\delta\varepsilon)/(1+\delta)$ and $\beta < 1-\alpha$ then any w such that $\phi_w \leq w < \theta - \phi_f$ is a subgame perfect equilibrium of the G_1 game. (v) If $\alpha \geq (1-\delta\varepsilon)/(1+\delta)$ and $\beta < 1-\alpha$ then $w = \phi_w$ is the unique subgame perfect equilibrium of the G_1 game.

Proof. A formal proof of this proposition can be found in Osborne and Rubinstein (1990). ∎

We now discuss the derivation of the conditions in Proposition 3. In any subgame perfect equilibrium of G_0 game the firm receives at least $\theta - \overline{w}$, and at most $\theta - \underline{w}$. In any subgame perfect equilibrium of G_0 game the worker receives at least $\underline{w}$, and at most $\overline{w}$. The worker's outside option is never binding if the payoff he receives from the outside option is less than the lowest equilibrium payoff he obtains from the G_0 game. In other words, if $\alpha \leq \varepsilon$ then the worker never exercises his outside option. Because of Assumption 3 it must be true that $\beta < 1-\alpha$. If it is also true that $\beta \geq 1-\varepsilon$, then the firm's outside option is always binding since ϕ_f is greater than the highest equilibrium payoff it can obtain in G_0 game. Therefore, if $\alpha \leq \varepsilon$ and $1-\varepsilon \leq \beta < 1-\alpha$, then in the unique equilibrium of G_1 game the worker receives his outside option. In the second case, the worker's outside option is never binding, and the firm's outside option is binding for some equilibria of the G_0 game. Hence any w such that $\underline{w} \leq w \leq \theta - \phi_f$ is a subgame perfect equilibrium of the G_1 game if $\alpha \leq \varepsilon$ and $\delta(1-\varepsilon)/(1+\delta) \leq \beta \leq 1-\varepsilon$. In the third case, neither the worker's nor the firm's outside option is binding. Thus, the set of equilibria of the G_1 game coincides with the set of equilibria of the G_0. In the fourth case, both players' outside options lie between their respective lowest and highest equilibrium payoffs of G_0 game. Therefore, the G_1 game has multiple equilibria in which the worker receives any wage, w, such that $\phi_w \leq w \leq \theta - \phi_f$. In the last case, worker's outside option is greater than the largest equilibrium payoff that he can obtain in G_0 game. Hence in the unique equilibrium of the G_1 game, the worker receives his outside option ϕ_w and the firm receives $\theta - \phi_w$.

Proposition 3 reveals that if the firm can easily replace the worker with new worker from the external market, while the worker cannot easily find a job that matches his acquired skills, then all the quasi-rents from the relationship will be captured by the firm. This can be the case during the bust phase of the business cycle where there is an excess supply of skilled workers. The opposite would occur if the external labor market conditions are

more accomodating for the worker than the firm, such as during the booms. This finding accords with the evidence on substantial procyclicality of real wages (see for example Solon et. al., 1994). For moderate levels of α and β the multiplicity of equilibria does not disappear with the presence of outside options. However in the second and fourth cases where at least one player's outside option is binding for some equilibria of G_0 game, the range of the equilibria shrinks.

It can be easily shown that inefficient equilibria continue to exist also in the second and fourth cases of the Proposition 3. Both players can obtain their lowest payoff in a perfect equilibrium where the agreement is reached in the first period. We first derive the range of the inefficient equilibria when $\varepsilon \leq \alpha \leq (1-\delta\varepsilon)/(1+\delta)$ and $\beta < 1-\alpha$. The worker can always obtain $w_c + \alpha(\theta - 1)$ in the first period. In order for the worker to be willing to shirk for T periods and receive w^* in period $T+1$, he should prefer to receive w_c for T periods and w^* thereafter. Hence,

$$\sum_{t=1}^{\infty} \delta^{t-1} \left[w_c + \alpha(\theta - 1) - c \right] \leq \sum_{t=1}^{T} \delta^{t-1} w_c + \sum_{t=T+1}^{\infty} \delta^{t-1} (w^* - c) \tag{8}$$

or

$$w_c + c + \frac{\alpha(\theta - 1) - c}{\delta^T} \leq w^*. \tag{9}$$

In the same manner, the firm can obtain its lowest equilibrium payoff, $1 - w_c + \beta(\theta - 1)$, in the first period. In order for the firm not to deviate from the equilibrium strategy, it should prefer to receive $(1 - w_c)$ for T periods and w^* thereafter. Hence, we have

$$\sum_{t=1}^{\infty} \delta^{t-1} \left[1 - w_c + \beta(\theta - 1) \right] \leq \sum_{t=1}^{T} \delta^{t-1} (1 - w_c) + \sum_{t=T+1}^{\infty} \delta^{t-1} (\theta - w^*) \tag{10}$$

which is equivalent to

$$w^* \leq \theta - 1 + w_c - \frac{\beta(\theta - 1)}{\delta^T}. \tag{11}$$

In order for w^* to exist, the term at the left hand side of inequality (9) has to be less than the term at the right hand side of inequality (11) which holds if $\delta^T > (\alpha+\beta)(\theta-1)/(\theta-1-c)$. In other words, with the presence of credible outside options, the existence of inefficient equilibria requires patient players

and delays are shortened. For $\alpha \leq \varepsilon$ and $\delta(1-\varepsilon)/(1+\delta) \leq \beta \leq 1-\varepsilon$ any w^{**} such that $w_c + c \leq w^{**} \leq \theta - 1 + w_c - (\beta(\theta-1)/\delta^T)$ is a subgame perfect equilibrium in which the worker shirks for T periods followed by an agreement of w^{**}.

5 Concluding Remarks

Following the pioneering work of Becker (1962) on human capital theory, labor economists largely have focused on institutional and contractual remedies that promote efficient investment on acquisition of both general and specific skills.[11] In this respect, most studies have analyzed ex-ante inefficiencies created by a hold-up problem. However, the question of how strategic disclosure of these skills may create ex-post inefficiencies in worker-firm bargaining has been little explored.

The existing literature on the wage bargaining between the firm and its skilled workers emphasizes that firm-specific human capital is the source of the worker's increased bargaining power. However, these models fail to capture the ex-post inefficiency that may arise as a result of the bargaining. In this paper, we study the bargaining relationship between a firm and its incumbent worker who possesses firm-specific human capital. The incumbent worker is more productive than the outsiders because of the special skills and information he acquires during his employment. During the contract renewal stage, the worker can strategically disclose these skills in order to increase his bargaining power.

We find that when one party's outside option is always binding, the bargaining game has a unique equilibrium. In these cases, the model predicts that wages are proyclical. In all other cases, however, the game has multiple equilibria in some of which there is delay in reaching agreement. Whenever the outside option of at least one party is binding for some equilibria, the delays are shortened. As it has been uncovered in empirical studies (such as Cingano, 2003), firm-specific skills are crucial source of wage growth. In addition, each parties' ability to extract rent is disciplined by external factors as in Lazear and Oyer (2004) who provides evidence on the impact of external factors on firm's wage setting behaviour in Sweden.

[11] Prendergast (1993), Acemoglu and Pischke (1999) and Balmaceda (2005) are just a few to name in this extensive literature.

Our model provides a theoretical rationale for an array of wage contracts that ranges from competitive skilled wage, $\underline{w}$, to premium skilled wage, $\overline{w}$, to be observed as an equilibrium outcome. This result is in accord with empirical studies of wage policies of individual firms. For instance, in their in-depth study of a large corporation's personnel data, Baker et. al (1999) documents that there is substantial individual variation in wages within each job level, as well as in their growth rate. Moreover, the same study reveals "cohort effects" where cohorts who earn more on entry maintain their advantage through time. In our model this effect is reflected by higher initial wages, w_c, later leading to higher negotiated wages on average.[12]

Although the skill acquisition is not explicitly modeled here, our model also have implications for efficient skill acquisition and who should pay for it. To the extent that firm-specific skills increases worker's bargaining power in wage negotiation, it is a valuable asset for the worker. In this respect, the standard view on workers' reluctance in investing in firm-specific skills does not apply here. The worker is better off with higher firm-specific skills when supply of these skills in the external market is scarce. Scones and Bernhardt (1998) provides a model where workers may invest in firm-specific capital without long-term contract. The driving force in their model is asymmetric information on worker's productivity.

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[12] Although explicit wage negotiations do not take place in formal wage system, the observed system may very well represent the outcome of such a hypothetical negotion.

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