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# INVESTOR BARGAINING POWER, RENTAL EXTERNALITIES AND HOUSING PRICES

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**Abstract.** In segmented markets for heterogeneous goods, prices reflect a mixture of demand for characteristics, bargaining power and market segmentation. This paper integrates bargaining into the canonical search model to investigate bargaining power in segmented markets for housing across investors and owner-occupiers whereby investment property is also subject to a rental externality discount. The model yields a framework for identifying price effects across market segments, which provides the empirical framework for estimating separate rental externality and bargaining power price effects. We exploit information on the Florida homestead exemption for owner-occupiers to identify sellers and buyers as investors or owner-occupiers. Data from Orange County, Florida, over 2000-2012, show the predicted rental and bargaining power effects. The results clearly indicate bargaining power differentials across investors and owner-occupiers. Rental discount and bargaining power effects systematically vary over the housing market cycle, weakest near the market peak and immediately after the most recent crash. In addition, rental and bargaining power price effects vary across types of neighborhoods, both appearing stronger in lower density, older, and structurally homogeneous neighborhoods. We also estimate the models on a matched sample using a propensity score matching model to control for selection bias in rental externality and bargaining power effects across market segments. Correcting for the endogeneity yields similar results for rental externality discounts and investor bargaining power as found without accounting for matched samples. So the rental discount we find is higher than when estimated in the conventional manner ignoring bargaining power effects.

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Keyword: price discovery, dealer market, bargaining, rental house, real estate

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## 1. INTRODUCTION

It is widely accepted that rental houses sell for less than comparable owner-occupied houses. The rationales for this persistent result include hard use by tenants and poor maintenance by landlords, the so-called rental externality (Henderson and Ioannides, 1983), as well as the difficulty of showing rental property when tenants are present (Harding et al., 2000; Iwata and Yamaga, 2008).[1] While valid, these arguments overlook a potential complication: rental houses are owned by investors who are likely more informed or may have better bargaining skills than owner-occupiers. The nature of their business means that investors have more experience in housing market transactions than owner-occupiers who are not real estate investors. If their experience and acumen lead to stronger bargaining power then the price discount associated with rental houses reflects two separate factors—the rental externality and bargaining power. Neither pertains to houses sold by owner-occupiers to other owner-occupiers. The unanswered question is, how much of the observed persistent price discount for investment property can be attributed to the rental externality and how much to differences in bargaining power between investors and others? This is the question addressed here.

Price differentials across sales reflect differentials to asymmetric information or differences in bargaining power among sellers and buyers in real estate asset markets (Harding et al., 2003a,b; Ihlanfeldt and Mayock, 2009; 2012; Bayer et al., 2012). Basically, bargaining power is lower for sellers of vacant units (Harding et al., 2003a,b; Clauretie and Wolverton, 2006) in rental-dominated neighborhoods (Turnbull and Zahirovic-Herbert, 2011), while higher for young and more educated, nonblack buyers (Harding et al., 2003a,b; Myers, 2004; Ihlanfeldt and Mayock, 2009; HUD, 2013). These studies do not, however, answer our primary question for rental houses that include both rental externality and bargaining power price effects.

The central goal of this paper is to identify how much of the observed price discount for investment property can be attributed to the rental discount and how much to differences in bargaining power. To do so, we formalize a simple search model with bargaining between sellers

[1] The rental externality is not an externality in the sense that outside properties are affected. It instead refers to the external effects of tenant behavior on the value of the landlord's residual interest. In any case, our use of this term follows convention.

and buyers in a segmented housing market. It turns out that information regarding the market segment plays a key role in identifying bargaining power differences across investors and owner-occupiers in their roles as sellers or buyers. To see this, note that the rental externality discount only applies to houses sold by investors, whether sold to another investor or to an owner-occupier. Those sold to owner-occupiers have both rental externality discount and bargaining power effects. We assume that investors do not enjoy relative bargaining power advantages when they are on both sides of the transaction. In this case, we estimate the pure rental discount and use this estimate to remove the rental discount price effect in transactions where both rental discount and bargaining power effects are present. At the same time, houses sold by owner-occupiers are not subject to the rental discount, so price differences for properties sold to investors or other owner-occupiers reflect pure bargaining power effects and provide a means of verifying bargaining power conclusions derived from mixed estimates.

The empirical analysis draws upon transaction and property data from Orange County, Florida, over 2000-2012. The existence of a homestead exemption for owner-occupiers is the key to identifying whether sellers and buyers are investors or owner-occupier; the homestead exemption is highly valuable,[2] so owner-occupiers self-identify in order to obtain the benefit.

The empirical results are consistent with the expected pattern of parameter estimates. Bargaining power affects rental externality estimates as expected; the rental discount is higher than when estimated in the conventional manner ignoring bargaining power effects. In addition, the rental discount and bargaining power effects vary systematically over phases of the housing market cycle, generally weakening near the peak of the boom market and in the immediate post-crash period. Both rental discount and bargaining power effects also vary systematically across neighborhoods. They appear to be stronger in lower density, older, and neighborhoods with homogeneous structural vintages when compared with high density, new, and heterogeneous vintages neighborhoods. We also test for property selection effects, since investors may be

[2] The homestead exemption gives the owner-occupier a partial tax exemption and limits future increases in taxable value.

attracted to specific types of properties within the lower price range. Using matched samples based on propensity score matching, we find results consistent with the pooled sample.

The remainder of this paper is organized as follows. Section 2 describes our conceptual model and section 3 our empirical approach. Section 4 describes the data and the exploratory analysis. Section 5 presents the results, and section 6 concludes.

## 2. SEARCH, BARGAINING AND SELLING PRICE

This section introduces Nash bargaining into the canonical housing market search model, extending earlier search-bargaining models (Arnott, 1989; Yavaş, 1992; Turnbull and Zahirovic-Herbert, 2011) to allow for each individual seller to confront a mix of potential buyers, owner-occupiers and investors, who enjoy different degrees of market acumen or trading experience, or have different outside options (Muthoo, 2000), hence exhibit different relative bargaining powers. Investor sellers face an additional complication in the form of a rental externality discount, the reduction in buyer willingness-to-pay associated with investment properties that have been occupied by renters.[3]

To illustrate the implications of bargaining in a segmented market, we consider two types of buyers and two housing market segments, owner-occupied and rental houses. We illustrate this in Figure 1 where we augment the exposition of Harding et al. (2003a) to allow for owner-occupied and rental housing. First, consider an owner-occupier selling a house. The buyer's bid ($\theta_B$) and seller's offer ($\phi_S$) functions represent the maximum bids and minimum offers of owner-occupiers for an existing owner-occupier house. Now in thin markets, as Harding et al. point out, the offer curve will not necessarily be tangent to the bid curve and excess surplus will no longer be zero. The surplus is the bid-offer spread ($\theta_B, \phi_S$) for a unit with housing characteristics $\boldsymbol{x}$ and reflects the scope for bargaining across buyer and seller. Let us consider owner-occupier seller (S=O) trading with owner-occupier buyer (B=O). This results in excess surplus ($\theta_{B=O}, \phi_{S=O}$) or (*a,c*). Now suppose instead that owner-occupier seller (S=O)

[3] The presence of a rental discount means that property valuation is correlated across types of sellers (investors vs homeowners), a case not considered by Harding et al. (2003a).

finds himself trading with a potential investor-buyer (B=I) with lower bid ($\theta_{B=I}$) function. This results in less excess surplus ($\theta_{B=I}, \phi_{S=O}$) or ($b,c$), and ceteris paribus a lower sales price. Second, consider now an investor selling off a rental housing unit. While the property shares similar characteristics as before, the rental externality functions such that ($\phi_{S=I}$)<($\phi_{S=O}$). When the investor-seller trades with an owner-occupier buyer with bid ($\theta_B$) function the bid-offer spread is ($\theta_{B=O}, \phi_{S=I}$) or ($a,d$), while for an investor buyer with bid ($\theta_{B=I}$) function the bid-offer spread is ($\theta_{B=I}, \phi_{S=I}$) or ($b,d$), and lowest. The observed selling price is thus a mixture of bargaining power and (rental) market segmentation.

In order to sort out the mixed bargaining power and market segmentation effects on selling price, we refer to a simple multi-stage game under imperfect information. We explain the general structure of the problem, focusing on the solution that provides a Bayesian-Nash solution with empirical implications rather than a formal presentation of the model (with notational glossary in the appendix). Consider a seller of a house with characteristics vector $\boldsymbol{x}$. In the first stage of the game, the seller, whether investor or owner-occupier, sets the reservation price $r$ to determine the stopping rule: negotiate with the buyer if the expected negotiated price exceeds the reservation price, or else wait (or search) for another potential buyer. The seller understands that buyers in the next stage of the game create ex ante uncertainty about the type of buyer that is resolved only after the reservation price is set. Buyers have a similar rule: negotiate over the house if they expect the negotiated price to be less than their valuation of the property. In the second stage, price $P$ is negotiated and the transaction subsequently consummated.

From the perspective of the representative seller, the seller is engaged in a game against nature, the latter is summarized in the distribution of buyer types. Index potential buyers s where each of their valuations of the house are a function[4] of characteristics, $b = w(\boldsymbol{x}, s) - v(\boldsymbol{x})$. The function $w(\boldsymbol{x}, s)$ reflects buyer type-$s$ willingness-to-pay for the owner-occupied house with

[4] This willingness-to-pay function is derived from buyers' search strategies and is the counterpart to the seller reservation price derived later. The underlying buyer search model giving rise to the wiliness-to-pay function is suppressed to keep the exposition concise.

characteristics $\boldsymbol{x}$. The additive term, $v(\boldsymbol{x}) \geq 0$, reflects the possible rental discount, the reduction in perceived value attributable to rental properties.

To characterize a Bayesian-Nash solution, consider first the final stage of the game. In the last stage, the seller and buyer negotiate a price for the seller's house. Assuming Nash bargaining, the relative bargaining power of the buyer and seller determines their net benefits from the house transaction. If the seller's reservation price $r$ and the buyer's maximum willingness-to-pay for this particular house is $b = w(\boldsymbol{x}, s) - v(\boldsymbol{x})$, the selling price $P$ of the house under Nash bargaining is

$$P \equiv argmax\{(w(\boldsymbol{x}, s) - v(\boldsymbol{x}) - P)^{1-\alpha}(P - r)^{\alpha}\}$$

where the parameter $\alpha$ summarizes the seller's bargaining power or negotiating skills relative to the buyer. The seller's and buyer's relative bargaining power is determined, in part, by their respective bargaining abilities, strategies, or possibly their command of market information. The selling price is

$$P = \alpha(w(\boldsymbol{x}, s) - v(\boldsymbol{x})) + (1-\alpha)r \quad (1)$$

A larger $\alpha$ corresponds to a seller with greater negotiating skills, which increases the seller's bargaining power and pushes the ultimate selling price closer to the buyer's reservation price $b = w - v$. A smaller $\alpha$ corresponds to a seller with weaker bargaining power which results in an ultimate selling price that is closer to the seller's reservation price, $r$. Voluntary exchange requires $\alpha \in (0,1)$.

When investors and owner-occupiers have different bargaining power, each seller faces two possible selling price outcomes for each type of buyer s. For example, if the seller is an owner-occupier then the property is currently not a rental unit and incurs no rental discount (so that $v = 0$). In this case the bargaining solution yields selling price

$$P_{OO} = \alpha_{OO} w(\boldsymbol{x}, s) + (1 - \alpha_{OO}) r_O \tag{2}$$

when the buyer is also an owner-occupier, and

$$P_{OI} = \alpha_{OI} w(\boldsymbol{x}, s) + (1 - \alpha_{OI}) r_O \tag{3}$$

when the buyer is an investor. Since the seller sets the reservation price before the type of buyer $s$ is known (the determination of $r$ is considered later), the owner-occupier seller's reservation price, $r_O$ , does not vary across possible types of buyers hence across bargaining outcomes.

If instead the seller is an investor then the buyer type-$s$ has the maximum willingness-to-pay, $b = w(\boldsymbol{x}, s) - v(\boldsymbol{x})$, taking into account the possible rental discount, $v \geq 0$. For the investor seller the bargaining solutions are

$$P_{IO} = \alpha_{IO}(w(\boldsymbol{x}, s) - v(\boldsymbol{x})) + (1 - \alpha_{IO}) r_I \tag{4}$$

$$P_{II} = \alpha_{II}(w(\boldsymbol{x}, s) - v(\boldsymbol{x})) + (1 - \alpha_{II}) r_I \tag{5}$$

when the buyer is an owner-occupier or investor, respectively.

Now consider the first stage of the seller's game. The seller sets the reservation price before contacting buyers. The seller knows his or her own type, but does not know the type of buyer, in terms of willingness-to-pay and bargaining ability, who will ultimately be interested in the property. For a particular house for sale, probability of a potential owner-occupier buyer or investor buyer arriving to examine this house during a unit of time is $\pi_O$ or $\pi_I$ , respectively.

The population of buyers is ordered by their willingness-to-pay (conditional on rental discount, if present) according to a well-behaved distribution function *B(s).* In the first stage of the game the house seller of type $j \in \{I, O\}$ sets reservation price $r_j$. The probability of a visit by a potential owner-occupier or investor buyer at a given time is $\pi_s$ so that the probability of a sale in any given period is the sum of $\pi_s$ times the probability that an arriving buyer $s$ is the type whose willingness-to-pay $b$ is greater than the seller's reservation price $r$, or

$$(\pi_O + \pi_I) \int_{w(\boldsymbol{x},s)-v\geq r} dB. \tag{6}$$

It is sufficient to consider the simplest search model with no time discounting and a stationary distribution of buyer types. The seller's optimal reservation price, $r_j^*$, satisfies the marginal waiting time condition (Lippman and McCall, 1976)

$$E\left[P - r_j^* \middle| w(x,s) - v \geq r_j^*\right] = c$$

where $c$ is the seller's search cost or single period cost of waiting for another buyer to arrive. This is the condition that the optimal reservation price equates the marginal cost of turning down a current offer, the waiting or search cost (the right hand side), with the marginal benefit, the expected gain from an offer possibly forthcoming in the next period (the left hand side). For our case, this condition becomes

$$\pi_O \int_{w(\boldsymbol{x},s)-v\geq r_j^*} \left(P_{iO} - r_j^*\right) dB + \pi_I \int_{w(\boldsymbol{x},s)-v\geq r_j^*} \left(P_{iI} - r_j^*\right) dB = c.$$

Substitute (2) – (5) for selling price into this condition and simplify to restate the seller's reservation price condition as

$$\int_{w(\boldsymbol{x},s)-v(\boldsymbol{x})\geq r_j^*} \left(w(\boldsymbol{x},s) - v(\boldsymbol{x}) - r_j^*\right) dB = \frac{c}{q} \tag{7}$$

where $q_j = (\pi_I \alpha_{jI} + \pi_O \alpha_{jO})$ is the weighted ex-ante relative bargaining power of seller type $j \in \{I, O\}$. Solve implicitly for the seller's reservation price

$$r_j^* = r_j(q, c, v, \boldsymbol{x}; \mu_B, \sigma_B) \tag{8}$$

where $\mu_B$ and $\sigma_B$ denote the parameters describing the buyer distribution function B in equilibrium. Implicitly differentiation of (7) yields the comparative static properties of the equilibrium reservation price as

$$\frac{\partial r_j^*}{\partial c} < 0; \ \frac{\partial r_j^*}{\partial q} > 0; \frac{\partial r_j^*}{\partial v} < 0 \tag{9}$$

so that the effects of arrival rates and bargaining power on reservation price are

$$\frac{\partial r_j^*}{\partial q}\frac{\partial q}{\partial \pi_j} > 0; \ \frac{\partial r_j^*}{\partial q}\frac{\partial q}{\partial \alpha_{sj}} > 0$$

The first set of results in (9) is intuitively appealing in light of the standard search theory results. Higher seller search costs $c$ or a lower probability of buyer arrival $q$ prompts the seller to set a lower reservation price. In light of (2) – (5), the lower reservation price from higher seller search cost or lower probability of buyer arrival leads to lower selling price in all cases, hence lower expected selling price. Similarly, the rental discount $v$ associated with current investment properties also reduces seller reservation price and the resultant selling price in (2) - (5). These results are standard. The new results pertain to bargaining power. Sellers with high bargaining power $\alpha_j$ enjoy greater expected weighted seller bargaining power $q$, which leads them to set higher reservation prices, $\frac{\partial r_j^*}{\partial q}\frac{\partial q}{\partial \alpha_{sj}} > 0$, and from (2) – (5) obtain higher expected selling price through this channel. Nonetheless, for a given seller (and reservation price), (2) – (5) also show that the greater the bargaining power of the realized buyer the lower the resultant selling price.

Finally the rental externality discount $v$ by itself affects expected selling price regardless of the relative bargaining power of seller and buyer. The investor seller reduces the reservation price to account for the lower buyer valuation of properties in the rental market segment. Since the rental discount reduces the buyer's willingness-to-pay and the seller's reservation price, it reduces expected selling price directly through these channels for both investor buyers and owner-occupier buyers. In sum, the observed outcomes for properties sold by investors necessarily include both bargaining power effects and rental externality discount effects on house price.

The search and negotiation process is a multi-stage game for which a solution is given by (7) and (2) – (5). The search and bargaining framework imposes parametric constraints on the empirical model. Substituting (8) into (2) – (5) gives realized price as a function of the usual property characteristics and market conditions, and the vector of ex-post bargaining power. Letting the vector **I** comprise the indicators for seller type $j$ and buyer type $s$. The hedonic price function can be expressed as

$$P = f(\boldsymbol{x}, \boldsymbol{I}).$$

Table 1 summarizes the empirical implications of the bargaining model with the rental discount. The top row identifies the buyer type and the first column the seller type. Transactions involving investor sellers are all subject to the rental discount. We assume symmetry, that buyers and sellers have no net bargaining power advantage over each other when both are investors or both are owner-occupiers. In this case, the top left cell in the table indicates that the rental discount is the only price effect when an investor sells to another investor. The next cell indicates that both the rental discount and a bargaining power differential can affect price when an investor sells to an owner-occupier. If the owner-occupier has less bargaining power than the investor, then the bargaining power effect by itself increases the expected selling price, offsetting any extant rental discount effect. On the other hand, there is no rental discount when the seller is an owner-occupier. These transactions therefore exhibit only bargaining power price effects. If investors enjoy stronger bargaining power than owner-occupiers then transactions in which owner-occupiers sell to investors will exhibit lower prices than owner-occupier to owner-occupier transactions.

Summarizing, using the case where both seller and buyer are owner-occupiers as reference, a rental discount and stronger investor bargaining power (relative to owner-occupiers) yield the following testable relationships where $P_{js}$ denotes the price when seller $j$ and buyer $s$ bargain with each other:

$$
\begin{aligned}
&P_{II} < P_{OO} \\
&P_{IO} > P_{II} \qquad (10) \\
&P_{OI} > P_{IO} \\
&P_{OI} < P_{OO}
\end{aligned}
$$

**3. ECONOMETRIC APPROACH**

*3.1 Hedonic regression model*

The empirical model relates sales price to the rental discount and the bargaining power between seller and buyer. The price function of the log of price *P* of property *i* at time *t* as a linear function of property characteristics and mix of seller and buyer types:

$$\ln P_{it} = \beta x_{it} + \beta_{II} I_{it}^{S=I \times B=I} + \beta_{IO} I_{it}^{S=I \times B=O} + \beta_{OI} I_{it}^{S=O \times B=I} + \varepsilon_{it} \qquad (11)$$

where *P* is the selling price; x the vector of relevant house characteristics, including location ZIP, and time year and monthly fixed effects. The last term $\varepsilon_{it}$ is the error term. We estimate the function for individual sales transactions reporting standard errors clustered at the census block level. The reference category refers to sales between owner-occupiers and is $I_{it}^{S=O \times B=O}$. According to our earlier discussion, the ability to identify separate rental externality and bargaining power price effects hinges upon being able to obtain a direct estimate of the rental externality discount (parameter b[S=I × B=I]). The bargaining power effect equals (b[S=I × B=O]-b[S=I × B=I]). In presenting our findings we report on our parameter estimates including the bargaining power effect for which we report adjusted standard errors using the delta method.

*3.2 Propensity score matching*

The baseline model discussed so far considers the rental externality discount and bargaining effects as if the property were sold as rental or owner-occupier randomly. Admittedly, this ignores the fact that not all houses are potential rental houses. Portfolio and cash flow considerations of rental units motivate investors to focus their attention on certain housing market segments that possibly differ from those targeted by owner-occupiers who may be primarily driven by consumption motives (Han, 2013; Turnbull and Zahirovic-Herbert, 2012). It is therefore reasonable to consider the implications of endogenous selection, with properties purposefully selected either as rental or as owner-occupier housing. The descriptive statistics suggest that most of these rental properties remain rental, with less than 10 percent of the property ever sold as rental ever bought by owner-occupiers over this twelve year period. This suggests that rental property and owner-occupier property are structurally different and likely the result of a choice process.

We use propensity score matching to create matched samples. The first stage estimates a logit model of investor property $I_{it}^{S=I}$ as a function of the vector of relevant house characteristics, including location, year, and monthly fixed effects. Next, for every investor property in the sample propensity scoring matching will indicate a matched owner occupier property, an owner-occupied property with characteristics that generate the same probability of becoming a rental property as the subject investor owned property. The matched sample comprises these match pairs of observations. The final stage estimates model (11) on the matched sample.

**4. DATA**

We collect all transactions for all single family dwellings (SFD) over 2000-2012 (through August 24, 2012) in Orange County, Florida. The Orange County Property Appraiser (OCPA) retains records for the last 5 transactions for each parcel, so we observe at most 5 transactions for each property and we are likely underreporting the number of transactions over 2000-2012. The likely amount of underreporting, however, turns out to be small. Analyzing the data, we find that we have the full transaction history over 2000-2012 for 95.1 percent of the SFD properties. For the remaining 4.94 percent of the total 266,897 SFD properties, we have the fifth most recent observation and may possibly miss some of the transaction history (as we do not know whether there are more than five transactions). Given the distribution of transactions, the number of missing transactions is most likely less than two percent of the total number of SFD property sales over 2000-2012.

In addition, we use annual tax role data to identify owners as investors or owner-occupiers based on whether the owner obtains a homestead exemption. Homestead exemptions are valuable in Florida, as they create an immediate property tax discount and impose stringent caps on future property tax increases. Only owner-occupiers can obtain homestead exemptions. Homestead exemption filing is an administrative process in which homeowners initially file or renew their homestead exemption by March 4 of every calendar year. Homestead exemption files are updated between March 4 and June 30 and property values and taxes become official on July 1. What is important here is that re-sales that occur within one year of a previous transaction may not reveal seller and buyer homeowner status correctly, because there is not enough time for owner-occupiers to file their homestead exemption. To deal with this possibility, we retrospectively construct the seller-buyer matches for the entire period back to 2000 to identify whether sellers and buyers are investors or owner-occupiers in each transaction. To map the information on homestead exemption into seller-buyer combinations we include sales that include information on calendar year (t-1), (t) and (t+1) such that the seller owns the property in the calendar year (t-1) and the buyer owns the property in calendar year (t+1). This implies, for example, that for sales in February the seller must occupy the house in the preceding two months, whereas the buyer must occupy the house for at least 10 months. This method allows us to use the recorded homestead exemptions to identify both sellers and buyers as investors or owner-occupiers over 2001 - 2011.

The empirical analysis draws upon the arms-length transactions that occur over 2001-2011 for which we have full information. Arms-length transactions exclude all foreclosures, special warranty deeds, tax claim deeds, quit claims and deeds transferred for administrative reasons. From these we selected the transactions for which the tax role correspondence address of the owner (either investor or owner-occupier) is located in Orlando. We do this because homestead exemption is typically absent for those with tax role correspondence addresses outside Orlando. This leaves use with 71,604 transactions[5] for 2001-2011. This is the sample used to estimate our models.

Table 2 reports the sample statistics of the variables used in this study (excluding location and time fixed effects). We report sample statistics for all observations, for investor sellers (S=I), for owner-occupier sellers (S=O), as well as for the various seller-buyer transaction types, viz. S=I×B=I, S=I×B=O, S=O×B=I and S=O×B=O. Table 2 shows that 30 percent of the transactions involve investor sellers with the remaining 70 percent owner-occupier sellers. Further, 39 percent of buyers are investors and 61 percent owner-occupier buyers. When considering types of seller S and buyer B, 44 percent of the sales is among owner-occupiers (S=O×B=O).

We are particularly interested in the differences between groups of sellers and buyers. To the extent that rental and bargaining effects are present in house sales, we explore differences in sales price. The sample statistics indicate a mean sales price for investor sellers of

[8] We removed the lower and upper 1% of the price distribution of below $6,700 and over $2,000,000, and all parcels with date of construction after the date of transaction.

$194,564, and $214,559 for owner-occupier sellers. These differences in sales price may, however, also relate to differences in property and characteristics or neighborhood type. Descriptive statistics indicate that owner-occupier property is higher quality; it is more often made from walls of concrete block stucco, larger in terms of living area, number of bedrooms, and parcel size, and more luxurious in terms of number of bathrooms and the presence of a swimming pool.

To further examine the property prices Figure 2 plots the median house price in (current) USD per sq. ft. over time. The top panel maps house price by type of seller. As can be observed from the graph, rental property sells at a discount although some variation over the house price cycle can be observed. Interestingly, most of the rental externality discount appears to disappear in 2006 - 2008.

The lower panel of Figure 2 illustrates house price by types of seller S and buyer B to further explore price differentials across pairs of sellers and buyers. The figure reveals a more refined pattern regarding the rental externality discount, as, conditional on the property class, house prices are highest for owner-occupier buyers (B=O) and lowest for investor buyers (B=I). It is this systematic price difference across types of sellers and buyers that we address in the empirical methodology. Note further that the systematic price difference across types of sellers and buyers appears to persist even in the aftermath of the global financial crisis and the associate rise in foreclosures when the market turned into a buyers' market in which house prices fell relatively sharply.

## 5. EMPIRICAL RESULTS

### *5.1 Hedonic regression model results*

Table 3 reports the estimates of the hedonic equation. Model (1) is the baseline model while model (2) presents the results for the mean rental discount effect of investor sellers (S=I). The hedonic models with bargaining are presented in models (3) – (6). Model (3) reports results for the pooled sample 2001-2011, while models (4) – (6) report results for various for subsamples. The subsamples pertain to different market phases; model (4) for the rising market (2001-2006), model (5) for the declining market (2007-2009), and model (6) for the market trough (2010-2011).

The estimates reported for house characteristics show the expected patterns consistently across the various models; larger houses (in terms of either rooms or area) sell for more, additional bathrooms or a swimming pool add value, as does a larger lot size.

Model (2) indicates that investor sell property for less, with on average -2.88 percent relative to owner-occupiers. Our result indicates a smaller discount than the -8.39 percent found by Turnbull and Zahirovic-Herbert (2012) for Baton Rouge, Louisiana over 1984 – 2005. To consider the underlying differences in greater detail we also estimate model (2) by year. These results are graphed in Figure 3 and reveal the estimates of the rental discount varying between (-5.13 and +0.52) percent. While we find smaller effects for the rental discount in absolute value, the overall the pattern of the market cycle effect of the discount is identical to Turnbull and Zahirovic-Herbert in that we also find the smallest value at the market extremum. Interestingly, this effect seems to hold for both extrema; at the market trough (as in Turnbull and Zahirovic-Herbert, 2012) and at the market crest (as we report here). However, as argued earlier, rental properties are sold by investors with possibly different bargaining skills relative to non-investors. The results when taking this complication into account are of central interest.

Model (3) provides results for equation (11). Recall that the omitted category is owner-occupier seller and buyer, or S=O×B=O. Focusing on the variables of interest, all of the seller-buyer indicator variable coefficients satisfy the predicted pattern in (10); these estimates are consistent with the notion that the rental discount is negative and that investors exhibit stronger bargaining power than owner-occupiers. The S=I×B=I coefficient estimate is -0.0702 and significant. Drawing on figure 1 and using the Kennedy (1981) adjustment, this estimate indicates a rental externality price effect of about -7.0 percent, within the range found by other studies. This result coupled with the S=I×B=O coefficient indicates that investors are able to obtain a 5.79 percent higher selling price because of their greater bargaining power when facing owner-occupier buyers.[6] At the same time the S=I×B=I coefficient implies that investor bargaining power allows them to buy houses sold by owner-occupiers for about 2.17 percent less than owner-occupiers pay for identical properties. These bargaining power price effects appear to fall within the range of price variation that would not trigger the attention of appraisers performing due diligence for mortgage lenders.

Looking at the rising market (model (4)), declining market (model (5)) and post-crash market (model (6)) estimates in table 3, the market phase appears to affect the results, although only modestly. For example, in the rising market of model (4), all of the patterns in equations (10) hold except for the inequality for the S=I×B=O and S=O×B=I coefficient estimates. Still, the results indicate an 8 percent price discount (-0.066 - 0.0148) from the rental discount and stronger investor bargaining power than owner-occupier bargaining power regardless of role as seller or buyer. The S=I×B=O estimate suggests that superior investor bargaining power leads to an approximate 5.1 percent higher price when selling to an owner-occupier than when selling to another investor; the S=O×B=I estimate suggests that the investor is able to buy a house from a owner-occupier for about 1.65 percent less than a owner-occupier pays. In comparison, the rental discount is stronger in the post-crash market (model (6)) than in the rising market as are the price effects arising from stronger investor bargaining power. The rental externality creates a discount of 10.3 percent. Investor bargaining power allows investors to sell at a premium of almost 10 percent and buy at a discount of almost 5 percent.

To evaluate the robustness of our estimation results, Table 4 reports key parameter estimates by year. The S=I×B=I coefficients decline in absolute value from 2001 through the market peak in 2007 and strengthen thereafter. One consequence of the price bubble appears to be the virtual disappearance of the rental discount price effect as we near the market peak. The S=I×B=O coefficients also suggest changes in investor bargaining power when selling houses over the market cycle. The price effect of investor bargaining power declines after 2004,

[6] Parameter b[S=I × B=O] include bargaining and rental externality effects. With rental externality effect b[S=I × B=I] = -0.0702 the pure bargaining effect is 0.0579 (or -0.0123 + 0.0702).

disappears in 2007-2008 and recovers thereafter. This is a surprising pattern, as it implies that investor sellers are not able to fully exploit their bargaining power advantage in the hottest phase of the market. This is consistent with a general breakdown of the price discovery process as the market reached its speculative peak. The S=O×B=I coefficient tells a slightly different story. The pricing advantage to investor buyers disappears over 2005-2007, once again in the hectic period leading up to the market peak. The advantage to investor buyers is strongest in 2009 right after the market peak but then declines in strength to price discounts between 3-5 percent, slightly greater than those observed in the early years of the sample period.

We next consider how the rental externality discount and bargaining power effects vary across neighborhoods. Table 5 reports key parameter estimates for the sample partitioned across types of neighborhoods in terms of population density, age of structures, vacancy rate, structure age distribution, homogeneous vs mixed house size, and owner-occupied vs rental neighborhoods. In this application, neighborhoods comprise census blocks. The rental externality discount differs considerably across high and low density neighborhoods, new and old neighborhoods, and homogeneous and heterogeneous structure age neighborhoods. The S=I×B=O coefficient estimates do not vary as much across these partitioned samples, which implies that the price premium obtained from investor bargaining power when selling to owner-occupiers varies according to the same general pattern observed for the rental externality price effect. The investor price advantage when buying from an owner-occupier shows a similar pattern across the same neighborhoods. In addition, there appears to be no investor bargaining power price discount in heterogeneous house age neighborhoods while the price discount is significant and over 2-3 percent in homogeneous house age neighborhoods. Overall, these estimates suggest that rental externality effects found in the literature also include bargaining power effects.

*5.2 Propensity score methods*

Finally, we consider the possibility that investors are attracted to certain types of houses to use as rentals. The question is whether this type of endogenous selection affects the bargaining power and rental externality estimates. Here we report on our estimation results based on our propensity score matching sample explained previously in Section 4. We have 43,488 observations in our matched sample. Table 6 - 8 present our main matched sample results (corresponding to Table 3 – 5 for the full sample), including estimation results for different market phases. Table 6 model (3) shows that the rental discount amounts to 7 percent. The estimate pertaining to investor bargaining power indicates that investors obtain a significant 5.85 percent premium when selling property. The bargaining power discount for owner-occupier sellers is 3.5 percent when selling off to investor buyers. Similar results are found in Tables 7 - 8 for specific years (Table 7) and for specific neighborhood types (Table 8).

Pulling these results together, controlling for sample selection effects with propensity scoring matched analysis does not alter our main findings for investors but it leads to some differences as for owner-occupiers. Comparing these estimates with the unmatched sample of Table 3 we observe that the rental discount effect remains in similar order of magnitude. So rental properties sell off with a discount of 7 percent over the period 2001-2011. Second, we observe that the bargaining effect of investors is about 5.8 percent. The main difference in results pertains to bargaining power effects. The matched sample reveals greater equivalence in bargaining effects than observed in the full sample. Nonetheless, F-tests of the linear restriction rejects strict equivalence in the matched sample, a qualitative outcome similar to the unmatched sample.

## 6. CONCLUSION

This paper estimates the effects of differences in investor and owner-occupier bargaining power on selling price when investment property is subject to a negative rental externality discount. In the multi-stage search-bargaining game, sellers set their reservation price before knowing their relative bargaining power when ultimately negotiating with a buyer over the price. The Bayesian-Nash solution provides price testable price effects across type of property (rental or owner-occupied) and buyer and seller types (investor or owner-occupier). We initially assume bargaining symmetry, that a type of buyer or seller enjoys no bargaining power advantage when negotiating with the same type on the other side of the transaction. Under this assumption and the assumption that investors have (weakly) stronger bargaining power than owner-occupiers, we are able to separate rental discount and bargaining power price effects across all transactions.

The Florida homestead exemption for owner-occupiers provides a method for identifying whether sellers and buyers are investors or homeowners; the exemption is valuable to owner-occupiers, so they have strong incentives to self-identify to obtain the benefit. We construct a record of seller and buyer types from the observed series of transactions for each property and the associated homestead exemption filings for Orange County, Florida, over 2000-2012. The empirical results are consistent with the expected pattern of parameter estimates and the expectation that investors enjoy relatively stronger bargaining power than do owner-occupiers on average.

The results show a larger rental externality discount than found with the conventional approach ignoring bargaining power. The rental externality discount and bargaining power effects vary over the housing market cycle; they are generally weaker when approaching the peak of the boom market and in the immediate post-crash period. In addition, both rental externality and bargaining power price effects vary systematically across neighborhoods, appearing to be stronger in lower density, older, and homogeneous structure age neighborhoods than in higher density, newer, and heterogeneous structure age neighborhoods. Perhaps more important, our results based on the matched sample offer some evidence of endogenous selection in investor property. Nonetheless, the results yield similar rental externality effects as found with conventional methods not taking selection effects into account. Regarding investor bargaining power, we find similar effects for both matched and full samples. Further, while our matched samples reveal greater equivalence in bargaining power whether an owner-occupier sells or buys from an investor, the latter effect is in absolute terms still significantly greater.

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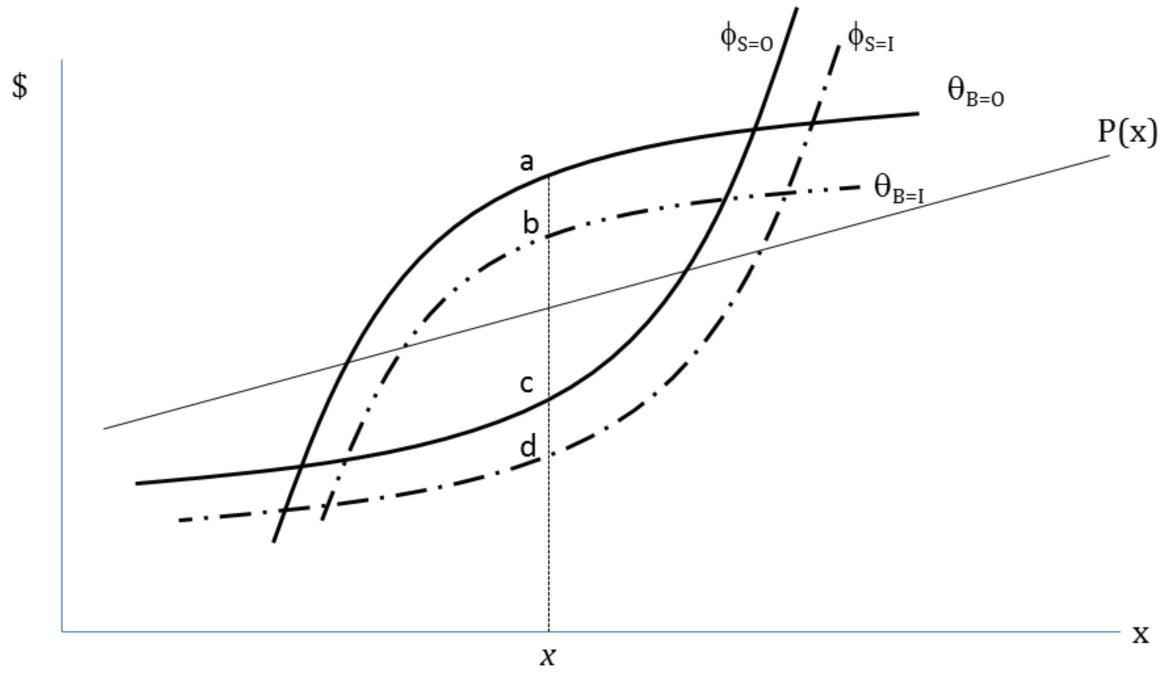
**APPENDIX A: NOTATIONAL GLOSSARY**

| | |
|---|---|
| *Theoretical model* | |
| $\theta_s$ | Bid function |
| $\phi_j$ | Offer function |
| $\mathbf{x}$ | House characteristics |
| $r$ | reservation price of seller |
| $P$ | Sales price of the property |
| $s$ | Buyer with I = investor and O = owner-occupier |
| $w(\mathbf{x},s)$ | Buyer *s* willingness to pay for the property with characteristics **x** |
| $v$ | Rental discount or discount |
| $\alpha$ | Investor relative bargaining power |
| $\pi_s$ | Arrival rate of buyer type *s* |
| $B(s)$ | Cumulative distribution function of *s* |
| $q_j$ | Weighted ex ante relative bargaining power of seller type *i* |
| $c$ | Seller search and holding costs per period |
| | |
| *Empirical model* | |
| $\beta$ | Parameters to be estimated |
| $i$ | Property i=1,…,N |
| $t$ | Time t=1,..., T |
| $I_{it}^{S=I \times B=I}$ | Indicator for investor seller and investor buyer |
| $I_{it}^{S=I \times B=O}$ | Indicator for investor seller and owner-occupier buyer |
| $I_{it}^{S=O \times B=I}$ | Indicator for owner-occupier seller and investor buyer |
| $I_{it}^{S=O \times B=O}$ | Indicator for owner-occupier seller and owner-occupier buyer (reference) |
| $I_{it}^{S=I}$ | Indicator for an investor property |

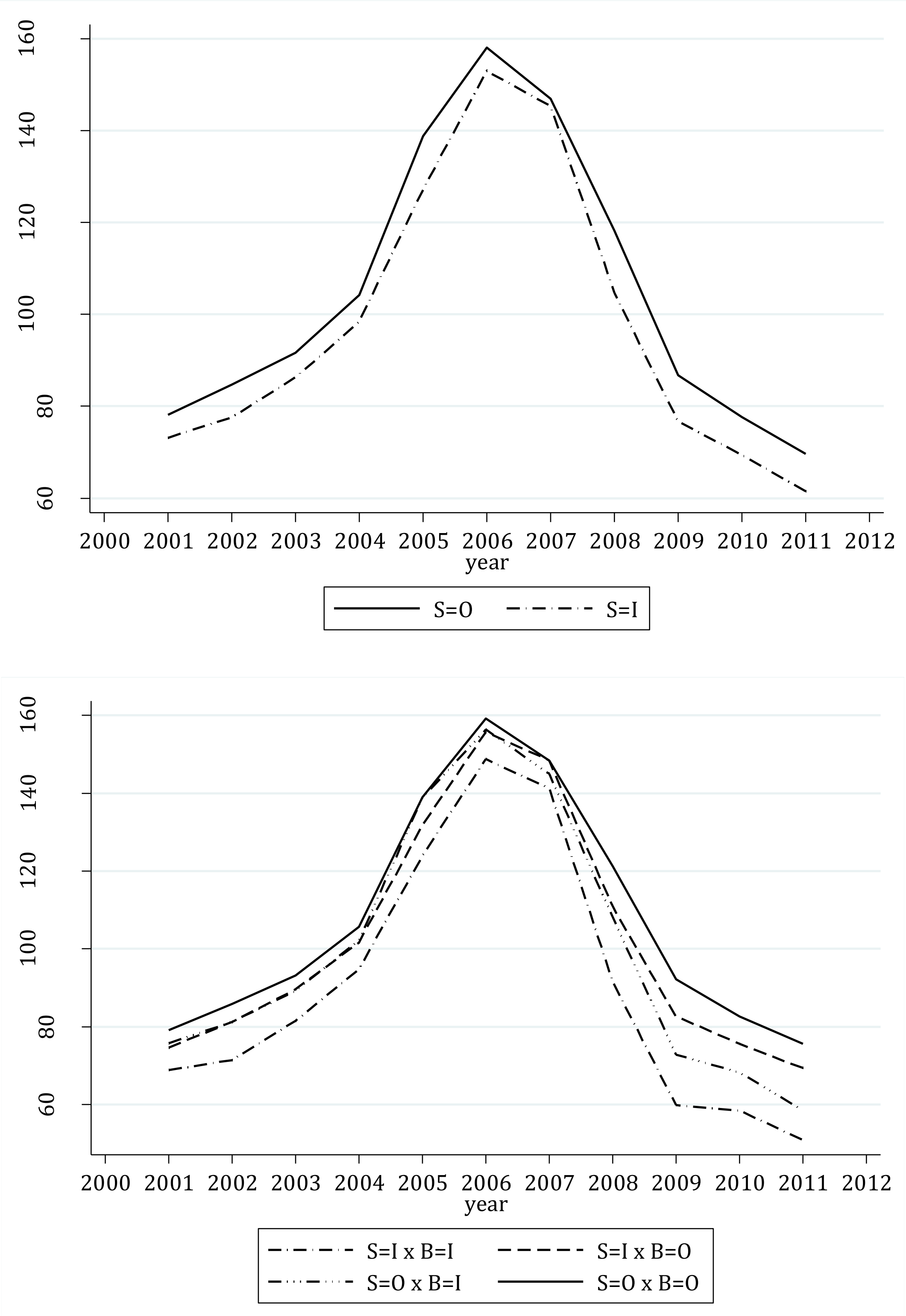
**FIGURES & TABLES**

**ON PROPERTY INVESTOR BARGAINING POWER, RENTAL EXTERNALITIES, AND HOUSE PRICES**




Note: figure maps the buyer's bid ($\theta$) and seller's offer ($\phi$) functions for owner-occupier and investor {O, I} represent the maximum bids and minimum offers of a single-family home. Point *a* refers to the bid of an owner-occupier buyer, *b* to the bid of an investor buyer. *c* refers to the offer of an owner-occupier seller, and *d* to the offer of an investor seller.

FIGURE 1: Bargaining and market segmentation




Note: graph maps simple descriptive of median house price per sq.ft living area by year.

FIGURE 2: House price by seller (top panel), and by seller and buyer (lower panel)


Note: the parameter estimate are based on the specification show in Table 2 model (2) by year. Estimation results for 2006-2008 are statistically insignificant from zero.

FIGURE 3: Parameter estimate of rental discount

TABLE 1: RENTAL DISCOUNT AND BARGAINING POWER PRICE EFFECTS

| Buyer [B] / Seller [S] | Investor [I] | Owner-occupier [O] |
|---|---|---|
| Investor [I] | Rental discount<br>**[S=I × B=I]** | Rental discount +<br>Bargaining differential<br>**[S=I × B=O]** |
| Owner-occupier [O] | Bargaining differential<br>**[S=O × B=I]** | Baseline<br>**[S=O × B=O]** |

TABLE 2: DESCRIPTIVE STATISTICS

| | Pooled | | S=I | | S=0 | | S=I × B=I | | S=I × B=0 | | S=0 × B=I | | S=0 × B=0 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mean | sd | mean | sd | mean | sd | mean | sd | mean | sd | mean | Sd | mean | sd |
| *Property characteristics* | | | | | | | | | | | | | | |
| Price ($, current) | 208,487 | 132,651 | 194,564 | 128,225 | 214,559 | 134,085 | 189,005 | 130,675 | 198,870 | 126,132 | 208,882 | 132,738 | 217,815 | 134,746 |
| CBD distance (miles) | 7.726 | 3.658 | 7.614 | 3.750 | 7.774 | 3.617 | 7.423 | 3.728 | 7.763 | 3.759 | 7.749 | 3.540 | 7.789 | 3.660 |
| Walls concrete block stucco | 0.544 | 0.498 | 0.509 | 0.500 | 0.560 | 0.496 | 0.481 | 0.500 | 0.531 | 0.499 | 0.533 | 0.499 | 0.575 | 0.494 |
| Number of bedrooms less than 3 | 0.099 | 0.299 | 0.130 | 0.336 | 0.086 | 0.280 | 0.149 | 0.356 | 0.115 | 0.319 | 0.093 | 0.291 | 0.082 | 0.274 |
| Number of bedrooms more than 3 | 0.340 | 0.474 | 0.317 | 0.465 | 0.350 | 0.477 | 0.306 | 0.461 | 0.326 | 0.469 | 0.334 | 0.472 | 0.360 | 0.480 |
| Living area (sq.ft) | 1,788 | 671 | 1,711 | 677 | 1,822 | 666 | 1,652 | 672 | 1,757 | 677 | 1,765 | 653 | 1,854 | 671 |
| Living area less than 1,500 | 0.397 | 0.489 | 0.461 | 0.498 | 0.369 | 0.482 | 0.505 | 0.500 | 0.427 | 0.495 | 0.411 | 0.492 | 0.344 | 0.475 |
| Living area more than 2,500 | 0.137 | 0.344 | 0.125 | 0.331 | 0.142 | 0.349 | 0.112 | 0.315 | 0.135 | 0.342 | 0.126 | 0.332 | 0.152 | 0.359 |
| Number of bathrooms | 2.13 | 0.64 | 2.06 | 0.68 | 2.16 | 0.62 | 2.00 | 0.69 | 2.11 | 0.66 | 2.11 | 0.62 | 2.18 | 0.62 |
| Number of baths = 1.00 | 0.096 | 0.295 | 0.141 | 0.348 | 0.077 | 0.266 | 0.177 | 0.382 | 0.113 | 0.317 | 0.094 | 0.292 | 0.067 | 0.249 |
| Number of baths = 1.50 | 0.039 | 0.193 | 0.050 | 0.218 | 0.034 | 0.181 | 0.060 | 0.237 | 0.043 | 0.202 | 0.040 | 0.195 | 0.031 | 0.173 |
| Number of baths = 2.50 | 0.103 | 0.304 | 0.102 | 0.302 | 0.103 | 0.304 | 0.095 | 0.294 | 0.107 | 0.309 | 0.099 | 0.299 | 0.106 | 0.307 |
| Number of baths > 2.50 | 0.150 | 0.357 | 0.137 | 0.343 | 0.156 | 0.363 | 0.126 | 0.332 | 0.144 | 0.352 | 0.138 | 0.345 | 0.167 | 0.373 |
| Pool | 0.276 | 0.447 | 0.225 | 0.418 | 0.298 | 0.457 | 0.202 | 0.402 | 0.243 | 0.429 | 0.274 | 0.446 | 0.312 | 0.463 |
| Parcel size (sq.ft.) | 38,540 | 39,689 | 35,146 | 38,622 | 40,020 | 40,056 | 32,982 | 40,317 | 36,823 | 37,171 | 36,930 | 40,154 | 41,793 | 39,892 |
| *Neighborhood type* | | | | | | | | | | | | | | |
| Low density | 0.260 | | 0.280 | | 0.251 | | 0.301 | | 0.264 | | 0.250 | | 0.252 | |
| High density | 0.210 | | 0.215 | | 0.208 | | 0.204 | | 0.225 | | 0.202 | | 0.211 | |
| Old (year built) | 0.304 | | 0.351 | | 0.284 | | 0.393 | | 0.318 | | 0.303 | | 0.272 | |
| New (year built) | 0.097 | | 0.115 | | 0.090 | | 0.102 | | 0.126 | | 0.083 | | 0.093 | |
| Low vacancy rate | 0.221 | | 0.198 | | 0.231 | | 0.179 | | 0.214 | | 0.217 | | 0.239 | |
| High vacancy rate | 0.234 | | 0.254 | | 0.226 | | 0.266 | | 0.244 | | 0.240 | | 0.218 | |
| Homogeneous in year built | 0.248 | | 0.264 | | 0.241 | | 0.263 | | 0.264 | | 0.246 | | 0.238 | |
| Heterogeneous in year built | 0.238 | | 0.251 | | 0.232 | | 0.269 | | 0.236 | | 0.237 | | 0.229 | |
| Homogeneous in living area | 0.731 | | 0.738 | | 0.728 | | 0.735 | | 0.740 | | 0.728 | | 0.728 | |
| Heterogeneous in living area | 0.129 | | 0.132 | | 0.128 | | 0.139 | | 0.127 | | 0.134 | | 0.125 | |
| Owner-occupied neighborhood | 0.605 | | 0.588 | | 0.613 | | 0.566 | | 0.605 | | 0.602 | | 0.619 | |
| Rental neighborhood | 0.046 | | 0.050 | | 0.044 | | 0.055 | | 0.046 | | 0.046 | | 0.042 | |

Continued on next page

Table 2 continued

| | Pooled | | S=I | | S=O | | S=I × B=I | | S=I × B=O | | S=O × B=I | | S=O × B=O | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mean | sd | mean | sd | mean | sd | mean | sd | mean | sd | mean | sd | mean | sd |
| *Transaction type* | | | | | | | | | | | | | | |
| S = I | 0.304 | | 1 | | 0 | | 1 | | 1 | | 0 | | 0 | |
| S = O | 0.696 | | 0 | | 1 | | 0 | | 0 | | 1 | | 1 | |
| B = I | 0.386 | | 0.436 | | 0.364 | | 1 | | 0 | | 1 | | 0 | |
| B = O | 0.614 | | 0.564 | | 0.636 | | 0 | | 1 | | 0 | | 1 | |
| S=I × B=I | 0.133 | | 0.436 | | 0 | | 1 | | 0 | | 0 | | 0 | |
| S=I × B=O | 0.171 | | 0.564 | | 0 | | 0 | | 1 | | 0 | | 0 | |
| S=O × B=I | 0.254 | | 0 | | 0.364 | | 0 | | 0 | | 1 | | 0 | |
| S=O × B=O | 0.443 | | 0 | | 0.636 | | 0 | | 0 | | 0 | | 1 | |
| Observations | 71,604 | | 21,744 | | 49,860 | | 9,491 | | 12,253 | | 18,173 | | 31,687 | |

Note: CBD distance relates to the distance to the Intersection of Central Blvd and Orange Av. Orlando Fl. Property characteristics come from the OCPA tax rolls.

TABLE 3: ESTIMATION RESULTS FOR PRICE MODELS, OLS ESTIMATES

| | (1)<br>2001 - 2011 | (2)<br>2001 - 2011 | (3)<br>2001 - 2011 | (4)<br>2001 - 2006 | (5)<br>2007 - 2009 | (6)<br>2010 - 2011 |
|---|---|---|---|---|---|---|
| S=I | | -0.0288*** | | | | |
| | | (0.00215) | | | | |
| S=I × B=I | | | -0.0702*** | -0.0660*** | -0.0403*** | -0.103*** |
| | | | (0.00371) | (0.00419) | (0.0111) | (0.0108) |
| S=I × B=O | | | -0.0123*** | -0.0148*** | 0.000438 | -0.00668 |
| | | | (0.00252) | (0.00297) | (0.00692) | (0.00717) |
| S=O × B=I | | | -0.0217*** | -0.0165*** | -0.0285*** | -0.0476*** |
| | | | (0.00291) | (0.00298) | (0.00863) | (0.00897) |
| CBD distance | -0.0117** | -0.0127** | -0.0137** | -0.0105* | -0.0270** | -0.0190 |
| | (0.00572) | (0.00574) | (0.00575) | (0.00602) | (0.0119) | (0.0121) |
| CBD distance squared | 0.000789*** | 0.000866*** | 0.000917*** | 0.000809** | 0.00156*** | 0.000935* |
| | (0.000294) | (0.000296) | (0.000297) | (0.000335) | (0.000551) | (0.000549) |
| Walls concrete block stucco | 0.0535*** | 0.0533*** | 0.0532*** | 0.0500*** | 0.0503*** | 0.0969*** |
| | (0.00462) | (0.00458) | (0.00454) | (0.00469) | (0.00958) | (0.00988) |
| Number of bedrooms less than 3 | -0.0139*** | -0.0134*** | -0.0134*** | -0.0186*** | 0.0108 | 0.00306 |
| | (0.00505) | (0.00504) | (0.00500) | (0.00507) | (0.0147) | (0.0175) |
| Number of bedrooms more than 3 | -0.0119*** | -0.0114*** | -0.0106*** | -0.0103*** | -0.0145* | -0.00218 |
| | (0.00313) | (0.00312) | (0.00308) | (0.00318) | (0.00852) | (0.00778) |
| Log living area | 0.564*** | 0.561*** | 0.559*** | 0.534*** | 0.569*** | 0.717*** |
| | (0.00872) | (0.00872) | (0.00872) | (0.00927) | (0.0206) | (0.0223) |
| Number of baths = 1.00 | -0.0925*** | -0.0900*** | -0.0871*** | -0.0834*** | -0.0795*** | -0.197*** |
| | (0.00663) | (0.00663) | (0.00659) | (0.00635) | (0.0194) | (0.0246) |
| Number of baths = 1.50 | -0.0728*** | -0.0711*** | -0.0693*** | -0.0632*** | -0.0818*** | -0.130*** |
| | (0.00832) | (0.00828) | (0.00817) | (0.00773) | (0.0200) | (0.0296) |
| Number of baths = 2.50 | 0.0329*** | 0.0341*** | 0.0347*** | 0.0381*** | 0.0197** | 0.0113 |
| | (0.00421) | (0.00417) | (0.00414) | (0.00469) | (0.00948) | (0.00914) |
| Number of baths > 2.50 | 0.109*** | 0.110*** | 0.111*** | 0.112*** | 0.0926*** | 0.0660*** |
| | (0.00551) | (0.00548) | (0.00544) | (0.00583) | (0.0116) | (0.0121) |
| Pool | 0.0879*** | 0.0866*** | 0.0860*** | 0.0833*** | 0.0937*** | 0.110*** |
| | (0.00259) | (0.00258) | (0.00258) | (0.00281) | (0.00749) | (0.00725) |
| Log land | 0.254*** | 0.252*** | 0.251*** | 0.234*** | 0.273*** | 0.365*** |
| | (0.00512) | (0.00514) | (0.00510) | (0.00510) | (0.0107) | (0.0101) |
| Observations | 71,604 | 71,604 | 71,604 | 53,699 | 10,872 | 7,033 |
| R-squared | 0.772 | 0.773 | 0.774 | 0.786 | 0.671 | 0.851 |
| Bargain effect<br>b[S=I × B=O]-b[S=I × B=I] | | | 0.0579*** | 0.0512*** | 0.0407*** | 0.0967*** |
| | | | ( 0.004) | (0.004) | (0.0115) | (0.0116) |

Note: Dependent variable is log of transaction price. The reference category include Number of Bedrooms equals 3, and Number of Bathrooms equals 2,00. The reference category in Models (3) – (7) is transaction type S=O × B=O. All models include constant term, fixed effects for year × month, and location ZIP-level. Standard errors are clustered at census block. Standard errors of the Bargain effect are computed using the delta method. Standard errors in parentheses with *** , **, * indicating significant at 1%, 5% and 10%, respectively.

TABLE 4: SUMMARY OF ESTIMATION RESULTS BY YEAR, OLS ESTIMATES

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S=I × B=I | -0.109*** | -0.102*** | -0.0851*** | -0.0604*** | -0.0485*** | -0.0237*** | 0.00168 | -0.0485* | -0.117*** | -0.115*** | -0.0882*** |
| | (0.0147) | (0.0112) | (0.0105) | (0.00891) | (0.00786) | (0.00908) | (0.0157) | (0.0263) | (0.0198) | (0.0154) | (0.0144) |
| S=I × B=O | -0.0346*** | -0.0208*** | -0.00853 | -0.0199*** | -0.00337 | 0.00254 | 0.0109 | -0.00685 | -0.00746 | -0.00257 | -0.00910 |
| | (0.00673) | (0.00706) | (0.00697) | (0.00595) | (0.00713) | (0.00791) | (0.0116) | (0.0146) | (0.0111) | (0.00952) | (0.00992) |
| S=O × B=I | -0.0292*** | -0.0342*** | -0.0228*** | -0.0177*** | -0.000729 | 0.00432 | 0.00462 | -0.0552*** | -0.0619*** | -0.0451*** | -0.0482*** |
| | (0.00805) | (0.00757) | (0.00536) | (0.00506) | (0.00707) | (0.00818) | (0.0116) | (0.0173) | (0.0158) | (0.0153) | (0.0103) |
| Bargain effect b[S=I × B=O]-b[S=I × B=I] | 0.0747*** | 0.0807*** | 0.0765*** | 0.0405*** | 0.0451*** | 0.0263*** | 0.009 | 0.0417 | 0.109*** | 0.112*** | 0.079*** |
| | (0.0141) | (0.011) | (0.010) | (0.009) | (0.008) | (0.010) | (0.0165) | (0.030) | (0.019) | (0.016) | (0.015) |
| Observations | 7,531 | 7,781 | 9,319 | 9,704 | 10,849 | 8,515 | 4,938 | 2,960 | 2,974 | 3,284 | 3,749 |
| R-squared | 0.755 | 0.737 | 0.734 | 0.786 | 0.734 | 0.652 | 0.604 | 0.626 | 0.791 | 0.841 | 0.863 |

Note: the dependent variable is log transaction value. Similar structural attributes as before. All models include constant term, fixed effects for month, and location ZIP-level. Standard errors are clustered at census block. Standard errors of the Bargain effect are computed using the delta method. Standard errors in parentheses with *** , **, * indicating significant at 1%, 5% and 10%, respectively.

TABLE 5: SUMMARY OF ESTIMATION RESULTS BY NEIGHBORHOOD TYPE, OLS ESTIMATES

| VARIABLES | (1) Low Density | (2) High Density | (3) Old Neighborhood | (4) New Neighborhood | (5) Low Vacancy | (6) High Vacancy | (7) Homo in Age | (8) Hetero in Age | (9) Homo Living area | (10) Hetero Living area | (11) Owner-occupier Neighborhood | (12) Rental Neighborhood |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S=I × B=I | -0.116*** | -0.00540 | -0.116*** | -0.00270 | -0.0619*** | -0.0661*** | -0.0677*** | -0.112*** | -0.0751*** | -0.0699*** | -0.0631*** | -0.100*** |
| | (0.00818) | (0.00718) | (0.00669) | (0.00658) | (0.00818) | (0.00841) | (0.00695) | (0.00886) | (0.00461) | (0.0102) | (0.00482) | (0.0222) |
| S=I × B=O | -0.0131** | -0.00384 | -0.00757 | -0.00921 | -0.0193*** | 0.00119 | -0.00101 | -0.0204*** | -0.0117*** | -0.0198** | -0.0138*** | -0.00376 |
| | (0.00528) | (0.00466) | (0.00526) | (0.00570) | (0.00527) | (0.00532) | (0.00488) | (0.00595) | (0.00290) | (0.00778) | (0.00350) | (0.0135) |
| S=O × B=I | -0.0540*** | 0.0133** | -0.0650*** | 0.0116* | -0.0282*** | -0.0134** | -0.0202*** | -0.0433*** | -0.0234*** | -0.0190** | -0.0152*** | -0.0294 |
| | (0.00554) | (0.00550) | (0.00523) | (0.00628) | (0.00548) | (0.00643) | (0.00471) | (0.00596) | (0.00335) | (0.00780) | (0.00357) | (0.0180) |
| Bargain effect b[S=I × B=O]-b[S=I × B=I] | 0.103*** | 0.0016 | 0.109*** | 0.0065 | 0.043*** | 0.067*** | 0.066*** | 0.091*** | 0.063*** | 0.050*** | 0.049*** | 0.097*** |
| | (0.009) | (0.006) | (0.008) | (0.0065) | (0.008) | (0.008) | (0.007) | (0.009) | (0.005) | (0.011) | (0.005) | (0.022) |
| Observations | 18,629 | 15,034 | 21,770 | 6,971 | 15,819 | 16,787 | 17,747 | 17,022 | 52,342 | 9,266 | 43,337 | 3,255 |
| R-squared | 0.755 | 0.825 | 0.724 | 0.831 | 0.773 | 0.793 | 0.747 | 0.770 | 0.764 | 0.823 | 0.785 | 0.766 |

Note: the dependent variable is log transaction value. Similar structural attributes as before. All models include constant term, fixed effects for year × month, and location ZIP-level. Standard errors are clustered at census block. Standard errors of the Bargain effect are computed using the delta method. Standard errors in parentheses with *** , **, * indicating significant at 1%, 5% and 10%, respectively.

TABLE 6: ESTIMATION RESULTS FOR PRICE MODELS, OLS ESTIMATES ON MATCHED SAMPLES

| | (1)<br>2001 - 2011 | (2)<br>2001 - 2006 | (3)<br>2007 - 2009 | (4)<br>2010 - 2011 |
|---|---|---|---|---|
| S=I × B=I | -0.0700*** | -0.0704*** | -0.0113 | -0.110*** |
| | (0.00490) | (0.00539) | (0.0172) | (0.0131) |
| S=I × B=O | -0.0115*** | -0.0189*** | 0.0264* | -0.0158 |
| | (0.00387) | (0.00421) | (0.0143) | (0.0114) |
| S=O × B=I | -0.0352*** | -0.0308*** | -0.0231 | -0.0830*** |
| | (0.00578) | (0.00594) | (0.0228) | (0.0216) |
| CBD distance | -0.00974 | -0.00823 | -0.0182 | -0.0142 |
| | (0.00762) | (0.00812) | (0.0212) | (0.0182) |
| CBD distance squared | 0.000774** | 0.000741* | 0.00109 | 0.000788 |
| | (0.000373) | (0.000401) | (0.000995) | (0.000858) |
| Walls concrete block stucco | 0.0597*** | 0.0519*** | 0.0690*** | 0.122*** |
| | (0.00576) | (0.00624) | (0.0165) | (0.0146) |
| Number of bedrooms less than 3 | -0.0191** | -0.0275*** | 0.0315 | -0.0110 |
| | (0.00827) | (0.00809) | (0.0283) | (0.0211) |
| Number of bedrooms more than 3 | -0.00948* | -0.0125*** | -0.00511 | -0.00462 |
| | (0.00490) | (0.00474) | (0.0145) | (0.0120) |
| Log living area | 0.540*** | 0.511*** | 0.578*** | 0.675*** |
| | (0.0127) | (0.0131) | (0.0387) | (0.0313) |
| Number of baths = 100 | -0.0919*** | -0.0848*** | -0.105*** | -0.230*** |
| | (0.00830) | (0.00832) | (0.0306) | (0.0304) |
| Number of baths = 150 | -0.0770*** | -0.0788*** | -0.0771** | -0.0885** |
| | (0.0135) | (0.0134) | (0.0314) | (0.0374) |
| Number of baths = 250 | 0.0342*** | 0.0384*** | 0.0153 | 0.0156 |
| | (0.00549) | (0.00602) | (0.0156) | (0.0131) |
| Number of baths = 300+ | 0.101*** | 0.103*** | 0.0753*** | 0.0636*** |
| | (0.00781) | (0.00801) | (0.0236) | (0.0163) |
| Pool | 0.0890*** | 0.0919*** | 0.0837*** | 0.104*** |
| | (0.00405) | (0.00480) | (0.0123) | (0.0114) |
| Log land | 0.247*** | 0.232*** | 0.275*** | 0.348*** |
| | (0.00652) | (0.00655) | (0.0157) | (0.0154) |
| Observations | 43,488 | 33,019 | 6,329 | 4,140 |
| R-squared | 0.769 | 0.780 | 0.669 | 0.851 |
| Bargain effect<br>b[S=I × B=O]-b[S=I × B=I] | 0.0585*** | 0.0515*** | 0.0377*** | 0.0941*** |
| | ( 0.004) | (0.004) | (0.0119) | (0.0115) |

Note: Dependent variable is log of transaction value. The reference category include Number of Bedrooms equals 3, and Number of Bathrooms equals 2,00. The reference category in Models (1) – (4) is transaction type S=O × B=O. All models include constant term, fixed effects for year × month, and location ZIP-level. Standard errors are clustered at census block. Standard errors of the Bargain effect are computed using the delta method. Standard errors in parentheses with *** , **, * indicating significant at 1%, 5% and 10%, respectively. Matched samples are obtained using propensity score matching.

TABLE 7: SUMMARY OF ESTIMATION RESULTS BY YEAR, OLS ESTIMATES ON MATCHED SAMPLES

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S=I × B=I | -0.105*** | -0.111*** | -0.0771*** | -0.0591*** | -0.0590*** | -0.0343** | 0.0320 | -0.0180 | -0.0959*** | -0.134*** | -0.0810*** |
| | (0.0177) | (0.0138) | (0.0123) | (0.0122) | (0.0111) | (0.0137) | (0.0268) | (0.0379) | (0.0268) | (0.0179) | (0.0178) |
| S=I × B=O | -0.0313*** | -0.0309*** | -0.00190 | -0.0203** | -0.0143 | -0.00963 | 0.0424* | 0.0193 | 0.00768 | -0.0262* | -0.00262 |
| | (0.0107) | (0.00997) | (0.0102) | (0.00922) | (0.0110) | (0.0132) | (0.0232) | (0.0271) | (0.0211) | (0.0158) | (0.0143) |
| S=O × B=I | -0.0428*** | -0.0583*** | -0.0169 | -0.0180* | -0.0323** | -0.00572 | -0.0158 | -0.0299 | -0.0146 | -0.113*** | -0.0510** |
| | (0.0146) | (0.0159) | (0.0131) | (0.0106) | (0.0142) | (0.0169) | (0.0346) | (0.0388) | (0.0406) | (0.0372) | (0.0224) |
| Bargain effect<br>b[S=I × B=O]-b[S=I × B=I] | 0.0738*** | 0.0800*** | 0.0752*** | 0.0388*** | 0.0447*** | 0.0247*** | 0.0104 | 0.0373 | 0.1036*** | 0.1074*** | 0.079*** |
| | (0.0143) | (0.012) | (0.010) | (0.009) | (0.008) | (0.010) | (0.0171) | (0.0305) | (0.0193) | (0.0165) | (0.015) |
| Observations | 4,797 | 4,904 | 5,668 | 5,916 | 6,584 | 5,150 | 2,977 | 1,646 | 1,706 | 1,995 | 2,145 |
| R-squared | 0.724 | 0.735 | 0.706 | 0.780 | 0.742 | 0.681 | 0.623 | 0.629 | 0.791 | 0.841 | 0.864 |

Note: the dependent variable is log transaction value. Similar structural attributes as before. All models include constant term, fixed effects for month, and location ZIP-level. Standard errors are clustered at census block. Standard errors of the Bargain effect are computed using the delta method. Standard errors in parentheses with *** , **, * indicating significant at 1%, 5% and 10%, respectively. Matched samples are obtained using propensity score matching.

TABLE 8: SUMMARY OF ESTIMATION RESULTS BY NEIGHBORHOOD TYPE, OLS ESTIMATES ON MATCHED SAMPLES

| VARIABLES | (1)<br>Low<br>Density | (2)<br>High<br>Density | (3)<br>Old<br>Neighborhood | (4)<br>New<br>Neighborhood | (5)<br>Low<br>Vacancy | (6)<br>High<br>Vacancy | (7)<br>Homo<br>Built | (8)<br>Hetero<br>Built | (9)<br>Homo<br>Living area | (10)<br>Hetero<br>Living area | (11)<br>Owner-occupier<br>Neighborhood | (12)<br>Rental<br>Neighborhood |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S=I × B=I | -0.106*** | -0.016*** | -0.100*** | -0.010 | -0.049*** | -0.0756*** | -0.072*** | -0.113*** | -0.0751*** | -0.0674*** | -0.0648*** | -0.0697*** |
| | (0.0127) | (0.0080) | (0.0109) | (0.0092) | (0.0106) | (0.010) | (0.010) | (0.012) | (0.0059) | (0.0140) | (0.0063) | (0.0258) |
| S=I × B=O | -0.0028 | -0.0119* | 0.0073 | -0.0154* | -0.0057 | -0.009 | -0.00575 | -0.019** | -0.0114** | -0.0145 | -0.0142*** | -0.0349 |
| | (0.0087) | (0.0069) | (0.0087) | (0.0089) | (0.008) | (0.008) | (0.008) | (0.009) | (0.0045) | (0.0130) | (0.0051) | (0.0225) |
| S=O × B=I | -0.068*** | -0.00218 | -0.075*** | 0.0104 | -0.0185* | -0.0268** | -0.0404*** | -0.058*** | -0.041*** | -0.0181 | -0.0288*** | -0.0569* |
| | (0.0126) | (0.0089) | (0.012) | (0.0107) | (0.0099) | (0.0113) | (0.0093) | (0.012) | (0.0068) | (0.0175) | (0.0065) | (0.0298) |
| Bargain effect<br>b[S=I × B=O]-b[S=I × B=I] | 0.103*** | 0.0042 | 0.107*** | -0.0052 | 0.044*** | 0.066*** | 0.066*** | 0.095*** | 0.064*** | 0.053*** | 0.051*** | 0.105*** |
| | (0.009) | (0.006) | (0.008) | (0.0067) | (0.008) | (0.008) | (0.007) | (0.010) | (0.005) | (0.011) | (0.005) | (0.022) |
| Observations | 12,101 | 8,929 | 14,922 | 4,447 | 8,909 | 10,650 | 11,204 | 10,691 | 31,939 | 5,726 | 25,680 | 2,120 |
| R-squared | 0.748 | 0.835 | 0.702 | 0.839 | 0.769 | 0.787 | 0.755 | 0.762 | 0.759 | 0.824 | 0.783 | 0.770 |

Note: the dependent variable is log transaction value. Similar structural attributes as before. All models include constant term, fixed effects for year × month, and location ZIP-level. Standard errors are clustered at census block. Standard errors of the Bargain effect are computed using the delta method. Standard errors in parentheses with *** , **, * indicating significant at 1%, 5% and 10%, respectively.
Matched samples are obtained using propensity score matching.