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A Simple Search and Bargaining Model of Real Estate Markets

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This paper examines the impact of brokers on buyers' and sellers' search behavior and on the transaction prices in real estate markets. It is shown that the seller and the buyer search less intensively if the house is listed with a broker. The seller gets a higher price when he employs a broker, but the increase in price is smaller than the commission fee. More specifically, the portion of the commission covered by the increase in price is directly related to the bargaining powers of the buyer and the seller. In the special case where the price is determined according to the Nash bargaining solution, the increase in price is shown to be half of the commission fee. It is also shown that an increase in the commission rate increases the equilibrium price but decreases the equilibrium search intensities.

Real estate markets can best be described by imperfect information; the players do not know the locations or the reservation prices of their potential trading partners. This lack of information compels each player to engage in search activity in order to find a trading partner. Once two players have contacted each other, they bargain over the price of the house. There is a linkage between the bargaining stage and the search stage of the game, in that the price a player expects to emerge from the bargaining process will affect his choice of search intensity. This paper provides a simple theoretical model for studying the search behavior of sellers and buyers in real estate markets, and relates their search intensities to the outcome of the bargaining process. The purpose of the study is to examine how the seller's choice with regard to employing a broker affects the search intensities and the bargaining outcome.

There have been some recent attempts to analyze the real estate markets in a search theoretical framework. Yinger (1981) was one of the first to use a search model in a formal analysis of real estate markets. He considered

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the impact of three types of uncertainty on the behavior of real estate brokers: Uncertainty about the number of buyers, uncertainty about the number of listings, and uncertainty about the number of matches between buyers and sellers. He concludes that too many resources are devoted to brokers' search activities, and that there could be substantial welfare gains from government intervention in the brokerage markets. Yinger's analysis, however, does not include buyers' and sellers' search activities explicitly, and it is restricted to the study of the behavior of real estate brokers. Wu and Colwell (1986) extend Yinger's model to include the behavior of buyers and sellers as well as that of brokers. Their analysis focuses on the impact of a change in search costs, and of the introduction of an MLS (Multiple Listing Service) system, on the price of housing and the broker's commission rate. Salant (1991) uses a dynamic search model to investigate the conditions under which the seller will prefer to sell the house himself or to list it with a broker at a given time period. He also proves that the seller's asking price declines monotonically throughout time, but jumps up in the period when the broker is first enlisted.

This paper differs from that of Yinger (1981) by incorporating the buyers' and sellers' search activities, and differs from those of Wu and Colwell (1986) and Salant (1991) by incorporating the bargaining stage into the model. The price in this paper is determined by a bargaining process between the buyer and the seller, as opposed to Wu and Colwell (1986) and Salant (1991) in which the seller posts an asking price that the buyer can either accept or reject. This paper also differs from Salant (1991) by providing a bilateral search framework where both the seller *and* the buyer search, and by allowing the traders to choose the intensity with which they search for each other. Salant (1991), in contrast, allows only the seller to search, and takes the probability of the seller meeting the buyer as exogenous (fixed search intensities). More importantly, this paper poses a different question than do the earlier papers. It focuses on the impact of brokerage on the players' search intensities and on housing prices. It does so by comparing the players' search strategies and the outcome of the bargaining process when the house is listed through a broker with those when the house is not listed through a broker.

The main results of the paper can be summarized as follows. The equilibrium search intensities of the seller and the buyer are smaller when the house is listed with a broker. The seller receives a higher price when he employs a broker, but the increase in price is smaller than the commission fee. More specifically, the portion of the commission covered by the increase in price is directly related to the bargaining powers of the buyer and the seller. In the special case where the price is determined according to the Nash bargaining solution, the increase in price is shown to be half of the commission fee. It is also shown that an increase in the commission rate increases the equilibrium price but decreases the equilibrium search intensities.

The next section studies the search behavior of the seller and the buyer when the seller chooses to sell the house himself. The third section examines the search behavior of the traders when the seller lists his house with a broker. The last section provides some concluding remarks and possible extensions of the model.

The Search Model without Brokerage

This part of the paper presents a one-period bilateral search model where a risk neutral seller and a risk neutral buyer search for each other in order to trade. The seller has a house for sale, and the buyer wants to buy a house. The characteristics that the buyer desires in a house (location, size, etc.) coincide with the characteristics of the seller's house. The seller values the house at P_s and the buyer values it at P_b. The valuations of the parties are private information.[1] Each party knows his own valuation but not the valuation of the other party. For the seller (buyer), the valuation of the buyer (seller) is uniformly distributed on the interval [0,1].[2]

In this section we examine the search behavior of the two traders when the seller chooses not to list the house with a broker (alternatively, this can be interpreted as the study of the search strategies of the traders in the absence of a broker in the market). At the beginning of the period, each trader chooses a search intensity to maximize his expected return from search.[3] The intensity of the search can be interpreted as the amount of

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[1] Why do the seller and the buyer have different valuations for the same property, hence have motives for trade? The reason could be that they have different liquidity needs, different preferences, or different plans for future (e.g., the seller is planning to move out of the town while the buyer is moving into the town).

[2] The assumption of uniform distribution and normalization of the valuations to the interval [0,1] is not crucial for the qualitative results of the paper. This assumption has been made to simplify the presentation of the paper.

[3] For the purpose of clarifying the presentation, the seller and the buyer will be portrayed as a male and the real estate broker as a female.

advertising (size and frequency of ads, number of newspapers in which they appear), the amount of neighborhood search for houses for sale, or the effort expended in spreading the word through friends and relatives. If the traders meet each other, they find out each other's valuation, and bargain over the price of the house.[4] It is assumed that the bargaining will result in a trade as long as there are gains from trade, i.e., as long as the buyer's valuation exceeds the seller's valuation ($P_b > P_s$). The negotiated price divides the surplus $P_b - P_s$ such that the seller receives ω portion of it, $1 \geq \omega \geq 0$, and the buyer gets $1-\omega$ portion of it. This implies that the house will be sold at price $P^* = \omega(P_b - P_s) + P_s$. The special case of $\omega = .5$ is the bargaining solution proposed by Nash (1950), Kalai and Smorodinsky (1975), and Rubinstein (1982).[5] We do not assign any specific value for ω here in order to see how a change in the bargaining solution affects the search and trading behavior of each side.

A trader's choice of search intensity affects the probability and the cost of meeting the other trader. Let $S \epsilon [0,1]$ be the search intensity of the seller and $B \epsilon [0,1]$ be the search intensity of the buyer. The probability that the two traders meet is given by the matching technology $0 \leq \theta(S,B) = \lambda(S+B) \leq 1$, $0 \leq \lambda \leq \frac{1}{2}$.[6] The cost of search is given by $\gamma C(S)$ for the seller, and by $\gamma C(B)$ for the buyer,[7] where $\gamma > 0$, and C is strictly increasing and convex ($C' > 0$, $C'' > 0$) with $C'(0) = 0$. The functions $\theta(S,B)$, $C(S)$ and

[4] Note that the traders choose their optimal search intensities without knowing each others' valuations. Each learns the other's valuation during the bargaining process. Chatterjee and Samuelson (1983) relax this assumption and assume, instead, that each player bargains under incomplete information regarding the other's valuation. They show that it is possible that the optimal bargaining strategies of the traders *may* result in a breakdown of negotiations altogether, despite the fact that there are mutual benefits from trade. This will affect the expected gains to the traders from search in our model, but it will have no qualitative impact on the results of the paper as long as there is a positive probability that bargaining will result in an agreement (otherwise the traders will have no incentives to search).

[5] The bargaining model of Rubinstein (1982) is a realistic way of modelling the actual bargaining process observed in housing markets; the buyer makes an offer, then the seller can either accept or reject the seller's offer. If the seller accepts, the house is sold to the buyer at the buyer's offer. If the seller rejects, then he makes a counter offer. Now, the buyer can either accept the seller's offer or reject it and make a counter offer. This process continues until both sides agree on a price. It can be verified that for the current model, the equilibrium price will split the surplus between the buyer and the seller (i.e., $\omega = .5$).

[6] Mortensen (1982) uses a similar matching technology.

[7] We could assume a different cost-of-search function for the seller than that assumed for the buyer, but doing so would have no impact on to the analysis of the paper.

$C(B)$ are common knowledge. These functional forms have been chosen for two reasons. One is that they allow a simple and clear presentation of the main ideas of the paper, while allowing us to do comparative statics on the equilibrium search intensities of the traders and the transaction price. The second reason is that the parameters λ and γ provide an explicit expression of how efficient and costly the search is. An increase in λ increases the probability of a match for any given S and B, hence making search more efficient, while an increase in γ makes search more costly. This will enable us to examine how the search behavior of the traders and the equilibrium transaction price are related to the efficiency and cost of the search.

The traders play a simultaneous Cournot-Nash game in which the seller chooses S and the buyer chooses B independently. Following the Cournot-Nash assumptions, each trader, in choosing his search intensity, treats the search intensity of the other trader as given. The seller anticipates that the buyer will choose $B(P_b)$ if the buyer's valuation is P_b. However, not knowing P_b, the seller must compute his gain from search by taking the expectation with respect to P_b. The seller of type P_s chooses a search intensity to maximize his expected return;

$$\max_{S} V_s(S, B^\circ) = \int_{P_s}^{1} \lambda(S + B^\circ(\tilde{P}_b))\omega(\tilde{P}_b - P_s)d\tilde{P}_b - \gamma C(S) \tag{1}$$

where B° is the seller's conjecture about the search intensity of the buyer, and " ~ " denotes a random variable. The lower bound of the integral represents the fact that the seller will be able to sell his house if and only if the buyer's valuation, P_b, is above the seller's valuation, P_s. When a sale occurs, the seller enjoys a surplus of $\omega(P_b - P_s)$.

The solution to equation (1), S^*, satisfies the following first-order condition:

$$\lambda\omega(.5 - P_s + \tfrac{1}{2}P_s^2) = \gamma C'(S). \tag{2}$$

Equation (2) implies that the seller searches up to the point where his expected marginal return from search is equal to the marginal cost of search. The following results follow directly from equation (2).

Result 1 $\partial S^*/\partial\lambda > 0$ and $\partial S^*/\partial\gamma < 0$: The equilibrium search intensity of the seller increases as search becomes more efficient, and decreases as search becomes more costly.

Result 2 $\partial S^*/\partial \omega > 0$: The equilibrium search intensity of the seller increases as his share of the surplus from a trade increases.[8]

These results follow from the fact that an increase in λ or ω increases the seller's expected return from search, while an increase in γ increases his marginal cost of search.

Result 3 $\partial S^*/\partial P_s < 0$: An increase in the seller's valuation results in a decrease in the seller's equilibrium search intensity (recall that $P_s \epsilon [0,1]$).

Similarly, the buyer of type P_b chooses a search intensity, B, to maximize his expected return from search:

$$\max_{B} V_b(B, S^\circ) = \int_0^{P_b} \lambda(B + S^\circ(\tilde{P}_s))(1-\omega)(P_b - \tilde{P}_s)d\tilde{P}_s - \gamma C(B), \tag{3}$$

where S° is the buyer's conjecture about the search intensity of the seller. Solving for optimum B, B^*, yields the following first-order condition:

$$\lambda(1-\omega)\tfrac{1}{2}P_b^2 = \gamma C'(B). \tag{4}$$

Equation (4) implies the following results:

Result 4 $\partial B^*/\partial P_b > 0$: An increase in the buyer's valuation results in an increase in the buyer's equilibrium search intensity.

The intuition is that as P_b increases, the buyer's expected surplus from a trade increases, so the buyer's incentive to search increases as well.

Result 5 $\partial B^*/\partial \omega < 0$: The equilibrium search intensity of the buyer decreases as his bargaining power diminishes.

If the search efforts of the traders result in a match, then they will trade with each other if $P_b > P_s$. Given the bargaining solution that we assumed, we can see that the ex-post transaction price will be

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[8] The variable ω represents the seller's bargaining power against the buyer. The magnitude of ω can depend on factors such as the demand and supply conditions in the market, the liquidity needs of the two parties, and the seller's future plans with regard to moving outside the market area.

$$P^* = \omega(P_b - P_s) + P_s.^9 \tag{5}$$

Result 6 The ex-post price of the house increases with the seller's valuation, the buyer's valuation, and the seller's bargaining power.

Note that the value of P^* is independent of the search intensities of the seller and the buyer. This result is in line with the intuition that once the search is completed, search costs become sunk costs, so they should have no effect on the price.

Note also that the search economy presented here involves positive externalities. An increase in the search intensity of one trader increases the probability of a match, hence the payoff for the other trader. Since each trader receives only a fraction of the surplus from a trade (ω for the seller, and $1-\omega$ for the buyer), and since neither trader takes into consideration the effects of his search on the additional gains to the other trader, this positive externality results in less search activity than would be in the joint interest of the two traders.

The Search Model with Brokerage

In this section, we study the search strategies of the traders when the seller chooses to list his house with a broker.[10] Listing the house with a broker increases the seller's probability of meeting the buyer. The new probability of a match between the buyer and the seller is given by $0 \leq \theta(S, B, M) = \lambda(S + B + \mu M) \leq 1$,[11] where $M \epsilon [0,1]$ is the search intensity of the broker and $0 \leq \mu \leq 1$ is a measure of the degree of efficiency of the broker's search efforts. Given that the seller meets the buyer, however, the probability that the buyer's valuation will exceed the seller's valuation is the same whether or not the seller employed a broker. In other words, as Salant (1991) points out, the broker speeds up the matching process but does not bring in better prospects. The seller has to pay k portion of the transaction price, $1 > k > 0$, as a commission fee to the broker. It is

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[9] The ex-ante value of the transaction price can be computed by taking the expectation of P^* with respect to P_s and P_b. This yields $P^* = (1 + \omega)/6$.

[10] It is possible that the broker represents the buyer. In the great majority of home sales, however, the brokers are employed by the sellers.

[11] The property of the matching technology that the broker increases the probability of a match is empirically supported by Jud (1983), who finds that sellers using brokers sell their houses more quickly than do those who do not employ brokers.

assumed that the value of k is determined competitively in the brokerage market.[12]

When the seller lists his house with a broker, his problem becomes:

$$\max_{S} W_s(S, \hat{B}, \hat{M}) = \int_{P_s}^{1} \lambda(S + \hat{B}(\tilde{P}_b) + \mu\hat{M})\omega \max\{0, \tilde{P}_b - P_s - kP(P_s, \tilde{P}_b)\} d\tilde{P}_b - \gamma C(S), \tag{6}$$

where $\hat{B}$ and $\hat{M}$ are the seller's conjecture regarding the search intensities of the buyer and the broker, $P(P_s, P_b)$ is the transaction price (which is calculated below), and $kP(P_s, P_b)$ is the commission fee that the seller has to pay the broker in the event that the house is sold. Following the practice observed in most housing markets, we assume that once the seller lists his house with a broker, he has to pay a commission fee to that broker when the house is sold even if the seller has contacted the buyer through his own search efforts. That is, we assume that the broker has an "exclusive right to sell".

Note from (6) that when the buyer and the seller meet each other, they will trade with each other only if the difference between their valuations exceeds the commission fee that the seller has to pay to the broker, i.e., only if $P_b - P_s > kP(P_s, P_b)$. This also explains the max function used in (6). This is different from the previous section where the seller and the buyer trade with each other as long as $P_b > P_s$. After the commission fee is deducted, the remaining part of the surplus, $\max\{0, P_b - P_s - kP(P_s, P_b)\}$, is divided according to the ω rule of the previous section.

The solution to equation (6) yields

$$\int_{P_s}^{1} \lambda\omega \max\{0, \tilde{P}_b - P_s - kP(P_s, \tilde{P}_b)\} d\tilde{P}_b = \gamma C'(S). \tag{7}$$

It can be checked that the results 1–3 reported earlier still hold. Let S^{**} be the solution to equation (7). A comparison of (7) with (2) yields the following additional result.

[12] The study by the Federal Trade Commission (1983) shows that the value of k, for almost all houses sold nationwide, is between 5% and 7%.

Result 7 $S^{**} < S^*$: The seller searches less intensively when he lists the house with a broker.

It will be shown in what follows that although the seller receives a higher price if he employs a broker, the increase in price is less than the commission fee. Hence, the commission fee decreases the seller's expected surplus from the sale of the house, and decreases the set of buyer types who will be willing to buy the house at a high price. These, in return, reduce the seller's expected return from search, and hence decrease his equilibrium search intensity. Note that S^{**} and S^* are functions of P_s, and that Result 7 holds for all P_s. That is, when the seller employs a broker he searches less intensively, regardless of his valuation.

Next, we can calculate the new transaction price. Let P^{**} be the ex-post transaction price when the seller employs a broker. As mentioned earlier, when the buyer and the seller trade their total net surplus is $P_b - P_s - kP^{**}$. The bargaining solution gives the seller $\omega(P_b - P_s - kP^{**})$ of this surplus. Further, by definition a transaction price of P^{**} generates a surplus of $P^{**} - P_s - kP^{**}$ for the seller. Equating this surplus to the surplus derived from the bargaining solution requires

$$P^{**} = [\omega(P_b - P_s) + P_s]/(1 - k + \omega k). \tag{8}$$

A comparison of (8) with (5) yields:

Result 8 $P^{**} \geq P^*$: The ex-post transaction price when the seller lists the house with a broker is higher than the transaction price that prevails when he sells the house himself.

To be more specific, we can state that $P^{**} > P^*$ for any $\omega < 1$. In the extreme case of $\omega = 1$, the seller has all the bargaining power (e.g., the seller might own the only house for sale in the area where the buyer wants to live) and takes all the surplus by selling the house at exactly $P^{**} = P^* = P_b$. Furthermore, it follows from (8) that

Result 9 $\partial P^{**}/\partial k > 0$: The transaction price increases as the commission fee increases.

Using Result 9 in equation (7) also yields $\partial S^{**}/\partial k < 0$: An increase in commission rate will decrease the equilibrium search intensity of the seller.

Result 9 is in line with the results of empirical studies by Doiron, et al. (1985) and Frew and Jud (1987), who conclude that the seller passes a portion of the commission fee to the buyer in the form of a higher price. Jud (1983) and Kamath and Yantek (1982), however, find that brokers do not seem to influence the selling prices of the houses in the samples analyzed. The theoretic model of Salant (1991), on the other hand, suggests that the seller's asking price can either increase or decrease at the time when the seller decides to employ a broker.

It is important to note that Result 9 is independent of the matching technology (θ function) and the distribution of the traders' valuations.

Result 10 $P^{**} - P^{*} < kP^{**}$ $\forall \omega < 1$: The difference between the transaction prices with and without a broker is less than the commission fee.

The results of Doiron, et al. (1985) and Frew and Jud (1987) suggest that the seller, through higher prices, passes on to the buyer only one-third to one-half of the commission fee. That is, $(P^{**} - P^{*})/kP^{**} \in [\frac{1}{3}, \frac{1}{2}]$. Using (5) and (8) this requires $(P^{**} - P^{*})/kP^{**} = (1 - \omega) \in [\frac{1}{3}, \frac{1}{2}]$, i.e., $\omega \in [\frac{1}{2}, \frac{2}{3}]$.

Result 11 In the case of the Nash, Rubinstein, and Kalai-Smorodinsky bargaining solution, $\omega = \frac{1}{2}$, we get $(P^{**} - P^{*})/kP^{**} = \frac{1}{2}$.

This result is particularly interesting because it provides a theoretical foundation for the empirical result reported in Doiron, et al. (1985) who find this ratio to be .57.

Given that he passes only part of the commission fee on to the buyer, why would the seller choose to employ a broker? The answer provided by the model is given in Result 7 earlier, where we show that the seller searches less when he employs a broker. Hence, the seller receives savings in search costs in return for his commission fee expenses.

If the buyer expects the seller to employ a broker, then his problem becomes:

$$\max_{B} W_b(B, \hat{S}, \hat{M}) = \int_0^{P_b} \lambda(B + \hat{S}(\tilde{P}_s) + \mu\hat{M})(1 - \omega)\max\{0, P_b - \tilde{P}_s - kP(\tilde{P}_s, P_b)\}d\tilde{P}_s - \gamma C(B). \tag{9}$$

The buyer's equilibrium search intensity, B^{**}, is given by the solution to

$$\int_0^{P_b} \lambda(1-\omega)\max\{0, P_b - \tilde{P}_s - kP(\tilde{P}_s, P_b)\}d\tilde{P}_s = \gamma C'(B). \tag{10}$$

Result 12 $B^{**} < B^{*}$: The buyer searches less intensively in the presence of a broker. This result follows directly from a comparison of (10) with (4).

Result 13 Total differentiation of equations (7) and (10) yields $\partial S^{**}/\partial k < 0$ and $\partial B^{**}/\partial k < 0$: An increase in commission rate will decrease the equilibrium search intensities of the seller and the buyer.

When the seller lists his house with the broker, he also informs the broker about his valuation. Hence, the broker knows P_s before she decides on a search intensity by which she locates the buyer.[13] Given the competitive commission rate k, the broker's problem becomes:

$$\max_{M} \pi(M, \hat{B}, \hat{S}) = \int_{P_s}^{1} \lambda(\mu M + \hat{B}(\tilde{P}_b) + \hat{S})kP(P_s, \tilde{P}_b)\Delta(P_s, \tilde{P}_b)d\tilde{P}_b - \varepsilon C(M) \tag{11}$$

where M is the broker's search intensity, μ is the parameter representing the efficiency of the broker's search efforts, ε is the parameter representing the broker's search costs, and

$$\Delta(P_s, \tilde{P}_b) = \begin{cases} 1 \text{ if } \tilde{P}_b - P_s \geq kP(P_s, \tilde{P}_b) \\ 0 \text{ otherwise.} \end{cases}$$

The dummy variable Δ represents the fact that the house will be sold only if the players' surplus from the transaction is large enough to cover the seller's commission fee expense.

[13] It is assumed here that the seller tells the broker his true valuation. This assumption can be defended on the grounds that the broker represents the seller's interests, and that a change in the price affects the seller and the broker in the same direction (e.g., a higher price increases the seller's surplus *and* the broker's commission fee, but decreases the probability that the buyer will be willing to buy at that price). There is, however, a potential research question here; Under what conditions the seller will reveal his true valuation or lie about it, and how the broker can use the seller's revelation as a signal to determine the seller's true valuation. In the extreme case where the broker believes that the seller's revelation has no signalling value with regard to his true valuation, for example, the broker simply integrates (11) with respect to P_s as well as P_b.

The broker's equilibrium search intensity, M^{**}, satisfies:

$$\int_{P_s}^{1} \lambda\mu k P(P_s, \tilde{P}_b)\Delta(P_s, \tilde{P}_b)d\tilde{P}_b = \varepsilon C'(M). \tag{12}$$

Clearly, the broker's search intensity depends positively on λ and μ, and negatively on ε. The parameters μ and ε also affect the seller's decision to list the house with a broker or sell it through his own search efforts (the latter is known as FSBO—For Sale by Owner). The seller will prefer to list the house with a broker if the expected gain from doing so exceeds the expected gain from selling the house himself. Substituting the optimum values of search intensities to equations (6) and (1), we can see that the seller will choose to employ a broker if:

$$W_s(S^{**}, B^{**}, M^{**}) > V_s(S^{*}, B^{*}). \tag{13}$$

The left-hand side is an increasing function of M^{**}, which, from Result 12, depends positively on μ and negatively on ε.

Result 14 The seller is more likely to employ a broker as the broker's search efforts become more efficient (bigger μ) and less costly (smaller ε).

The intuition is that an increase in μ and/or a decrease in ε will increase the broker's optimal search intensity choice. As the broker searches more intensively, her contribution to the seller's expected benefits exceeds the cost of her services to the seller (the part of the commission fee absorbed by the seller). Furthermore, it can be concluded that in order for the seller to employ a broker, the broker must be more efficient in her search for a buyer than is the seller. For example, the broker might have better information about the locations of potential buyers, or she might have access to better search techniques (experienced personnel, more efficient information gathering systems, lower advertising costs per unit, etc.). Otherwise, the seller would simply spend the commission fee on searching more intensively, rather than on buying the less efficient search service of the broker. It is easy to see that for any given k, there exist ε, μ, and γ values for which equation (13) holds. If, for example, the seller's search costs (γ) are prohibitively high, while the broker's (ε) are sufficiently low, the seller will choose to employ a broker. If, on the other hand, the broker's search efforts add very little to the probability of finding the buyer (i.e., very small μ), equation (13) will not hold and the seller will choose to search by himself. Yet, the complexity of the model does not allow us to specify the whole set of parameters for which equation (13) holds.

An important issue is whether the existence of brokers in housing markets has a positive or negative welfare impact. Using total expected surplus (the seller's + the buyer's + the broker's) to measure welfare, we show that the welfare impact of brokers is ambiguous.[14] We start with the simpler case where the welfare impact is positive. Let γ (the cost-of-search parameter for the buyer and the seller) be very high, such that the optimal search intensities of the seller and the buyer are close to zero. As a result, the total expected surplus for the seller and the buyer without a broker ($V_s + V_b$, evaluated at $S^* = B^* \approx 0$) is close to zero. The introduction of a broker into such a search market can serve only to make the seller and the buyer better off, if ε is adequately low. Since the broker will provide the brokerage service only if her expected profits are non-negative, the total surplus in the presence of the broker will be higher than that without a broker. A more challenging task is to show that the broker can reduce welfare, because the seller is free to choose whether or not to enlist a broker's help. The crucial point is that the buyer's search intensity level in the presence of a broker will depend on whether the buyer expects the seller to employ a broker. In the former case the buyer chooses B^*, while in the latter case he chooses B^{**}, where $B^* > B^{**}$. Because the valuations of the traders are private information (i.e., because we have a game of incomplete information), it is possible for there to be an equilibrium where the seller chooses not to employ a broker while the buyer conjectures that the seller will employ a broker. This equilibrium will involve S^* and B^{**} as the traders' search intensities. Given that there are positive externalities (hence each trader searches less than the amount that maximizes their joint payoffs), and given that $B^{**} < B^*$, we find that this equilibrium in the presence of a broker yields smaller surplus than does the equilibrium in the absence of a broker. Hence the welfare impact of the broker can be either negative or positive. Note that this welfare result holds regardless of whether we include the broker's expected profits in the welfare calculations or not.

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[14] Here we provide an intuitive proof of this result. A more rigorous proof of this result and a more detailed study of the welfare impact of intermediation in search markets can be found in Bhattacharya and Yavaş (1992) and Yavaş (1992a, 1992b, 1992c).

Will the broker search harder to sell more expensive houses? According to equation (12) the answer is ambiguous. A higher price increases the broker's commission revenue, thereby increasing her expected returns from search. Meanwhile, a higher price also decreases the probability of selling the house to a buyer (captured by $\Delta(P_s, \tilde{P}_b)$ in equation (12)), which in turn decreases the broker's expected gains from search. The net effect will depend on the magnitudes of these two opposing effects.

Note that if the broker lists the house through an MLS (Multiple Listing Service), then the only thing the buyer needs to do in order to contact the seller is to approach any participating broker. Since it is costless for the buyer to do so, the seller will have no incentive to search ($S^{**}=0$) if he lists the house with a broker, because listing the house ensures a match with the buyer.[15] This match, however, does not guarantee a sale because the buyer's valuation of the house might be less than the seller's reservation price. If the house is listed through an MLS, then the commission fee in equation (11) should be interpreted as the expected commission fee that the selling agent receives (based on the probability that she contacts the buyer). The impact of MLSs on the search strategies of traders and brokers is beyond the scope of this paper. This issue has been analyzed in detail by Yinger (1981) and Wu and Colwell (1986).

Concluding Remarks

This paper provides a simple search and bargaining model to examine how the seller's choice of whether to employ a broker affects search intensities and housing prices. It is shown that the seller and the buyer search less intensively when the house is listed with a broker. The seller receives a higher price when he employs a broker, but the increase in price is less than the commission fee. More specifically, the amount of commission covered by the increase in price is directly related to the bargaining powers of the buyer and the seller. In the special case in which the price is determined according to the Nash bargaining solution, the increase in price is shown to be half of the commission fee. It is also shown that an increase in the commission rate increases the equilibrium price but decreases the equilibrium search intensities.

[15] This is not true if there is more than one MLS in that market and the MLSs do not share their listings (i.e., if a house does not get listed in all of the MLSs or if the buyer's agent does not have access to all the MLSs).

An interesting extension of the model would be to consider the ultimatum bargaining games where the seller sets an ask price for the house and the buyer can either accept or reject it. In addition to its impact on the bargaining solution, this bargaining game adds a new dimension to the seller's problem; the seller, in his choice of the ask price, should now take into consideration the effect of his ask price on the search efforts of the broker.

Another interesting question is why the real estate markets are dominated by brokers, instead of dealers (such as specialists in stock markets, used car dealers, etc.). Anglin and Arnott (1991) provide an informal discussion of this subject, arguing that greater risk and higher inventory costs associated with houses are important factors. Yavaş (1992a) also addresses the issue and proves, in a search theoretical framework, that the higher search costs and greater difficulty in finding trading partners that characterize real estate markets can explain the dominance of brokers over dealers in these markets.

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