

# Client Externality Effects of Agents Selling Their Own Properties

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Published online: 19 December 2015

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**Abstract** This study is the first to examine the principal-agent issues surrounding how agents' efforts to sell their own properties affect their efforts to sell concurrently listed client properties. The principal-agent model shows that listed agent-owned properties induce agents to work harder over all, but diminish effort dedicated to marketing concurrently listed client properties, leading to reduced liquidity and/or lower selling prices for those properties. The empirical results show that client properties competing with agent-owned properties remain on the market 30 to 46 % longer and sell for 1.8 % less than properties whose agents have no such conflict of interest.

**Keywords** Principal/Agent conflict · Asymmetric information · Moral hazard

## Introduction

This study is the first to examine the principal-agent problem that exists when a client's property is marketed concurrently with properties owned by the listing agent. It focuses on the extent to which agents' sales efforts on behalf of clients are influenced by their interest in marketing their own properties. Previous studies have examined differences in sale price and/or time on market between agent-owned properties and client properties. Agency theory predicts that real estate agents work harder to sell their own

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properties than they do client properties (Rutherford et al. 2005). Empirical results show that owner-agent properties stay on the market for equal or longer period of time but sell at a price premium relative to client properties (Rutherford et al. 2005; Levitt and Syverson 2008), evidence of misaligned principal-agent incentives between sellers and their real estate agents.

This paper explores a different dimension of the principle-agent problem in real estate brokerage. Instead of focusing on the difference in individual sales of agent-owned and agent-represented properties, we focus on how agents allocate their selling efforts across listings in order to isolate how selling their own properties affects performance on concurrently listed client properties. The stylized model of agent selling effort predicts that agent-owned properties on the market at the same time as client properties lead to inferior marketing outcomes for client properties; agents work harder overall but also divert effort from client properties to marketing their own, creating an agent-listing externality on client properties. The empirical study draws on 11 years of housing sales data to test the relative performance hypothesis, estimating how client selling price and time on market change when the listing agent is simultaneously marketing his or her own properties. The results are relevant to understanding housing market performance, given that approximately 85 % of homeowners rely on the services of licensed real estate professionals when selling their homes (National Association of Realtors 2011).

It is not unusual for real estate agents to engage in personal transactions for speculation, long-term investing, or buying and selling personal residences. In our sample, approximately 6 % of listings are owned by a licensed real estate agent. This percentage is considerably larger than the roughly 3 % reported by Levitt and Syverson (2008) and Rutherford et al. (2005). This difference may be attributed to differences in sample periods and locations. The sample in our study covers 1999–2009, which includes the bubble of the early-to-mid 2000s and the market collapse later in the decade. In contrast, Rutherford et al. (2005) and Levitt and Syverson (2008) look at earlier periods, 1998–2002 and 1992–2002, respectively.

The typical seller, whether a real estate professional or not, is looking for an expedient transaction at the maximum selling price. Real estate agents are typically compensated for their services in the form of a commission when successfully marketing a client property and the entire selling price when marketing their own property.<sup>1</sup> Since many agents market their own properties concurrently with client properties and their efforts on behalf of a client are not directly observable, they have an opportunity to shirk on servicing client properties. Standard search theory suggests that lower agent effort reduces the arrival rate of potential buyers for client properties and decreases expected selling price and/or liquidity. The housing market data confirm the predicted price and liquidity wedges for client properties represented by agents with and without their own properties on the market.

## Background Literature

Existing studies examine principal-agent conflicts inherent in real estate brokerage from a variety of perspectives including agent effort, compensation, and dual agency (Miceli

<sup>1</sup> The presence or absence of co-brokerage commissions does not alter the conclusions.

1989; Geltner et al. 1991; Anglin and Arnott 1991; Arnold 1992; Munneke and Yavas 2001; Rutherford et al. 2005; Gardiner, et al. 2007; Levitt and Syverson 2008; Hendel et al. 2009; and Waller et al. 2010). Asymmetric information may create an incentive for agents to misrepresent market information to the principal (Arnold 1992). Anglin and Arnott (1991) argue that asymmetric information drives the principal-agent problem between seller and agent and conclude that commission-based contracts do not allocate risk efficiently or provide appropriate incentives for agents.

Geltner et al. (1991) scrutinize the principal-agent conflict from two dimensions; the level of selling effort exerted by the listing agent and agent effort to influence the seller's reservation price. They contend that the principal-agent conflict is greatest at the start of the listing period as agents are likely to rationally procrastinate, increasing effort only as the listing period nears its end. On the other hand, Miceli (1989) suggests that listing contracts of limited duration can help overcome agent rational procrastination and can be structured to elicit greater agent effort on behalf of the seller. There is evidence that longer listing contracts lead to longer marketing durations (Waller et al. 2010). However, using limited contract duration to increase agent effort may have its own costs. Clauretie and Daneshvary (2008) find that properties are sold at lower prices near the expiration of listing contracts. Their result suggests that agents' incentive to induce lower sale prices becomes stronger when listing contracts approach their end.

Previous studies acknowledge the principal-agent dilemma surrounding agent-owned properties and as such have focused on the selling price and liquidity of owner-agent properties relative to client-owned properties. The results of these studies find that agent-owned properties transact at significantly higher selling prices relative to client owned properties with mixed results for property liquidity. This is attributed to, at least in part, asymmetric information. Levitt and Syverson (2008) examine approximately 98,000 transactions from an Illinois MLS occurring between 1992 and 2002, of which approximately 3.4 % involved owner-agents. Using OLS, the authors find that agent-owned properties sell at a 4.8 % premium and sustain an extended marketing duration of almost 17 days relative to client owned properties. After taking into account agent reputation and experience, agent-owned properties continue to have longer marketing durations of approximately 11 days relative to client-owned properties and transact for a 4.2 % premium. After adjusting for location differences, they find that agent-owned properties stay on the market approximately 10 days longer and sell for 3.7 % more than client properties. They suggest that agents' greater market knowledge and the commission form of agent compensation lead to client properties being sold too quickly at a lower price.

Rutherford et al. (2005) use MLS data from 1998 to 2002 to examine the same questions. In order to address censoring associated with the unsold properties the authors use a Weibull hazard model for estimating duration. The pricing model is a standard log-linear OLS hedonic equation. In addition to capturing the impact of owner-agents on selling price and marketing duration, the authors also use dummy variables to capture the impact of agents that have sold multiple owner-agent properties. Their results indicate that, while having approximately the same degree of liquidity as client-owned properties, owner-agent properties tend to sell for 4.5 % higher prices.

This paper differs from previous owner-agent studies. It focuses on client properties, examining how an agent's attempt to sell his or her own property influences price and

liquidity performance on client properties. The next section of the paper presents a simple model of agent behavior that illustrates why agents selling their own properties will expend greater total sales effort across their inventory of listings, but will also tend to reallocate effort from selling client properties to selling their own property. As a consequence, client properties being concurrently marketed with agent-owned properties will have lower realized prices and longer time on the market. Section 4 provides an overview of the data and sample, in which over 11 % of client properties listed over the sample period compete with an agent-owned property. Section 5 explains the empirical approaches used in this study. Following earlier agency studies, we use a 3SLS simultaneous model of price and liquidity, an OLS hedonic pricing model, and a Weibull hazard duration model. Section 6 presents the empirical estimates. Sale prices of client properties are negatively affected by concurrently listed agent-owned properties by nearly 2 %. The negative impact of concurrently listed agent-owned properties on the liquidity of client properties is much more pronounced and robust across all methodologies taking as much as 56 % longer to sell client properties that are concurrently listed with agent-owned properties than client properties that are not. We offer concluding remarks in section 7.

## Agent Search Effort

This section offers a stylized agent search model to study the incentives confronting listing agents. We adopt the simple bargaining structure of Rutherford et al. (2005) in which the seller's asking price is treated as a take-it-or-leave-it offer to the buyer.<sup>2</sup> We assume that the seller of the property sets the asking price  $P$ .<sup>3</sup> As a result, a buyer will accept an asking price if and only if the asking price is below his or her reservation price. The continuous density function of buyers' reservation prices is given by  $f(\cdot)$  over the interval  $[p, \bar{p}]$ . As a member of the local multiple listing service (MLS), the listing agent submits the listing to the MLS. There is a large number of agents who are members of the MLS; any other agent procuring a buyer for the listing is referred to as the selling agent. Along with the information about the property, the listing agent also indicates the percentage of the price  $k_s$  that he or she will share with the selling agent. The MLS then disseminates the listing to all other members of the MLS. Following the current practice in the industry, the listing agent receives  $k$  percentage of the price as commission from the seller upon the sale of the property. Out of the total commission, the listing agent pays  $k_s$ ,  $k_s < k$ , proportion of the price to the selling agent. If the listing agent finds the buyer himself or herself, he or she retains the entire commission  $kP$ . Following convention, we assume that the total commission rate,  $k$ , and the selling agent's share,  $k_s$ , are exogenously determined in the market.

<sup>2</sup> This model, like most agency models, suppresses the buyer-seller negotiation process. See Harding et al. (2003) and Merlo and Ortalo-Magne (2004) for empirical analyses of bargaining issues.

<sup>3</sup> Real estate agents may attempt to influence sellers' asking prices in which case they may have an incentive to suggest suboptimal asking prices (Arnold 1992; Rutherford et al. 2005). This model does not address these complications.

Using this notation, the listing agent’s expected payoff  $V$  from a single contract is given by

$$V = \psi(L) \int_P^{\bar{P}} kP f(p) dp + \varphi(L, L^S) \int_P^{\bar{P}} (k - k_s) P f(p) dp - C(L) \tag{1}$$

where  $\psi(L)$  is the probability that the listing agent will find a buyer, the dual agency outcome in which the listing agent represents both the seller and the buyer. We assume the listing agent’s search effort  $L$  increases  $\psi$  at a decreasing rate,  $\psi' > 0$  and  $\psi'' < 0$ . The first additive term in (1) is the expected payoff under dual agency, under which the listing agent receives the entire commission  $kP$ . The commission  $kP$  is first integrated within the range  $[P, \bar{P}]$ , and it is then weighted by the probability of dual agency,  $\psi(L)$ . The second additive term in (1) is the expected payoff from a co-brokered sale assisted by another (selling) agent.  $\varphi$  is the probability that one of the other MLS agents locates a buyer.  $\varphi$  is jointly determined by the listing agent’s search effort,  $L$ , and search effort exerted by other selling agents,  $L^S$ . Given the large number of MLS members and the competition among them to sell the property, we assume  $L^S$  to be exogenous to the listing agent. We also assume the listing agent’s search effort  $L$  decreases  $\varphi$  at a decreasing rate,  $\varphi_L < 0$  and  $\varphi_{LL} > 0$ . In the co-brokered case, the listing agent receives  $(k - k_s)P$ . The third additive term in (1),  $C(L)$ , is the listing agent’s search or selling cost, which is increasing in total effort at an increasing rate,  $C' > 0$  and  $C'' > 0$ .

Suppose the listing agent simultaneously services  $n$  contracts, indexed by subscripts  $i \in [1 \dots n]$ . The agent chooses search effort levels for each property,  $L_1, \dots, L_n$ , to maximize the total expected payoff. Thus, the listing agent’s problem is

$$\max_{L_1 \dots L_n} \Pi(L_1 \dots L_n) = \sum_n V_i = \sum_n \left[ \psi(L_i) \int_P^{\bar{P}} k_i P_i f(p) dp + \varphi(L_i, L_i^S) \int_P^{\bar{P}} (k_i - k_s) P_i f(p) dp \right] - C \left( \sum_n L_i \right) \tag{2}$$

The  $n$  first-order conditions for an interior solution are given by

$$\psi'(L_i) \int_P^{\bar{P}} k_i P_i f(p) dp + \varphi_L(L_i, L_i^S) \int_P^{\bar{P}} (k_i - k_s) P_i f(p) dp - C' \left( \sum_n L_i \right) = 0, \forall i \tag{3}$$

The first two terms of (3), collectively, is the agent’s marginal benefit from additional effort. The third term is the agent’s marginal cost of greater search intensity. The agent’s search efforts  $L_1, \dots, L_n$  satisfy (3); the agent’s effort on each property equates the expected marginal payoff from additional effort to the common marginal cost of search. Since  $C' > 0$  this condition requires that the first two terms are positive in equilibrium; an increase in agent selling effort increases the expected benefit from a sole brokered transaction more than it decreases the expected benefit from a co-brokered transaction. This relationship is used to determine the sign of some comparative statics below.

To find the impact of the commission rate  $k_j$  on agent effort to sell property  $j$ , implicitly differentiate the system of  $n$  Eq. (3) and solve for

$$\frac{\partial L_j^*}{\partial k_j} = - \left[ \psi'(L_j) \int_P^{\bar{p}} P_j f(p) dp + \varphi_L(L_j, L_j^S) \int_P^{\bar{p}} P_j f(p) dp \right] \frac{\det H_{n-1}}{\det H_n} > 0 \quad (4)$$

where  $H_r$  is the  $r$ -order principle minor of the Hessian matrix of (2) and  $\det H_{n-1} / \det H_n < 0$  using the negative definiteness of the Hessian for the strictly concave objective function (2). The bracketed expression is positive from (3). As a consequence, (4) is unambiguously positive. The intuition here is straightforward. A greater commission rate  $k_j$  for one particular property increases the expected marginal payoff and, hence, induces greater search effort for that property.

Turning to the effect of commission rate for another property  $i$  on the effort to sell property  $j$ , first note that, because (3) must be satisfied for all properties, it is true that

$$\begin{aligned} & \psi'(L_i^*) \int_P^{\bar{p}} k_i P_i f(p) dp + \varphi_L(L_i^*, L^S) \int_P^{\bar{p}} (k_i - k_s) P_i f(p) dp \\ &= \psi'(L_j^*) \int_P^{\bar{p}} k_j P_j f(p) dp + \varphi_L(L_j^*, L^S) \int_P^{\bar{p}} (k_j - k_s) P_j f(p) dp \end{aligned} \quad (5)$$

The agent allocates effort such that expected marginal payoffs are the same across properties. Differentiating (5) illustrates that the agent decreases the amount of effort allocated to other properties  $i$  (holding total effort constant) when the commission rate  $k_j$  rises:

$$\left( \frac{\partial L_i^*}{\partial k_j} \right)_{dL=0} = - \frac{- \left[ \psi'(L_j^*) \int_P^{\bar{p}} P_j f(p) dp + \varphi_L(L_j^*, L^S) \int_{P_i}^{\bar{p}} P_j f(p) dp \right]}{\psi''(L_i^*) \int_P^{\bar{p}} k_i P_i f(p) dp + \varphi_{LL}(L_i^*, L^S) \int_{P_i}^{\bar{p}} (k_i - k_s) P_i f(p) dp} < 0 \quad (6)$$

This is intuitively appealing; the agent has an incentive to allocate (relatively) less effort to other properties when the commission rate on one increases. But while intuitively appealing, this relationship does not consider the concomitant effect of the agent increasing or decreasing total search effort as the commission rate  $k_j$  on property  $j$  changes. Differentiating the system of Eq. (3) for  $n=2$  without loss of generality (where applying (5), subscript  $i$  now indicates a representative other listing) yields

$$\frac{\partial L_i^*}{\partial k_j} = \frac{-C'' \left[ \psi'(L_j^*) \int_P^{\bar{p}} P_j f(p) dp + \varphi_L(L_j^*, L^S) \int_{P_i}^{\bar{p}} P_j f(p) dp \right]}{\det H_2} < 0 \quad (7)$$

so that the agent unambiguously reduces search effort expended on behalf of other properties when the effective commission rate for one property rises. The effect on total agent effort across all properties follows from (4) and (7), which together yield

$$\frac{\partial L^*}{\partial k_j} = \frac{\partial L_i^*}{\partial k_j} + \frac{\partial L_j^*}{\partial k_j} = \frac{-\psi'' \left[ \psi'(L_j^*) \int_P^{\bar{P}} P_j f(p) dp + \varphi_L(L_j^*, L^S) \int_P^{\bar{P}} P_j f(p) dp \right]}{\det H_2} > 0 \quad (8)$$

In sum, in response to an increase in the commission rate for one property, the agent expends more total effort (8) but channels that additional effort (4) as well as some effort reallocated from other properties (7) into selling the higher commission property. A higher commission rate for one property creates a negative effort allocation externality for other properties in the agent’s portfolio of listings. These relationships drive the main conclusions of the analysis, considered next.

While there is some variation in commission rates across properties (Turnbull and Sirmans 1997; Sirmans et al. 1991; Schnare and Kulick 2009; Wiley, Benefield, and Allen 2014), most full service contract rates nonetheless lie within a fairly narrow range of 5–7 % in many housing markets, a range that is generally narrower for cross-sectional samples over fairly short time periods than over extended periods covering various market phases.<sup>4</sup> Therefore, it appears reasonable to expect variation in selling effort across client properties arising from differences in commission rates to be relatively small at a given point in time. The exception is when the agent sells his own property.

When a buyer for the agent’s property is located by the listing agent, the owner-agent receives  $P - R$ , which is the difference between the selling price  $P$  and the owner-agent’s reservation price  $R$ . When a buyer is located by other agents, the listing agent receives  $P - R - k_s P$  for his or her property. In either case, we can view owner-agent properties as a special type of contract with a commission rate  $k_O$  greater than prevailing market commission rate  $k$ . Cast this way, (4), (7), and (8) predict that, while an agent with his or her own properties on the market exerts more total sales effort, the agent nonetheless expends less sales effort on client properties relative to client properties of other agents without property for sale. The latter relationship has not yet been studied in the empirical literature. It is to this task that we now turn.

Before doing so, however, we note that Hubbard (2002) argues that reputation effects can mitigate moral hazard by agents providing expertise, like doctors, mechanics, and lawyers, although he admits the theory is not developed and the process is not fully understood. It seems reasonable that the same rationale may apply to real estate agents, vitiating the client externality moral hazard identified here. In any case, the presence or absence of agent-owned effects on client properties remains an unanswered empirical question.

<sup>4</sup> Turnbull and Sirmans (1997) show that much of the commission rate variation reflects varying housing (hence brokerage) market conditions over time over the housing market cycle.



## Data

The data used in this analysis covers residential properties listed with a real estate agent and displayed for sale in a central Virginia MLS. The data in the sample are limited to exclusive right to sell listings, which entitles the listing agent to a commission during the term of the listing contract, regardless of who sells the property. The sample covers residences listed for sale over the 11 year period 1999–2009. The data set used in this study allows us to identify those client properties which are marketed concurrently with the listing agent's own property. Just over 11 % of client listed properties (1,215) in the sample data competed directly with their listing agent's property in the sense that they were concurrently listed for sale with at least one property owned and listed for sale by their listing agent. Of those 1,215 client properties concurrently listed for sale with agent owned properties, 125 were listed with agents with more than one agent-owned property listed for sale.

The data are vetted for incomplete, missing or illogical entries. Since MLS data are entered by the listing agent or office staff, we compare random samples of the MLS data with property tax records as an additional check for accuracy. The sampled MLS data are in full agreement with property tax records. Additional filtering includes removing transactions with lot sizes exceeding 1 acre. Given a limited number of agent-owned properties list for less than \$75,000 or greater than \$265,000, we focus on transactions in this price range to enhance comparability across agent-owned and client properties. Tests for structural differences in the omitted lower price and higher price data confirm that the omitted price segments should not be pooled with this sample. The final data set comprises 10,818 observations of which 7,406 are sold and 3,412 withdrawn from the MLS or expired listings. There are 583 agent-owned properties, approximately 5.4 % of the final sample. Of the owner-agent properties listed for sale, 341 were sold and 242 were withdrawn or allowed to expire during the sample period.

The MLS provides data on almost all properties listed for sale in the area, regardless of whether the property is sold. Data collected from the MLS include the usual property characteristics such as age, square footage, various amenities including a garage or fireplace, MLS determined location, lot size, and listing and selling prices. We use the reported calendar information to construct a quarterly time index to control for changing market conditions. The data also indicate whether the owner of the property holds a real estate salesperson license, essential information for this study. Table 1 provides a complete list of variables and definitions.

In order to get a sense of the similarities between client and owner-agent properties and how such properties are likely to compete for similar buyers, Table 2 reports the descriptive statistics for client properties being concurrently marketed with agent-owned properties compared to agent-owned properties on the market. A comparison of means between agent-owned and concurrently marketed client properties reveals no significant differences in listing price (\$149,998 versus \$148,002), selling price (\$145,046 versus \$141,477), square footage (1,687 versus 1,712 square feet), fireplaces (0.57 versus 0.54), garages (0.34 versus 0.32), brick exterior (0.56 versus 0.54), or finished basements (0.20 versus 0.23). These results suggest that the properties owned by these listing agents are likely substitutes for those they are concurrently marketing for their clients. Agent-owned properties are more likely to be vacant (0.30 versus 0.15), have hardwood floors (0.54 versus 0.43) and ceramic tile flooring (0.27 versus



**Table 1** Variable definitions

Variable	Description
<i>SP</i>	Selling price
<i>TOM</i>	Number of days on market
<i>OACL</i>	Dummy variable, 1 if owner/agent property concurrently listed with client property
<i>OAMCL</i>	Dummy variable, 1 if agent owner has multiple properties concurrently listed with client property
<i>OASQFT</i>	Relative size of client property relative to owner-agent property
<i>OADISTANCE</i>	Distance from client property to owner-agent property
<i>OwnerAgent</i>	Dummy variable, 1 if owner/agent owned property
<i>Institutional</i>	Dummy variable, 1 if owned by institutional owner, 0 otherwise
<i>SQFT</i>	Square footage of living area
<i>Age</i>	Age of property
<i>Institutional</i>	Dummy variable, 1 if owned by institutional owner, 0 otherwise
<i>Tenant</i>	Dummy variable, 1 if occupied by tenant, 0 otherwise
<i>Vacant</i>	Dummy variable, 1 if vacant, 0 otherwise
<i>New</i>	Dummy variable, 1 if new construction, 0 otherwise
<i>Bedrooms</i>	Number of bedrooms
<i>Fullbath</i>	Number of full bathrooms
<i>Halfbath</i>	Number of half bathrooms
<i>Finished basement</i>	Dummy variable, 1 finished basement, 0 otherwise
<i>Paved drive</i>	Dummy variable, 1 paved driveway, 0 otherwise
<i>Whirlpool</i>	Dummy variable, 1 if whirlpool bath, 0 otherwise
<i>Heatpump</i>	Dummy variable, 1 if property has heat pump, 0 otherwise
<i>Twozone Pump</i>	Dummy variable, 1 if property has two-zone heat pump, 0 otherwise
<i>Condo Townhouse</i>	Dummy variable, 1 if condo or townhouse, 0 otherwise
<i>Hardwood</i>	Dummy variable, 1 hardwood floors, 0 otherwise
<i>Ceramic tile</i>	Dummy variable, 1 ceramic tile floors, 0 otherwise
<i>Vinyl floor</i>	Dummy variable, 1 if vinyl flooring, 0 otherwise
<i>Garage</i>	Dummy variable, 1 if property has garage, 0 otherwise
<i>Fire</i>	Dummy variable, 1 if property has fireplace, 0 otherwise
<i>Brick</i>	Dummy variable, 1 if brick exterior, 0 otherwise
<i>Vinyl siding</i>	Dummy variable, 1 if vinyl siding, 0 otherwise
<i>Area <i>i</i></i>	Dummy variable, 1 if located in area <i>i</i> , 0 otherwise
<i>Time</i>	Chronological quarterly control variable
<i>Mortgage rate</i>	Fed funds rate at listing date
<i>Agent Inventory</i>	Agent productivity, measured by total listings over sample period
<i>Listing Density</i>	Listing density measure (see text for explanation)
<i>Competition</i>	Competition measure (see text for explanation)

0.23). Client properties listed with agents concurrently marketing an agent-owned property spend a significantly longer time on market than do agent-owned properties (170 versus 140 days).

**Table 2** Difference in means for owner-agent versus sample of concurrently listed client properties

Variable	Sample		Client properties		Owner-agent properties		<i>t</i> -value
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	
<i>SP</i>	140,444	40,782.49	141,477.1	41,536.49	145,045.7	43164.61	-1.32
<i>TOM</i>	115.8380	93.6898	170.0305	118.4471	139.9451	116.7092	5.07
<i>Institutional</i>	0.2439	0.4294	0.3794	0.4854	0.4030	0.4909	-0.96
<i>SQFT</i>	1744.29	547.57	1712.268	541.2683	1687.379	486.4228	0.94
<i>Age</i>	27.5795	27.3423	23.0922	28.0230	25.7976	29.9855	-1.87
<i>Tenant</i>	0.0186	0.1350	0.0189	0.1363	0.0411	0.1988	-2.77
<i>Vacant</i>	0.2187	0.4134	0.1547	0.3617	0.3001	0.4587	-7.29
<i>New</i>	0.1844	0.3878	0.3481	0.4765	0.3344	0.4722	0.57
<i>Bedrooms</i>	3.0731	0.7377	2.9991	0.7456	3.0583	0.7552	-1.57
<i>Fullbath</i>	1.8990	0.5899	1.8781	0.5594	1.8970	0.5650	-0.67
<i>Halfbath</i>	0.4311	0.5313	0.5094	0.5397	0.4065	0.4985	3.88
<i>Finished basement</i>	0.2871	0.4524	0.2345	0.4239	0.2041	0.4034	1.45
<i>Paved drive</i>	0.6056	0.4979	0.6534	0.4880	0.5488	0.5216	4.16
<i>Whirlpool</i>	0.0430	0.2028	0.0502	0.2184	0.0566	0.2312	-0.57
<i>Heatpump</i>	0.6980	0.4591	0.7473	0.4347	0.7478	0.4346	-0.02
<i>Twozone</i>	0.1078	0.3101	0.0979	0.2973	0.1046	0.3063	-0.44
<i>Condo Townhouse</i>	0.2049	0.4039	0.2584	0.4379	0.2195	0.4143	1.79
<i>Hardwood</i>	0.5096	0.4999	0.4271	0.4948	0.5420	0.4986	-4.60
<i>Ceramic tile</i>	0.2306	0.4213	0.2271	0.4191	0.2727	0.4457	-2.11
<i>Vinyl floor</i>	0.7616	0.4261	0.8139	0.38927	0.7135	0.4524	4.85
<i>Garage</i>	0.2980	0.4574	0.3152	0.4647	0.3430	0.4751	-1.18
<i>Fire</i>	0.6374	0.4808	0.5390	0.4986	0.5677	0.4958	-1.14
<i>Brick</i>	0.5865	0.4925	0.5423	0.4984	0.5557	0.4973	-0.53
<i>Vinyl siding</i>	0.5330	0.4989	0.6139	0.4870	0.5866	0.4928	1.11
<i>Time</i>	25.6095	8.7315	26.0757	8.8943	26.924	8.4926	-1.92
<i>Time<sup>2</sup></i>	732.0802	436.41	758.9877	447.637	796.931	429.23	-1.70
<i>Mortgage rate</i>	2.9387	1.6737	2.972428	1.6350	3.1183	1.6693	-1.76
<i>Agent Inventory</i>	107.4081	147.64	245.0239	260.355	69.2367	113.911	15.60
<i>Listing Density</i>	2.6409	3.9271	3.5293	4.4859	2.7937	3.3350	3.52
<i>Competition</i>	361.8540	817.94	679.5644	1123.217	401.3735	598.3744	5.61

Note: 1,215 client properties are listed concurrently with agent-owner properties of which 813 sold. 583 Owner-agent properties are concurrently listed with client properties of which 341 sold

## Empirical Models

The principal objective of this study is to determine whether real estate agents are apt to allocate less effort to client properties that are concurrently being marketed with their agent-owned listings. The empirical test is conceptually straightforward: compare selling prices and marketing durations of client properties concurrently marketed with an agent-owned property to client properties with no such potential principal-agent conflict.

There are differing philosophies regarding the best empirical approach for pricing and liquidity or time-on-market models. Some studies use OLS for pricing models (Rutherford et al. 2005; Levitt and Syverson 2008) as well as liquidity models (Belkin et al. 1976; Levitt and Syverson 2008). However, since OLS may be inappropriate for estimating duration or time on market (Lancaster 1990) and is no longer a standard practice in the literature (Benefield et al. 2014), we follow a second branch of the empirical liquidity literature and also apply the Weibull hazard model to analyze duration in the single equation approach (Anglin et al. 2003; Rutherford et al. 2005; Waller et al. 2010; Rutherford and Yavas 2012).

Another approach in the pricing and duration literature does not treat price and liquidity as independent outcomes, but instead models them as a system of simultaneous equations. Examples include Sirmans et al. (1991), Knight (2002), Turnbull and Dombrow (2006, 2007), Clauretie and Daneshvary (2008), and Waller et al. (2010).

This study uses each of these approaches in order to both provide estimates that are methodologically comparable to previous studies looking at other aspects of the principal-agent problem in house sales and to assess the robustness of the empirical results. The OLS price model, the Weibull duration model of liquidity, and the 3SLS simultaneous price-liquidity model broadly follow the same general framework, with the specific differences in empirical specifications noted below.

The single equation price and liquidity empirical models are based on the estimated equations

$$\ln SP = \beta_0 + \beta_1 OACL + \beta_5 OASQFT + \beta_6 OADISTANCE + \sum \beta_i X_i + \varepsilon_p \quad (9)$$

$$\ln TOM = \alpha_0 + \alpha_1 OACL + \alpha_2 OAMCL + \alpha_3 OASQFT + \alpha_4 OADISTANCE + \sum \alpha_i X_i + \varepsilon_L \quad (10)$$

where  $\ln(SP)$  is selling price,  $X$  is a vector of property characteristics, fixed effect controls, time and economic controls,  $OACL$  is a dummy variable indicating if the listing agent has an owner-agent concurrent listing being marketed with the client property, and  $OAMCL$  is a dummy variable indicating if the listing agent has more than one such agent-owned property being concurrently marketed with the client property. We expect that the degree of substitutability between the client and agent-owned properties may affect the sales outcome, so we construct two variables to capture the similarities between a client property and its concurrently listed agent-owned properties.  $OASQFT$  is the square footage of a client property relative to a concurrently listed owner-agent property. In instances where an agent owns more than one property concurrently competing with a client property, the average square footage of owner-agent properties is used in the calculation:

$$OASQFT = \frac{SQFT(\text{Client property}) - SQFT(\text{Agent owned property})}{SQFT(\text{Agent owned property})}$$

The variable *OADISTANCE* is the (great circle) distance between the client property and the concurrently marketed owner-agent property. In instances where an agent owns more than one property concurrently competing with a client property, the measure uses average distance of the owner-agent properties from the subject client property. Finally,  $\varepsilon$  are the Gaussian error terms.

Rutherford et al. (2005) and Levitt and Syverson (2008) represent one approach, estimating separate price and liquidity equations using OLS. Another approach follows Rutherford and Yavas (2012), estimating the single equation duration framework using a Weibull hazard model.

The third approach estimates price and liquidity as a simultaneous system. This is our preferred approach. The empirical model is motivated by search theory, which implies that both price and time on the market are co-determined by identical factors (Krainer 2001). This creates econometric problems, since the system of price and liquidity equations implied by search theory is not identified. Early studies using simultaneous price-liquidity approaches rely on ad hoc restrictions in order to identify both equations (Sirmans et al. 1991). In contrast, Zahirovic-Herbert and Turnbull (2008) offer a practical procedure for dealing with the identification problem.

We briefly summarize the approach and its rationale here. Following Turnbull and Dombrow (2006, 2007), the variable *COMP* measuring surrounding or neighborhood competition is defined as the distance-weighted number of houses in the surrounding neighborhood that are on the market at the same time as the subject property (by construction, *COMP* measures competition in terms of house-days). Competing houses are those that are no more than 20 % larger or smaller than the subject property. This variable captures the surrounding neighborhood market conditions and, following the implications of search theory, appears in both price and liquidity equations like (9) and (10) as do all of the other house and location characteristics. Using these modified equations as a starting point, Zahirovic-Herbert and Turnbull (2008) show that including time on the market as an explanatory variable in the selling price equation (as implied by search theory) means that the estimated coefficient on the *COMP* variable in the price equation is not the total effect of the number of competing houses on the market at the same time as the subject property, but instead is the effect of the number of competing houses on the market per day of subject market exposure, which is defined as the listing density (*LD*). Imposing this parametric restriction across the Eqs. (9) and (10) with *COMP* included yields the simultaneous system

$$\begin{aligned} \ln SP = & \beta_0 + \beta_1 \ln TOM + \beta_2 OACL + \beta_3 OAMCL + \beta_4 OASQFT \\ & + \beta_5 OADISTANCE + \beta_6 LD + \sum \beta_i X_i + \varepsilon_P \end{aligned} \quad (11)$$

$$\begin{aligned} \ln TOM = & \alpha_0 + \alpha_1 \ln SP + \alpha_2 OACL + \alpha_3 OAMCL + \alpha_4 OASQFT \\ & + \alpha_5 OADISTANCE + \alpha_6 COMP + \sum \alpha_i X_i + \varepsilon_L \end{aligned} \quad (12)$$

This system of equations is identified. The search theory that motivates the simultaneous price-liquidity system also implies cross-equation correlation of error terms, in which case 3SLS is asymptotically more efficient than 2SLS (Belsley 1988).

The interpretation of the coefficients on the *LD* and *COMP* variables follows Turnbull and Dombrow (2006). If a greater number of nearby houses on the market only increases the competition among sellers for the same pool of potential buyers then *LD* and *COMP* will have a negative coefficient in the price equation and/or positive coefficient in the liquidity equation, respectively. If, however, more nearby houses on the market also increases buyer search traffic in the neighborhood then the coefficients may be positive in the price and/or negative in the liquidity equations, indicating the presence of shopping externalities from the surrounding properties.<sup>5</sup>

The agent-owner listing variables are interpreted the same regardless of the empirical approach taken; 3SLS, OLS single price equation, or Weibull single equation duration model. The theory predicts that agents with agent-owned properties concurrently marketed with client properties will reallocate effort from client listings toward their own listing. We expect an owner-agent listing (*OACL*) concurrently marketed with client properties to reduce selling price and/or increase marketing duration of client properties. If agents with one agent-owned property concurrently marketed with client properties reallocate greater effort toward their own listings then multiple owner-agent listings concurrently marketed with client properties (*OAMCL*) will also reduce selling price and/or increase marketing duration of client properties.

The degree of substitutability between the client and agent-owned properties may affect the sales outcome. If so, we expect that client properties that are poorer substitutes for the agent-owned property, measured by size of client property relative to the agent's own property (*OASQFT*), may suffer less diversion of selling effort to the agent-owned property, in which case greater relative size leads to higher seller price and/or shorter marketing time. Similarly, client properties located near a concurrent owner-agent property (*OADISTANCE*) are expected to exhibit negative price and/or positive market time effects to the extent that proximity indicates greater substitutability.

## Empirical Results

The simultaneous price-liquidity model follows from search theory and so represents the preferred model; single equation estimates are also provided for comparison and evidence of robustness. Table 3 reports the results of the jointly estimated price-liquidity models for the full sample period analyzing the marketing outcome of a client's property that is concurrently listed with a competing property owned by their listing agent. The signs and magnitudes of typical variables included in pricing and duration models are consistent with previous studies. Looking at the Table 3 estimates for the full sample period 1999–2009, the *OACL* coefficient for the pricing model is

<sup>5</sup> See Turnbull and Dombrow (2006) for a thorough discussion of the relationship between the estimated coefficients and underlying competition and shopping externality effects.

**Table 3** 3SLS estimates of price-liquidity model with *OACL* (1999–2009 sample)

	LnSP		LnTOM	
	Coef.	Std. Err.	Coef.	Std. Err.
<i>OACL</i>	-0.0128**	0.0065	0.4482***	0.1154
<i>OwnerAgent</i>	0.0242**	0.0101	-0.5798***	0.1942
<i>Institutional</i>	-0.0268***	0.0061	0.5014***	0.1344
<i>LnTom</i>	0.0166***	0.0047		
<i>LnSP</i>			18.6424***	2.3645
<i>LnSQFT</i>	0.4400***	0.0107	-8.0484***	1.0716
<i>LnAGE</i>	-0.1121***	0.0027	2.0813***	0.2698
<i>Tenant</i>	-0.0893***	0.0157	1.7540***	0.3604
<i>Vacant</i>	-0.0482***	0.0046	0.9207***	0.1411
<i>New</i>	-0.0735***	0.0098	1.5956***	0.2489
<i>Bedrooms</i>	-0.0197***	0.0035	0.3648***	0.0821
<i>Fullbath</i>	0.0582***	0.0043	-1.0803***	0.1618
<i>Halfbath</i>	0.0111***	0.0040	-0.2019**	0.0807
<i>Finished basement</i>	-0.0430***	0.0047	0.7692***	0.1356
<i>Paved drive</i>	0.0320***	0.0038	-0.6227***	0.1033
<i>Whirlpool</i>	0.0279***	0.0088	-0.4800***	0.1818
<i>Heatpump</i>	0.0288***	0.0047	-0.5641***	0.1120
<i>Twozone Pump</i>	0.0547***	0.0064	-1.0549***	0.1670
<i>Condo Townhouse</i>	-0.1260***	0.0062	2.4233***	0.3359
<i>Hardwood</i>	0.0404***	0.0042	-0.7601***	0.1264
<i>Ceramic tile</i>	0.0364***	0.0045	-0.6800***	0.1219
<i>Vinyl floor</i>	-0.0179***	0.0045	0.3245***	0.0939
<i>Garage</i>	0.0823***	0.0043	-1.5190***	0.2104
<i>Fire</i>	0.0863***	0.0045	-1.6292***	0.2221
<i>Brick</i>	0.0256***	0.0038	-0.5055***	0.0908
<i>Vinyl siding</i>	-0.0373***	0.0043	0.6990***	0.1221
<i>Time</i>	0.0206***	0.0014	-0.4180***	0.0533
<i>Time-sq</i>	-0.0001***	0.0000	0.0032***	0.0006
<i>Mortgage rate</i>	0.0419***	0.0042	-0.8036***	0.1254
<i>Agent Inventory</i>	0.00002	0.00001	-0.0006***	0.0002
<i>Listing Density</i>	-0.0044***	0.0007		
<i>Competition</i>			0.0006***	0.0001
<i>_cons</i>	7.9310***	0.0806	-145.2916***	18.9508
<i>Location Fixed Effect</i>	Yes			

Note: \*\*\*, \*\*, and \* denote significance at the 1, 5 and 10 % levels, respectively

LnSP ( $p$ -value = 0.000); LnTOM ( $p$ -value = 0.000)  $N = 7,067$

negative and significant, indicating that sale prices of client properties are negatively impacted by concurrently listed agent-owned properties. The estimated *OACL*

coefficient indicates that a competing agent owned property would negatively impact a client's property selling price by 1.3 %<sup>6</sup> or approximately \$1,800 based on the sample average selling price. Table 3 also reports liquidity equation estimates. As expected, the coefficient for *OACL* is positive and significant, indicating that client properties remain on the market longer when marketed concurrently with an agent-owned property. Client properties being concurrently marketed with that of the listing agent is expected to remain on the market for over 55 % longer or an additional 64 days based on average marketing duration.

In order to examine the extent to which agent effects vary with housing market conditions, we partition the full sample into two sample periods: 1999–2006, 2007–2009, capturing rising market and the post-crisis declining market, respectively.<sup>7</sup> We define the last quarter of 2006 as the market peak. The FHFA quarterly House Price Index, both U.S. and the State of Virginia, peaked during the first quarter of 2007. Thus, properties listed after the last quarter of 2006 were mostly marketed during the housing market contraction that began in early 2007. Table 4 examines the impact of the client property outcomes over different market phases. The impact of selling prices on client properties are more pronounced during the rising market 1999–2006, where selling prices are negatively impacted by 1.9 % or approximately \$2,800 evaluated at the sample mean. Marketing durations of client properties are virtually identical to those in the overall sample period. For the post-financial crisis period, 2007–2009, the estimated coefficients for neither the selling nor duration models are significant, although they maintain their expected signs. It is also worth noting that agent-owned properties sell at a premium and sell more quickly than client properties; agents appear to exert different efforts when selling their own properties than when selling their clients' properties, as found by Levitt and Syverson (2008) and Rutherford et al. (2005).

Probing more deeply into factors associated with the relationship between client and owner-agent properties, we add variables for multiple agent-owner properties, the relative size and the distance between the properties. Table 5 reports estimates for the full sample period 1999–2009, the *OACL* coefficient for the pricing model is negative and significant, albeit marginally. The coefficient for agents with more than one agent-owned property (*OAMCL*) is insignificant in the pricing equation. These results offer no evidence that the agent own-listing externality on client properties increases with the number of agent-owned listings. The positive and significant *OASQFT* coefficient indicates that larger client properties relative to the agent-owned property sell at higher prices, although the effect is very modest. Finally, the distance of an agent-owned property (*OADISTANCE*) relative to that of a concurrently marketed client property does not have a significant impact on the selling price of the latter.

Table 5 also reports liquidity equation estimates. As in the base model, the coefficient for *OACL* is positive and significant, supporting the notion that client properties remain on the market longer when marketed concurrently with an agent-owned property. The client property being concurrently marketed with that of the listing agent is expected to remain on the market approximately 56 % longer or an additional 65 days based on the average sample marketing duration. The negative and marginally

<sup>6</sup> Dummy variable estimates are interpreted using the Kennedy (1981) bias adjustment throughout the paper.

<sup>7</sup> Chow tests confirm that pooling the entire 1999–2006 is appropriate.



**Table 4** 3SLS estimates of price-liquidity model with *OACL* (pre/post financial crisis subsamples)

	1999–2006				2007–2009			
	LnSP		LnTOM		LnSP		LnTOM	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
<i>OACL</i>	-0.0191***	0.0074	0.4419***	0.0963	-0.00001	0.0127	0.6121	1.1008
<i>Owner Agent</i>	0.0329***	0.0115	-0.5499***	0.1596	-0.0022	0.0204	-0.2664	1.8147
<i>Institutional</i>	-0.0242***	0.0071	0.3150***	0.1052	-0.0329***	0.0116	3.0014	3.7106
<i>LnTom</i>	0.0301***	0.0052			-0.0131	0.0102		
<i>LnSP</i>			13.2606***	1.4237			90.5161	106.0254
<i>LnSQFT</i>	0.4551***	0.0119	-5.9106***	0.6794	0.3880***	0.023	-34.6577	40.8681
<i>LnAGE</i>	-0.1126***	0.0031	1.4949***	0.1664	-0.1148***	0.0053	10.3017	12.1026
<i>Tenant</i>	-0.0800***	0.0177	1.0989***	0.265	-0.1060***	0.0326	10.2895	11.9977
<i>Vacant</i>	-0.0525***	0.0052	0.7100***	0.1023	-0.0347***	0.0094	3.3063	3.8557
<i>New</i>	-0.0735***	0.0113	1.1886***	0.181	-0.0836***	0.02	8.1888	9.5056
<i>Bedrooms</i>	-0.0192***	0.0039	0.2559***	0.0606	-0.0207***	0.0074	1.8546	2.2855
<i>Fullbath</i>	0.0591***	0.0047	-0.7772***	0.1075	0.0564***	0.0094	-5.1255	6.1018
<i>Halfbath</i>	0.0110**	0.0045	-0.1435**	0.0627	0.0139	0.0088	-1.1867	1.687
<i>Finished basement</i>	-0.0476***	0.0051	0.5959***	0.0987	-0.0233**	0.0104	2.0809	2.61
<i>Paved drive</i>	0.0284***	0.0043	-0.4046***	0.0697	0.0424***	0.0079	-3.8489	4.5594
<i>Whirlpool</i>	0.0200**	0.0093	-0.2422**	0.1328	0.0537**	0.0217	-4.6539	5.8981
<i>Heatpump</i>	0.0200***	0.0052	-0.2847***	0.0771	0.0534***	0.0098	-4.9789	5.8355
<i>Twozone Pump</i>	0.0533***	0.0067	-0.7093***	0.1136	0.0408**	0.017	-4.1565	4.741
<i>Condo Townhouse</i>	-0.1151***	0.0069	1.5844***	0.1979	-0.1698***	0.0134	15.5918	18.4451
<i>Hardwood</i>	0.0433***	0.0047	-0.5859***	0.0903	0.0316***	0.0089	-2.8243	3.4493
<i>Ceramic tile</i>	0.0437***	0.0051	-0.5941***	0.093	0.0247***	0.009	-2.1364	2.7233
<i>Vinyl floor</i>	-0.0214***	0.0051	0.2692***	0.0753	-0.0121	0.0089	1.1288	1.5279
<i>Garage</i>	0.0821***	0.0047	-1.0718***	0.1321	0.0842***	0.0094	-7.6169	8.9975
<i>Fire</i>	0.0846***	0.0051	-1.1557***	0.1397	0.0937***	0.009	-8.4041	9.9183
<i>Brick</i>	0.0228***	0.0043	-0.3327***	0.0645	0.0394**	0.008	-3.6289	4.2346
<i>Vinyl siding</i>	-0.0410***	0.0047	0.5313***	0.0898	-0.0235***	0.0092	2.333	2.7979
<i>Time</i>	0.0007	0.0032	-0.01425	0.1794	0.1874***	0.0563	-14.2136	18.6118
<i>Time-sq</i>	0.0004***	0.0001	-0.00471***	0.1712	-0.0026***	0.0008	0.1998	0.2615
<i>Mortgage rate</i>	0.0092	0.0068	-0.11738	0.2688	-0.0244*	0.0137	2.1928	2.8752
<i>Agent Inventory</i>	0.00002	0.00001	-0.0004**	0.1034	0.00003	0.00003	-0.0041	0.0047
<i>Listing Density</i>	-0.0056***	0.0008		0.1506	-0.0026**	0.0012		
<i>Competition</i>			0.00054***	0.0442			0.0015	0.0014
<i>_cons</i>	8.1606***	0.1055	-106.268***	0.0012	6.0421***	0.9632	-589.3344	675.8611
<i>Location Fixed Effect</i>	Yes				Yes			
<i>N</i>	5,567				2,040			

Note: \*\*\*, \*\*, and \* denote significance at the 1, 5 and 10 % levels, respectively

significant *OASQFT* coefficient indicates that larger client properties relative to the agent-owned property sell quicker. But additional owner-agent properties (*OAMCL*)

**Table 5** 3SLS estimates of price-liquidity model with *OACL*, *OAMCL*, *OASQFT* and *OADISTANCE* (1999–2009 sample)

	LnSP		LnTOM	
	Coef.	Std. Err.	Coef.	Std. Err.
<i>OACL</i>	-0.0138*	0.0072	0.4506***	0.1337
<i>OAMCL</i>	0.0118	0.0105	-0.0954	0.2045
<i>OASQFT</i>	0.00005**	0.00002	-0.0009*	0.0004
<i>OADISTANCE</i>	-0.0006	0.0007	0.0099	0.0145
<i>OwnerAgent</i>	0.0177*	0.0105	-0.4878**	0.2017
<i>Institutional</i>	-0.0272***	0.0061	0.5158***	0.1385
<i>LnTom</i>	0.0155***	0.0048		
<i>LnSP</i>			18.9871***	2.4800
<i>LnSQFT</i>	0.4391***	0.0107	-8.1845***	1.1191
<i>LnAGE</i>	-0.1119***	0.0027	2.1179***	0.2821
<i>Tenant</i>	-0.0898***	0.0157	1.7902***	0.3717
<i>Vacant</i>	-0.0480***	0.0046	0.9356***	0.1460
<i>New</i>	-0.0738***	0.0098	1.6281***	0.2583
<i>Bedrooms</i>	-0.0194***	0.0035	0.3674***	0.0839
<i>Fullbath</i>	0.0584***	0.0043	-1.1021***	0.1689
<i>Halfbath</i>	0.0114***	0.0040	-0.2109***	0.0828
<i>Finished basement</i>	-0.0429***	0.0046	0.7823***	0.1401
<i>Paved drive</i>	0.0323***	0.0038	-0.6398***	0.1077
<i>Whirlpool</i>	0.0287***	0.0088	-0.5005***	0.1870
<i>Heatpump</i>	0.0287***	0.0047	-0.5731***	0.1151
<i>Twozone Pump</i>	0.0548***	0.0064	-1.0773***	0.1730
<i>Condo Townhouse</i>	-0.1263***	0.0062	2.4744***	0.3514
<i>Hardwood</i>	0.0399***	0.0042	-0.7663***	0.1298
<i>Ceramic tile</i>	0.0366***	0.0045	-0.6940***	0.1264
<i>Vinyl floor</i>	-0.0178***	0.0044	0.3289***	0.0960
<i>Garage</i>	0.0824***	0.0043	-1.5493***	0.2200
<i>Fire</i>	0.0864***	0.0045	-1.6607***	0.2321
<i>Brick</i>	0.0252***	0.0038	-0.5084***	0.0932
<i>Vinyl siding</i>	-0.0372***	0.0043	0.7119***	0.1261
<i>Time</i>	0.0206***	0.0014	-0.4257***	0.0558
<i>Time-sq</i>	-0.0001***	0.0000	0.0033***	0.0006
<i>Mortgage rate</i>	0.0422***	0.0042	-0.8225***	0.1309
<i>Agent Inventory</i>	0.0000***	0.0000	-0.0006**	0.0002
<i>Listing Density</i>	-0.0043***	0.0007		
<i>Competition</i>			0.0006***	0.0001
<i>_cons</i>	7.9393***	0.0807	-148.1140***	19.8862
<i>Location Fixed Effect</i>	Yes			

Note: \*\*\*, \*\*, and \* denote significance at the 1, 5 and 10 % levels, respectively

LnSP ( $p$ -value = 0.000); LnTOM ( $p$ -value = 0.000)  $N = 7,607$

and the distance from the owner-agent property (*OADISTANCE*) do not have a significant impact on client property marketing duration.

Table 6 provides the 3SLS pricing and liquidity estimates for the 1999–2006 and 2007–2009 time periods. As in the full sample estimates, agent-owned properties that are concurrently marketed with client properties significantly reduce the selling price of client properties and by a larger margin of 2.1 % or almost \$3,000 during the rising market phase. Similarly, concurrent listing of an agent-owned property significantly lessens the liquidity of client properties, much like in the full sample. The price and liquidity results are consistent with the principal-agent effects identified in the theoretical model. If the type of reputation effects identified by Hubbard (2002) exist, the 1999–2006 sample estimates reveal that they are not strong enough to fully offset the principal-agent effects in the rising market phase. It may be that principal-agent effects are stronger in this sample period because agents anticipated that the rising market would not continue indefinitely, reinforcing their incentive to dispose of their properties while the market was still hot.<sup>8</sup> In any case, the liquidity equation *OACL* estimate indicates that client properties concurrently marketed with an owner-agent property will, on average, endure marketing duration of approximately 55 % longer than properties with no such conflicts. This amounts to an additional 65 days based on the average 116 days marketing duration.

The *OAMCL* coefficient is insignificant in the 1999–2006 period. Having a concurrently listed agent-owned property matters, but having more than one generates no significant additional liquidity penalty for client properties. As in the full sample period, the relative size of client properties relative to agent properties (*OASQFT*) is positive and significant albeit very modest while the distance of the owner-agent property from the client property (*OADISTANCE*) remains insignificant.

The 3SLS results for the post-crisis period 2007–2009 are also reported in Table 6 with none of the variables of interest being significant in either the pricing or duration models. Taken as a whole, these estimates suggest that the transactions patterns in the boom market simply do not carry over into the post-crisis period. This does not mean that the principal-agent problem arising from concurrent marketing of client and agent-owned properties is not as important as before the crisis; instead, it reinforces the notion that price discovery and sales performance were deeply disrupted during the housing market collapse and its immediate aftermath to the extent that it is hard to pick up stable relationships among the variables of interest.

As explained earlier, other studies of related housing market principal-agent issues tend to rely on single equation price and liquidity models. In order to evaluate how sensitive the results are to the estimation method, we re-estimate agent-owned property externality effects on client properties using the single equation models explained earlier. Table 7 reports price equation OLS estimates. Table 8 reports the Weibull duration model estimates. Looking at the price equation results first, neither the *OACL*, *OAMCL* nor *OADISTANCE* variables are significant in 1999–2009 time period. As in the 3SLS model, relative size does have a positive but modest impact. The price function OLS estimates reported in Table 7 indicate that concurrently marketed owner agent properties do not significantly impact client property's selling prices in the rising

<sup>8</sup> We are indebted to an anonymous reviewer for suggesting this interpretation.

**Table 6** 3SLS estimates of price-liquidity model with *OACL*, *OAMCL*, *OASQFT* and *OADISTANCE* (pre/post financial crisis subsamples)

	1999–2006				2007–2009			
	LnSP		LnTOM		LnSP		LnTOM	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
	-0.0212***	0.0081	0.4566***	0.1098	0.0098	0.0159	-0.4078	1.829
<i>OAMCL</i>	0.0164	0.0119	-0.1123	0.1683	0.0127	0.0211	-1.0526	2.6542
<i>OASQFT</i>	0.00006**	0.00002	-0.0007*	0.0004	0.00002	0.00004	-0.0024	0.0055
<i>OADISTANCE</i>	-0.0007	0.0007	0.0071	0.0105	-0.0038	0.003	0.4007	0.6009
<i>OwnerAgent</i>	0.0256**	0.0118	-0.4842***	0.1643	-0.0169	0.0227	1.2266	2.9975
<i>Institutional</i>	-0.0251***	0.0071	0.3285***	0.108	-0.0327***	0.0116	3.2996	4.4849
<i>LnTom</i>	0.0287***	0.0053			-0.0144***	0.0103		
<i>LnSP</i>			13.4877***	1.4893			99.9564	129.8832
<i>LnSQFT</i>	0.4544***	0.0119	-6.0057***	0.7075	0.3868***	0.023	-38.1497	49.861
<i>LnAGE</i>	-0.1126***	0.0031	1.5201***	0.1736	-0.1146***	0.0053	11.3505	14.7839
<i>Tenant</i>	-0.0799***	0.0176	1.1144***	0.2705	-0.1070***	0.0326	11.4598	14.7996
<i>Vacant</i>	-0.0522***	0.0052	0.7196***	0.1051	-0.0345***	0.0094	3.6327	4.6918
<i>New</i>	-0.0741***	0.0113	1.2140***	0.1868	-0.0838***	0.02	9.0761	11.6761
<i>Bedrooms</i>	-0.0189***	0.0039	0.2574***	0.0617	-0.0206***	0.0074	2.0345	2.7594
<i>Fullbath</i>	0.0592***	0.0047	-0.7919***	0.1115	0.0569***	0.0094	-5.7093	7.5243
<i>Halfbath</i>	0.0116***	0.0045	-0.1528***	0.0642	0.014	0.0088	-1.3226	2.0258
<i>Finished basement</i>	-0.0475***	0.0051	0.6056***	0.1016	-0.0235**	0.0104	2.3125	3.1761
<i>Paved drive</i>	0.0287***	0.0043	-0.4149***	0.0718	0.0423***	0.0079	-4.2361	5.5588
<i>Whirlpool</i>	0.0213**	0.0093	-0.2590*	0.1359	0.0538**	0.0217	-5.1283	7.1331
<i>Heatpump</i>	0.0199***	0.0052	-0.2878***	0.0785	0.0533***	0.0098	-5.488	7.1281
<i>Twozone Pump</i>	0.0533***	0.0067	-0.7229***	0.1167	0.0406**	0.017	-4.5748	5.781
<i>Condo Townhouse</i>	-0.1153***	0.0069	1.6157***	0.206	-0.1704***	0.0134	17.289	22.656
<i>Hardwood</i>	0.0428***	0.0047	-0.5905***	0.0924	0.0305***	0.0089	-3.01	4.0579
<i>Ceramic tile</i>	0.0441***	0.0051	-0.6073***	0.0965	0.0248***	0.009	-2.3812	3.3195
<i>Vinyl floor</i>	-0.0215***	0.005	0.2744***	0.0769	-0.0119	0.0089	1.2261	1.8029
<i>Garage</i>	0.0822***	0.0047	-1.0907***	0.1373	0.0845***	0.0094	-8.4477	11.0529
<i>Fire</i>	0.0846***	0.0051	-1.1753***	0.145	0.0940***	0.009	-9.3074	12.1715
<i>Brick</i>	0.0224***	0.0043	-0.3330***	0.0658	0.0394***	0.008	-4.0091	5.1866
<i>Vinyl siding</i>	-0.0410***	0.0047	0.5402***	0.0923	-0.0232**	0.0092	2.554	3.3761
<i>Time</i>	0.0004	0.0032	-0.0121	0.0449	0.1889***	0.0563	-15.8433	22.6607
<i>Time-sq</i>	0.0004***	0.0001	-0.0049***	0.0012	-0.0026***	0.0008	0.2227	0.3185
<i>Mortgage rate</i>	0.0091	0.0068	-0.1183	0.0957	-0.0241*	0.0137	2.3948	3.4249
<i>Agent Inventory</i>	0.00001	0.00001	-0.0004*	0.0002	0.0000	0.0000	-0.0041	0.0052
<i>Listing Density</i>	-0.0056***	0.0008			-0.0026**	0.0012		
<i>Competition</i>			0.0005***	0.0001			0.0017	0.0018
<i>_cons</i>	8.1741***	0.1055	-108.2312***	12.4022	6.0286***	0.9633	-649.4048	827.8113
<i>Location Fixed Effect</i>	Yes				Yes			
<i>N</i>	5,567				2,040			

Note: \*\*\*, \*\*, and \* denote significance at the 1, 5 and 10 % levels, respectively

**Table 7** OLS price equation estimates

	1999–2009		1999–2006		2007–2009	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
<i>OACL</i>	-0.0082	0.0070	-0.0124	0.0079	0.0095	0.0156
<i>OAMCL</i>	0.0152	0.0104	0.0220*	0.0118	0.0125	0.0212
<i>OASQFT</i>	0.0001***	0.0000	0.0001***	0.0000	0.00002	0.00005
<i>OADISTANCE</i>	-0.0006	0.0007	-0.0008	0.0007	-0.0038	0.0030
<i>OwnerAgent</i>	0.0142	0.0104	0.0196*	0.0117	-0.0148	0.0225
<i>Institutional</i>	-0.0300***	0.0061	-0.0286***	0.0071	-0.0347***	0.0116
<i>LnTOM</i>	0.0046**	0.0023	0.0104***	0.0026	-0.0123***	0.0051
<i>LnSQFT</i>	0.4436***	0.0107	0.4606***	0.0118	0.3870***	0.0232
<i>LnAGE</i>	-0.1121***	0.0027	-0.1135***	0.0031	-0.1135***	0.0053
<i>Tenant</i>	-0.0869***	0.0158	-0.0764***	0.0177	-0.1083***	0.0327
<i>Vacant</i>	-0.0469***	0.0046	-0.0509***	0.0052	-0.0356***	0.0094
<i>New</i>	-0.0793***	0.0093	-0.0791***	0.0108	-0.0928***	0.0190
<i>Bedrooms</i>	-0.0203***	0.0035	-0.0197***	0.0039	-0.0207***	0.0074
<i>Fullbath</i>	0.0591***	0.0043	0.0603***	0.0047	0.0580***	0.0095
<i>Halfbath</i>	0.0118***	0.0040	0.0111**	0.0045	0.0156*	0.0088
<i>Finished basement</i>	-0.0435***	0.0046	-0.0486***	0.0051	-0.0232**	0.0105
<i>Paved drive</i>	0.0313***	0.0039	0.0266***	0.0043	0.0414***	0.0080
<i>Whirlpool</i>	0.0314***	0.0088	0.0257***	0.0093	0.0514**	0.0217
<i>Heatpump</i>	0.0296***	0.0047	0.0203***	0.0052	0.0543***	0.0098
<i>Twozone Pump</i>	0.0492***	0.0063	0.0467***	0.0067	0.0402**	0.0169
<i>Condo Townhouse</i>	-0.1361***	0.0059	-0.1241***	0.0066	-0.1789***	0.0129
<i>Hardwood</i>	0.0412***	0.0042	0.0445***	0.0047	0.0313***	0.0090
<i>Ceramic tile</i>	0.0367***	0.0045	0.0442***	0.0051	0.0240***	0.0090
<i>Vinyl floor</i>	-0.0179***	0.0045	-0.0215***	0.0050	-0.0121	0.0090
<i>Garage</i>	0.0821***	0.0043	0.0807***	0.0047	0.0855***	0.0095
<i>Fire</i>	0.0871***	0.0045	0.0852***	0.0051	0.0939***	0.0091
<i>Brick</i>	0.0226***	0.0038	0.0194***	0.0043	0.0377***	0.0080
<i>Vinyl siding</i>	-0.0389***	0.0043	-0.0433***	0.0047	-0.0251***	0.0092
<i>Time</i>	0.0200***	0.0014	-0.0002	0.0032	0.1727***	0.0546
<i>Time-sq</i>	-0.0001***	0.0000	0.0004	0.0001	-0.0024***	0.0008
<i>Mortgage rate</i>	0.0411***	0.0042	0.0083	0.0068	-0.0223	0.0139
<i>Agent Inventory</i>	0.00001	0.00001	-0.000001	0.000014	0.00003	0.00003
<i>_cons</i>	7.9738***	0.0796	8.2327***	0.1050	6.2863***	0.9382
<i>Location Fixed Effect</i>	Yes		Yes		Yes	
<i>N</i>	7,652		5,604		2,048	
<i>R<sup>2</sup></i>	0.7430		0.7631		0.6963	
<i>F-statistic</i>	595.02		484.66		124.58	

Note: \*\*\*, \*\*, and \* denote significance at the 1, 5 and 10 % levels, respectively

market unless the agent has more than one property on the market. Surprisingly, the estimated coefficient for agents with more than one property is positive and significant,

**Table 8** Weibull duration estimates

	1999–2009		1999–2006		2007–2009	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
<i>OACL</i>	0.3332***	0.0286	0.3494***	0.0336	0.3075***	0.0554
<i>OAMCL</i>	0.4019***	0.0427	0.4042***	0.0505	0.2954***	0.0774
<i>OASQFT</i>	0.0002*	0.0001	0.0002*	0.0001	0.0000	0.0001
<i>OADISTANCE</i>	-0.0086***	0.0032	-0.0095***	0.0032	-0.0094	0.0092
<i>OwnerAgent</i>	-0.3544***	0.0423	-0.3578***	0.0499	-0.3464***	0.0813
<i>LnSP</i>	0.1165**	0.0459	0.2865***	0.0564	-0.2380***	0.0803
<i>Institutional</i>	0.1149***	0.0252	0.1454***	0.0303	0.0429	0.0436
<i>LnSQFT</i>	0.1614***	0.0477	0.1077*	0.0565	0.1677*	0.0880
<i>LnAGE</i>	0.0081	0.0119	0.0320**	0.0144	-0.0466**	0.0216
<i>Tenant</i>	0.1225*	0.0644	0.0786	0.0755	0.2120*	0.1181
<i>Vacant</i>	0.0919***	0.0188	0.0798***	0.0221	0.1290***	0.0341
<i>New</i>	0.4983***	0.0371	0.5281***	0.0440	0.4179***	0.0696
<i>Bedrooms</i>	0.0089	0.0144	0.0047	0.0168	0.0208	0.0272
<i>Fullbath</i>	0.0275	0.0177	0.0214	0.0202	0.0553	0.0348
<i>Halfbath</i>	-0.0133	0.0163	-0.0461**	0.0189	0.0901***	0.0320
<i>Finished basement</i>	-0.0694***	0.0189	-0.0628***	0.0215	-0.0646*	0.0377
<i>Paved drive</i>	-0.0260*	0.0157	-0.0426**	0.0184	0.0297	0.0292
<i>Whirlpool</i>	0.0799**	0.0358	0.0672*	0.0397	0.0831	0.0805
<i>Heatpump</i>	-0.0507***	0.0187	-0.0520**	0.0218	-0.0595	0.0358
<i>Twozone Pump</i>	-0.0841***	0.0259	-0.0306	0.0289	-0.2995***	0.0609
<i>Condo Townhouse</i>	0.2604***	0.0247	0.3079***	0.0288	0.0930*	0.0487
<i>Hardwood</i>	-0.0084	0.0173	-0.0210	0.0202	0.0203	0.0329
<i>Ceramic tile</i>	0.0257	0.0185	0.0102	0.0220	0.0713**	0.0333
<i>Vinyl floor</i>	-0.0209	0.0184	-0.0277	0.0218	-0.0105	0.0329
<i>Garage</i>	0.0456**	0.0179	0.0080	0.0207	0.1109***	0.0349
<i>Fire</i>	-0.0630***	0.0188	-0.0991***	0.0224	0.0218	0.0343
<i>Brick</i>	-0.0501***	0.0157	-0.0598***	0.0183	-0.0372	0.0300
<i>Vinyl siding</i>	-0.0227	0.0176	-0.0445**	0.0204	0.0564*	0.0339
<i>Time</i>	-0.0650***	0.0061	-0.0332**	0.0138	1.5420***	0.1956
<i>Time-sq</i>	0.0012***	0.0001	0.0003	0.0003	-0.0215***	0.0028
<i>Mortgage rate</i>	0.0241	0.0186	0.0540	0.0292	0.0408	0.0517
<i>Agent Inventory</i>	-0.0005***	0.0001	-0.0004***	0.0001	-0.0006***	0.0001
<i>_cons</i>	2.8303***	0.4805	0.8642***	0.6251	-21.5313***	3.4096
<i>Location Fixed Effect</i>	Yes		Yes		Yes	
<i>/ln_p</i>	0.482357	0.008239	0.489476	0.009568	0.522843	0.016533
<i>p</i>	1.619888	0.013345	1.631462	0.01561	1.686816	0.027888
<i>1/p</i>	0.617327	0.005086	0.612947	0.005865	0.592833	0.009801

Note: \*\*\*, \*\*, and \* denote significance at the 1, 5 and 10 % levels, respectively

albeit only marginally. Clearly, the implications of agent-owned properties for selling prices of client properties are sensitive to whether the endogeneity of time on the

market is controlled (as in 3SLS) or not (as in OLS). On the other hand, the OLS and 3SLS price models yield the same conclusions for the post-crisis period.

The liquidity or marketing time results, however, tell a different story. Table 8 presents the marketing duration results for the single equation Weibull models. The key variables offer strong evidence of a stable concurrent agent listing effect on expected selling time; the *OACL* and *OAMCL* coefficients are both significantly positive in the pooled sample and in both subsamples. The full sample and the 1999–2006 rising market results are qualitatively in line with the 3SLS results discussed earlier. And the post-crisis 2007–2009 sample period results are surprisingly similar to the full sample results, something not observed in the 3SLS approach. Table 8 also reveals that the relative size (*OASQFT*) effect on liquidity is marginally significant and positive in the pooled sample and 1999–2006 time periods for the Weibull approaches. This indicates that a larger client property relative to the agent-owned property takes a longer time to sell, in contrast with the 3SLS estimates. The distance from agent-owned property (*OADISTANCE*) variable coefficients are significantly negative in the Weibull models for the full and the 1999–2006 samples. The negative coefficient on this variable suggests that agent-owned listings farther away from client properties depress client property prices more than when the agent-owned listings are closer.<sup>9</sup>

As a final robustness test, we re-estimate the simultaneous price-liquidity model using a propensity scoring method (PSM) matched sample approach. This method is designed to control for omitted variable or self-selection effects. This approach allows for the possibility that certain types of clients may be attracted to certain characteristics of agents with their own properties for sale (regardless of whether or not clients know their agents have their own properties on the market). These agent characteristics may or may not be directly observed in the data. Alternatively, it may be that agents with their own properties to sell are more likely to list certain types of client properties. In this application, the PSM provides consistent estimates of the concurrent agent-owned listing effect on price and liquidity of client properties (Rosenbaum and Rubin 1983). The PSM method allows us to evaluate the extent to which these neglected factors may be influencing our results.

The first stage of the analysis estimates the probability that a house is listed by an agent with his or her own property listed concurrently, conditional on the set of property characteristics included in the price and liquidity equations. The propensity score of a particular property is the predicted logistic value based on the function estimated in the first stage. This approach has the advantage of reducing the multiple dimension matching problem to a single dimension (Dehejia and Wahba 2002). We construct the matched sample using the predicted logistic values based on the function estimated in the first stage to match a property listed with an agent with no agent-owned property on the market with each observation of a client property listed with an agent with a concurrently listed agent-owned property. There are several techniques for matching observations of the treated samples with those of the control sample,

<sup>9</sup> As a robustness check, we further control for agent-level heterogeneity by eliminating agents with very small number of listings during the sample period. It is possible that agents who sold their own properties may be more likely to be part-timers and, perhaps, are less talented relative to others. To rule out a part-time effect, we eliminate properties listed by agents with three or less properties. The conclusions remain unchanged. These estimates and models including agent-fixed effects are available upon request.



including nearest-neighbor, radius, kernel matching, and stratification techniques (Becker and Ichino 2002; Guo and Fraser 2010). We apply the nearest-neighbor technique, whereby treated observations and control observations are randomly ordered

**Table 9** 3SLS propensity scoring method matched sample estimates for 1999–2009 sample period

	LnSP		LnTOM	
	Coef.	Std. Err.	Coef.	Std. Err.
<i>OACL</i>	-0.0042	0.0098	0.3746*	0.1981
<i>Owner Agent</i>	0.0168	0.0111	-0.5130*	0.2714
<i>Institutional</i>	-0.0101	0.0122	0.2068	0.2854
<i>LnTom</i>	0.0062	0.0108		
<i>LnSP</i>			21.9783***	8.2756
<i>LnSQFT</i>	0.4165***	0.0226	-8.9180**	3.4919
<i>LnAGE</i>	-0.1226***	0.0056	2.6809***	1.0159
<i>Tenant</i>	-0.0747***	0.0274	1.7211**	0.8639
<i>Vacant</i>	-0.0380***	0.0099	0.8309**	0.3855
<i>New</i>	-0.1022***	0.0212	2.5958***	0.9454
<i>Bedrooms</i>	-0.0198***	0.0075	0.4120*	0.2341
<i>Fullbath</i>	0.0543***	0.0089	-1.2103**	0.5020
<i>Halfbath</i>	0.0002	0.0085	-0.0068	0.1910
<i>Finished basement</i>	-0.0409***	0.0099	0.8794**	0.4033
<i>Paved drive</i>	0.0419***	0.0081	-0.9813***	0.3771
<i>Whirlpool</i>	0.0260***	0.0177	-0.6072	0.4511
<i>Heatpump</i>	0.0282***	0.0099	-0.6887**	0.3233
<i>Twozone Pump</i>	0.0579***	0.0132	-1.2170**	0.5632
<i>Condo Townhouse</i>	-0.1167***	0.0125	2.6842***	1.0379
<i>Hardwood</i>	0.0353***	0.0086	-0.7819**	0.3549
<i>Ceramic tile</i>	0.0436***	0.0091	-0.9872**	0.4168
<i>Vinyl floor</i>	-0.0223**	0.0094	0.4907*	0.2798
<i>Garage</i>	0.0789***	0.0086	-1.7119**	0.6889
<i>Fire</i>	0.0991***	0.0092	-2.2317***	0.8460
<i>Brick</i>	0.0299***	0.0078	-0.7162**	0.3042
<i>Vinyl siding</i>	-0.0589***	0.0091	1.2878**	0.5249
<i>Time</i>	0.0226***	0.0030	-0.5317***	0.1978
<i>Time-sq</i>	-0.0002***	0.0001	0.0047**	0.0020
<i>Mortgage rate</i>	0.0395***	0.0088	-0.8763**	0.3901
<i>Agent Inventory</i>	0.00001	0.00002	-0.0004	0.0004
<i>Listing Density</i>	-0.0044***	0.0015		
<i>Competition</i>			0.0006***	0.0001
<i>_cons</i>	8.2069***	0.1691	-177.4504	68.0884
<i>Location Fixed Effect</i>	Yes		Yes	

Note: \*\*\*, \*\*, and \* denote significance at the 1, 5 and 10 % levels, respectively.  $N=1,830$

and paired based on closest propensity scores. The resultant matched pair sample comprises 1,455 total observations.

The second stage of the matched sample analysis estimates the 3SLS price-liquidity model using the matched pair sample. If the full sample and the matched sample yield significantly different results, then the difference indicates omitted variable or selection bias in the full sample results. If, however, the full and matched samples yield estimates that are not significantly different, then this indicates that the treatment effect (owner-agent concurrent listing,  $OACL = 1$ ) can be interpreted as the underlying causal effect on price and liquidity outcomes.

Table 9 reports the results from the second stage 3SLS estimation of the price-liquidity system on the matched sample. The price effect of concurrent agent-owned listing remains negative but is insignificant. The liquidity effect, however, is significant. As in the full sample analysis without matching, concurrent agent-owned listing significantly increases selling time of client properties. In sum, the matched sample estimates are broadly consistent with the non-matched sample results; concurrent listings of agent-owned properties appear to adversely affect sales outcomes for client properties, whether in terms of lower selling prices or longer marketing time. The PSM analysis indicates that this conclusion is not being driven by omitted variable or neglected selection effects.

## Conclusions

This study examines the principal-agent issue surrounding agent sales performance when the listing agent is marketing his or her own property at the same time as client properties. The theory shows that listing an agent's own property creates an incentive to expend greater total search and selling effort, but at the same time prompts agents to reallocate effort away from selling client properties to selling their own property. In this sense, concurrently listed agent-owned properties create a negative externality for client properties in the agent's listing inventory. This is a new dimension of real estate agency moral hazard previously overlooked in the literature.

The empirical analysis draws upon 11 years of housing market transaction data in Virginia to test the basic propositions regarding agent-owned listings and sales performance on client listings. The study applies a simultaneous price-liquidity system approach as well as single equation OLS and hazard models for comparison. The pooled estimates provide strong support for the agent-owned negative externality effect identified in the theory; client properties on the market concurrently with their agent's property tend to take longer to sell and transact at lower prices. The propensity scoring matched sample approach to the simultaneous price-liquidity model provides evidence that the 3SLS results are not being driven by omitted variables or selection effects.

The 3SLS estimates indicate that client properties listed with agents who have their own properties concurrently on the market endure significantly longer selling time, ranging from 39 to 56 % longer, depending upon estimation method. The results offer new evidence on a previously overlooked dimension of the principal-agent problem inherent in real estate brokerage, new evidence that helps clarify the multifaceted roles of real estate agents in the market process and their influence on housing market performance.

The empirical results support the notion that agents' efforts to sell their own properties adversely affect their clients, and the effects are economically significant. While measuring aggregate efficiency costs of this particular principle-agent problem is beyond the intended scope of this study, the results nonetheless argue for seriously considering regulations requiring agents to disclose to their clients when they have their own properties on the market. Sellers can then consciously choose to either accept or avoid the type of agency costs identified here.

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