

# Dealing with Eminent Domain\*

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## Abstract

In light of the recent U.S. Supreme Court decision, *Kelo vs. New London*, there has been a renewed interest in problems dealing with the acquisition of perfectly complementary inputs, specifically in the context of land assembly and eminent domain. Using a sequential Nash bargaining model we examine a scenario where a buyer can purchase  $N$  identical properties from  $N$  queued sellers. We examine the

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scenario with respect to two bargaining processes, (i) where each contingent price must be agreed upon by buyer and seller, (ii) where the buyer has an additional option to execute a transaction at a predetermined price for a fee. Using the first mechanism, theory predicts, given equal bargaining weights, that sellers who are later in the queue will receive lower prices. Using the second mechanism, theory predicts that prices should be equal when sellers have equal bargaining weight. We experimentally test these predictions and find evidence that welfare is maximized in both treatments, and that price predictions in the second protocol align with the theory.

# 1 Introduction

Eminent domain (ED) is the right of the state to acquire property from a seller in exchange for just compensation. In the United States, the power of ED is provided through the takings clause of the 5th Amendment. The interpretation of this clause has largely been left to the judicial system. In 2005, ED was given a slightly new interpretation by the US Supreme Court's ruling on the Kelo vs. New London case. Prior to the decision, private companies could not obtain land via the takings clause. Kelo vs. New London shifted this interpretation so that private companies can use eminent domain for development if it can be shown that the project provides public benefits.

This decision has sparked interest in areas of the economic literature that have been dormant for some time. Land assembly is a problem where a buyer must assemble multiple inputs that are perfectly complementary in order to produce output. Failure to obtain one of these inputs prevents production. The Coase theorem suggests that negotiations in which both parties benefit should be successful in the absence of prohibitive transactions cost. Yet, in a private negotiation setting, many projects that are profitable to a developer may not be realized because of perceived or real difficulties in assembly. Assembly may involve prohibitively high transactions cost due to

the length of negotiations or due to private information, which is costly to discover credibly.

Property assembly can fall prey to holdup; later sellers can demand high prices for their properties that make the project unprofitable for a buyer, even though, a priori, there are positive gains from trade. ED is meant to overcome this problem of holdup. If a buyer has a valuation for the final output in excess of the sum of court determined prices and legal fees, the project may go forward regardless of the sellers' valuations. An alternative solution to the holdup problem is the use of contingent contracts or the use of refunds(Hawkins, 2011). Both of these solutions have unpleasant properties. In the case of ED, deals may occur when gains from trade are negative, and contingent contracts result in an inequitable distribution of surplus.

In this paper we consider a model where a buyer is tasked with purchasing  $N$  identical perfectly complementary goods from  $N$  queued sellers with exogenous ordering. We examine the scenario using two different mechanisms. In one scenario, contracted prices must be agreed upon between the buyer and each seller. However, these contracts are contingent on successful negotiation with all sellers. In the next protocol, if a buyer and seller are unable to agree on a contracted price, the buyer has the additional option to obtain

the property at a predetermined price (under eminent domain), but must incur a transaction cost to use this feature. We apply a sequential-Nash-bargaining solution(Moresi et al., 2008) to our model. Applied to the first mechanism, sequential Nash bargaining predicts that conditional on equal bargaining weights, sellers later in the queue obtain lower prices than those earlier in the queue. Applied to the second mechanism, the prediction is that all sellers obtain equal prices in equilibrium.

We test these predictions using a laboratory experiment. Our results show that when ED was available to the buyer, subject behavior aligned with the sequential Nash bargaining. However, when using contingent contracts, behavior of subjects in the laboratory was not consistent with sequential Nash bargaining.

Our experimental design utilizes a free-form negotiation between buyer and seller. This format allows us to observe how prices are determined between the buyer and each seller, as well as how these contracted prices compare to the theoretical predictions. We are also able to make direct comparisons of efficiency between contingent contracting and eminent domain. Furthermore, we are able examine the distribution of surplus between the buyer and each seller.

Our study contributes to several aspects of existing literature. First, we extend a model of sequential Nash bargaining (Moresi et al., 2008) to include features relevant to eminent domain. In our framework contracts made by each seller are contingent upon the completion of all contracts required for assembly. Because our modeling assumption relies on contingent contracts, our model's predictions differ substantially from papers that assume that previously negotiated contracts represent sunk costs, which typically find that many projects will never be started.<sup>1</sup> Our model and experimental design also contribute to the existing ED literature, which has tended to focus on rigid ultimatum-style bargaining (Swope and Schmitt, 2008). We instead allow for free form bargaining which may be a better analogue to the real world in many contexts.

## 2 Nash Bargaining

We consider two versions of the following bargaining scenario. A developer (buyer) must acquire property from a number ( $N$ ) of land owners (sellers) in order to go forward with a project. Each seller is queued exogenously and

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<sup>1</sup>An incomplete list: Heller, 1998; Buchannan and Yoon, 2001; Goswami et al., 2005.

the buyer negotiates sequentially with each seller. Negotiations between the buyer and the current seller must conclude before the buyer can move on to the next seller in the queue. If all the land is acquired, the developer receives the benefits of the project ( $V_B$ ) minus the sum of the purchase prices of the land. If a land owner sells his property he receives a transfer payment ( $P_i$ ) from the developer. If a land owner does not sell his property, he receives his use value of the land ( $V_s$ ). If and when the developer exercises eminent domain to acquire a parcel of land, the land owner receives a court-determined transfer payment ( $C$ ) from the developer, and the developer must pay court fees ( $F$ ). These values are all common knowledge. We assume that sellers have homogenous bargaining weights ( $\alpha$ ).

We apply a sequential-Nash-bargaining solution to the model outlined above to generate predictions. These predictions are outlined in the following subsections.

## **2.1 Sequential Bargaining with Contingent Contracting**

We begin by presenting the solution for the special case where  $N = 2$  to provide intuition for the generalized model. Due to the sequential nature of

the problem, we use backwards induction, solving for the last seller's contracted price, and then proceed to solve for the first seller's optimal price. We maximize the Nash product with respect to the current sellers contracted price in each step of the problem.

First we solve the following maximization problem for seller 2. The first term of the product captures the payoff to the buyer, who receives their value of the project minus the prices contracted with the sellers. If the negotiations fail, the buyer receives their outside option value of zero. Seller 2 receives their contracted price minus their value.

$$\arg \max_{P_2} (V_B - P_1 - P_2)^{(1-\alpha)} (P_2 - V_S)^\alpha$$

Maximizing the objective function with respect to seller 2's contracted price, the relevant first order condition is:

$$FOC : \frac{\alpha}{P_2 - V_S} - \frac{1 - \alpha}{V_B - P_1 - P_2} = 0$$

The value that satisfies this first order condition is then:

$$P_2^* = (1 - \alpha)V_S + \alpha(V_B - P_1)$$



The optimal price that seller 2 contracts is a function of the buyers bargaining power,  $(1 - \alpha)$ , the sellers value, the bargaining power of seller 2,  $\alpha$ , and the remaining surplus available to the buyer. For every dollar contracted to seller 1, the price contracted with seller 2 is reduced by  $\alpha$ . Note that in terms of the buyers surplus,  $(V_B - P_1 - P_2)$ , the buyer prefers to give an additional dollar to the earlier seller because it reduces the price contracted with the later seller, leaving more surplus for the buyer than when giving an additional dollar to seller 2.

Now that we have a value for the optimal  $P_2$ , we can solve for  $P_1^*$  by substituting  $P_2^*$  into Seller 1's maximization problem:

$$\arg \max_{P_1} V_B - P_1 - ((1 - \alpha)V_S + \alpha(V_B - P_1))^{(1-\alpha)}(P_1 - V_S)^\alpha$$

After rearranging, the problem simplifies to:

$$\arg \max_{P_1} (1 - \alpha)(V_B - P_1 - V_S)^{(1-\alpha)}(P_1 - V_S)^\alpha$$

Maximizing the problem with respect to Seller 1's contracted price yields the following first order condition :

$$FOC : \frac{\alpha}{P_1 - V_S} - \frac{1 - \alpha}{V_B - P_1 - V_S} = 0$$

The optimal value of  $P_1$  is then:

$$P_1^* = (1 - \alpha)V_S + \alpha(V_B - V_S)$$

Imagine now, for the sake of simplicity, that the values of  $V_B$ ,  $V_S$ , and  $\alpha$ , are as follows:

$$V_B = 1$$

$$V_S = 0$$

$$\alpha = .5$$

When we plug these values into the equations we get for  $P_1^*$  and  $P_2^*$ , we obtain the following optimal prices:

$$P_1^* = 1/2$$

$$P_2^* = 1/4$$

Note the higher contracted price for the seller positioned earlier in the bargaining queue. This result is driven by the aforementioned relationship between  $P_2^*$  and  $\alpha * P_1$ .

More generally, to find the Nash bargaining solution when  $N$  sellers bargain using contingent contracts, we solve the following maximization problem for the  $n^{th}$  seller:

$$\begin{aligned} & \arg \max_{P_n} (1 - \alpha) \ln[(1 - \alpha)^{(N-n)} (V_B - \sum_{i=1}^{n-1} P_i - P_n - \sum_{j=n+1}^N V_S)] \\ & + \alpha \ln[P_n - V_S] \end{aligned}$$

$$\begin{aligned}
FOC & : \frac{\alpha}{P_n - V_S} - \frac{(1 - \alpha)}{(V_B - \sum_i P_i - P_n - \sum_j V_S)} = 0 \\
P_n^* & = (1 - \alpha)V_S + \alpha(V_B - \sum_{i=1}^{n-1} P_i - \sum_{j=n+1}^N V_S)
\end{aligned}$$

Note that  $P_i$ 's must be at least as large as  $V_S$ , and as  $n$  increases,  $V_S$  terms are replaced by  $P_i$  terms. Therefore,  $P_n^*$  is weakly decreasing in  $n$ .<sup>2</sup> The intuition for the general case is analogous to the special  $N = 2$  case, discussed previously. Any surplus given to the earlier sellers reduces the amount of surplus available to split with subsequent sellers. Paying an earlier seller an extra dollar reduces the buyer's final payoff by less than a dollar. This creates a pecuniary externality that earlier sellers can exploit to secure higher prices for themselves.

This result is driven by the exogenously determined queue. If for example buyers and sellers could endogenously determine their ordering, this result would not hold. Furthermore, if contracts were not contingent, they could fall prey to the holdup problem.

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<sup>2</sup> $P_n^*$  is strictly decreasing in  $n$  when  $0 < \alpha < 1$  and  $V_B/N > V_S$ .

## 2.2 Sequential Bargaining with Eminent Domain

Again, we begin by presenting the solution for the special case where  $N = 2$  before generalizing to  $N$  sellers. When ED is available to the buyer, the developer can exercise this option if private negotiations stall. In this case the land owner receives a court-determined transfer payment,  $C$ , from the developer, and the developer must pay court fees,  $F$ .

Once again, due to the sequential nature of the bargaining, we solve the problem using backwards induction. We solve the following maximization problem for seller 2:

$$\begin{aligned} & \arg \max_{P_2} (V_B - P_1 - P_2 - (V_B - P_1 - C - F))^{(1-\alpha)} (P_2 - V_S - (C - V_S))^\alpha \\ & = \arg \max_{P_2} (-P_2 + C + F)^{(1-\alpha)} (P_2 - C)^\alpha \end{aligned}$$

Under ED, the outside option of the buyer and sellers change. If the property can not be acquired through private negotiations, it will be acquired through court proceedings, which is reflected in the threat point of both the buyer and the seller with the inclusion of the court award,  $C$ , and court fees,  $F$ . Maximizing with respect to seller 2's contracted price yields the following

first order condition:

$$FOC : \frac{\alpha}{P_2 - C} - \frac{1 - \alpha}{P_2 + C + F} = 0$$

The value that satisfies this first order condition is then:

$$P_2^* = C + \alpha F$$

Under ED, the property will be acquired either privately or in court, the buyer only has to pay the seller at least  $C$  to acquire the property and would like to avoid costly court fees  $F$ , which lead the buyer and seller to split the court fees according to their bargaining weights. Note that the optimal solution,  $P_2^*$ , is no longer a function of the previous seller's contracted price. Now that we have a value for  $P_2^*$ , we can solve for  $P_1^*$  using the following maximization problem:

$$\begin{aligned} & \arg \max_{P_1} (1 - \alpha) \ln(V_B - P_1 - (C + \alpha F)) - (V_B - C - F - (C + \alpha F)) \\ & + \alpha \ln(P_1 - V_S - (C - V_S)) \end{aligned}$$

This simplifies to:

$$\arg \max_{P_1} (1 - \alpha) \ln(-P_1 + C + F) + \alpha \ln(P_1 - C)$$

Our first order condition is then:

$$FOC : \frac{\alpha}{P_1 - C} - \frac{1 - \alpha}{P_1 + C + F} = 0$$

The optimal value of  $P_1$  is then:

$$P_1^* = C + \alpha F$$

We now assign values to  $V_B$ ,  $V_S$ , and  $\alpha$ , as follows:

$$V_B = 1$$

$$V_S = 0$$

$$\alpha = .5$$

$$C = 0$$

$$F = .5$$

Under ED, each seller's price is no longer a function of their position in the queue. Each seller is simply trying to capture as much of the court fee as possible. Under the parameterization, we derive the following optimal prices.

$$P_1^* = 1/4$$

$$P_2^* = 1/4$$

Generalizing to  $N$  sellers, to find the Nash Bargaining solution when the buyer has the option of ED, we solve the following maximization problem for the  $n^{th}$  seller:

$$\begin{aligned} & \arg \max_{P_n} [(V_B - \sum_{i=1}^{n-1} P_i - P_n - \sum_{j=n+1}^N (C + \alpha F)) \\ & - (V_B - \sum_{i=1}^{n-1} P_i - C - F - \sum_{j=n+1}^N (C + \alpha F))]^{(1-\alpha)} \\ & * [(P_n - V_S) - (C - V_S)]^\alpha \end{aligned}$$



$$\begin{aligned}
&= \arg \max_{P_n} (1 - \alpha) \ln[C + F - P_n] + \alpha \ln[P_n - C] \\
FOC &: \frac{\alpha}{P_n - C} - \frac{(1 - \alpha)}{(C + F - P_n)} = 0 \\
P_n^* &= C + \alpha F
\end{aligned}$$

The solution no longer depends on positioning in the queue or seller private valuations. Each seller faces the same set of choices, either negotiate a private offer or receive an award from the court valued at  $C$ . In order for a seller to accept, the buyer only has to offer slightly above the court assessed price. However, going to court causes the buyer to incur a legal fee of  $F$ . Each seller in line is negotiating to capture as much of  $F$  as possible. Because all sellers face this choice, the equilibrium prices are predicted to be equal when bargaining weights are equal and are independent of previously contracted prices. This result is generally robust to other features of the protocol, such as the contingency of contracts.

## 2.3 Hypotheses

Using the models presented above, we can derive the following testable hypotheses.

**Hypothesis 1:** Total welfare is maximized using either bargaining protocol.

**Hypothesis 2:** With contingent contracts, prices paid to sellers later in the queue will be lower than those paid to earlier sellers.

**Hypothesis 3:** With eminent domain, seller prices should not be correlated with seller position.

Hypothesis 1 is derived from the sequential Nash bargaining model when assuming there are gains from trade. Hypotheses 2 and 3 are derived assuming additionally that all agents have equal bargaining weight. The intuition for hypothesis 1 comes from the recognition that the threat points that come from potential outside options are just that, "threats" that upon successful bargaining should never be exercised. Intuition for hypothesis 2 and 3 come directly from the price predictions made in this section. In particular, for hypothesis 2, with contingent contracts we get:

$$P_n^* = (1 - \alpha)V_S + \alpha(V_B - \sum_{i=1}^{n-1} P_i - \sum_{j=n+1}^N V_S)$$

where  $P_i > V_S$  for all  $V_S$ . For hypothesis 3, with eminent domain we have:

$$P_n^* = C + \alpha F$$

where clearly  $P_n^*$  is not a function of  $n$ .

### 3 Experimental Design

For the experiment, we implement a multi-treatment design to test the hypotheses stated in the previous section. A multi-treatment design allows us to compare welfare results using the two different bargaining protocols. We can further compare price differences between sellers (within the same protocol) who are at varying positions in the queue. To this end, subjects were randomly assigned into groups of five, with one group member assigned the role of the buyer and the rest as sellers. If assigned the role of a seller, the subject was also assigned a position in the bargaining queue.

Nash bargaining does not specify the structure of bargaining, therefore we imposed no order in which sides must make offers and counter offers. For any active buyer-seller pair, either side could propose offers and counter offers until an agreement was reached. An agreement was made if both the buyer and the current seller agreed on the most recent proposal. Once an agreement was made with the first seller, negotiations proceeded to the next seller in the queue.

During the experiment sellers waiting in the queue were locked out of the negotiations and were asked to quietly read the school newspaper. The screen was only active between the buyer and the  $n^{th}$  seller. Contracted prices between the buyer and previous sellers were visible to the current seller. There were two treatments investigated: a no eminent domain (NED) treatment and an eminent domain (ED) treatment.

In the NED treatment, sellers were given the option to end negotiations. Ending negotiations, or walking away, voided all previous contingent contracts made between buyers and sellers. In this scenario, each seller obtained a payoff equal to their usage value and the buyer received a payoff of zero.

In the ED treatment, the option to acquire properties by force was available to the buyer. If this option was used, there was a set court-determined

price,  $C$ , as well as known legal fees,  $F$ . If the buyer decided to use eminent domain, only the current property was obtained through the ED process. The buyer received the property at a cost of  $C + F$  and the seller received  $C$ . This did not directly affect negotiations between the buyer and other sellers in the queue.

The experiment was parameterized as follows. Each buyer had a project value of \$50. In the NED treatment, each seller had a private use value for the property of \$4. In the ED treatment, the court award  $C$ , was set to be \$4, and the legal fees charged for the process were set at \$8.50. Given these parameters, neither treatment should have been prey to holdup, and in both treatments gains from trade were available. Furthermore, the "walk away" payoff for each subject was the same as if eminent domain were exercised on all sellers. In this way the outside options were comparable though not identical.

Subjects were students from the University of Arizona who were recruited from the Economics Science Laboratory database. We implement the experiment using computers running zTree experimental software. We held six sessions of 15-20 subjects each; three to run the contingent contract, NED treatment, three to run the ED treatment. We had 12 groups of 5 subjects

each in the NED treatment and 11 groups of 5 subjects each in the ED, totaling 23 groups (115 subjects). Subjects were awarded a five dollar show up fee in addition to their earnings in the experiment. Subjects were unable to identify the other members of their group. After being seated, subjects were given time to read over the instructions, which were then read aloud by an experimenter. Once assigned to groups, the subjects played the bargaining game a single time. Subjects made just under \$15 on average in both treatments including show-up fees.

## 4 Experimental Results

Overall, our results are mixed. On the one hand, efficiency is generally high in both treatments and there is little variation in the prices received by sellers in the ED treatment, as predicted. On the other hand, we find no evidence that seller prices are negatively correlated with position in the queue in the NED treatment. We more closely examine each hypothesis in the following sections. We also look at results dealing with empirical bargaining weights as an alternative to our price analysis, so that we may test more direct assumptions on the primitives of the bargaining model.

## 4.1 Hypothesis 1

Our first hypothesis is that welfare is maximized and should be the same in each treatment. Only one group out of twelve (8.3%) failed to reach a deal in the NED treatment, and in the ED treatment, ED was only used to collect 3 of the 44 properties (6.8%). Indeed, we find that the relative efficiency of the two protocols is very similar (91.7% vs. 93.2%). In this sense, the theory is supported in that both treatments had statistically identical levels of efficiency. Furthermore, we note that despite not aligning perfectly with theory, results of over 90% efficiency seem pretty good, especially for the laboratory setting. It should therefore be noted that Hypothesis 1 actually does rather well.

## 4.2 Hypotheses 2 and 3

Hypotheses two and three examine the relationship between seller position in the queue and treatment status. In the NED treatment, sellers who bargain later in the queue should receive lower prices. In the ED treatment; prices should be equal throughout the queue.

In the NED treatment, there is a great deal of variation in the observed data, while in the ED treatment, prices range over a smaller set of values.

The first seller in the NED treatment obtained an average price of \$6.88, with the maximum price received equal to \$16 and the minimum equal to \$2.50. Sellers later in the queue averaged between \$7.50 and \$8.75. This is in contrast to our stated hypothesis that later sellers would earn less than the first seller. In the ED treatment, the first seller also averaged \$6.88, with the prices ranging from \$3.50 - \$12. Figure 1 and Table 2 summarize the observed prices by seller position for each treatment. Figure 1 also includes theoretical price predictions of our model given equal bargaining weights.

Because we do not see a downward trend in the prices, we turned to a series of pair wise comparisons of the prices by seller position. We perform a Mann-Whitney test on the prices by seller position within each treatment. In the NED treatment we find no evidence of differences in the observed prices by seller position. The full results are displayed in Table 3. The table also shows the pair wise comparisons for the ED treatment. The ED model predicts that all sellers obtain the same price. Our results show that there are no significant differences for adjacent sellers; however, there are statistical differences between Seller 1 and Seller 4, as well as Seller 2 and Seller 4 (at the 10% level).<sup>3</sup>

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<sup>3</sup>We find no evidence of decreasing prices in the NED treatment using a Jonckheere-Terpstra test. In the ED treatment, we find evidence of increasing prices, rejecting the



### 4.3 Empirical Bargaining Weight

The assumption of equal bargaining weights for all subjects is a rather strong one. If we look at the one primitive of the theory that is not induced by experimental design (bargaining weight), and assume that all subjects bargaining weights are drawn from the same normal distribution, an error structure becomes available.

In this subsection we assume that the bargaining weights of agents are drawn from the same (normal) distribution. We need make no assumptions about beliefs about other sellers' bargaining weights as future sellers' bargaining weights have no impact on  $P_n^*$ . We show this using the following maximization problem for the  $n^{th}$  seller.

$$\begin{aligned} & \arg \max_{P_n} (1 - \alpha_n) \ln \left[ \left( \prod_{h=n+1}^N (1 - \alpha_h) \right) (V_B - \sum_{i=1}^{n-1} P_i - P_n - \sum_{j=n+1}^N V_S) \right] \\ & + \alpha_{N-1} \ln [P_{N-1} - V_S] \end{aligned}$$

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null of flat prices at the 5% level.

$$\begin{aligned}
FOC & : \frac{\alpha_n}{P_n - V_S} - \frac{(1 - \alpha_n) \left( \prod_{h=n+1}^N (1 - \alpha_h) \right)}{\left( \prod_{h=n+1}^N (1 - \alpha_h) \right) (V_B - \sum_i P_i - P_n - \sum_j V_S)} = 0 \\
P_n^* & = (1 - \alpha_n)V_S + \alpha_n \left( V_B - \sum_{i=1}^{n-1} P_i - \sum_{j=n+1}^N V_S \right)
\end{aligned}$$

We use this result, as well as the observed prices and experimental parameters to back out empirical bargaining weights (summarized in Table 4). We then use these empirical bargaining weights to construct pair-wise comparisons between sellers using the Mann-Whitney Test.

Table 5 summarizes the comparisons. We find that in the NED treatment, we must reject that the data generating process is from the same distribution for Sellers 1 and 3 and Sellers 1 and 4.<sup>4</sup> In the ED treatment we must also reject the assumption, as we find significant differences between Sellers 2 and 4 and Sellers 1 and 4.

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<sup>4</sup>Although it seems the majority of the sellers in the NED treatment did not behave according to the theory, chat logs show that at least one subject understood the position he was in. This particular chat log is presented as an appendix.

## 5 Conclusions

We solve a sequential Nash bargaining model of the assembly of multiple identical perfectly-complimentary goods from queued sellers. We show that, with contingent contracting, the surplus captured by sellers should be decreasing in their queued order. This result shows that the hold-up problem should theoretically be mitigated using contingent contracts. It also stands conventional anti-commons intuition on its head in that later sellers not only lose their bargaining advantage but are in fact disadvantaged by their position. With eminent domain, we show that prices are constant across sellers and are, importantly, not based on seller value. This result appears in most models of eminent domain, but is still interesting because, while goods are assumed to be identical, the queue order creates a heterogeneity among sellers making intuition non-trivial.

When we test these results in an experimental setting, we find interesting deviations from both theory and intuition. The eminent domain results fit the theory adequately, though there may be a slightly upward trend in prices. Meanwhile, results from the contingent contracting treatment were notable. Theory predicts declining prices while intuition might suggest increasing prices. Instead, prices were rather flat. Evidence suggests that these

deviations may result from certain behavioral factors including bounded rationality and other-regarding preferences. Since our design is not specifically tailored to distinguish between these various factors, additional experimental study would likely be fruitful.

We also find that there does not seem to be a significant difference between using eminent domain and contingent contracting in our setting. Neither treatment fell pray to potential hold-up problems and both resulted in similar average price vectors. This is significant in that it suggests that, when sufficient gains from trade exist and buyers and sellers can contract contingent prices, eminent domain may not be necessary. That said, it remains to be seen what differences may arise in other settings, particularly when there are little or even negative gains from trade. This again suggests that additional experimentation could be helpful.

Given the debate surrounding eminent domain policies in recent years, it is important to gain a better understanding of bargaining behavior under an eminent domain regime. It is equally important to gain a better understanding of bargaining behavior under an alternative like contingent contracting. Our results provide insight into behavior in both cases, and suggest that sequential Nash theory may not capture all important aspects of bargaining

behavior.

## A Appendix (Tables and Figures)

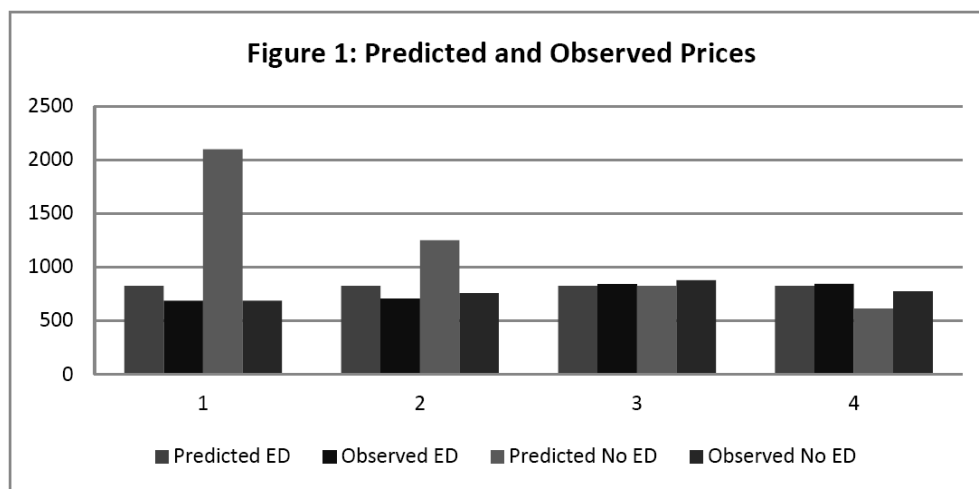


Table 2 - Prices

	NED		ED	
	Price	Std. Dev.	Price	Std. Dev.
Seller 1	6.88	(4.34)	6.88	(2.91)
Seller 2	7.57	(3.39)	7.04	(2.27)
Seller 3	8.75	(3.61)	8.41	(2.03)
Seller 4	7.75	(2.72)	8.43	(2.23)

Table 3 - Within Treatment Price Comparison

	NED		ED	
	MW Stat	P Value	MW Stat	P Value
Seller 1 vs 2	-0.658	0.511	-0.417	0.677
Seller 1 vs 3	-1.316	0.188	-1.248	0.212
Seller 1 vs 4	-0.888	0.375	-1.649	0.099
Seller 2 vs 3	-0.363	0.717	-1.238	0.216
Seller 2 vs 4	-0.066	0.948	-1.671	0.095
Seller 3 vs 4	0.560	0.576	-0.725	0.469

Table 4 - Bargaining Weights

	NED		ED	
	Weight	Std. Dev.	Weight	Std. Dev.
Seller 1	0.092	(0.131)	0.339	(0.343)
Seller 2	0.138	(0.114)	0.358	(0.267)
Seller 3	0.221	(0.187)	0.519	(0.239)
Seller 4	0.220	(0.153)	0.522	(0.263)

Table 5 - Within Treatment Bargaining Weight Comparison

	NED		ED	
	MW Stat	P Value	MW Stat	P Value
Seller 1 vs 2	-1.149	0.251	-0.417	0.677
Seller 1 vs 3	-1.806	0.071	-1.248	0.212
Seller 1 vs 4	-2.003	0.045	-1.649	0.099
Seller 2 vs 3	-0.952	0.341	-1.238	0.216
Seller 2 vs 4	-1.248	0.212	-1.671	0.095
Seller 3 vs 4	-0.164	0.870	-0.725	0.469

## B Appendix (Chat Log)

Here we present a chat log between a buyer and a seller. The chat log is atypical, but it evidences a rare situation where the seller seems to catch on to the intuition underlying our theoretical predictions in the NED treatment.

**Buyer:** thats so ridiculously high

**Seller:** not really. you see if I walk you get nothing and every other seller gets 400. so all seller 4 needs is to get just over 400 to make it worth their while. you have 2650 left, so if you were to give them 450 to make them happy, that leaves me with 2200

**Buyer:** there is no advantage for me in this then. I would make 0 profit

**Seller:** you make 0 profit if i walk though also

**Buyer:** ok so its a lose-lose for me is what youre trying to say.

**Seller:** pretty much, unfortunately you dont have much control in this one

**Seller:** but ill make you a deal, ill give you the same deal i would get if i walked, 400 profit after you give #4 450, so make it 1800 and you get a profit

**Buyer:** how about I give you 450

**Seller:** that gives me 1800, seller 4 450, and you 400, everyone wins

**Buyer:** who says seller 4 will take 450?

**Seller:** cause its better for them then walking and taking 400

**Buyer:** 1600 and ill bargain with 4. I know its better for you if i accept your deal than chosing to walk away

**Seller:** 4 is the last seller, they have no bargaining power, they will take



what they can get as long as it is better than if they walk, I have all the power here, as egotistical as that sounds. I still have bargaining room, neither of you do.

**Seller:** i will do 1750, that is my final answer, you and seller 4 get 450 each, they wont complain, and if they do, well then, you are at the same place as if i walk now anyways

**Buyer:** so you are benefiting the most here. After talking with you, I dont think I want you profiting the most here

**Seller:** all you have to do is explain that 450 is all you will part with and that it is better than the 400 they will get if they walk

**Buyer:** I dont want to trust that they will accept, because i doubt they will

**Buyer:** 1700. How about we all try to walk away with some money

**Seller:** deal

## C Appendix (Instructions)

NED treatment instructions:

This is a bargaining experiment. You will have up to 30 minutes to

bargain with other players. The entire experiment will take place through computer terminals. It is important that you do not talk or in any way try to communicate with other subjects during the experiment. Also be sure to read through these instructions carefully.

### **The Situation**

A buyer is tasked with purchasing plots of land from sellers for a project. The value of the project to the buyer, if completed, is 5000 cents. In order for the project to be completed, the buyer must purchase one plot from each seller.

### **The Bargaining**

Each participant in the experiment will be randomly assigned to the role of either the buyer, or a seller. Participants can then bargain over the prices of the four plots of land. The bargaining will take place between the buyer and one seller at a time. Seller 1 will go first. The buyer and seller 1 can bargain over price to be paid for plot 1. If and when an agreement is reached, bargaining will commence between seller 2 and the buyer, bargaining will proceed until an agreement is made with each seller. If a deal is reached between the buyer and each seller, payoffs are as follows:

Seller 1 gets Price 1.

Seller 2 gets Price 2.

Seller 3 gets Price 3.

Seller 4 gets Price 4.

The buyer gets  $5000 - \text{Price 1} - \text{Price 2} - \text{Price 3} - \text{Price 4}$ .

### **Walking Away**

The sellers each have an additional option which allows each of them to end negotiations while they are bargaining. A seller can click the “Walk Away” button and all previously agreed on prices will be voided, and negotiations will end. If this occurs, payoffs are as follows:

Each seller gets 400 cents

The buyer gets nothing.

### **The Computer Interface**

The interface for all players is very similar. On the left half of the screen there is chat box that allows you to communicate with your current bargaining partner. The right half of the screen is divided into two boxes: In the upper right hand corner participants can propose prices for consideration, and in the lower right hand corner participants can review and accept the most recent proposal. Only the most recent proposal can be reviewed and accepted. Participants are encouraged to discuss a potential deal in the chat

box before (and after) submitting it for review. Deals accepted by the buyer and prior sellers can also be viewed in the bottom right box. Note: if you are a seller and it is not your turn to bargain, your screen will be blank, please wait patiently for your turn, and for those after you.

### **Waiting in the Queue**

While you are waiting, feel free to read the Arizona Daily Wildcat, but please keep an eye on your screen. The use of portable devices such as cell phones or mp3 players is prohibited.

ED treatment instructions:

This is a bargaining experiment. You will have up to 30 minutes to bargain with other players. The entire experiment will take place through computer terminals. It is important that you do not talk or in any way try to communicate with other subjects during the experiment. Also be sure to read through these instructions carefully.

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Seller 4 gets Price 4.

The buyer gets  $5000 - \text{Price 1} - \text{Price 2} - \text{Price 3} - \text{Price 4}$ .

### **Take by Force**

The buyer has an option which allows him or her to bypass the bargaining process. He or she can click the “ED” button and force a specific deal on the current seller. The deal is as follows: the seller gets 400 cents from the buyer and the buyer gets the land (bargaining moves on to the next seller), but the

buyer also must pay a fee for using this option of 850 cents (each time it is used). If (for example) “Take by Force” was exercised on sellers 2 and 4, the final payouts would be as follows:

Seller 1 gets Price 1.

Seller 2 gets 400 cents

Seller 3 gets Price 3.

Seller 4 gets 400 cents

Buyer gets  $5000 - \text{Price 1} - 400 - 850 \text{ (fee)} - \text{Price 3} - 400 - 850 \text{ (fee)}$ .

### **The Computer Interface**

The interface for all players is very similar. On the left half of the screen there is chat box that allows you to communicate with your current bargaining partner. The right half of the screen is divided into two boxes: In the upper right hand corner participants can propose prices for consideration, and in the lower right hand corner participants can review and accept the most recent proposal. Only the most recent proposal can be reviewed and accepted. Participants are encouraged to discuss a potential deal in the chat box before (and after) submitting it for review. Deals accepted by the buyer and prior sellers can also be viewed in the bottom right box. Note: if you are a seller and it is not your turn to bargain, your screen will be blank, please

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