Cunningham, Chris

Working Paper

Estimating the holdout problem in land assembly

Working Paper, No. 2013-19

Provided in Cooperation with:
Federal Reserve Bank of Atlanta

Suggested Citation: Cunningham, Chris (2013) : Estimating the holdout problem in land assembly, Working Paper, No. 2013-19, Federal Reserve Bank of Atlanta, Atlanta, GA

This Version is available at:
https://hdl.handle.net/10419/101014

FEDERAL RESERVE BANK *of* ATLANTA **WORKING PAPER SERIES**

Estimating the Holdout Problem in Land Assembly

Chris Cunningham

Working Paper 2013-19
December 2013

Abstract: The Supreme Court's recent decision in *Kelo v. New London* allows the use of eminent domain to facilitate private economic development. While the court's condition for allowing takings was highly expansive, there may be a market failure that warrants state intervention when parcels of land need to be combined for redevelopment. The collective action or strategic holdout problem associated with land assembly may limit redevelopment of older communities when one or more existing owners seek to capture a disproportionate share of the potential surplus. The problem may be compounded by landowners' uncertainty as to the true value of the expected surplus to be divided (Eckart, 1985; Strange, 1995). At the same time, developers may attempt to disguise the assemblage through the use of straw purchasers. This paper employs administrative Geographic Information System and assessor data from Seattle, Washington, to identify lots that were ultimately assembled. The paper then matches them to their pre-assembly sales. Controlling for lot and existing structure characteristics and census tract-year fixed effects, I find that land bought in the process of a successful assembly commands an 18 percent premium. Consistent with theory, this premium falls with a parcel's relative size in the assemblage. I also find some evidence that parcels toward the center of the development may command a larger premium than those at the edge, suggesting that developers retain or are perceived to retain some design flexibility.

JEL classification: H8, R5

Key words: holdouts, land assembly, ultimatum game

The author thanks Julia Koschinsky for providing him with data, and he also thanks Chris Jansen of the King County Department of Development and Environmental Services. He also thanks seminar attendees at Georgia State and the meetings of the American Real Estate and Urban Economics Association and the North American Regional Science Council. The views expressed here are the author's and not necessarily those of the Federal Reserve Bank of Atlanta or the Federal Reserve System. Any remaining errors are the author's responsibility.

Please address questions regarding content to Chris Cunningham, Research Department, Federal Reserve Bank of Atlanta, 1000 Peachtree Street, N.E., Atlanta, GA 30309, chris.cunningham@atl.frb.org.

I. INTRODUCTION

The Supreme Court's recent decision in Kelo vs. New London recognized broad powers of eminent domain in the name of economic development. The Court's condition for takings was highly expansive, effectively stating that public benefit in the eyes of the state was sufficient. Still, there may be a market failure that justifies state intervention to facilitate private development. Specifically, a collective action problem may exist that raises the cost of assembling larger parcels for redevelopment. Larger parcels may be required to accommodate high rise construction technology or to capture sufficient positive spillovers from the redevelopment (Strange, 1992). Raising the cost of land assembly may slow redevelopment or induce urban sprawl by driving new development to green field sites at the urban edge (Miceli and Sirmans, 2006). The assembly premium confronting developers may be compounded by uncertainty about the direction of future land prices and the ultimate surplus to be generated from redevelopment (Eckart, 1985; Strange, 1995).

While there is a compelling theoretical case for a holdout problem, there has been limited empirical investigation to date. Existing landowners may find it costly to monitor adjoining sales or developer behavior. Firms attempting to assemble parcels may hide their intentions by employing straw purchasers or employing front companies when negotiating purchases. Even if one observed a premium for land sold as part of an assembly, this might not be evidence of strategic behavior on the part of the seller but instead of the cost of overcoming the idiosyncratic attachment of individual owners to particular properties, or unobserved spatial heterogeneity that raise the value of land in a particular area but also increases its propensity for redevelopment.

Employing two vintages of an administrative GIS file of parcel boundaries in Seattle, I am able to identify parcels that were assembled in the process of building a new structure between 2002

and 2007. I incorporate these instances of assembly, or "plottage", along with select features of the newly assembly parcel, such as number of constituent parcels, the sold parcel's relative size and its location within the assemblage into a conventional hedonic regression.

I find that properties sold before an assemblage command a statistically significant and economical large premium of 13 dollars per square foot, a seventeen percent premium relative to non-assembled land sold in the same census tract. This finding is robust to inclusion a rich set of control variables for time and space. Consistent with the game theoretic literature, the premium decreases with an individual parcel's share of the total assemblage. Finally, parcels at the center of ultimate assembly may command higher premiums than do parcels at the edge, suggesting that developers retain, or at least are able to convince would-be holdouts that they can build around a holdout. I briefly review the existing theoretical work and limited empirical literature below. I describe, in some detail, how I construct the dataset in Section III and present the econometric specifications and results in Section IV. There is a brief conclusion.

II. THEORETICAL FRAMEWORK

Eckart (1985) develops a game-theoretic model of land assembly with uncertainty, in which a would-be developer requires a fixed amount of land currently in the possession of *n* landowners. The developer will accept any bids for which the weighted average of all individual bids yields a non-negative profit. The developer knows the ultimate expected return from the assemblage, but, critically, landowners do not. The developer makes an initial offer on the lots and the existing owners respond based on their uncertain belief of the developers' payoff. The landowners, in attempting to maximize their expected payoff, must balance the higher price of their own counter

offer against the possibility that the weighted average price of all landowners exceeds the developer's maximum price and the assemblage is abandoned.

There are several key insights from solving for the possible Nash equilibria. First, smaller landowners will engage in more aggressive pricing because the impact of their own price on the weighted average price confronting the developer is smaller and thus the probability that the developer walks away is lower. As a corollary, the average price paid should rise with the number of landowners, and as Eckart (1985) also shows, if landowners collude they will actually demand a lower price because all owners now internalize the externality of a failed assembly. Strange (1995) keeps the same basic setup but builds on Eckart's paper by modeling landowners' conjecture of developers' payoffs as a form of Bayesian updating. However, except in the case when landowner prices are strategic complements and the largest landowner thus has an incentive to accept a first round offer in order to become a price leader, developer bids are not, in the end informative. Thus, Strange (1995) largely validates the predictions of Eckart (1985). Both papers note that increasing ask price of landowners as the number of landowners rises also increases the probability that the developer abandons a project that is inefficient. Miceli and Simans (2006) show that assemblage premium will drive developers to larger tracts of land at urban edge.[1]

Both Eckart (1985) and Strange (1995) impose a number of assumptions on their models that make the analysis tractable but may not reflect actual developer behavior. First, they assume that developers conduct all their negotiation simultaneously. If the developer bought each lot

[1] The reader should also note that findings in the nascent empirical literature on the "zoning tax" (Glaeser, Gyourko, Saks, 2005 and Chueng and Illanfeldt, 2007) are identified off the intensive and extensive marginal value of land. The difference between the consumption value of land (estimated from a hedonic house price regression that includes lot size) and the value of land that includes the right to build (sales price less structure value) is attributed to the regulatory barriers to obtain an additional building permit. The premise is that in the absence of zoning and other regulations, existing lots would be cleared and re-subdivided into ever smaller lots or eventually multifamily structures as land prices rise. However, if there is a holdout problem, it too might generate stasis in housing density in the face of rising land price.

sequentially, the developer's bargaining position would weaken with each successive deal as the loss from a failure to complete the deal rises. However, this assumption, in turn is necessitated by the developer's specified indivisible demand function for land. Developers may credibly threaten to build around a particular holdout and assemble only a subset of the ultimate lot. Indeed, the underlying developer profit function, whether or not observed by landowners, is not incorporated into the nascent theoretical holdout literature. If a developer is attempting to capture some of the positive externality from redevelopment (Strange 1992), then she may only require a sufficient density of surrounding parcels. Even if the assembly is driven by the engineering costs of a particular structure, there is, presumably a price at which a less efficient structure would be profitable. For example, a square is an efficient way to enclose a given area. However, a developer could still choose to build an "L" shaped structure and reject a particularly high counter offer. On the other hand, developers may simply be able to mask their assembly by using intermediaries.

Two empirical papers have specifically attempted to estimate the size of the holdout problem empirically. Using a dataset from Hong Kong, Fu, McMillen and Somerville (2006) find evidence generally consistent with the presence of a holdout problem as predicted by Eckart (1985) and Strange (1995). However, they do not find that sales occur simultaneously as assumed in the theoretical work and the last parcel sold, ostensibly a holdout, commands a significant premium. Brooks and Lutz (2011) use a dataset covering 11 years of property records in Los Angeles. They find that parcels subject to assemble command a large premium of 35 to 60 percent. This paper seeks expand this nascent literature by testing three hypotheses related to the holdout problem. First, the price for all lots subject to a successful assemblage should command a premium relative to other sales. Second, the premium is larger for relatively smaller parcels within the assemblage. Finally, the holdout premium is highest for parcels at the center of the planned assemblage.

III. DATA

The dataset is drawn from properties and sales in Seattle, Washington. The city is well suited to the study of redevelopment as it has experienced a rapid increase in land prices. Existing housing and commercial properties, build when land was relatively affordable, may no longer be of optimal size. At the same time, in an attempt to curb rural development and to deter automobile dependence, the county and city governments have passed growth management legislation to facilitate the densification of existing urban areas (Cunningham, 2006) by reducing zoning limits in designated urban areas. Thus, the relative underutilization of land in its current state, combined with modestly accommodative regulatory environment, generated considerable redevelopment activity; some of which necessitated land assembly. The summary statistics for the assembled parcels and the dependent and independent variables used in the hedonic analysis are presented in Tables 1 and 2 and described below.

Identifying assembled parcels

Assembled parcels are identified in two ways, both employing a series of GIS algorithms to screen for likely candidates. Assessor files of all real property in King County, Washington are linked to a GIS file of all parcel boundaries.[2] For the city of Seattle only, I obtained a file of building footprints in 2007. From this footprint file I then filtered out any garages, porches or ancillary structures that might be owned jointly or built in the absence of a formal lot line adjustment. To ensure that I am not generating a false positive from mis-drawn lot lines or building footprints I create a negative buffer 10 feet inside the actual building walls and lay these images over a 2002 vintage parcel file. In doing this, I locate over three thousand structures that straddle at least

[2] This file is maintained and made available for sale by King County GIS.

one lot line. However, most of these parcels were assembled in the distant past. Indeed, many appear to have been combined at the original date of platting. To identify new assemblages, I limit the analysis to parcels that were sold no more than two years before the year of construction and that were not sold by the same individual.

However, in some cases, assembly is required even if the structure does not actual occupy multiple lots. For example, parcel a developer may wish to construct two towers with a shared court yard. To account for this, I isolate instances of formal lot mergers. That is, by laying an early 2008 version of the GIS parcel file over a 2002 vintage parcel file, I can identify all lots that were ultimately merged with neighboring parcels to create a single larger parcel observed in 2008. Figure 1 shows a portion of the 2008 vintage overlaid on the 2002 vintage and some apparent instances of land assembly. To ensure that simple lot line adjustments or data cleaning are not wrongly taken as instances of land assembly, I only include 2002 parcels that are completely encompassed by the 2008 lot lines. I also exclude instances of assembly in that may be associated with a right-of-way and potentially backed by the threat of eminent domain. This is accomplished by excluding 2008 parcels that are explicitly listed as a road or whose ratio of perimeter to area suggests that it is a road.[3]

The exclusion criteria explained above may preclude the identification of all assemblies in Seattle. For example, a developer, in an attempt to capture spillovers from the positive externalities of redevelopment, may buy up whole city blocks, tear down the existing structures, and rebuild them within the existing lots. I do not identify these instances of assembly. Another limitation of the assessor sales file is that it is difficult to identify when assemblage actually occurred. Thus, I include

[3] Specifically, I exclude all '08 properties for which: $\frac{(Perimeter/4)^2}{Area} > 3$. Note that a perfectly square parcel would have a ratio of 1, and a parcel 3 times as long as it is wide would have a ratio of 1.33 (4/3) so this restriction only excludes very long and skinny parcels.

all sales that occurred in the three years prior to construction. Taking the union of the building file overlap and the newly joined lots leaves a total of 92 instance of assemblage that successfully matched to 151 parcels that sold a total of 214 times in the three years before redevelopment.

GIS-derived covariates

Utilizing the 2002 GIS parcel file, I create two measures of the relative bargaining strength of an existing landowner when leading up to final land assembly. As proposed in Eckart (1985) and Strange (1994), larger land owners (relative to other sellers) will, in a Nash bargaining game, extract a smaller premium as they have internalize more of the loss from a failed assemblage. Thus, for each parcel assembled, I calculate its share of the ultimate parcel's total lot area. I also include a count of the number of parcels assembled.

Finally, developers may retain some design flexibility, or at least may convince the current land owners that they do, and that they can thus credibly threaten to build around a particular holdout. I posit that this threat is most credible when dealing with owners at the edge of a planned assemblage and least credible for owners near the center. To measure the centrality of a parcel to the ultimate development, I count the number of adjacent parcels that were also assembled.[4] I also create a measure of total adjacent parcels to control for the possibility that, absent their strategic value as, lots surrounded by other lot may be relatively less valuable in non-assembly transactions. Presumably, corner lots with fewer adjacent parcels are, absent land assembly bargaining, more valuable.

Dependent variable

[4]I deem adjacent to be within seventeen feet of the index parcel to account for plottages that subsume an alleyway which are no more than sixteen feet across.

The dependent variable, sales price per acre, is created by taking the King County Assessor's office records of all real property transactions between 1997 and 2006, converting them to real 2007 prices, and then dividing by lot size to yield a real price per square foot of land. I limit the sample to non-related party sales and exclude any transactions that include multiple parcels, involve a government agency, contain partial interest in the property, or where the sale price was below 10,000 dollars. I also exclude sales as part of a divorce, sales in which personal property was included or where the property was deemed historic or had sold its development rights. In total, the analysis dataset consists of 118,074 sales that occurred between 1991 and 2007. Nominal prices are converted to real 2007 prices using the CPI-U deflator.[5]

Other control variables

I create several geospatial controls using the '02 parcel file. The county assessor documents specific lot characteristics including a four point score of view quality and whether the property was zoned commercial or residential. The assessor also tracks building features. I control for whether there is a building currently on the lot and if so, the buildings age. If there was a building on the land in '02, I include building age as a quadratic, build square footage and the assessor's assessment of structure quality. These structure variables are interacted with the commercial dummy to allow the coefficients to vary by land use.

IV. ECONOMETRIC SPECIFICATION AND RESULTS

[5] One limitation of the assessor dataset is that I only observe the final sales price, not the biding history, nor time, if any, on the market. A warning code in the file does note whether a property sold without any market exposure.

The econometric exercise at the heart of the paper is a hedonic regression of property sales price (per lot square foot) on a conventional set of controls for lot and building quality. The main variable of interest is a dummy variable for whether the lot will soon be involved in a land assembly. The principal challenge to identifying the assemblage premium is the simultaneity between land value and land assembly. The basic urban model (Alonso, 1964; Muth, 1969; Mills, 1972) assumes that profit maximizing developers, in the absence of zoning constraints add capital to land until the marginal profit on an additional floor is zero. As land value rises, builders substitute capital for land, building taller, denser structures. One of the determinants of redevelopment is driven by the need to re-optimize the current mix of capital and land on an existing lot. However, the fixed costs underlying these taller structures (high-rise construction cranes, elevators, more rigorous permitting and review) may make larger lots more attractive and drive land assembly as developers seek to amortize the fixed investments by increasing the building's footprint. Thus, land price, the dependent variable, would be an independent variable in any model of the timing of redevelopment and thus land assembly. One econometric strategy for dealing with the simultaneity problem is to incorporate the determinants of plottage into the first stage of a two-stage regression. However, successful land assemblies in my dataset are fairly rare, less than 0.3% of all properties between 2002 and 2007 making it somewhat difficult to construct a significantly predictive first stage. There is also the perhaps greater challenge of finding a compelling exclusion restriction.

As an alternative, I exploit the very large number of observations over (100,000) and incorporate a number of dummy variables for space and time in an attempt to absorb any observed variation in land price. The equation below provides the formal specification:

$$p_{it} = \beta_0 + L_i'\delta + X_i'\gamma + \alpha D_{it}^{redev} + \theta_1 D_{it}^{assembled} + \left(D_j^{tract} \times D_t^{year} \right)' \gamma + \varepsilon_{it}$$

where the real sales price, *p*, of parcel *i*, sold in year *t*, is regressed upon an intercept, the vector of lot characteristics, L_i, and, for non-vacant lots, a vector of building characteristics, X_i and an indicator, D_i^{redev}, for whether a new structure will be built on the lot within the next two years. The full description of these variables was provided in Section III above. The dummy variable, $D_i^{assembled}$, indicates that the parcel sold was ultimately merged with adjoining parcels to create a new, larger parcel with a new building on it. I fully interact a vector of census tracts and year dummies in an attempt to absorb spatial, temporal and inter-temporal cross-spatial variation in land values.[6] The parameter of interest, θ_1, captures any premium paid for parcels that were assembled. Formally, I test the null hypothesis, $H_0 : \theta_1 \leq 0$ against the alternative hypothesis: $H_a : \theta_1 > 0$.

Column 1 of Table 2 provides the parameter estimate for θ_1 when only lot and existing building characteristics (and time dummies) are included and can be interpreted as the premium paid per square foot for assembled land. The parameter estimate, $\hat{\theta}_1$, is large and economically significant. A developer planning to merge two or more lots together pays, on average, 32 dollars more per square foot, a 43 percent premium. However, as discussed above, redevelopment and its associated assemblage is likely non-random. Redevelopment is more likely to occur on sites where existing structures are worn-out or alternatively where demand has increased. As a control for a redevelopment premium (or discount) I include an additional variable for sales that occur up to three years before a new structure is built. This dummy includes all of the sales associated with assemblage, but also lots that would soon be built upon within the existing lot lines. As presented in column 2, despite a rich set of controls for existing structure age size and quality, property that is soon developed commands a small premium (3 dollar per square foot) over other lots consistent we

[6] Robust standard errors are calculated to correct for the false precision arising from any repeat sales of a non-assembly property in the period of analysis.

redevelopment concentrating in more desirable areas. However controlling for development activity does not appreciably change the assemblage premium. Still, to more seriously address concerns of unobserved spatial heterogeneity, the specification presented in Column (3) includes a full set of tract dummy variables. Controlling for any time-invariant land values at the tract level halves the estimate premium for assembled land to 14 dollars per square foot. It also flips the sign on the redevelopment premium suggesting, as one might expect, that less valuable structures in good neighborhoods are the most likely to be torn down. However, land values can change dynamically over time and space as new employment centers and amenities arise or as the existing stock of structures depreciated and are replaced (Brueckner and Rosenthal, forthcoming). Thus, the specification results presented in column (4) of Table 2 include fully interacted year and tract dummies to absorb inter-temporal cross-sectional variation in land rents. These richer set of controls lowers the assemblage premium only slightly.

Columns 5 and 6 provide two robustness checks of the specification of Column (4) above. In the specification presented in Column 5 I use the linear distance to the nearest plottage to pretend that all sales within a 10^{th} of a mile, and in the same year as an actual plottage sale are themselves assembly sales. Employing these "placebo" plottages allows me to check whether my assembly premium is simply picking up some exceptionally localized land premium; one that might, for example, attract new development and land assembly. Note that in the placebo specification, actual instances of assembly are excluded. The parameter estimate on the "assembled" land in this specification falls to 3 dollars per square foot but remains statistically significant. Another challenge to the finding of Column 4 is that exceptionally attractive lots, perhaps because they have favorable zoning compared to their neighbors or are adjacent to a prized local amenity such as a park or pedestrian retail strip are more likely to be assembled. As a second check, the specification in

Column 6 replicates column 4 but limits the sales to those that occurred more than 3 before redevelopment; well before the assemblage was likely completed. As revealed in Column 6, these pre-plottage parcels trade at a much smaller (but statistically insignificant) premium of 5 dollars per square foot. Combined, the two robustness checks suggest that there is something exceptional about land assembly that command a lot premium.

Strategic behavior by landowners

To test for evidence of the relative bargaining power inferred by game theory, two additional variables are incorporated into the specification: the number of parcels ultimately assembled and the index parcel's share of the total assembled parcel's land area. Recall from the discussion in section II that as the number of parcels required for assembly rises, the bargaining power of each individual land owners goes up because they can credibly threaten to hold up the entire development but only risk their own profit. Also, recall that a high holdout price from a small landowner is less likely to raise the average price of the assemblage high enough to cause the developer to abandon the project and will thus holdout for a higher pay out. Thus, I incorporate a second variable: parcel *i*'s share of the ultimate assemblages parcel size. The formal specification is:

$$p_{it} = \beta_0 + L_i'\delta + X_i'\gamma + \theta_1 D_i^{assembled} + \alpha D_{it}^{redev} + D_{it}^{assembled} \times \left(\theta_2 n_k + \theta_3 \frac{area_i}{\sum_{k=1}^{n_k} area_k} \right)$$
$$+ \left(D_j^{tract} \times D_t^{year} \right)' \gamma + \varepsilon_{it}$$

where θ_2 is the coefficient on the number of parcels within assemblage *k* and θ_3 is the coefficient on parcel *i's* share of assemblage *k*. The null hypotheses are $H_0 : \theta_2 \leq 0$, more lots do not raise the

premium paid to each landowner and $H_0 : \theta_3 \geq 0$, a larger share of the total assemblage does not lower the parcels premium $H_a : \theta_2 > 0$ and $H_a : \theta_3 < 0$ respectively.

The specification in column (1) of Table for 4 replicates the richest specification of Table 2 with fully interacted time and tract fixed effects and includes a count of the total number of parcels ultimately assembled. The coefficient estimate, $\hat{\theta}_2$, is negative and significantly different from zero at the 10 percent significance level; a finding inconsistent with expectations. In place of a linear trend for the number of parcels assembled, the specification presented in Column (2) includes dummy variables for number of assembled lots. The parameter estimates from this specification reveal that a three parcel assembly results in a larger payout to landowners than a two parcel, but that assemblies involving four or more lots actually sell for less than unassembled land (though these estimates are imprecisely estimated and not statistically different from zero).

Column (4) of Table 3 provides the parameter estimates when lot *i*'s share of the assemblage is included. The parameter estimate, $\hat{\theta}_3$, is negative and significantly different from zero at standard cut-offs suggesting that the null hypothesis should be rejected in favor of the alternative: larger land owners extract a smaller premium from the developer. Note that the despite the very large (in magnitude) of size of the parameter estimate, on the share of ultimate assembly is associated with a large standard error. Employing an F-test, I cannot reject the null hypothesis that $H_0 : \theta_{n=3} + \theta_3 \times .99 = 0$ (prob>0, 0.058) *i.e.* an assemblage in which one parcel occupies just under 100 percent of the future assembled parcel commands no premium in the market place.

While Strange (1995) and Eckhart (1985) holds the number of parcels required for an assemblage immutable, in the real world, developers can, at some cost, build around a holdout.

However, the cost of doing so rises with the centrality of the potential holdout. The idea is that a parcel on the edge of the assembly (and thus only abutting a small portion of it) could be more easily dropped from the assemblage without jeopardizing the development and will thus command a smaller holdout premium. To control for the fact that lots with a large number of neighbors may be relatively less attractive in the absence of a bargaining game, less street frontage for example, I include the total number of abutting properties as well. The formal specification is below:

$$p_{it} = \beta_0 + L_i'\delta + X_i'\gamma + \theta_1 D_i^{assembled} + D_i^{assembled} \times \left(\theta_2 n + \theta_3 \frac{area_i}{\sum_{k=1}^{n} area_k} + \beta_1 \sum_{l=1, l\neq i}^{m} d_l^{adjacent} + \theta_4 \sum_{k=1, k\neq i}^{n} d_k^{adjacent} \right)$$
$$+ \left(D_j^{tract} \times D_t^{year} \right)' \gamma + \varepsilon_{it}$$

The parameter estimates are presented in Column (4) of Table 3. The parameter estimate, $\hat{\theta}_4$, though positive is not statistically different from 0 at the 10 percent level. However, as a final check on the specification, I limit the analysis exclusively to sales of parcel that would soon be redeveloped. The logic for this is that parameters on the structure variables may be different for tear-downs relative to lots that will not be redevelopment. Limiting the analysis effectively interacts the redevelopment dummy, D_{it}^{redev}, with all the other covariates. This finale specification significantly improves the model's fit yielding an R^2 of .75. It also reduces the magnitude of the share of development parameter estimate. Finally, in this more targeted regression, the coefficient for the number of adjacent parcels in the assemblage, θ_4, is statistically different from zero at the 10 percent level (one-tailed test). A parcel adjacent to two other assembled parcels would command a 15 dollar premium over a parcel that abutted only one other assembled parcel. The finding is consistent with the hypothesis that parcels at the center of a planned development command a relatively larger

premium. In the absence of an assemblage, parcels surrounded by more lots are no more or less valuable.

V. CONCLUSION

I find evidence consistent with strategic holdout behavior on the part of landowners. Assembled parcels appear to command a premium. This premium is smaller if an individual lot is a relatively large part of the assemblage. Finally, parcels at the edge of a planned assemblage may have a weaker hand in the bargaining game.

There are several limitations to the current analysis, some of which I hope to address in future work. First, no model of the determinants of land assembly is offered or tested. Within a census tract and year, assembly is assumed to occur randomly. There are also several technical challenges in constructing my plottage indicator variable. First, I do not capture the universe of land assembly. If a developer assembles and then re-subdivides the land, then I will not identify these parcels as having been assembled unless the new lots completely encompass the original lots. Second, a developer, with the exception of a condominium project, need not formally merge the parcels together in order to construct a new structure upon it. The builder of a commercial or apartment structure could construct a building that straddles the lot line without ever formally merging the lots into a single new parcel. More generally, land assembly may entail more than simply building large structure on a single piece of land but could require a sufficient amount of land to capture any positive externalities from a new development, as modeled in Strange (1992).[7] Finally, the sample identified only includes instances of successful assembly. Thus, the premium estimated is may be an upper-bound estimate of the average premium. However, even this claim is

[7] New condominiums are obliged to file a new plat because ownership of the land and structure will ultimately be apportioned to the units.

subject to a couple of caveats. A developer is more likely to succeed when the value generated by the assemblage is higher than the landowners expect or if there is little uncertainty as to the true rents to be generated. If landowners have a good idea of the developer expected return they are less likely to holdout for too high of a price and jeopardize the assemblage. Finally, this estimate is generated in a single real estate market in the middle of the housing and condo bubble and may not be representative of the experience of other markets.

REFERENCES

Alonso, F, 1964. Location and Land Use (Harvard University Press).

Brooks, Leah and Byron Lutz, "Sclerosis of the City: An Empirical Investigation of Urban Land Assembly" University of Toronto working paper, November 2011.

Brueckner, Jan and Stuart Rosenthal, "Gentrification and Neighborhood Cycles: Will America's Future Downtowns Be Rich?" *Review of Economics and Statistics*, Review of Economics and Statistics, 91(4), 725-743.

Cadigan, John, *et al* "An Experimental Study of the Holdout Problem in a Multilateral Bargaining Game", working paper.

Cheung, Ron, Keith Ihlanfeldt and Tom Mayock, 2009 "The Incidence of the Land Use Regulatory Tax", Journal of Housing Economics, vol. 18, 24-48.

Cunningham, Christopher R., 2007, "Real Options and Growth Controls", *Review of Economics and Statistics*, vol. 89, issue 2 (May 2007), pp. 343-58

Cunningham, Christopher R., 2006, "New Housing Density, Local Control and Growth Management." Federal Reserve Bank of Atlanta Working Paper

Eckart, Wolfgang (1985). "On the land assembly problem," Journal of Urban Economics 18, 364-378.

Fu Yuming, Daniel P. McMillen, and Tsur Somerville "Land Assembly: Measuring Holdup." (CUER working paper 02-08)

Glaeser, Edward L.,Joseph E. Gyourko and Raven E Saks,. **"**Why Have Housing Prices Gone Up**"** NBER Working Paper No. W11129

Menezes, F. and R. Pitchford. (2004a). A Model of Seller Holdout. *Economic Theory* 24(2): 231 - 253.

Menezes, F. and R. Pitchford. (2004b). The Land Assembly Problem Revisited. *Regional Science andUrban Economics* 34(2): 155 – 162.

Miceli, Thomas Jand Kathleen Segerson, 2007. "A Bargaining Model of Holdouts and Takings, " (University of Connecticut Working Paper 2006-22R)

Miceli, Thomas J. and C. F. Sirmans, 2004. "The Holdout Problem and Urban Sprawl," (University of Connecticut Working Paper 2006-22R)

Mills, Edwin S., 1972. Studies in the Structure of the Urban Economy (Johhs Hopkins Press).

Muth, Richard F., 1969. Cities and Housing (University of Chicago Press).

Nosal, E. (2007). Private Takings. Federal Reserve Bank of Cleveland, Working Paper: 0713.

Strange, William C., "Overlapping Neighborhoods and Housing Externalities," *Journal of Urban Economics*, 32, 1992, pp. 17-39.

Strange, William. 1995. “Information, Holdouts, and Land Assembly,” 38 Journal of Urban Economics 317-332.

Table 1. Summary Statistics Parcels Sold Between 1992 and 2007

Variable	Full Sample (standard errors)	Sales of properties assembled	Just properties 3 years before redevelopment
N	118,183	211	4131
price per square foot	74.8 (79.17)	97.3 (73.9)	67.8 (66.4)
$D_{it}^{assembled}$	0.002	1	0.05
D_{it}^{redev}	0.035	1	1
number of lots assembled	0.004 (0.103)	2.30 (0.84)	0.118 (0.539)
mean/count, $D_{it}^{assembled}=1$			
2	0.0015	178	178
3	0.0001	15	15
4	0.0001	8	8
5+	0.0001	10	10
mean/ $D_{it}^{assembled}=1$			
Lot *i*'s share of total assemblage	0.0006 (0.015)	0.31	0.31
Number immediately adjacent lots in assembly	0.007 (0.17)	3.76 (1.48)	0.19 (0.89)
Number of immediately adjacent parcels total	.002 (.062)	1.26 (0.81)	0.06 (0.33)

Other covariates available from the author upon request.

Table 2. Premium paid for Assembled Parcels

Dependent variable price/square foot (lot size)	Column (1) Structure and lot characteristics	Column (2) pre-new construction dummy	Column (3) census tract dummies	Column (4) census tract dummies × year dummies	Robustness checks	
					Column (5) "placebo" non-assembled parcel near an assemblage ($1/10^{th}$ mile)	Column (6) Pre-assembled parcels sold more than 3 years before new construction
$D_{it}^{assembled}$	31.63	29.36	14.06	13.48	3.12	4.97
	(5.76)	(5.81)	(6.07)	(5.42)	(0.76)	(6.93)
$D_{it}^{redev\ 2}$		3.15	-3.35	-4.11	-3.78	-3.78
		(1.25)	(1.16)	(1.07)	(1.07)	(1.07)
Land quality controls	Yes	Yes	Yes	Yes	Yes	Yes
Structure quality controls	Yes	Yes	Yes	Yes	Yes	Yes
Year and quarter fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Census tract fixed effect	No	No	Yes	Yes	Yes	Yes
Census tract-year fixed effect	No	No	No	Yes	Yes	Yes
R^2	0.27	0.27	0.42	0.56	0.57	0.57
N	118,180	118,180	117,792	117,792	117,581	117,690

[1]Robust standard errors clustered by parcel id to account for multiple sales.
[2]Sold parcel redeveloped within 3 years of sale.

Table 3. Strategic Behavior by Landowners and Developers

Dependent variable price/square foot	Column (2) Total number of parcels assembled	Column (3) Monotonic?	Column (4) parcel *i's* share of total area assembled	Column (5) number of adjacent parcels	Column (6) Only pre-development sales
$D_i^{assembled}$	54.73				
	(21.04)				
#assembled parcels$_n$[2]	-18.01				
	(9.50)				
$D_n^{\#assembled}$					
2		17.53	58.33	44.28	16.64
		(5.50)	(12.04)	(17.12)	(14.07)
3		28.92	65.01	46.79	27.81
		(12.59)	(16.09)	(22.70)	(19.8)
4		-28.93	7.32	-27.01	-41.21
		(28.60)	(27.44)	(42.98)	(41.71)
5+		-52.45	-29.16	-56.35	-13.38
		(45.12)	(44.37)	(56.92)	(8.80)
$D_i^{assembled} \times$ Share of assemblage[3]			-128.89	-130.83	-47.98
			(43.49)	(43.78)	(19.98)
N adjacent[4]				1.78	1.19
				(4.88)	(2.53)
$D_i^{assembled} \times$ N adjacent[5]				7.66	13.61
				(9.49)	(8.80)
Full set of controls as presented in Column 4 of Table 2	Yes	Yes	Yes	Yes	Yes
R^2	0.57	0.56	0.56	0.56	0.75
N	117,690	117,792	117,792	117,792	4113

[1]Robust standard errors clustered by parcel id to account for multiple sales.

[2]Number of parcels ultimately assembled into a new development.

[3]Parcel *i*'s share of the ultimate assemblies land area: $\frac{area_i}{\sum_{k=1}^{n} area_k}$

[4]The number parcels within 16 feet of parcel *i:* $\sum_{k=1,k\neq i}^{n} d_k^{adjacent}$

[5] The number parcels within 16 feet of parcel *i* that were also assembled: $\sum_{k=1,k\neq i}^{n} (d_k^{adjacent} \times D_k^{assembled})$