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Delegated Bargaining and Renegotiation*

Helmut Bester †‡, József Sákovics§

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Abstract

We examine the commitment effect of delegated bargaining when the delegation contract is renegotiable. We consider a seller who can either bargain face-to-face with a prospective buyer or delegate bargaining to an intermediary. The intermediary is able to interrupt negotiating with the buyer to renegotiate the delegation contract. We show that the time cost of renegotiation prevents a full elimination of the commitment effect of delegation. Indeed, there are always gains from delegation when the players are sufficiently patient. An extension to a search market environment shows that the gains from delegation are negatively related to the efficiency of search.

Keywords: bargaining, commitment, delegation, renegotiation, search
JEL Classification No.: C72, C78

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1 Introduction

Commitment is one of the central issues in bargaining. A player's bargaining power reflects the extent to which he can commit himself to insist on some share of the available surplus. This depends on how credibly he can threaten the opponent not to accept a less favorable division. As Schelling (1960) has pointed out, a player may enhance his degree of commitment through a contract with a third-party. In a bargaining situation such a contract may be beneficial because the "use of a bargaining agent affects the power of commitment" (p. 29). The basic idea is that the player signs a public contract with an intermediary to bargain on his behalf. Since the incentives of the intermediary are influenced by the contract, the payoff structure of the bargaining game is altered and so the bargaining power of the opponent may be reduced.

In the recent literature on contract design, however, Schelling's third-party device has become somewhat discredited because it fails to consider the possibility of renegotiation (see, for example, Dewatripont (1988) and Green (1990)). Unless communication is impossible, the contract between the intermediary and his employer is not irrevocable. The intermediary may contact his employer to renegotiate his contract when he feels that otherwise an agreement with the other party cannot be reached. Since the other party will take this into account, it may seem as if renegotiation would erode the commitment effect of delegation.

In this paper, we investigate this issue in a strategic model of delegated bargaining and renegotiation. Our model builds on the alternating offers game of Rubinstein (1982). In this game the bargainers are impatient and a player's bargaining power depends on how fast he can make a counterproposal after rejecting an offer from the opponent. We extend this framework by allowing one of the two parties to hire an intermediary. More specifically, in Section 2 we consider a seller who can either bargain face-to-face with a prospective buyer or hire an intermediary to bargain on his behalf. In the latter case, he signs a contract with the delegate that specifies his compensation as a function of the agreement with the buyer. The delegate is thus provided with an incentive scheme and chooses a bargaining strategy that maximizes his own payoff.[1] If the intermediary's compensation is not renegotiable, it turns out that the seller can appropriate the entire gains from trade through delegation.

To introduce the possibility of renegotiation, we enable the delegate to interrupt his negotiation with the buyer in order to communicate with the seller. After an offer from the buyer, he has the option to contact the seller and to propose a change in his compensation scheme. Such a proposal may be acceptable for the seller if it reduces the delay until an agreement is reached. Since the seller cannot make herself unavailable for her delegate, hiring an intermediary effectively leads to a three-person bargaining problem. The solution of this problem depends not only on how fast the intermediary and the buyer can exchange offers and counteroffers but also on the speed of communication between the intermediary and the seller.

Our analysis reveals that the gains from delegated bargaining depend on two different types of communication costs: First, intermediation involves a *delegation cost* which reflects the time that the seller needs for contacting an intermediary and designing the delegation contract. Second, there is a *renegotiation cost.* This cost is incurred when the intermediary spends some time to switch back and forth between the buyer and his employer to renegotiate his compensation. The renegotiation cost turns out to be crucial for the commitment effect of delegated bargaining: Unless the cost of delegation is prohibitive, the seller gains from employing a bargaining agent only if renegotiation is sufficiently time consuming. The time cost of renegotiation appears thus as a natural measure of the commitment effect of contracting with a third party. Importantly, this commitment effect remains positive even in the limit when the players become infinitely patient. In fact, the delegation cost vanishes in this limit and so delegation is always profitable for the seller.

Our result shows that renegotiation does not fully eliminate the commitment effect of delegation in a strategic model of bargaining. This may explain why intermediation is used in many bargaining situations. A typical example is the housing market, where real estate agents deal with potential customers on behalf of the owner. In many other markets, however, intermediation plays at most a minor role. In Section 3 we extend our model to a simple search market environment with a large set of potential buyers. Here we show that the gains from delegation are inversely related to the efficiency of search. Indeed, when the seller's time cost of searching for a buyer is sufficiently small, it is never profitable for her to delegate search and bargaining to a third party. His ability to search for another trading partner acts as a substitute for increasing his bargaining power through a delegate. As a result, intermediation does not occur in a highly competitive market with small search frictions.

There are a few papers that investigate Schelling's idea of increasing bargaining power through a bargaining agent.[2] Fershtman, Judd and Kalai (1991) provide a general analysis of the payoffs that can be achieved through contractual delegation. In a model of collective bargaining, Haller and Holden (1997) investigate the commitment effects of a ratification requirement which stipulates that the agreement reached by the delegate is subject to approval by his principals. These papers, however, presume that contracts are irrevocable and do not address the issue of renegotiation.

To our knowledge, only Green (1990) studies delegation and renegotiation in a bargaining context. He adopts an axiomatic approach to derive the bargaining solution and concludes that with renegotiation there are no gains from contractual delegation. We arrive at a different conclusion because in our strategic approach the (time) costs of negotiations determine the bargaining solution. Crawford (1982), Muthoo (1992, 1996) and Bolt and Houba (1998) study bargaining environments in which each party can make a commitment which is costly to revoke. This cost strengthens the bargaining position of a player. In contrast with our model, these papers do not explicitly specify how commitments are established and which factors determine the cost of revoking them. It is perhaps worth mentioning that commitment through delegation may also be limited when the delegation contract is not publicly observable. This issue, which is analyzed in Katz (1991) and Fershtman and Kalai (1997), is not addressed in our setting where contracts are assumed to be public.

Finally, Section 3 of this paper is related to Rubinstein and Wolinsky (1987) and Bester (1994, 1995). Bester (1994) considers a search market in which the sellers can either commit to a fixed price or haggle with their customers. Rubinstein and Wolinsky (1987) study intermediation and bargaining in a random matching market. Yet, their model does not consider the potential commitment effects of delegation. Instead, intermediation occurs because the intermediary enjoys a comparative advantage in making contacts and, thereby, speeds up the process of exchange. This differs from our model where the intermediary uses the same search technology as the seller. Bester (1995) proposes a bargaining model of financial intermediation which is based on the incentive effects of delegation. His model, however, does not contain a strategic description of the bargaining process and fails to address the problem of renegotiation.

This paper is organized as follows. In Section 2 we study the gains from delegation in a bilateral monopoly. Here we present a strategic model of bargaining, delegation and renegotiation. To study the commitment effects of delegation, we solve this model for its subgame perfect equilibrium in stationary strategies. Section 3 introduces a simple search technology and extends the analysis of the previous section to a random matching market. Section 4 offers concluding remarks and discusses possible extensions.

2 Bilateral Monopoly

2.1 Bargaining and Delegation

We begin our analysis with the simplest possible case, where a single seller and a single buyer bargain over the sale of an indivisible good. The buyer's valuation and the seller's reservation price are normalized to one and zero, respectively. They both have linear utilities for money and discount future payoffs by the common discount factor $\delta \in (0, 1)$. That is, if they agree to trade at time t for the price p, the payoffs are $\delta^t p$ and $\delta^t(1 - p)$ for the seller and buyer, respectively.

To study the commitment effects of delegation, we compare the outcomes of two different bargaining games. In the first setting, bargaining between the seller and the buyer proceeds face-to-face according to the benchmark, alternating offers model of Rubinstein (1982). In this game, the seller makes the first offer so that he gets the payoff $1/(1 + \delta)$. In the second setting, the seller uses the option to employ an agent to negotiate on his behalf. Since the agent is bound by the (public) contract signed with his employer, his bargaining behavior depends on his compensation scheme. This, in principle, translates into a larger bargaining power making the idea of delegation attractive to the seller. We assume that the utility function of the agent is the same as those of the seller and the buyer, i.e. he discounts future monetary payoffs by the factor δ. Therefore, the crucial issues, which determine the success of delegation, are the compensation offered to the intermediary and the commitment to this contract.

2.2 Delegation with Commitment

For this section, we assume that there is full commitment to the contract signed between the seller and the intermediary. After the compensation scheme has been agreed upon and made public, the intermediary and the buyer engage in a standard Rubinstein alternating offers negotiation, where the intermediary makes the first offer. The most straightforward way for the seller to use the commitment power of delegated bargaining is a compensation scheme which requires the agent to pay him a fixed amount $f \in [0, 1]$ whenever trade occurs. We will show that this scheme enables the seller to extract all the surplus. In addition, it does not require a verification of the outcome of the negotiation between the agent and the buyer. When the intermediary and the buyer agree at time t on the price p, their payoffs are $\delta^t(p - f)$ and $\delta^t(1 - p)$, respectively. The seller obtains $\delta^t f$.

For a given contract f, the solution of the bargaining game between the intermediary and the buyer is familiar from the standard Rubinstein game: The equilibrium is stationary so that the intermediary offers some price p_I, whenever it his turn to make a proposal. Similarly, the buyer always offers some price p_B. The buyer accepts a price p if an only if $p \leq p_I$; the intermediary accepts a price if and only if $p \geq p_B$. The prices p_I and p_B satisfy

$$p_B - f = \delta(p_I - f), \;\; 1 - p_I = \delta(1 - p_B), \tag{1}$$

so that each party is indifferent between accepting a proposal and making a counteroffer at the next stage. The unique solution of these equilibrium conditions is

$$\hat{p}_I = \frac{1 + \delta f}{1 + \delta}, \;\; \hat{p}_B = \frac{\delta + f}{1 + \delta}. \tag{2}$$

Since the agreement is reached in the first round of bargaining, the seller's equilibrium payoff is simply f. The intermediary and the buyer realize the payoffs $\hat{p}_I - f = (1 - f)/(1 + \delta)$ and $1 - \hat{p}_I = \delta(1 - f)/(1 + \delta)$, respectively.

We assume that the intermediary's outside option payoff is zero so that he accepts any contract under which he expects a non-negative payoff.[3] The seller, therefore, can appropriate the entire surplus by setting $f = 1$. Thus the use of a bargaining agent appears as a rather effective commitment device. At least this is true when the contract f cannot be renegotiated. To see that there is possibly an incentive for renegotiation, suppose that in some subgame the buyer makes an offer slightly below $\hat{p}_B$. Rather than rejecting this offer, the intermediary may find it profitable to contact the seller to propose a reduction in f. Indeed, the seller may accept to modify the initial contract in order not to delay an agreement. Of course, the gains from renegotiation depend on the cost of communication between the intermediary and the seller. To study the limitations of delegating bargaining without commitment, we introduce a formal model of intermediation and renegotiation in the following section.

2.3 Delegation and Renegotiation

Unless renegotiation is too costly, there may be room for a Pareto improvement. Therefore, in general, we should not expect the full commitment result of the previous section to prevail. Instead, depending on the actual cost of renegotiation, some intermediate levels of commitment should arise. To stay as closely as possible within the framework of the Rubinstein model, we model the cost of renegotiation by the time delay that is required for communication between the intermediary and the seller. The extensive form of our game is described by the following stages:

Stage 0. The seller decides whether to employ an intermediary. If he bargains directly, he expects the payoff $1/(1+\delta)$. Otherwise, it takes him M time units to contact the intermediary and to negotiate the delegation contract. He chooses a contract, f_S, which requires the intermediary to pay f_S after any sale, independently of the transaction price. The agent accepts or rejects. In case of acceptance, stage 1 begins. If the agent rejects f_S, the seller bargains directly with the buyer and obtains the payoff $\delta^M/(1+\delta)$. In this case, the intermediary's payoff is his outside option, which is normalized to zero.

Stage 1. The intermediary proposes a price, p_I, to the buyer. If the buyer accepts, they trade and the game ends. Otherwise, it proceeds to the next stage after a delay of one time unit.

Stage 2. The buyer makes a counteroffer p_B. The intermediary either accepts, rejects or goes for renegotiation. If he accepts, they trade and the game ends. If he rejects, the game returns to stage 1 after one time unit. Finally, if the intermediary goes for renegotiation, stage 3 is entered after $T/2$ time units.

Stage 3. The intermediary proposes a new contract, f_I. If the seller accepts, it takes the intermediary $T/2$ time units to return to the buyer and to sell the good at the price previously proposed by the buyer. Then the intermediary pays f_I to seller. If the seller rejects, the old contract stays valid and stage 1 is entered, after a delay of $1 + T/2$ time units.[4]

Our model distinguishes between three types of time costs. In stage 0, there is a *delegation* cost of M time units. In stages 1 and 2 the delay between offers and counteroffers represents the cost of *bargaining,* which is normalized to unity. The cost of *renegotiation* in stages 2 and 3 is represented by the T

time units that it takes the intermediary to switch back and forth between the buyer and the seller.

We now derive a subgame perfect equilibrium in stationary, that is, history independent, strategies.[5] In fact, we show that such equilibrium strategies can be described by a six-tuple $(f_S^*, p_I^*, p_B^*, p_B^r, p_B^a, f_I^*)$ with the following interpretation:

- In stage 0, the seller proposes f_S^*. The intermediary accepts any $f_S \leq f_S^*$; he rejects any $f_S > f_S^*$.
- In stage 1, the intermediary proposes p_I^*. The buyer accepts any price $p_I \leq p_I^*$; he rejects any $p_I > p_I^*$.
- In stage 2, the buyer proposes p_B^*. The intermediary rejects any price $p_B < p_B^r$; he goes for renegotiation if $p_B^r \leq p_B < p_B^a$; he accepts any $p_B \geq p_B^a$.
- In stage 3, the intermediary proposes f_I^*. The seller accepts any $f_I \geq f_I^*$; he rejects any $f_I < f_I^*$.

Indeed, (re)negotiation between the seller and his agent is always successful in equilibrium. If the intermediary were to reject the seller's proposal, the seller would strictly prefer to negotiate directly with the buyer. If the seller were to reject the intermediary's renegotiation proposal, the buyer would strictly prefer to make an acceptable offer to the intermediary in the first place (in fact, he would accept the intermediary's offer).

Consequently, the seller's optimal take-it-or-leave-it offer is the one which extracts all the surplus from his agent. Therefore, we have the following lemma:

Lemma 1 *The intermediary makes zero profit in equilibrium.*

Moreover, we obtain that no renegotiation occurs on the equilibrium path.

Lemma 2 *The intermediary's offer is always accepted by the buyer in equilibrium. Therefore, by Lemma 1,*

$$p_I^* = f_S^*. \tag{3}$$

Proof: Suppose the contrary. Since, by Lemma 1, the intermediary makes no profit anyway, the seller would be able to deviate and set a lower f,which would leave room for a Pareto improving offer by the intermediary which would therefore be accepted by the buyer. Q.E.D.

Finally, we can also conclude that in stage 3 the seller must be indifferent between accepting and rejecting f_I^*. Since upon acceptance he obtains f_I^* after $T/2$ units of delay, while after rejection he expects f_S^* after $1 + T/2$ time units, this implies

$$f_I^* = \delta f_S^*. \tag{4}$$

In stage 2, the intermediary obtains $\delta(p_I^* - f_S^*) = 0$ by rejecting the buyer's offer and proposing p_I^* in stage 1.[6] As we have seen before, if the intermediary goes for renegotiation it must be successful and so he obtains $\delta^T(p_B - f_I^*)$. Finally, if he accepts, he obtains $p_B - f_S^*$. Therefore,

$$p_B^a - f_S^* = \delta^T(p_B^a - f_I^*), \quad \delta^T(p_B^r - f_I^*) = \delta(p_I^* - f_S^*) = 0, \tag{5}$$

so that p_B^a makes the intermediary indifferent between accepting the offer and renegotiating f_S^*, while p_B^r makes him indifferent between renegotiating f_S^* and rejecting the offer. Solving (5) yields

$$p_B^a = f_S^* \frac{1 - \delta^{T+1}}{1 - \delta^T}, \quad p_B^r = \delta f_S^*. \tag{6}$$

In stage 2, the buyer sets either $p_B = p_B^r$ or $p_B = p_B^a$, depending on which of these two prices maximizes his payoff. By choosing $p_B = p_B^r$ he provokes renegotiation and obtains $\delta^T(1 - p_B^r)$; by choosing $p_B = p_B^a$ he gets $(1 - p_B^a)$ right away. Thus

$$p_B^* = \begin{cases} p_B^a & \text{if } p_B^a \leq 1 - \delta^T(1 - p_B^r), \\ p_B^r & \text{otherwise.} \end{cases} \tag{7}$$

In stage 1, by Lemma 2, the intermediary's offer makes the buyer indifferent between accepting and rejecting. Therefore

$$1 - p_I^* = \delta \max\left[\delta^T(1 - p_B^r),\, 1 - p_B^a\right]. \tag{8}$$

Using the previous equations, this simplifies to

$$1 - f_S^* = \delta \max\left[\delta^T(1 - \delta f_S^*),\, 1 - f_S^* \frac{1 - \delta^{T+1}}{1 - \delta^T}\right]. \tag{9}$$

It is easy to see that the second term in the bracket on the r.h.s. cannot yield a solution such that $0 \leq f_S^* \leq 1$. Therefore our candidate for the solution is the one using the first term. It can be verified that at this solution the first term is indeed exceeding the second. Note that this observation amounts to $\delta^T(1 - p_B^r) > 1 - p_B^a$, which proves the following result:

Lemma 3 *If the buyer gets to make an offer he will always provoke renegotiation.*

It is in fact the intermediary who forces this outcome by insisting on renegotiation, whenever he expects it to succeed. Note that when he goes for renegotiation the seller is on the defensive, he has to accept if he wants to avoid further delay. When the buyer's offer is lower than f_S^*, the agent chooses to renegotiate f_S^* in order to avoid a loss, while if the offer is better, it turns out that the delay cost suffered is more than compensated by his improved bargaining position with respect to the seller. Observe also that this result shows that, at least off the equilibrium path, having full commitment and having infinitely expensive renegotiation are not equivalent.

It is now straightforward to derive the solution for the parameters that characterize the stationary equilibrium. By (3), (4), (6), (7) and (9) we obtain the following proposition:

Proposition 1 *In the subgame where the seller delegates bargaining, the unique stationary equilibrium is characterized by the following values:*

$$f_S^* = p_I^* = \frac{1-\delta^{T+1}}{1-\delta^{T+2}}, \quad p_B^* = p_B^r = f_I^* = \frac{\delta - \delta^{T+2}}{1-\delta^{T+2}}, \tag{10}$$

and

$$p_B^a = \frac{\left(1-\delta^{T+1}\right)^2}{\left(1-\delta^T\right)\left(1-\delta^{T+2}\right)} \geq 1. \tag{11}$$

Therefore, in the limit $\delta \to 1$ where all delay costs vanish, f_S^*, p_I^*, p_B^*, p_B^r, and f_I^* approach $[1+T]/[2+T]$ and p_B^a approaches $(1+T)^2/[T(2+T)]$.

When the seller employs a bargaining agent, the buyer has to pay p_I^* for the good. Note that this price is increasing in the time cost of renegotiation, T. For $T = 0$ it coincides with the price that would result from direct face-to-face bargaining between the seller and the buyer. As T tends to infinity, p_I^* approaches one.

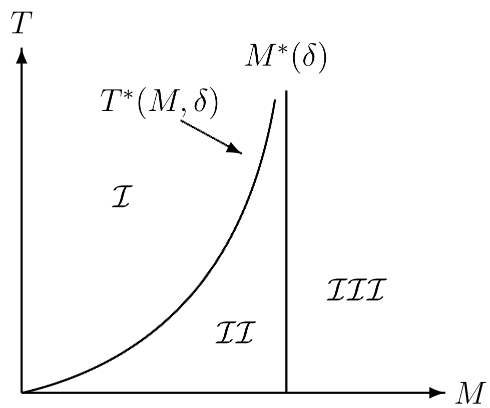

Figure 1: *Gains from Delegation*

2.4 The Gains from Delegation

In stage 0, the seller decides whether to delegate bargaining or to bargain directly with the buyer. Hiring an intermediary involves a delay cost M of time units and gives the seller the payoff $\delta^M f_S^*$. By bargaining face-to-face with the buyer he expects the payoff $1/(1+\delta)$. Therefore, his gain from delegation is

$$G(\delta, T, M) = \frac{\delta^M(1-\delta^{T+1})}{1-\delta^{T+2}} - \frac{1}{1+\delta}. \tag{12}$$

Note that $\partial G/\partial T > 0$, $G(\delta, 0, M) < 0$ and $G(\delta, \infty, M) = \delta^M - 1/(1+\delta)$, for all $\delta \in (0,1)$ and $M > 0$. Therefore, by defining the cutoff values

$$M^*(\delta) \equiv -\frac{\ln(1+\delta)}{\ln \delta}, \quad T^*(M,\delta) \equiv \ln\left(\frac{1-\delta^M-\delta^{M+1}}{\delta^2-\delta^{M+1}-\delta^{M+2}}\right) / \ln \delta, \tag{13}$$

we obtain the following result:

Proposition 2 *Delegation is profitable for the seller if and only if the time cost of delegation M is sufficiently small and the time cost of renegotiation T is sufficiently large. More specifically, $G(\delta, T, M) > 0$ if and only if $M < M^*(\delta)$ and $T > T^*(M, \delta)$.*

Figure 1 illustrates the situation for a given discount factor δ. The seller delegates bargaining to the intermediary only if the parameters M and T lie in region $\mathcal{I}$. For parameter values in regions $\mathcal{II}$ and $\mathcal{III}$ he prefers to bargain directly with the buyer. Note that δ^M is the surplus with delegation that would result if full commitment were possible. In region $\mathcal{III}$, where $M^*(\delta) < M$, delegation is simply more costly than the maximum benefit it could provide. For lower delegation costs, the issue is whether the renegotiation cost is sufficiently high to create enough commitment power to compensate for the price of delegation.

As the cost of delay vanishes, we can observe two effects. First, by definition, the cost of delegation tends to zero, so region $\mathcal{III}$ disappears. Second, the minimum necessary commitment for profitable delegation converges to zero, so region $\mathcal{II}$ disappears too. That is,

$$\lim_{\delta \to 1} M^*(\delta) = \infty, \ \lim_{\delta \to 1} T^*(M, \delta) = 0. \tag{14}$$

This observation explains the following result:

Proposition 3 *For δ sufficiently close to unity, delegation is always more profitable for the seller than face-to-face bargaining because*

$$\lim_{\delta \to 1} G(\delta, T, M) = \frac{T}{4 + 2T} > 0. \tag{15}$$

Even when the time cost of renegotiation becomes arbitrarily small, delegation creates a positive commitment effect. For example when $T = 1$, making a counteroffer to the buyer takes the intermediary as much time as renegotiating the contract with the seller. Still, for δ close to one the seller gains approximately 1/6 of the available surplus through delegated bargaining.

3 A Search Market

3.1 Direct Trade

In this section we extend our analysis to a simple search market environment with a large number of potential buyers. The monopolistic seller, who owns a single indivisible good, can either search by himself for a bargaining partner or he can delegate search and bargaining to an intermediary. We begin by studying the benchmark case without delegation. In this case, the seller is matched randomly with one of the buyer with probability $\alpha \in (0, 1)$ per period. He continues to bargain with this buyer until either an agreement is reached or he meets another buyer. Thus, as in Rubinstein and Wolinsky (1985), the seller switches to another buyer with probability α whenever a proposal is rejected.

More specifically, we consider the following extensive form game. The seller meets a potential buyer with probability $\alpha \in (0,1)$ in each period. When he is matched with a buyer, bargaining proceeds as follows:

Stage 1. The seller proposes some price p_S. If the buyer accepts, the game ends. Otherwise, with probability $(1-\alpha)$ stage 2 is entered after one period. With probability α the seller is matched with another buyer and stage 1 starts after one period.

Stage 2. The buyer proposes some price p_B. If the seller accepts, the game ends. Otherwise, with probability $(1-\alpha)$ stage 1 is entered after one period with the same buyer. With probability α the seller is matched with another buyer and stage 1 starts after one period.

It is now straightforward to derive the stationary equilibrium with direct trade: In stage 1 the seller's proposal leaves the buyer indifferent between accepting and rejecting, and in stage 2 the buyer's proposal leaves the seller indifferent between accepting and rejecting. Therefore, we have that

$$1 - p_S = \delta(1-\alpha)(1-p_B), \;\; p_B = \delta p_S. \tag{16}$$

These two equations have the unique solution

$$\hat{p}_S = \frac{1-\delta(1-\alpha)}{1-\delta^2(1-\alpha)}, \;\hat{p}_B = \frac{\delta(1-\delta(1-\alpha))}{1-\delta^2(1-\alpha)}. \tag{17}$$

The seller's *ex ante* payoff from direct trade, v_S^D, is therefore given by

$$v_S^D = \alpha \hat{p}_S + \delta(1-\alpha)v_S^D, \tag{18}$$

which yields

$$v_S^D = \frac{\alpha}{1-\delta^2(1-\alpha)}. \tag{19}$$

Note that, in the limit as $\delta \to 1$ we have that $v_S^D = 1$.

3.2 Delegated Search

To delegate search and bargaining, the seller contacts an intermediary. This requires M time units. Then the game proceeds as follows:

Stage 0. The seller proposes a contract, f_S, which requires the intermediary to pay f_S to the seller after any sale. The intermediary accepts or rejects. If he rejects, the seller searches herself for a buyer and expects the payoff $\delta^M v_S^D$. In case he accepts, the intermediary starts searching for a buyer. Per period he is matched with a potential buyer with probability α. After a match, stage 1 begins.

Stage 1. The intermediary proposes the price p_I to the buyer. If the buyer accepts, they trade and the game ends. Otherwise, with probability $1-\alpha$ the game proceeds to the next stage after one time unit. With probability α the intermediary is matched with another buyer and stage 1 starts again after a delay of one period.

Stage 2. The buyer makes a counteroffer p_B. If the intermediary accepts, the game ends. If the intermediary rejects, with probability $1-\alpha$ he returns to stage 1 after one period with the same buyer. With probability α the intermediary is matched with another buyer. In this case, stage 1 starts with the new buyer after one period. If the intermediary decides to renegotiate the existing contract f, stage 3 is entered after $T/2$ time units.

Stage 3. The intermediary proposes the contract f_I. If the seller accepts, the good is sold $T/2$ periods later at the price p_B and the intermediary pays f_I to seller. If the seller rejects, the old contract remains valid and stage 1 is entered after a delay of $1 + T/2$ time units.

As in the bilateral monopoly model, we look for an equilibrium in stationary strategies, described by the six-tuple $(f_S^*, p_I^*, p_B^*, p_B^a, p_B^r, f_I^*)$. Observe that Lemmas 1 and 2 directly apply to the current model. Consequently, we have that

$$f_I^* = \delta f_S^* = \delta p_I^*. \tag{20}$$

Similarly, the analysis of stage 2 coincides with that of the bilateral monopoly, since the intermediary is indifferent between making a counterproposal to the same buyer or making a first offer to the new buyer. Thus equations (5) - (7) apply without any modification.

In stage 1, however, the threat of competition from another buyer makes the buyer more inclined to accept the intermediary's proposal. The intermediary's offer makes the buyer indifferent between accepting and rejecting if

$$1 - p_I^* = (1-\alpha)\delta \max[\delta^T(1-p_B^r),\, 1-p_B^a]. \tag{21}$$

Effectively, the equilibrium conditions for the search market environment differ from the bilateral monopoly case only in that the above equation replaces condition (8).

The solution of the equilibrium conditions yields the following result:

Proposition 4 *When the seller delegates search and bargaining, the unique stationary equilibrium is characterized by the following values:*

$$f_S^* = p_I^* = \frac{1-(1-\alpha)\delta^{T+1}}{1-(1-\alpha)\delta^{T+2}},\; p_B^* = p_B^r = f_I^* = \frac{\delta-(1-\alpha)\delta^{T+2}}{1-(1-\alpha)\delta^{T+2}}, \tag{22}$$

and

$$p_B^a = \frac{\left(1-\delta^{T+1}\right)\left(1-(1-\alpha)\delta^{T+1}\right)}{\left(1-\delta^{T}\right)\left(1-(1-\alpha)\delta^{T+2}\right)} \geq 1. \tag{23}$$

Therefore, in the limit $\delta \to 1$ where all delay costs vanish, f_S^*, p_I^*, p_B^*, p_B^r, and f_I^* approach 1 and p_B^a approaches $1 + 1/T$.

Notice that (22) and (23) coincide with (10) and (11) in the limiting case $\alpha = 0$. As α is increased, the price that the buyer has to pay, p_I^*, also becomes higher. Note also that, since $\delta^T(1-p_B^r) > 1-p_B^a$, the buyer's proposal p_B^* always triggers renegotiation just as in the bilateral monopoly.

3.3 The Gains from Delegated Search

We now evaluate the profitability of delegating search and bargaining. At the end of stage 0, the seller's payoff from employing the intermediary is

$$v_S^I = \alpha f_S^* + \delta(1-\alpha)v_S^I. \tag{24}$$

By Proposition 3, this equals

$$v_S^I = \frac{\alpha[1-(1-\alpha)\delta^{T+1}]}{[1-(1-\alpha)\delta^{T+2}][(1-(1-\alpha)\delta]}. \tag{25}$$

The seller's gain from delegation, $H(\alpha, \delta, T, M) = \delta^M v_S^I - v_S^D$, can therefore be written as

$$H(\alpha, \delta, T, M) = \frac{\alpha\delta^M(1-(1-\alpha)\delta^{T+1})}{[1-(1-\alpha)\delta^{T+2}][(1-\delta(1-\alpha)]} - \frac{\alpha}{1-\delta^2(1-\alpha)}. \tag{26}$$

Similarly to the bilateral monopoly model, we observe that $\partial H/\partial T > 0$, $H(\alpha, \delta, 0, M) < 0$ and $H(\alpha, \delta, \infty, M) = [\alpha\delta^M/(1-\delta(1-\alpha))] - [\alpha/(1-\delta^2(1-\alpha))]$, for all $\alpha > 0$, $\delta \in (0,1)$ and $M > 0$. Thus, we can define

$$\begin{aligned} \tilde{M}(\delta, \alpha) &\equiv \ln\left(\frac{1-\delta(1-\alpha)}{1-\delta^2(1-\alpha)}\right) / \ln\delta, \\ \tilde{T}(M, \delta, \alpha) &\equiv \ln\left(\frac{1-\delta^M + (1-\alpha)\left(\delta^{M+2}-\delta\right)}{\delta(1-\alpha)\left[\delta - \delta^M + (1-\alpha)\left(\delta^{M+2}-\delta^2\right)\right]}\right) / \ln\delta \end{aligned} \tag{27}$$

to obtain the following result:

Proposition 5 *Delegation is profitable for the seller if and only if the time cost of delegation M is sufficiently small and the time cost of renegotiation T is sufficiently large. More specifically, $H(\alpha, \delta, T, M) > 0$ if and only if $M < \tilde{M}(\delta, \alpha)$ and $T > \tilde{T}(M, \delta, \alpha)$.*

Let us compare this result with Proposition 2. First, note that

$$\lim_{\alpha\to 0} \tilde{M}(\delta, \alpha) = M^*(\delta), \quad \lim_{\alpha\to 0} \tilde{T}(M, \delta, \alpha) = T^*(M, \delta). \tag{28}$$

As search becomes totally inefficient, even though the gain H decreases to zero, the cutoff values for profitable delegation become identical to those in the bilateral bargaining model.

Next, it can be shown that $\partial\tilde{M}(\delta, \alpha)/\partial\alpha < 0$ and that for $M < \tilde{M}(\delta, \alpha)$, $\partial\tilde{T}(M, \delta, \alpha)/\partial\alpha > 0$. This implies that, for $\alpha \in (0, 1)$, in Figure 1 the $\tilde{M}$ schedule lies to the left of M^* and that $\tilde{T}$ lies above T^*. Thus - *ceteris paribus* - the scope for intermediation in a search market is smaller than in a bilateral monopoly. The intuition is that competition among the buyers creates a sort of commitment effect that tends to render commitment through intermediation redundant. Indeed, we have

$$\lim_{\alpha\to 1} \tilde{M}(\delta, \alpha) = 0, \quad \lim_{\alpha\to 1} \tilde{T}(M, \delta, \alpha) = \infty. \tag{29}$$

We therefore get the following result:

Proposition 6 *For α sufficiently close to unity, intermediation is not profitable for the seller because*

$$\lim_{\alpha\to 1} H(\alpha, \delta, T, M) = \delta^M - 1 < 0. \tag{30}$$

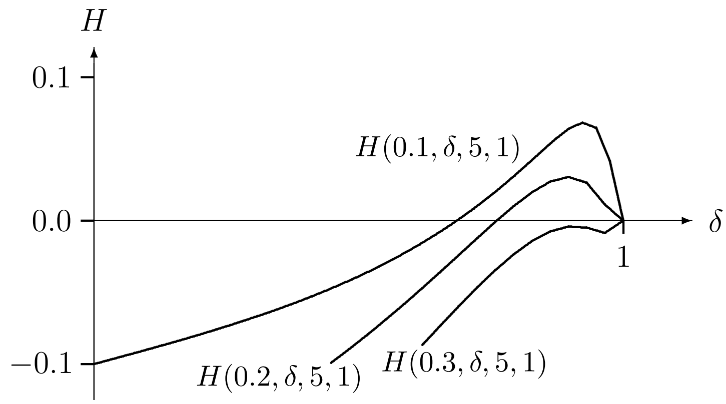

Figure 2: *The Function* $H(\alpha, \delta, T, M)$

Intermediation is never profitable if search is sufficiently efficient! A highly competitive environment precludes a role for intermediation.

The previous statement can be qualified by examining the equilibrium when the time costs of search and bargaining vanish. Following Rubinstein and Wolinsky (1985), we call the search market 'frictionless' in the limit $\delta \to 1$.

Proposition 7 *In a frictionless market intermediation is not profitable for the seller because*

$$\lim_{\delta \to 1} H(\alpha, \delta, T, M) = 0. \tag{31}$$

The intuition for this observation is that the seller is able to appropriate the entire surplus through direct trade when switching from one buyer to another involves no delay cost. This is in contrast with the bilateral monopoly, where in the limit as $\delta \to 1$ we have $G(\delta, T, M) \to T/(4 + 2T) > 0$.

Figure 2 illustrates our findings. It shows how the gain H from delegated search and bargaining depends on δ. The delegation cost and the renegotiation cost are fixed at $M = 1$ and $T = 5$, respectively. The figure shows that for $\alpha = 0.3$ delegation is never profitable. For $\alpha = 0.2$ and $\alpha = 0.1$, however, there is a critical value $0 < \bar{\delta}_\alpha < 1$ such that there are gains from delegation if and only if $\bar{\delta}_\alpha < \delta < 1$.

4 Conclusion

By employing a bargaining agent a player may increase his share of the available surplus even when the delegation contract is subject to renegotiation. We obtain this conclusion from a strategic model of bargaining which explicitly takes into account that the exchange of proposals and counterproposals is time consuming. In such a framework, naturally, renegotiating an existing contract also requires time. It is exactly this time cost which prevents a full elimination of the commitment effect of delegation. Importantly, this effect does not vanish when the delay costs of negotiations become negligible. Indeed, when the players' common discount factor is sufficiently large, delegation is always profitable in a bilateral monopoly.

This observation casts some doubt on much of the literature on contract design and renegotiation, which typically concludes that employing a third party generates no commitment effect if the delegation contract is not irrevocable. Our results show that this conclusion may no longer be valid when the process of contract design and renegotiation is described by a strategic bargaining model.

The strategic bargaining approach can easily be imbedded in a market environment. This allows us to address the question of which market conditions favor the use of intermediation. We study a simple search market model and show that the gain from delegating search and bargaining disappears when search is sufficiently efficient. In a highly competitive market a trader cannot increase his share of the surplus through precommitment. This is in line with the Walrasian paradigm in which intermediation plays no role because all trade occurs at a centralized location.

In our model only one of the bargainers has the option of employing a delegate. In principle, this setting can be extended by allowing also the other party to hire an agent. In this case, however, the derivation of equilibrium becomes more complicated because two-sided delegation leads to a four-person bargaining game. Nonetheless, the consideration of two-sided delegation would be interesting not only in the bilateral monopoly but also in the random matching model. We conjecture that the side of the market with higher search costs also has higher incentives to resort to intermediation.

5 References

Aghion, P. and P. Bolton, 1987. Contracts as a Barrier to Entry. American Economic Review 77, 488-501.

Bester, H., 1994. Price Commitment in Search Markets. Journal of Economic Behavior and Organization 25, 109-120.

Bester, H., 1995. A Bargaining Model of Financial Intermediation. European Economic Review, 39, 211-228.

Bolt W. and H. Houba, 1998. Strategic Bargaining in the Variable Threat Game. Economic Theory 11, 57-77.

Brander, J. A. and T. R. Lewis, 1986. Oligopoly and Financial Structure: The Limited Liability Effect. American Economic Review 76, 956-970.

Crawford V., 1982. A Theory of Disagreement in Bargaining. Econometrica 50, 607-638.

Dewatripont, M., 1988. Commitment through Renegotiation-proof Contracts with Third Parties. Review of Economic Studies 60, 377-390.

Fershtman, C. and K. L. Judd, 1987. Equilibrium Incentives in Oligopoly. American Economic Review 77, 927-940.

Fershtman, C., K. L. Judd and E. Kalai, 1991. Observable Contracts: Strategic Delegation and Cooperation. International Economic Review 32, 551-559.

Fershtman, C. and E. Kalai, 1997. Unobserved Delegation. International Economic Review 38, 763-774.

Green, J. R., 1990. Commitments with Third Parties. Harvard University, Discussion Paper No. 1519.

Haller, H. and S. Holden, 1997. Ratification Requirement and Bargaining Power. International Economic Review 38, 825-851.

Katz, M., 1991. Game-Playing Agents: Unobservable Contracts as Precommitments. Rand Journal of Economics 22, 307-328.

Muthoo, A., 1992. Revocable Commitment and Sequential Bargaining. Economic Journal 102, 378-387.

Muthoo, A., 1996. A Bargaining Game Based on the Commitment Tactic. Journal of Economic Theory 69, 134-152.

Rubinstein, A., 1982. Perfect Equilibrium in a Bargaining Model. Econometrica 50, 97-109.

Rubinstein, A. and A. Wolinsky, 1985. Equilibrium in a Market with Sequential Bargaining. Econometrica 53, 1133-1150.

Rubinstein, A. and A. Wolinsky, 1987. Middlemen. Quarterly Journal of Economics 102, 581-593.

Schelling, T. C., 1960, The Strategy of Conflict, Harvard University Press, Cambridge, Massachusetts.

Footnotes

1. In the terminology of Fershtman and Kalai (1997), this type of intermediation amounts to 'incentive delegation' as opposed to 'instructive delegation', where the delegate's behavior is regulated by the contract.

2. A number of papers discusses contractual commitments in other contexts; see, for example, Aghion and Bolton (1987), Brander and Lewis (1986), and Fershtman and Judd (1987).

3. This assumption is without loss of generality: If the intermediary had a positive reservation value, the seller would optimally compensate him by an up-front payment.

4. Here we follow the standard interpretation of the alternating offers model: After rejecting an offer it takes one time unit to formulate a counteroffer.

5. Note that a player responds optimally by using a stationary strategy when the other players employ stationary strategies. Thus we are not restricting the strategy space but merely performing an equilibrium selection.

6. The offer, p_I^* , must be accepted in equilibrium, since by stationarity, if it is optimal for the agent to reject today he will never provoke renegotiation. Consequently, the subgame is just like in the standard model and all offers are accepted in equilibrium.

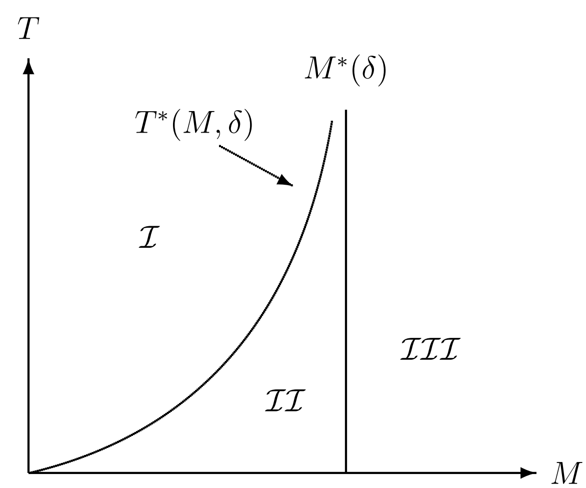

Figure 1: *Gains from Delegation*

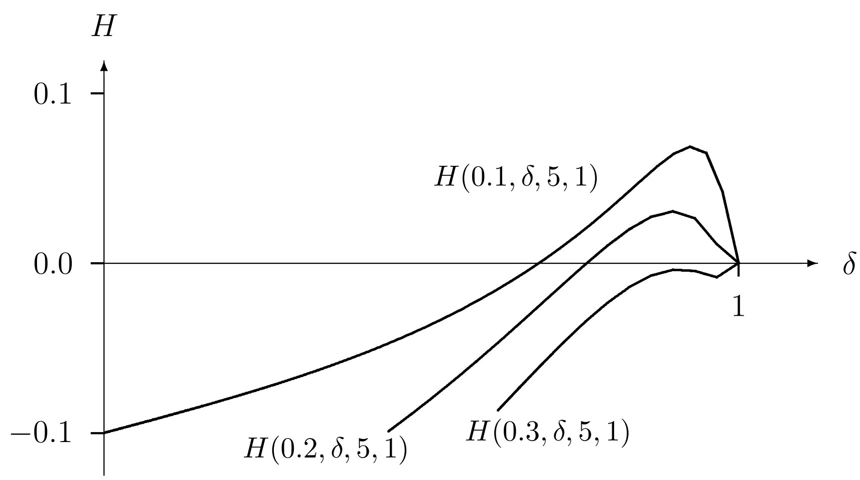

Figure 2: *The Function* $H(\alpha, \delta, T, M)$