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# The holdout problem and urban sprawl: Experimental evidence

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ABSTRACT

Conventional wisdom as well as economic theory suggests it is more costly to reassemble fragmented land due to transactions costs and strategic bargaining costs. Both costs are expected to increase with the number of sellers. Inefficient allocation of land resources may result including property entropy (Parisi, 2002), urban sprawl (Miceli and Sirmans, 2007) and deteriorating inner cities. Given the difficulty of observing actual values attached by buyers and sellers to land, little empirical evidence exists to support the conventional wisdom and theoretical work. We use experimental methods to examine transactions costs and strategic bargaining costs in a land-assembly market game with one buyer, 1–4 sellers, and complementary exchanges. The buyer's final earnings vary inversely with the number of sellers, *ceteris paribus*, indicating an incentive to purchase consolidated land. Delay costs reduce holdout, but result in lower payoffs for both buyers and sellers. Competition between sellers reduces holdout and the buyer's total purchase price.

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## 1. Introduction

Land-assembly problems arise when multiple adjacent parcels must be acquired by a developer to complete an indivisible project. The potential exists for individual landholders to refuse to negotiate initially, strategically delay agreement, or increase their demands, in an attempt to capture a greater share of the total surplus created by an exchange. Because of potential inefficiencies from delay costs and failed land exchanges, land assembly and the "holdout problem" have received considerable attention (e.g. Eckart, 1985; O'Flaherty, 1994; Strange, 1995; Menezes and Pitchford, 2004a,b; Miceli and Segerson, 2007). The land-assembly problem has been framed in property theory and law as the "anticommons" dilemma (Michelman et al., 1982; Heller, 1998; Vanneste et al., 2006), which refers to the case when multiple owners of a resource each have the power of exclusion, making it difficult for anyone to establish the "full ownership" over a "bundle of rights" necessary for productive use of the resource. Conventional wisdom and the theoretical work on land assembly and anticommons suggest it is more costly to reassemble fragmented land due to transactions costs and strategic bargaining costs. Furthermore, assembly costs and the probability of failed agreements are expected to increase with the number of sellers (Eckart, 1985; Strange, 1995). Inefficient allocation of land resources may result including property entropy (Parisi, 2002), urban sprawl (Miceli and Sirmans, 2007) and deteriorating inner cities. The holdout problem has been cited as a potential justification for eminent domain[1] (Miceli and Sirmans, 2007; Nosal, 2007). Holdout problems may exist in other contexts as well, including wage negotiations (Houba and Bolt, 2000; van Ours, 1999; Gu and Kuhn, 1998; Cramton and Tracy, 1992), debt restructuring (Miller and Thomas, 2006; Hege, 2003; Datta and Iskandar-Datta, 1995; Brown, 1989), and corporate takeovers (Cohen, 1991).

Because of the inherent difficulty in observing landowners' reservation prices and the value a developer places on a development project, studies of land assembly and the holdout problem have been almost exclusively theoretical in nature. Our research provides empirical insight into the holdout problem through a laboratory bargaining experiment modeled after a land-assembly game. Two other experimental approaches are presented in Tanaka (2007) and Cadigan et al. (2009).

Tanaka (2007) uses laboratory experiments to compare the efficiency of alternative market institutions for consolidating fragmented land. Importantly, in contrast to subjects in our experiment, all subjects in the Tanaka experiments are initially landowners and may subsequently be buyers or sellers of land.

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[1] Eminent domain refers to the legal power of the state to expropriate property without the owner's consent. Eminent domain may also be called compulsory purchase, compulsory acquisition, or expropriation.

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Although focused on comparing the efficiency of alternative market mechanisms and not holdout or bargaining behavior per se, Tanaka reports strategic holdout behavior in one of his treatments, a two-sided combinatorial market with a small number of subjects and commodities.

Cadigan et al. (2009) examine the holdout problem through six experimental bargaining treatments that vary the bargaining institution (whether buyers or sellers make the offers), the number of bargaining periods, and the costs associated with delay. The results demonstrate that holdout is common across treatments and is, on average, a payoff-improving strategy for responders. Delay costs led to more generous buyer offers and seller demands, and less overall holdout. The availability of more bargaining periods led to more aggressive initial bargaining stances by buyers and sellers (that is, lower offers by buyers and higher demands by sellers), both with and without delay costs. Importantly, they found that nearly all exchanges eventually occurred in the repeated-offer treatments, leading to a relatively high level of overall efficiency, both with and without delay costs.

All of the treatments in Cadigan et al. (2009), however, involved just two sellers. The focus in the Cadigan et al. (2009) study was on how bargainers respond to an increase in the potential bargaining period and an increase in the cost of bargaining delay. The focus in the current paper is on the important issue of how an increase in the number of sellers affects proposals (particularly the joint offer made by the buyer and the collective demands made by sellers) and the likelihood of failed agreements, both with and without competition between sellers. We also gain important insight into how and why increasing the number of sellers affects the buyer's final expected earnings. If an increase in the number of sellers, *ceteris paribus*, decreases the buyer's payoff because of transactions costs and strategic bargaining costs (as we find it does), then potential developers may have an incentive *ex ante* to seek consolidated land for development even if the total economic surplus from such projects is smaller than that of a projects assembling more fragmented land. This bias for consolidated land may lead to inefficient land allocation and associated costs from urban sprawl, as land tends to be more fragmented near city centers (Henderson, 1985). Thus, understanding the land developer's investment decisions improves our understanding of how market forces impact the development of cities. It also helps explain developments in real estate law (such as undisclosed buyer provisions) and the challenges facing urban planners concerned with the efficient spatial organization of cities.

To this end we examine bargaining treatments with 1–4 sellers. We maintain the same institutional framework as Cadigan et al. (2009) by using a repeated-offer bargaining game, where the buyer makes take-it-or-leave-it offers to buy in half of the treatments, and the sellers make take-it-or-leave-it demands to sell in the others. Of the 10 total treatments, four have costless delay and six have costly delay.

It is important to empirically investigate the impact of competition and the number of sellers on holdout, efficiency, and the distribution of the economic surplus. Most land-assembly models associate holdout and delay with efficiency losses because players are assumed to discount future payoffs. Others, such as Strange (1995) and Eckart (1985), find in their models that increasing the number of landowners (by reducing the size of individual landholdings) increases the total asking price of landowners, resulting in a higher probability of failed agreements. While this may be consistent with common perceptions of small landholders holding up large development projects, the impact has yet to be empirically demonstrated or quantified, and the potential justification for using eminent domain rests largely on the severity of the holdout problem. Competition between landowners, on the other hand, should result in lower landowner asking prices, therefore largely mitigating potential holdout and anticommons problems. Competition between landowners may arise when a project is divisible, or because the developer has good alternative development locations.

As in Cadigan et al. (2009), we find that holding out is a payoff-improving strategy, on average, in each of the treatments studied. That is, responders' average final earnings were higher, in every case, than if responders had accepted every initial offer, even in the presence of costly delay. However, the Cadigan et al. (2009) experiments all involved just two sellers from whom consent was required. We demonstrate here that the introduction of extraneous sellers (e.g. more sellers than are needed to complete the project) in our competition treatments increases the speed at which agreements take place, thereby increasing efficiency. Qualitatively consistent with equilibrium predictions, the presence of extraneous sellers also serves to increase the bargaining payoff of buyers relative to sellers, particularly when *sellers* make take-it-or-leave-it demands to the buyer. However, increasing the number of required consenting sellers, *ceteris paribus*, results in significantly greater delay, more failed agreements, and lower overall efficiency. The increase in the deadweight loss here appears to come primarily from the buyer's share of the surplus. The bargaining institution (that is, which side is making the offers) affects the distribution of the surplus, but has very little effect on the efficiency of exchange.

In Section 2 we present the basic model that motivates the experimental design, and we provide equilibrium game-theoretic predictions. Section 3 describes the experimental treatments. Experimental results are given in Section 4. Section 5 presents an alternative behavioral model to explain the results. Section 6 concludes.

## 2. Modeling framework and equilibrium predictions

### 2.1. Modeling framework

Following Menezes and Pitchford (2004b), Miceli and Segerson (2007), and Cadigan et al. (2009) consider a simple model in which a single risk-neutral agent (the "buyer") wishes to purchase $N$ complementary units of a good from $N$ other independent, risk-neutral agents (the "sellers"). The units can be interpreted as intermediate inputs into the production of a large project. Each seller $i$ has one unit for sale and incurs a cost $c_i$ for this unit. The value of the project to the buyer is $V$ if $N$ input units can be acquired, but is zero otherwise. Let the buyer's valuation and the sellers' costs be such that

$$\sum_{i=1}^{N} c_i < V \tag{1}$$

indicating that there is an economic surplus generated by the project.

If $N$ input units can be acquired, the payoff to the buyer is

$$\left(V - \sum_{i=1}^{N} p_i\right) \tag{2}$$

where $p_i$ is the price paid for unit $i$, and each seller $i$ receives a payoff $(p_i - c_i)$. We assume that the buyer is able to write contingent contracts such that all parties receive a payoff of zero if any of the required input units are not purchased.

To examine holdout, we allow bargaining over several periods. Delay is costly such that payoffs are reduced by a factor $\delta$ (where $0 \leqslant \delta \leqslant 1$) for each additional period, on average, needed for agreements to be reached. For example, payoffs would be reduced by $\delta$ if all agreements were reached in the second period, reduced by $2\delta$ if