‘Bankruptcy, Takeovers and Wage Contracts*

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Abstract

Takeovers give raiders the opportunity of breaking implicit contracts inside the firm. If implicit contracts are adopted by workers and management to reach more efficient outcomes then the possibility of takeovers may cause a welfare loss.

We show that, under some conditions, this argument can go through even if the firm and the workers can write *explicit* and *complete* contracts. The crucial assumption is that the profitability of the firm is linked to its financial situation, in the sense that a firm which has a high probability of bankruptcy will face fewer opportunities than a financially solid firm. In this framework, the possibility of takeovers imposes constraints on the set of feasible employment contracts, leading to inefficient outcomes.

1 Introduction

The welfare effects of takeovers have long been debated. Proponents of a 'free takeovers' policy argue that takeovers improve efficiency by eliminating incompetent managers, and that the threat of takeovers helps mitigate agency costs. Opponents reply that most of the gains to shareholders realized through takeovers are actually obtained by redistributing surplus from other stakeholders. According to this view, raiders that take over a firm ruthlessly break implicit contracts existing between the former management and the other stakeholders, and are therefore able to appropriate a larger share of the surplus. If this is anticipated, implicit contracts become impossible and potentially efficient long-term relationships are jeopardized. For example, Knoeber (1986) argues that longer periods in office by managers give shareholders the opportunity of better evaluating their performance. In his model, risk neutral shareholders want to induce risk averse managers to make a costly effort. The long term performance of the firm is a more reliable signal of managers' effort than short run performance. Under the optimal compensation scheme, a long term relationship is established and successful managers receive bonuses late in their careers. Takeovers destroy this arrangement, because raiders will behave opportunistically and refuse to pay the promised bonus. Reputation considerations restrain current shareholders, represented by the board of directors, from this kind of opportunistic behavior.

Shleifer and Summers (1988) use a different argument to reach the same conclusion. According to them, "hiring and entrenching trustworthy managers enables shareholders to commit to upholding implicit contracts with stakeholders". Implicit contracts are needed to induce firm-specific investment by stakeholders (e.g. human capital investment by employees), and therefore increase efficiency. Hostile takeovers are a way to remove trustworthy managers who are expected to honor implicit contracts and replace them with unscrupulous managers ready to shift rents from workers to shareholders. This limits the opportunities for long term contracting, leading to a sub-optimal level of investment in human capital. This *underinvestment effect* has been formally analyzed by Schnitzer (1995), who also discusses how takeover defenses such as poison pills and golden parachutes may help to lessen the problem.

A crucial element of these arguments is that contracts between shareholders and other stakeholders are implicit, and can therefore be broken at will by a raider. There is no doubt that 'real' observed contracts are incomplete, but we think it interesting to explore whether takeovers may have an adverse effect on efficiency even if the relationship between the workers and the firm can be governed by *complete* and *explicit* contracts. This case is more than a theoretical curiosum. If implicit contracts are the root of the problem, we should observe a shift toward explicit contracts as it becomes clear that non-explicit arrangements will be broken. It is therefore interesting to ask whether inefficiencies would persist even in this case.

If any contract whatsoever can be written, then takeovers cannot be harmful. It would be enough for workers and shareholders to sign a contract forbidding the sale of shares. In order to make the analysis interesting, this has to be ruled out. In this paper we assume a specific institutional setting: The firm is a publicly traded corporation, and the trading of shares cannot be restricted. Shareholders are protected by limited liability, and do not take responsibility for the contractual obligations of the firm. The workers are not shareholders, so a genuine conflict of interest between the two groups exists. Apart from that, the firm and the workers are free to write wage contracts of any desired complexity and contingent on any observable variable.

We will show that, under some conditions, a raider will be able to force voluntary renegotiation of explicit contracts. It follows that the possibility of takeovers can jeopardize the establishment of long-term relationships and cause a loss of efficiency *even if explicit contracts are allowed.* The assumption driving the result is that the firm's profitability depends on its leverage. If the firm's debt is so high that bankruptcy is possible, banks will ask higher interest rates, suppliers will require higher prices and so on. This leads to an increase in costs, and a decline in profitability, for the overly leveraged firm. This fact can be used by a raider to force renegotiation of the wage contract.

The story we are going to analyze is the following. Suppose that our assumption linking profitability and financial situation holds. Through a takeover, a raider can raise money to buy the firm and then use the revenue generated by the firm to pay the debt. In this way, the firm's financial situation deteriorates, as the money borrowed by the raider is given to former shareholders. All the firm is left with is the debt to pay. With an increased debt, the profitability of the firm is reduced. This reduces the expected payments to workers under the original wage contract. This is easy to see in the case in which, for example, the wage contract states that workers are paid a fixed total wage bill $\overline{w}$. In that case, assuming wage claims have priority in bankruptcies, the workers are paid just the net revenue R whenever $R < \overline{w}$. If the higher debt increases the probability of low realizations of R, the expected payments to workers decrease. It may then be in the workers' interest to accept a reduction in wages. If wages are reduced, the probability of bankruptcy decreases. This in turn increases the probability of high realizations of the revenue R, increasing the probability that the full wage is paid. In other words, a wage cut has two effects, working in opposite directions. First, for any given level of revenue it reduces the payment to the workers. Second, by reducing firm's liabilities it reduces the probability of low realizations of revenue, thus increasing expected payments. Workers will be willing to voluntarily accept a wage cut if the second effect is stronger than the first. This in turn implies that a raider can force renegotiation of the wage contract by increasing the firm's debt. We will see that the possibility of forcing renegotiation of wage contracts through takeovers may create problems for the establishment of a long-term relationship between the workers and the firm, thus creating inefficiencies.

Three things have to be pointed out. First, the strategy of increasing debt in order to force workers to renegotiate wages can in principle be used also by the current management. We are assuming however that this behavior can be prevented because, since the workers and the management can write contracts of any desired complexity, the financial structure of the firm can be contracted upon *ex ante*. Second, it will be assumed that workers have priorities in bankruptcies. Our results would only be strengthened if the assumption were dropped. Third, in this paper it will be assumed that mutually agreed modifications of a pre-existing contract are possible and enforced by courts. See Dnes (1995) for a discussion of the legal treatment of mutually agreed contract modifications.

The role of debt as a strategic weapon in contract renegotiation is also analyzed by Perotti and Spier (1993). Their model, however, is in the incomplete contracts framework.

The paper is organized as follows. Section 2 first offers an overview of the model and then proceeds to the formal analysis, showing how the possibility of takeovers may induce inefficiencies. In section 3 we present a numerical example. Section 4 discusses the empirical implications of the model and concludes the paper.

2 The Model

We consider a simple two-period model where workers accumulate firm-specific human capital in the first period, so that it is efficient to establish a long-term relationship. The profitability of the firm is unknown at the beginning of the relationship. At the end of the first period, only management observes revenue, while at the end of the second period the total revenue of the firm in the two periods becomes common knowledge.

If workers are patient enough, then the optimal long term contract would delay all payments to the time at which revenue is observed by all parties. The reason is that workers' compensation in the first period cannot be made contingent upon revenue. It may therefore happen that the firm is unable to pay the promised wage, but workers refuse a wage cut because the message by management that the firm is unable to pay is not credible. Hence, bankruptcy occurs whenever the firm is unable to meet its contractual obligations.

If there are limits to the amount that can be paid in the second period, the firm may be forced to promise a positive wage in the first period to induce the workers to accept the contract. In our model the upper bound on wages in the second period comes from the possibility of a takeover. A takeover is a means of burdening the firm with extra debt while bringing no new cash (which is instead paid to former shareholders in order to acquire control). We will assume that a highly indebted firm is less profitable.

This implies that the indebted firm can more credibly ask workers to accept a wage cut. By accepting a reduction in wages, workers help to restore the financial viability of the firm and increase its profitability. This in turn increases the probability that wages will actually be paid.

We turn now to the formal analysis. Denote by w_t the amount paid to workers in period t, with R_t the difference between gross revenue and non-labor costs at time t, and with T_t the amount of takeover-induced debt to be paid at time t. Takeovers will only occur in the second period, so $T_1 = 0$. Cash flow in period t, denoted by CF_t is:

$$CF_t = R_t - w_t - T_t$$

Let R_1 and R_2 be random variables with distributions F_1 and F_2 satisfying the following assumption:

Assumption 1 *R_1 and R_2 are independent random variables whose support is contained in the interval $[0, \overline{R}]$. Distributions F_1 and F_2 are such that $F_2(R) < F_1(R)$ for each $R \in (0, \overline{R})$.*

The assumption states that the distribution of revenue in the second period (first order) stochastically dominates the distribution of the first period. This models the lock-in effect: If the firm is active in the first period, workers will be more experienced and productive in the second period, so efficient production requires a two-period relationship.

Both the workers and the firm are risk neutral with zero discount rates, so their objective is simply the maximization of expected income. The objective function of the firm is simply $E(CF_1 + CF_2)$ and the objective function of workers is $E(w_1 + w_2)$. If the firm desires to borrow money in period 1, it can incorporate this in the wage contract, by reducing w_1 and raising w_2.

Definition 1 *We say that a firm is* **bankrupt at time** *t if $CF_t < 0$.*

At time t, the firm knows the value of each variable dated t or earlier, and in particular the realization of R_t. All the other agents, and in particular workers and potential raiders, do not observe R_1 unless bankruptcy is declared at the end of period 1. However they do observe the sum $V = R_1 + R_2$

at the end of period 2. Thus, w_1 cannot depend on R_1, while w_2 can depend on V. Since the firm may sometimes be unable to meet contractual obligations, we distinguish *actual* and *contractual* payments, denoting by $\underline{x}$ the actual payment of the contractual variable x. Thus, $\underline{w}_1$ is the wage actually paid at the end of period 1. At last, it is assumed that workers have the possibility to earn w^* in each period if employed outside the firm, where $E(V) > 2w^*$.

The sequence of events is as follows. At the beginning of period 1 the workers and the firm sign a contract which establishes the total wage bill for each period, w_1 and $w_2(V, I)$, where I denotes any public information known at the beginning of period 2. This includes the actual wage $\underline{w}_1$ paid at the end of period 1, whether a takeover has occurred and so on. It will be convenient to write I as $I = I' \cup \xi$, where I' is all the information not relative to the occurrence of a takeover, while ξ takes value NO if no takeover occurs and YES if a takeover occurs.

Notice that in our model the only new information which is revealed between the beginning of period 2 and the end of period 2 is V, so that we are not restricting in any way the set of feasible contracts.

After the contract is signed, the firm observes the realization of R_1. At this point the firm can propose a new wage contract for the continuation of the relationship. If the firm proposes a new contract, it may be accepted or refused. If the workers refuse, either the firm is bankrupt (when $w_1 > R_1$) or the old contract remains valid. Notice that period 2 payments can be made contingent on the fact that the firm tried unsuccessfully to renegotiate in period 1. As pointed out in the introduction, we assume that workers have priority in bankruptcies. Given the simplified structure of our model, this implies that if a bankruptcy occurs at the end of period 1, workers receive all the firm's cash.

If no bankruptcy occurs in the first period, then at the beginning of period 2 there is an ongoing labor contract specifying payments at the end of period 2. At this point, a raider can decide to take over the firm. This is done by borrowing money, which is paid to shareholders to buy their shares. The debt is then repaid using the firm's revenue. After the takeover, the raider can ask for renegotiation of the wage contract. The workers may accept or refuse the renegotiation, and in case they refuse they can either leave the firm or continue in the firm with the original contract. After that, R_2 realizes, V is observed and wages are paid. Again, remember that w_2 can be made dependent on whether a takeover occurs.

As we said, we assume that the possibility of bankruptcy influences the distribution of R_2. The rationale for this is that a heavily indebted firm may be looked upon with suspicion by other members of the business community, and its promises to pay may be discounted. Therefore, banks will ask for higher interest rates, suppliers will want higher prices and so on. This increases costs, and therefore lowers R_2. In assumption 2 we make clear how to capture formally this influence of the financial situation on firm's profitability.

The total debt of the firm in period 2 is $D(V) = w_2(V, I) + T(V)$ i.e. the sum of the money due to workers and of takeover debt. Let $\mathcal{D}$ be the space of real-valued functions defined on the interval $[0, 2\overline{R}]$, and $\mathcal{F}$ the space of probability distributions with support contained in $[0, \overline{R}]$. Note that $\mathcal{D}$ can be interpreted as the space of total (i.e. wages plus financial debt) debt contracts contingent on V. The dependence of revenue on the total debt of the firm is formalized by assuming the existence of a function that, for any given total debt schedule and for any given state of public information I, selects a distribution in $\mathcal{F}$. More formally, for any state of public information I we assume the existence of a function $\phi_I : \mathcal{D} \to \mathcal{F}$ with the properties summarized in the following assumption:

Assumption 2

1. *If $D(V) \leq V - \underline{w}_1$ for each V then $\phi_I(D) = F_2$, where F_2 is the distribution defined in assumption (1).*

2. *If $D'(V) \geq D(V)$ for each V then $\phi_I(D)$ first-order stochastically dominates $\phi_I(D')$.*

Point (1) states that whenever there is no risk of bankruptcy (debt is lower than revenue in each contingency), the distribution of revenue is given by F_2. Point (2) roughly states that when the risk of bankruptcy is higher the revenue prospects deteriorate. This implies that potential income for the firm is lower the higher the debt.

In a world of complete contracts the first best would be reached setting, for example, $w_1 = 0$ and $w_2(V, I) = \alpha V$ for each I, with α such that $\alpha E(V) = 2w^*$. This contract is individually rational for the workers and makes sure that payments are feasible in period 1, so that bankruptcy is not possible. Let us now make Assumption 3, under which such a contract may not be feasible.

Assumption 3 *It is impossible to sign a contract between the workers and the firm forbidding the sale of shares after the first period.*

We now try to characterize the set of contracts that can survive a takeover. Suppose that at the end of period 1 a wage $\underline{w}_1$ has been paid and the right to a wage $w_2(V, I' \cup \xi)$ is established. Let $(\tilde{w}, T)$, where $\tilde{w}$ is a renegotiated wage contract for period 2, and T is a takeover induced debt contract (both $\tilde{w}$ and T are functions of V), be a solution to the program:

$$\max_{\tilde{w},T} \; E^{\tilde{D}}\left[V - \tilde{w}(V)|I'\right] - \underline{w}_1 \tag{1}$$

$$\begin{aligned} \text{s.t.} \qquad & E^{\tilde{D}}\left[\tilde{w}(V)|I'\right] \geq \max\left\{E^{D}\left[w_2(V, I' \cup YES)|I'\right], w^*\right\} \\ & E^{\tilde{D}}\left[\min\left\{T(V), V - \tilde{w} - \underline{w}_1\right\}|I'\right] = E^{\tilde{D}}\left[V - \tilde{w} - \underline{w}_1|I'\right] \end{aligned}$$

where $\tilde{D}(V) = \tilde{w}(V) + T(V)$ and $D(V) = w_2(V, I' \cup YES) + T(V)$. The notation E^D means that the expectation is taken using distribution $\phi_I(D)$. The pair $(\tilde{w}, T)$ is the outcome of competition in the capital market. The expression $E^{\tilde{D}}\left[V - \tilde{w}(V)|I'\right] - \underline{w}_1$ is the value of the firm when $\underline{w}_1$ has been paid, the wage schedule $\tilde{w}$ is expected to be adopted, and the distribution of expected revenue is given by $\phi_I(\tilde{D})$. Notice that conditioning on I' is needed because the revenue in the first period is not known. Furthermore, since takeovers do not offer new information on R_1, it is equivalent to condition with respect to I' or $I = I' \cup YES$. Competition among potential raiders makes sure that the price paid for the firm is equal to this expression. The first constraint in (1) says that raiders should be able to force voluntary renegotiation of wages. The second constraint says that lenders should be offered a credible repayment schedule.

The second constraint can be written as $T(V) \geq V - \tilde{w}(V) - \underline{w}_1$. In fact, we will assume that the following stronger condition holds:

$$T(V) = V - \tilde{w}(V) - \underline{w}_1$$

This means that $(\tilde{w}, T)$ does not reduce the profitability of the firm. A rationale for this is that if strict inequality held for some value of V then there would be strong incentives to recontract the takeover debt T.

We now analyze the consequences of the possibility of takeovers for the set of feasible contracts.

Definition 2 *A contract* $(w_1, w_2(V, I))$ *is* **takeover-proof** *if the expected payment to workers cannot be decreased through a takeover.*

Formally, this means that for each state of information I' *the solution* $(\tilde{w}_2, T)$ *to program (1) is such that:*

$$E\left[V - \tilde{w}(V)|I'\right] \leq E\left[V - w_2(V, I' \cup NO)|I'\right]$$

In other words, a contract is takeover-proof when there is no way to increase the value of the firm through a takeover. This implies that the original contract will remain in place and it will not be challenged by a raider.

Definition 3 *We say that* α *is* **attainable given information** I' *if there exists a takeover-proof contract such that* $E\left[w_2(V, I' \cup NO)|I'\right] = \alpha$.

We can now state and prove the following result.

Proposition 1 *There is an upper bound on the expected payment which is possible to credibly postpone to the second period. More precisely, for any* *state of information I' there exists a cutoff value $\overline{w}_2(I')$ such that, when the first period information is I', contracts with $E\left[w_2(V, I' \cup NO)|I'\right] > \overline{w}_2(I')$ are not takeover proof.*

<u>Proof</u>. It is enough to show that if a given value a is not attainable then any value $b > a$ is not attainable. The proof will be by contradiction. Suppose w_2 is a takeover proof contract such that $E\left[w_2(V, I' \cup NO)|I'\right] = b$, and let $q = b - a$. The contract w_2' given by $w_2' = w_2 - q$ is such that $E\left[w_2'(V, I' \cup NO)|I'\right] = a$. Since a is not attainable, the contract w_2' is not takeover proof. Let $(\tilde{w}', T')$ be a combination taking over w_2'. Using this contract, we show that it is possible to build a combination $(\tilde{w}, T)$ which satisfies the following conditions:

1. $E\left[V - \tilde{w}|I'\right] > E\left[V - w_2(V, I' \cup NO)|I'\right]$.

2. $E^{\tilde{w}+T}\left[\tilde{w}(V)|I'\right] \geq \max\left\{E^{w_2+T}\left[w_2(V, I' \cup YES)|I'\right], w^*\right\}$.

3. $T(V) = V - \tilde{w}(V) - w_1$.

where the expectation in point 1 is taken using the distribution F_2 (i.e. assuming that debt is never greater than revenue). If a pair $(\tilde{w}, T)$ satisfies these three requirements then w_2 cannot be takeover proof, since another contract has been found that satisfies the constraints of program (1) and attains an higher value of the objective function. The combination we use is:

$$\tilde{w} = \tilde{w}' + q \qquad T = T' - q$$

First observe that $\tilde{w} + T = \tilde{w}' + T'$ and $w_2 + T = w_2' + T'$. Thus:

$$E^{\tilde{w}+T}\left[\tilde{w}(V)|I'\right] = E^{\tilde{w}'+T'}\left[\tilde{w}|I'\right] = E^{\tilde{w}'+T'}\left[\tilde{w}'|I'\right] + q \tag{2}$$

and:

$$E^{w_2+T}(w_2(V, I' \cup \xi)|I') = E^{w_2'+T'}(w_2(V, I' \cup \xi)|I') = \tag{3}$$

$$E^{w_2'+T'}(w_2'(V, I' \cup \xi)|I') + q$$

for any value of ξ. To show that condition 1 is satisfied observe:

$$E^{\tilde{w}+T}\left[V - \tilde{w}(V)|I'\right] = E^{\tilde{w}'+T'}\left[V - \tilde{w}'(V)|I'\right] - q >$$

$$E^{w_2'+T'}\left[V - w_2'(V, I' \cup NO)|I'\right] - q = E^{w_2+T}\left[V - w_2(V, I' \cup NO)|I'\right]$$

where the strict inequality follows from the fact that $(\tilde{w}', T')$ takes over w_2'. Moreover, since $(\tilde{w}', T')$ takes over w_2', we have:

$$E^{\tilde{w}'+T'}\left[\tilde{w}'(V)|I'\right] \geq \max\left\{E^{w_2'+T'}\left[w_2'(V, I' \cup YES)|I'\right], w^*\right\}$$

which, together with (2) and (3) implies:

$$E^{\tilde{w}+T}\left[\tilde{w}(V)|I'\right] \geq \max\left\{E^{w_2+T}\left[w_2(V, I' \cup YES)|I'\right], w^*\right\}$$

Condition 2 is therefore satisfied. At last, condition 3 is obviously satisfied.

$\square$

Proposition 1 puts an upper bound on the wage that can be given to workers in the second period for any given wage paid in period 1. Therefore, the workers and the firm are not completely free to shift payments from one period to another as required by efficiency considerations. In particular, if the upper bound defined in proposition 1 is less than $2w^*$ when the first period wage is 0, then it must be the case that $w_1 > 0$, otherwise the workers would not join the firm. This introduces the possibility of bankruptcy.

Since bankruptcy is possible, the parties cannot be sure that all the contracted payments will actually take place. In particular, the parties could be willing to recontract the period 1 wage. Any given contract (w_1, w_2) thus generates functions $\underline{w}_1(R_1)$ and $\underline{w}_2(R_1, R_2)$ defining the actual payments to workers for any sequence (R_1, R_2). These functions are determined as the outcome of the game played between the workers and the firm after the contract is signed. In this game the firm, after observing R_1, makes a new proposal at the end of period 1, and the workers can accept or refuse the new proposal. Since we allow mixed strategies, it is understood that $\underline{w}_1(R_1)$ is, for a given R_1, a random variable.

A feasible contract (w_1, w_2) induces functions $(\underline{w}_1, \underline{w}_2)$ such that workers are given at least their reservation wage, the firm earns a non negative profit and no takeover occurs. More formally:

Definition 4 *A* **feasible contract** *is a contract w that induces functions $(\underline{w}_1, \underline{w}_2)$ such that:*

1. *$E(\underline{w}_1 + \underline{w}_2) \geq 2w^*$.*
2. *$E(V - \underline{w}_1 - \underline{w}_2) \geq 0$.*
3. *For any possible state of information at the end of period 1 $(\underline{w}_2)$ is takeover proof.*

Let us summarize the structure of the game:

- the firm and the workers sign a contract (w_1, w_2);
- R_1 is realized and becomes known to the firm. If the firm agrees to pay w_1 everything goes on as stated in the contract. Otherwise, it proposes a reduced wage $\hat{w}_1$ (there is no need to recontract w_2, since it can be agreed *ex ante* how it should change in case of renegotiation);
- if the firm proposes a wage reduction then the workers may accept or refuse. Let a and r denote acceptance and refusal, respectively. If the workers accept, the wage contract becomes $(\hat{w}_1, w_2(V, \hat{w}_1, a))$ (here $(\hat{w}_1, a)$ indicates that the information publicly known is that a proposal $\hat{w}_1$ has been made and it has been accepted). If it refuses, then either the firm is bankrupt, i.e. $w_1 < R_1$, or not. In the first case

the firm receives 0, while workers obtain R_1 in the first period and w^* in the second. In the second case w_1 is paid in the first period and the wage contract for the second period becomes $w_2(V, w_1, r)$.

- At this point a takeover may occur. If it occurs, the wage schedule becomes $w_2(V, I', YES)$, where I' includes the proposals of the firm (whether or not a wage cut was asked), the reaction of workers and the actually paid wage $\underline{w}_1$. The raider can propose a renegotiated wage $\tilde{w}(V)$. If workers accept then they are paid according to $\tilde{w}$. If they refuse, they can maintain the wage stated in original contract $w_2(V, I', YES)$ or leave the firm and earn w^* elsewhere.

2.1 Feasible Contracts and Efficiency

We now analyze the effect of the possibility of takeovers on efficiency. In our model, the main source of inefficiency is the possibility of bankruptcy at the end of period 1. Are there feasible contracts that avoid bankruptcy for sure? If the answer is yes, then takeovers are not harmful to efficiency. Otherwise, the restrictions imposed by the possibility of takeovers imply that bankruptcy occurs with positive probability. Since bankruptcy could be entirely avoided in the absence of constraints on the set of contracts, this is an inefficiency that can be attributed to takeovers.

We will show that when the upper bound on second period wages is severe enough then efficiency is impossible: In every equilibrium of the renegotiation game induced by a feasible contract, bankruptcy occurs with positive probability.

Suppose that the firm has proposed a feasible contract (w_1, w_2) and that the workers have signed it. At the end of period 1 the firm observes R_1 and decides whether to pay w_1 or ask for a wage reduction $\hat{w}_1 < w_1$. In the latter case the workers may accept or refuse. Acceptance yields:

$$\Pi^u(a, \hat{w}_1) = \hat{w}_1 + E[w_2(V, \hat{w}_1, a)|\hat{w}_1]$$

where expectation is taken conditional to firm's proposal, which represents new information about R_1 for the workers. Rejection yields:

$$\begin{aligned}\Pi^u(r, \hat{w}_1) \quad = \quad & \Pr(R_1 < w_1|\hat{w}_1)E(R_1 + w^*|\hat{w}_1, R_1 < w_1)+ \\ & \Pr(R_1 \geq w_1|\hat{w}_1)E(w_1 + w_2(V, w_1, r)|\hat{w}_1, R_1 \geq w_1)\end{aligned}$$

Denote by $q(\hat{w}_1)$ the optimal strategy of the workers after a wage proposal $\hat{w}_1$, with $q \in [0, 1]$ being the probability of refusing a wage cut.

Consider now the problem of the firm. It knows the realization of R_1 and it has to issue a wage proposal $\hat{w}_1 \leq R_1$, which will be rejected with probability $q(\hat{w}_1)$. If the proposal is accepted the profit of the firm is:

$$\Pi^f(\hat{w}_1, a) = R_1 - \hat{w}_1 + E\left(R_2 - w_2(V, \hat{w}_1, a)\right| R_1)$$

If the proposal is rejected profit is:

$$\Pi^f(\hat{w}_1, r) = \begin{cases} R_1 - w_1 + E\left(R_2 - w_2(V, w_1, r)\middle|\, R_1\right) & \text{if} \quad R_1 \geq w_1 \\ 0 & \text{if} \quad R_1 < w_1 \end{cases}$$

The case $R_1 < w_1$ is the one where bankruptcy occurs; the firm liquidates all its revenue toward the wage debt and then it is shut down.

We will look for perfect Bayesian equilibria of this game. The strategy of the firm will be denoted by $z(\hat{w}_1|R_1)$, indicating the probability of proposing $\hat{w}_1$ when first period revenue is R_1. We introduce the following definition:

Definition 5 *An equilibrium is* **efficient** *if the workers always accept an offer $\hat{w}_1$ when there is a positive probability that refusal will lead to bankruptcy, i.e. $q(\hat{w}_1) = 0$ whenever $z(\hat{w}_1|R_1) > 0$ for some $R_1 < w_1$.*

In an efficient equilibrium bankruptcy never occurs and the first best is achieved. The following proposition gives a sufficient condition for the first best to be impossible to achieve.

Proposition 2 *If the upper bound on the amount of payments which can be credibly shifted to the second period is tight enough, then all equilibria involve bankruptcy with positive probability.*

More precisely, if $\Pr(0) > 0$, *i.e.* 0 *has positive mass probability and the upper bound stated in proposition 1 is such that* $\overline{w}_2(I') < 2w^*$ *for each* *possible state of information I' at the end of period 1, then no equilibrium is efficient.*

<u>Proof</u>. In a no bankruptcy equilibrium every wage cut which is proposed with positive probability in the case $w_1 > R_1$ must be accepted. Since $\hat{w}_1 = 0$ is the only feasible proposal when $R_1 = 0$ occurs, it is observed with positive probability in equilibrium. Therefore workers may get less than $2w^*$ with positive probability, and in order to make them accept the contract they must be awarded more than $2w^*$ in other contingencies. This violates the incentive compatibility constraint for the firm. Suppose that a value of R_1 has occurred such that the firm is supposed to give workers a total expected wage $w_1 + E(w_2(w_1, V, a)|R_1) > 2w^*$. For the firm to be willing to accept to pay w_1 rather than proposing $\hat{w}_1 = 0$ the following inequality must hold:

$$w_1 + E(w_2(V, w_1, a)|R_1) \leq 0 + E(w_2(V, 0, a)|R_1) < 2w^*$$

where the last inequality follows from the assumption. Thus a contradiction is established. □

Proposition 2 shows how the constraints on a contract imposed by the possibility of takeovers may lead to inefficient outcomes. Only the constraints on the expected wage following $R_1 = 0$ are used to prove the proposition, although we have to assume that the constraints hold for all possible states of information.

3 A Numerical Example

We now provide a numerical example in which the conditions of Proposition 2 are satisfied and the inefficient result of bankruptcy occurs with positive probability.

In period 1 the revenue of the firm is 120 with probability $\pi = .9$ and 0 with probability .1. In period 2, revenue is 120 with probability 1, provided the debt is less than revenue. Public information at the end of period 1 can be summarized by the conditional probability that income in period 1 was 120, denoted π_I. The reservation wage is $w^* = 100$.

We must now explain how the possibility of bankruptcy affects the revenue of the firm in the second period, i.e. we must specify the function ϕ_I. We assume that 0 and 120 are still the only values that can occur for any probability distribution induced by a debt schedule. Total income V over the 2 periods is $0, 120$ or 240, so a debt schedule D is simply a triplet (D_0, D_{120}, D_{240}), with D_x denoting the amount due when total revenue is x. This allows us to express the function $\phi_I(D)$ simply as $p_I(D)$, the probability that income in period 2 will be 120 when the debt is D. Assume that only the amount of debt due when $V = 240$ influences the revenue of the firm. In particular, when $\underline{w}_1$ has been paid in the first period the probability that revenue will be 120 in the second period is:

$$p_I(D) = \begin{cases} 1 & \text{if} \quad D_{240} \leq 240 - \underline{w}_1 \\ 1 - \pi_I & \text{otherwise} \end{cases}$$

Thus, revenue in the second period is 120 if total debt is less than total revenue minus the first period wage bill, but if $D_{240} > 240 - \underline{w}_1$, then bankruptcy occurs when 120 is realized in both period and this leads to a decrease in the probability that the income in second period will actually be 120 (the particular form assumed is just to simplify computations).

Having explained how revenue depends on the possibility of bankruptcy, we can compute the upper bound $\overline{w}_2(I)$. Suppose $\underline{w}_1$ has been paid and π_I is the probability that firm's revenue in the first period was 120. Denote by $w_2(V, I', YES)$ the wage paid in second period when total revenue is V, information is I' and a takeover has occurred. Suppose that a raider borrows money to buy the firm offering a payment schedule:

$$T(0) = 0 \qquad T(120) = 120 - \tilde{w}_{120} - \underline{w}_1 \qquad T(240) = 240 - \tilde{w}_{240} - \underline{w}_1$$

with $\tilde{w}_{240} < w_2(240, I', YES)$. After the takeover, the raider offers the workers the renegotiated wage schedule $(0, \tilde{w}_{120}, \tilde{w}_{240})$. What should workers do? Notice that $T(240) + w_2(240, I', YES) > 240 - \underline{w}_1$, so if 240 is realized the firm will be bankrupt. If the workers refuse to renegotiate, firm's revenue in the second period is 120 with probability $1-\pi_I$ and 0 with probability π_I, so the expected wage would be:

$$E^D\left[w_2(V,I',YES)|I'\right] = (1-\pi_I)\left[(1-\pi_I)w_2(120,I',YES)\right] + \tag{4}$$

$$\pi_I\left[\pi_I w_2(120,I',YES) + (1-\pi_I)w_2(240,I',YES)\right]$$

If renegotiation is accepted the revenue is 120, so the expected wage is:

$$E^{\tilde{D}}\left[\tilde{w}(V)|I'\right] = (1-\pi_I)\tilde{w}_{120} + \pi_I\tilde{w}_{240}$$

It follows that workers will accept to renegotiate their wage if:

$$(1-\pi_I)\tilde{w}_{120} + \pi_I\tilde{w}_{240} \geq \max\left\{E^D\left[w_2(V,I',YES)|I'\right], w^*\right\}$$

Since $w_2(120,I',YES) \leq 120 - \underline{w}_1$ and $w_2(240,I',YES) \leq 240 - \underline{w}_1$, we conclude that the upper bound on compensation in period 2 is reached when $w_2(V,I',YES) = V - \underline{w}_1$ for each V. Substituting $w_2(120,I',YES) = 120 - \underline{w}_1$ and $w_2(240,I',YES) = 240 - \underline{w}_1$ into equation 4 we obtain:

$$E^D\left[w_2(V,I',YES)|I'\right] = 120 - \left(1 + \pi_I^2 - \pi_I\right)\underline{w}_1$$

so that the upper bound on wages is given by:

$$\overline{w}_2(I) = \max\left\{120 - \left(1 + \pi_I^2 - \pi_I\right)\underline{w}_1, w^*\right\}$$

Any wage schedule promising more than $\overline{w}_2(I)$ could be successfully renegotiated by a raider. There is no contract such that $w_1 = 0$ and workers get an expected value of at least $2w^* = 200$. If $w_1 = 0$ the upper bound in period 2 is $\overline{w}_2 = 120$. Since $\overline{w}_2 < 2w^*$, there is no way to give workers at least $2w^*$ in the second period.

On the other hand, any contract promising $w_1 > 0$ and an expected payment of $2w^*$ over the two periods, must be such that the workers refuse with positive probability to accept a wage cut at the end of period 1. Otherwise, the firm could always claim that $R_1 = 0$, ending up paying at most $120 < 2w^*$ over the two periods. In other words, when $w_1 > 0$ there is no equilibrium in which the workers accept a wage cut with probability 1, because in this case the firm would always ask for a wage cut and workers would be unable to obtain their reservation utility. Therefore, in equilibrium the workers must refuse a wage cut with positive probability and bankruptcy must occur with positive probability at the end of period 1, since when $R_1 = 0$ occurs the firm has to ask for a wage cut, but the workers refuse with positive probability. This positive probability of bankruptcy represents the welfare loss induced by the possibility of takeovers.

To complete the example, we now compute the equilibrium induced by a feasible contract and the probability of bankruptcy induced by the contract. The contract we consider prescribes a wage $w_1 = 120$ in the first period. The wage schedule in the second period depends on what happened in period 1. When a takeover does not occur, wages are as follows:

- If w_1 has been paid and the firm did not ask to renegotiate the contract then $w_2 = 92$ (if w_1 has been paid it is known that $R_1 = 120$, so $V = 240$ and there is no need to make the wage in second period contingent on revenue).

- If the firm asked to renegotiate but workers refused then $w_2(240, r) = 100$ (again, total revenue is known because w_1 was paid).

- If the firm asked to renegotiate and workers accepted then $w_2(240, a) = 120$, $w_2(120, a) = 120$.

If a takeover occurs and $\underline{w}_1 = 0$ then the wage schedule becomes:

$$w_2(120, YES) = 120 \qquad w_2(240, YES) = 240$$

If a takeover occurs and $\underline{w}_1 = 120$ then the wage in second period is still $w_2 = 92$.

In words, the contract works as follows. A wage $w_1 = 120$ is promised in period 1. If such a wage is paid, the wage in second period is 92. If $R_1 = 0$ the firm cannot pay w_1. In that case the firm will ask for renegotiation, and if the workers accept they are paid in the second period the maximum amount allowed by the takeover constraint, i.e. $\overline{w}_2(I) = 120$. If the workers refuse the wage cut, then the firm is bankrupt and the workers obtain the reservation wage $w^* = 100$, while the firm obtains zero. If a takeover occurs when $\underline{w}_1 = 0$ then wages are increased to their maximum level, in order to maximize workers' bargaining power. A takeover occurring after $\underline{w}_1 = 120$ is irrelevant, since the wage in second period cannot be pushed below the promised level.

Notice that the firm is tempted to claim that $R_1 = 0$ when $R_1 = 120$. However, if the workers refuse to renegotiate the firm is worse off, since it will have to pay $w_1 + 100$, more than what it would pay not having asked for renegotiation. If it were possible to make $w_2(240, r)$ high enough the firm would never ask for renegotiation when $R_1 = 120$, and the efficient outcome would be obtained. What makes this impossible is the upper limit due to the possibility of takeover (in this case $w_2(240, r) \leq \max\{120 - w_1, w^*\} = 100$).

The equilibrium is in mixed strategies. The firm cheats with a positive probability of $\frac{1}{45}$ when $R_1 = 120$, and the workers refuse with a positive probability of $q = .92$ a wage cut when proposed. If $R_1 = 0$ the firm always asks a wage cut, as this is the only thing it can do (the appendix contains the computations). The ex ante payoff for the workers is:

$$E(\underline{w}_1 + \underline{w}_2) = .1\,[qw^* + (1-q)w_2(120, a)] + .9\,[w_1 + w_2(ok)] = 200.96$$

which exceeds the reservation payoff. Any contract giving to the workers an expected wage of at least 200 over the two periods must induce bankruptcy with positive probability. The probability of bankruptcy is given by the probability that R_1 is 0 times the probability that workers refuse a wage cut, i.e. $(1 - \pi)q = 0.092$, in which case the revenue in the second period is zero rather than 120, a welfare loss induced by the possibility of takeovers. Without the takeover threat there would be no upper bound on the wage to be paid in the second period, so that the probability of bankruptcy could be reduced to zero.

4 Empirical Implications and Conclusions

The model previously described was highly stylized. It is obvious that in the real world some degree of contract incompleteness exists. However, the assumption that raiders can break previously existing agreements at will is also extreme. Furthermore, when it becomes clear that implicit contracts are dangerously easy to break, we should expect agents to try hard to innovate contractual arrangements in a way that makes them more resistant to raiders' attacks. The relevance of the insights obtained from complete and incomplete contracts models must therefore be checked using the available empirical observation.

In the 'complete contracts' model described in this paper takeovers do not happen. The model could be enriched in order to get takeovers with positive probability, e.g. by assuming that with positive probability some outsider is able to increase the revenue of the firm. In this case, the prediction of the model is that takeovers, when they occur, do not redistribute wealth from workers to shareholders.

The evidence on this is not conclusive, but there are reasons to think that redistribution may not play a big role in takeovers. Shleifer and Summers (1988) point out the case of TWA, where wage concessions apparently were twice the takeover premium. The case is suggestive, but it is not obvious that it is representative. Pointiff, Shleifer and Weisbach (1990) analyze pension asset reversions following takeovers. They find some evidence that hostile takeovers increase the probability of pension fund reversion, but conclude that "on average, pension fund reversions are too small to be the sole, or even the dominant, takeover motive". Rosett (1990) studies whether union wealth concessions caused by changes in real wage growth associated with takeovers explain target firm premia. He finds that, as an effect of takeovers, union losses approximate 1% to 2% of target shareholders' gains over the first six years and 5% in 18 years. Restricting attention to hostile takeovers, he finds a *positive* effect on wage growth. He concludes that redistribution from workers to shareholders is too small to play an important part in explaining takeover premia. However, the paper does not take into account losses induced by layoffs and reduction in employment levels. These are considered by Bhagat, Shleifer and Vishny (1990) who study 62 "big" (more than \$ 50 millions) hostile takeovers. They find that on average layoffs explain between 10% and 20% of the takeover premium, but are strongly concentrated in a few cases. In over half of the cases there is no evidence of layoffs. They conclude that "layoffs are clearly not the whole story behind hostile takeovers, and it is hard to believe that plans for future layoffs is an important takeover motive".

This is consistent with the point of view taken in this paper. Rational workers and rational managers will take into account the possibility of a takeover when designing the (implicit or explicit) employment contract. Thus, takeovers should never happen only, or mainly, for redistributive reasons.

A paper directly concerned with the issues considered here is Neumark and Sharpe (1992). While the papers previously cited analyzed the effect of takeovers on wages and employment in general, Neumark and Sharpe explicitly consider the effect on "extramarginal wages", i.e. wages which are higher than the marginal product of workers, presumably because of long-term implicit contracts. The question they try to answer is the following: Are firms with employees earning extramarginal wages more likely to experience hostile tender offers? They find some weak evidence of a positive answer. However, the proxies for extramarginal wages turn out to be non significant when controls for diversification and other factors are inserted.

An interesting result in Neumark and Sharpe is that the presence of lower than average extramarginal wages increases the probability of a firm going private. In our model this can be interpreted as follows: Firms with less than average extramarginal wages are firms that, because of the takeover threat, are unable to adopt the efficient compensation scheme. Thus, these firms should go private in order to shield themselves from the pressure of takeovers and be able to adopt more efficient compensation schemes.

To conclude, the analysis of this paper suggests that the *possibility* of takeovers has an impact on industrial relations, even if takeovers do not happen for redistributive reasons. We have shown that the possibility of a takeover puts constraints on the set of feasible wage contracts, and these constraints may damage the firm-workers relationship, sometimes leading to bankruptcy. The source of inefficiency that we find is specific to the publicly held corporation. Alternative institutional arrangements can overcome the problem, although a global assessment of the efficiency of different organizational forms is not attempted in this paper.

Appendix

We provide the details of the computations in section 3. Let q be the probability that workers refuse the wage cut and z the probability that a firm observing $R_1 = 120$ asks for a wage cut, and remember that if $R_1 = 0$ the firm always asks a wage cut, as this is the only thing it can do. The probability that $R_1 = 0$ given that a wage cut has been asked is:

$$\Pr(R_1 = 0|\text{cut asked}) = \frac{1-\pi}{1-\pi+\pi z}$$

Workers must be indifferent between acceptance and refusal, therefore the following equality must be satisfied:

$$\frac{1-\pi}{1-\pi+\pi z} w_2(120,a) + \frac{\pi z}{1-\pi+\pi z} w_2(240,a) =$$
$$\frac{1-\pi}{1-\pi+\pi z} w^* + \frac{\pi z}{1-\pi+\pi z} \left[w_1 + w_2(240,r)\right]$$

This yields:

$$z = \frac{1-\pi}{\pi} \frac{w_2(120,a) - w^*}{w_1 + w_2(240,r) - w_2(240,a)} = \frac{1}{45}$$

To compute q, observe that the firm must be indifferent between asking and not asking a wage cut when the revenue is $R_1 = 120$. Therefore:

$$240 - w_1 - w_2(ok) = 240 - \{q\left[w_1 + w_2(240,r)\right] + (1-q)w_2(240,a)\}$$

which yields:

$$q = \frac{w_1 + w_2(ok) - w_2(240,a)}{w_1 + w_2(240,r) - w_2(240,a)} = 0.92$$

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