Essays in Economic Incentives and Businesses

Essay One

The Role of Bargaining Power in Agricultural Contracts

Paula Cordero Salas
AED Economics Department,
The Ohio State University
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Abstract

We study the economic consequences of shifting bargaining power in relational contracts through interventions that endow the agent (seller) with some power to negotiate contract terms in a market where the principal (buyer) traditionally holds significant market power. Existing theories of relational contracts predict that such a bargaining power transfer will have no impact on market efficiency. In contexts where enforcement institutions are weak, a standard assumption from existing theories of relational contracts - the existence of an enforceable base payment - may not hold. In this case, we show that a transfer of bargaining power can erode market efficiency in a dynamic relational contracting environment, which contradicts findings from existing models of relational contracting. When buyers hold significant market power, they forgo short-term opportunistic behavior by honoring promised performance bonuses in order to keep sellers engaged in trade over time and to accumulate surplus over many periods. With a market power eroded, buyers’ long-run gains to trade shirk. When this is coupled with the absence of an enforceable base payment, short-term opportunistic behavior becomes more appealing and trade is more likely to break down. The results here provide policy-makers insight into the economic consequences of enacting policies attempting to balance bargaining power within a framework of fully informal contract enforcement.

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

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‡Corresponding author. AEDE Department, The Ohio State University. Tel.:+1 614-292-9616. Email address: corder-salas.1@osu.edu. Postal address: 2120 Fyffe Road Room 342 Columbus, OH 43210.
The world’s food and agriculture sector has experienced considerable consolidation. A few firms have acquired significant market power along the production chain. The concentration may provide these firms with the ability to extract additional rents from smaller agents with less power. Other sectors have followed this trend. For instance, there is debate about the leverage that small businesses and consumers have to bargain for premiums with health care insurer and providers (Lee, 2002). These observations highlight possible disparities in the rates of return of the contracts used in many markets in the developed and developing world. In the agricultural and many other markets, some contingencies of contracts may not be formally enforceable due to cost or lack of third-party verifiability of product characteristics. As a result, parties enforce contracts using informal mechanisms that may allow for significant opportunism, which may be exacerbated in the presence of uneven bargaining power. Consequently, groups of these ‘weak agents’ have organized to bargain collectively with the objective of increasing negotiating power over prices and contract terms. For example, in the agricultural sector, growers have formed bargaining cooperatives (Grow et al., 2003; Helmberger and Hoos, 1965; Iskow and Sexton, 1992). Moreover, political pressure has emerged to support the redistribution of bargaining power in favor of growers and production workers (the Democratic Staff, 2004).

This article explores rent distribution in contractual relationships by studying the economic consequences of varying bargaining power in a market where one party traditionally holds all bargaining power and trade takes place repeatedly using contracts characterized by imperfect third-party enforceability. Specifically, we look at the effects on efficiency, cooperation, and distribution of gains of trade of endowing the agent (seller) with some bargaining power to negotiate contract terms with the principal (buyer) in a repeated-interaction setting. The model shows that shifting bargaining power from one party to the other has diverse effects on cooperation and in some cases social efficiency across different contract enforcement regimens.
We consider a buyer/seller model where the buyer purchases one unit of a quality good from the seller. Rather than assuming that the buyer makes take-it-or-leave-it offers as in standard principal-agent models, parties negotiate the terms of the contract using an alternating-offer procedure.\(^1\) The contract includes a payment scheme that combines a base price and a discretionary payment to induce the desired quality, similar to the case of the processing-tomato industry in California (Hueth and Ligon, 2002). After agreeing on contract terms parties decide to stick to the contract or renego on the contract terms. The article analyzes whether the division of the surplus resulting from the bargaining process affects the parties' ability to self-enforce contracts under three different scenarios: i) perfect contract enforceability – the benchmark – where a third-party enforces all terms of the contract; ii) no contract enforceability, in which product characteristics are not third-party verifiable nor are any contract terms formally enforceable; and, iii) partial contract enforceability, in which quality is not verifiable but the base price is perfectly enforced.

We find that under perfect and partial contract enforceability, parties find that it is in their best interest to cooperate rather than renego (in the latter, this holds for sufficiently high discount factors). As a result the efficient outcome is always attained and long-term relationships are sustained, reaffirming past findings from the relational contracting literature. More interestingly, the model predicts that when none of contract terms are enforceable and when the seller is endowed with more bargaining power than the buyer, then she may reap too much of the surplus and the equilibrium only exists for discount factors close to one. In this case, the buyer loses the ability to induce high quality through a conditional payment because he is limited by the gains from trade that he can accrue. However, the seller is less sensitive to this payment and nevertheless supplies high quality as she gets most of the

\(^1\)The bargaining process has also been analyzed using the random proposer model developed by Binmore (1987), for which the results of the alternating offer game also hold. In addition, the alternating bargaining game approaches the asymmetric Nash bargaining solution when the motivation to reach an agreement is made negligible (Binmore, Rubinstein, and Wolinsky, 1986); therefore the results presented here also hold when using the Nash bargaining model. Proofs can be obtained from the author upon request.
surplus through a higher base price by exercising her bargaining power.

Additionally, if the seller’s bargaining power is too high the transaction fails because the buyer reneges on the promise to pay both the base and contingent payments at the time of delivery. Intuitively, his short-term gains exceed the long-term benefits of the relationship as he can withhold the complete payment in anticipation of any quality delivered. Hence, cooperation breaks down and efficiency is not achieved. This result implies that the problems of efficiency and distribution of welfare can no longer be separated. Another implication is that if the seller has significantly more bargaining power, she is better off exercising her power only up to the limit at which the long-term relationship breaks down. In this way she gets higher profits by reaping the highest possible surplus while trading in the long-term instead of just getting the short-term gains and reservation payoff thereafter.

The results of this article are of interest for several reasons. First, contracts are normally studied using a principal-agent setting where the principal chooses the terms of the contract by making take-it-or-leave-it-offers. In most cases, the principal’s optimal offer yields the agent no additional gains over her alternative production opportunity and the principal accrues all gains from cooperation. However, in many cases it is more reasonable to assume that the terms of contracts result from a bargaining process in which the outcome depends on the parties’ relative bargaining power. The model here captures some realistic aspects of the terms of trade used in certain markets where parties engage in negotiations over contract terms (e.g., bargaining between marketing cooperatives/bargaining association and processors/retailers in agricultural markets, hospital-HMOs, and labor unions and firms). Second, this article contributes to the understanding of the effect of bargaining power on the formation of contract terms and its role in welfare outcomes. It provides insight into the economic consequences of policies that attempt to redistribute bargaining power among parties that trade under self-enforcing contracts. Third, the article gives an alternative explanation of some facts found in the agricultural sector. Hueth and Ligon (2002) and Hueth
Marcoul (2003, 2002) found little evidence of increasing prices for growers in the presence of bargaining groups in the U.S. agricultural markets. Our model predicts that the seller is better off by earning long-term benefits and not exercising bargaining power higher than the limit in which relationships break down. The cases reported by Hueth and Ligon and Heuth and Marcoul suggest that in those circumstances the bargaining groups cannot strongly exercise their bargaining power without losing the possibility of selling to the processors in the future – a situation that matches the predictions of the model here.

In the existing literature, many authors have studied relational contracts in different environments. In contrast with this article, previous relational contract models have focused on the case where the principal holds all bargaining power and makes take-it-or-leave-it offers. For instance, Bull (1987), MacLeod and Malcomson (1989, 1998) and Levin (2003) use this assumption. Other authors have looked at contract design and bargaining under incomplete information. Inderst (2002) focuses on contract design that brings the agent to reveal his type when he can offer a contract afterwards. Inderst (2003), Wang (1998) and Sen (2000) explore bargaining over two-items contracts when one party has private information. In these cases, all contract terms are fully enforceable. On the other side, Wu and Roe (2007a,b) look at relational contracting under different enforcement regimes; however, they assume that the principal holds all bargaining power. Finally, another set of articles look at contract renegotiation and bargaining. Examples of this literature include Fernandez and Glazer (1991) and Macleod and Malcomson (1995) who examine renegotiation for wage-contracts and contracts over a flow of goods and services respectively.

The structure of this article is as follows. Section two develops the model. Section three presents the equilibrium of the bargaining game. Sections four, five and six analyze the consequences of bargaining under the three different contract enforceability levels, and finally, section seven discusses some policy implications and presents some conclusions.
IN SOME AGRICULTURAL SUBSECTORS, IN MANY REGIONS THERE ARE NUMEROUS GROWERS VYING FOR CONTRACTS WITH ONLY ONE OR FEW PROCESSORS SO THAT PROCESSORS POTENTIALLY HOLD MARKET POWER. IN LIVE- STOCK SECTORS, GROWER HAVE FEW OUTSIDE OPPORTUNITIES AND PROCESSORS OFTEN POSSESS MARKET POWER DUE TO AN EXCESS SUPPLY OF GROWERS VYING FOR CONTRACTS. THEREFORE, SIMPLY WALKING AWAY FROM THE RELATIONSHIP BECOMES EXTREMELY COSTLEY TO GROWERS, NOT TO MENTION THAT PROCESSORS MAY NOT LOSE MUCH WHEN ANY ONE GROWER WALKS AWAY BECAUSE THERE IS ALWAYS ANOTHER GROWER WAITING TO REPLACE A DEPARTED GROWER.

1 The Model

Consider two risk-neutral parties, a buyer and a seller, who have the opportunity to trade at dates \( t = 0, 1, 2, 3, \ldots \), and that bargain over the terms of a contract that will be used for trading one unit of a good.\(^2\) The contract, \( y_t = \langle p_t, D_t(q_t) \rangle \), specifies a compensation scheme that the seller is entitled when delivering the good of quality \( q_t \in Q = [\underline{q}, \overline{q}] \) in period \( t \). Quality is observable by both parties but may not be enforceable because quality may not be verifiable by a neutral third-party. Consequently, the desired quality, \( q^* \), may differ from the delivered quality, \( q_t \). The total compensation is defined as \( P_t(q_t) = p_t + D_t(q_t) \) and consists of a base payment, \( p_t \), and a contingent payment rule \( D_t(q_t) \). The base payment, \( p_t \), is paid at the end of period \( t \) and may not be enforceable as in Wu and Roe (2007b) contrasting with the conventional assumption of enforceable base payments. The contingent payment is a mapping from outcome to payment, \( D_t : Q \to \mathbb{R} \) and its existence depends on the contract enforcement regime. The contingent payment may be used as an instrument to induce the

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\(^2\) The quantity of a good is normalized to 1 for simplicity but can be thought analogously to any quantity parties want to specify in the contract.
desired quality, $q^*$. In this case it is positive, $D_t = b(q_t)$, a *bonus* to reward high quality. It can also be negative, a *deduction*, $D_t = d(q_t)$. In this case this payment is used to punish the seller when she deviates from the desired quality or as a means for the buyer to deviate from the contract. Since the contingency payment depends on unverifiable quality, it cannot be made a legally binding obligation.

At the beginning of each period $t$, the buyer and the seller bargain over the terms of the contract by using an alternating-offer mechanism. Parties may bargain for an arbitrarily large number of rounds until reaching an agreement. Once parties agree on the terms of the contract in the bargaining stage, a trading stage starts and, depending on the level of contract enforcement parties make decisions about quality and payments, to be described momentarily. If the parties do not reach an agreement before period $t$ ends, then the parties do not trade in that period and receive fixed payments, to be defined. This sequence of events repeats in each period $t$, and the parties interact repeatedly following the assumptions of the theory of repeated games (Watson, 2002): (i) buyers and sellers know only the past actions of the trading partners with whom they have traded allowing for the creation of relationships in which cooperation is an important characteristic; (ii) the parties care about the sum of a stream of discounted future payoffs, where the common discount factor is $\delta \in (0, 1]$; and (iii) the ongoing interaction sustains the equilibrium by allowing the parties to support future terms of trade on the good performance of present trade. The parties cooperate if the history of play in all periods has been cooperation, where cooperation is defined as both parties fulfilling the contract. The parties break-off trade forever if any deviation is observed.\textsuperscript{3} This allows for self-enforcing contracts — relational contracts — since it contains a complete plan for the relationship that describes behavior on and off the equilibrium path. Following Levin

\textsuperscript{3}As in Levin (2003) there is no loss of assuming that deviation causes the parties to break-off trade forever because this outcome never happens in equilibrium. Furthermore, it can be assumed that parties behave as in one-time interactions in which the buyer offers a contract in which there is no performance incentives and the seller responds providing the lowest quality.
(2003), parties cannot renegotiate the trading decision after quality is observed. The reason for this is that if a self-enforcing contract is optimal given any history, then the contract is strongly optimal. This strongly optimal contract has the property that parties cannot jointly gain from renegotiating a new self-enforcing contract even off the equilibrium path. Additionally, each period is played following Nash equilibrium and parties use a stationary contract (Levin, 2003), in which the buyer always offers the same payment scheme, the seller always takes the same action, and the rents to the relationship are attractive enough for parties to self-enforce the contract and stay in the relationship (Baker, Gibbons, and Murphy, 1994; MacLeod, 2006; MacLeod and Malcomson, 1989, 1998). Moreover, repetition allows players to maintain a Sub game Perfect Nash Equilibrium (SPNE) where parties honor the contract and maintain long-term relationships which create social surplus that is split between trading partners. Furthermore, because buyer’s behavior is perfectly observable, a stationary contract bid for the optimal surplus.

The mechanism governing contract bargaining is an application of Rubinstein (1982) and is described as follows: at the beginning of date $t$, the buyer and the seller bargain over the terms of the contract by alternating offers of a pair $y_{it} = \langle p_{it}, D_{it}(q_{it}) \rangle$, where $i$ denotes the buyer and seller, i.e. $\{b,s\}$. Each period $t$ is an interval of time that is divided into $N$ discrete rounds in which the parties bargain and each bargaining round is indexed by $n = 0, 1, 2, 3...$. Following Binmore, Rubinstein, and Wolinsky (1986), $\Delta_i$ is the length of time elapsed between offers. The length of time represents the individual cost of haggling and this cost is assumed to be different for each party, $\Delta_b \neq \Delta_s$, to capture the difference in bargaining power. Furthermore, the times between offers are assumed to be arbitrarily close to zero as is reasonable to assume in many settings. This assumption states that the parties make counteroffers arbitrarily rapidly so the bargaining process can continue for an
arbitrarily large number of rounds within a single trading period. If the buyer proposes a contract \( y_b \) in round \( n \) of period \( t \), the seller may accept the offer in which case the negotiation is over and trade takes place in period \( t \), or the seller may reject the offer and counteroffer by proposing a contract \( y_s \) in round \( (n + 1) \) of period \( t \). Similarly, the buyer or counteroffer in round \( (n + 2) \) of period \( t \). This process will go on until parties reach an agreement or period \( t \) ends.

If a contract \( y_{it} = \langle p_{it}, D_{it}(q_{it}) \rangle \) is accepted by both parties in round \( n \) then trade occurs and the seller immediately chooses the quality \( q_t \in Q \) to deliver at the end of the period and incurs a cost \( c_t(q_t) \) for providing \( q_t \) where \( c'(\cdot) > 0 \), \( c''(\cdot) \geq 0 \), and \( c(q) = 0 \). The seller’s profits are given by \( U_t = P_t(q_t) - c_t(q_t) \). Similarly, at the end of period \( t \) and upon delivery, the agent’s quality provision generates a direct benefit for the buyer, \( R_t(q_t) \), where \( R'(\cdot) > 0 \), \( R''(\cdot) \leq 0 \), and \( R(q) = 0 \). He also chooses whether or not to pay \( p_{it} \) and \( D_{it}(q_{it}) \), depending on the contract enforcement regime. The buyer’s profits are given by \( \pi_t = R_t(q_t) - P_t(q_t) \). Also, \( R'(\cdot) > c'(\cdot) \forall q \in Q \), so it is socially efficient to trade \( q = \bar{q} \), since \( \bar{q} \) maximizes the total surplus defined by \( S(q_t) = R(q_t) - c(q_t) \).

If parties do not reach an agreement before the end of period \( t \) trade does not occur and both parties receive fixed payoffs; \( u \) for the seller and \( \pi \) for the buyer. These options are assumed to be less attractive than trading, but they are desirable for the parties to choose if there is not enough incentives in place for the agent to perform. The sum of the fixed payoffs, \( \bar{s} = \bar{u} + \bar{\pi} \), is the social value of the outside options. The net social surplus is given by \( S(q_t) - \bar{s} \), and we assume \( S(q_t) - \bar{s} > 0 \ \forall \ q \in Q \) and \( q \neq \bar{q} \), and \( S(\bar{q}) > S(q) \geq 0 \). The net social surplus is the rent to the relationship because it represents the difference between the return of the relationship and the second-best market opportunity. Furthermore, the net surplus represents the pie over which the buyer and the seller bargain. Therefore, both parties want to maximize the size of the net surplus.

Following Levin (2003), each party’s objective is to maximize the future stream of
payments which depends on the contracting enforcement level and the bargaining process. Specifically, the objective of the seller is to maximize her utility, the discounted stream of payments given as

\[ \sum_{t=0}^{\infty} \delta^t \{ d_t(P_t(q_t) - c(q_t)) + (1 - d_t)\pi \} \]

and the buyer’s objective is to maximize the discounted sum of profits,

\[ \sum_{t=0}^{\infty} \delta^t \{ d_t(R(q_t) - P(q_t)) + (1 - d_t)\pi \} \]

where \( d_t = 1 \) if the parties reach an agreement in the bargaining process and trade occurs in period \( t \), and \( d_t = 0 \) if the parties end the period with no agreement and no trade occurs.

2 Equilibrium of the bargaining game

Consider the beginning of any period \( t \) and \( n = 0 \) when the buyer and the seller start bargaining over the terms of the contract. Each party follows a strategy \( f_i = (f^t)^N_{n=0} \) which consist in a sequence of decision rules characterized by the following properties (Muthoo, 1999): I) No delay: whenever each player makes an offer, his equilibrium offer is accepted by the other player; II) Stationary: in equilibrium each player always makes the same offer.

Recalling \( \delta \), the common discount factor, and \( \Delta_i \), the cost of bargaining for each party which is always positive. This assumption captures the friction of the bargaining process.

The next proposition is an application of the main theorem of Rubinstein (1982):

Proposition 1. There exists a unique SPNE of the bargaining game in which parties reach an agreement in the first round and always implement the following equilibrium strategies:
Buyer’s strategy:

\[ f_b^* = \begin{cases} 
\text{Offers } y_b^* & \text{ whenever he is the proposer} \\
\text{Accepts } y_s & \text{ if } \pi(y_s) \geq \pi + \delta \Delta_b V_b^* \\
\text{Rejects } y_s & \text{ if } \pi(y_s) < \pi + \delta \Delta_b V_b^* 
\end{cases} \]

Seller’s strategy:

\[ f_s^* = \begin{cases} 
\text{Offers } y_s^* & \text{ whenever she is the proposer} \\
\text{Accepts } y_b & \text{ if } U(y_b) \geq \bar{u} + \delta \Delta_s V_s^* \\
\text{Rejects } y_b & \text{ if } U(y_b) < \bar{u} + \delta \Delta_s V_s^* 
\end{cases} \]

where \( V_b^* = \frac{(1-\delta \Delta_s)}{1-\delta b\delta s} (S(\bar{q}) - \bar{s}) \), \( V_s^* = \frac{(1-\delta \Delta_b)}{1-\delta b\delta s} (S(\bar{q}) - \bar{s}) \) and \( y_i^* = \langle p_i^*, D_i^*(\bar{q}) \rangle \) are the equilibrium offers that player \( i \in \{b, s\} \) makes whenever he proposes.

**Proof.** All proofs are in the appendix and can be obtained from the author upon request.  

Following proposition 1, \( f_b^* \) and \( f_s^* \) are optimal for each party in any round \( n \) given the other player’s strategy. It follows by optimality that the buyer offers a contract \( y_b^* \) such that he maximizes his profits subject to the seller being indifferent between accepting or rejecting the offer: \( U(y_b^*) = \pi + \frac{\delta \Delta_s (1-\delta \Delta_b)}{1-\delta b\delta s} (S(\bar{q}) - \bar{s}) \). This implies that \( y_b^* \) provides incentives for the provision of \( q^* = \bar{q} \) where the efficient quality is the unique solution that maximizes social surplus, \( p_i^* \) is the optimal fixed payment and \( D_i^* \) the optimal discretionaty payment.

Similarly, the seller offers a contract \( y_s^* \) such that: \( \pi(y_s^*) = \bar{\pi} + \frac{\delta \Delta_b (1-\delta \Delta_s)}{1-\delta b\delta s} (S(\bar{q}) - \bar{s}) \).

Recalling the assumption that parties are able to counteroffer arbitrarily rapidly, claim 1 states the limiting equilibrium values for the conditions derived from the bargaining process as \( n \to \infty \) and the ratio of the parties’ cost of bargaining remains constant, \( \frac{\Delta}{\Delta_b} = \kappa \):
Claim 2.1. The limiting equilibrium value of the equilibrium contracts are given by

\[ U_t(y^*_b) = \bar{u} + \beta(S(q) - \bar{s}) , \text{ and} \]

\[ \pi_t(y^*_s) = \bar{\pi} + (1 - \beta)(S(q) - \bar{s}) \]

where \( \beta = \frac{1}{1 + \kappa} \) and \( \beta \in (0, 1] \).

Equation (3) (BCS) and equation (4) (BCB) give the bargaining conditions for the seller and the buyer respectively, in which \( \beta \) represents the bargaining power of the seller. When the period between consecutive offers in the bargaining process is short, then the bargaining power of the parties is captured by the relative magnitude of the players’ cost of haggling (Binmore, Rubinstein, and Wolinsky, 1986; Muthoo, 1999). Note that the smaller the value of \( \kappa \), the larger is \( \beta \) and hence the stronger the seller is. Moreover, the first proposer loses any advantage as a result of offering first because as \( n \to \infty \) the contract offers converge to the same, \( y_b = y_s = y^* \), and the equilibrium partition of the surplus depends on the players’ bargaining power (Binmore, Rubinstein, and Wolinsky, 1986; Muthoo, 1999). The seller and the buyer set the quality to the level which maximizes the social surplus, \( S(q) \), and use the payment in the contract as an instrument to split the surplus generated. Thus, the division of the surplus depends on the parties’ relative cost of bargaining. If \( \kappa < 1 \) the seller’s cost of bargaining is smaller relative to the buyer’s cost and therefore the relative stronger party the seller is. The bargaining process results in corollary 1:

Corollary 2.1. The standard individual rationality constraints do not bind while the bargaining conditions derived by the bargaining process bind.

Corollary 1 states the conditions to be satisfied in the optimization program to set the optimal stationary contract.

\textsuperscript{5}I exclude zero from the interval because although \( \Delta_i \) may be arbitrarily small, it is always positive.
3 Bargaining and complete enforcement

As a benchmark, consider without a loss of generality an alternating-offer bargaining game where the buyer is the first proposer and contracts are perfectly enforceable. In this regime, the quality is third-party verifiable and it can be explicitly included in the contract. Therefore, the contract \( y_b \) is given by \( y_b = \langle p_b, q_b \rangle \). Given the strategies described in proposition 1, buyer proposes a contract \( y_b^* \) maximizing his stream of future payoffs subject to the bargaining condition established by inequality (3).

Proposition 2. If contracts are perfectly enforceable and parties bargain over the terms of the contract, for any distribution of bargaining power, \( \beta \in (0, 1] \), full efficiency is reached, \( q_t = q^* = q \), and the gains from trade are distributed according to the relative bargaining power of the parties, which characterize their profit functions:

\[
\pi^* = \frac{(1 - \beta)(R(q) - c(q) - \pi) + \beta \pi}{1 - \delta}, \text{ and}
\]

\[
U^* = \frac{(1 - \beta)(\pi) + \beta(R(q) - c(q) - \pi)}{1 - \delta}
\]

Proposition 2 gives the results for efficiency and distribution under verifiable quality, complete contract enforcement and bargaining. In this setting both players agree to trade with any distribution of bargaining power because each party receives at least the reservation payoff given that contracts are fully third-party enforceable. This follows because the parties can structure a contract that redistributes surplus without altering the incentives to provide full efficiency and generate social surplus.

Equations (5) and (6) characterize the distribution of surplus which depends on the value of \( \beta \) and \( (1 - \beta) \). When the seller has a bargaining power \( \beta \), then the seller gets a proportion \( \beta \) of the surplus. Therefore, when contracts are fully enforceable and the seller is able to bargain over contract terms, the surplus is more equally distributed among
partners relative to the case when a take-it-or-leave-it offer is always made by the buyer (when the buyer does not have any cost of haggling, $\Delta_b = 0$). The new set of possible welfare distributions is compatible with full efficiency achievement. In other words, the redistribution of the bargaining power only affects the distribution of the welfare but not efficiency.

Figure 1 shows the distribution of surplus for different values of $\beta$. Parties receive fixed payments when they do not trade, point I in the figure. Parties generate additional social surplus when decide to trade with each other, and the surplus is represented by the shaded area in the figure where trading the efficient quality $q$ represents the maximum surplus achievable. The distribution of the surplus can be at any point along the frontier from II to III. In the case when the buyer always gets to make take-it-or-leave-it offers to the seller, holding all bargaining power, the distribution of surplus is given by II. The seller gets the value of her reservation payoff and the buyer obtains all surplus. Similarly, when the seller holds all bargaining power and make always a take-it-or-leave-it-offer, she gets all surplus while the buyer gets the value of his reservation payoff. Point III in the figure illustrates that case. Additionally, parties can have an allocation of bargaining power such as $0 < \beta < 1$, ...
then the distribution of surplus is on any point on the frontier between II and III in the figure depending on the value of $\beta$.

4 Bargaining and no contract enforceability

In this section we analyze the case of fully incomplete enforceability of contracts, where $q$ is not verifiable by a third-party. Hence, the buyer must offer a contract $y = \langle p, D(q) \rangle$ through which he provides additional incentives, $D(q)$, to the base payment, $p$, for the seller to deliver the desired quality. A bonus, $b(q^*)$, is used as a reward for providing $q_t \geq q^*$ and a negative discretionary payment, $d(q_t)$, is used to punish for low quality, $q_t < q^*$. Because none of the terms of the contract are enforceable, the ex post total compensation can be zero. In this case the buyer does not have the means to enforce quality and the seller cannot obtain payment from the buyer through formal mechanisms.\(^6\)

This assumption contrasts with the announcements used conventionally in the literature as in MacLeod and Malcomson (1998) and Levin (2003). These articles model a labor market in which a discretionary bonus cannot be formally enforced but a fixed (base) wage is enforceable by a third party regardless of the final outcome (We consider such situation in the next section). In non-labor contracts such as common supply contracts ex post reductions as a response to a low quality product delivery are acceptable (Wu and Roe, 2007b). For instance, Banerjee and Duflo (2000) show evidence from the Indian software industry in which firms ameliorate own errors by paying part of the overrun with the objective of maintaining a good reputation. In the current context, the assumption that $p_t$ may not be enforceable gives a result more relevant to supply contracts. As an example in both the developed and the developing world, it is common practice to delay payments up to 60 days

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\(^6\)In this case, the buyer has the latitude of making potential adjustments upward or downward to the price. He can offer a contract with promised base payment and later he can renege on paying it; or he can offer only a discretionary payment. In both cases, the buyer can adjust the total payment to zero. In this article we adopt the former case.
after delivery with no upfront payment as a way to ensure quality (Brown and Sander, 2007). This clearly creates an opportunity for buyers to withhold payments altogether.

Under this regime, the seller bargains for the terms of the contract with the buyer, and the expected compensation for both parties under cooperation is given by the bargaining conditions derived from the alternating-offer bargaining process, given by inequalities (3), and (4) respectively. The game is the same as in the complete enforcement regime but now after the seller accepts a contract $y_b^*$, she decides on the quality to supply that may differ from the desired quality induced by the contingent payment rule in the contract. She can cooperate and choose $q_t \geq q^*$, or can shirk by supplying a lower quality. The buyer, after observing the quality delivered, may cooperate by paying $P_t(q_t) = p_t + b_t(q_t)$. Or he may renege the contract by choosing the most profitable deviation, $P_t(q_t) = 0$.

To solve for the SPNE we can use backward induction to derive the dynamic incentive compatibility constraint (DICC) for each party given by (7) and (8). A seller cooperates if and only if:

$$\frac{p + b(q^*) - c(q^*)}{1 - \delta} \geq p + d(q_t) - c(q) + \frac{\delta}{1 - \delta} \pi$$

The left hand side is the payoff of the seller for cooperating and supplying $q_t \geq q^*$. The right hand side represents the payoffs if she shirks. Note that the most profitable deviation for the seller is to supply $q$, but in this case the buyer after observing quality delivered sets total payment to zero by imposing $d_t(q_t) = -p_t$.

On the other hand, (8) states when the buyer cooperates. The left hand side gives payments if the buyer cooperates and the right hand side gives payments if he deviates.

$$\frac{R(q^*) - p - b(q^*)}{1 - \delta} \geq R(q^*) - p - d(q^*) + \frac{\delta}{1 - \delta} \pi$$

As in Levin (2003), since both parties can deviate from the payments in the con-
tract then the discretionary payment proposed has to be credible to ensure a self-enforcing contract. It follows that the compensation scheme is bounded by the future gains of the relationship and the optimal stationary contract is defined in proposition 3.

**Proposition 3.** Under fully incomplete contract enforcement, if parties bargain over the terms of the contract and repeatedly interact, and assuming $\delta$ high enough, an optimal stationary contract $(p^*, D^*(q^*))$ that implements $\bar{q}$, must satisfy (3),(4), (7), and (8), where (3) and (8) bind, and the total compensation package is characterized by:

\[
(9) \quad b(q) - d(q) \geq c(q) - c(\bar{q}) - \frac{\delta}{1 - \delta} \beta(S(q) - \bar{S}) , \text{ and} \\
(10) \quad p + b(q) = u + c(q) + \beta(S(q) - \bar{S})
\]

Proposition 3 characterizes the equilibrium contract when none of the terms of the contract are enforceable. Inequality (9) gives the size of the conditional payment on the quality that the buyer offers to induce a desired quality. On the RHS of (9) the first two terms are the difference in the cost of providing optimal quality and of providing low quality, which is what should be paid to induce optimal quality in the case the buyer holds all bargaining power. However, when the seller holds some bargaining power, the range of conditional payments decreases by the third term in (9), which represents the present value of the share of surplus that the seller gets given her bargaining power. The result implies that the buyer offers a smaller discretionary payment than what he would offer when there is no bargaining. In addition, equation (10) shows that the total compensation is increasing in $\beta$. As the seller’s bargaining power increases, the seller can obtain a higher payment from the bargaining process that depends proportionally on the power that she exercises.

A consequent result is that the ability of buyers to induce high quality decreases as the bargaining power of the seller increases. This makes intuitive sense because the total compensation and, therefore, the discretionary payments are limited by the proportion of
surplus that the buyer extracts given his bargaining power. When the buyer negotiates with a seller, who has some bargaining power, he has to offer a higher base component of the total payment to satisfy her demands. The base price is increasing in $\beta$, $dp/d/\beta > 0$. Therefore, the size of the contingent part decreases and the contract is characterized by small explicit contingency payments. As in Baker, Gibbons, and Murphy (1994), as the alternative payment increases, the base payment through more power of the seller, then the available present value of the relationship for buyers falls so the feasible discretionary payment declines.

However, in this case the small size of discretionary payments does not unravel the efficiency level as the seller becomes residual claimant of the trade surplus. Since her payment depends on a $\beta$-proportion of the total surplus, then, it is of her interest to supply the quality which maximizes the surplus and thus her payment. Consequently, the more the seller’s bargaining power, the higher the quality she is willing to supply as long as the contingent payment is non-negative. In this way, the profit that the seller gets increases and the buyers’ profits decreases with the seller’s bargaining power.

**Proposition 4.** Under full incomplete enforceability of contracts, if parties repeatedly trade and bargain over contract terms, cooperation and relational contracts are unraveled when $\beta > \hat{\beta} = \frac{\delta R(q) - c(q) - \pi}{s(q) - \pi}$, since it requires a discount factor, $\delta$, close to one. At the limit when $\beta = 1$, then $\delta \geq 1$. That is self-enforcing agreement are not sustainable when the bargaining power of sellers is greater than $\hat{\beta}$.

Proposition 4 states that as sellers’ bargaining power increases, the set of discount factors that sustain cooperation and relational contracts decreases causing the relationship to collapse when $\beta > \hat{\beta}$. The intuition is as follows: each party has a discount factor that reflects how much they value the future relative to the present. As the seller’s bargaining power increases, the discount factor needed to cooperate and keep trading with the same partner rises. Although, some parties strongly value the future, when the discount factor needed to
sustain cooperation increases, the number of parties willing to participate in the relationship decreases until nobody is willing to cooperate. Thus, in a completely unenforceable contract environment, if the seller has bargaining power, \( \beta \), higher than \( \hat{\beta} \), then cooperation cannot be sustained for any \( \delta < 1 \). The increase of the seller bargaining power allows for greater rents which encourages the seller to deliver high quality. Then, conditional payments are not necessary for reaching efficiency. Social efficiency is potentially offset by the fact that cooperative equilibrium is harder to sustain since opportunistic behavior takes over the relationship and buyers try to obtain short-term rents.

The unsustainability of the relationship can be explained by the ability of buyers of withholding payments. That is, the buyer can behave opportunistically by choosing to pay any price, including a zero transfer to the seller, and earn the short-term gains. This ability of withholding payments also protects the buyer from low quality delivering; therefore, the buyer is more willing to discontinue the relationship with a specific seller (Wu and Roe, 2007b). Accordingly, sustainability requires both parties have sufficiently high discount factors to prevent the buyer shirking on payment and to continue cooperation.

These results contrast with the standard relational contracting outcomes in which efficiency and the distribution of surplus can be separated. In the current case shifting the distribution of surplus can alter efficiency. If the seller demands a greater share of the gains from trade through \( \beta > \hat{\beta} \), efficiency may be harmed and trade diminishes by the lack of cooperation and the presence of shorter relationships since buyers have a higher incentive for opportunistic behavior when their gains over the surplus shrink. This matches what Oczkowski (2006) finds in his article. When sellers hold all bargaining power through a bargaining co-operative no trade occurs because if a buyer chooses to participate in trade then he will incur a loss. Thus, we can state that under these assumptions the problem of efficiency can no longer be separated from the distribution of welfare. Accordingly, the change in bargaining power in this regime results in the next corollary:
Corollary 4.1. When none of the terms of the contract are third-party enforceable, if the
seller has a bargaining power $\beta > \hat{\beta}$, she is better off by exercising only $\hat{\beta}$ and continuing the
relationship.

If the seller exercises bargaining power $\beta > \hat{\beta}$ the buyer gets a higher payoff by deviating
and taking short-term gains. If instead the seller exercises $\hat{\beta}$, then the buyer will not deviate
and remains trading with the seller. In this way she gets higher profit by trading in the long-
term. Under this regime, this is the best a seller can do even if she has a higher bargaining
power than $\hat{\beta}$. However, the seller can do better if contracts are at least partially enforceable
as shown in the next section.

5 Bargaining and partial contract enforceability

In this section we analyze partial contract enforcement. In this intermediate regime the
base price $p_t$ is enforceable but the quality is not, a conventional assumption used in the
literature. The buyer can only renege on payment of the bonus. Consequently, the seller’s
and the buyer’s DICC are respectively given by:

$$\frac{p + b(q) - c(q)}{1 - \delta} \geq p - c(q) + \frac{\delta}{1 - \delta} \bar{u} \, , \text{ and}$$

$$\frac{R(q) - p - b(q)}{1 - \delta} \geq R(q) - p + \frac{\delta}{1 - \delta} \pi$$

Note that now the most profitable deviation for the seller is to supply $q$ and for the
buyer is to not pay $b(q)$. The bargaining conditions remain the same as in inequalities (3)
and (4).

Proposition 5. If contracts are partially enforceable and parties bargain over the contract
terms and repeatedly interact, efficiency is achievable and cooperation and self-enforcing
contracts are sustainable over time if the parties have a discount factor $\delta > \hat{\delta} = \frac{c(q) - c(q)}{R(q) - c(q) - \bar{u} - \pi}$,
and the compensation scheme is characterized by:

\begin{align}
 b(q) & \geq c(q) - c(q) - \frac{\delta}{1 - \delta} \beta (S(q) - \overline{s}) , \text{ and} \\
p + b(q) & = \overline{u} + c(q) + \beta (S(q) - \overline{s})
\end{align}

Proposition 5 states that the results on efficiency and distribution in the partial enforce-
ment regime are the same as the ones in the complete enforcement case for any distribution
of the bargaining power if the parties sufficiently value the future. The main result is that
the surplus can be redistributed through the redistribution of bargaining power and efficient
trade is sustained whereas in the no contract enforcement regime a shift in bargaining power
raises the minimum discount factor needed for self-enforcement.

Figure 2: Set of feasible contracts

Figure 2 shows the set of feasible contracts under the no contract and the partial
enforcement regimens. As figure 2(a) shows the set of feasible contracts gets smaller as the
bargaining power of the seller increases. The higher the seller’s power the more parties need
to value the future to sustain cooperation. In contrast, figure 2(b) demonstrates that parties’
valuation of the future required to maintain cooperation remains constant as the bargaining
power shifts to the seller. Then, as the figures show the set of contracts that sustain efficiency and self-enforcing contracts is greater when the base payment is enforceable.

6 Policy Implications and Conclusions

The results discussed in the previous sections have several implications for public policy. The key question is: What are the implications of supporting redistribution of bargaining power when contracts are incomplete and not perfectly enforceable? There are two types of policy that can affect trade relationships: 1) policies that enhance the bargaining rights or market position of the weaker party (e.g. encouraging the formation of bargaining groups); and 2) policies that regulate the behavior of the market participants through contract regulation (e.g. increasing enforcement of contracts).

The first case analyzed is the benchmark where contracts can be fully enforced by a formal court. The distribution of the surplus depends on each party’s bargaining power. If policies are used to enhance the weaker party’s bargaining position, then the weaker party gains more rents and economic efficiency is maintained. Policies on contract regulation (other than enforcement of contracts) are not needed since parties reach an agreement through negotiation reflecting each party’s market position.

In the second, when the contracts are completely unenforceable, the implications of redistribution of bargaining power are more ambiguous. If the government implements policies supporting such redistribution, then the consequences on efficiency may be negative if the bargaining power of the weaker party becomes too high. While government supports the balancing of bargaining power in favor of a weaker party (e.g. growers, small businesses, consumers of health care services, etc.), through a mechanism such as collective bargaining, shifting the power too much may have significant costs in social efficiency by breaking down the trading relationship.
Because the lack of enforcement causes an undesirable outcome as a result of shifting bargaining power, the alternative may be for the government to regulate contracts by making them more complete through enforcement. If the enforcement level is partially incomplete (that is, when the base payment is enforceable) then first-best efficiency is reachable and surplus can be split concomitantly with the parties’ bargaining power. Legislation that makes the base payment enforceable or encourages up-front payments while supporting redistribution of power achieves this result. However, there is a caveat: the model predicts that cooperation is achievable under the partial enforcement regime only if parties have a sufficiently high valuation of the future, $\delta > \hat{\delta}$. This implies that increasing the enforceability of contracts may only work if all parties sufficiently value the future.

In addition, the practical ability of governments to regulate and enforce contracts becomes an important issue for discussion. Generally, contracts are private, and often, incomplete, agreements between parties, making enforcement difficult. If the government wants to enforce a base or upfront payment, then it needs mechanisms to monitor their existence. For instance, in the case of an agricultural contract, the government can require vertical cooperation agreements between the growers and the processors/buyers. Through these vertical agreements growers can get upfront payments in the form of cash, seeds or capital for initial investment from the buyers.

The government may also regulate the existence of bank guarantees from processors to generate a more formal obligation of paying. However, in this case, there are additional transaction costs that might deter buyers from dealing with growers who require bank guarantees, further weakening these grower’s power. But if an important number of growers belong to a bargaining group it might be worthwhile for the buyer to incur the financial cost. Therefore, the government’s support for the bargaining group formation is important for successful use of bank guarantees as a tool to ensure payments.

On the other hand, if the weaker party reaches a very high relative bargaining power,
the model predicts that she can exercise all power and breakdown future trade or take a smaller share of the surplus in the short-term but conserve the long-term relationship. It is reasonable, then, that the seller does not exercise bargaining power that may breakdown the relationship with the buyer because it is in her best interest to keep trading. The bargaining power threshold for breakdown in the model is given by \( \hat{\beta} \), and the model predicts that the seller should not exercise a \( \beta > \hat{\beta} \) if want to stay in the relationship. This result is an alternative explanation for what Hueth and Ligon (2002) and Hueth and Marcoul (2003, 2002) observed. They find a little evidence for bargaining groups that increase prices for growers, supporting the prediction of the model that bargaining cooperatives cannot exercise a strong bargaining power without losing the long-term relationship. However, these observations may also reflect the existence of poor legislation that support collective bargaining or differences between members that belong to the group and a weak cohesion of the coalition may have a negative effect on the ability of the group to exercise any bargaining power.

The implications of policies that support redistribution of bargaining power in the agricultural sector are especially important for development and distribution since farming is still a family-owned operation in most places around the world (Siebert, 2001). In this sense, economic analysis of this type of intervention is crucial and needs to account for intra-firm organization and relationships among firms as well the mechanisms in which poor producers and countries connect with producers and consumers in the global economy.

Two final items merit consideration. First, as economies open, outside options emerge from international markets, giving more opportunity for opportunistic behavior. The use of partners from other countries may make contracts more incomplete and make it more difficult for sellers to get higher profits even when they locally hold some bargaining power. Then, the results of this research are important for analyzing the consequences of these changes. Second, from our model we can predict that no matter the level of contract enforcement,
sellers can obtain more rents if they are endowed with greater bargaining power. However, under fully incomplete contract enforcement, cooperation is harder to sustain as the seller bargaining power increases. This result combined with the possibility of multiple equilibria within repeated-game monopoly-monopsony contexts suggests that it is necessary to conduct some empirical analysis to determine if these theoretical predictions match behavior of partners in real-world situations.
Appendix

Proof of Proposition 1. Consider a Sub game Perfect Nash Equilibrium (SPNE) in which an equilibrium offer is accepted by any player whenever the other player has to make an offer (no delay property). Also, in equilibrium an offer is stationary which means that each player makes the same offer whenever he has to make an offer (stationary property). Let $y^*_i = (p^*_i, D^*_i(q^*_i))$ be the equilibrium offer that player $i$ makes at any time in which he has to make an offer. Moreover, let $V^*_b \equiv \pi(y^*_b)$ and $V^*_s \equiv U(y^*_s)$. Let $\delta = -e^{-rn}$ the common discount factor and $\Delta_i$ the cost of haggling for each party. From no delay and stationary properties it follows that when the seller rejects any offer today the best payoff the seller can make is $\pi + \delta \Delta_s V^*_s$. Similarly when the buyer rejects an offer, his best payoff is $\pi + \delta \Delta_b V^*_b$.

Then, the seller accepts an offer $y_b$ that gives her a higher payoff than her reservation payoffs and what she can potentially get by waiting for the next round: $U(y_b) > \pi + \delta \Delta_s V^*_s$. Furthermore, by no delay property $U(y^*_b) \geq \pi + \delta \Delta_b V^*_b$. The same rationality applies for the buyer in which case $\pi(y^*_s) \geq \pi + \delta \Delta_b V^*_b$. The buyer does not offer $U(y^*_b) > \pi + \delta \Delta_s V^*_s$ because he could get a higher profit by offering a lower payment. Thus, he offers a contract $y^*_b$ such as

\begin{equation}
(A-1) \quad U(y_b^*) = \pi + \delta \Delta_s V^*_s
\end{equation}

Analogously, the seller offers a contract $y^*_s$ such as

\begin{equation}
(A-2) \quad \pi(y^*_s) = \pi + \delta \Delta_b V^*_b
\end{equation}

Because by optimality the buyer’s equilibrium offer $y^*_b$ maximizes his profits $\pi(y_b)$ subject to A-1, the optimization program implies that the equilibrium contract provides a compensation scheme that implement the social efficient quality $\overline{q}$, which is the solution to $R'(.) = c'(.)$. 

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Using A-1 we can define

\[ V_b^* = S(\overline{q}) - \overline{\pi} - (\overline{u} + \delta \Delta s V_s^*) \]  

(A-3)

where \( S(\overline{q}) \) is the efficient total surplus. Symmetrically, when the seller offers the contract and by using A-2 we get

\[ V_s^* = S(\overline{q}) - \overline{\pi} - (\pi + \delta \Delta b V_b^*) \]  

(A-4)

By combining A-3 and A-4 we get:

\[ V_s^* = \frac{(1 - \delta \Delta b)}{1 - \delta \Delta b \delta \Delta s} (S(\overline{q}) - \overline{s}) \]  

(A-5)

\[ V_b^* = \frac{(1 - \delta \Delta s)}{1 - \delta \Delta b \delta \Delta s} (S(\overline{q}) - \overline{s}) \]  

(A-6)

Finally, we verify that the strategies are a SPNE. First lets show that buyer’s strategy is optimal at any round when he has to make an offer given the seller’s strategy. If he implements the strategy stated in Proposition 1, his payoff is \( \overline{\pi} + V_b^* \). Let an alternative strategy where \( y_o^b \) denotes the offer he makes at bargaining round \( n \). If \( U(y_o^b) \geq u + \delta \Delta s V_s^* \), the seller accepts \( y_o^b \). But because \( y_s^* \) maximizes buyer’s profits subject to \( U(y_o^b) \geq u + \delta \Delta s V_s^* \), then deviating to the alternative strategy is not profitable. Now suppose that \( y_o^b \) is such that \( U(y_o^b) < u + \delta \Delta s V_s^* \). It follows that the seller rejects the offer. Since the seller rejects any offer such that \( U(y_o^b) < u + \delta \Delta s V_s^* \) and always counteroffer \( y_s^* \) the alternative payoff for the buyer is less than or equal to \( \max\{\delta \Delta s \pi(y_s^*), \delta^2 \Delta b V_b^*\} \), where \( V_b^* \) is the maximum value of \( \pi(y_o^b) \) subject to \( U(y_o^b) \geq u + \delta \Delta s V_s^* \). Then, by A-2 it follows that the alternative strategy is not profitable. A symmetric argument applies for the seller’s strategy.

Proof of Claim 1. Recalling \( U(y_o^b) = \overline{\pi} + \frac{\delta \Delta b (1 - \delta \Delta s)}{1 - \delta \Delta b \delta \Delta s} (S(\overline{q}) - \overline{s}) \) and \( \pi(y_s^*) = \overline{\pi} + \frac{\delta \Delta s (1 - \delta \Delta b)}{1 - \delta \Delta b \delta \Delta s} (S(\overline{q}) - \overline{s}) \),
Also, \( \delta = -e^{-rn} \) and \( \delta^\Delta_i = -e^{-rn\Delta_i} \). Now take the limit \( \Delta_i \to 0 \) and \( \Delta_b^n = \kappa \). This is equivalent to the limit \( n \to \infty \). Then by L’ hopital’s rule:

\[
\begin{align*}
(A-7) \quad \lim_{n \to \infty} \frac{\delta^\Delta_i (1 - \delta^\Delta_i)}{1 - \delta^\Delta_b^\Delta_s} &= \frac{\Delta_b}{\Delta_s + \Delta_b} \\
(A-8) \quad \lim_{n \to \infty} \frac{\delta^\Delta_b (1 - \delta^\Delta_b)}{1 - \delta^\Delta_b^\Delta_s} &= \frac{\Delta_s}{\Delta_s + \Delta_b}
\end{align*}
\]

Let \( \beta = \frac{1}{1+\kappa} \) and \( (1 - \beta) = \frac{\kappa}{1+\kappa} \). It follows that the limiting values for the bargaining individual rationality conditions are:

\[
\begin{align*}
(A-9) \quad U(y_b^*) &= \overline{u} + \beta(S(q) - \overline{s}) \\
(A-10) \quad \pi(y_s^*) &= \overline{\pi} + (1 - \beta)(S(q) - \overline{s})
\end{align*}
\]

Proof of Corollary 1. First lets show that the seller’s Individual rationality constraint (IRC) does not bind. Let the \( IRC_s \) bind, that is \( P(q) - c(q) = \overline{u} \). Substituting \( IRC_s \) into the bargaining constraint for the seller, (3), and rearranging gives \( 0 = S(q) - \overline{s} \), which is a contradiction since by assumption \( S(q) - \overline{s} > 0 \forall q \in [q, \overline{q}] \) and \( q \neq \overline{q} \). Now, having (3) binding: \( P(q) - c(q) = \overline{u} + \beta(S(q) - \overline{s}) \). Substituting it on \( IRC_s \) and rearranging we get: \( S(q) - \overline{s} \geq 0 \), which is satisfied since \( S(q) - \overline{s} > 0 \forall q \in [q, \overline{q}] \) and \( q \neq \overline{q} \). Now, lets prove that the buyer’s IRC does not bind either and the bargaining condition (4) binds. Let the \( IRC_b \) bind, that is \( R(q) - P(q) = \overline{\pi} \). Substituting \( IRC_b \) into the bargaining constraint for the buyer, (4), and rearranging gives \( 0 = S(q) - \overline{s} \), which is a contradiction since by assumption \( S(q) - \overline{s} > 0 \forall q \in [q, \overline{q}] \) and \( q \neq \overline{q} \). Now, having (4) binding: \( R(q) - P(q) = \overline{\pi} + (1 - \beta)(S(q) - \overline{s}) \). Substituting it on \( IRC_b \) and rearranging we get: \( S(q) - \overline{s} \geq 0 \), which is satisfied since \( S(q) - \overline{s} > 0 \forall q \in [q, \overline{q}] \) and \( q \neq \overline{q} \).

Proof of Proposition 2. Let \( y_b^* \) be the equilibrium contract that a buyer offers to the seller.
A rational buyer that maximizes profits offers a price that ensures the acceptance of the seller. Since the IRCs does not bind and the bargaining constraint binds, it yields to:

\[(A-11) \quad P = c(Q) + \pi + \beta(S(Q) - \pi)\]

Substituting equation A-11 into the objective function of the buyer and solving for the First Order Kuhn-Tucker conditions:

\[
R'(q) \begin{cases} 
< \frac{c'(q)}{\delta} & \text{if } q^* = q \\
= \frac{c'(q)}{\delta} & \text{if } q < q^* < q \\
> \frac{c'(q)}{\delta} & \text{if } q^* = \overline{q}
\end{cases}
\]

since \(R'(\cdot) > c'(\cdot)\) by assumption, the buyer sets \(q^* = \overline{q}\). Since the contract is completely enforceable, if the seller accepts, then she has to supply \(q = \overline{q}\). This results in:

\[(A-12) \quad P^* = c(\overline{q}) + \overline{u} + \beta(S(\overline{q}) - \overline{\pi})\]

\[(A-13) \quad \pi^* = \frac{(1 - \beta)(R(\overline{q}) - c(\overline{q}) - \overline{u}) + \beta \overline{\pi}}{1 - \delta}\]

\[(A-14) \quad U^* = \frac{(1 - \beta)(\overline{u}) + \beta(R(\overline{q}) - c(\overline{q}) - \overline{\pi})}{1 - \delta}\]

where A-12 is the payment schedule, A-13 is the profits for the buyer, and A-14 is the profits for the seller. Now we check the bargaining condition of the buyer (BCB): \(\pi = R(q) - P \geq \pi + (1 - \beta)(S(q) - \pi)\). Substituting A-12 into it, we get \(R(\overline{q}) - c(\overline{q}) - \overline{u} - \beta(S(\overline{q}) - \overline{\pi}) \geq \pi + (1 - \beta)(S(\overline{q}) - \pi)\), that results in \(S(\overline{q}) - \overline{\pi} \geq S(\overline{q}) - \pi\), which is true and the result does not rely on the value of \(\beta\).

Now let’s prove that the results hold for any distribution of power. The case of \(\beta = 0\) occurs when the seller does not have bargaining power. This case is the benchmark in which cooperation is sustainable. For more details on the results refer to Wu and Roe
(2007b). Now we examine the extreme case when \( \beta = 1 \). Then, equation A-12 becomes
\[
P = c(\bar{q}) + \bar{u} + (S(\bar{q}) - \bar{\pi}).
\]
Now profits are given by \( \pi = \frac{\bar{\pi}}{1-\delta} \) and \( U = \frac{(R(\bar{q}) - c(\bar{q}) - \bar{\pi})}{1-\delta} \) respectively. The BCB reduces to: \( R(q) - c(q) - \bar{u} - (S(q) - \bar{\pi}) \geq \bar{\pi} \), and both sides reduce to \( \bar{\pi} \), so the condition is satisfied: \( \pi \geq \bar{\pi} \).

\[\square\]

Proof of Proposition 3. First lets prove that (3) and (8) bind. Proof of Corollary 1 proved that none of the standard individual rational contracts bind and instead the individual bargaining conditions bind. Lets prove that the bargaining condition for the seller (BCS) binds. If BCS binds, then \( p(q) - c(q) = U + \beta(S(q) - \bar{\pi}) \). From the sellers’ DICC and since \( d(q) = -p \) and \( b(q) = 0 \) on the RHS, then we have: \( \frac{p-b(q)}{1-\delta} \geq -c(q) + \frac{\delta}{1-\delta} \bar{u} \). Substituting (3) in the seller’s DICC it yields to: \( \frac{\bar{\pi} + \beta(S(q) - \bar{\pi})}{1-\delta} \geq -c(q) + \frac{\delta}{1-\delta} \bar{u} \). Following: \( U + \beta(S(q) - \bar{\pi}) \geq -c(q) + \frac{\delta}{1-\delta} \bar{u} \), which is true. Then the BCS binds. Lets check if buyers’ bargaining condition (BCB) binds. That is \( R(q) - P(q) = \bar{\pi} + (1-\beta)(S(q) - \bar{\pi}) \). Substituting in the buyers’ DICC we get \( \frac{\bar{\pi} + (1-\beta)(S(q) - \bar{\pi})}{1-\delta} \geq R(q) + \frac{\delta}{1-\delta} \bar{\pi} \). This leads to \( \bar{\delta}(S(q) - \bar{\pi}) \geq c(q) - \bar{u} - \delta(R(q) - \bar{\pi}) \), which is not true for any \( q > q^* \). Then the buyers’ BCB does not bind.

Lets check the DICC for both seller and buyer. If the sellers’ DICC binds then:
\[
\frac{p+b(q)-c(q)}{1-\delta} = p + d(q) - c(q) + \frac{\delta}{1-\delta} \bar{u}.
\]
This results in \( b(q) = d(q) + \delta(c(q) + \bar{u} - p - d(q)) \). Substituting this in the BCS and since \( d(q) = -p \) we get: \( -\delta(-c(q) - \bar{u} - c(q) - \bar{u}) \geq \beta(S(q) - \bar{\pi}) \). This leads to \( -\beta(S(q) - \bar{\pi}) \geq (1-\delta)(c(q) + \bar{u}) \), which is not true. Then the DICC of the sellers does not bind.

If the buyer’s DICC binds, then \( \frac{R(q) - p - b(q)}{1-\delta} = R(q) - p - d(q) + \frac{\delta}{1-\delta} \bar{\pi} \). It follows that \( b(q) = d(q) + \delta(R(q) - p - d(q) - \bar{\pi}) \). Given the buyer’s BCB \( R(q) - P(q) \geq \bar{\pi} + (1-\beta)(S(q) - \bar{\pi}) \) and substituting the DICC we get \( \beta(S(q) - \bar{\pi}) \geq \delta(\bar{\pi} - R(q) - c(q) - \bar{u}) \), which is true because the LHS is positive and the RHS is negative for any \( q > q^* \). Then the buyers’ DICC binds.

Now let \( y^*_b \) the equilibrium contract that a buyer offers to a seller, where \( P(q_t) = p_t + b_t(q_t) \). The contract has to satisfy the BCS. He wants to maximize profits thus he holds
(3) with equality and solve for $p$:

$$(A-15) \quad p = c(q) + \bar{u} + \beta(S(q) - \bar{s}) - b(q)$$

Since he wants to induce a desired quality of $q^*$ he also solves for $p$ in the DICC for the seller given by: $p + \frac{b(q) - c(q)}{1 - \delta} \geq p + d(q) - c(q) + \frac{\delta}{1 - \delta} \bar{u}$ we get:

$$(A-16) \quad p \geq \bar{u} + c(q) - d(q) + \frac{d(q) - b(q) - c(q) + c(Q)}{\delta}$$

Substituting A-15 on A-16 and rearranging we get:

$$(A-17) \quad b(q) - d(q) \geq c(Q) - c(q) - \frac{\delta}{1 - \delta} \beta(S(Q) - \bar{s})$$

Thus, we can define $b(q) \geq c(Q) - c(q) + d(q) - \frac{\delta}{1 - \delta} (S(Q) - \bar{s})$. Since the buyer is maximizing profits, he will only offer a $b(q)$ large enough to induce quality, so he sets the equation with equality and substitute it in A-15 and rearranging it leads to:

$$(A-18) \quad p = \bar{u} + c(q) - d(q) + \frac{\beta(S(Q) - \bar{s})}{1 - \delta}$$

which represents how the base payment is related to $\beta$.

Now to solve for the entire compensation package, from A-17 we get: $-d(q) \geq c(Q) - c(q) - b(q) - \frac{\delta}{1 - \delta} \beta(S(Q) - \bar{s})$, setting it equal because maximizing behavior and substituting this in A-18 we get:

$$(A-19) \quad P(q) = p + b(q) = \bar{u} + c(Q) + \beta(S(Q) - \bar{s})$$
Then, the buyer solves the following maximization problem when offering a contract:

\[
\max_{P(q), q} \left( \frac{R(q) - P(q)}{1 - \delta} \right)
\]

subject to \( P(q) = \bar{u} + c(q) + \beta(S(q) - \bar{s}) \)
and \( q \in [q, \bar{q}] \).

Recalling \( S(q) - \bar{s} = R(q) - c(q) - \bar{u} - \bar{s} \), substituting \( P(q) \) in buyer’s objective function, and solving for the First Order Kuhn-Tucker conditions results in:

\[
R'(q) \begin{cases} 
  < c'(q) & \text{if } q^* = \bar{q} \\
  = c'(q) & \text{if } \bar{q} < q^* < \bar{q} \\
  > c'(q) & \text{if } q^* = \bar{q}
\end{cases}
\]

and since \( R'(q) > c'(q) \ \forall \ q \in [q, \bar{q}] \) and \( q \neq \bar{q} \) by assumption then buyer requests \( q^* = \bar{q} \).

Therefore, \( P(\bar{q}) = p + b(\bar{q}) = c(\bar{q}) + \bar{u} + \beta(S(\bar{q}) - \bar{s}) \). Now let’s check the bargaining condition of the buyer. Substituting \( P(q) \) we get: \( R(q) - c(q) - \bar{u} - \beta(S(q) - \bar{s}) \geq \bar{\pi} + (1 - \beta)(S(q) - \bar{q}) \), that ends being \( (S(q) - \bar{s}) \geq (S(q) - \bar{s}) \), which is true.

**Proof of Proposition 4.** First check the participation constraint for the buyer when \( \beta = 1 \), e.g. the seller has all bargaining power: \( R(\bar{q}) - c(\bar{q}) - \bar{u} - (S(\bar{q}) - \bar{s}) \geq \bar{\pi} \), which can be rewritten as \( R(\bar{q}) - c(\bar{q}) - \bar{u} - R(\bar{q}) + c(\bar{q}) + \bar{u} + \bar{s} \geq \bar{\pi} \), and leads to \( \bar{s} \geq \bar{\pi} \). For cooperation to be achievable, it must be the case that the DICC of both parties hold. In the case of the seller, she cooperates if and only if equation (7) is satisfied. If seller deviates buyer will choose the most profitable deviation that is given \( d(q) = -p \), and substituting it in (7): \( \frac{p + b(q) - c(q)}{1 - \delta} \geq -c(q) + \beta(S(q) - \bar{s}) \geq \bar{\pi} + (1 - \beta)(S(q) - \bar{q}) \), \( \forall q \geq \bar{q} \). Therefore, DICC for the seller does not bind. Turning to the buyer’s DICC, given \( d(q) = -p \), and substituting it into equation (8):
\[
\frac{R(q) - p - b(q)}{1 - \delta} \geq R(q) + \frac{\delta}{1 - \delta} \pi. \quad \text{Given } P = p + b(q) = c(q) + \pi + \beta(S(q) - \bar{s}), \text{ then:}
\]

\[
(A-21) \quad \frac{R(q) - c(q) - \pi - \beta(S(q) - \bar{s})}{1 - \delta} \geq R(q) + \frac{\delta}{1 - \delta} \pi
\]

Solving for \( \delta \), we get:

\[
(A-22) \quad \delta \geq \frac{c(q) + \pi + \beta(S(q) - \bar{s})}{R(q) - \pi}
\]

When \( \beta = 1 \), then \( \delta \geq 1 \).

Now, to find the threshold for \( \beta \), go back to the DICC of the buyer given by \( \frac{R(q) - p - b(q)}{1 - \delta} \geq R(q) - p - d(q) + \frac{\delta}{1 - \delta} \pi \), and given \( d(q) = -p \), solve for \( \beta \) to get:

\[
(A-23) \quad \hat{\beta} \leq \frac{\delta R(q) - \delta \pi - c(q) - \pi}{S(q) - \bar{s}}
\]

where \( \hat{\beta} \) represent the higher value of the bargaining power of the seller under which cooperation and relational contracts are sustainable.

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**Proof of Corollary 2.** Recalling seller’s profits under no contract enforcement regime: \( U = \frac{\pi + \beta(S(q) - \bar{s})}{1 - \delta} \), which are increasing in \( \beta \) as \( \frac{dU}{d\beta} \geq 0 \ \forall \ q \in [\underline{q}, \bar{q}] \) and \( q \neq \underline{q} \). If the seller exercises \( \hat{\beta} \), then the buyer does not deviate because

\[
(A-24) \quad \frac{R(q) - c(q) - \pi - \beta(S(q) - \bar{s})}{1 - \delta} \geq R(q) + \frac{\delta}{1 - \delta} \pi
\]

Substituting: \( \hat{\beta} = \frac{\delta R(q) - \delta \pi - c(q) - \pi}{S(q) - \bar{s}} \), we get that the DICC for the buyer is met:

\[
(A-25) \quad \frac{R(q) - \delta R(q) - \delta \pi}{1 - \delta} \geq R(q) + \frac{\delta}{1 - \delta} \pi
\]
Then the buyer does not deviate and the seller gets a profit of:

\[(A-26) \quad U^\hat{\beta} = \frac{\delta R(q) - \delta \pi - c(q)}{1 - \delta} \]

If the seller exercises a bargaining power $\beta > \hat{\beta}$, the buyer deviates because he will get higher payoff by deviating. For instance if $\beta = 1$, the DICC of the buyer results in:

\[(A-27) \quad \frac{\pi}{1 - \delta} \geq R(q) + \frac{\delta}{1 - \delta} \pi \]

Clearly, the buyer is better off by deviating. His most profitable deviation is to set the total payment to zero. Then, the seller gets profits of:

\[(A-28) \quad U^{\beta > \hat{\beta}} = -c(q) + \frac{\delta \pi}{1 - \delta} \]

Then, the seller is better off by only exercising $\hat{\beta}$ as $U^\hat{\beta} > U^{\beta > \hat{\beta}}$

\[(A-29) \quad \frac{\delta R(q) - \delta \pi - c(q)}{1 - \delta} > -c(q) + \frac{\delta \pi}{1 - \delta} \]

$\square$

Proof of Proposition 5. Let $y_b^*$ the equilibrium contract that a buyer offers to a seller, where $P(Q) = p + b(Q)$. The contract has to satisfy the BCS. As in the proof of proposition 3, the buyer maximizes profits holding equation (3) with equality, and solving for $p$ in both the BCS and the DICC given by equation (11):

\[(A-30) \quad p \geq \bar{u} + c(q) + \frac{c(q) - c(q) - b(q)}{\delta} \]
Substituting A-15 on A-30 and rearranging we get:

\[(A-31) \quad b(q) \geq c(q) - c(q) - \frac{\delta}{1-\delta} \beta(S(q) - \bar{s})\]

Since the buyer is maximizing profits, he will only offer a \(b(q)\) large enough to induce quality, so inequality A-31 holds with equality. Substituting back in A-15 and rearranging it leads to:

\[(A-32) \quad p = \bar{u} + c(q) + \frac{\beta(S(q) - \bar{s})}{1-\delta}\]

Now to solve for the entire compensation package, adding A-31 and A-32 we get:

\[(A-33) \quad P(q) = p + b(q) = \bar{u} + c(Q) + \beta(S(q) - \bar{s})\]

Then, the buyer solves the following maximization problem when offering a contract:

\[(A-34) \quad \max_{P(q), q} \left( \frac{R(q) - P(q)}{1-\delta} \right)
\text{subject to} \quad P(q) = \bar{u} + c(q) + \beta(S(q) - \bar{s})
\text{and} \quad q \in [\underline{q}, \bar{q}]\]

which satisfy the First Order Kuhn-Tucker conditions as in the proof of proposition 3, and again since \(R'(q) > c'(q) \quad \forall q \in [\underline{q}, \bar{q}]\) and \(q \neq \underline{q}\) by assumption then buyer requests \(q^* = \bar{q}\). Therefore, \(P(\bar{q}) = p + b(\bar{q}) = c(\bar{q}) + \bar{u} + \beta(S(\bar{q}) - \bar{s})\).

Now let’s check the participation constraint of the buyer. Substituting \(P(q)\) we get:

\(R(\bar{q}) - c(\bar{q}) - \bar{u} - \beta(S(\bar{q}) - \bar{s}) \geq \bar{u} + (1 - \beta)(S(\bar{q}) - \bar{s}),\) that ends being \((1 - \beta)(S(\bar{q}) - \bar{s}) \geq (1 - \beta)(S(\bar{q}) - \bar{s}),\) which is true since \(q = \bar{q}\) and by assumption \(S(\bar{q}) - \bar{s} > 0 \quad \forall q \in [\underline{q}, \bar{q}]\) and \(q \neq \underline{q}\).
For cooperation to be achievable, the DICC of both parties must hold. Then, combining equations (11) and (12) we get:

\[(A-35) \quad \hat{\delta} \geq \frac{c(q) - c(q)}{R(q) - c(q) - \bar{u} - \bar{\pi}}\]

Hence, cooperation takes place for all values of delta that satisfy A-35. \qed
References


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