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Bargaining power and segmented markets: Evidence from rental and owner-occupied housing

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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 article integrates bargaining into the search model to investigate bargaining for housing across investors and owner-occupiers when the investment housing segment is also subject to a rental property discount. It provides a framework for empirically identifying separate price effects of property type and bargaining power. We exploit homestead exemption information to empirically identify sellers and buyers as investors or owner-occupiers. Data from Orange County, Florida, over 2000–2012 show a greater rental discount when controlling for investor bargaining power than when estimated in the conventional manner. In addition, investor relative bargaining power is not the same when selling to an owner-occupier as when buying from an owner-occupier. The results are robust across market phases and across neighborhoods.

KEYWORDS

bargaining, investors, market segments, owner-occupiers, rental externality, rental house

1 | INTRODUCTION

It is widely accepted that rental houses sell for less than owner-occupied houses. The rationales for this persistent result include hard use by tenants and poor maintenance by landlords, as well as the difficulty of showing rental property when tenants are present (Harding et al., 2000; Iwata & Yamaga, 2008).[1] Although reasonable, these arguments overlook bargaining power in segmented markets: rental houses are sold by investors who may have better bargaining skills than owner-occupiers. 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 rental house prices reflect two separate factors—the long recognized rental discount and investor bargaining power. Neither pertains to houses sold by owner-occupiers to other owner-occupiers. Therefore, the key question is how much of the observed persistent price differential for rental houses can be attributed to the rental discount and how much to differences in bargaining power between investors and others.

House price differentials across sales are generally attributed to asymmetric information or differences in bargaining power among sellers and buyers in real estate asset markets (Bayer et al., 2017; Bracke, 2021; Harding, Knight, & Sirmans, 2003; Harding, Rosenthal, & Sirmans, 2003; Hayunga & Munneke, 2021; Ihlanfeldt & Mayock, 2009, 2012). These studies basically find that bargaining power is lower for sellers of vacant units (Clauretie & Wolverton, 2006; Harding, Knight, & Sirmans, 2003) and in rental-dominated neighborhoods (Turnbull & Zahirovic-Herbert, 2011), while it is higher for younger and more educated buyers (Ihlanfeldt & Mayock, 2009; Harding, Rosenthal, & Sirmans, 2003; HUD, 2013; Myers, 2004). These studies do not, however, answer our question for rental houses that include both the rental discount and bargaining power price effects.

We formulate a choice-theoretic model of search and bargaining that is consistent with the observed rental discount while allowing for bargaining power price effects. We show that sellers' and buyers' ex ante reservation prices and maximum willingness to pay depend on their uncertain bargaining power in the later stage of the transaction (the price negotiation stage) with uncertainty arising from the unknown identity of their eventual transaction counterparties. Each party's perceived expected bargaining power alters their reservation price or maximum willingness-to-pay, which alters the potential gains from trade in subsequent bargaining. The ex post price thus reflects both how the potential gains from trade are affected ex ante by expected bargaining power and how the potential gains from trade are split ex post, the latter being the focus of previous approaches.[2] We show how information in segmented markets for heterogeneous goods can be exploited to identify bargaining power differences across sellers and buyers without imposing the strong bargaining power symmetry assumption underpinning the approach taken by Harding, Rosenthal, & Sirmans (2003) and subsequent studies. We provide an empirical approach

[1] The literature sometimes refers to this as a *rental externality* (Henderson & Ioannides, 1983). Rather than an externality in the sense that outside properties are affected, the terminology instead refers to the effects of tenant behavior on the value of the landlord's residual interest. It is, however, often used to denote any of the factors reducing rental house value, including those listed here. To reduce ambiguity, we instead use the more general term *rental discount* to reflect all of these factors.

[2] For example, Harding, Rosenthal, & Sirmans (2003) informally cast the reduced form bargaining power approach in terms of the division of gains from trade between sellers and buyers. They do not consider the price consequences of bargaining power on the search process itself which, as is shown here, determines threat points, hence potential gains from trade.

for separating bargaining power effects from the underlying rental discount, which is consistent with both search and bargaining models.

In our empirical analysis, we aim to identify how much of the observed price differentials can be attributed to the rental discount and how much to differences in bargaining power. However, importantly, observed price differentials might also reflect unobserved differences in housing quality. These differences may relate to unmeasured quality differences at the time of construction (the stock of quality) and those arising from differences in maintenance (the flow of quality). We will explore several different estimation strategies to reduce the effect of unobserved differences in housing quality. We draw upon transaction and property data from Orange County, Florida, over 2000–2012. We observe precise information about housing characteristics, location, and surrounding parcels. We use the existence of a homestead exemption for owner-occupiers to distinguish between investors and owner-occupiers; homestead exemption is highly valuable,[3] so owner-occupiers have strong incentives to self-identify to obtain the benefit.

Unobserved heterogeneity is a concern in this type of analysis, so we employ several different estimation strategies to minimize its effects on our results. We include a control for the subject property age relative to the average age of properties in the neighborhood, recognizing that older homes may be more likely to filter into rental properties than newer properties (Bruecker & Rosenthal, 2009). We also directly address heterogeneity in neighborhood quality, both by controlling for neighborhood fixed effects and by adapting the approach taken by Aliprantis (2017), combining several measures of neighborhood quality into a single-dimensional neighborhood quality index of observable and unobservable characteristics. We use the resultant single quality index to define high- and low-quality neighborhoods to control for neighborhood quality in the estimation. As an alternative, we also apply propensity scoring to create matched samples on observables for properties that have been ever investor sold to control for possible selection and heterogeneity effects driving the transition of properties into and out of the rental sector. We will show that our conclusions are robust across all approaches and that the Oster (2019) test provides no evidence that the empirical results are being driven by unobservable heterogeneity effects.

Our empirical results are consistent with the expected pattern of parameter estimates. Bargaining power affects rental discount estimates; the discount for rental property is smaller when estimated in the conventional manner—ignoring bargaining power—than when controlling for bargaining power. The rental discount and bargaining power effects also vary systematically over phases of the housing market cycle, generally weakening near the peak of the boom market and in the immediate postcrash period. Finally, investor bargaining power relative to owner-occupiers depends on whether they are sellers or buyers in the transaction.

2 | A MODEL OF SEARCH, BARGAINING AND SELLING PRICE

This section introduces Nash bargaining into the canonical housing market search model. The framework extends earlier search-bargaining models (Turnbull & Zahirovic-Herbert, 2011; Yavas, 1992) to allow each individual seller and buyer to recognize that they do not know whether they will end up bargaining with an owner-occupier or an investor when determining their stopping rule for the anticipated search. Owner-occupiers and investors have different degrees of market acumen or trading experience or have different outside options; hence, they may exhibit different

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

relative bargaining powers. Investor sellers face an additional complication of the rental property discount or the reduction in buyer willingness-to-pay associated with investment properties that have been occupied by renters. The presence of a rental discount means that property valuation varies whether the seller is an investor or owner-occupier, a case not addressed in earlier studies (Harding, Knight, & Sirmans, 2003; Harding, Rosenthal, & Sirmans, 2003; Turnbull & Zahirovic-Herbert, 2012).

2.1 The setting

We adopt the following terminology to distinguish the variety of households involved in transactions (Appendix A defines all notation). Sellers and buyers vary by what we label *class*—investor or owner-occupier—indicated with subscripts I and O, respectively. They also vary by what we label *type*, differences reflecting their underlying idiosyncratic utility, or personal valuation of a house with characteristics vector x.[4] Seller types are indexed by s, and buyer types are indexed by b.

The general structure of the problem is as follows. This is a two-stage game. In the first stage, each seller of type s sets their minimum reservation price $r(s, x)$, and each buyer of type b sets their maximum willingness-to-pay $w(b, x)$ for a house with characteristics vector x. The market distribution function for seller types is $S(s)$ and for buyer types is $B(b)$. It is sufficient to consider the simplest search model with no time discounting and a stationary distribution of types. Let us consider a seller of a house with characteristics vector x. The seller is forward-looking and rational and thus understands that buyers in the next stage of the game create ex ante uncertainty that is resolved only after the reservation price is set. Therefore, in the first stage of the game, the seller sets the reservation price $r(s, x)$. The reservation price follows the optimal stopping rule: negotiate with the first buyer for whom the expected negotiated price exceeds or equals the seller's reservation price, or else wait for another potential buyer (Lippman & McCall, 1976). Each rational buyer of type b has a similar rule, setting their maximum willingness-to-pay $w(b, x)$ to fulfill the parallel optimal stopping rule: negotiate for the house if they expect the final price to be less than or equal to their willingness-to-pay for the property; otherwise continue searching. In the second stage of the game, the seller and buyer bargain to determine selling price P, and the transaction is consummated.

We use the backward solution method to derive the properties of the seller and buyer reservation price and willingness-to-pay strategies that are consistent with the distribution of final stage (bargaining) outcomes. This approach yields a Bayesian–Nash solution to the game.[5] Note that

[4] Owner-occupier utility is a function of their consumption value of the property characteristics. Investor utility is a function of expected profit generated by the property, which in turn reflects the utility that anticipated renters derive from the property characteristics.

[5] Following the approach of Harsányi (1967–1968), the search environment in this game allows us to model the first stage incomplete information of each party (not knowing the identity, hence reservation price or the willingness-to-pay of their transaction counterparty) as uncertainty or imperfect information in which counterparty identification is stochastic and modeled as a random move by nature. When recast as an imperfect information game, the consistency condition stated in the text fulfills the consistent player prior beliefs condition for Bayesian–Nash equilibrium. The prior beliefs condition in Bayesian–Nash equilibrium rules out differences in investor and owner-occupier bid and offer functions arising from differences in beliefs about $B(b)$ and $S(s)$ distribution functions in contrast with Bracke (2021).

rental houses are subject to the discount $v(x)$, the loss of value associated with rental property.[6] We suppress characteristics vector x in what follows.

In the second stage of the game, the Nash bargaining outcome is the selling price maximizing the weighted surplus of each party in the transaction (Binmore, et al., 1986; Nash, 1950) or

$$P \equiv \arg\max\,(P-r)^{\alpha}(w-P)^{(1-\alpha)},$$

where $w(b)$ and $r(s)$ are the buyer's willingness-to-pay (maximum bid) and seller's reservation price (minimum offer) for the house, defined earlier, and the parameter α_{ij} summarizes seller class i's bargaining power or negotiating skills relative to buyer class j. Suppressing subscript notation for the time being, the selling price for given seller and buyer under Nash bargaining is

$$P = \alpha w + (1-\alpha) r. \tag{1}$$

Turning to the first stage of the game, sellers and buyers fully recognize the nature of the second stage uncertainty and the possibilities of how it will be resolved when making their first-stage decisions. By construction, their first-stage decisions are consistent with the equilibrium distribution of possible second-stage outcomes.

We assume no bargaining power advantage when the same class of seller and buyer are on opposite sides of a transaction, that is, $\alpha_{II} = \alpha_{OO} = 0.5$. At the same time, owner-occupiers and investors know they enjoy different bargaining power when on opposite sides of a transaction, say $\alpha_{OI,}$ when the seller is an owner-occupier and buyer an investor. We also allow for the possibility that investors' more frequent transactions in the housing market and their participation in the market, as landlords may provide them with skills that yield greater bargaining power than owner-occupiers, so that $\alpha_{OI} < 0.5$ and $\alpha_{IO} > 0.5$, although this pattern is not essential for what follows.

2.2 | Seller ex ante strategy

Each seller and buyer knows their own class (investor or owner-occupier), their own type (s and b, respectively), the mix of investors and owner-occupiers participating in the market, and the distribution functions S and B. They do not, however, know with certainty the class $\{I, O\}$, or type of buyer (b) or seller (s) with whom they will engage in the search sequence or as their counterparty in the transaction.

Consider an owner-occupier seller first. The seller knows that the probability of an owner-occupier arriving is π and the probability of an investor is $(1-\pi)$. The seller's house does not exhibit the rental discount, so if the buyer wants to bargain, the negotiated price will be

$$P_{OO} = 0.5\,(w + r_O) \tag{2}$$

if the buyer is an owner-occupier and

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

[6] This rental discount is independent of the bargaining power differential that come from different degrees of market acumen, trading experience, or different outside options.

if the buyer is an investor, where δ_b is a willingness-to-pay variation (which we shall show later is nonzero if there is a difference in relative bargaining power) arising from an investor's bargaining power when buying from an owner-occupier. Given the payoffs to the seller for the possible outcomes, the seller's optimal strategy is to negotiate with the first buyer whose willingness-to-pay exceeds the seller's reservation price r_O. For notational convenience, the buyer class indicator function I equals 1 for investor buyers, and 0 otherwise. Then, the reservation price r_O sets the marginal benefit of waiting for the next buyer, and the expected gain in seller surplus $E_{w-I\delta\geq r}(P-r)$, is equal to the marginal cost of additional search or waiting c (Lippman & McCall, 1976), which in this case can be expressed as

$$\pi \int_{w\geq r} (P_{OO} - r_O)\, dB + (1-\pi) \int_{w-\delta\geq r} (P_{OI} - r_O)\, dB = c.$$

Substituting the Nash bargaining prices into this condition yields

$$0.5\pi \int_{w\geq r} (w - r_O)\, dB + \alpha_{OI}(1-\pi) \int_{w-\delta\geq r} (w-\delta - r_O)\, dB = c. \tag{4}$$

Next, let us consider an investor selling a house with identical characteristics vector x, except now it is a rental property. The investor seller's reservation price is r_I. Given the rental discount v, the negotiated prices are

$$P_{II} = 0.5\,(w - \delta_b - v + r_I) \tag{5}$$

if the buyer is also an investor, and

$$P_{IO} = \alpha_{IO}\,(w - v) + (1-\alpha_{IO})\, r_I \tag{6}$$

if the buyer is an owner-occupier.

The investor seller's optimal reservation price satisfies the optimal stopping rule

$$\pi \int_{w-v\geq r} (P_{IO} - r_I)\, dB + (1-\pi) \int_{w-\delta-v\geq r} (P_{II} - r_I)\, dB = c,$$

where the distribution of buyer types by willingness to pay is $B(s)$. Substituting the Nash bargaining prices into this condition yields

$$\alpha_{IO}\pi \int_{w-v\geq r} (w - v - r_I)\, dB + 0.5(1-\pi) \int_{w-\delta_b-v\geq r} (w - \delta_b - v - r_I)\, dB = c. \tag{7}$$

Implicitly differentiating (7) yields $\partial r_I/\partial v = -1$. Using this result, if $\alpha_{IO} = \alpha_{OI} = 0.5$ so that investors and owner-occupiers have equal bargaining power, then (4) and (7) imply $r_I = (r_O - v)$. If, however, investors have stronger bargaining power than owner-occupiers, then $\alpha_{OI} < 0.5$ ($\alpha_{IO} > 0.5$) which, with $\partial r_O/\partial\alpha_{OI} > 0$ and $\partial r_I/\partial\alpha_{IO} > 0$ from (4) and (7), imply that the investor seller's reservation price includes a variational term $\delta_s > 0$ arising from the investor's relatively stronger bargaining power when conducting a transaction with an owner-occupier buyer; therefore,[7]

$$r_I = (r_O - v) + \delta_s. \tag{8}$$

[7] It can be shown that the variation is negative if the owner-occupier enjoys relatively stronger bargaining power when dealing with investors. The empirical results, of course, will show which case pertains.

2.3 | Buyer ex ante strategy

The derivation of buyer's willingness-to-pay in the first stage parallels the derivation of seller's reservation price. First, let us consider an owner-occupier buyer. This buyer is willing to pay w for houses with the given characteristics if owner-occupied and $(w - v)$ if it is a rental property. If the buyer's reservation price or willingness-to-pay for this house is w_O, then the Nash bargaining price in the second stage of the game is

$$P_{OO} = 0.5\,(w_O + r_O), \tag{9}$$

while for a house being sold by an investor, the selling price is

$$P_{IO} = \alpha_{IO}\,(w_O - v) + (1 - \alpha_{IO})\,(r_O - v + \delta_s), \tag{10}$$

taking into account the rental discount, where δ_b is the reservation price variation derived in the seller reservation price strategy model above. The increment to buyer surplus from a completed transaction is $(w - P)$ for owner-occupied houses and $w - v - P$ for rental houses. Given the above payoffs, the buyer's optimal strategy is to negotiate to buy the first property in the search that has a selling price at or below his willingness-to-pay. Let the seller class indicator function I be 1 for investor sellers, and 0 otherwise. The optimal willingness-to-pay of an owner-occupier w_O satisfies the optimal search condition that the marginal benefit of searching for the next house, the expected gain in buyer surplus $E_{w-I\delta\geq r}(w - Iv - P)$, equals the marginal cost of additional search or waiting, c, expressed as

$$\pi \int_{w\geq r_O} (w_O - P_{OO})\,dS \;+\; (1 - \pi) \int_{w\geq r_O+\delta-v} (w_O - v - P_{OI})\,dS \;=\; c.$$

Substituting the Nash bargaining prices yields

$$0.5\pi \int_{w\geq r} (w_O - r_O)\,dS \;+\; \alpha_{IO}\,(1 - \pi) \int_{w-v\geq r} (w_O - \delta_s - r_O)\,dS \;=\; c. \tag{11}$$

Now consider an investor buying an otherwise identical house. If it is a rental property, given the rental discount, v, the Nash bargaining price will be

$$P_{II} = 0.5\,(w_I + r_O + \delta_s) - v. \tag{12}$$

If the seller is an owner-occupier, the price is

$$P_{OI} = \alpha_{OI}\,w_I + (1 - \alpha_{OI})\,r_O. \tag{13}$$

The investor buyer's optimal willingness-to-pay condition is

$$\pi \int_{w\geq r} (w_I - P_{OI})\,dS \;+\; (1 - \pi) \int_{w-v\geq r} (w_I - P_{II})\,dS \;=\; c.$$

Substituting the Nash bargaining prices into this condition yields

$$\alpha_{OI}\pi \int_{w\geq r} (w_I - r_O)\, dS \;+\; 0.5(1 \;-\; \pi) \int_{w-v\geq r} (w_I - \delta_s - r_O)\, dS \;=\; c\,. \tag{14}$$

When we follow the procedure used in the seller's case to derive the investor buyer's willingness-to-pay variation from the owner-occupier's willingness-to-pay, suppose $\alpha_{IO} = \alpha_{OI} = 0.5$, so that investors and owner-occupiers have equal bargaining power. Then (11) and (14) require $w_I = w_O$. If, however, investors have stronger bargaining power than owner-occupiers, then $\alpha_{OI} < 0.5$ ($\alpha_{IO} > 0.5$), which, with $\partial w_O / \partial \alpha_{IO} > 0$ and $\partial w_I / \partial \alpha_{OI} > 0$ from (11) and (14), imply that the investor buyer's willingness to pay includes the variation $-\delta_b < 0$ from the investor's relatively stronger bargaining power when conducting a transaction with an owner-occupier; therefore,

$$w_I = w_O - \delta_b, \tag{15}$$

which is the same relationship used in the derivation of the seller's optimal reservation price strategy. Hence, if neither buyer nor seller enjoys a relative advantage, then it turns out that the investor buyer's willingness-to-pay variation δ_b is the same as the (absolute value of) the investor seller's reservation price variation from bargaining power δ_s.

2.4 | Nash bargaining equilibrium prices

Assuming that investors have no relative bargaining power advantage when their counterparty is also an investor implies that $\delta_s = \delta_b = \delta$ is in equilibrium. The second-stage realized Nash bargaining prices implied by the Bayesian–Nash solution are

$$\begin{aligned} P_{OO} &= 0.5(w + r) \\ P_{OI} &= \alpha_{OI}\, w + (1 - \alpha_{OI})\, r - \alpha_{OI}\delta \\ P_{IO} &= \alpha_{IO}\, w + (1 - \alpha_{IO})\, r + (1 - \alpha_{IO})\,\delta - v \\ P_{II} &= 0.5(w + r) - v \end{aligned} \tag{16}$$

using $w_O = w$ and $r_O = r$ to simplify notation. Taking expectations over the distribution of buyer and seller types yields expected selling prices. In any case, these relationships show that the extent to which property prices contain the effects of both bargaining power (α and δ) and rental discount (v) depends on the mix of owner-occupiers and investors on each side of the transactions.

Note that even with the same investor reservation price r_I and willingness-to-pay variation δ, the investor's relative bargaining power may differ, depending on whether they are sellers or buyers facing an owner-occupier; that is, α_{OI} and $1 - \alpha_{IO}$ need not be equal. Harding, Rosenthal, & Sirmans (2003) assume $\alpha_{OI} = 1 - \alpha_{IO}$ in their empirical reduced form approach to integrating bargaining into the hedonic framework. In contrast, the structural approach taken here derives price relationships consistent with optimizing Bayesian agents engaging in search with subsequent bargaining to find that this restriction is not essential and is instead an empirically testable relationship.

TABLE 1 Rental discount and bargaining power price effects

Buyer Seller	Investor	Owner-occupier
Investor	Rental discount $[S = I \times B = I]$	Rental discount + Bargaining differential[a] $[S = I \times B = O]$
Owner-occupier	Bargaining differential[a] $[S = O \times B = I]$	Baseline $[S = O \times B = O]$

[a]Investor relative bargaining power need not be the same for investor sellers as investor buyers.

Table 1 summarizes the key empirical relationships implied by (16). The top row identifies the buyer class, and the first column identifies the seller class. The sales prices of owner-occupied properties to investors only include bargaining power effects. In contrast, sales prices of rental properties to owner-occupiers include a mix of bargaining power and rental discount effects. Conversely, selling prices of rental properties to investors only include rental discount effects, which provides the opportunity to measure the pure rental discount as the difference in expected prices $P_{II} - P_{OO} = -\upsilon$. This estimate is needed to evaluate the investor bargaining power effect, α_{IO}, and to test whether the bargaining power symmetry imposed by Harding, Rosenthal, & Sirmans (2003), Harding, Knight, & Sirmans (2003), and Hayunga and Munneke (2021) holds for investors facing owner-occupiers in transactions.

3 | DATA

Data cover Orange County, Florida, and come from Orange County Property Appraiser (OCPA) records. These annual property tax records consist of information on property characteristics, ownership, and transactions for the entire stock of properties. For every property, we have information on property features, mailing address of owner(s), homestead exemption details, and the five most recent transactions. Information about transactions includes deed type, sale date, and sale amount. We gather sales for single-family dwellings (SFD) with the owner's mailing address located in Orange County Florida over each of the tax years 2000–2012.

The empirical analysis draws upon the arms-length transactions of SFD. Arm-length transactions exclude all foreclosures, special warranty deeds, tax claim deeds, quit claims, and deeds transferred for administrative reasons.[8] From these, we select the transactions for which the mailing address of the owner is in Orange County, Florida, to reduce heterogeneity in buyer type. Selecting in-county owners only removes all out-of-county owners, of which some are out-of-town investors while others are second-home owners.

We use tax records to identify two types of buyers and two types of property segments: Investors who hold property for rental use reasons and owner-occupiers who hold it for private use reasons. We identify these types 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.[9] Owners may claim homestead exemptions as

[8] Arms-length transactions include warranty deed transactions as well as short sales transactions.

[9] Ihlanfeldt (2021) indicates an immediate flat-rate exemption of about $1,000, and a cap-related saving—which depends on the assessed value and the holding period—of another $1,000 (when evaluated at our sample mean sales value of $208,000, a mileage rate of 17%, a cap of 2% or a benefit of 3%).

US citizen or green-card holder, if permanently living in the house and not already receiving a homestead exemption in or outside of Florida.

Homestead exemption could be prone to measurement error when some eligible homeowners do not apply, whereas others may claim it who are not eligible. First, understating homestead exemption would arise if an eligible owner has not applied for exemption. Homestead exemption filing is an administrative process in which owner-occupiers need to initially file or renew their homestead exemption by March 4 of every calendar year and become official on July 1. Although homeowners may fail to apply, many property appraisal offices consider it good public relations to notify homeowners; high take-up rates are therefore expected. Ihlanfeldt (2021) finds average take-up rates above 90% in Florida and even higher rates for above median income neighborhoods. However, take-up rates are lower for low-income neighborhoods, which are typically also lower-priced neighborhoods. Florida's OCPA has specific outreach and extension services in place to inform residents of low-appraised properties to help them when claiming the homestead exemption. Alternatively, homeowners may falsely claim homestead exemption. The penalties for intentionally evading property tax are considerable. Ihlanfeldt (2021) documents that, when caught, owners are required to cover evaded liabilities for up to 10 years, including a 50% penalty, at an interest rate of 15% per year. Based on these considerations, we conjecture that homestead exemption is measured without systematic measurement error except for house flipping. House flipping relates to properties that investors fix and sell within 6 months after initial purchase. For these properties, homestead exemption registration may come with systematic measurement error. We therefore exclude these sales from our estimation samples. Furthermore, we also remove resales that occur within a calendar year of the initial transaction because these may also not reveal seller and buyer homeownership status correctly. Next, for each seller, we assign homestead exemption status using information from previous tax year records $[t-1]$, whereas for buyers, we use next-year tax records $[t+1]$.[10]

The sample for estimation contains 71,453 transactions for the period of 2001–2011.[11] 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 ($S = O$), and for the various seller–buyer transaction classes. Table 2 shows that 30% of the transactions involve investor sellers, with the remaining 70% transacted with owner-occupier sellers. Furthermore, 39% of buyers are investors, and 61% are owner-occupiers. Finally, 44% of the sales transactions occur between owner-occupiers.

We are particularly interested in the differences between sellers and buyers. Looking at raw differences in sales prices, the sample statistics indicate a mean sales price for investor sellers of $194,827 and $214,719 for owner-occupier sellers. These differences in sales price, however, also relate to differences in property and neighborhood quality. Descriptive statistics indicate that owner-occupied property is generally of higher quality; it is more often made with concrete block stucco walls (a desirable feature in a hurricane-prone climate infested with termites), 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.

Figure 1 plots the median house price in (current) dollars per sq. ft. over time. The top panel graphs house price by type of seller. Clearly, rental property sells at a discount, although there

[10] The years 2000 and 2012 are used only to extract homestead exemption information for sellers and buyers, respectively. The sample for estimation includes the years 2001–2011.

[11] We omit 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.

TABLE 2 Descriptive statistics

	Pooled		$S = I$		$S = O$		$S = I \times B = I$		$S = I \times B = O$		$S = O \times B = I$		$S = O \times B = O$	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Property characteristics														
Price ($, current)	208,682	132,789	194,827	128,529	214,719	134,158	189,327	130,913	199,077	126,497	209,126	132,883	217,920	134,780
CBD distance (miles)	7.731	3.660	7.621	3.751	7.779	3.619	7.433	3.729	7.766	3.761	7.757	3.543	7.791	3.661
Walls concrete block stucco (1 = yes)	0.545		0.510		0.561		0.482		0.532		0.534		0.576	
Living area (sq. ft.)	1,789	671.7	1,712	677.2	1,823	666.5	1,653	671.4	1,758	678.2	1,766	654.0	1,855	671.4
Number of bedrooms	3.289	0.724	3.237	0.765	3.311	0.705	3.208	0.795	3.259	0.740	3.288	0.710	3.325	0.701
Number of bathrooms	2.13	0.639	2.07	0.675	2.16	0.622	2.01	0.691	2.11	0.659	2.11	0.619	2.19	0.621
Pool (1 = yes)	0.276		0.225		0.298		0.203		0.243		0.274		0.312	
Parcel size (sq. ft.)	38,584	39,718	35,187	38,665	40,064	40,079	33,032	40,372	36,853	37,208	36,994	40,180	41,821	39,915
Construction year	1981	18.46	1980	19.79	1982	17.80	1978	20.33	1981	19.23	1981	17.94	1983	17.69
Older than mean age neighborhood (1 = yes)	0.604		0.619		0.598		0.642		0.602		0.618		0.586	
Neighborhood quality index														
Low-quality neighborhoods (1 = yes)	0.509		0.560		0.486		0.607		0.525		0.539		0.456	
High-quality neighborhoods (1 = yes)	0.491		0.440		0.514		0.393		0.475		0.461		0.544	
Transaction types														
$S = I$	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	
$S = I \times B = I$	0.132		0.436		0		1		0		0		0	
$S = I \times B = O$	0.171		0.564		0		0		1		0		0	
$S = O \times B = I$	0.253		0		0.364		0		0		1		0	
$S = O \times B = O$	0.443		0		0.636		0		0		0		1	
Observations	71,453		21,686		49,767		9,452		12,234		18,113		31,654	

Note: CBD distance is the distance to the intersection of Central Blvd and Orange Av. Orlando Fl. Property characteristics are drawn from the OCPA tax rolls. Neighborhood quality index derivation is described in the text. See Appendix A for notational glossary.

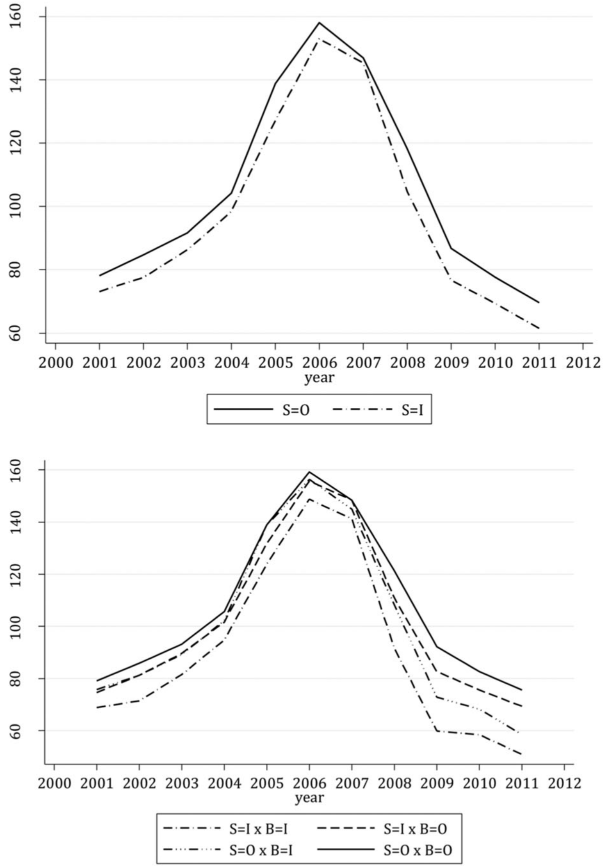

FIGURE 1 House price by seller (top panel) and by seller and buyer (lower panel)
Note: Graph portrays the median house price per sq. ft. living area by year.

is some variation over the housing market cycle. Interestingly, most of the discount associated with rental houses appears to disappear during 2006–2008, the peak of the boom market. The lower panel plots house prices for investor and owner-occupier sellers S and buyers B to further explore raw price differentials across pairs of sellers and buyers. This lower panel reveals a more refined pattern regarding the discount for rental houses; conditional on the property class, house prices are highest for owner-occupier buyers ($B = \mathrm{O}$) and lowest for investor buyers ($B = \mathrm{I}$). 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 pairs of sellers and buyers appears to persist even in the aftermath of the housing market crash and the associated rise in foreclosures during which house prices fell sharply.

4 | EMPIRICAL RESULTS

4.1 | The hedonic model

The empirical model relates sales price to the rental discount and the bargaining power between seller and buyer in addition to the usual property characteristics,

$$\ln P_{it} = \beta x_{it} + \beta_{II} I_{it}^{S=I \times B=I} + \beta_{IO} I_{it}^{S=I \times B=O} + \beta_{OI} I_{it}^{S=O \times B=I} + \varepsilon_{it}, \tag{17}$$

where P is the selling price and x is the vector of relevant house characteristics, including census tract, and year and monthly time fixed effects. The vector of house characteristics also includes a dummy variable, *Older than mean age neighborhood*, indicating houses that are older than the median in the census block group (as reported in the American Community Survey [ACS]). We include this variable to help control for unobserved differences in quality (Brueckner & Rosenthal, 2009; Rosenthal, 2008). The empirical model also includes indicator variables reflecting the mix of investors and sellers involved in the transaction. The last term, ε_{it}, is the error term. We estimate the function for individual sales transactions by reporting standard errors clustered at the census block level.

We are specifically interested in the price differences across sellers and buyers. The empirical approach taken here allows an investor to have different degrees of relative bargaining power when buying from an owner-occupier and when selling to an owner-occupier. The reference category for the mix of buyer and seller types refers to sales between owner-occupiers. The coefficient β_{OI} for owner-occupier seller and investor buyer provides a direct estimate of investor buyer bargaining power in these transactions. In contrast, the coefficient β_{IO} for investor seller and owner-occupier buyer comprises the investor seller bargaining power and the rental discount. The ability to identify separate rental discount and investor seller bargaining power price effects hinges on being able to obtain a direct estimate of the rental discount (coefficient β_{II}, that is, the coefficient on the dummy variable pertaining to the investor selling to the investor buyer). Referring to Table 1, the bargaining power effect of investors as sellers is captured by the coefficient for investor seller and owner-occupier buyer minus the coefficient for investor seller and investor buyer, or $\beta_{IO} - \beta_{II}$. When presenting the empirical results, we report the parameter estimates along with the investor seller bargaining power effect $\beta_{IO} - \beta_{II}$ with adjusted standard errors using the delta method.

4.2 | Full sample results

Table 3 reports the estimates of the hedonic equation. Column (1) provides the baseline model estimates, while (2) presents the results for the traditional approach estimating the mean rental discount effect of investor sellers. Columns (3)–(6) give the bargaining model results. Column (3) reports the results for the pooled sample 2001–2011, while (4)–(6) report the results for various subsamples. The subsamples pertain to different market phases: (4) for the rising market (2001–2006) (5) for the declining market (2007–2009), and (6) for the early stages of recovery (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, and additional bathrooms or a swimming pool add value, as does a larger lot size.

The results in column (2) show that investors sell property for less, on average −2.5% relative to owner-occupiers, using the Kennedy (1981) bias adjustment. This is considerably more modest than the −8.39% discount found by Turnbull and Zahirovic-Herbert (2012) for Baton Rouge, Louisiana over 1984−2005. To consider the underlying differences in greater detail, we also re-estimate model (2) by year. Figure 2 illustrates the results and shows that the rental discount estimates vary between −5.13% and 0.52%. Although we find smaller effects for the rental discount in absolute value, the overall pattern of the market cycle effect of the discount resembles Turnbull and Zahirovic-Herbert in that the smallest discount occurs at the market extremum. Interestingly, this effect seems to hold for both extrema, at the market trough (as in Turnbull & Zahirovic-Herbert, 2012) and at the market peak (as we report here). As argued earlier, however,

TABLE 3 Estimation results for price models, OLS estimates

	(1) 2001–2011	(2) 2001–2011	(3) 2001–2011	(4) 2001–2006	(5) 2007–2009	(6) 2010–2011
$S = I$		−0.0253***				
		(0.00224)				
$S = I \times B = I$			−0.0621***	−0.0566***	−0.0345***	−0.0959***
			(0.00398)	(0.00418)	(0.0113)	(0.0108)
$S = I \times B = O$			−0.0108***	−0.0120***	−0.00115	−0.00579
			(0.00259)	(0.00292)	(0.00722)	(0.00713)
$S = O \times B = I$			−0.0190***	−0.0134***	−0.0285***	−0.0418***
			(0.00262)	(0.00265)	(0.00866)	(0.00788)
CBD distance	−0.0647***	−0.0647***	−0.0643***	−0.0610***	−0.0690***	−0.0775***
	(0.00807)	(0.00806)	(0.00801)	(0.00875)	(0.0185)	(0.0201)
CBD distance squared	0.00254***	0.00256***	0.00255***	0.00244***	0.00288***	0.00301***
	(0.00034)	(0.00034)	(0.00034)	(0.00040)	(0.00077)	(0.00082)
Walls concrete block stucco	0.00970**	0.00982**	0.0103***	0.00899**	0.00862	0.0385***
	(0.00390)	(0.00389)	(0.00389)	(0.00412)	(0.0104)	(0.0101)
Number of bedrooms less than 3	−0.0139***	−0.0136**	−0.0136***	−0.0198***	0.0175	−0.00179
	(0.00528)	(0.00527)	(0.00526)	(0.00538)	(0.0152)	(0.0177)
Number of bedrooms more than 3	−0.00644**	−0.00599*	−0.00532*	−0.00522	−0.00847	0.00322
	(0.00308)	(0.00307)	(0.00307)	(0.00333)	(0.00824)	(0.00806)
Log living area	0.527***	0.525***	0.523***	0.501***	0.530***	0.648***
	(0.00884)	(0.00885)	(0.00886)	(0.00965)	(0.0205)	(0.0199)
Construction year	0.00450***	0.00446***	0.00437***	0.00406***	0.00440***	0.00471***
	(0.00020)	(0.00020)	(0.00020)	(0.00022)	(0.00051)	(0.00049)

(Continues)

TABLE 3 (Continued)

	(1) 2001–2011	(2) 2001–2011	(3) 2001–2011	(4) 2001–2006	(5) 2007–2009	(6) 2010–2011
Older than neighborhood	−0.0281***	−0.0286***	−0.0290***	−0.0319***	−0.0279***	−0.0320***
	(0.00434)	(0.00435)	(0.00437)	(0.00468)	(0.00896)	(0.00893)
Number of baths = 1.00	−0.0259***	−0.0242***	−0.0226***	−0.0203***	−0.0225	−0.128***
	(0.00660)	(0.00659)	(0.00657)	(0.00676)	(0.0175)	(0.0216)
Number of baths = 1.50	−0.0195***	−0.0185**	−0.0176**	−0.0129*	−0.0297	−0.0885***
	(0.00729)	(0.00729)	(0.00723)	(0.00714)	(0.0223)	(0.0286)
Number of baths = 2.50	0.0189***	0.0199***	0.0205***	0.0218***	0.00993	0.0112
	(0.00391)	(0.00391)	(0.00392)	(0.00423)	(0.0101)	(0.00953)
Number of baths > 2.50	0.0840***	0.0854***	0.0863***	0.0867***	0.0696***	0.0485***
	(0.00492)	(0.00492)	(0.00494)	(0.00529)	(0.0116)	(0.0113)
Pool	0.0946***	0.0935***	0.0930***	0.0906***	0.101***	0.113***
	(0.00259)	(0.00260)	(0.00260)	(0.00284)	(0.00764)	(0.00734)
Log land	0.309***	0.308***	0.307***	0.284***	0.328***	0.428***
	(0.00665)	(0.00667)	(0.00668)	(0.00686)	(0.0143)	(0.0128)
Observations	71,453	71,453	71,453	53,546	10,874	7,033
R^2	0.788	0.788	0.789	0.802	0.691	0.867
Bargaining effect			0.051***	0.045***	0.033***	0.090***
			(0.051)	(0.004)	(0.012)	(0.012)

Note: Dependent variable is log of transaction price. The reference categories are number of bedrooms equals 3, and number of bathrooms equals 2.00. The reference category in (3)–(7) is transaction type $S = O \times B = O$. All models include a constant term, fixed effects for year × month, and location tract–level. Standard errors are clustered at the census block level. Bargaining effect is $b[S = I \times B = O] - b[S = I \times B = I]$, which standard errors are computed using the delta method. Standard errors in parentheses with ***, **, and * indicating significance at 1%, 5%, and 10%, respectively.

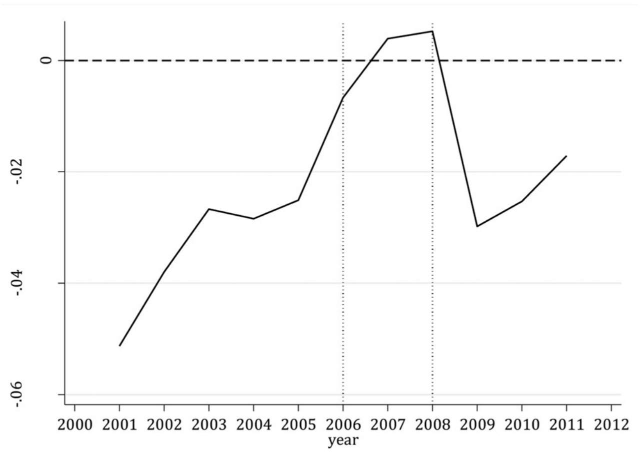

FIGURE 2 Rental discount by year
Note: Rental discount parameter estimates are based on the specification in Table 2, model (2), by year. Estimates for 2006–2008 are not statistically significant.

rental properties are sold by investors with possibly different bargaining skills relative to owner-occupiers. The results when taking this complication into account are of central interest.

Table 3, column (3), reports pooled sample estimates for the complete bargaining power model. Recall that the omitted category is owner-occupier seller and buyer. Focusing on the variables of interest, all the seller–buyer indicator variable coefficients are consistent with the theoretical patterns indicated by Table 1 for a negative rental discount and when seller investors exhibit stronger bargaining power than owner-occupier buyers. The coefficient β_{II} estimate is −0.0621 and significant. This estimate indicates a rental discount price effect of approximately −6.2%, which is considerably larger (in absolute value) than our initial estimate for the traditional model (2). This result coupled with the coefficient β_{IO} indicates that investors are able to obtain a 5.1% (β_{IO} − β_{II}= −0.0108 − −0.0621 = 0.0513) higher price due to their greater bargaining power when selling to owner-occupier buyers. At the same time, the coefficient β_{II} implies that investor bargaining power allows them to buy houses sold by owner-occupiers for approximately 1.9% (coefficient β_{OI}) less than owner-occupiers pay for identical properties. This pattern indicates significantly weaker investor relative bargaining power when buying from owner-occupiers than when selling to them. It clearly rejects the assumption underpinning the Harding, Rosenthal, , & Sirmans (2003) empirical bargaining model. Nonetheless, our bargaining power price effects appear to fall well 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 in column (4), declining market in column (5) and postcrash market in column (6) estimates in Table 3, the market phase appears to affect the size of the rental discount and the relative strength of investor bargaining power. The rental discount is significantly greater in the recovering market and significantly less in the declining market than in the earlier rising market. The same pattern is evident for investor seller bargaining power. In contrast, buyer investor bargaining power relative to owner-occupiers is much more stable across market phases.

4.3 | Neighborhood quality

Neighborhoods may vary in quality, and the question is whether these differences influence our conclusions. Here, we probe deeper into the issue of observed and unobserved quality

TABLE 4 Principal component analysis of neighborhood characteristics

Coefficients on first eigenvector		Proportion of variance explained		
Variable	**Coefficient**	**Eigenvector**	**Eigen value**	**Proportion**
Median household income	0.561	1	1.957	0.65
Percentage high school graduates	0.606	2	0.597	0.20
Percentage Black households	−0.564	3	0.446	0.15

Note: This table reports the results of principal component analysis (PCA) on 2010 census block characteristics. We check data adequacy for PCS using the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy. The value of KMO is 0.669, suggesting that PCA is acceptable.

differences across neighborhoods. Following Aliprantis (2017), consider a single dimension neighborhood quality index comprising both observed and unobserved neighborhood characteristics. We use census block group characteristics reported in the 2010 ACS, specifically, median household income, percentage of high school graduates, and percentage of Blacks, as observed neighborhood characteristics. We apply principal component analysis (PCA) to the data to determine which single index provides the most information. Table 4 summarizes the results from the PCA. We find that the first eigenvector has an eigenvalue of almost two and explains 65% of the variance. None of the other eigenvectors have eigenvalues above 1. The left panel of Table 4 shows the coefficients.

The next step uses the first eigenvector to characterize neighborhood quality. To identify low- and high-quality neighborhoods, we begin by predicting the score for the first eigenvector for each neighborhood. We then define low neighborhoods as those with scores below or equal to the median and high-quality neighborhoods as those with scores strictly above the median.

Table 5 reports the hedonic function estimates for the low- and high-quality neighborhood subsamples. The rental discount (the coefficient β_{II}) does not vary significantly across the two types of neighborhoods. Seller investor bargaining power, however, is significantly stronger in low-quality neighborhoods than in high-quality neighborhoods; the price premium investors obtain when selling to owner-occupiers in low-quality neighborhoods is not quite double that in high-quality neighborhoods. The β_{OI} estimates show a similar pattern, with stronger buyer investor bargaining power in low-quality neighborhoods than in high-quality neighborhoods. Although the size of the effect varies, the overall bargaining power patterns hold across different neighborhoods.[12]

4.4 | Matched sample results

The models discussed thus far consider the rental discount and bargaining effects as if the property were sold as rental or owner-occupied 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

[12] As an additional robustness test, we also construct an alternative indicator of owner-occupiers based on an owner's homestead exemption *and* the number of properties they own in the county. For this we count the number of properties using information on names of first and second owner for all properties (those that sell and do not sell) and all property types (not only single-family units, but also other types, including townhouses and condos) for each of the tax years 2000–2012. This provides the number of properties per owner. We then redefine owner-occupiers as having homestead exemption and owning at most one property in the county. These estimates fall within the confidence intervals reported here, and do not alter our conclusions. See Tables B1 and B2.

TABLE 5 Estimation results by neighborhood quality, OLS estimates

	(1) Low−quality neighborhoods		(2) High−quality neighborhoods	
$S = I \times B = I$	−0.0678	***	−0.0532	***
	(0.00521)		(0.00556)	
$S = I \times B = O$	−0.00536		−0.0179	***
	(0.00376)		(0.00348)	
$S = O \times B = I$	−0.0271	***	−0.0108	***
	(0.00359)		(0.00356)	
CBD distance	−0.0568	***	−0.0593	***
	(0.0128)		(0.0113)	
CBD distance squared	0.00275	***	0.00195	***
	(0.00068)		(0.00044)	
Walls concrete block stucco	0.0148	***	0.00676	
	(0.00486)		(0.00594)	
Number of bedrooms less than 3	−0.0324	***	0.00338	
	(0.00685)		(0.00723)	
Number of bedrooms more than 3	0.00330		−0.00975	**
	(0.00439)		(0.00402)	
Log living area	0.470	***	0.571	***
	(0.0113)		(0.0125)	
Construction year	0.00495	***	0.00323	***
	(0.00030)		(0.00026)	
Older than neighborhood	−0.0183	***	−0.0453	***
	(0.00581)		(0.00609)	
Number of baths = 1.00	−0.0402	***	0.00415	
	(0.00768)		(0.00998)	
Number of baths = 1.50	−0.0233	***	−0.0197	
	(0.00808)		(0.0140)	
Number of baths = 2.50	0.0138	**	0.0152	***
	(0.00577)		(0.00510)	
Number of baths > 2.50	0.0876	***	0.0687	***
	(0.00862)		(0.00594)	
Pool	0.0970	***	0.0896	***
	(0.00389)		(0.00339)	
Log land	0.234	***	0.352	***
	(0.00844)		(0.0100)	
Observations	36,362		35,091	
R^2	0.736		0.789	

(Continues)

TABLE 5 (Continued)

	(1) Low–quality neighborhoods	(2) High–quality neighborhoods
Bargaining effect	0.062***	0.035***
	(0.006)	(0.006)

Note: Dependent variable is log of transaction price. The reference categories are Number of Bedrooms equals 3 and Number of Bathrooms equals 2.00. The reference category in (3)–(7) is transaction type $S = O \times B = O$. All models include a constant term, fixed effects for year × month, and location tract–level. Data cover 2001–2011. Standard errors are clustered at the census block level. Bargaining effect is $b[S = I \times B = O] - b[S = I \times B = I]$, which standard errors are computed using the delta method. Standard errors in parentheses with ***, **, and * indicating significance at 1%, 5%, and 10%, respectively.

from those targeted by owner-occupiers who may be primarily driven by consumption motives (Han, 2013). It is therefore reasonable to recognize that some properties may be purposefully selected either as rental or as owner-occupied housing. The descriptive statistics show that most of these rental properties have different property characteristics, suggesting that rental property and owner-occupied property are structurally different and likely the result of a choice process.

We use propensity score matching to create matched samples to control for the effects of observable characteristics (and any correlated unobservables) that may influence the choice of rental housing. The first stage of the procedure 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, the propensity score based on the estimated logit is used to identify matching owner-occupied property for every investor property in the sample; that is, 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 pairs of observations. As shown in Appendix C, the matched sample is balanced. The final stage estimates the hedonic model on the matched sample of 43,372 observations.

Table 6, column (2), shows that the rental discount amounts to 6.6%. The estimate pertaining to investor bargaining power indicates that investors obtain a significant 5.2% premium when selling property. The bargaining power discount for owner-occupier sellers is 3.8% when selling to investor buyers. The patterns for market phases and across types of neighborhoods are also consistent with the results found above. Drawing the results together, we find that controlling for selection effects with propensity scoring matched analysis does not alter our main conclusions.

4.5 | A test for unobserved heterogeneity effects

The method for evaluating sensitivity arising from unobserved heterogeneity is based on a comparison of parameter estimates β and R^2 values for models with different sets of control variables to define bounds for the parameter of interest (Oster, 2019). Suppose the true model in the case of unobserved variables W_i is

$$\ln P_{it} = \beta x_{it} + \beta_{II} I_{it}^{S=I \times B=I} + \beta_{IO} I_{it}^{S=I \times B=O} + \beta_{OI} I_{it}^{S=O \times B=I} + \beta_w W_i + \varepsilon_{it}. \quad (18)$$

Equation (18) indicates that in the presence of unobserved variables, W_i, the original hedonic equation without W_i provides estimates $\tilde{\beta}_{II}, \tilde{\beta}_{IO}, \tilde{\beta}_{OI}$ and $\tilde{R}^2$ rather than $\beta_{II}, \beta_{IO}, \beta_{OI}$ and R^2. For notational convenience, they are hereafter denoted as $\tilde{\beta}_Z$ and $\tilde{R}^2$, and β_Z and R^2, respectively.

TABLE 6 Estimation results on matched samples, key OLS estimates

	(1) 2001–2011	(2) 2001–2011	(3) 2001–2006	(4) 2007–2009	(5) 2010–2011	(6) 2001–2011 Low–quality neighborhoods	(7) 2001–2011 High–quality neighborhoods
$S = I$	−0.0197***						
	(0.00349)						
$S = I \times B = I$		−0.0666***	−0.0611***	−0.0338**	−0.115***	−0.0718***	−0.0565***
		(0.00532)	(0.00567)	(0.0158)	(0.0140)	(0.00740)	(0.00708)
$S = I \times B = O$		−0.0149***	−0.0166***	−0.00124	−0.0228**	−0.00981	−0.0199***
		(0.00417)	(0.00450)	(0.0125)	(0.0112)	(0.00624)	(0.00528)
$S = O \times B = I$		−0.0382***	−0.0283***	−0.0690***	−0.0813***	−0.0496***	−0.0206***
		(0.00557)	(0.00564)	(0.0209)	(0.0179)	(0.00790)	(0.00681)
Bargaining effect		0.052***	0.045***	0.033***	0.092***	0.062***	0.037***
		(0.004)	(0.004)	(0.012)	(0.012)	(0.006)	(0.006)
Observations	43,372	43,372	32,909	6,396	4,067	24,100	19,272
R^2	0.78	0.78	0.80	0.71	0.88	0.73	0.79

Note: The dependent variable is log transaction price. All models include the same structural attributes as in Tables 3 and 5 and fixed effects for month and location tract level. Standard errors are clustered at the census block level. Bargaining effect is $b[S = I \times B = O] - b[S = I \times B = I]$, which standard errors are computed using the delta method. Standard errors in parentheses with ***, **, and * indicating significance at 1%, 5%, and 10%, respectively. Matched samples are obtained using propensity score matching.

TABLE 7 Summary of Oster test results on matched samples

	(1) $\tilde{\beta}_Z$	(2) $\tilde{R}^2$	(3) β_Z^*	(4) Δ
$S = I$	−0.022	0.778	−0.032	[−0.032; −0.022]
$S = I \times B = I$	−0.068	0.780	−0.068	[−0.068; −0.068]
$S = I \times B = O$	−0.017	0.780	−0.067	[−0.067; −0.017]
$S = O \times B = I$	−0.037	0.780	−0.019	[−0.037; −0.019]

Note: Oster test results for Table 6. The first row refers to Table 6, model (1). Rows 2–4 refer to Table 6, model (2). Matched samples are obtained using propensity score matching. Data cover 2001–2011.

The test procedure calculates a consistent bias-adjusted estimate $\beta_Z^* \xrightarrow{p} \beta_Z$ for which two assumptions need to be made (Oster, 2019). Define $\gamma = \text{cov}(W, Z)/\text{var}(W) \ / \ \text{cov}(X, Z)/\text{var}(X)$, which is the coefficient of proportionality between observables X and unobservables W. The parameter γ provides information on the degree to which the estimate of β_Z is driven by correlation with elements of W. When $\gamma = 1$, then observables are at least as important as unobservables. The first assumption is $\gamma = 1$, as suggested by Oster (2019). Next, define the maximum R^2 (or R^2_{max}) for model (17), which is anywhere between $\tilde{R}^2$ and 1, depending on, for instance, the degree of measurement error. The second assumption is $R^2_{\text{max}} = 1$.

The robustness test procedure for this specification is as follows: First, estimate the hedonic model assuming $\gamma = 0$, which provides $\tilde{\beta}_Z$ and $\tilde{R}^2$. Then, estimate the hedonic model assuming $\gamma = 1$ and $R^2_{\text{max}} = 1$, which provides β_Z^*. Finally, the estimate of β_Z is determined to be robust when the interval $\Delta = [\tilde{\beta}_Z, \ \beta_Z^*]$ excludes zero. The estimate is not robust when the interval Δincludes zero.

Table 7 reports the results of the Oster test for the matched sample models reported in Table 6. The first row reports the test for the matched sample model (1), and the second through fourth rows report the tests for the key coefficients in the matched sample model (2). As indicated in column (4), the Oster test provides evidence that our earlier results are robust with respect to unobservables. Of course, this test, like our other attempts to control for possible unobservable effects in this article (and in the broader literature), assumes that unobservable effects are correlated to some extent with observable controls included in the model.[13]

5 | CONCLUSION

House prices reflect a mixture of demand for characteristics, bargaining power and market segmentation. This article develops a simple theoretical model and an empirical framework to identify and estimate both rental property discounts and the effects of differences in investor and owner-occupier bargaining power on selling prices when only investor-owned property is subject to rental discounts.

In a multi-stage search-bargaining game, sellers set their reservation price before knowing with whom they ultimately will be bargaining, hence, before knowing their relative bargaining power when negotiating the selling price. Buyers similarly set their maximum offers before knowing

[13] Halket et al. (2020) examine unobserved quality across rental and owner-occupied housing segments in a switching regression framework using the English Housing Survey with self-reported rents and house values. They measure unobserved quality across segments, comparing $E(\varepsilon_{\text{rent}}|X, \text{rent})$ and $E(\varepsilon_{\text{own}}| \ X, \ \text{own})$, and examine how unobserved quality varies with distance to CBD, size, and dwelling type.

with whom they will be bargaining. The theory illustrates that one's bargaining power affects both reservation prices and maximum willingness-to-pay in addition to determining how the transactional surplus is divided between parties. More generally, the framework also illustrates how property attribute effects that are perfectly correlated with seller characteristics, like the rental discount associated with investor-sold properties, nonetheless can be identified and used to derive separate bargaining power effects. Furthermore, the solution provided here does not assume that an investor's relative bargaining power is the same whether selling to or buying from an owner-occupier; the symmetry assumption is needed to operationalize earlier reduced form empirical models incorporating bargaining effects (Harding, Rosenthal, & Sirmans, 2003; Hayunga & Munneke, 2021). In contrast, this article provides an example of how such bargaining symmetry can be tested.

We use the Florida homestead property tax exemption for owner-occupiers to empirically identify whether sellers and buyers are investors or owner-occupiers; 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 status in this regard from the observed series of transactions for each property and the associated homestead exemption filings for Orange County, Florida, over the period 2000–2012. The empirical results are consistent with the relationship implied by theory and reject the type of bargaining power symmetry assumed in earlier studies. Nonetheless, the results imply that investors enjoy relatively stronger bargaining power than owner-occupiers on average, whether as sellers or buyers.

The results show a larger rental discount than that found with the conventional approach that ignores bargaining power. Unsurprisingly, parameter estimates vary across the market cycle, but the underlying pattern remains consistent with the relationship identified in the theory. The rental discount does not appear to vary across neighborhoods of different quality, but investor bargaining power appears to be stronger in lower quality neighborhoods. Perhaps as important, the propensity score–matched sample yields the same conclusions as the full sample. This suggests that selection or unobservable effects are not driving the empirical results. The Oster (2019) test for unobservable bias supports the robustness of the matched sample results.

Pulling the empirical implications together, this study provides evidence that previous estimates of rental discounts are systematically biased by investor relative bargaining power effects. As expected, investors exhibit stronger relative bargaining power than owner-occupiers. Nevertheless, the evidence for the investor/owner-occupier setting considered here also rejects the type of bargaining power symmetry assumption underlying the reduced form empirical approach used in earlier efforts to estimate bargaining power price effects between other types of buyers and sellers. Why investors' bargaining power varies over time, across both sides of the transaction, or across low- and high-quality neighborhoods has not been addressed in this article. Similar to the interplay with market liquidity and simultaneously modeling time on the market, we leave these questions for future research.

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APPENDIX A: NOTATIONAL GLOSSARY

Theoretical model	
x	House characteristics
r	reservation price of seller
P	Sales price of the property
w	Willingness-to-pay of buyer for the property
δ	Parameter of variation
v	Rental property discount
α_{ij}	Relative bargaining power of seller i in transaction with buyer j
π	Arrival rate of owner-occupier buyer
$1-\pi$	Arrival rate of investor buyer
$B(b), S(s)$	Cumulative distribution functions of buyer types b and seller types s
c	Search or waiting costs per period
Empirical model	
β	Parameters to be estimated
i	Property $i = 1,\ldots,N$
t	Time $t = 1,\ldots,T$
$I_{it}^{S=I\times B=I}$	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

APPENDIX B: MEASURE BASED ON HOMESTEAD EXEMPTION AND NUMBER OF PROPERTIES

TABLE B1 Estimation results for the new measure of owner–occupier, key OLS estimates

	(1) 2001–2011	(2) 2001–2011	(3) 2001–2006	(4) 2007–2009	(5) 2010–2011	(6) 2001–2011 Low–quality neighborhoods	(7) 2001–2011 High–quality neighborhoods
$S = I$	−0.0234***						
	(0.00211)						
$S = I \times B = I$		−0.0512***	−0.0439***	−0.0342**	−0.0897***	−0.0596***	−0.0402***
		(0.00334)	(0.00354)	(0.00967)	(0.00914)	(0.00451)	(0.00447)
$S = I \times B = O$		−0.00577**	−0.00633**	−0.00429	−0.00367	−0.00301	−0.0104***
		(0.00260)	(0.00293)	(0.00715)	(0.00714)	(0.00374)	(0.00351)
$S = O \times B = I$		−0.0138***	−0.00934***	−0.0193**	−0.0347***	−0.0212***	−0.00686*
		(0.00269)	(0.00269)	(0.0090)	(0.00835)	(0.00835)	(0.00371)
Observations	71,453	71,453	53,546	10,874	7.033	36,362	35,091
R^2	0.79	0.79	0.80	0.70	0.87	0.74	0.79

Note: The dependent variable is log transaction price. All models include the same structural attributes as in Tables 3 and 5 and fixed effects for month and location tract level. Estimation results for Table 3 (columns (2)–(6)) and Table 5 (columns (1)–(2)) now include new measures of owner-occupiers (O) and investors (I). Owner-occupiers now refer to those property owners receiving homestead exemption and owning 1 property. Investors refer to owners not receiving homestead exemption or owning multiple properties. Standard errors are clustered at the census block level. Standard errors in parentheses with ***, **, * indicating significance at 1%, 5%, and 10%, respectively.

TABLE B2 Estimation results for the new measure of owner−occupier on matched samples, key OLS estimates

	(1) 2001–2011	(2) 2001–2011	(3) 2001–2006	(4) 2007–2009	(5) 2010–2011	(6) 2001–2011 Low−quality neighborhoods	(7) 2001–2011 High−quality neighborhoods
$S = I$	−0.0218***						
	(0.00349)						
$S = I \times B = I$		−0.0584***	−0.0552***	−0.0215	−0.111***	−0.0608***	−0.0533***
		(0.00520)	(0.00567)	(0.0156)	(0.0136)	(0.00769)	(0.00632)
$S = I \times B = O$		−0.0104**	−0.0144***	−0.00101	−0.0196*	−0.00322	−0.0197***
		(0.00420)	(0.00445)	(0.0123)	(0.0011)	(0.00652)	(0.00505)
$S = O \times B = I$		−0.0242***	−0.0209***	−0.0232	−0.0377***	−0.0313***	−0.0130**
		(0.00576)	(0.00562)	(0.0197)	(0.0169)	(0.0084)	(0.0065)
Observations	43,372	43,372	32,909	6396	4067	24,100	19,272
R^2	0.78	0.78	0.80	0.70	0.87	0.73	0.79

Note: The dependent variable is log transaction price. All models include the same structural attributes as in Tables 3 and 5 and fixed effects for month and location tract level. Estimation results for Table 6 now include new measures of owner-occupiers (O) and investors (I). Owner-occupiers now refer to those property owners receiving homestead exemption and owning one property. Investors refer to owners not receiving homestead exemption or owning multiple properties. Matched samples are obtained using propensity score matching as described in Appendix C. Standard errors are clustered at the census block level. Standard errors in parentheses with ***, **, * indicating significance at 1%, 5%, and 10%, respectively.

APPENDIX C: MATCHED SAMPLES

We use propensity score matching to create matched samples of different types of sellers and buyers for comparable properties. The issue of having comparable groups of properties is crucial, given that our identification is based on a comparison of house prices for different types of sellers and buyers. The estimate may be biased, however, if the groups in the matched sample are not comparable (Dehejia & Wahba, 2002). This appendix summarizes the propensity score matching procedure used in the analysis and reports tests of the matching assumptions.

We use propensity score matching by taking an investor-sold property as the treatment. The matching is based on a logit function of property characteristics. Subsequently, a matched sample of properties is created based on similarity in estimated probabilities of being an investor-sold property. The matched sample then involves the pairing of investor units and matched owner-occupier units with similar observables. We use the matched sample to estimate the hedonic price equation reported in Table 6.

An important assumption in matching is that covariates in treatment and control are sufficiently similar. We use balancing tests to compare observables for both groups of property to test whether this condition holds. Table C1 reports the tests for all covariates. The results reveal comparable properties among both the treatment and control groups.

TABLE C1 Covariate balance summary propensity score matching

	Standardized differences		Variance ratio	
	Raw	Matched	Raw	Matched
CBD distance	−0.0428	0.0141	1.0742	1.0187
CBD distance squared	−0.0233	0.0155	1.0272	0.9397
Walls concrete block stucco	−0.1014	0.0103	1.0145	0.9981
Number of bedrooms less than 3	0.1420	−0.0086	1.4391	0.9771
Number of bedrooms more than 3	−0.0703	−0.0051	0.9517	0.9965
Log living area	−0.0205	−0.0029	1.1654	1.0675
Construction year	−0.1402	0.0126	1.2373	1.0815
Older than mean age neighborhood	0.0436	−0.0059	0.9808	1.0026
Number of baths = 1.00	0.2081	−0.0225	1.7141	0.9397
Number of baths = 1.50	0.0790	0.0102	1.4420	1.0500
Number of baths = 2.50	−0.0041	0.0086	0.9894	1.0227
Number of baths > 2.50	−0.0560	−0.0048	0.8941	0.9907
Pool	−0.1661	−0.0167	0.8345	0.9832
Log land	−0.2262	−0.0014	1.2100	1.0593

Note: Table denotes differences in means and variances between the treated and control groups for each variable. Balanced samples have standardized differences of 0 and variance ratio of 1. The number of observations is 71,453. The treated number of observations is 21,686. The number of observations in the matched sample is 43,372.