The Hold-Out Problem

Flavio Menezes and Rohan Pitchford
Getulio Vargas Foundation
Graduate School of Economics
Praia de Botafogo 190
11o. andar, Botafogo
Rio de Janeiro
RJ, 22253-900, Brazil
fmenezes@fgv.br.
and
The Australian National University
ACT 0200, Australia.

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Abstract

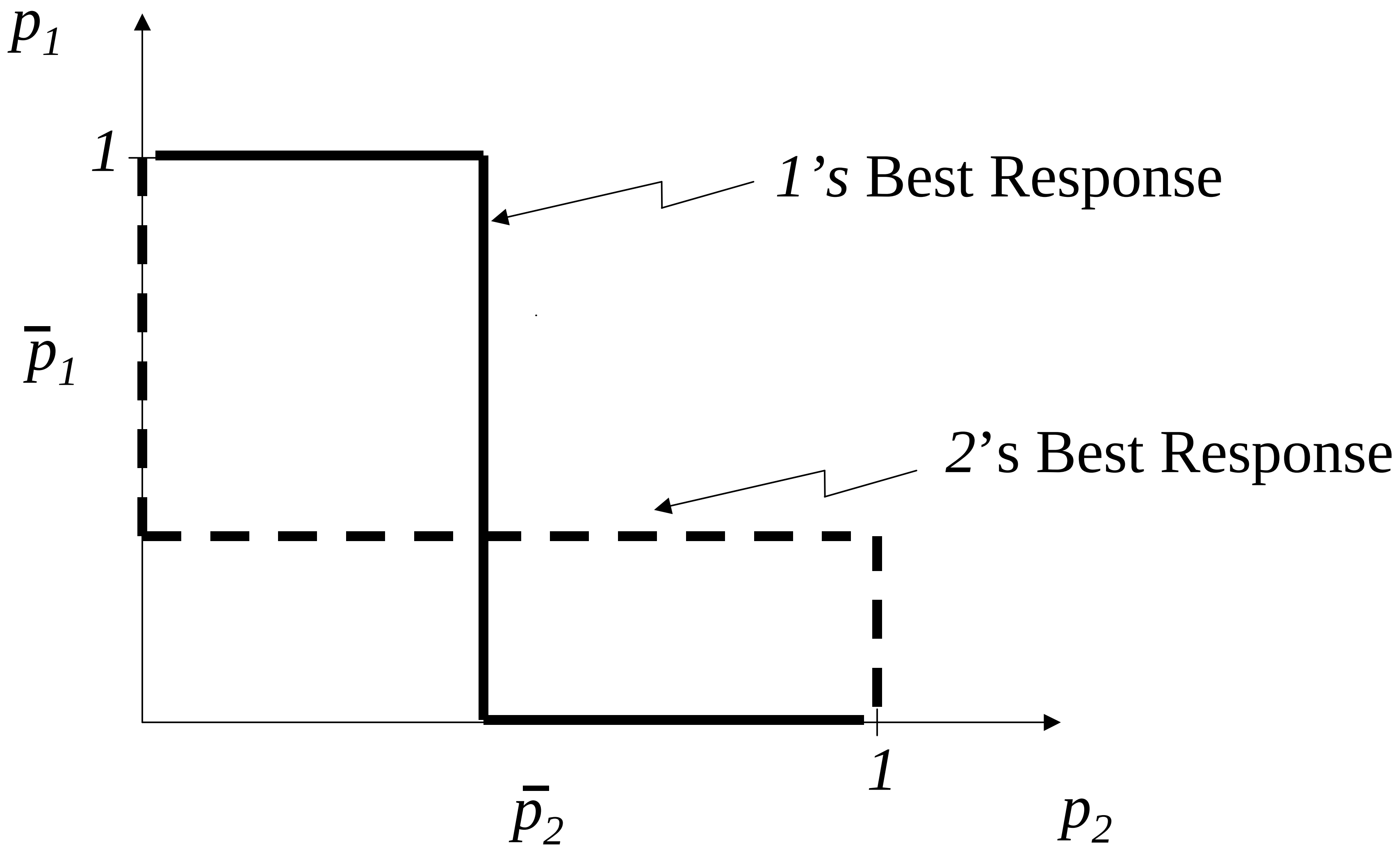
In this paper we develop a framework to analyze strategic situations where players may have an incentive to delay the start of negotiations. This is the hold-out problem. We show that both hold-out and simultaneous agreements are possible outcomes when players choose when to negotiate.

Preliminary: Please Do Not Cite.

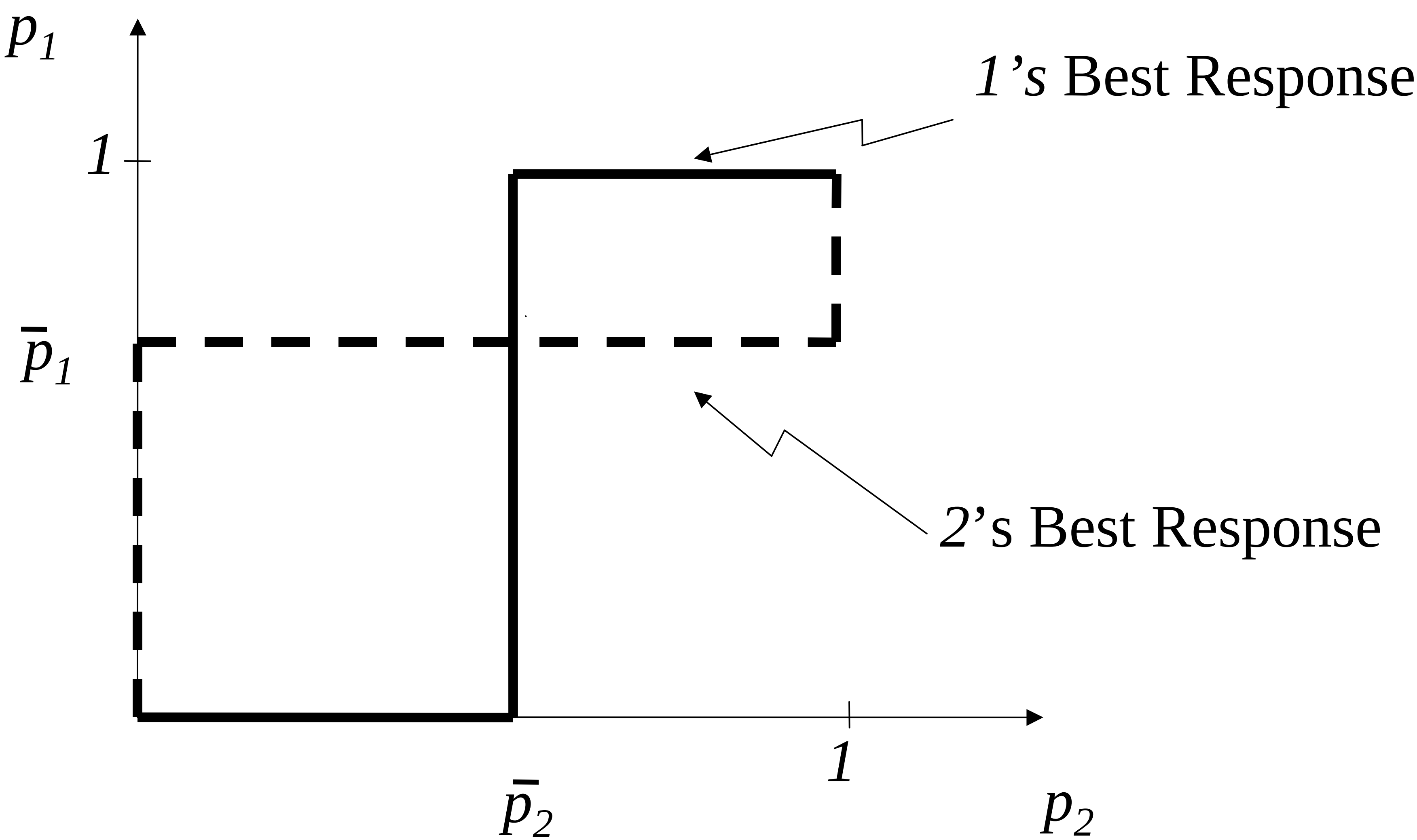
1 Introduction

Suppose a developer wants to buy two adjacent blocks of land that are currently in the possession of two di¤erent owners. The value of the two blocks of land to the developer is greater than the sum of the individual values of the blocks for each owner. Under complete information about individual valuations, the developer could make a take-it-or-leave-it simultaneous o¤er to both owners equal to their valuations.

$Diagram\,1:\ \Delta_{i1} < 0, \Delta_{i0} > 0$



$Diagram\ 2: \Delta_{i1} > 0, \Delta_{i0} < 0$



The owners would accept the offers, the outcome would be efficient and the developer would get all the surplus.

On the other hand, if the owners were to approach the developer sequentially, the final division of the surplus would depend on who makes the final offer. This individual would end up with the entire surplus and the efficient allocation would be implemented but at the expense of costly delay. Given the possible advantage that arises from being the last to make an offer, players may strategically delay the start of a negotiation. This is the hold-out problem.

It is our contention, however, that both inefficient allocations and efficient allocations achieved after costly delay are observed. For example, sometimes a developer successfully manages to buy all the adjacent blocks of land she needs to build a shopping mall. On the other hand, development are sometimes built around a property that the developer failed to acquire. Along the same lines, it is common to see mergers that were successful in realizing particular synergies and mergers that were unsuccessful.

Cramton and Tracy (1992) analyzed a sample of 5,002 labor contract negotiations in the US from 1970 to 1989 involving bargaining units of 1,000 or more workers. They found that holdouts occurred in 47 percent of the negotiations — a holdout in this context is defined as the time between the expiration of the previous contract and either the beginning of a strike or the settlement of a new contract, whichever comes first. Cramton and Tracy develop a private-information model where labor disputes signal a firm's willingness to pay. In contrast, we establish a basic framework under complete information where individuals might holdout because there is a strategic advantage in going late to the negotiating table. In addition to the developer game described above, there are several markets where this type of strategic advantage may be relevant such as in the purchase of patents, purchase of companies and contractual bargaining of professionals.

Cramton (1992) also analyzes the role of strategic delay when a buyer and a seller are engaged in trading a single object and have private information about their own preferences. Cramton constructs an equilibrium where delay again is used strategically to signal private information. Cramton extends the work of Admati and Perry (1987) who examine a setting with one-sided uncertainty and only two possible types.

These papers have assumed the same basic extensive form as in Rubinstein (1982), namely, an alternating offer framework. An important question is why should one assume an alternating offer structure in a bargaining game and, more importantly, how do the results change if we assume a different game form. Mckelvey and Palfrey (1997) offer a partial answer to this question in the context of a concession game; in each period, there is a simultaneous move in which each player chooses either to give in or to hold out. The game continues until at least one of the players chooses to give in, at which point agreement is reached and the game ends, with a benefit accruing to each player, and a privately known cost to the player who gave in. For any discount factor, they find that for asymmetric enough priors over the types of the players, there is a unique Nash equilibrium in which the two players alternate in their willingness to give in. Thus, an alternating offer equilibrium arises endogenously, even though the underlying game form has a simultaneous move structure.

In this paper we also examine a situation where players may negotiate in turn – such as in the alternating offer framework described in the previous paragraph – or simultaneously. We consider a simple model under complete information and ask whether costly delay is possible due to the holdout. In our model players choose a probability of going to the bargaining table. We show that in addition to costly delay in the form of a hold out, a simultaneous agreement is also possible. That is, we develop a framework that is flexible enough to accommodate both costly delay and simultaneous decisions. This framework may be particularly suitable for studying negotiations between parties where valuations exhibit synergies and in the absence of the possibility of binding contracts between parties outside of the negotiation table –

either because it is not legal as in the case of mergers or because of the di¢culty of enforceability of conditional contracts as in the case of a developer making a payment to one of the land owners conditional on the …nal acquisition from other land owners.[1]

2 The Model

There are three players in the model. A developer (player 0) wants to buy two blocks of land, and realize a value v from owning the entire set. However, each of these two blocks of land are owned by players 1 and 2 respectively, who value the blocks of land at $w_i;\ i = 1;2$. The developer values an individual block of land at v_i Ideally, the developer would like to engage each of these players together, make a take-or-leave-it o¤er, and realize the value v, less payments to the owners. However, an owner may …nd it in her interest to avoid going to the bargaining table. Thus, players $i = 1;2$ simultaneously choose vectors of probabilities $p_i = (p_{i1;}p_{i2})$, where p_{it} 2 $[0;1];$ $§_{t=1}^{2} p_{it} = 1$ is the probability that player i goes to the bargaining table in period $t = 1;2$. There are two bargaining periods, to admit the possibility of an owner being the last player to go to the bargaining table and sell her block to the developer.

The possible outcomes from player i's bargaining participation decisions are denoted $x_i = (x_{i1};x_{i2})$ 2 X; where

$$X = f(1;0);(0;1);(0;0);(1;1)g:$$

The notation $x_{it} = 1$ indicates that i must bargain with the developer, and any other that is present at time t. The notation $x_{it} = 0$ indicates that i successfully avoids engaging in bargaining at time t.

We assume that bargaining is e¢cient once players are at the bargaining table. This is consistent with a variety of extensive form bargaining games, such as Rubenstein's bargaining game, that admit e¢cient bargaining as subgame-perfect equilibria.

[1] Stole and Zwiebel (1996) also examine a bargaining situation – that between the …rm and its employees – in the absence of binding contracts. Their bargaining protocol captures the power that an employee has to leave the …rm before production is complete. In contrast, our model is intended to capture the ability parties have to avoid bargaining for strategic advantage.

The payoff to player i from bargaining when the outcome is (x_1, x_2) is $s_i : X^2 \rightarrow \mathbb{R}$. Let π_i denote player i's expected payoff. The payoff for player $i = 1, 2 \neq j$ is

$$\begin{aligned} \pi_i &= p_{i1} p_{j1} s_i(1,0,1,0) + p_{i1}(1 - p_{j1}) s_i(1,0,0,1) \\ &\quad + (1 - p_{i1}) p_{j1} s_i(0,1,1,0) + (1 - p_{i1})(1 - p_{j1}) s_i(0,1,0,1) \end{aligned}$$

We can simplify the notation for payoffs by noting that with two players, it is sufficient to list the presence or absence of player 1 and player 2 at date 1, by the pair (x_{i1}, x_{j1}). With some abuse of notation, let the s_i be written as functions of (x_{i1}, x_{j1}) instead of (x_i, x_j), and drop the second superscript on the p_{i1}, writing instead p_i:

$$\begin{aligned} \pi_i &= p_i p_j s_i(1,1) + p_i(1 - p_j) s_i(1,0) \\ &\quad + (1 - p_i) p_j s_i(0,1) + (1 - p_i)(1 - p_j) s_i(0,0) \end{aligned}$$

The payoff for player 0 is

$$\begin{aligned} \pi_0 &= p_1 p_2 s_0(1,1) + p_1(1 - p_2) s_0(1,0) \\ &\quad + (1 - p_1) p_2 s_1(0,1) + (1 - p_1)(1 - p_2) s_0(0,0) \end{aligned}$$

3 Results

To derive the set of possible equilibria, consider player i's choice of p_i. The derivative with respect to p_i is

$$\frac{\partial \pi_i}{\partial p_i} = (1 - p_j)\left[s_i(1,0) - s_i(0,0)\right] + p_j\left[s_i(1,1) - s_i(0,1)\right].$$

Define

$$\Delta_{i0} = s_i(1,0) - s_i(0,0)$$

as the gain to player i from immediate bargaining, if player $j \neq i$ chooses to delay bargaining until $t = 2$. Similarly, define

$$\Delta_{i1} = s_i(1,1) - s_i(0,1)$$

as the gain to i from immediate bargaining if player $j \neq i$ chooses to bargain immediately. Therefore

$$\frac{\partial \pi_i}{\partial p_i} = (1 - p_j)\,\Delta_{i0} + p_j\,\Delta_{i1}. \tag{1}$$

Proposition 1 The following table summarizes the equilibria, up to symmetry, that obtain for different values of Δ_{ix_j}.

Δ_{10}	Δ_{11}	Δ_{20}	Δ_{21}	$(p_1; p_2)$
+	+	+	+	$(1;1)$
+	+	−	+	$(1;1)$
+	−	+	+	$(0;1)$
−	−	−	−	$(0;0)$
−	−	−	+	$(0;0)$
−	−	+	+	$(0;1)$
−	−	+	−	$(0;1)$
−	+	−	+	$(p_1^a; p_2^a)$
+	−	+	−	$\left(p_1^b; p_2^b\right)$

Where $(p_1^a; p_2^a) \in \{(0;0);(1;1);(\overline{p}_1;\overline{p}_2)\}$, $\left(p_1^b; p_2^b\right) \in \{(1;0);(0;1);(\overline{p}_1;\overline{p}_2)\}$, and $(\overline{p}_1;\overline{p}_2) = \frac{\Delta_{i0}}{\Delta_{i0} - \Delta_{i1}}$

Proof. All but the last two rows follow directly from examination of 1. The last two rows can be derived directly from the best-response correspondences of each player. Consider the case $\Delta_{i0} < 0$, $\Delta_{i1} > 0$ for $i = 1;2$. The best response correspondences are

$$p_i = \begin{cases} 0 \text{ for } p_j < \overline{p}_j \\ [0;1] \text{ for } p_j = \overline{p}_j \\ 1 \text{ for } p_j > \overline{p}_j \end{cases}$$

which admit the equilibria stated – see diagram 1. For the case $\Delta_{i0} > 0$, $\Delta_{i1} < 0$, $i = 1;2$, the best response correspondences are

$$p_i = \begin{cases} 1 \text{ for } p_j < \overline{p}_j \\ [0;1] \text{ for } p_j = \overline{p}_j \\ 0 \text{ for } p_j > \overline{p}_j \end{cases}$$

which admit the equilibria stated – see diagram 2. ■

Intuition for this proposition can be derived directly from the interpretation of the Δ's. For example, $\Delta_{i0} < 0$ means that player i would like to delay, if she knew player j delayed bargaining, and $\Delta_{i1} > 0$, means i would like to delay if player j bargains. This case has the set of equilibria $\{(0;0);(1;1);(\bar{p}_1;\bar{p}_2)\}$, because both parties have a preference for being at the bargaining table together. If instead $\Delta_{i0} > 0$ and $\Delta_{i1} < 0$, both players have a preference for being at the bargaining table separately. This case is a neat representation of the hold-out problem, although note that many of the other cases represented in the table have hold-out.

3.1 Example: Generalized Nash Bargaining

Let α_i denote the i's share of net surplus when all three parties bargain so that $\Sigma_i \alpha_i = 1$. Define $\beta_{ij} = \frac{\alpha_i}{\alpha_i + \alpha_j}$ as the i's share when i and j only bargain together $i \neq j = 1;2$. Suppose that the developer values the block of land owned by player i, $i = 1;2$, more than player i himself, namely, $v_i \geq w_i$

This leads to the following state-contingent payoffs:

$$s_i(1;1) = s_i(0;0) = \alpha_i (v - w_1 - w_2)$$

$$s_1(1;0) = \frac{\alpha_1}{\alpha_1 + \alpha_0}(v_1 - w_1)$$

$$s_2(1;0) = \frac{\alpha_2}{\alpha_2 + \alpha_0}\left(v - w_2 - \frac{\alpha_1}{\alpha_1 + \alpha_0}(v_1 - w_1)\right)$$

$$s_2(0;1) = \frac{\alpha_2}{\alpha_1 + \alpha_0}(v_2 - w_2)$$

$$s_1(0;1) = \frac{\alpha_1}{\alpha_1 + \alpha_0}\left(v - w_1 - \frac{\alpha_2}{\alpha_1 + \alpha_0}(v_2 - w_2)\right)$$

Therefore the crucial Δ parameters are:

$$\Delta_{10} = \frac{\alpha_1}{\alpha_1 + \alpha_0}(v_1 - w_1) - \alpha_1 (v - w_1 - w_2)$$
$$\Delta_{20} = \frac{\alpha_2}{\alpha_2 + \alpha_0}(v_2 - w_2) - \alpha_2 (v - w_1 - w_2)$$

$$\Delta_{11} = \alpha_1(v - w_1 - w_2) - \frac{\alpha_1}{\alpha_1+\alpha_0}\left(v - w_1 - \frac{\alpha_2}{\alpha_2+\alpha_0}(v_2 - w_2)\right)$$

$$\Delta_{21} = \alpha_2(v - w_1 - w_2) - \frac{\alpha_2}{\alpha_2+\alpha_0}\left(v - w_2 - \frac{\alpha_1}{\alpha_1+\alpha_0}(v_1 - w_1)\right)$$

Proposition 2 With generalized Nash bargaining, (i) If $v_i = w_i$, $i = 1;2$ and $v > v_1 + v_2$ then there is hold-out by both players $(0;0)$; (ii) If v is sufficiently large, there is hold-out by both players $(0;0)$.

Proof. For (i), note that $\Delta_{i0} = -\alpha_i(v - v_1 - v_2) < 0$ and $\Delta_{j0} = -\alpha_j(v - v_1 - v_2) < 0$, and $\Delta_{j1} = -\alpha_j v_i + \left[\alpha_j - \frac{\alpha_j}{\alpha_j+\alpha_0}\right](v - v_j) < 0$, $j \neq i$ This case covers rows 3 and 4 in the table (noting symmetry), so that $(0;0)$ is obtained. For (ii), $\Delta_{i0} < 0$ for $v \geq \frac{1}{\alpha_i+\alpha_0}(v_i - w_i) + w_1 + w_2 \equiv v^{i*}$, and $\Delta_{i1} < 0$ for $v > -\frac{\alpha_i+\alpha_0}{\alpha_j}(w_1 + w_2) - \frac{1}{\alpha_j}\frac{\alpha_j}{\alpha_j+\alpha_0}(v_j - w_j) - w_i \equiv v^{i**}$. For $v > \max_i(v^{i**}; v^{i*})$ the result obtains. ■

The intuition of these cases is as follows. Consider (i) $v_i = w_i$, $i = 1;2$ and $v > v_1 + v_2$. When $v_i = w_i$, a player makes zero surplus if she is the first party to bargain alone. However, if a player delays, she make a positive surplus regardless of the presence of the other player at the bargaining table. This case could be considered a leading case, because it can be interpreted as land being useless for business purposes on its own ($v_i = w_i$) unless both blocks are owned ($v > v_1 + v_2$); examples of such would be if there are small blocks of land, and the developer wishes to build a large supermarket. For (ii), the intuition is straightforward: both players would like to be alone at the bargaining table after the other player has settled, so they can reap a larger fraction of the larger gain v as compared with v_i. Thus, hold-out is more of a problem with a very profitable development project.

4 Exogenous Renegotiation

In this section we modify the basic model by including an exogenous probability that the final outcome is negotiated. This may reflect either some legal right where players have a cooling-off period – as in the sale of real estate – when they can perhaps change their minds or perhaps it is the result of a dispute mediator nominated by the courts whose decision is binding – as prescribed by the industrial relations legislation in many countries. Here we assume that the exogenous probability that renegotiation does not occur is given by a function $\lambda(p_1; p_2)$. Moreover, we assume that in case the renegotiation will take the form of a Nash bargaining game and that the emerging outcome is the Nash solution where each player receives an equal share of the surplus, namely, $\frac{v - w_1 - w_2}{3}$:

Now we can write player i's expected profits, $i = 1; 2$, as follows

$$\pi_i = \lambda(p_1; p_2)\{p_i p_j s_i(1; 1) + p_i(1 - p_j) s_i(1; 0)$$

$$+ (1 - p_i) p_j s_i(0; 1) + (1 - p_i)(1 - p_j) s_i(0; 0)\} +$$

$$(1 - \lambda(p_1; p_2)) \frac{v - w_1 - w_2}{3}:$$

To determine the equilibrium probabilities of going to the bargaining table, player i chooses p_i to maximize his expected profits yielding:

$$\frac{\partial \pi_i}{\partial p_i} = (1 - p_j)\Delta_{i0} + p_j \Delta_{i1} - \tag{2}$$

$$\frac{\lambda(p_1; p_2)}{\partial p_i} \left\{ \frac{v - w_1 - w_2}{3} - p_i \Delta_{i0} - p_i p_j \Delta_{i1} + p_i p_j \Delta_{i0} - p_j s_i(0; 1) - (1 - p_j) s_i(0; 0) \right\}$$

Where Δ_{i0} and Δ_{i1} are as defined in the previous section.

It is not difficult to see from 2 that the introduction of exogenous renegotiation is still consistent with the existence of both hold out and simultaneous agreement. In the next proposition we establish sufficient conditions for simultaneous negotiations to be an equilibrium even under the (exogenous) threat of mandatory renegotiation. The proof is omitted.

Proposition 3 When the total surplus $(v - w_1 - w_2)$ is sufficiently small, it suffices for $\lambda(p_1; p_2)$ to be nondecreasing in both arguments for an agreement to be reached simultaneously in equilibrium.

The intuition is quite straightforward. The fact that the probability of renegotiation $(1 - \lambda(p_1; p_2))$ decreases with one's probability of going to the table reinforces one's decision to go to the negotiation table over and above the case with no renegotiation. It does not suffice, however, for the probability of renegotiation to be increasing in one's probability for holdout to persist as an equilibrium. This probability must be sufficiently increasing for that to occur.

5 Endogenous Renegotiation

6 N players

7 Conclusion

Admati, A. and M. Perry, 1987, "Strategic Delay in Bargaining," Review of Economic Studies 54, 345-364.

Cramton, P. C., 1992, "Strategic Delay in Bargaining with Two-Sided Uncertainty," Review of Economic Studies 59, 205-225.

Cramton, P. C. and J. S. Tracy, "Strikes and Holdouts in Wage Bargaining: Theory and Data," 1992, American Economic Review 82(1), 100-121.

McKelvey, R. D. and T. R. Palfrey, 1997, "Endogeneity of Alternating Offers in a Bargaining Game," Journal of Economic Theory 73, 425-437.

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

Stole, L. A. and J. Zwiebel, 1996, "Intra-Firm Bargaining Under Non-Binding Contracts," Review of Economic Studies 63, 375-410.