Does Contract Enforcement Limit the Distribution of Bargaining Power? An Experimental Study

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Does Contract Enforcement Limit the Distribution of Bargaining Power? An Experimental Study *†

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Abstract

In more consolidated markets where asymmetric bargaining power leaves one party with small contract rents, policies that attempt to balance bargaining power may be implemented. The economic effects of such policies depend on the degree of legal enforcement. This paper examines how redistributing bargaining power among sellers and buyers affects long-term relationships when third party enforcement is partially and fully absent. I implement an experimental design that adjusts the bargaining power of sellers and the enforceability of the contract. I find that bargaining increases the use of efficiency wage contracts when partial enforcement is available. When enforcement is absent, bargaining has a negative effect on cooperation if it is actually exercised but it does not deter trade and does not affect the overall level of efficiency. However, contract enforcement limits the exercise of bargaining power. Sellers get higher rents if bargaining is implemented when contracts are partially enforceable. Regardless of the distribution of bargaining power sellers get a higher share of the surplus when partial enforcement is in place. These results provide insight for economic policy into the consequences of shifting bargaining power in market settings characterized by informal institutions.

Key words: contracts, incomplete enforcement, bargaining, experiments, distribution, institutions.
JEL Codes: D86, K12, L14, O12, Q13.

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1 Introduction

The ability of parties to enforce agreements is key for efficient performance and economic development. In developing countries, where legal enforcement is weak, parties often use informal incentives and good faith to self-enforce agreements. However, the existence of asymmetric bargaining power among parties that operate in more consolidated markets has risen concerns about the distribution of the contract rents, especially when formal contract enforcement is incomplete (Lee, 2002; MacDonald et al., 2004; the Democratic Staff, 2004). This is particularly true in the agricultural sector, in which verification of product attributes may be very costly and some dimensions of performance such as timing of delivery or contract renewal policies are not explicitly included in contracts. Some agricultural contracts often specify a payment formula which includes a base price and adjustments from it in the form of premiums and discounts which depend on the observed product characteristics. This contract structure endows buyers with a higher discretionary power to adjust final payments and leave farmers with lower contract rents. Even in developed countries, farmers have complained about the unfairness in agricultural contracts (Lee et al., 2008; Love and Burton, 1999; MacDonald et al., 2004; Wu, 2006).

In this context, policies that attempt to balance bargaining power have been discussed and sometimes implemented with little knowledge about their consequences on self-enforcing contracts.[1] Past literature have looked bargaining and relational contracts in separate settings. In fact, literature regarding the effect of bargainining on relational contracting is scarse. This paper fills this gap by examining new experimental evidence on how redistributing bargaining power among sellers and buyers affects long-term relationship, efficiency and surplus distribution when third party enforcement is partially and fully absent. I find that bargaining does not improve overall social efficiency or increase the sellers' contract rents as bargaining introduces a new source of inefficiency. Furthemore, the implementation of only partial enforcement results in a pareto improvement outcome relative to the implementation of bargaining with partial or fully incomplete enforcement: overall social surplus is higher and sellers and buyers share the surplus more equally. These results provide

[1] For example the Agricultural Fair Practices Act in 1967, the Producer Protection Act in 2000 and the 2010 Patient Protection and Affordable Care Act (PPACA) in the U.S. and the Australian Trade Practices Act in Australia.

insight into the economic consequences of shifting bargaining power in relational contracting and provide some guidance to draw policies that attempt to improve bargaining conditions of weaker parties when they trade in market settings characterized by informal institutions.

I implement an novel experimental design that adjusts the bargaining power of sellers (agents) and the enforceability of the contract. In the main treatments, sellers may counteroffer after rejecting a buyers' first offer while contract enforcement is partially or fully absent. In the control treatments, sellers only accept or reject buyers' first offers. If parties agree on a contract, they trade one unit of a good which quality is not contractible, and parties have the latitute to decide if they comply with the quality and compensation in the contract or if they deviate by choosing lower quality provision and payments.

I find that the possibility of bargaining has positive impact in the overall rate of cooperation and does not deter trade when formal enforcement is absent; however, when sellers actually exercise their bargaining power cooperation decreases because buyers behave opportunistically as their payoffs shrink. Enforcement does not change the level of cooperation but it improves social surplus by increasing the number of trades relative to when bargaining is not in place (decreases efficiency loss due to loss trade). Bargaining increases the level of quality traded when enforcement is fully absent, but the gains of trade from such higher quality are eroded by the use of bargaining power (increases efficiency loss due to bargaining). When contract enforcement is partial, bargaining does not affect the level of quality traded or the number of trades, but the exercise of bargaining power taxes the social surplus generated resulting in a lowering surplus to distribute.

Contract enforcement limits the exercise of sellers' bargaining power. Sellers reject more of the buyers' offers and use counteroffers more in the presence of partial contract enforcement than when contract enforcement was fully absent. The evidence shows that enforcement supports sellers' exercise of bargaining power. In fact, bargaining did not increase the overall sellers' payoffs or share of overall surplus regardless of the enforcement level. Bargaining was only effective in increasing sellers' share of surplus and payoffs for completed transactions and when partial enforcement was in place. In contrast, enforcement has a positive and significant effect on overall sellers' rents.

When partial enforcement is in place, bargaining affects contract structure by increasing the

size of the price and lowering the size of the bonus included in the contract. As consequence contracts take the form of efficiency wage contracts when bargaining and enforcement are implemented.

From a policy perspective, if the goal is to increase the contract rents for the weaker party through an improvement of her bargaining position, the evidence in this paper suggests that a policy to shift bargaining power needs to be coupled with the implementation of formal enforcement of at least of an up-front payment. However, the social planner can minimize the efficiency loss due to bargaining and still achieve a more egalitarian distribution of the surplus if only formal enforcement is implemented.

Related Literature. This paper related to existing literature on relational contracts and bargaining. On one hand, literature has looked at market interactions and the existence of relational contracts under different enforcement conditions. Brown et al. (2004) (hereto referred to as BFF) use experimental economics to show how the absence of third-party enforceability impacts the nature of market interactions including the initiation of contracts, formation of long-term relationships, contract terms and how all these affect efficiency and the distribution of the surplus generated by trading. The experiment simulates firm-worker relationships and they implement three different treatments to test the endogenous emergence of long-term relationships.

Wu and Roe (2007b) (hereto referred to as WRb) also use experimental economics to examine how the nature and efficiency of trade differs across different relational contracting environments. WRb's model is based on a buyer-seller relationship and use the same design and implement two treatments from BFF. Additionally, they implement two incomplete contracting treatments in which buyers can adjust prices ex post. Both of these papers examine cooperation and long-term relationships under different contract enforcement regimes. However, they maintain constant bargaining power across treatments. In essence firms (buyers) make take-it-or-leave-it offers that workers (sellers) accept or reject (ultimatum game). In contrast, the experimental design of this paper varies the bargaining power exogenously across treatments. In the main treatments subjects play a bargaining game to agree on contract terms. In addition, treatments with an ultimatum game are also implemented and are used as control treatments. Furthermore, the experiment here differs from previous contracting experiments in the implementation of an infinite repeated game

while only finite repeated games have been previously implemented.

On the other hand, bargaining has been examine in laboratory setting by using a variety of games including ultimatum and alternating offer games. Examples of this literature are Ochs and Roth (1989) Guth et al. (1982), Prasnikar and Roth (1992), Roth and Murnighan (1982) and Kagel et al. (1996). This experimental evidence indicates that in games where participants have symmetric payoffs and full information the first mover obtains a medium return of the 60% of the total surplus or less. However, it is not clear how subjects respond in a more complex environment in which they have to split the surplus generated through a gift exchange game.

In contrast to this research, the papers cited do not implement the bargaining game in a contracting context in which there is enforcement variability. In fact, literature regarding the effect of shifting bargaining power on relational contracting under diverse enforcement regimes is scarce. This paper contributes to the literature by testing the hypothesis derived from a theoretical model (Cordero Salas (2011)) where bargaining power is shifted in the context of self-enforcing, relational contract theory and by implementing a new experimental design in which an alternating offer game is jointly implemented with a gift exchange game.

The structure of the paper is as follows. Section two develops briefly the model. Section three describes the experimental design and procedures. Section four forward the predictions and hypothesis. Section five presents the results and section six concludes.

2 Relational Contracting Model with Bargaining

I briefly outline the relational contracting model with bargaining (Cordero Salas (2011)). Assume a buyer and a seller have the opportunity to trade one unit of a good of quality $q_t \in Q = [\underline{q}, \overline{q}]$ at dates $t = 0, 1, 2, 3 \ldots$. Quality is observable by both parties but it is not enforceable by a neutral third party. Payments may or may not be enforceable depending on the enforcement regime. At the beginning of each period t, the buyer and the seller are aware of the enforcement regime and engage in a Nash bargaining process over the profit-sharing rule included in the contract. A contract includes a total compensation defined as $P_t(q_t) = p_t + D_t(q_t)$ and consists of a base payment, p_t, and a contingent-payment, $D_t(q_t)$. The base payment is not enforceable when contract enforcement

is fully incomplete but it is enforceable if partial enforcement is implemented. In contrast, the contingent payment always depends on unverifiable quality, therefore it is never contractible. A negative $D_t = d(q_t)$ is a *discount* and is used as a punishment or for deviations from the buyer when p_t is not contractible. A positive $D_t = b(q_t)$ is a *bonus* and is used to reward high quality. [2]

If parties agree on a contract in the bargaining phase, they move into the trading phase and make independent decisions about quality and payments. The seller chooses the quality $q_t \in Q$ to deliver and incurs a cost $c_t(q_t)$, where $c'(.) > 0$, $c''(.) \geq 0$, and $c(\underline{q}) = 0$. The seller's profit per trading round is $U_t = P_t(q_t) - c_t(q_t)$. The seller's quality provision generates a direct benefit for the buyer, $R_t(q_t)$, where $R'(.) > 0$, $R''(.) \leq 0$, and $R(\underline{q}) = 0$. The buyer chooses whether to pay $b_t(q_t)$ and, in the fully incomplete enforcement regime, p_t. The buyer's profit for the trading round is given by $\pi_t = R_t(q_t) - P_t(q_t)$. It is also assumed that $R'(.) > c'(.)\ \forall\ q \in Q$, so that it is socially efficient and Pareto optimal to trade $q = \overline{q}$, since $\overline{q}$ maximizes the total surplus defined by $S(q_t) = R(q_t) - c(q_t)$. This sequence of events repeats in each period t (figure **??** illustrates a single stage of the repeated game).

If disagreement occurs while parties bargain, they receive zero payoffs. If either party decides to opt out of the bargaining process trade does not occur, the game ends and both parties receive fixed payoffs: $\overline{u}$ for the seller and $\overline{\pi}$ for the buyer. These fixed payoffs are assumed to be less attractive than trading, and any breakdown in trade represents a socially inefficient outcome. Assume that $\overline{s} = \overline{u} + \overline{\pi}$ and the net social surplus is $S(q_t) - \overline{s}$, where $S(q_t) - \overline{s} > 0\ \forall\ q \in (\underline{q}, \overline{q}]$, and $S(\overline{q}) > S(\underline{q}) \geq 0$. Parties bargain over the surplus and each party's share through the contract needs to satisfy the individual rational constraint (IRC) for the seller, $U = P(q) - c(q) \geq \overline{u}$ and for the buyer, $\pi = R(q) - P(q) \geq \overline{\pi}$.

As parties bargain over the contract terms, the optimal contract reflects how the surplus is split depending on the bargaining power that each party exercises in the bargaining process. The bargaining outcomes are derived from an application of the asymmetric Nash bargaining solution

[2] Most papers in relational contracts—e.g. Levin (2003)—assume that the decision to use the contingent payment belongs to the buyer if the adjustment is positive (bonus) and to the seller if it is negative (deduction). In this model, the decision belongs only to the buyer, as this case mimics supply agricultural contracts where all payments are made ex post depending on quality delivered. Furthermore, Iskow and Sexton (1992) find that fruit and vegetable growers often complain about payments made well after delivery, which supports the assumption about the base payment in the fully incomplete case in this paper.

(ANBS) with outside options where β represents the bargaining power of the seller. As a result, the optimal contract, satisfies $U_t(y_i^*) = \beta S(\overline{q})$ and $\pi_t(y_i^*) = (1-\beta)S(\overline{q})$ where $\beta S(\overline{q}) \geq \overline{u}$ and $(1-\beta)S(\overline{q}) \geq \overline{\pi}$ respectively such that the IRCs are satisfied.

Parties interact repeatedly and care about the stream of payments where the common discount factor is $\delta \in (0,1]$; parties support future trade contingent on the satisfactory performance of present trade. The parties cooperate if the history of play in all periods has been cooperation, and break-off trade forever if any deviation is observed (as assumed in Levin (2003)). Additionally, each period is played following a Nash equilibrium, parties use stationary contracts and repetition allows players to self-enforce the contract and maintain a Subgame Perfect Nash Equilibrium (SPNE).

When contracts are fully unenforceable, neither the quality nor the base price p_t or the bonus are enforceable. Since parties can deviate from the contract without a formal penalty, the optimal contract must additionally satisfy a dynamic incentive compatibility constraint (DICC) for each party such that it insures the parties get more gains from honoring the contract than from reneging. The contract also has to satisfy both IRCs and bargaining outcomes. The DICC are given by $\frac{p+b(q)-c(q)}{1-\delta} \geq p + d(q_t) - c(\underline{q}) + \frac{\delta}{1-\delta}\overline{u}$ for the seller and $\frac{R(q)-p-b(q)}{1-\delta} \geq R(q) - p - d(q) + \frac{\delta}{1-\delta}\overline{\pi}$ for the buyer, where the left hand side are the gains from cooperation and the right hand side represents the gains from deviation respectively. Note that the most profitable deviation for the seller is to supply $\underline{q}$, but in this case the buyer after observing quality delivered, sets the total payment to zero by imposing $d_t(q_t) = -p_t$. By the same token, the most profitable deviation for the buyer is to pay nothing.

Given the IRCs, the bargaining outcomes and the DICCs when contract enforcement is fully incomplete, an optimal stationary with a total compensation of $P(q) = c(q) + \beta S(q)$, implements the optimal level of quality, $\overline{q}$, if the parties have a discount factor

$$\delta > \hat{\delta}_{IE} \equiv \frac{c(q) + \beta S(q)}{R(q) - \overline{\pi}}.$$

This implies that self-enforcing constraints the effective bargaining power the seller can exercise. In equilibrium, the seller can only exercise a bargaining power $\beta < \hat{\beta} \equiv \frac{\delta R(q) - \delta\overline{\pi} - c(q)}{S(q)}$ and continue the relationship. Then, the compensation scheme is characterized by: $b(q) - d(q) \geq$

$c(q) - \frac{\delta}{1-\delta}(\beta S(q) - \overline{u})$ and $p = -d(q) + \frac{\beta S(q) - \delta\overline{u}}{1-\delta}$. In this case, there is little to say about the structure of the incentive provision since the base price is indeterminate because it also contains the value of the discount. Intuitively, this reflects the enforcement incompleteness as the base price is inversely related to the buyer's latitude to adjust the total payment to zero and that the total payment is all contingent on performance.

Proposition 1. *Cooperation and full efficiency depend on the exercise of the seller's bargaining power. Cooperation and full efficiency is the equilibrium outcome if* $\beta S(q) = \overline{u}$ *and* $\delta > \hat{\delta}_{IE} \equiv \frac{c(q)+\overline{u}}{R(q)-\overline{\pi}}$*, or if* $\beta \leq \hat{\beta}$*. If* $\beta > \hat{\beta}$ *trade breaks down causing an efficiency loss.*

Proposition 2. *Self-enforcing constraints the effective bargaining power the seller can exercise and the rents she can get.*

If partial enforcement is implemented, the total payment includes p_t, which is now contractible, and $b_t(q_t)$ that the buyer promises to pay as long as the seller does not shirk. The optimal contract also needs to satisfy the parties' DICC. In this case, the seller cooperates if only if $\frac{p+b(q)-c(q)}{1-\delta} \geq p - c(\underline{q}) + \frac{\delta}{1-\delta}\overline{u}$. Note that the most profitable deviation for the seller is to supply $\underline{q}$, but in this case the buyer after observing the quality, will not pay the bonus. On the other hand, a buyer cooperates if and only if $\frac{R(q)-p-b(q)}{1-\delta} \geq R(q) - p + \frac{\delta}{1-\delta}\overline{\pi}$. The most profitable deviation for the buyer is to withhold the bonus.

Given the IRCs, the bargaining outcomes and the DICCs, when contracts are partially enforceable, an optimal stationary contract with a total payment of $P(q) = c(q) + \beta S(q)$, implements the optimal level of quality, $\overline{q}$, if the parties have a discount factor

$$\delta > \hat{\delta}_{PE} \equiv \frac{c(q)}{R(q) - \overline{u} - \overline{\pi}},$$

and the compensation scheme is characterized by: $b(q) = c(q) - \frac{\delta}{1-\delta}(\beta S(q) - \overline{u})$ and $p = \frac{\beta S(q) - \delta\overline{u}}{1-\delta}$. Note that as the seller's bargaining power increases, the contract takes the form of efficiency wages and not contingent performance payments to induce the seller's performance.

Proposition 3. *If the base payment is enforced and* $\delta > \hat{\delta}_{PE} \equiv \frac{c(q)}{R(q)-\overline{u}-\overline{\pi}}$*, cooperation and full efficiency is the equilibrium outcome regardless of the distribution of bargaining power.*

Proposition 4. *The seller can exercise full bargaining power and receive rents accordingly. The efficient self-enforcing contract takes the form of a bonus contract when the seller's bargaining power is low and takes the form of an efficiency wage contract when the seller's bargaining power is high.*

3 Experimental Design

I implement a variation of the repeated labor market experimental design of Brown et al. (2004) and the repeated supply market experiments of Wu and Roe (2007a,b). I modify the basic experimental platform to test the model predictions and examine how bargaining power affects the formation of long-term relationships and market outcomes. The supergame consists of an infinite market interaction between sellers and buyers in contrast to the finite games implemented by Brown et al. (2004) and Wu and Roe (2007a,b). Buyers and sellers use contracts to establish the terms of trade for one unit of a good. In the first treatment, which I call no contract enforcement with no bargaining (NN), I implement an ultimatum game in which the buyer makes take-it-or-leave it offers to the seller and the seller, upon acceptance, may choose any feasible quality irrespective of the contractually agreed upon level. The buyer could also choose any feasible level of price and bonus, therefore the buyer has the latitude to adjust the total payment to zero. That is, the total payment is discretionary and contingent on quality delivered. In the second treatment, which I call no contract enforcement with bargaining (NB), I allow sellers to counteroffer the buyer one time after he has made the first offer (implements an alternating offer game with two offers). The buyer could also adjust the total payment to zero. In the third and fourth treatments, which I call the partial contract enforcement condition with no bargaining (PN) and the partial contract enforcement condition with bargaining (PB), I implement the ultimatum game and the alternating offer game as in the NN and NB conditions respectively, but in these two treatments the price is exogenously enforced by the computer while all other variables in the contract are not enforced. Then, the buyer could also choose any feasible (non-negative) level of bonus. Figure 1 summarizes the treatments.

In each treatment, subjects were exogenously matched into pairs of one buyer and one seller that interacted anonymously through the computer network. A random termination rule was

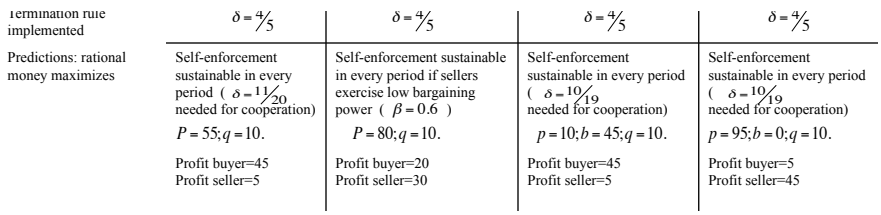

Figure 1: Summary of treatment conditions

implemented such that subject pairs played for an infinite number of periods. Subjects knew that they would keep trading with the same partner for an additional period with a 4/5 probability. This commonly known probability of continuation controlled for subjects' belief about the possibility of future interaction. Then, each pair expected to play together for 5 periods.[3]

The stage game in all treatments has two sub phases: a negotiation phase and a trading phase. Figure 2 summarizes the sequence of action in the stage game. In the negotiation phase of the treatments with no bargaining, each buyer makes a take-it-or-leave-it- contract offer to his matched seller. The seller decides to accept or reject the contract. If the seller accepts, the pair moves to the trading phase. If the seller rejects, the pair does not trade in that period. In contrast, in the treatments with bargaining, if the seller rejects the offer, she can offer a contract (counteroffer) to the matched buyer. In this case, the buyer gets to accept or reject. If the buyer accepts, the pair moves to the trading phase where the traded good gives lower benefits to the parties if they have traded through counteroffers. If the buyer rejects, the pair does not trade in that period. Each proposed contract included a level of quality, a price and a bonus. The set of allowable qualities is $\{1, 2, \ldots, 10\}$ and the set of allowable prices and bonus is $\{0, 1, 2, 3, \ldots, 100\}$.

The trading phase consists in two phases: quality determination and payment determination. Because quality is discretionary in all treatments, the quality determination sub phase was the same for all treatments and sellers could choose any quality from 1 to 10. The payment determination sub phase differs from the partial enforcement (PE) to the no enforcement (NE) treatments. In the PE treatments, the price is binding and the computer ensures that the price specified in the

[3]The expected number of periods of a game with a continuation probability of δ is equal to $T = \frac{1}{1-\delta}$. Therefore, with $\delta = 4/5$ the expected number of periods each pair interacts equals 5.

contract is paid, which ranges between 0 and 100. In the NE treatments the computer does not enforce the price such that the buyer can chose to pay a different price than the one in the contract; in both treatments buyers can choose any bonus ranging from 0 to 100 after observing the quality. Therefore, a buyer in the NE treatments can adjust the total payment to zero while in the PE treatments a buyer has to pay the contracted price. Once all decisions are made, payments are made and each party receives payoffs.

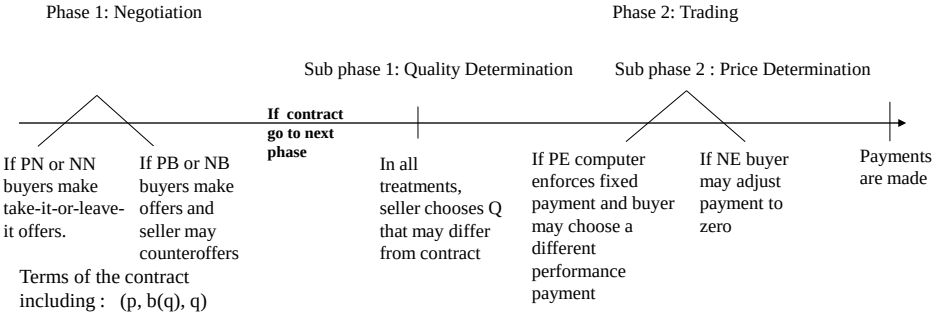

Figure 2: Stage game by phases for all treatments

The stage game payoffs in the no bargaining treatments (PN and NN) for the buyer, π_B^{NB}, and seller, π_S^{NB}, are given by

$$\pi_B^{NB} = \begin{cases} 10Q - p - b(Q) & \text{if contract was concluded} \\ 0 & \text{if contract was not concluded} \end{cases}$$

$$\pi_S^{NB} = \begin{cases} p + b(Q) - 5Q & \text{if contract was concluded} \\ 5 & \text{if contract was not concluded} \end{cases}$$

In the bargaining treatments (PB and NB), the discount factor in the alternating offer game with two offers is included in the payoff functions, $\beta = 0.9$. It reflects the cost of delay trade for the player who makes a counteroffer (seller). If a buyer accepts a counteroffer, he receive discounted profits by 0.1. The payoffs are given by :

$$\pi_B^B = \begin{cases} 10Q - p - b(Q) & \text{if contract was concluded with a first offer} \\ (0.1)(10Q - p - b(Q)) & \text{if contract was concluded under a counteroffer} \\ 0 & \text{if contract was not concluded} \end{cases}$$

$$\pi_S^B = \begin{cases} p + b(Q) - 5Q & \text{if contract was concluded with a first offer} \\ 0.9(p + b(Q) - 5Q) & \text{if contract was concluded under a counteroffer} \\ 5 & \text{if contract was not concluded} \end{cases}$$

The cost for all sellers was $5Q$. If subjects did not trade, the seller got 5 points and the buyer 0. All buyers and sellers in the same treatments face the same payoff parameters in all experimental sessions. Payoff functions, the cost schedule and the termination rule were common knowledge. However, only the pair of traders involved in each transaction were informed about the actual payoffs and quality level delivered. Therefore, parties could only build a reputation with the partner with whom they were trading.

At the end of each trading period, each participant is informed about the contract $(p, b(q), q)$ he had concluded, the actual quality delivered, q, the payment made, his own payment, as well as about his trading partner's payoff.

3.1 Procedures

Session were run at the Experimental Economics Laboratory at the Ohio State University using undergraduate student from a variety of majors recruited via E-mail. Table 1 summarizes information about the 17 experimental sessions that have been held. At check in subjects were assigned a random ID number to preserve anonymity. Each subject was randomly assigned to a networked computer and was told that they will participate in a computerized trading experiment. The experiments were programmed using the Z-TREE software (Fischbacher, 1999) and took place on networked computers. At the beginning of the experiment participants were randomly assigned to

the role of either a buyer or a seller. These roles were fixed for the duration of the session. Each subject had an identification number for the role (IDR), e.g. buyer 1, seller 5 which was also fixed during each contracting game allowing subjects to keep track of trading partners. Each buyer was paired randomly with a seller. Each pair played an uncertain number of trading games. There were $R = T * N/2$ trades per game, where N is the number of subjects participating in the session and T is the number of periods played in each game.

One single treatment was run in each experimental session and a different group of subjects participated in each session. Each experiment consisted of a trial unpaid game, two surveys, a control questionnaire and the paid treatment. The treatment was run one to six times, where the number of times depended on the results of the random termination rule and the time left after each termination. Each time subjects were matched with a different partner and they played together until the continuation rule indicated. All sessions lasted between one and half and two hours depending on the random termination rule.

Instructions for the main treatment were read aloud for both buyers and sellers and each subject was given a printed copy for reference. When instructions were read, subjects did not know whether they had been assigned to be buyers or sellers. In addition, subjects answered a computerized control questionnaire formulated to test understanding of the treatment. In order to help the subjects to understand the game structure, the questionnaire contained hypothetical situations in the game from the perspective of both roles, buyers and sellers, and the correct answers were provided afterwards. The trading game did not start until all subjects understood the game. To further ensure that all subjects understood the game, after completing the control questionnaire, subjects were assigned randomly to be sellers or buyers, and participated in two practice rounds. The practice rounds were identical to normal rounds with the exception that no money was earned. Practice rounds had the purpose of familiarizing subjects with the computer controls and screens. Subjects were not able to see actual choices or payments in order to avoid possible deception.

Once the practice periods were over, the real periods of the game started. Each subject received a \$5 balance in their account (250 experimental points). Because of the random termination rule, some experiments were longer than others and if the experiment ended prior to the allotted

time for the evening's session, then additional games were played until the allotted time expired. For each new game, subjects were matched with a different partner, avoiding any possibility of contagion effects across treatments.

Once all games were over, subjects were asked to complete an exit survey while experimenters determined payouts. Finally, subjects were paid privately. The subjects earned a show-up fee plus additional earnings that were proportional to the points earned during the experiment. The exchange rate was 50 experimental points per \$1 which ensured that subjects had incentives to increase their points earnings. Subjects earned an average of \$16.61 with a maximum \$32 and a minimum of \$6.

4 Predictions and Hypothesis

The socially efficient level of quality is $Q = 10$ because marginal revenue (10) is greater than marginal cost (5) for all quality levels. The efficient level of quality maximizes the social surplus at 50. Participants are assumed to be self-interested, risk-neutral utility maximizers and that this is common knowledge. The degree of cooperation in each treatment is defined as the proportion of subject pairs that honor the the contract, the seller supplying the contracted quality and the buyer paying the contracted payment. The acceptance rate reflects the willingness to trade. I denote q as the requested quality and $q*$ as the delivered quality.

4.1 Treatment 1: No enforcement, no bargaining (NN)

When contract enforcement is absent and no bargaining takes place, the ongoing interaction sustains the efficient outcome for discount factors equal to or greater than $\delta_{NE} = \frac{c(q)+\overline{u}}{R(q)-\overline{\pi}} = \frac{5Q+5}{10Q} = 0.55$. Then, cooperation is sustainable and efficiency is reached in every period for the probability of continuation used in the experiments, $\delta = 4/5$. The predictions are summarized as follows.

Prediction 1. *The buyer offers a contract* $(P(q), q) = (55, 10)$ *and the seller accepts.*

Prediction 2. *In each period, the efficient outcome is sustained, actual quality equals* 10 *and surplus equals* 50. *The equilibrium payoffs are* $(\pi_B, \pi_S) = (45, 5)$ *for the buyer.*

Prediction 3. *Cooperation is observed in every period.*

This treatment is conductive to cooperation under the assumptions of the model because for any quality greater than one, the gains from cooperation are greater than the gains from deviation for both parties. For any given quality level, the ICCs reduce to $p + b(q) \geq 5Q + 4$ for the seller, and $10Q \geq p + b(q)$ for the buyer. For example, if parties trade at a quality level of 2, the buyer pays $P(q) = 15$ (as the seller's IRC binds) and the payoffs are $(\pi_B, \pi_S) = (5, 5)$, which satisfies incentive compatibility. The minimum discount factor that would sustain cooperation when the traded quality is 2, is 3/5, which is lower than the termination rule used. Then, even for low quality levels, cooperation is the dominant strategy.

4.2 Treatment 2: No enforcement, with bargaining (NB)

The second treatment, NB, is identical to the NN treatment with the exception that sellers can exercise bargaining power by using counteroffers. In this treatment, cooperation sustains the efficient outcome if $\delta_{NE} \geq \frac{c(q)+\beta S(q)}{R(q)-\bar{\pi}} = \frac{5Q+0.5*5Q}{10Q} = 0.95$. The continuation probability of $\delta = 4/5$ used does not sustain cooperation if the sellers exercise all their bargaining power, in which case, the buyer's dynamic incentive compatibility constraint is not satisfied $\frac{10Q-9.5Q}{0.2} \geq 10Q + 0 \Rightarrow 0.5Q \geq 2Q$. Then, for any given quality, the buyer gets a higher payoff by deviating.

Self-enforcement limits the sellers' exercise of bargaining power in this treatment, but if sellers exercises less bargaining power, the efficient outcome can be sustained by increasing the buyers' stage payoff from cooperating. That is the seller claims less of the surplus by accepting a lower payment. The buyer's self-enforcing constraint sets the maximum bargaining power the seller can exercise without the buyer reneging, $\frac{10Q-5Q-\beta 5Q}{0.2} \geq 10Q \Rightarrow 3/5 \leq \beta$. If the seller only exercises a bargaining power equivalent to 0.6 cooperation is sustained and the efficient outcome is achievable.

Prediction 4. *If the sellers exercise all available bargaining power the efficient outcome is not sustained. The buyers take short term profits and deviation is observed in every period.*

Prediction 5. *If sellers exercise bargaining power of 0.6 or less, the efficient outcome is sustainable, actual quality equals* 10 *and the surplus equals* 50*. The seller accepts the equilibrium contract* $(P(q), q) = (80, 10)$ *and the equilibrium payoffs are* $(\pi_B, \pi_S) = (20, 30)$.

Prediction 6. *Cooperation is observed in every period if sellers exercise* $\beta \leq 0.6$.

This treatment is less conductive to cooperation, when compared to the NN treatment. Subjects in the role of sellers can use counteroffers to increase their payoffs and claim most of the surplus. Moving from payoffs $(\pi_B, \pi_S) = (2Q, 3Q)$ to any distribution that gives less profit to the buyer and more to the seller, triggers deviation from the buyers. Then, the set of contracts for which cooperation is the dominant strategy is smaller. Furthermore, the possibility of counteroffer introduces an additional source of inefficiency because bargaining is costly and the surplus available for the parties shrinks. Consequently, this treatment is less conductive to efficiency but sellers ambiguously get higher payoffs.

4.3 Treatment 3: Partial enforcement, no bargaining (PN)

Treatment three, PN, modifies NN by enforcing the contracted price, p. A discount factor equal to $\delta_{PE} = \frac{c(q)}{R(q)-\overline{u}} = \frac{5Q}{10Q-5} = 10/19$ or higher sustains cooperation under this treatment. Therefore, the efficient outcome is sustained as a sequential equilibrium for the continuation probability implemented in the experiments, $(\delta = 4/5 > 10/19)$. The predictions are summarized as follows.

Prediction 7. *Buyers offer the equilibrium bonus contract given by* $(p, b(q), q) = (10, 45, 10)$ *and sellers accept.*

Prediction 8. *In each period, the efficient outcome is sustained, actual quality equals* 10 *and the surplus equals* 50. *The equilibrium payoffs are* $(\pi_B, \pi_S) = (45, 5)$.

Prediction 9. *Cooperation is observed in every period.*

Since there is no bargaining as in the NN treatment, the equilibrium payoffs are the same. Parties find easier to cooperate in this treatment relative to the NN treatment because the enforcement of the price lowers the discount factor needed for cooperation. For example, if parties trade at a quality level of 2, the minimum discount factor that would sustain cooperation is 2/3, which is lower than the minimum discount factor that sustains cooperation in the NN treatment for that same level of quality. Although this treatment is more conducive to cooperation relative to the NN treatment the level of cooperation is expected to be the same as cooperation is predicted

be observed in every period given the parameters used in the experiment. Because no bargaining takes place and partial enforcement is available, high efficiency is more likely than in the NN and NB treatments.

4.4 Treatment 4: Partial enforcement, with bargaining (PB)

The fourth treatment, PB, alters NN by enforcing the contracted price, p, and allowing sellers to make counteroffers. Cooperation is also sustainable for discount factors greater than or equal to $\delta_{PE} = \frac{c(q)}{R(q)-\overline{u}} = 10/19$. Therefore, the efficient outcome is sustained given the continuation probability of 4/5 implemented. The predictions are summarized as follow.

Prediction 10. *Buyers offer the equilibrium efficiency wage contract* $(p, b(q), q) = (95, 0, 10)$ *and sellers accept.*

Prediction 11. *In each period, the efficient outcome is sustained, actual quality equals* 10 *and the surplus equals* 50*. The equilibrium payoffs are* $(\pi_B, \pi_S) = (5, 45)$*.*

Prediction 12. *Cooperation is observed in every period.*

Although the discount factor that sustains cooperation is lower for any given quality in this treatment relative to NN, subjects are expected to cooperate at the same level because cooperation is predicted to be observed in every period. The presence of formal enforcement contributes to increase trade outcomes but because of the possibility of bargaining this treatment is ambiguously more conducive to efficiency relative to the NN treatment while sellers are able to exercise higher bargaining power due to the presence of formal enforcement, and as a consequence reach higher payoffs.

4.5 Hypotheses

Following the prediction of the theoretical I summarize the testable hypotheses with respect to efficiency, surplus distribution and cooperation.

Hypothesis 1. *Bargaining increases the rejection of buyers' offers (NN vs. NB, PN vs. PB) and decreases trade when enforcement is absent (NB vs. NN).*

Hypothesis 2. *Bargaining decreases cooperation when contract enforcement is absent (NB vs. NN) while enforcement does not change the level of cooperation (PN = PB vs. NN).*

Hypothesis 3. *Overall social surplus should follow* $PN \geq PB \geq NN \geq NB$.

Hypothesis 4. *Contract enforcement limits the sellers' exercise of bargaining power (NB vs PB). Sellers' rents and surplus share follow* $PB > NB > PN \geq NN$. *Sellers' rent are close to reservation payoffs and their surplus share is close to zero in the NN and PN treatments.*

Hypothesis 5. *The use of efficiency wage contracts increases with the increase of seller's bargaining power (PB vs. PN).*

5 Results

The general results are summarized in figure 3 and figure 4 . Figure 3 summarizes predictions and mean results for efficiency outcomes and distribution of surplus for all exchanges that resulted in trade (circles) and all pairs including non-trades (triangles). Figure 3 shows the same results in terms of medians. The axis correspond to seller (horizontal) and buyer (vertical) payoffs respectively. The solid line represents the efficient frontier which contains all possible combinations of surplus when full efficiency is achieved (q=10 and surplus=50) while the dotted line is a 45 degree line indicating an equal share of surplus for different levels of efficiency. Note that the flat portion of the frontier from point (5, 45) to point (0, 45) corresponds to the outside option of the seller. The diamond-shaped markers represent the predictions by treatment ((45, 5) for PB, (30, 20) for NB and (5, 45) for PN and NN). The circles represent outcomes for only completed contracts and the triangles for all offers. Then, the former includes only efficiency losses due to bargaining while the latter also includes efficiency losses due to no trade. Arrows show the NN treatment outcomes, which is the benchmark treatment.

Bargaining increases the level of quality traded but it does not improve overall social surplus because the efficiency gains from higher quality are eroded by the exercise of bargaining. Bargaining does not increase overall sellers' payoffs either but increases cooperation and decreases the relative spread of payoffs between buyers and sellers when they completed the transactions. In contrast,

enforcement has a positive effect on overall efficiency by increasing the number of trades when bargaining was absent and by avoiding loss due bargaining when it was a possibility. Furthermore, enforcement had a positive effect on sellers' payments. But when only partial enforcement was implemented (without bargaining, PB), subjects achieved a higher overall social surplus and the distribution was more even among sellers and buyers as shown in figures 3 4.

In the next sections I analyze with more detail the evidence for each hypothesis. Table 2 presents the summary statistics by treatment. The unit of analysis is a pair per period. There were 1493 possible trades, of which 934 resulted in exchange. There were 1669 contracts proposed (1450 offers, 219 counteroffers). The appendix defines each of the variables in table 2. In addition, table 3 presents the averages by treatment for the variables of interest and the non-parametric analysis for key pair-wise treatment differences. The significance is measured by the p-values of the two-sided Mann-Whitney tests using each partnership-period as an independent observation. I examine the results in more detail by using hypothesis tests and regression analyses in the following sections and account for potential clustering of unobservables at the partnership level. I also control for learning effects and difference in played periods according to the random termination rule (the appendix also includes this analysis).

5.1 The effect of bargaining on trade

The opportunity to counteroffer gives sellers the possibility to trade after rejecting first offers under different terms of trade conditional to buyers acceptance. I compare the acceptance rate for contracts offered by buyers across treatments within the same enforcement condition. The acceptance rate reflects the parties' willingness to engage in a trading relationship and cooperate under given terms of trade. Table 3 shows that the acceptance rate of buyers' offers in the NN and PN treatments are higher than in the NB and PB treatments (significant at the 10% and 1% level respectively). This evidence supports the idea that bargaining impacts negatively the acceptance of buyers' offers, however, a probit model estimating the probability of accepting the contract through first offers does not confirm that the introduction of only bargaining decreases the acceptance rate (table 4). Although the coefficient for the bargaining dummy is negative, it

is not statistically significant, even when other determinants of the acceptance rate are included (terms of contracts in the offers).[4] However, enforcement has a positive effect while the bargaining-enforcement combination has a significant negative effect on the acceptance of first contracts. The results support the non-parametric analysis.

Although bargaining has a negative effect on the acceptance of buyers' offers, the evidence suggests that bargaining does not affect the realization of trade within the enforcement conditions. This result suggests that bargaining does not deters trade but it is used to negotiate over the terms of trade. Furthermore, contract enforcement has a positive impact on overall trade but is only significant when there is not opportunity to bargain. When enforcement is in place, sellers are able to secure the price regardless of the decisions made in the trading phase. Therefore, sellers have more control over their payoffs and are more willing to accept contracts when the price is enforced.

Result 1. *Bargaining has a negative effect on the acceptance rate of buyer's offers and it is stronger when partial enforcement is in place. However, it does not deters trade but serves as a negotiation mechanism regardless of the enforcement conditions. Enforcement increases significantly the number of trades when bargaining is not in place.*

5.2 The effect of bargaining on cooperation

Once parties agree on a contract, cooperation is defined as both parties meeting their obligations according to the agreed contract. Table 3 shows that cooperation is significantly higher in the NB treatment than in the other treatments. These results contradict hypothesis 2 because as sellers exercise bargaining power in the NB treatment, trade was predicted to break down more often. The result is consistent with the idea that subjects use informal incentives to maintain a relationship and cooperate as the literature has shown (for example Brown et al. (2004); Wu and Roe (2007a,b). However, the cooperation rate may differ depending if contracts were reached through offers or counteroffers.

When trade takes place through first offers, the level of cooperation is even higher in the NB treatment relative to the other treatments and cooperation levels are the same if trade takes

[4]This is also true when I also include in the regression the counteroffers.

place through counteroffers regardless of the enforcement (NB vs. PB). But when enforcement is absent, cooperation is lower if contracts are reached through counteroffers while it is the same when partial enforcement is in place (cooperation rate if offer vs. if counteroffer, $p-value = 0.0081$ and $p-value = 0.5791$ respectively). This evidence suggests that while the possibility of bargaining increases overall cooperation when enforcement is absent, the actual exercise of bargaining decreases cooperation. When a seller counteroffers, the buyer's profit shrinks and this triggers his opportunistic behavior. As his per period payoffs shrink by the bargaining factor, the buyer tries to maximize his short-term payments by given the seller a lower payment. Furthermore, some sellers knowing this may also choose to deviate and supply a lower quality than what promised. This results in a lower cooperation rate.

On the other hand, enforcement and the combination of bargaining-enforcement does not change impact the cooperation rate as the levels of cooperation achieved in the NN, PN and PB treatments are not different from each other.

Result 2. *The possibility of bargaining increases overall cooperation when contract enforcement is absent but the actual exercise of bargaining power lowers the cooperation rate by triggering opportunistic behavior. Enforcement does not change the level of cooperation.*

5.3 The effect of bargaining on efficiency

Efficiency loss occurs when trading takes place at a lower quality levels than the optimal, when parties do not trade (loss in trade) and when parties use bargaining (loss due bargaining). When all efficiency loss is taken in account, bargaining has no effect on efficiency when enforcement is fully absent. The non-parametric analysis in table 3 shows that the overall surplus generated in the NB treatment is no different than the overall surplus in the NN treatment (p-value=0.5025). However, bargaining has a negative effect on overall social surplus when partial enforcement is in place (p-value=0.0350). Enforcement increases overall efficiency but if it is couple with bargaining does not change the overall surplus available relative to NN. Although enforcement increases welfare, the resulting surplus is not different than the surplus available when bargaining is in place and contract enforcement in absent (NB vs. PN). The econometric analysis in table 5 supports partially the

non-parametric analysis. The dependent variable is the overall social surplus and the estimation (columns 4 and 5) includes as explanatory variables the presence of bargaining (dummy taking a value of one if bargaining was in place and 0 otherwise) and enforcement (dummy takes a value of one if enforcement was in place and 0 otherwise) as well as an interaction term. Controls for the length of the relationship, buyer's and seller's previous earnings and period dummies are included. The constant term represents the NN treatment in which no bargaining and no enforcement are in place. None of the treatment coefficient have any significance over the NN treatment on the overall surplus.

The results over overall efficiency may be result from the the different kind of efficiency loss. When efficiency loss due the use of bargaining and due to loss trade are excluded from the analysis, efficiency in the NB treatment is significantly higher than in all other treatments as shown in the non-parametric analysis in table 3 (social surplus no loss). Furthermore, the econometric analysis in table 6 confirms the non-parametric analysis for only completed contracts. The coefficient for bargaining is significant and positive for actual quality and social surplus (columns 1, 2 and 3). Subjects that completed trades in the NB treatment used informal incentives to trade at higher levels of quality which generated the highest level of surplus. However, the high level of quality traded in the NB erodes with the loss in efficiency due to loss trade and the use of bargaining (compared to results on overall social efficiency). In addition, bargaining does not affect the levels of quality delivered when partial enforcement in place.

When social surplus only includes the efficiency loss due to bargaining, the social surplus is no different between the NN, NB and PN treatments (social surplus loss bargaining). The econometric analysis confirms this result (columns 4 and 5 in table 6). The gains from trading higher quality achieved in the NB treatment are lost due to the use of bargaining. Furthermore, the use of bargaining significantly lower the social surplus when partial enforcement is in place, although the econometric analysis does not confirm this result.

When only loss in efficiency due to loss trade is accounted for (including pairs that offer/counteroffer but did not trade), the social surplus was also greater in the NB and PN treatments than NN. Bargaining did not deter trade as found before, and even more subjects were able

to trade at higher levels quality by negotiating over the terms of trade. Enforcement also decreased the efficiency loss due no trade. However, bargaining did not affect the levels of efficiency loss due to no trade when partial enforcement was available.

Result 3. *Enforcement weakly improves overall social surplus while bargaining does not have any impact on it when contract enforcement was absent. Bargaining weakly deacreases overall social surplus when partial enforcement is available. Although bargaining increases the level of quality traded when enforcement is absent, the use of bargaining erodes this efficiency gains. Enforcement improves the overall social suplus by decreasing the loss in trade when enforcement is absent.*

5.4 The effect of bargaining on surplus distribution

Bargaining does not increases overall sellers' rents regardless of the enforcement level. The average sellers' payoffs were not different from each other in the NN and NB treatments and in the PB and PN treatments as shown in table 3 (p-values= 0.2602 and 0.5511 respectively). On the other hand, enforcement has a significant positive effect on sellers' rents. The payoffs for sellers in the partial enforcement treatments were significantly higher than in its correspondent no enforcement treatments (NB vs. PB, p-value=0.0158, and NN vs. PN, p-value=0.0002). The average overall seller's share of the surplus also confirms this results. Sellers captured a higher share of the surplus when partial enforcement was available and bargaining did not have any effect on it. The results follow from the fact the median values for sellers' payoffs and share of surplus are the same within each enforcement treatment. The median sellers' payoff and share were 0 in the NN and NB treatments. The median sellers' payoff was 10 in both PB and PN treatments while the seller's share was 0.40 and 0.39 respectively (table 2).

In the case of the buyers' payoffs, the results were consistent with the seller's payoffs when comparing NB with NN and NB with PB. The buyers' rents were not different among NB and NN treatments and were lower in PB than in NB. However, when comparing the buyer's payoffs in NN with PN and in PN with PB, the results differ from the seller's payoffs results. The buyer's payoffs in the PB treatment were significantly lower than in the PN treatment while the seller's payoffs were the same. The traded quality was the same across PB and PN but the available surplus after

bargaining (including only loss due bargaining) and the overall social surplus were significantly lower in the PB treatment. The loss in efficiency due to bargaining was passed to the buyers in the form of lower rents.

In the NN and PN treatments, the buyer's payoffs were the same while the sellers' payoffs were higher in the PN than in the NN treatment. When bargaining is absent, the enforcement of the price increased the number of trades as the acceptance rate shows. As a consequence, the subjects in the PN treatment were able to reach higher overall efficiency by trading more. This gains translated to higher payoffs for sellers while buyers earned the same rents.

For only completed exchanges, bargaining does not affect sellers' payoff or surplus share when contract enforcement is absent. However, in the partial enforcement treatments, sellers obtained significant higher payoffs and share of surplus if bargaining was available (PB vs. PN). The social surplus and the buyers' payoffs were significantly lower in the PB treatment than in the PN treatment. This means that when contract enforcement was partial sellers were able to exercise their bargaining power and accrue higher payoffs.

Enforcement has a significant effect on the sellers' share of surplus regardless of the bargaining power distribution. Although, sellers' payoffs were not different between the NB and PB treatments for completed trades, sellers' share of surplus was significantly higher. Then, formal enforcement reinforced the sellers' ability to exercise bargaining power.

Even though the sellers' payoffs are not different among NB and NN, the payoffs' relative spread is significantly smaller in the NB than in the NN. The latter result suggests that bargaining does not increase the seller share of the surplus in the NB but it does decrease the difference between seller and buyer payoffs. Bargaining also reduces the difference in payments in the PB treatment relative to PN. Furthermore, the payoffs' relative spread is significantly lower in the PB than in the NB treatment. Perhaps sellers were more timid in using aggressive counteroffers in the NB treatment because of fear of opportunistic behavior by the buyers. Table 2 presents the percentage of first offers acceptance and the use of counteroffers per treatment. Sellers rejected more offers in the PB treatment than in the NB treatment. Sellers use counteroffers in only in 24% and 37% of the possible interactions in the NB and PB treatments respectively, while in 51% and

79 % of the times that sellers rejected an offer, they couteroffered in the NB and PB treatments respectively. This supports the idea that sellers did not exercise much of their bargaining power because formal enforcement was absent. Then, the lack of enforcement may have an important effect on how surplus is distributed: a transfer of bargaining power to the seller when formal contract enforcement is non-existent does not achieve the objective of a greater seller share of the surplus. The lack of formal enforcement limits the exercise of sellers' bargaining power.

Although on the equilibrium path buyers should offer the equilibrium offer from the alternating offer game, in the experiment the use of counteroffers reflects the exercise of sellers' bargaining power. Table 4 also presents the results of a probit model estimating the probability of the use of counteroffers. This regression only includes data from bargaining treatments. The constant coefficient which represents the presence of bargaining in combination with no enforcement (NB treatment) is negative confirming that no enforcement decreases the use of counteroffers when bargaining is in place. The enforcement dummy has a significant positive effect on the probability of using counteroffers. Even though the coefficient is less significant once the terms of contracts in the offers are taken in account, these results give additional evidence that contract enforcement limits the sellers' exercise of bargaining power.

One possibility is that subjects may learn throughout the experiment and move toward the equilibrium offer. In the bargaining game, the proposer makes an equilibrium offer such that it gives the receiver the same expected payoff as if the receiver were to counteroffer. One learning trajectory might be that subjects use counteroffers more often in the first periods and decrease their use as the offer approaches the equilibrium offer. Figure 5 shows that the percentage of pairs per period that used counteroffers decreases over time while the sellers' potential average profits derived from first offers[5] increase over time. These trends suggest that over time buyers offered a potentially higher payoff to the seller so that she does not use the counteroffer. Because of these more attractive gains from trade, sellers used counteroffers in a decreasing fashion. In this way, bargaining power affects the distribution of surplus.

Note that even though the use of counteroffers declines from early periods to later periods,

[5]The potential profits are scaled to a range between zero and one by dividing potential profits by 100, so that they can be plotted in the same graph as the percentage of pairs that used counteroffers.

more than 10% of the pairs use counteroffers in all periods in both bargaining treatments. In each period, more subjects used counteroffers in the PB treatment than in the NB treatment which supports the evidence that contract enforcement constrained sellers in the use of bargaining power.

In addition, table 7 presents the econometric results for completed exchanges. The dependent variables are the seller payoffs, the raw seller share and the spread in payoffs. If the introduction of bargaining is improving seller payoffs and share of surplus, then the coefficient on the bargaining dummies should be positive in the payoffs and share regressions while it should be negative in the spread in payoffs estimation. I run an OLS regression for each measure's dependent variable and report robust standard errors adjusted for clustering on pair. The regressions show that the introduction of bargaining has a positive impact on seller payoffs and share when contract enforcement is absent. However, the coefficient is only statistically significant in the robust regressions for all variables and in the median regression for both the seller share and spread in payoffs. The results are consistent with the idea that for sellers in pairs that cooperate (stay close to the median), bargaining significantly increases their payoffs and share of the surplus. However, if sellers are in pairs that often deviate, then bargaining does not increases significantly their distributional outcomes when contracts are not enforceable.

Finally, in the no bargaining treatments the buyer is predicted to capture the entire surplus, leaving the seller with only her reservation payoff in each period. A Wilcoxon test rejects the hypothesis that seller payoffs are equal to the outside option of 5 in the NN and PN treatments ($p = 0.0000$ for both). Sellers got higher payoffs in the PN and NN treatments that what was predicted by the model.

Result 4. *Contract enforcement limits the exercise of sellers' bargaining power. Bargaining does not increase the overall sellers' payoffs or share of overall surplus regardless of the enforcement level while enforcement has a positive and significant effect. For completed exchanges, enforcement also increased sellers' share of surplus and bargaining was effective in increasing sellers' payoffs when partial enforcement was in place. Sellers got higher payoffs in the NN and PN than reservation payoffs.*

5.5 The effect of bargaining on contract structure

Bargaining has a significant effect on contract structure. Table 3 gives evidence that contracts used in the PB treatment are structured with higher prices and lower bonuses than the contracts used in the PN treatment. The contracted price is significantly greater and the contracted bonus is significantly smaller in PB than in PN. Furthermore, table 8 gives additional evidence supporting these results. Columns one and two present tobit models for price and bonus respectively. Bargaining has a significantly positive effect on contracted price while it has a negative effect on the size of the bonus (although it is not significant). These results support the hypotheses that the inclusion of bargaining affects how contracts are structured. When bargaining is in place contracts take the form of efficiency wage contracts by including higher prices and lower bonuses, while in the absence of bargaining, contracts are structured with smaller prices and higher bonuses in the form of performance contracts.

Result 5. *Bargaining affects contract structure by increasing the size of the price and lowering the size of the bonus. Then, prices are greater in the PB condition than in the PN condition, and the opposite is true for the bonus.*

6 Summary results and conclusion

Policies that attempt to balance bargaining power have been discussed with the objective of increasing contract rents for the weaker parties in more consolidated markets. The level of contract enforcement may impact the effectiveness of such policies. This paper implemented economic experiments to examine how redistributing bargaining power affects long-term relationships when third party enforcement is partially and fully absent.

The experimental evidence supports most hypothesis derived from the theoretical model while some results contrast with the predictions. When looking at mean outcomes (figure 3), subjects achieved a lower level of efficiency in all treatments than what was predicted by the model. However, the results give an idea of what would be the result from implementing bargaining and enforcement measures when none of them exist in the first place. When only efficiency loss due to bargaining

is accounted for, the introduction of the bargaining-enforcement combined improves social surplus and improves the sellers' rents. When all efficiency loss due to bargaining and loss trade is taken in account, implementing bargaining and partial enforcement (PB) does not improve efficiency but gives the seller significantly higher payoffs. If only bargaining is implemented (NB), efficiency is not improved and the distribution does not change. When only enforcement is implemented (PN), there is an improvement on efficiency and parties share available surplus more equally.

When considering the median outcomes (figure 4) and only the efficiency loss from bargaining, subjects achieved higher efficiency and equal distribution of surplus with only the introduction of bargaining (NB), while introducing both bargaining and enforcement did not change efficiency (PB). The introduction of enforcement alone does not change efficiency levels nor the surplus distribution. If I consider also the efficiency loss due to no trade, the introduction of only bargaining reduced efficiency while seller median payoffs remain at zero. The implementation of either enforcement or the enforcement-bargaining combination results in higher efficiency, however it is greater if only enforcement is introduced. In fact, sellers get exactly the same payoffs with either PB or PN but buyers get higher payoffs when only enforcement is implemented (PN). Then, the introduction of only enforcement results in a Pareto improvement with respect to all other treatments.

Consequently, if a social planner's objective is to improve efficiency (social surplus) when contract enforcement is incomplete, the results give evidence that implementing bargaining increases the level of quality traded but not the overall efficiency level if contract enforcement is lacking. This is because the loss of efficiency due to bargaining. If the social planner's goal is to improve the bargaining position of the weaker party so that she achieves a higher share of the surplus, then shifting bargaining power needs to be complemented by the implementation of formal enforcement of at least the base price. However, the social planner can achieve a more egalitarian distribution of the surplus and minimize the efficiency loss from bargaining and no trade by only implementing more formal enforcement.

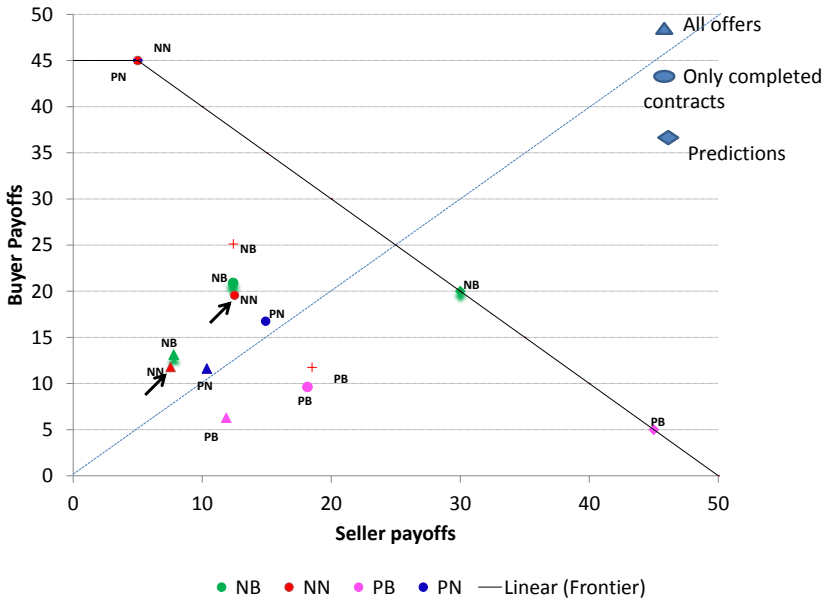

Figure 3: Social surplus by treatment: Predictions and observed outcomes (means)

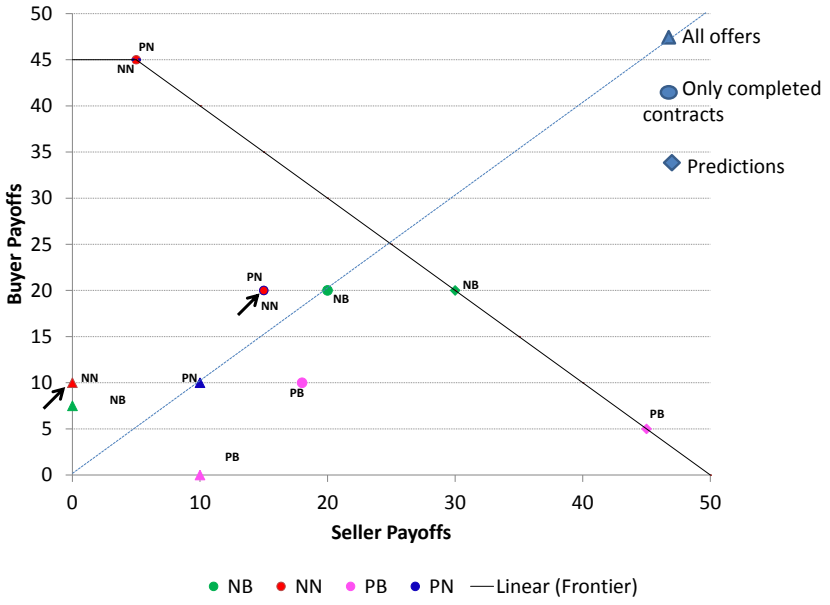

Figure 4: Social surplus by treatment: Predictions and observed outcomes (medians)

Session	Treatment (Date)	Number of Subjects	Number of games	Number of pairs	Total number of periods
1	NEBP (09 27 10)	6	3	9	11
2	NENBP (09 29 10)	6	3	9	13
3	PEBP (10 05 10)	8	1	4	9
4	PENBP (10 11 10)	8	1	4	16
5	NEBP (10 12 10)	12	3	18	10
6	PEBP (10 13 10)	10	5	25	16
7	NEBP (10 26 10)	10	5	25	18
8	NENBP (10 26 10)	10	5	25	19
9	PENBP (10 28 10)	8	3	12	25
10	NENBP (11 02 10)	10	5	24[6]	22
11	PEBP (11 02 10)	10	5	25	20
12	PENBP (11 03 10)	8	4	16	18
13	NEBP (11 03 10)	12	3	18	17
14	PEBP (11 09 10)	12	3	18	14
15	PENBP (11 09 10)	12	4	24	22
16	PEBP (11 10 10)	12	2	12	19
17	NENBP (11 10 10)	14	4	28	26
Total		168	56	296	295
Average		9.88	3.29	17.41	17.35

Table 1: Experimental sessions

	NB	NN	PB	PN
All possible interactions				
Possible trades	285	426	414	368
Offer fraction	0.98	0.97	0.98	0.95
Acceptance rate fraction	0.53	0.60	0.53	0.69
Counteroffer fraction	0.24	na	0.37	na
Counteroffer after rejection fraction	0.51	na	0.79	na
Counteroffer acceptance rate	0.40	na	0.34	na
Number of pairs	70	86	84	56
Av. Length of relationship	4.04	4.94	4.96	6.52
Pairs used offer, fraction	1	0.99	0.94	1
Pairs used counteroffer, fraction	0.50	na	0.73	na
Pairs contracted by offer, fraction	0.80	0.86	0.95	0.96
Pairs contracted by counteroffer, fraction	0.63	na	0.56	na
Av. proposed quality	8.37	7.81	7.14	7.44
Av. proposed payment	62.82	60.70	56.28	55.37
Av. proposed quality (offers)	8.59	7.81	7.23	7.44
Av. proposed payment (offers)	61.71	60.70	55.88	55.37
Av. proposed quality (counteroffers)	7.46	na	6.89	na
Av. proposed payment counteroffers	67.45	na	57.38	na
Median sellers' payoff	0	0	10	10
Median sellers' share	0	0	0.4	0.39
Completed exchanges, N	176	249	266	243
Av. contracted quality	8.57	8	7.71	7.79
Av. actual quality	7.51	6.41	6.05	6.33
Av. contractual payment	66.64	61.71	60.49	57.94
Av. actual payment	49.94	44.57	48.77	46.58
Av. buyer's payoffs	20.90	19.57	9.63	16.75
Av. seller's payoffs	12.39	12.50	18.15	14.91
Median seller's payoffs	20	15	18	15
Av. Surplus (no loss)	37.53	32.07	30.26	31.67
Av. surplus (loss bargaining)	33.29		27.79	
Overall seller's share	0.24	0.54	1.19	0.84
Overall seller's share (median)	0.50	0.43	0.61	0.50
Seller's share if offer	0.31	0.54	1.30	0.84
Seller's share if counteroffer	-0.16	na	0.75	na
Truc. Seller's share	0.43	0.38	0.64	0.50
Payoffs relative spread	0.16	0.30	-0.97	-0.60
Cooperation rate	0.49	0.36	0.38	0.41
Cooperation rate if offer	0.54	0.36	0.39	0.41
Cooperation rate if counteroffer	0.26	na	0.35	na
Treatment Effects				
Bargaining	Yes	No	Yes	No
Enforcement	None	None	p	p

Table 2: Summary data

	Means				Mann-Whitney (p-values)				
Overall effects	NB	NN	PB	PN	NB vs. NN	NB vs. PB	NN vs. PN	PB vs.PN	NN vs.PB
Offer Acceptance rate fraction	0.53	0.60	0.52	0.69	0.0647*	0.8701	0.0086**	< 0.000***	0.0261**
Acceptance rate fraction given bargaining	0.63	0.60	0.65	0.69	0.4963	0.5019	0.0086**	0.2343	0.1337
Av. Overall social surplus (all loss)	20.92	19.33	18.16	21.99	0.5025	0.3191	0.0350**	0.0102**	0.7506
Av. Social surplus (loss trade)	23.59	19.33	19.78	21.99	0.0209**	0.0694*	0.0350**	0.1229	0.4935
Av. Overall buyer's payoffs (all loss)	13.13	11.80	6.30	11.63	0.5745	< 0.000***	0.9357	< 0.000 * **	< 0.000 * **
Av. Overall seller's payoffs (all loss)	7.79	7.54	11.86	10.35	0.2602	0.0158**	0.0002***	0.5511	<0.000***
Overall seller's share (all loss)	0.16	0.33	0.86	0.59	0.2950	< 0.000***	< 0.000***	0.1977	< 0.000***
Completed exchanges									
Av. contracted quality	8.57	8	7.71	7.79	0.0044***	0.0005***	0.690	0.8341	0.5822
Av. contracted price	na	na	39.63	31.59	na	na	na	<0.000***	na
Av. contracted bonus	na	na	20.87	26.35	na	na	na	<0.000***	na
Av. actual quality	7.51	6.41	6.05	6.33	0.0005***	<0.000***	0.8089	0.3201	0.2301
Av. contractual payment	66.64	61.71	60.49	57.94	0.0013***	0.0001***	0.1115	0.3934	0.4059
Av. actual payment	49.94	44.57	48.77	46.58	0.0310**	0.0918*	0.6360	0.3991	0.2141
Av. Social surplus (no loss)	37.53	32.07	30.26	31.67	0.0005***	<0.000***	0.8089	0.3201	0.2301
Av. Social surplus (loss bargaining)	33.29	32.07	27.79	31.67	0.1363	0.0001***	0.8089	0.0070**	0.0029**
Av. buyer's payoffs (loss bargaining)	20.90	19 .57	9.63	16.75	0.2292	<0.000***	0.0551*	<0.000***	<0.000***
Av. seller's payoffs (loss bargaining)	12.39	12.50	18.15	14.91	0.1030	0.4935	0.0874*	0.0918*	0.0011***
Overall seller's share (loss bargaining)	0.26	0.54	1.31	0.84	0.1407	<0.000***	<0.000***	0.0036***	<0.000***
Payoffs relative spread (loss bargaining)	0.16	0.30	-0.97	-0.60	<0.000***	<0.000***	<0.000***	<0.000***	<0.000***
Cooperation rate	0.49	0.36	0.38	0.41	0.0063**	0.0172**	0.2952	0.5230	0.6686
Cooperation rate if offer	0.54	0.36	0.39	0.41	0.0006***	0.0050**	0.2952	06703	0.5586
Cooperation rate if counteroffer	0.26	na	0.35	na	na	0.4338	na	na	na
Treatment Effects									
Bargaining	Yes	No	Yes	No					
Enforcement	None	None	p	p					

Notes: Median values for overall seller share and seller payoffs are in table 2 for reference.

Table 3: Hypothesis test for treatment effects

Regressors	Probability of acceptance Coeff./Std Error	Probability of acceptance Coeff./Std Error	Probability of counteroffer Coeff./Std Error	Probability of counteroffer Coeff./Std Error
Constant	-0.0952	-0.7365***	-0.8564**	-0.0475
	(0.1604)	(0.2174)	(0.4046)	(0.5031)
Bargaining dummy	-0.1254	-0.0808		
	(0.1452)	(0.1568)		
Enforcement dummy	0.2265	0.4870***	0.4090**	0.3370*
	(0.1568)	(0.1584)	(0.1761)	(0.1832)
Bargaining*enforcement	-0.2953	-0.4215**		
	(0.2031)	(0.2141)		
Contracted quality		0.0072		0.0557
		(0.0278)		(0.0493)
Contracted price		0.0140***		-0.0266***
		(0.0043)		(0.0069)
Contracted bonus		0.0019		-0.0124**
		(0.0044)		(0.0063)
Length of relationship	-0.0088	-0.0026	0.1946	0.1364
	(0.0421)	(0.0417)	(0.1871)	(0.2214)
Buyer's previous earnings	0.0177***	0.0136***	-0.0113**	-0.0046
	(0.0032)	(0.0034)	(0.0047)	(0.0049)
Seller's previous earnings	0.0292***	0.0251***	-0.0093*	-0.0029
	(0.0042)	(0.0044)	(0.0051)	(0.0052)
Observations	1156	1156	534	534
Log pseudolikelihood	-713.99146	-693.40854	-318.71962	-299.74677
Pseudo R2	0.0888	0.1150	0.0481	0.1048

Notes: Estimation are probit models with a dummy that takes value of 1 if the contract was accepted or counteroffer was used respectively and zero otherwise as dependent variables respectively. Asterisks indicate the significance level of the estimate: * at 10% level, ** at 5% level and *** at 1% level. Adiditional controls are current lengh of the relationship, buyer's and seller's payoffs and dummies for each period. Standard errors reported are robust and adjusted for clustering on buyer-seller pairs. Both estimations use subdata for only offers made by buyers. Data excludes observations for first period interactions. In addition, estimation for probability of counteroffers limits data to bargaining treatments.

Table 4: Determinants of contract acceptance and counteroffer use

Regressors	Actual Quality Coeff./Std Error	Social Surplus (loss trade) Coeff./Std Error	Social Surplus (loss trade) Coeff./Std Error	Social Surplus (overall loss) Coeff./Std Error	Social Surplus (overall loss) Coeff./Std Error
Constant	-0.4035	19.6682***	7.8799***	18.8390***	7.2924***
	(0.6364)	(2.1666)	(2.003)	(2.1648)	(2.0393)
Bargaining dummy	1.1337*	3.9009	4.3170**	1.2844	2.4791
	(0.6094)	(3.0396)	(1.9034)	(3.0622)	(1.8803)
Enforcement dummy	0.4924	2.1623	0.4953	2.1387	0.5025
	(0.6323)	(3.5917)	(2.0598)	(3.5914)	(2.0960)
Bargaining*enforcement	-1.3136	-5.8880	-4.8275*	-4.8664	-4.3497
	(0.8308)	(4.4912)	(2.7237)	(4.4654)	(2.6641)
Length of relationship	0.1145	1.0631	0.5625	0.9995	0.5234
	(0.1514)	(0.8090)	(0.4376)	(0.8057)	(0.4407)
Buyer's previous earnings	0.1250***		0.4831***		0.4704***
	(0.0138)		(0.0496)		(0.0498)
Seller's previous earnings	0.1880***		0.7098***		0.7224***
	(0.0163)		(0.0624)		(0.0638)
Sigma	4.9223***				
	(0.2081)				
Observations	1156	1450	1156	1450	1156
Log pseudolikelihood	-2559.59				
R-squared		0.0243	0.2909	0.0199	0.2814

Notes: The estimation for actual quality is a tobit model. There were 421 left-censored observations at 0. Estimations for social and private surplus are OLS with additional controls for party's history in columns three and five, which use data restricted to interactions after period one. Asterisks indicate the significance level of the estimate: * at 10% level, ** at 5% level and *** at 1% level. Additional controls included dummy variables for each period. Standard errors reported are robust and adjusted for clustering on buyer-seller pairs. All regressions include all contracts offered.

Table 5: Actual quality, social surplus and private surplus estimates (all offers)

Regressors	Actual Quality Coeff./Std Error	Social Surplus (no efficiency loss) Coeff./Std Error	Social Surplus (no efficiency loss) Coeff./Std Error	Social Surplus (loss bargaining) Coeff./Std Error	Social Surplus (loss bargaining) Coeff./Std Error
Constant	3.0463***	30.7562***	18.7183***	29.6088***	17.9190***
	(0.1356)	(2.0628)	(2.1361)	(2.1003)	(2.1901)
Bargaining dummy	1.3165***	5.6109**	6.0655***	1.3165	3.0612
	(0.4468)	(2.6734)	(2.0474)	(2.9034)	(2.1593)
Enforcement dummy	-0.4108	-0.8768	-1.7536	-0.9795	-1.7997
	(0.4480)	(3.2396)	(2.2098)	(3.2292)	(2.2302)
Bargaining*enforcement	-1.0840	-6.4244	-4.6811	-4.6411	-3.8662
	(0.6551)	(4.0226)	(2.9286)	(4.1235)	(2.9190)
Length of relationship	0.1205***	1.3554***	0.5728***	1.2720***	0.5218***
	(0.0467)	(0.4286)	(0.2154)	(0.4289)	(0.2209)
Buyer's previous earnings	0.1003***		0.4546***		0.4390***
	(0.0112)		(0.0488)		(0.0516)
Seller's previous earnings	0.1130***		0.5086***		0.5127***
	(0.0130)		(0.0563)		(0.00622)
Sigma	3.0463***				
	(0.1356)				
Observations	735	934	735	934	735
Log pseudolikelihood	-1709.2363				
R-squared		0.0441	0.3361	0.0338	0.3041

Notes: The estimation for actual quality is a tobit model. There were 108 left-censored observations at 1. Estimations for social and private surplus are OLS with additional controls for party's history in columns three and five, which use data restricted to interactions after period one. Asterisks indicate the significance level of the estimate: * at 10% level, ** at 5% level and *** at 1% level. Additional controls included dummy variables for each period. Standard errors reported are robust and adjusted for clustering on buyer-seller pairs. All regressions include only completed contracts.

Table 6: Actual quality, social surplus and private surplus estimates

Regressors	Seller payoffs		Seller share				Spread in payoffs			
	OLS Coeff./ Std Error	Robust reg. Coeff./ Std Error	OLS Coeff./ Std Error	Robust reg. Coeff./ Std Error	Quantile (50) Coeff./ Std Error	Quantile (90) Coeff./ Std Error	OLS Coeff./ Std Error	Robust reg. Coeff./ Std Error	Quantile (50) Coeff. Std Error	Quantile (90) Coeff. Std Error
Constant	2.2943	-3.1721***	1.3907***	0.4666***	0.5420***	4.2034 ***	-2.0347***	0.0312	-0.2063***	3.0419***
	(2.6694)	(0.9277)	(0.3365)	(0.0376)	(0.0234)	(0.0709)	(0.6687)	(0.0759)	(0.0293)	(0.2027)
Bargaining dummy	1.1232	3.4486***	0.0014	0.1442***	0.0387**	0.0133	-0.3233	-0.3070***	-0.1352***	-0.2368
	(2.3729)	(0.7823)	(0.1803)	(0.0317)	(0.0194)	(0.0553)	(0.3465)	(0.0640)	(0.0244)	(0.1693)
Enforcement dummy	2.1148	2.4420***	0.3450**	0.0410	0.0387**	0.0163	-0.6897**	-0.0815	-0.1352***	-1.2664***
	(1.6653)	(0.6846)	(0.1677)	(0.0278)	(0.0170)	(0.0502)	(0.3413)	(0.0560)	(0.0215)	(0.1347)
Bargaining*enforcement	3.6011	-0.7058	0.3063	0.0492	0.0924***	0.1692**	-0.3004	-0.0817	-0.0979***	-0.1461
	(2.5486)	(1.0160)	(0.2247)	(0.0412)	(0.0253)	(0.0753)	(0.4353)	(0.0832)	(0.0318)	(0.2185)
Actual quality	0.6810***	2.1524***	-0.1718***	-0.0145***	-0.0206***	-0.3696***	0.3539***	0.0310***	0.0571***	-0.0407**
	(0.2549)	(0.0870)	(0.0314)	(0.0035)	(0.0022)	(0.0092)	(0.0624)	(0.0071)	(0.0027)	(0.0191)
Buyer previous earnings	0.0573	0.0712***	-0.0002	0.0002	-0.0022***	-0.0074***	0.0029	-0.0004	0.0058***	-0.0111*
	(0.0560)	(0.0182)	(0.0049)	(0.0007)	(0.0005)	(0.0017)	(0.0098)	(0.0015)	(0.0006)	(0.0059)
Seller previous earnings	0.3710***	0.0851***	0.0217***	0.0027***	0.0075***	0.0100***	-0.0407***	-0.0048***	-0.0151***	-0.0226***
	(0.0724)	(0.0206)	(0.0062)	(0.0008)	(0.0005)	(0.0018)	(0.0124)	(0.0017)	(0.0006)	(0.0058)
Length of relationship	0.0612	-0.0710	0.0225	-0.0004	-0.0029	0.0000	-0.0551	0.0000	0.0018	0.0000
	(0.1926)	(0.2131)	(0.0212)	(0.0086)	(0.0053)	(0.0124)	(0.0435)	(0.0174)	(0.0068)	(0.0258)
Observations	735	735	735	735	735	735	735	735	735	735
R-squared	0.1659		0.1544				0.1603			
Pseudo R2					0.0223	0.2543			0.0237	0.1757

Notes: Columns one, three and seven are OLS estimations with seller's payoff, seller's share and payoff spread as dependent variables respectively. Columns two, four and eight are robust regressions for the same dependent variables. Columns five, six, nine and ten are median and 90 percentile regressions respectively. Asterisks indicate the significance level of the estimate: * at 10% level, ** at 5% level and *** at 1% level. Additional controls are quality level delivered, the current lengh of the relationship, buyer and seller payoffs and dummies for each period (not included in output). Standard errors reported are robust and adjusted for clustering on buyer-seller pairs for the OLS estimations.

Table 7: Distributional outcomes

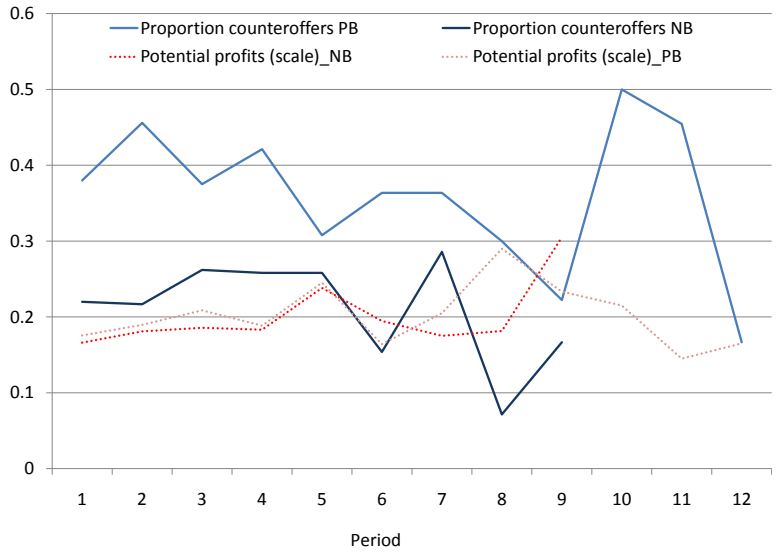

Figure 5: Number of counteroffers and potential sellers' profits in offers

Regressors	Contracted Price Coeff./Std Error	Contracted Bonus Coeff./Std Error	
Constant	20.1102***	26.7579***	
	(2.8792)	(3.0905)	
Bargaining dummy	10.2022***	-5.1524	
	(2.8023)	(3.2583)	
Length of relationship	1.0240*	-1.1720*	
	(0.5811)	(0.6580)	
Buyer previous earnings	0.3931***	0.0740	
	(0.0925)	(0.1053)	
Seller previous earnings	0.4701***	-0.0226	
	(0.0955)	(0.0882)	
p3	-4.9348**	3.7702	
	(2.1578)	(2.4724)	
p4	-5.5992**	1.3222	
	(2.3906)	(2.4458)	
p5	-5.2252	5.4539	
	(3.6098)	(4.0222)	
p6	-12.3600***	9.6626**	
	(4.2306)	(4.6904)	
p7	-9.6331*	9.6618	
	(5.5954)	(6.5043)	
p8	-15.4979**	21.8971**	
	(6.0232)	(9.0065)	
pl	-12.9785*	12.6187	
	(6.7161)	(8.7038)	
Sigma	16.4522***	18.3279***	
	(0.9842)	(1.3839)	
Observations	411	411	
Log pseudolikelihood	-1725.3486	-1731.1145	
Pseudo R2	0.0311		0.0066

Notes: The estimations are tobit models and used observations from period 2 and above. Total payment regression used data from all treatments and had 34 left-censored observations at 0; price and bonus regressions used data only from partial enforcement treatments and have 3 and 149 left-censored observations at 0 respectively. Asterisks indicate the significance level of the estimate: * at 10% level, ** at 5% level and *** at 1% level. Standard errors reported are robust and adjusted for clustering on buyer-seller pairs. Additional controls include period dummies in which pl is a dummy for period 9 and above.

Table 8: Bargaining effect in contract structure

Appendix

This appendix presents technical details about the experimental design. Each treatment was run in four sessions except the PB treatment, which was run in five sessions.

Matching procedure: Subjects were matched into pairs by using a rotation matching scheme. In each session, subjects were randomly divided into two groups: buyers and sellers. In each match, every buyer was paired with a seller and subjects were not paired with each other more than once. Moreover, the pairing was done in such a way that the decisions made by one subject in one match could not affect them in any future match interactions. These features were explained to the participants. Because subjects were matched with each other only once, the total number of possible matches per session is $N/2$, where N is the number of subjects attending a session.

Infinitely repeated games: In each treatment, a random termination rule was used to induce infinitely repeated games. The probability of continuation used was $\delta = 4/5$, which was the same for all treatments. In each trading period the supergame is expected to go on for 5 additional periods.[7] This was done at the end of each trading period by having the computer draw a number between 0 and 1, using a uniform distribution. The supergame terminated if the computer draw was 0.81 or higher. This randomization mechanism generates a infinitely repeated game because there is always a possibility of interacting with the same subject in the next round. The probability of continuation allows us to control for the subjects' beliefs regarding the probability of continuation as subjects played a game with an uncertain number of trading periods. Because of the random termination rule, each supergame may have a different number of periods but all supergames have the same expected duration of five rounds. Then, each experimental session may be formed of one long-duration supergame or various short-duration supergames of the same treatment with different partners depending on the random termination rule. The number drawn by the computer serves as a public randomization device as in all sessions all participants observe the same drawn number.

Stage game payoffs: The stage game payoffs differ among bargaining and no bargaining treatments. In the bargaining treatments, I include in the payoff functions the parameter β from the

[7]The expected number of periods of a game with a continuation probability of δ is equal to $T = \frac{1}{1-\delta}$. Therefore, with $\delta = 4/5$ the expected number of periods each pair interacts equals 5.

theroretical model. The parameter reflects the bargaining power which in the traditional alternating offer game is the cost of delaying trade. In the experiments it serves as a way to transfer bargaining power between players by not only giving the opportunity to the seller to counteroffer but also by inflicting an asymmetric cost of delay for parties.

Implementation of the bargaining: To implement the difference in bargaining power in the experiment, the design included two different conditions. In the first condition the buyer made a take-it-or-leave-it offer to the seller who could only accept or reject – in essence an ultimatum game. In the second condition, the seller was able to make a counteroffer if he or she rejected the buyer's offer–an alternating offer game with two offers and an asymmetric cost for delaying trade for each party.

Subjects' total earnings: All payoffs were in points. At the end of each session, the points earned by each subject were converted into dollars at the exchange rate of 50 points= \$1. Subjects were paid privately the equivalent of points earned plus the money resulting from a pre-experimental gamble that the subjects had the option to play by using their show-up fee of \$8. Note the resolution of this gamble did not occur until the end of the session.

Order of treatments: Subjects could participate in only one session and each subject played only a single treatment. Therefore, there was no possibility of spillover effects from one treatment to another.

Throughout the pre-experimental activities subjects neither received feedback about their decisions nor information about other subjects' decisions. They were not informed about their own payoffs until the end of the experiment. Subjects were informed about these procedures, and they were also aware that their decisions in the pre-experimental activities were completely independent of the trading game.

Summary statistics. Offer fraction shows the proportion of possible interactions in which a buyer made an offer. *Acceptance rate fraction* shows the proportion of those offers accepted by the seller. *Counteroffer fraction* shows the proportion of all possible interactions that resulted in a counteroffer and *Counteroffer after rejection fraction* shows the proportion of rejected offers that were followed by a counteroffer. *Counteroffer acceptance rate* shows the proportion of those coun-

teroffers accepted by buyers. *Number of pairs* shows the number of distinct subjects pairs. *Average length of the relationship* shows how many periods each pair interacted. *Pairs used offer, fraction* and *Pairs used counteroffer, fraction* show the proportion of pairs that used offers and counteroffers respectively while *Pairs contracted by offer, fraction* and *Pairs contracted by counteroffer, fraction* show the proportion of pairs that agreed on a contract by using offers or counteroffers respectively. *Av. proposed quality* and *Av. proposed payment* show the average for all contracts that were proposed regardless if they were accepted or not. *Av. proposed quality (offers*, *Av. proposed payment (offers)*, *Av. proposed quality (counteroffers)* and *Av. proposed payment (counteroffers)* show the average regardless of acceptance or rejection but for contracts proposed as offer and as counteroffers respectively.

The remaining variables in Table 2 are restricted to the actual contracts that were accepted including offers and counteroffers. *Average contracted quality* and *Average contracted payment* show the averages specified in the accepted offers and counteroffers, while *Average actual quality* and *Average actual payment* show the averages actual delivered by both the seller and buyer respectively. *Average buyer payoffs* and *Average seller payoffs* and *Median seller payoffs* are the average and median seller earnings in points per period. *Overall seller share* and *Overall seller share (median)* show the mean and median proportion of the private surplus (sum of parties' payoffs) captured by the seller including all contracts respectively, while *Seller share if offer* and *Seller share if counteroffer* show the proportion of the surplus captured by the seller when the contract was reached by an offer or counteroffer respectively. *Trunc. seller share* is similar to overall seller share but it truncates the ratio of payoffs to total available private surplus to the unit interval. In this case, if the payoff of either party is negative, the share is set to 0 and the other party's share is set to one. *Payoffs relative spread* presents another way of looking at surplus distribution. It is the ratio of the spread between buyers' and sellers' payoffs to the total available private surplus. Finally, the *Cooperation rate* shows the overall average cooperation which is defined as pairs that act according to the contract while *Cooperation rate if offer* and *Cooperation rate if counteroffer* show the average cooperation when the contract was achieved through an offer and counteroffer respectively.

NB	NN	PB	PN
4.04^{a}	$4.94^{a,b}$	$4.96^{b,c}$	6.52^{c}

Notes: Different letter superscripts indicate that numbers are statistically distinct.

Table 9: Average number of periods per match

Tests for effects Because the experiments mimic the infinite repetition of the theoretical model, the realized durations varied considerably and subjects play games with different lengths. The number of played rounds may impact subject's decisions. A Mann-Whitney tests give evidence that the number of periods played per match is significantly different between some treatments (Table 9 presents the average number of periods per match). Therefore, I control for the length of the relationship in the econometric analysis.

In addition, because subjects may learn throughout the experiment, subjects' behavior may be substantially different from the theoretical equilibrium in earlier periods, but, over time subjects adjust their choices and converge to the theoretical equilibrium. As a consequence potential differences across treatments may be due to learning effects, especially between those that have significantly different length.

To explore if this is an issue, I test for learning effects across games, for each treatment and early and later periods across treatments. First, I compare subjects' decisions across the games played in each single session across treatments.[8] I find a significant difference in the mean values of the most relevant variables between some of the games (superscripts in table 10). This evidence suggests that subjects' early behavior differs somewhat from later behavior.

Furthermore, subjects became more familiar with the incentive structure of the indefinite repetition across games in the same sessions. Figure 6 shows the learning trend in cooperation between games across treatments. Participants increase cooperation from the first two games to the later games. Even though cooperation is lower in game 5, it is not statistically different than cooperation in game 4. However, the difference in cooperation among games is significant at 5% level (Kruskal-Wallis test).

[8]Because of the use of a random termination rule, one or more games were played in each session. Then, the game number represents the order in which the game was played in a session (first, second, third, etc.).

Variable N=934	Game 1 n=252	Game 2 n=200	Game 3 n=246	Game 4 n=161	Game 5 n=75
Av. contracted quality	7.53^{a}	$7.58^{a,b}$	8.37^{c}	$8.58^{c,d}$	$7.89^{b,c,d}$
Av. actual quality	6.08^{a}	$5.53^{a,b}$	6.89^{c}	7.68^{d}	$6.63^{c,d}$
Av. contractual payment	58.09^{a}	$59.05^{a,b}$	63.83^{c}	$63.88^{c,d}$	$64.43^{c,d}$
Av. actual payment	44.33^{a}	$40.34^{a,b}$	49.75^{c}	55.21^{d}	$50.84^{c,d}$
Av. seller's payoffs	13.89^{a}	$12.46^{a,b}$	$15.17^{a,c}$	$16.77^{c,d}$	$17.66^{c,d}$
Av. buyer's payoffs	15.02^{a}	$13.66^{a,b}$	$17.34^{a,c}$	21.38^{d}	$12.78^{b,c}$
Cooperation rate	0.36^{a}	$0.32^{a,b}$	$0.44^{a,c}$	$0.53^{c,d}$	$0.40^{b,c,d}$
Av. Surplus	30.40^{a}	$27.63^{a,b}$	34.47^{c}	38.42^{d}	$33.13^{c,d}$
Private Av. Surplus	28.91^{a}	26.11	32.51^{b}	38.15	$30.43^{a,b}$

Notes: Numbers within a row with different letter superscripts are statistically distinct according to pairwise Mann-Whitney tests. Differences among games are statistically significant at 1% or 5% levels .

Table 10: Mean values per game across treatments

When I test for learning effects within each individual treatment, I find that the no enforcement treatments present some significant increasing differences among games for desired quality, actual quality, desired total payment, cooperation and surplus. This evidence suggests that the small learning trend observed in the overall analysis is driven by the no enforcement treatments, especially by the NN treatment where learning trends are significant at the 1% level for almost all variables. I also compare the means of the variables of interest among early and later periods across treatments and for each treatment. The analysis gives evidence of learning trends in subject behavior. As in the previous analysis, the presence of learning effects is stronger in the NE treatments than in the PE treatments. Therefore, I control for learning effects in the econometric analyses.

A final consideration is the difference in the number of periods played among games. In the NB treatment the longest game had 9 periods while in the NN, PB and PN treatments the longest game had 17, 12 and 20 periods respectively. I test for potential differences among treatments because of the presence of longer games. By using the pooled data for all treatments, I find a significant difference in the total payment (MW test p=0.0410), sellers' profits (MW test p=0.0604) and cooperation (MW test p=0.0102). When I analyze the differences among sessions for individual treatments, I only find significant differences in the NN treatment. Therefore, I include all

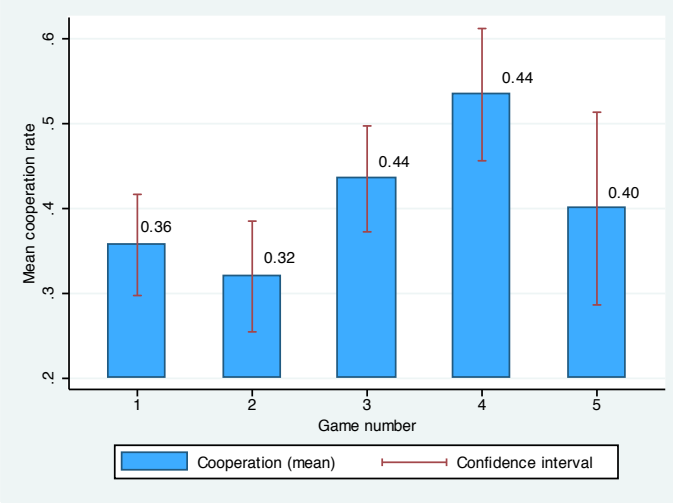

Figure 6: Average cooperation across games in all treatments

observations in the analysis and I control for potential differences due to longer games by including dummy variables for each period.

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