Relational Contracts under Uncertain Conditions: An Experimental Study

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EXTENDED ABSTRACT

The efficiency wage theory is one of the foremost explanations for the existence of wage rigidity. The fair wage-effort version of the theory (Akerlof [1982, 1984], Akerlof and Yellen [1990]) based on psychological theories (Homans [1961] and Adams [1963]) claims that an increase in wages raises workers' effort if wages have been below a fair reference wage level. For this reason, paying wages above market clearing level might be profitable to the firm. It is well documented in interview labor market studies (Agell and Lundborg 1995, 1999, Bewley 1998 (in recessions the firms fire the least productive/lazy/worst workers), Blinder and Choi 1990, Campbell and Kamlani 1997, Kaufman 1984) that employers are reluctant to hire outside workers who offer their labor services below the prevailing wage. Employers recognize that the wage paid to workers is one of the factors influencing workers' morale. Workers receiving higher wages appreciate the generosity and respond by exerting a high effort in return. A low wage, on the other hand, might be perceived as a lack of trust of the employee or might signal a relatively low importance of the job, and thus workers might perform poorly. The fair wage-effort version of efficiency wage theory has received support in experimental works of Fehr, Kirchsteiger, and Riedl [1993, 1998]. The positive correlation between wage and effort in static conditions has been demonstrated in other experimental studies as well (Fehr, Gächter, and Kirchsteiger [1997], Fehr and Falk [1999], Brown, Falk, and Fehr [2004] and many others).

We create a laboratory environment in which technological shocks take place. Firms engaging in long term relationships with workers can choose to react or not to react to such changes by decreasing wages or maintaining them at the current level and thus forgoing parts of their profits. A decrease in wages corresponds to a temporary transfer of the shock burden onto workers. The profit maximizing firm might be interested in a long-term relationship because of the idiosyncratic asset of the worker -- the reputation with the firm. If the firm knows that the employee works hard then it might pay him a higher wage to induce higher effort and to keep him for future periods. Hiring a new worker from the market without an established reputation with the firm brings uncertainty about his job-related characteristics. Even if the firm could hire a new worker and pay a lower wage, such decisions do not necessarily need to be optimal because of the nature of hidden action under the incomplete contract.

We report the results of a laboratory experiment studying whether firms are willing to continue paying high wages to the workers when they face negative technological shocks. The shocks bring unfavorable conditions for maintaining the employer's reputation because firms have to decide whether to absorb their effects themselves or to transfer them on to the workers which might mean damaging their own reputation and perhaps decreasing the probability of the continuation of a successful relationship. We do not find support for downward wage rigidity in the data. Once the shocks occur, firms lower the wages and relationships often break down. The workers who accept a lower wage respond with exerting a lower effort. We conjecture that the subjects' behavior is driven by uncertainty about the technology coefficient and a perceived entitlement to profit similar to the one in previous period. Further exploration of reasons why relationships break down will give useful insight in regard to other major issues related to labor markets, such as the complexity of decisions of labor market participants given the repeated interactions, trust between two contracting parties, determinants of involuntary unemployment, and the importance of asymmetric information about the technological shocks. All the above are relevant for labor market policy implications.

INTRODUCTION

The efficiency wage theory is one of the foremost explanations for the existence of wage rigidity. The fair wage-effort version of the theory (Akerlof [1982, 1984], Akerlof and Yellen [1990]) based on psychological theories (Homans [1961] and Adams [1963]) claims that an increase in wages raises workers' effort if wages have been below a fair reference wage level. For this reason, paying wages above market clearing level might be profitable to the firm. It is well documented in interview labor market studies (Agell and Lundborg 1995, 1999, Bewley 1998 (in recessions the firms fire the least productive/lazy/worst workers), Blinder and Choi 1990, Campbell and Kamlani 1997, Kaufman 1984) that employers are reluctant to hire outside workers who offer their labor services below the prevailing wage. Employers recognize that the wage paid to workers is one of the factors influencing workers' morale. Workers receiving higher wages appreciate the generosity and respond by exerting a high effort in return. A low wage, on the other hand, might be perceived as a lack of trust of the employee or might signal a relatively low importance of the job, and thus workers might perform poorly. The fair wage-effort version of efficiency wage theory has received support in experimental works of Fehr, Kirchsteiger, and Riedl [1993, 1998]. The positive correlation between wage and effort in static conditions has been demonstrated in other experimental studies as well (Fehr, Gächter, and Kirchsteiger [1997], Fehr and Falk [1999], Brown, Falk, and Fehr [2004] and many others).

This study focuses on the question whether or not firms in long-term relationships are willing to continue paying high wages in order to keep workers when they face negative technological shocks. An environment with negative exogenous shocks is a more appropriate experimental test for the existence of wage-rigidity because it brings stronger incentives to decrease the wage than a setting when market conditions are relatively stable or improving. This work is intended to be a boundary experiment testing for the presence of downward wage-rigidity. Our objective is to shed more light on the increased complexity of decisions of labor market participants given the repeated interactions while increasing the proximity to market conditions.

We create a laboratory environment in which technological shocks take place. Firms engaging in long term relationships with workers can choose to react or not to react to such changes by decreasing wages or maintaining them at the current level and thus forgoing parts of their profits. A decrease in wages corresponds to a temporary transfer of the shock burden onto workers. The profit maximizing firm might be interested in a long-term relationship because of the idiosyncratic asset of the worker -- the reputation with the firm. If the firm knows that the employee works hard then it might pay him a higher wage to induce higher effort and to keep him for future periods. Hiring a new worker from the market without an established reputation with the firm brings uncertainty about his job-related characteristics. Even if the firm could hire a new worker and pay a lower wage, such decisions do not necessarily need to be optimal because of the nature of hidden action under the incomplete contract.

Brown, Falk, and Fehr [2004] (henceforth BFF) set up a labor market with observable identification numbers (IDs) of players, thus allowing for reputation building and for the possibility of repeated interactions between firms and workers in incomplete contracts. The workers could choose any effort regardless of what was agreed upon in the contract. This treatment is contrasted with two other treatments: a complete contract condition with the effort level enforced by the experimenter and with a treatment which has random reassigning of IDs after each period to rule out the possibility of building a reputation. The results demonstrate that without third party enforcement the majority of trades are initiated by private offers by firms to the workers and the surplus is shared. The threat of relationship termination disciplines workers to exert high levels of effort throughout all the periods. Competition resulting from excess labor supply seems to have little impact on the contracts; both parties prefer to stay in a more profitable long lasting relationship. If contracts are third party enforceable, then most trades are one-shot and initiated through public offers. As a result, surplus sharing and long-term relations disappear.

In the current experiment, we alter the BFF design of incomplete contracts by incorporating technological shocks. The comparison of the experimental treatments with shocks and without enables us to give a different perspective on the importance of idiosyncratic assets in a long term relationship.

In our design a firm observes the realization of the technological shock at the start of the period, a worker only after the period is over. The information about the shock can affect the players in two ways. First, if the worker does not know the realization of the shock, he has no means to evaluate whether the wage offered by the firm is either high enough or too low. Provided the firm is concerned with its reputation, the firm might want to offer a wage tied to the realization of the shock. Furthermore, if the firm is concerned with keeping the worker for the next period, it might decide to add a premium to the wage in case of a negative shock. Such a premium signals willingness to continue the relationship and encourages the worker to exert high effort. However, if the firm is not concerned with its reputation and the firm is self-regarding, it will offer a low wage whenever the realization regardless of the shock. Also, since the worker does not know the information about the realization, the firm can pretend the realization was negative and offer a low wage. Similar aspects of behavior can be found in the experimental literature on ultimatum games. As Camerer [2003] notes, most studies investigating the asymmetry of information reveal that responders accept less in the condition with low information when they only know the distribution of possible pies or nothing at all. The proposers exploit this behavior and offer low shares even if the stake is high (see Camerer and Loewenstein [1993], Straub and Murnighan [1995], Croson [1996], Raporport, Sundali, and Potter [1996], and Gűth and Hűck [1997]).

1. EXPERIMENTAL DESIGN

We implement two experimental conditions: technological Shocks and a constant technology coefficient (No Shocks). As observed by BFF, repeated transactions with the same partner are possible and common because subjects had fixed ID numbers and therefore, the contracts could be offered to specific traders in each period. The presence of a shock changes a marginal revenue product of firms.

In both experimental conditions, the material payoff of a firm is given by

$$\pi_f = \begin{cases} A*e-w & \text{if a contract is concluded} \\ 0 & \text{if no contract is concluded} \end{cases}$$

Where e is the effort level, w is the wage paid and A is the technology coefficient in the production function. A is a random variable exogenously drawn by nature.

Workers receive a payoff

$$\pi_w = \begin{cases} w-c(e) & \text{if a contract is concluded} \\ 5 & \text{if no contract is concluded} \end{cases}$$

Where c(e) is the cost of exerting effort. The reservation wage of a worker is 5 (i.e., the unemployment benefit of a worker who has no contract concluded is 5). The feasible set of effort is {1, 2, …, 10} and the feasible set of wage is {1, 2, …, 100}. The cost schedule for the workers is presented in Table 2.

Table 2. Cost of Effort Schedule.

Total Effort	1	2	3	4	5	6	7	8	9	10
Total Cost	0	1	2	4	6	8	10	12	15	18
Marginal Cost	0	1	1	2	2	2	2	2	3	3

In each laboratory session, there are 17 subjects participating. 7 subjects play the role of firms and 10 subjects take the role of workers. Identification numbers (IDs) 1, …,7 are assigned to the firms and IDs 1,…,10 are assigned to the workers. A subject's role and ID is fixed during the whole experiment. There are 15 trading periods. Each period lasts 3 minutes. A firm can employ at most one worker and a worker can accept a maximum of one job offer per period. Therefore, there is always an excess supply of three workers. Once a worker accepts one of the offers, a contract is concluded and both the firm and the worker are removed from the market. The workers' payoff function (2), the number of firms and workers, the cost schedule c(e) and the length of the experiment being 15 trading periods is common knowledge among all subjects. All subjects know the format of the firms' payoff function (1). However, whether the technology coefficient A is observed by a market participant depends on the experimental conditions. The detailed description of the two conditions is as follows.

Technological Shocks (Condition S)

In this condition, at the beginning of each trading period, the technology coefficient A is assigned to the firms. A is either equal to 10 or 7, with a 50/50 probability. There is a new drawing of A each period for each firm. This information is common knowledge among all firms and all workers. Each firm observes its own technology coefficient as soon as A is assigned. However, a firm does not observe other firms' technology coefficients. A worker does not observe any firm's technology coefficient at this point.

A trading period has two stages. In the first stage, firms make contract offers to the workers. A worker can either accept one of the offers or deny them, in which case she earns 5 experimental dollars. A contract offer includes a wage w, a desired effort level and the firm's ID. Firms can either make private or public offers. For private offers, the firm specifies a worker's ID in the contract. Then only the worker whose ID is specified in the contract is informed about the offer and only that worker has the ability to accept the offer. For public offers, all workers are informed about the offer and as a consequence all workers can accept the offer. Firms always observe the workers in the market who have not yet accepted any offer. This is done to prevent firms from making private offers to the workers who are not available anymore.

During the trading period a firm can make as many private and public offers as it wants. However, as soon as a worker takes one of its offers, all its other standing offers will immediately disappear from the market. Then the firm is matched with that worker and the firm observes the worker's ID. If a firm and a worker conclude a contract, they will enter the second stage. In the second stage, the worker chooses the effort level e. At the end of each trading period, payoffs are determined and each firm's technology coefficient A is revealed to all firms and all workers.

No Shocks (Condition N)

In this condition, the market participants' IDs are fixed and there is no technological shock. The technology coefficient A is always fixed at 7 for all firms, representing a permanent negative shock. A is common knowledge among all subjects. The procedure in the N condition is identical to that of S condition.

2. RESULTS

The experiment was computerized using the "z-tree" software (Fischbacher 1999). We ran four S sessions (S1-S3 and S 7) and three N sessions (N1-N3) sessions in the Economic Science Laboratory, University of Arizona and three S and N (all labelled 4-6) sessions at SHUFE Economics Lab in Shanghai, China in spring semester 2006. The recruited subjects were all undergraduate students from the respective universities. However, there were 2 sessions in Arizona (S7 and N3) where less then 17 subjects showed up and several graduate students from Economics, Finance, and Accounting were asked to serve as subjects to fill in the empty spots. The average payoff in the sessions conducted in Arizona was 25 USD. The average payoff in the sessions conducted in Shanghai was 30 Yuan (8 Yuan = 1 USD) per person. In Shanghai, the average salary of a college graduate is about 12 Yuan per hour. The average salary of a University of Arizona student was around 7 dollars per hour at the time of the experiment.

Before starting the experiment, the subjects were asked to read the hard copy of instructions (provided in appendix) and answer the questionnaire testing their understanding of the setup. The experimenters then displayed the correct answers and responded to subjects' questions (if any). Then a verbal part of the protocol followed. The experimenters read from a script that the show up fee would be credited to the payoff account at the beginning of the experiment. Any profits would be added to this amount and any losses would be subtracted from the show up fee. The script is available from the authors upon request.

The subjects then participated in two trial periods without monetary incentives to become familiar with the software, followed by 15 trading periods. One session lasted approximately 100 minutes. Each subject participated in only one session. The sessions were run under single-blind social distance protocol. The instructions and experimental design were framed as a market with buyers and sellers. We implemented an across-subjects design; that is, different subjects participated in the experimental market S and N.

Wages

We start with the description of the data for the two conditions. In six N sessions the lowest observed wage was 1 in period 11 of session N4, the highest 60 in period 1 of session 5. The average wage across all periods of the N six sessions was 26.94.

In seven S sessions the lowest wage was 1 and was observed three times - in periods 10 and 15 of session S7 (once by firm 1 and once by firm 2; in the first case the coefficient A was equal to 10, in the second case it was equal to 7) and in period 1 of session S6 (firm 2, coefficient 10). The highest wage was 100 offered also twice -- in period 8 of session S2 and in period 6 of session S5. The realization of A was both time 7. The average wage offered in condition S was 28.80 (26.37 for A=7 and 31.04 for A=10).

One way of examining the wage rigidity under temporary negative technological shocks is to compare the wages that firms offer in condition S when hit by the shock with wages offered in its absence. Firms engaged in a long term relationship with their workers face three types of incentives when their technology coefficient is decreased. First, they might be willing to lower the wages in order to transfer the burden onto workers (decrease workers' rent). The finding that more productive firms offer higher wages has been documented in Fehr, Gächter and Kirchsteiger [1996] and Fehr, Kirchsteiger, and Riedl [1996]. Second, if the firms are aware of a positive correlation between wage and effort, they might be reluctant to lower the wages to prevent the effort from going down as in Fehr, Kirchsteiger, and Riedl [1993]. Third, BFF find that firms might be concerned that a lower wage could decrease the probability of continuation of a successful relationship.

What do the data from condition S say about wage rigidity? The average wage offered by firms who experienced a negative technological shock in a given period exceeds the average wage of firms which have not experienced it only in periods 7, 8, 10, and 12. We apply a nonparametric Mann-Whitney test to session averages as individual observations to test the hypothesis that the wages are equal. The null is rejected at p=0.003. If we use the pooled data instead of session averages, the null is rejected at p=0.000. We conclude that under the negative technological shock the incentive to share the burden with workers is stronger than incentives for maintaining the wage at the no-shock level and hence we do not observe wage rigidity in our setting.

We also report the outcome of the interaction between the effect of different productivity levels per se on wage determination and the asymmetric information about the technology coefficient. It is intuitive that the two effects work in the opposite direction as asymmetric information could allow the firms to decrease the wages pretending there was a shock. No matter whether we treat the session averages as individual data or use pooled data, the tests yield qualitatively the same result: The wages in the S condition are on average higher in the absence of the negative technological shock than in the N condition (p-value = 0.008 and 0.000, respectively). This suggests that firms pay more attention to differences in productivity levels than to asymmetric information when setting wages.

Another way of looking at wage rigidity and at the same time answering our main research question is to compare the wages in N condition with those in S condition when a shock occurred. This corresponds to a comparison of wages offered under a permanent versus a temporary shock. It is obvious that if a shock is permanent, a profit maximizing firm would not be willing to incur per period losses just to keep the current workers because even in the long run there is no possibility of recouping the lost profits. Therefore, the wage level in N constitutes a natural benchmark as to how low one would expect the wages to drop in a labor market with an idiosyncratic asset.

The firms in the S condition are on average more productive (A equals to 7 or 10) than in the N condition (A always equals to 7). We have previously concluded that the more productive firms in condition S of our experiment offer higher wages. Therefore, the firms in the S condition should on average offer higher wages than in N. The question is whether firms offer higher wages also in the bad periods of S when the technology coefficient A is equal to 7 just like in N. If the wages in condition S do not fluctuate and are above the wage level in N, then the data provide support for wage rigidity. Such wage rigidity is caused by the employer's concern for long-term relationship.

The average N wage was lower than S_7 in 7 out of 15 periods (4, 7, 8, 10, and 12-14). The average wage across all periods is almost the same (26.94 in N versus 26.37 in S_7). Not surprisingly the Mann-Whitney test with session averages as individual observations does not reject the null that the wages in the two samples are equal (p = 0.350), nor does the one with pooled data (p=0.289). The result that firms offer the same wages in N as in S_7 does not support our prediction that firms absorb shocks to keep the good workers. It provides further evidence against the wage-rigidity in the boundary conditions of laboratory environment. It also demonstrates the BFF result on the strength of long-term relationships with an idiosyncratic asset not to be robust to negative technological shocks.

We conclude that the firms recognize the benefits of a long-term relationship and in the presence of a temporary negative shock do not set wages as low as firms engaged in one-shot interaction would. The previous statement is backed up by another observation. As time progresses, firms are making more and more private offers (that lead to contracts) in conditions N and S, but not SR. Moreover, the vast majority of the private offers are to the same worker as in the preceding period. The firms and workers thus engage in a relationship lasting more than one period. Note that the average number of such contracts in S is lower than in N (p-value < 0.01), yet it is still increasing over time. Naturally, since the maximum number of contracts in each period is seven, the number of accepted public offers is decreasing in conditions N and S.

Wage-Effort Relation

In this section we check whether a higher wage induces a higher effort of workers in our data. We find that both the average and median effort levels are increasing in wage.

The correlation between wage and effort is higher in the condition N and yields 0.87. The correlation in conditions S is equal to 0.73. In both cases Spearman's correlation test rejects the independence of wage and effort (p=0.000).

The estimated coefficients of the $effort=\alpha+\beta\cdot wage+\varepsilon$ regression are all positive and significant in all three conditions and provide a strong support for a fair wage-effort theory and against the hypothesis H7.

Last, we test check whether the effort level in the last periods of conditions N and S is higher than the theoretical prediction for self-regarding workers in a one-shot game. We use the Kolmogorov-Smirnov test for individual data against the prediction that effort is equal to 1. In all cases K-S tests reject the null.

Relationship Break-ups

In the previous sections we have demonstrated that the presence of negative technological shocks decreases wages and that lower wages result in lower effort levels. But what are the overall consequences of negative shocks to relationships? Are relationships stable in such conditions or do they break up?

First we analyze what happens in the condition S when A drops from 10 to 7 between two consecutive periods. To analyze the relationships we focus our attention on the data where the firm made a private offer in the period with A = 10. One might argue that a relationship could be formed even through a public offer. However, including relationships which started up through public offers would include cases when a firm was just feeling out the workers and thus would provide a noisier measure of break ups.

If a firm made a private offer in the period when A=10 then there are three possibilities what could happen in the next period with A=7. The firm could make a private offer to the same worker; the firm could make a private offer to another worker; or the firm could offer a wage publicly. The first scenario indicates the firm wishes to continue the relationship, whereas the latter two indicate the opposite. Conditional on that the firm wishes to continue a relationship and offers privately to the same worker, the relationship can also be terminated if the worker declines the offer.

As A drops from 10 to 7 we observe a total of 108 accepted private offers in the "first" period. The firms that made these private offers on average lower the wage by 2.40 in the "second" period after their coefficient drops to 7.

The relationship breaks down a total of 43 times (39.8%). Out of the 43 discontinued relationships, 32 are terminated by firms that made either a public offer or a private offer to another worker; 11 times the offer is rejected by workers. There are 65 relationships that survived the negative shock. The main reason why they survived is that the 65 firms offered a wage only by 1.09 lower than in the "first" period. The wage offered after the shock still had a negative impact on the effort level as those workers who accepted the new wage decreased their effort on average by 0.82.

Next we compare the relationships in which the firms offer a lower wage after the shock with those where firms offer the same wage or a higher wage. In 48 out of the 108 relationships we examine firms lowered the wage. There are 39 firms which did not change their wages and 21 firms that actually increased their wages as A dropped. Let's first consider the 48 relationships in which firms lowered the wage. Altogether there are 25 relationships (52.1%) that got terminated. In 18 cases out of 25 (72%) it was the firm that decided to discontinue the cooperation and in the remaining 7 it was the worker (28%). The 23 workers who accepted contracts with lower wages responded with a 2.00 average decrease in the effort level.

On the other hand, significantly fewer relationships got broken up when the firms did not change the wage or even increased it. Out of the 60 such cases 18 resulted in a break up (30%). The firms did not make an offer to "their" worker 14 times (77.8%) and there were 4 workers (22.2%) who did not accept the new offer. The 42 workers who accepted contracts with the same or higher wage on average decreased their effort level by 0.17. Fisher's exact test does not reject the hypothesis that the frequencies of break ups depending on which party initiated it are the same.

Out of 170 observed drops in A between two periods, 89 firms (52.4%) decide to keep the same wage as before (51 firms) or even higher (38 firms).

Lastly, we explore the question whether firms exploit the asymmetry in information about the realization of the shock. Suppose a firm's coefficient in a given period is 10 and the firm does not face a shock in the next period either. Yet, the firm lowers the wage. We interpret such behavior as pretending there was a shock to increase own profits and ignore the explanation that the firm is "feeling out" the worker(s) about what the response will be to a drop in wage. In the S data we observe a drop in wage 140 times. In 56 cases (40%) the firms' coefficient did not change but in 84 cases the firms faced a real drop in A. The frequency with which firms were pretending that there was a shock is statistically significantly different from zero. Hence, we conclude that a non-trivial fraction of subjects acting as firms exercises their power and takes advantage of the asymmetry in information as noted by Camerer [2003].

3. CONCLUSIONS

We report the results of a laboratory experiment studying whether firms are willing to continue paying high wages to the workers when they face negative technological shocks. The shocks bring unfavorable conditions for maintaining the employer's reputation because firms have to decide whether to absorb their effects themselves or to tranSer them on to the workers which might mean damaging their own reputation and perhaps decreasing the probability of the continuation of a succesSul relationship. We do not find support for downward wage rigidity in the data. Once the shocks occur, firms lower the wages and relationships often break down. The workers who accept a lower wage respond with exerting a lower effort. We conjecture that the subjects' behavior is driven by uncertainty about the technology coefficient and a perceived entitlement to profit

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