UCF COLLEGE OF BUSINESS ADMINISTRATION

Dr. P. Phillips School of Real Estate

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Duong T. Pham
University of Central Florida

Geoffrey K. Turnbull
University of Central Florida

Bennie D. Waller
Longwood University

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Duong T. Pham*
University of Central Florida
Duong.Pham@UCF.edu

Geoffrey K. Turnbull
University of Central Florida
Geoffrey.Turnbull@UCF.edu

Bennie D. Waller
Longwood University
wallerbd@longwood.edu

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Abstract

This paper offers a search model with Nash bargaining to identify various channels through which agent gender affects selling price and selling time in the resale market for houses. The theory is used in conjunction with the empirical model to infer agent bargaining power when dealing with the same or opposite sex agents on the other side of the transaction. The results reveal that the bargaining power of agents depends on their sex and that of the agent on the other side of the transaction, but it also depends on housing market conditions. Female selling agents have stronger bargaining power when facing female listing agents than when facing male agents in rising or falling markets. The bargaining power of male selling agents is stronger when facing female listing agents than when facing male agents in the rising market, but it is invariant with respect to listing agent sex in the declining market.

Keywords: real estate brokers, agent gender, bargaining power

*Communicating author.

1 Introduction

There is a growing body of evidence that women and men behave differently in business settings in terms of ethics, negotiation methods, and influence on others' managerial decisions. The existing literature draws largely from groups of coworkers, colleagues or rivals interacting in situations in which it is often difficult to ascertain individual performance. Of course, this describes most business settings. Nonetheless, more evidence from one-on-one face-to-face negotiations may offer useful insights. This study begins filling this gap in the literature, focusing on how women and men perform in one-on-one negotiations in a market setting—as listing and selling agents in the resale market for houses. The setting allows us to look more closely at how agent gender and mix of genders involved in transactions affect outcomes, using the framework to sort out the relationship between agent gender and bargaining power in mixed and same sex negotiations.

Women play important roles in real estate; the National Association of Realtors 2013 member profile reports that 57% of Realtors are female. But for an industry in which women play such an important role, the real estate literature offers only limited evidence concerning whether or how such a large female presence affects market outcomes and no evidence regarding how the sexes interact. For example, Hsieh and Moretti (2003) report a positive correlation between home prices and the proportion of female agents in a market. On the other hand, Turnbull and Dombrow (2007) find no significant gender impact on pricing outcomes after controlling for agent specialization in listing or selling functions. More recently, Seagrave and Gallimore (2013) conclude that the higher price and shorter time on market enjoyed by women agents are not attributable to superior skills. Instead, they are due to the choices made by their clients. In particular, they find that the price differential for properties sold by male and female agents disappears after controlling for agent selection by clients.

The effect of agent gender on housing market performance remains an open question. This paper examines the role of gender on transactions outcomes. Motivated by the broader business literature, the approach taken here adopts a broad view of how gender may affect outcomes. The sex of the listing agent or selling agent captures only one part of the picture. If it is true that women and men tend to use different approaches in risky negotiations, then the mix of agents' genders in co-brokered transactions where the property seller and buyer rely on different agents may reflect these differences.

This paper provides the first empirical evidence for how the gender and mix of agents' genders influence price and liquidity in the resale housing market. We begin by viewing transactions as a two stage process - the initial search and matching process which affects time on market and the subsequent negotiation process which affects realized prices. Turnbull and Zahirovic-Herbert (2011) incorporate bargaining over price into the canonical housing market search model. We extend that approach to allow the house seller to take into account uncertainty over what type of agent, male or female, their listing agent ultimately will face in the negotiation stage of the transaction process when setting their search strategy. The realized price is a function of the seller's initial reservation price in search equilibrium and the realized mix of listing and selling agents in the transaction. The property seller is forward-looking and rational in the Baysian sense, so greater expected bargaining power increases the seller's reservation price, which in turn puts upward pressure on negotiated prices and reduces expected liquidity. Lower realized bargaining power, however, puts downward pressure on the realized transaction price. Therefore, the theoretical model plays a key role when sorting out observed price and liquidity effects in terms of the relative bargaining power associated with agent gender or the gender mix of agents involved in the transaction.

The housing market is a search market and price and liquidity (time on the market) are co-determined in search markets (Krainer, 2001). The empirical analysis therefore applies the simultaneous price-liquidity approach developed by Turnbull and Dombrow (2006) and Zahirovic-Herbert and Turnbull (2008). This approach has been successfully adapted to a range of property market applications. More importantly for our purposes, the empirical framework allows us to empirically identify separate agent gender and agent gender mix effects on both selling price and liquidity.

Housing transactions data provide some advantages in answering the broader gender question. First of all, they allow us to investigate selling ability of male and female real estate agents in an environment involving relatively high economic benefits and extended experience, efforts, and exchanges of information from both sides of the transaction. Comparing with other studies such as Ayres (1991) and Ayres and Siegelman (1995) who study automobile sales performance, real estate agents exert more individual efforts in sales and thus expect higher compensation in a complex decision making process. Second, real estate transactions enable us to measure outcomes of a one-on-one negotiation conducted through listing and selling agents, who play a crucial facilitating role throughout the entire real estate transaction process (Turnbull and Dombrow, 2007). In addition, the success of a real estate transaction can be measured by two observable outcomes, realized price and time on the market or liquidity. Therefore, comparing real estate negotiation outcomes offers a two-dimension evaluation of agent performance. Third, real estate transactions provide a direct measurement of the outcomes from interaction between two agents, possibly shedding some light on the one-on-one interactions of the sexes that are buried in many finance and management settings involving multiple individuals or board members.

The paper is organized as follows. The next section provides a succinct overview of the literature looking at the role of gender in both broader business settings and in real estate agency in particular. The third section develops a theoretical search and bargaining model in which agent gender mix is uncertain during the search phase but known during the negotiation phase of the transaction. The fourth section explains the data and empirical model. The fifth section presents the estimates and the final section concludes.

2 Gender Differences in Business Settings

The impact of gender on real estate transactions outcomes can be related to three branches of the gender difference literature: gender difference in behavior, gender difference in negotiations, and the impact of women's presence. In this section, we provide an overview of the broader gender difference literature and how gender difference has been investigated in the real estate literature in relation to our paper.

2.1 Gender differences in behavior

Studies have found evidence of gender differences in various business settings. Dawson (1997) shows that there are significant ethical differences between salesmen and saleswomen in relational situations. Not only in sales but in the work place, Onemu (2014) shows that different incentive schemes (individual incentives, group incentives, and a combination of the two) create different reactions or adaptations from male and female workers. In particular, group incentives (without individual incentives) improve co-worker relationships for women, but deteriorate co-worker relationship for men. Barber and Odean (2001) examine gender differences in stock trading behavior and find that men trade more aggressively than women due to the fact that males are relatively more overconfident than females. The paper by Huang and Kisgen (2013) documents differences in corporate decisions between male and female CEOs and CFOs and also attributes the gender differences to the relative overconfidence of male CEOs and CFOs.

On the other hand, in many cases, researchers find no significant or systematic differences between men and women after controlling for abilities, knowledge, and selection bias. Johnson and Powell (1994) study risk preference of males and females in non-managerial and managerial population and find no gender differences in the managerial population. Similar results are also reported by Master and Meier (1988) with participants who owned a small business. Atkinson, Baird, and Frye (2003) compare performance and investment behavior between male and female mutual fund managers and find no differences. Their results suggest that differences in investment behavior often attributed to gender may be related to investment knowledge and wealth constraints. Seagraves and Gallimore (2013) study the gender gap in real estate selling prices and find that the higher selling prices in female agent transactions are attributable to seller and buyer's selection bias rather than female negotiation skills.

2.2 Gender differences in negotiations

Another branch of literature focuses on gender differences in negotiation skills. Examining the gender differences in competitive environments, researchers have found that men and women behave differently in negotiations. A majority of research find that men tend to outperform women in negotiations of different settings and try to explain the gender gap in negotiation performance. The first approach attributes the gender gap in negotiation performance to gender per se, while the second approach takes into account the impact of gender pairing.

Women are less competitive than men as reported in Niederle and Vesterlund (2007) and Vandergrift and Yavas (2009). These papers consistently find that women tend to shy away from competition while men compete too much. In particular, when facing a choice between tournament compensation and piece rate compensation, men choose the tournament at a much higher rate than women although, interestingly, there is no difference in task performance between the two sexes. Women also seem to be more cooperative in negotiation than men. Eckel, Oliveira, and Grossman (2008) report that women tend to be more egalitarian than men and often ask for less in negotiation.

They also find that women are more sensitive to the context of the negotiation and are less likely to fail to reach an agreement than men. The behavioral differences of women seem to explain why women tend to be outperformed by men when comparing negotiation results of the two opposite sexes.

Other research studies the impact of negotiation partners on final outcomes and find that women perform better if they are competing with other women (Gneezy, Niederle, and Rustichini, 2003). This suggests that in competitive environments, with whom the subject competes is an important factor determining final outcomes. Consistent with Gneezy et al. (2003), Holm (2000) also finds that both males and females behave more competitively and more "hawkish" when they know their opponent is female. Holm (2000) finds that discrimination with regards to the opponent's sex helped the parties coordinate and increases the average earnings in the subject mixed sex group when compared to the unisex group. Sutter et al. (2009) also observe much more competition and retaliation and, thus, lower efficiency when the bargaining partners have the same gender than when they have the opposite gender. Thus, we could expect that the gender pairing in negotiation also has significant impacts on the final results.

2.3 The impact of women's presence

Various research supports the idea that the presence of women has significant impacts in some settings. In corporate settings, for example, Adam and Ferreira (2009) report that the presence of females on the board of directors has significant positive impacts on corporate governance. The study finds that having women on corporate boards improves broad attendance and monitoring power. Krishnan and Park (2005) also find a positive relationship between the proportion of women on top management teams and organizational performance.

The impact of female presence in groups is complex. Karremans et al. (2009) suggests that men's cognitive performance is impaired after an interaction with someone of the opposite sex. The study argues that the impairment is due to men's attempts to make good impression on the opposite sex counterpart. Through experiments, they also find that the more attractive the woman is in a mixed-sex interaction, the more cognitive function is reduced for male subjects. Further, Nauts et al. (2012) find that even the mere anticipation of an interaction with a woman can impair men's cognitive ability; men experience cognitive impairment when informed of such an encounter.

2.4 Gender differences in real estate

The impact of agent gender has been studied in real estate as well, but the focus has been somewhat limited. One branch of literature examines how agent gender (an indicator variable) affects real estate agent compensation under the human capital framework rather than the hedonic price and liquidity model. A study by Abelson, Kacmar, and Jackofsky (1990) (hereafter, AKJ, 1990) found that female sales associates earned significantly higher compensation than their male counterparts. Since using a human capital model, AJK (1990) failed to link commission performance to the property characteristics. Moreover, the research only studies sales associates rather than real estate agents in general and does not address self-selection by female sales staff. AJK (1990) nevertheless provide a more focused analysis, refining Chinloy (1988) by examining only residential brokerage rather than pooling the sample with commercial brokers.

Follain, Lutes, and Meier (1987), on the other hand, find no significant impact of being a female on agent compensation. This study again did not take into account any relationship between property type and agent income; it only examines agent's own characteristics, work effort, and general firm and market factors. Their sample includes residential sales people from both urban (most of the sample) and rural areas (16.93% of the sample) and commercial real estate agents (4.73% of the sample). Hence, there is no surprise as to why they find that agent gender does not play a significant role in the empirical results since commercial real estate is dominated by male agents and is often associated with higher rates of commission than the female dominated residential real estate field.

Crellin, Frew, and Jud (1988) find a negative impact of being a woman on real estate commissions, but they do not distinguish between commercial and residential real estate. Sirmans and Swicegood (1997) differentiates between commercial and residential brokerage using indicator variables and find that selling primarily residential real estate has negative impacts on income. They also find that being female hurts agent compensation.

Another branch of literature looks at the impact of agent gender on price and liquidity, generally introducing agent sex into the hedonic price framework. A recent paper by Salter, Mixon, and King (2012) examines how a real estate agent's beauty affects sales price. Listing and selling agent gender (indicators) are both included in the hedonic pricing model. The paper found male listing and selling agent have negative impacts on selling prices of real estate with the same characteristics. This result is consistent with Seagraves and Gallimore (2013), considered next.

Seagraves and Gallimore (2013) offer more detailed analysis of agent gender by addressing endogeneity of time-on-market and self-selection by home buyers and sellers with two-stage least squares (2SLS). The paper also examines the impacts of agent pairing on sales price for both simple ordinary least squares and 2SLS models. Interestingly, the male-male pairing has significantly negative impact on selling prices but the paper does not address this phenomenon in detail. The authors conclude that the positive impact of being a female agent on price, liquidity and agent income are not due to gender per se, but attributable to the choices of agents made by real estate owners.

3 A Model of Search and Bargaining

This section introduces Nash bargaining into the canonical search model. Turnbull and Zahirovic-Herbert (2011) develop a search model with bargaining when each seller confronts buyers who are homogeneous in terms of their relative bargaining power. This model allows for buyers who differ with respect to bargaining power. The framework is a multi-stage game under imperfect information. This section explains the general structure of the setting, focusing on the properties of a Baysian-Nash game solution rather than a formal presentation of the game format. In the first stage of the game, the seller sets his or her reservation price in order to determine the stopping rule: negotiate with the buyer if the expected negotiated price exceeds the reservation price, or else wait (or search) for another potential buyer. The seller understands that buyers and agents in the next stage of the game create ex ante uncertainty that is resolved only after the reservation price is set. Buyers have a similar rule: negotiate for the house if the buyer expects the negotiated price to be less than his or her (idiosyncratic) valuation of the property. In the second stage, the price is negotiated and the transaction subsequently consummated. From the perspective of a representative seller, the seller is engaged in a game against nature, the latter summarized in the distribution of buyer types (indexed by their idiosyncratic valuation of the property, b). The existence of agents with different relative bargaining powers provides another set of uncertain parameters facing the seller when setting the reservation price.

Consider the final stage of the game first; the seller and buyer are in contact with each other in order to negotiate a price for the seller's house. Under Nash bargaining the relative bargaining power of the buyer and seller determines their net benefits from the house transaction. Denoting the seller's reservation price r and the buyer's maximum willingness-to-pay for this particular house b, the selling price P of the house under Nash bargaining is

$$P \equiv \arg\max\{(b-P)^{1-\beta}(P-r)^{\beta}\}$$

where the parameter β summarizes the seller's bargaining power or negotiating skill relative to the buyer. The seller's and buyer's relative bargaining power is determined, in part, by their respective agent's bargaining abilities or strategies. Performing the above optimization and solving the optimality condition for P yields the selling price under bargaining as

$$P = \beta b + (1-\beta)r \tag{1}$$

A larger β corresponds to a seller's agent with greater negotiating ability, which increases the seller's bargaining power and pushes the ultimate selling price closer to the buyer's reservation price, b. A smaller β corresponds to a seller's agent with weaker negotiating ability, which decreases the seller's bargaining power and results in an ultimate selling price that is closer to the seller's reservation price, r. Since both the buyer and seller must be better off with the transaction for them to voluntarily engage in it, they each enjoy positive net benefits from the transaction and it must be true that $\beta \in (0,1)$.

If bargaining power varies by gender then each seller faces two possible selling price outcomes. For example, if the listing agent is female then the bargaining solution yields selling price

$$P_{FF} = \beta_{FF} b + (1-\beta_{FF})r_F \tag{2}$$

when the buyer's agent is also a female and

$$P_{FM} = \beta_{FM} b + (1-\beta_{FM})r_F \tag{3}$$

when the buyer's agent is male. Since the seller sets the reservation price before the type of buyer is known, r_F does not vary across possible bargaining outcomes. On the other hand, if the listing agent is male then the bargaining solutions are

$$P_{MF} = \beta_{MF} b + (1-\beta_{MF})r_M \tag{4}$$

$$P_{MM} = \beta_{MM} b + (1-\beta_{MM})r_M \tag{5}$$

when the buyer's agent is female or male, respectively.

The seller sets the reservation price before contacting buyers. The seller knows his or her agent is type M or F. Consider a particular house that is listed for sale. The probability of a potential buyer with type M or F agent arriving to visit this house during a unit of time is π_M or π_F, respectively. The population of buyers is ordered by their willingness-to-pay, b, summarized in the distribution function $\Phi(b;\mathbf{x})$, where the distribution of buyers is in general a function of property characteristics, **x**. We suppress property characteristics to simplify notation without loss of generality since we are focusing on a given house.

Now consider the house seller with agent type $i \in \{F, M\}$ and a reservation price of r_i. The probability of a visit by a potential buyer with agent type i at a given time is π_i so that the probability of a sale in any given period is the sum across i-types π_i times the probability that an arriving buyer is of the type whose willingness-to-pay, b, is greater than the seller's reservation price r, or

$$q = (\pi_M + \pi_F)\int_{b \geq r} d\Phi(b) \tag{6}$$

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

$$E[P - r_i^* \mid b \geq r_i^*] = c$$

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

$$\pi_M \int_{b \geq r_i^*} (P_{iM} - r_i^*) d\Phi(b) + \pi_F \int_{b \geq r_i^*} (P_{iF} - r_i^*) d\Phi(b) = c$$

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

$$\int_{b \geq r_i^*} (b - r_i^*) d\Phi(b) = \frac{c}{(\pi_M \beta_{iM} + \pi_F \beta_{iF})} \tag{7}$$

The seller with agent type *i* has a weighted ex ante relative bargaining power of $\omega = (\pi_M \beta_{iM} + \pi_F \beta_{iF})$. Solve implicitly for the seller's reservation price

$$r_i^* = r_i(\omega, c; \Phi) \tag{8}$$

where Φ in this function denotes a vector of parameters describing the buyer distribution function in equilibrium. Implicitly differentiating (7) yields the comparative static properties of the equilibrium reservation price as

$$\frac{\partial r_i^*}{\partial \omega} > 0; \ \frac{\partial r_i^*}{\partial c} < 0 \tag{9}$$

so that

$$\frac{\partial r_i^*}{\partial \omega}\frac{\partial \omega}{\partial \pi_j} > 0; \ \frac{\partial r_i^*}{\partial \omega}\frac{\partial \omega}{\partial \beta_{ij}} > 0, \quad j \in \{F, M\}$$

These results are intuitively appealing in light of standard search theory results; higher seller search cost or lower probability of buyer arrival prompts the seller to set a lower reservation price. In light of (2)-(5), higher search cost or lower probability of buyer arrival each leads to lower selling price in all cases The new results pertain to bargaining power. Greater expected weighted seller bargaining power ω leads to a higher reservation price, as does greater bargaining power relative to any one type of buyer agent. In light of (2)-(5), greater expected weighted seller bargaining power leads to higher selling price in all cases, while the effects of greater bargaining power relative to a buyer type has ambiguous effects on selling price in several cases.

The search and negotiation process is a multi-stage game for which the Baysian- Nash equilibrium is given by (7) and (2)-(5). The results (9) and (2)-(5) turn out to be important for interpreting estimated coefficients in the empirical price model later, but there are combinations of estimates that can yield ambiguous implications about the underlying pattern of bargaining power. Fortunately, the liquidity analysis provides results that are generally easier to interpret. Substituting the equilibrium reservation price *r* into (6) and differentiating yields the comparative statics on the probability of sale at a given point in time (given that the property remains unsold to that point) as $q(\omega, c; \Phi)$ where

$$\frac{\partial q}{\partial \omega} < 0; \ \frac{\partial q}{\partial c} > 0$$

The equilibrium liquidity or expected selling time $E[T]^*$ is proportional to $1/q$ so the expected selling time effects take the opposite signs as the effects. The seller's expected time on the market is

$$E[T]^* = T(\omega, c; \Phi) \tag{10}$$

which has the following derivative properties

$$\frac{\partial E[T]^*}{\partial \omega} > 0; \quad \frac{\partial E[T]^*}{\partial c} < 0 \tag{11}$$

Greater seller expected weighted bargaining power leads to longer selling time, as does greater bargaining power relative to any one type of agent on the other side of the transaction. It bears emphasis that the liquidity results are important because they provide a straightforward tie between the expected weighted relative bargaining power and expected time-on-market, unlike the more complicated relationship between the various possible realized prices (2)-(5) and ω and the realized β_{ij}'s.

The search and bargaining framework imposes parametric constraints on the empirical model. Substituting (8) into (2)-(5) yields realized price as a function of the usual property characteristics and market conditions, **X**, and the vector of ex post bargaining power $\boldsymbol{\beta} = [\beta_{MM} \quad \beta_{MF} \quad \beta_{FM} \quad \beta_{FF}]$

$$P = \sum_i \sum_j a_{ij} P_{ij}(\mathbf{X}, \boldsymbol{\beta})$$

where a_{ij} takes a value of one for listing agent type i and selling agent type j and zero otherwise. The hedonic price function can be expressed as

$$P = P(T, \mathbf{X}, \mathbf{A}) + \varepsilon_p \tag{12}$$

where $\mathbf{A} = [a_{ij}]$ and ε_P is the stochastic error term. The liquidity equation follows immediately from (19), making explicit the presence of **X** suppressed earlier for notation convenience,

$$T = T(P, \mathbf{X}, \mathbf{A}) + \varepsilon_L \tag{13}$$

where ε_L is a stochastic term jointly distributed with ε_P. Thus far the theory requires that the hedonic price and selling time equations are functions of the same property characteristics variables **X** and agent type variables **A**. The stochastic errors may be correlated across the equations because realized price and selling time are co-determined. The empirical approach takes these complications into account.

4 The Empirical Analysis

4.1 The data

The data is drawn from multiple listing service (MLS) records for central Virginia. The data set provides sufficient agent information for identifying various aspects of the listing and selling agent including the agent's gender. The initial data includes observations listed for sale between 1999 and 2009. The data are carefully culled for incomplete, missing or illogical data. The final data set includes 10,332 observations of completed transactions. The MLS provides data on practically all properties that are listed for sale in the area, regardless of whether the property is ultimately sold or otherwise removed from MLS. Data collected from the MLS include property characteristics such as age, square footage, various amenities such as a garage or fireplace, geographic location information, lot size, listing and selling price of properties and listing and selling agents. Calendar information including a quarterly time trend variable is included to control for changing market conditions. Table 1 provides variable definitions and Table 2 presents sample summary statistics.

4.2 The empirical model

The search model of the housing market shows that price and selling time are jointly determined and changes in exogenous factors generally lead to both price and liquidity effects. This suggests that empirical hedonic price analysis should take into account simultaneous selling time or liquidity effects whenever possible. The econometric problem confounding many studies that attempt to deal with the simultaneous nature of both price and liquidity is that they are determined by the same factors. As a consequence, any set of price and liquidity equations is under-identified. As illustrated by (12) and (13) above, integrating agent bargaining power into the analysis does nothing to resolve this econometric issue. Fortunately, the method proposed by Zahirovic-Herbert and Turnbull (2008) for the model without bargaining can be applied to the model with bargaining as well. This method relies on variables capturing neighborhood market conditions to fully identify the system of equations, which allows us to estimate individual price and liquidity equations.

To understand the intuition underlying the empirical model, introduce neighborhood market conditions summarized in the variable C along with the characteristics vector $\mathbf{X}$ into both price and liquidity equations, restated here as

$$P = \varphi_p(T, \mathbf{X}, C, \mathbf{A}) + \boldsymbol{\varepsilon}_p \tag{14}$$

$$T = \varphi_T(P, \mathbf{X}, C, \mathbf{A}) + \boldsymbol{\varepsilon}_T \tag{15}$$

The variable *C* captures the localized or neighborhood competition arising from other nearby houses for sale at the same time as the subject property. The approach taken here follows Turnbull and Dombrow (2006) and Zahirovic-Herbert and Turnbull (2008); see the latter for a complete explanation of the model implementation and interpretation of parameter estimates. Since localized competition effects are not central to our main question, we focus solely on the role of these variables in econometrically identifying the system of simultaneous equations (14)-(15).

The subject house may be affected by neighborhood competition from nearby houses for sale at the same time as the subject house. The competition measures the number of other houses on the market with the subject house, inversely weighted by the distance between the houses to reflect the assumption that nearby houses will have stronger effects on the sale of the subject than will competing houses farther away. The days-on-market or selling time is $s(i) - l(i) + 1$, where $l(i)$ and $s(i)$ are the listing date and sales date for house i. Denoting the listing date and sales date for competing house j by $l(j)$ and $s(j)$, the overlapping time on the market for these two houses is $\min[s(i), s(j)] - \max[l(i), l(j)]$. The straight-line distance in miles between houses i and j is $D(i, j)$. The measured competition for house i is defined as

$$C(i) = \sum_j (1 - D(i,j))^2 \{\min[s(i), s(j)] - \max[l(i), l(j)]\} \tag{16}$$

where the summation is taken over all competing houses j, that is, houses for sale within one mile and 20 percent larger or smaller in living area of house i. We also define another variable, listing density, as the measure of competing overlapping listings per day on the market

$$LD(i) = \frac{\sum_j (1 - D(i,j))^2 \{\min[l(i), l(j)] - \max[s(i), s(j)]\}}{s(i) - l(i) + 1} \tag{17}$$

Now notice that regressing sales price on the right hand side variables in (14) yields the estimated effect of competition on price as the partial derivative $\partial \phi_p / \partial C$ holding selling time constant.

Changing competition while holding selling time constant, however, is simply a change in listing density (17). Therefore, $\partial\phi_p / \partial C \equiv \partial\phi_p / \partial L$ so that imposing this parametric constraint directly into the price function (14) recognizes that it is a function of the listing density (17) and not competition (16). With this parametric restriction the estimating equations can be expressed as

$$P = \varphi_p'(T, \mathbf{X}, \mathbf{A}, LD) + \boldsymbol{\varepsilon}_p \tag{18}$$

$$T = \varphi_T(P, \mathbf{X}, A_L, C) + \boldsymbol{\varepsilon}_T \tag{19}$$

The separate *LD* and *C* variables make it possible to identify both equations in the estimation (Zahirovic-Herbert and Turnbull 2009).[1] As important, this approach also explicitly introduces empirical controls for the neighborhood market conditions that--when neglected--justify the need to correct spatial correlation in housing price models. This approach models the spatial competition effects directly and therefore obviates the usual rationale for applying spatial estimation methods.

The empirical models are all based on semilog forms of (18)-(19), with the only differences across models being the set of variables used to capture agent gender and gender mix effects. The system is estimated using 3SLS to deal with possible cross-equation correlation in the errors of the individual equations.

4.3 The empirical results

We estimate the price and liquidity equation system (18)-(19) using 3SLS on data covering the entire 1999-2009 sample period. All models include natural logs of the property characteristics and location fixed effects in Table 2 and a quadratic time trend. The ln*SP* equations also include the *LD* variable and the ln*TOM* equations the *C* variable discussed above. Table 3 reports key parameter estimates for these models.

Gneezy, et al. (2003), Holm (2000), Sutter et al. (2009), Karremans et al. (2009), and Nauts et al. (2012) argue that the presence of a woman in a transaction environment affects the outcome. This raises the question of whether mixed male-female agents on opposite sides of a house transaction affects the outcome and, if so, how are price and liquidity affected? Table 3 reports the coefficient estimates for the various agent variables. Model (1) includes the variable *LAM* which

[1] One consequence of this identification approach is that the liquidity variable coefficient in the price equation captures both liquidity and neighborhood competition effects. This study is not concerned with the liquidity effect on selling price per se, so this aspect of the model raises no concerns in this application.

equals one when the listing agent is male and *SAM* which equals one when the selling agent is male. The *LAM* coefficients in both the price and liquidity equations are insignificant and the *SAM* coefficient is significantly negative in the price equation and significantly positive in the liquidity equation. Female selling agents do affect outcomes; when compared with female selling agents, male agents obtain lower prices for their buyers but also lead to longer marketing times. But these results suggest that the mix of agents' sexes do not influence the outcomes since the sex of the listing agent appears to not matter.

The data include sales by dual agents, cases in which one agent handles both sides of the transaction. In order to remove the effects of dual agency on the agent effects estimates, model (2) includes a variable controlling for dual agent sex, *DUALMALE*, which indicates a male dual agent. The set of variables *LAFSAM* (female listing and male selling agents), *LAFSAF* (female listing and selling agents), *LAMSAF* (male listing and female selling agents) and *LAMSAM* (male listing and selling agents) pertain to non-dual agent transactions only. Dual female agents represent the omitted category. Model (2) is estimated on the full sample period 1999-2009. The significant negative *DUALMALE* coefficient in the price equation and the insignificant coefficient in the liquidity equation indicate that male dual agents obtain lower selling prices than female dual agents. The former benefit buyers while the latter benefit sellers. Interestingly, all of the non-dual agent coefficient estimates are insignificant in model (2), which suggests that the male selling performance differential observed in model (1) is attributable to dual agency and not any sex-related bargaining power advantage. Still, the sample period encompasses both a strong expansionary phase over 1999-2006 and a precipitous decline and a modest recovery over 2007-2009. The question remains whether or not gender effects depend upon market conditions.

In order to address this question, models (3) and (4) estimate the expanded model on the 1999-2006 and 2007-2009 subsamples. Looking at the estimates reported in Table 3, it is clear that market conditions matter. Male dual agents complete sales at lower prices than do their female counterparts in the rising market as indicated in model (3), but the male-female performance differential disappears in the declining market as indicated in model (4). Turning to agents involved in non-dual agency transactions, female listing agents obtain significantly lower selling prices and take longer to sell properties than do female dual agents in the rising market 1999-2006. The *LAFSAM* and *LAFSAF* coefficients are not significantly different, which implies that the sex of the selling agent does not affect selling price when the listing agent is female. The *LAMSAF* and *LAMSAM* coefficients are not significantly different from zero in either the price or liquidity equations. These estimates imply that properties listed by males sell for the same price and exhibit the same liquidity as properties sold by female dual agents. As in the female listing agent case (non-dual agent), the sex of the selling agent appears not to matter in the rising market.

The declining market estimates in model (4) uncover different agent effects than found in the rising market. The coefficient estimate for *DUALMALE* is not significantly different from zero, indicating that the sex of the agent does not influence price or liquidity in dual agency in the declining market. Similarly, all of the non- dual agency variable coefficients are insignificant except for *LAMSAF*. The significant positive coefficient in the price equation and insignificant coefficient in the liquidity equation imply that male listing agents obtain higher selling prices than female dual agents, but only when coupled with a female selling agent. No such effect is observed for properties sold by male listing and male selling agents.

What do the model (3) and (4) estimates imply for agent bargaining power? Looking first at model (3) liquidity equation coefficients for *LAFSAM* and *LAFSAF*, the comparative static prediction for ω in (11) shows that the positive coefficient in the liquidity equation implies that the seller sets a higher reservation price when the listing agent is female because the seller views the female listing agent as having greater expected weighted relative bargaining power; $r_F > r_M$. The ex post sales price equations (2)-(5) show that a higher reservation price by itself increases the sales price. But the *LAFSAM* and *LAFSAF* coefficients in the price equation are negative. Coupled with the insignificant *LAMSAF* and *LAMSAM* variables, these estimates imply $P_{FF} < P_{MF}$ and $P_{FM} < P_{MM}$. Using (2)-(5), $P_{FF} < P_{MF}$ implies

$$\beta_{FF} b + (1 - \beta_{FF}) r_F < \beta_{MF} b + (1 - \beta_{MF}) r_M$$

Let $r_F = r_M + \Delta$ where $\Delta > 0$ and substitute into the above inequality to get

$$(\beta_{FF} - \beta_{MF})(b - r_M) < -(1 - \beta_{FF})\Delta$$

so that $-(1 - \beta_{FF})\Delta < 0$ and $b - r_M > 0$ imply

$$\beta_{FF} < \beta_{MF} \tag{20}$$

The relative bargaining power of female selling agents is stronger when confronting female listing agents than when coupled with male listing agents. This result is consistent with Gneeze et al.

(2003) and Holm (2000) that women behave more competitively when they know the opponent is female.

Similar analysis reveals that $P_{FM} < P_{MM}$ implies

$$\beta_{FM} < \beta_{MM} \tag{21}$$

so that the relative bargaining power of male selling agents is stronger when coupled with female listing agents than when coupled with male listing agents. This result is consistent with Niederle and Vesterlund (2008) that women perform worse in mixed-sex negotiation than in a single-sex setting. In any event, we find that the mix of agents' genders leads to different bargaining powers hence different sales outcomes. But more than the mix of agents matters. We find evidence that the role taken by each agent, either listing agent or selling agent, determines relative bargaining power as well in the rising market.

Turning to the declining market estimates, the fact that none of the non-dual agent mix variables is significant in the liquidity equation implies $r_F = r_M$. The significant positive coefficient on the *LAMSAF* variable and the insignificant coefficients on the rest in this case imply $P_{FF} < P_{MF}$ and $P_{FM} = P_{MM} = P_{FF}$. The latter implies $\beta_{FM} = \beta_{MM} = \beta_{FF}$ while the former implies

$$\beta_{FF} b + (1 - \beta_{FF}) r_F < \beta_{MF} b + (1 - \beta_{MF}) r_M$$

Since $r_F = r_M$, this inequality yields

$$(\beta_{FF} - \beta_{MF})(b - r_M) < 0$$

which implies (20). The relative bargaining power of female selling agents is stronger when coupled with female listing agents than when facing male listing agents--just as in the rising market phase. In the declining market, however, $\beta_{FM} = \beta_{MM}$ and the relative bargaining power of male selling agents is now invariant with respect to the sex of the listing agent. Relative bargaining power not only depends upon agent sex and the role taken by the agent in the transaction, it also depends upon broader market conditions.

5 Conclusion

Recognizing the important role of women in real estate, this paper examines how agent gender affects housing market outcomes. We develop a theoretical model that motivates the empirical approach and can be used in conjunction with parameter estimates to determine relative bargaining power of males and females and how their relative bargaining power is affected by dealing with same sex or opposite sex agents. Using 10 years of MLS data from Virginia, we find that the listing agent sex and the mix of listing and selling agents involved in a transaction affects selling prices and time on the market. The price and liquidity function estimates reveal that the relative bargaining power of agents not only depends on their sex and the sex of the agent on the other side of the transaction, but it also depends on housing market conditions. The relative bargaining power of female selling agents is stronger when confronting female listing agents than when coupled with male listing agents in rising or declining market phases, consistent with the notion that female is more competitive when facing same sex opponent in negotiation. But while the relative bargaining power of male selling agents is stronger when facing female listing agents than when facing male listing agents in the rising market, the relative bargaining power of male selling agents is invariant with respect to listing agent sex in the declining market.

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Table 1. Variable Legend

VARIABLE	DESCRIPTION
SP	Selling price
TOM	Time on market
SQFT	Living area square footage
AGE	Age of property
TENANT	Dummy variable = 1 if property is tenant occupied
VACANT	Dummy variable = 1 if property is vacant
BEDROOMS	Number of bedrooms
FULLBATH	Number of full bathrooms
HALFBATH	Number of half bathrooms
CONDOTOWN	Dummy variable = 1 if condo or townhouse
HARDWOOD	Dummy variable = 1 if hardwood flooring
CERAMICTILE	Dummy variable =1 if ceramic tile flooring
GARAGE	Dummy variable =1 if property has a garage
FIREPLACE	Dummy variable = 1 if property has fireplace
BRICK	Dummy variable = 1 if property has brick exterior
LISTTIME	Chronological time control variable
FRMLD	Interest rate for FHMLC 30-year fixed rate mortgage
LAM	Dummy variable = 1 if listing agent male
SAM	Dummy variable = 1 if selling agent male
DUALMALE	Dummy variable = 1 if dual agency (same agent is listing and selling agent) and male
LAMSAF	Dummy variable, 1 if the listing agent is male and selling agent is female
LAFSAF	Dummy variable, 1 if the listing agent is female and selling agent is female and not dual agency
LAMSAM	Dummy variable, 1 if the listing agent is male and selling agent is male and not dual agency
LAFSAM	Dummy variable = 1 if listing agent male and selling agent male

Table 2. Sample Descriptive Statistics

VARIABLE	OBS	MEAN	STD. DEV.	MIN	MAX
SP	10332	163775.30	104262.60	6800	2650000
TOM	10332	95.422	73.152	0	916
SQFT	10332	1967.388	814.156	417	8578
AGE	10332	32.674	28.391	1	267
TENANT	10332	0.015	0.123	0	1
VACANT	10332	0.272	0.445	0	1
BEDROOMS	10332	3.239	0.784	1	8
FULLBATH	10332	1.977	0.732	1	6
HALFBATH	10332	0.407	0.538	0	4
CONDOTOWN	10332	0.093	0.290	0	1
HARDWOOD	10332	0.592	0.492	0	1
CERAMICTILE	10332	0.229	0.420	0	1
GARAGE	10332	0.360	0.480	0	1
FIREPLACE	10332	0.712	0.453	0	1
BRICK	10332	0.548	0.498	0	1
AREA 1	10332	0.061	0.239	0	1
AREA 2	10332	0.158	0.365	0	1
AREA 3	10332	0.024	0.154	0	1
AREA 4	10332	0.491	0.500	0	1
AREA 5	10332	0.055	0.228	0	1
LISTTIME	10332	24.676	8.487	2	41
FRMLD	10332	6.175	0.505	4.81	8.64
DUALMALE	10332	0.065	0.247	0	1
LAFSAM	10332	0.168	0.374	0	1
LAMSAF	10332	0.206	0.405	0	1
LAFSAF	10332	0.461	0.498	0	1
LAMSAM	10332	0.165	0.372	0	1

Table 3. Price-Liquidity Model 3SLS Agent Gender Parameter Estimates

	(1)		(2)		(3)		(4)	
Sample:	1999-2009		1999-2009		1999-2006		2007-2009	
Equation:	ln*SP*	ln*TOM*	ln*SP*	ln*TOM*	ln*SP*	ln*TOM*	ln*SP*	ln*TOM*
LAM	0.0041	-0.0826						
	(0.0046)	(0.0678)						
SAM	-0.0114**	0.1630**						
	(0.0005)	(0.0718)						
DUALMALE			-0.0212**	0.2373	-0.2222*	0.1773	-0.0129	0.3108
			(0.0105)	(0.1564)	(0.0113)	(0.1174)	(0.0242)	(1.2404)
LAFSAM			-0.0106	0.1770	-0.0224**	0.2402**	0.0179	-0.8255
			(0.0080)	(0.1231)	(0.0092)	(0.0955)	(0.0190)	(1.2404)
LAMSAF			0.0046	-0.0631	-0.0096	0.1104	0.0452**	-2.3383
			(0.0080)	(0.1168)	(0.0087)	(0.0887)	(0.0183)	(0.1489)
LAFSAF			-0.0057	0.1059	-0.016***	0.1886**	0.0218	-1.0614
			(0.0075)	(0.1083)	(0.0080)	(0.0831)	(0.0173)	(1.3220)
LAMSAM			-0.0096	0.1625	-0.0135	0.1793*	-0.0063	0.1489
			(0.0095)	(0.1373)	(0.0103)	(0.1051)	(0.0212)	(1.0640)

Notes: ***significant at 1% level, **significant at 5% level, *significant at 10% level. Standard errors in parentheses. All models include the property characteristics in Table 2 as well as a quadratic time index and location fixed effects.