THE EXISTENCE OF SELF-ENFORCING IMPLICIT CONTRACTS*

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Implicit contracts are nontrivial Nash equilibria to the post-hiring trading game between a worker and the employer. These are supported by intrafirm, rather than labor market, reputations. The existence of an implicit contract that supports efficient trade is proved in a simple model.

INTRODUCTION: ENFORCEABILITY AND IMPLICIT CONTRACTS

This paper is an effort to explain, in part, an empirical paradox in the U. S. labor market. Many types of behavior in this market, notably layoff and real wage behavior, have proved inexplicable if the labor market is modeled as a sequence of spot auction markets. However, if we treat trade in this market as being mediated via long-term contracts, we gain a great deal of explanatory power. A particular example of this is the progress made by the "implicit" contract literature [Azariadis, 1975; Baily, 1974; Gordon, 1974]. There is, though, one major problem with explaining U. S. labor market behavior in terms of optimal contracts, and that is that explicit labor contracts are rare. Indeed, labor contracts are almost coterminous with the unionized sector of the labor market, which means that, at most, 20 percent of the U. S. labor market is governed by contracts.[1] Thus, we have a puzzle: much behavior in the labor market seems to be explicable only in terms of long-term labor contracts, and yet such contracts are rare.[2]

This puzzle can be sharpened into the following two distinct,

    1. Even union contracts differ from the long-term contracts in the literature in being nonbinding on union members.
    2. The lack of explicit labor contracts does not per se imply a lack of labor contracts. In the goods markets, for instance, there are truly implicit contracts [Calamari and Perillo, 1977, pp. 9–20]. It is the employment-at-will doctrine that rules out implied contractual clauses and so allows us to conclude from the lack of explicit contracts that no contracts exist. This situation may be changing as in some states the courts appear to be starting to circumscribe the employment-at-will doctrine, e.g., *Toussaint* [1980], and find implied contracts instead, as in the McGraw-Hill case [Lewin, 1983].

but economically closely related, questions:
  (i) Given their lack of enforceability by the courts, why do so many agents in the labor market choose noncontractual agreements instead of contracts?
  (ii) Given their lack of enforceability, why are noncontractual agreements valuable?
An answer to the first of these questions based upon asymmetric information will be given in Section I. However, the bulk of the paper will concentrate on answering the second question. In doing so, it is important to note that an agreement can be broken in two distinct ways: either party can cease to trade with the other and trade instead with a third party, or either party can unilaterally change the terms of trade. The first form of breach will not occur if, after the worker has been hired, the transactions costs to both the firm and the worker of trading with a third party are prohibitive. Several sources of such transactions costs have been identified. On this see Hall [1980], Hall and Lazear [1984], Mayers and Thaler [1979], and Williamson et al. [1975]. Moreover, such costs can explain the observed job tenure data.[3] Thus, the assumption of prohibitive transactions costs of trading with third parties that is usual in the "implicit" contract literature[4] and that is adopted here may be a reasonable first approximation, at least for prime age males.

     Prohibitive transaction costs, however, do nothing to prevent the second form of breach—unilaterally changing the terms of trade. The only force that can prevent this is reputation. Holmstrom [1981] and Carmichael [1984] have tried to deal with this using market reputations. However, reputation effects are only as strong as the information flows that support them. Strong reputation effects require that accurate information about breach of the agreement flows rapidly to a large portion of the labor market. While in some labor markets, e.g., for economics professors, one might argue that information flows fulfill such requirements, it seems unlikely that they are fulfilled in most markets, e.g., unskilled or semi-skilled, blue-collar workers. In fact, it will be argued in Section I that it is precisely the very imperfect nature of information flows from the parties to the trade to third party enforcers that make contracts infeasible and force agents to choose

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     3. In 1978, 43 percent of all U. S. workers were in jobs that had lasted, or were expected to last, ten years or more. Twenty-eight percent were in jobs that had lasted or were expected to last twenty years or more. Approximately half the male workers aged thirty-five or over were in jobs lasting twenty years or more [Hall, 1982].
     4. Bull [1983] is an exception to this.

noncontractual agreements in the first place. Certainly the importance of word-of-mouth information transmission [Granovetter, 1974; Datcher, 1983] indicates that information is likely to flow slowly to the market. Accuracy of information is also a problem. The reputation effect itself will give rise to incentives for strategic information transmission; after a breach both parties have an incentive to claim that the other side is at fault. This, of course, compounds the inference problem of people in the market. For these reasons, it is unlikely that market reputation effects will, in many labor markets, be strong enough to support noncontractual agreements.

While the market will not have timely, accurate information on the outcomes of trades within the firm, the information flows within the firm will be fast and accurate. Given that we have assumed that upon hiring, the firm and the worker are locked into a finitely repeated trading game, these intrafirm information flows give rise to strong intrafirm reputation effects. It is these strong intrafirm reputations that will support noncontractual agreements.

We can, then, summarize the analysis of the paper as follows. Hiring is modeled as the firm and new hire entering into a finitely repeated, bilateral trading game. Anticipation of this provides the incentive for both sides to precommit to strategies via a long-term labor contract. However, the third parties who would enforce the contract cannot, unlike the firm and its workers, observe some of the outcomes of the trading game, and so these aspects of the trade cannot be written into the contract. Because of this problem, firms and workers enter into noncontractual agreements concerning the sequence of trades. As flows of information to third parties are very imperfect, it is intrafirm reputations that will support such agreements. We then define an implicit contract as follows:

DEFINITION. An implicit contract is a noncontractual agreement that corresponds to a Nash equilibrium to the repeated, post-hiring, bilateral trading game other than the degenerate agreement consisting of a sequence of Nash equilibria to the one-shot trading game.[5]

The paper is organized as follows. Section I presents the simple model of hiring in a labor market in which the rest of the analysis is conducted. The optimal contract is derived, and it is shown how the

5. If the hiring process together with the trading game were modeled as a game of incomplete information, then this definition would have to be modified to require the noncontractual agreement to be a sequential equilibrium.

informational asymmetry between the firm and workers on one hand and third parties on the other causes the contract to break down and so gives rise to incentives to form an implicit contract. Section II deals with the trading game and in particular the complications caused by the finite life of each worker and the infinite life of the firm. The existence of an implicit contract together with the corresponding intrafirm reputations is established. Section III contains some concluding comments.

I. TRADE WITH COMPLETE, EXPLICIT CONTRACTS

This section presents the simple model of hiring in a labor market within which the analysis of the paper will be conducted. It also shows the incentives to use a contract and how an information asymmetry can destroy the viability of some clauses in such a contract and force the parties to use a noncontractual agreement instead.

Every worker has a working life of finite length which, for ease of exposition, is assumed to be two periods long. Each worker is indexed by $s \ \epsilon \ (-\infty, \infty)$, the period in which he entered the labor market. Apart from this index, all workers are identical. In particular, they all have the same utility function over the consumption good c and their level of work effort e. The lifetime utility U_L^s of an individual who enters the labor market at s is given by

$$(1) \qquad U_L^s = U(c_s^s, -e_s^s) + \beta U(c_{s+1}^s, -e_{s+1}^s).$$

Here, and throughout the paper, the superscript denotes the individual's index, while the subscript denotes the time period. The above function is assumed to be increasing in all its arguments, quasi-concave, and to fulfill the conditions,

$$\lim_{c \to 0} \frac{\partial U(.\,,.)}{\partial c} = \infty, \qquad \lim_{c \to \infty} \frac{\partial U(.\,,.)}{\partial c} = 0,$$

$$\lim_{e \to 0} \frac{\partial U(.\,,.)}{\partial e} = 0, \qquad \lim_{e \to \infty} \frac{\partial U(.\,,.)}{\partial e} = -\infty.$$

The following restrictions are imposed:

$$c_t^s \epsilon \ [0, \infty), \ \forall \ t, \ e_t^s \ \epsilon \ [0, \infty), \ \forall \ t, \ 0 < \beta \leq 1.$$

In the labor market a job consists of a sequence or vector of payments to the worker, $y^s = \{y_s^s, y_{s+1}^s\}$ together with a sequence of effort levels, $e^s = \{e_s^s, e_{s+1}^s\}$. For simplicity, we assume that all workers have access to a perfect capital market on which the real

rate of interest r is such that $(1 + r)^{-1} = \beta$. Define the discounted present value of a vector of payments, y^s, as $V(y^s)$. Access to this capital market is crucial for the existence of an efficient implicit contract as it leaves the time path of payments free to be adjusted to provide the required strategic incentives. In contrast, in the implicit contract literature, because of a lack of access by workers to capital markets, the time path of payments must try to fulfill both an incentive and an income smoothing role.[6]

Assume that in every period new entrants to the labor market can assure themselves of a lifetime utility U by working elsewhere. Further, assume that having joined the firm it is prohibitively costly to leave the firm during one's working life.

Firms, in contrast to workers, are assumed to be infinitely long-lived institutions. The current owners of the firm are assumed to try to maximize the net present value of the firm. Labor is the only variable input to the firm, and the firm is constrained to hire zero or one worker of each index. The profit from hiring a new worker at s to perform a job (y^s, e^s) is given by

$$(2) \qquad \Pi(-y^s, e^s) = \pi(-y^s_s, e^s_s) + (1 + r)^{-1} \pi(-y^s_{s+1}, e^s_{s+1}),$$

where $\pi(.\,,.)$ is increasing in its arguments, quasi-concave, and fulfills

$$\lim_{e^s_{s+t} \to 0} \frac{\partial \pi}{\partial e^s_{s+t}} = \infty,$$

and

$$\lim_{e^s_{s+t} \to \infty} \frac{\partial \pi}{\partial e^s_{s+t}} = 0, \qquad t = 0, 1.$$

Assume that having hired a worker, it is prohibitively costly to fire him.

The hiring decision in this environment will depend crucially on the prevailing institutions because both parties know that, ex post, they will be locked into a bilateral monopoly and consequently a post-hiring bargaining game. This prospect provides a strong incentive for both parties to precommit themselves to strategies at the time of hiring, most obviously by the use of a multiperiod contract. See Klein et al. [1978], Hashimoto and Yu [1980], Hall and Lazear [1984], and Crawford [1982]. Let us assume, then, that there is perfect, costless enforcement of labor contracts provided by a third party which shall simply be called the courts.

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6. For a thorough analysis of the roles of capital markets and savings in implicit contracts, see Topel and Welch [1983].

Given this institutional setting, the firm's decision problem, because of the separability of the profit function across workers, is

$$(3) \qquad \max \Pi(-y^s, e^s), \ \forall s, \text{ subject to}$$
$$U_L^s \geqq \overline{U}$$
$$e_{s+t}^s \geqq 0, \qquad t = 0, 1$$
$$y_{s+t}^s \geqq 0, \qquad t = 0, 1.$$

It is crucial to note that the form of this maximization assumes that the firm can physically observe the worker's level of effort. This assumption will be maintained throughout the rest of the paper. Let the set of pairs of vectors $(\hat{y}^s, \hat{e}^s)$ that solve (3) for each s be denoted by S. The assumptions about the profit and utility functions ensure that S is not empty and that e^s is unique and positive, while the stationarity of the problem ensures that $\hat{e}^s$ is the same for all generations of workers. This is, of course, not true for $\hat{y}^s$. Given that the workers have access to perfect capital markets, that $\beta = (1 + r)^{-1}$, *and* that the stream of payments is guaranteed by the threat of enforcement by the courts, (3) only determines a unique $V(\hat{y}^s) > 0$.

At present there is no incentive for either party to use a noncontractual agreement of any kind. Note especially that removing the workers' access to some capital markets, as in the implicit contract literature, would give rise to incentives for the firm to smooth the time path of wage payments but would not give rise to any incentives to use noncontractual agreements. Consider instead introducing an asymmetry of information between the trading partners and the third party enforcers of the contract.[7]

While it may be reasonable to assume that the courts can observe, i.e., find objective data on, whether worker A is in fact working for firm B and on whether firm B pays worker A the amount specified in the contract, it is less plausible that objective data are available to the courts concerning the work effort expended by worker A. Time cards and pay slips provide evidence on the former, while only the testimonies of the employer, the worker, and his coworkers are usually available on the latter. This informational asymmetry makes the enforceability of the effort clause of the contract dubious, thereby raising the probability that the worker will breach the contract. In the limit, as the data available to the courts become completely uninformative, the effort clause becomes

completely unenforceable and so redundant. In this limiting case it is clear that the effort sequence in the set of optimal contracts S will no longer be incentive compatible and the worker will provide zero effort. A trade involving zero effort is inefficient, and so there is a strong incentive for both parties to enter into a noncontractual agreement concerning worker effort to complement the wage contract. Of course, to be of use, the agreement must be self-enforcing. The existence and structure of a self-enforcing, noncontractual agreement that will allow an efficient trade to take place is dealt with in the next section.

II. Trade with an Implicit Contract

We are interested in establishing the existence of a noncontractual agreement that will support the efficient trade that would be carried out in the presence of complete, costless contracting. This can be done most easily if some necessary conditions on the form of such a noncontractual agreement are established. These necessary conditions arise from the finite life, and so sequence of trades, of the workers.[8]

Consider an agreement that is in some sense a minimal deviation from a complete labor contract. The worker promises to provide the sequence of levels of effort $\hat{e}^s$ and in return the firm contracts to pay the worker a sequence of payments $\hat{y}^s$. Although this combination of a promise and a contract constitutes a productively efficient trade, obviously it is not strategically viable as, having signed the wage contract and joined the firm, the worker has a clear incentive to provide zero effort.[9] In particular, in order to ensure that the worker provides the required level of effort in the last period of his career with the firm, the firm must offer some payment, $R^s_{s+1} > 0$, which will be paid to the worker if and only if $e^s_{s+1} \geq \hat{e}^s_{s+1}$. This type of payment, a form of severance pay or bonding, is analogous to a nonvested pension or retirement bonus. See Lazear [1981, 1983] and Abowd and Manaster [1983].

This fact that the firm must promise a payment R^s_{s+1} after the

8. This feature differentiates the post-hiring trading game from the infinitely repeated trading games dealt with in the oligopoly literature pioneered by Friedman [1971, 1977]. The approach used here of having the finitely lived players' information sets overlap has been used in Hammond [1975] and Berman and Schotter [1982].
9. The worker is assumed to ignore the risk of bankruptcy on the part of the firm. This would be correct if the firm's labor force were large and the workers behaved noncooperatively.

completion of the worker's last period of work is important. Because the payment of R_{s+1}^s is conditional on the worker's effort, it cannot be enforced through the courts and so cannot be part of the explicit labor contract. Moreover, the payment occurs after the worker's last period of work; i.e., the firm (the infinitely lived player) has the last play in the game against the worker (the finitely lived player). Thus, although initially the lack of enforceability of the effort clause of the labor contract created the problem of how to make the workers keep their promises about effort, we see that in order for the productively efficient trade to take place, the firm must also be made to behave honestly.

In order to simplify the analysis, we restrict the firm's strategy set by the following two assumptions.[10]

A1. The only conditional payment the firm can agree to make is a single payment $R > 0$ after the last period of each worker's career with the firm.

A2. The firm must pay either all of R to the worker or none of R to the worker.

Both of these assumptions work against a successful noncontractual agreement by restricting the firm, if it wishes to break the agreement, to breaking the agreement totally and after the worker has completed his career.

One final assumption is needed before the post-hiring trading game can be analyzed. Define a payment scheme as a pair $(\hat{w}, R)$, where $\hat{w}$ is a nonnegative vector of contractual wage payments and R is a payment that the firm promises to make if and only if the worker provides $\hat{e}^s$. Let S be the set of payment schemes that would yield a firm which honestly followed the scheme nonnegative profits given that, at entry, each new worker planned to fulfill the agreement concerning effort. Let all potential employees have a common prior probability p^H on the honesty of each firm in the industry. For any given payment scheme, the expected utility from joining a firm and providing $\hat{e}^s$, denoted by $EU(p^H; w, R)$, is increasing in p^H. The expected utility from joining a firm and providing zero effort, denoted by $EU(\hat{w})$, is, however, independent of p^H and R. Thus, in order to have productively efficient trades take place, it is necessary that a firm can adopt a payment scheme that can attract workers, give them an incentive to provide $\hat{e}^s$ and that will, if adhered to by

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10. In view of the stationarity of the problem, to simplify notation the sub- and superscripts on R are dropped.

the firm, yield the firm nonnegative profits. We therefore assume
A3. p^H is such that for at least one payment scheme in S,

$$EU(p^H;\hat{w},R) \geqq \overline{U}$$

and

$$EU(p^H;\hat{w},R) \geqq EU(\hat{w}).$$

Notice that this assumption is phrased as a restriction on the workers' prior beliefs. However, to the extent that these beliefs are a function of the true fraction of honest firms in the labor market, this is really an assumption concerning the existence of a certain type of labor market equilibrium. The question of the existence of a labor market equilibrium such that workers have rational expectations which fulfill A3 is discussed briefly at the end of this section.

The post-hiring trading game can now be examined. The asymmetry of information between third parties and the worker-firm combination means that unattached workers in the market have no information with which they can distinguish honest and dishonest firms. They will therefore, given A3, join a randomly chosen firm and in their first period of work there provide $\hat{e}_s^s$. At the end of this period, worker s observes whether worker $s - 1$ provided $\hat{e}^{s-1}$ and whether that worker receives R or not. On the basis of this observation worker s carries out the following strategy.

S1: (a) If $s - 1$ provided $\hat{e}$ and received (did not receive) R, then s goes on to provide $\hat{e}_{s+1}^s$ (zero effort).
   (b) If $s - 1$ did not provide $\hat{e}$, then s goes on to provide zero effort.

The rationale behind (a) stems from the workers' belief that firms in the industry follow a pure strategy of either fulfilling the noncontractual agreement—being honest—or of not fulfilling it—being dishonest. Given this belief, a Bayesian worker would conclude that he was with an honest (dishonest) firm if he observed R being paid (not paid) and so would choose to provide (not provide) effort in his last period with the firm. From the stationarity of the problem, if worker s observed that $s - 1$ did not provide $\hat{e}$, then he would conclude that he was with a dishonest firm and so should not provide effort in his last period.

For this strategy to be part of a Nash equilibrium that will support the efficient trade, the firm, when maximizing against this

strategy, must choose a pure honesty strategy. Define

$$\Pi_t^H = \Pi(-w_t^t, e_t^t) + \beta(-\hat{w}_{t+1}^t - R, e_{t+1}^t) \qquad \text{and}$$

$$\Pi_t^D = \Pi(-w_t^t, e_t^t) + \beta(-\hat{w}_{t+1}^t, 0).$$

Then the efficient trade will constitute a Nash equilibrium under the conditions of the following proposition.

PROPOSITION 1. Given the utility and profit functions of the previous section and assumptions A1–A3, then strategy S1 by all workers and a pure honesty strategy by the firm constitutes a Nash equilibrium if, and only if, for all s

$$\Pi(-\hat{w}_{s+1}^s - R, \hat{e}_{s+1}^s) + \sum_{t=s+1}^{\infty} \beta^{t-(s+1)} \Pi_t^H$$

$$> \Pi(-\hat{w}_{s+1}^s, \hat{e}_{s+1}^s) + \sum_{t=s+1}^{\infty} \beta^{t-(s+1)} \Pi_t^D.$$

Proof of Proposition 1. See Appendix.

The condition contained in this proposition is intuitively appealing. The firm's "punishment" for dishonesty consists of reduced effort on the part of future workers, and so one would expect that if the firm had a discount rate of infinity ($\beta = 0$) or its profits did not depend upon effort, then the pure honesty strategy would not be optimal. This is, indeed, the case. With $\beta = 0$, the condition reduces to $\Pi(-\hat{w}_{s+1}^s - R, \hat{e}_{s+1}^s) > \Pi(-\hat{w}_{s+1}^s, \hat{e}_{s+1}^s)$ which is never fulfilled while if the firm's profit function is independent of effort $\Pi_t^H < \Pi_t^D$, for all t, and again the condition is violated. Similarly, as one would expect, the smaller is R, the smaller are the gains from cheating, i.e., not paying R, and so the easier it is to fullfill the condition in Proposition 1.

Given that the condition in Proposition 1 holds, we have seen that an implicit contract exists and, moreover, that one exists which will support the efficient trade that would have taken place under full, costless, explicit contracting. This does not mean that, from an efficiency point of view, the absence of explicit contracts is insignificant. In a market equilibrium, P^H, the unattached worker's prior belief that a randomly chosen firm will turn out to be honest, would reflect the actual proportion of honest firms in the market. In such an equilibrium, if it exists, unattached workers would bear a risk that would not be present if costless and complete explicit contracting were available. Moreover, the mix of honest and dishonest firms in market equilibrium will differ between explicit and implicit

contracting equilibria which could have adverse effects from the point of view of productive efficiency. For an explicit example in which the existence and efficiency of such market equilibria are discussed, see Bull [1985].

III. CONCLUSIONS

The previous sections have given an answer to why implicit contracts are used to mediate a large proportion of all trades despite the fact that from an enforcement point of view they are worthless. In Section II it was shown that such "gentlemen's agreements" can bind parties ex post to trade and so fulfill the role of a legal, multiperiod contract.

Perhaps the most encouraging aspect of the paper is that it holds out the hope of understanding some of the "myths" and "traditions" surrounding the labor market rather than dismissing them as the attempts of economically beknighted participants to rationalize their actions.[11] The "image" or "reputation" of the industry to potential workers, p^H in the paper, is in fact an important restriction on the types of implicit contracts that can be arrived at. In the model of this paper, if the potential workers' perception of the industry is that it is populated by rogues who would break any promise, then no implicit contract could exist. In the same vein, the objection to myopic profit-maximizing behavior toward older employees is often that such behavior would be regarded as "unfair" by, and would result in a loss of "morale" among, the workforce. In the model of the previous sections, such myopic profit maximization would result in a discrete drop in the expected utility of the young workers, and presumably long faces around the plant, together with reduced labor effort, all of which could be described as an unprofitable drop in the morale of the workforce. Moreover, when asked why they were behaving in such a way, the young employees might well complain about the unfair breach of a promise on the part of the employer.

APPENDIX

Proof of Proposition 1. S1 is obviously an optimal response to firms playing pure honesty or pure dishonesty strategies. Consider any strategy by the firm that, with probability one, will involve not

11. The use of a repeated resource allocation game to explain customs and social institutions has been developed by Schotter [1981].

paying R to a worker that has supplied $\hat{e}$. Denote the set of such strategies by Ω. The only feasible strategies not in Ω are the pure honesty strategy and mixed strategies that require the firm to be dishonest with probability zero. These latter strategies will be treated as the equivalent of pure strategies. Let the worker who is first dishonestly treated under strategy ω in Ω be s and so the period in which this occurs is $s + 1$. The firm's profits up to $s + 1$ are the same under ω as under the pure honesty strategy. Thus, for the latter to dominate the former it must generate higher discounted profits as of $s + 1$. These profits under a pure honesty strategy are

$$\Pi(-\hat{w}^s_{s+1} - R, \hat{e}^s_{s+1}) + \sum_{t=s+1}^{\infty} \beta^{t-(s+1)} \Pi^H_t.$$

Alternatively, if the firms does not pay R at $s + 1$, its discounted profits are

$$\Pi(-\hat{w}^s_{s+1}, \hat{e}^s_{s+1}) + \sum_{t=s+1}^{\infty} \beta^{t-(s+1)} \Pi^D_t.$$

Hence, the firm will only choose a pure honesty strategy over a strategy in Ω if the condition in Proposition 1 is fulfilled.

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