A Comparison of Real Estate Marketing Systems: Theory and Evidence†

Abdullah Yavaş*
Peter F. Colwell**

Abstract. The objective of this paper is twofold. One is to provide a search-theoretical model of the marketing choice of the seller. The model explains the seemingly contradictory empirical results as to whether a seller raises the price of his house to pass on a portion of the broker's commission to the buyer. The second is to offer empirical evidence on the impact of the MLS on the price. We control for selectivity bias in the data and obtain a surprising result that the decision to use a multiple listing service decreases the sale price of a property.

Introduction

A seller of a real estate generally has three alternative ways of marketing his property. He can search for the buyer on his own efforts (FSBO – For Sale By Owners), list the house with an MLS (Multiple Listing Service) broker, or list it with a non-MLS broker. The choice of the marketing system may have broad implications for the seller. It may affect the time on the market, the seller's marketing costs, characteristics of the buyers contacted through that maketing system, buyers' search efforts, and the selling price. The focus of this paper will be on the relationship between the marketing system choice and the selling price.

A number of recent studies have examined whether a seller raises the price of his house to pass on a portion, if not all, of the broker's commission to the buyer when he chooses to sell his house through a real estate broker. These studies provided seemingly conflicting empirical answers to this question. Doiron et al. (1985), and Frew and Judd (1987) found that one-third to one-half of the broker's commission fee is passed on to the buyer through the higher price paid for housing, while Tirtiroĝlu (1996) reports that the increase in price can even be greater than the commission amount. On the other hand, Jud (1983) reports that houses sold through brokers do *not* sell for significantly more than houses sold by owners. The results of Kamath and Yantek (1982) and Zumpano, Elder and Baryla (1995) suggest that if the brokerage commissions influence the prices at all, they lead to lower prices.

The contribution of this paper to the literature is twofold. One is to provide a theoretical model to explain these seemingly contradictory empirical results. We extend the search model of Yavaş (1992) to show that the price of a house sold by FSBO can be lower, the same, or higher than the price of a similar house sold through a broker. Hence, each of the above-mentioned seemingly conflicting empirical findings can be explained by

differences in characteristics of the markets from which they have been derived. Similarly, we argue that the price of a house sold through an MLS broker can be lower, the same, or higher than the price of a similar house sold through a non-MLS broker.

The second contribution of the paper is empirical. While the existing studies look at the price differences between houses sold through brokers and houses sold by owners, the current study focuses on the price differences between houses sold through MLS services and houses sold through non-MLS brokers and FSBOs. To our knowledge, this is the first attempt to examine the impact of the MLS on the prices. Unlike earlier studies, we also test for potential selectivity bias problems in the data by employing the two-stage estimation procedure described in Lee (1978) and Lee and Trost (1978). The first stage utilizes a probit equation with MLS choice as the limited dependent variable and calculates the selectivity bias variables. The second stage uses a least squares procedure to check for selectivity bias in the data and to test for price differential between the houses sold through MLS and non-MLS. The results indicate that sample selection bias did not exist in our sample. Finally, we find that the expected price difference has a significant impact on the choice of marketing strategy and, as expected, a higher price differential raises the likelihood of MLS choice. When calculating the effect of the MLS decision on the price differential, we conclude that the decision to use a multiple listing service decreases the sale price of a property.

The paper is organized as follows. The theoretical model is presented in the second section. The econometric methodology is explained, and the empirical results are reported in section three. Section four provides some concluding remarks.

The Theoretical Model

The purpose of this part of the paper is to provide a theoretical explanation for the conflicting results in the literature (Kamath and Yantek, 1982; Jud, 1983; Doiron et al., 1985; Frew and Jud, 1987; Tirtiroĝlu, 1994) concerning the impact of brokerage on housing prices. The search model used here is an extension of the search model used in Yavaş (1992). We will argue later that the analysis can also be used to study the impact of the MLS on housing prices.

Consider a one-period bilateral search model where a risk-neutral seller and a risk-neutral buyer search for each other 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 at P_b. The valuations of the parties are private information. Each party knows his own valuation but not the valuation of the other party. From the viewpoint of the seller (buyer), the valuation of the buyer (seller) is uniformly distributed on the interval [0,1].

Search and Trading without a Broker

We first examine the search behavior of the two traders and the pricing strategy of the seller in the absence of a broker. Alternatively, this can be interpreted as the study of the search and trading strategies of the traders when the seller chooses not to list the house with a broker. At the beginning of the period, each trader chooses a search intensity to maximize his expected return from search.[1] If the traders meet each other, the buyer

decides whether or not to purchase the house at the price (P) requested by the seller. The buyer will purchase the house if his valuation of the house is greater than or equal to the seller's price. Otherwise, he will not purchase the house. In the bargaining literature, this bargaining game is known as the *ultimatum game* where the seller makes an offer and the buyer can either accept or reject the offer.[2]

A trader's choice of the search intensity affects the probability and the cost of meeting the other agent. 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 agents meet is given by the matching technology $0\leq\theta(S,B)=\lambda(S+B)\leq1$, $0\leq\lambda\leq\frac{1}{3}$.[3] The cost of search is given by $\gamma_sC(S)$ for the seller, and by $\gamma_bC(B)$ for the buyer, where $\gamma_s>0$, $\gamma_b>0$, and C is strictly increasing and convex ($C'>0$, $C''>0$) with $C'(0)=0$. The functions $\theta(S,B)$, $C_s(S)$, and $C_b(B)$ are common knowledge. Note that an increase in λ increases the probability of a match for any given S and B, hence makes search more efficient for the traders, while an increase in $\gamma_s(\gamma_b)$ makes search more costly for the seller (buyer). Thus, the parameters λ and γ represent efficiency and cost of search, respectively.

The traders play a simultaneous Cournot-Nash game where the seller chooses S and P, 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. Given his conjecture about the search intensity of the buyer, $B°$, the problem of the seller is to choose a search intensity and a price to maximize his expected return;

$$\max_{S,P} V_s(S,B°) = \int_P^1 \lambda(S+B°(\tilde{P}_b))(P-P_s)d\tilde{P}_b - \gamma_sC(S)\,,\tag{1}$$

where "~" denotes a random variable.

The lower bound of the integral represents the fact that the buyer will be willing to purchase the house only if his valuation P_b, is greater than or equal to the seller's ask price, P. When a sale occurs, the seller enjoys a surplus of $P–P_s$. Clearly, the seller will choose $P\geq P_s$. Otherwise, he gets negative surplus from selling the house, in which case he is better off by not selling it.

Using the Leibnitz rule, the solution to equation (1), S^* and P^*, can be shown to satisfy the following first-order conditions;

$$\lambda(1–P)(P–P_s)=\gamma_sC'(S),\text{ and}\tag{2}$$

$$\int_P^1 B°(\tilde{P}_b)d\tilde{P}_b +(1-P)S-(P-P_s)(S+B°(P))=0\,.\tag{3}$$

Equation (2) implies that the seller searches up to the point where his expected marginal return from search is equal to his marginal cost of search. Equation (3) reflects the two opposing effects of a change in P. The first two terms in (3) reflect the fact that an increase in P increases the seller's gains in the case he sells the house, whereas the last term in (3) reflects the fact that an increase in P decreases the seller's gains by decreasing the probability that the buyer will be willing to pay P for the house.

As mentioned earlier, the buyer chooses a search intensity, B, without knowing the S and P choices of the seller. The buyer anticipates that the seller will choose $S(P_s)$ and $P(P_s)$ if the seller's valuation is P_s. However, not knowing P_s, the buyer must compute his

gain from search by taking the expectations with respect to P_s.

$$\max_B V_b(B, S^\circ) = \int_0^1 \lambda(B + S^\circ(\tilde{P}_s)) \max\{0, P_b - P(\tilde{P}_s)\} d\tilde{P}_s - \gamma_b C(B), \qquad (4)$$

where S° is the buyer's conjecture about the search intensity of the seller. Solving (4) for optimum B, B^*, yields the following first-order condition:

$$\int_0^1 \lambda \max\{0, P_b - P(\tilde{P}_s)\} d\tilde{P}_s - \gamma_b C'(B). \qquad (5)$$

Equation (5) equates the buyer's expected marginal return from search to his marginal cost of search.

Search and Trading with a Broker

Next, we study the search and pricing strategies of the traders when the seller chooses to list his house with a broker. Listing the house with a broker will increase the seller's probability of meeting the buyer. The new probability of a match between the buyer and the seller is given by $0 \le \theta(S, B, M) = \Delta(S + B + \mu M) \le 1$, where $0 \le \Delta \le \frac{1}{3}$, $M \epsilon [0,1]$ is the search intensity of the broker, and $0 \le \mu \le 1$ is a measure of the degree of efficiency of the broker's search efforts. Note that the broker affects the efficiency of the buyer's and seller's search efforts as well. This is reflected by the variable Δ: $\Delta > \lambda$ if the broker's and the traders' search efforts are complements (i.e., if the broker increases the contribution of S and B on θ for any given S and B), and $\Delta < \lambda$ if the broker's and the traders' search efforts are substitutes (i.e., if the broker decreases the contribution of S and B on θ for any given S and B). Given that the seller meets the buyer, however, the probability that the buyer's reservation price will be higher than the seller's ask price is the same with or without 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, in return, has to pay k portion of the transaction price as a commission to the broker. It will be assumed that the value of k is determined competitively in the brokerage market. The value of k, for almost all the houses sold, is between 5% and 7%.

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

$$\max_{S,P} W_s(S, B^{\circ\circ}, M^{\circ\circ}) = \int_P^1 \Delta(S + B^{\circ\circ}(\tilde{P}_b) + \mu M^{\circ\circ}(P))(P - P_s - kP) d\tilde{P}_b - \gamma_s C(S), \quad (6)$$

where $M^{\circ\circ} \epsilon [0,1]$ and $B^{\circ\circ}$ are the seller's conjecture about the search intensities of the broker and the buyer, $0 \le \mu \le 1$ is a measure of the degree of efficiency of the broker's search efforts, and kP is the commission fee that the seller has to pay to the broker in the event that the house is sold.[4] We assume an "exclusive-right-to-sell" listing contract between the seller and the broker where seller has to pay the commission fee to the broker when the house is sold even if the seller contacts the buyer on his own search efforts.

The solution to equation (6), S^{**} and P^{**}, will satisfy the following first-order conditions:

$$\Delta(1-P)(P-P_s-kP)=\gamma_s C'(S),\tag{7}$$

and

$$\int_{P}^{1} B^{\circ\circ}(\tilde{P}_b)(1-k)d\tilde{P}_b + (1-P)[(S+\mu M^{\circ\circ})(1-k)+\mu M^{\circ\circ\prime}(P)(P-P_s-kP)]\tag{8}$$

$$-(S+B^{\circ\circ}(P)+\mu M^{\circ\circ})(P-P_s-kP)=0.$$

The buyer's problem in the presence of a broker becomes:

$$\max_{B} W_b(B,S^{\circ\circ}, M^{\circ\circ}) = \int_{0}^{1} \Delta(B+S^{\circ\circ}(\tilde{P}_s)+\mu M^{\circ\circ}(P(\tilde{P}_s)))\max\{0,P_b\tag{9}$$

$$-P(\tilde{P}_s)\}d\tilde{P}_s - \gamma_b C(B).$$

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

$$\int_{0}^{1} \Delta B \max\{0, P_b - P(\tilde{P}_s)\}d\tilde{P}_s = \gamma_b C'(B).\tag{10}$$

When the seller lists his house with the broker, he also informs the broker about his price. Hence, the broker knows P (hence P_s) before she decides on a search intensity by which she searches for the buyer. Given the competitive commission rate, k, the broker's problem becomes:

$$\max_{M} \pi(M, B^{\circ\circ}, S^{\circ\circ}) = \int_{P}^{1} \Delta(\mu M + B^{\circ\circ}(\tilde{P}_b)+S^{\circ\circ})kPd\tilde{P}_b - \gamma_m C(M),\tag{11}$$

where M is the broker's search intensity, μ is the parameter representing efficiency of the broker's search efforts, and γ_m is the parameter representing the broker's search costs. The broker's equilibrium search intensity, M^{**}, satisfies,

$$\Delta\mu kP(1-P) = \gamma_m C'(M).\tag{12}$$

It is interesting to note here that $M^{**\prime}=\partial M^{**}/\partial P<0$ when $P>\frac{1}{2}$ (i.e., when $P>\frac{1}{2}$, an increase in the price of the house decreases the broker's search intensity), while $M^{**\prime}>0$ when $P<\frac{1}{2}$ (i.e., when $P<\frac{1}{2}$, an increase in the price of the house increases the broker's search intensity). An increase in P increases the broker's commission from the sale of the house (kP), but at the same time decreases the probability of selling the house ($1-P$). This result suggests that the former effect dominates the latter one when $P<\frac{1}{2}$, and the latter effect dominates the former one when $P>\frac{1}{2}$. Note also that the broker's search intensity also depends positively on μ, and negatively on γ_m.

A Comparison of the Prices

We will now use the above model to explain the seemingly conflicting empirical results in the literature by showing that the broker might have a positive, negative, or zero impact

on the housing prices, depending on the parameters of the model. We will provide an example for each of these three cases.

Let search be costless for the traders ($\gamma_s = \gamma_b = 0$). This yields $S = B = 1$. Let also $C(M) = M^2$. From (12), we get $M^{**}(P) = \Delta\mu Kp(1-P)/2\gamma_m$ and $M^{**'}(P) = \Delta\mu k(1-2P)/2\gamma_m$. In a market with these characteristics, the price without a broker, P^*, is given by (from equation 3)

$$P^* = (1 + P_s)/2 \, , \tag{3a}$$

while the price under the broker, P^{**} (from equation 8) will be given by the solution to

$$(1 - P^{**})[(1-k)(2+\mu M^{**}) + \mu M^{**'}(P^{**} - P_s - kP^{**})]$$
$$-(2+\mu M^{**})(P^{**} - P_s - kP^{**}) = 0 \, . \tag{8a}$$

Example 1: $P^{**} > P^*$ Let $P_s = \frac{1}{2}$, $k = 5\%$, $\mu = 1$, and γ_m small enough such that $M^{**} = 1 \ \forall P^{**}$ (hence, $M^{**'} = 0$). Then, (3a) yields $P^* = .75$, while (8a) yields $P^{**} = .763$.

Example 2: $P^{**} = P^*$ Let $P_s = 0$, $k = 5\%$, $\mu = 1$, and γ_m small enough such that $M^{**} = 1$ $\forall P^{**}$. Then, the solution to (3a) and (8a) becomes $P^* = P^{**} = \frac{1}{2}$.

Example 3: $P^{**} < P^*$ Let $P_s = \frac{1}{2}$, and $\Delta\mu k/2\gamma_m = 4$. Then, (3a) yields $P^* = .75$, while (8a) yields $P^{**} = .556$.[5]

A comparison of Examples 1 and 2 illustrates that the valuation of the house by the seller can be important in determining the impact of using a broker on the price. A comparison of Examples 1 and 3, on the other hand, illustrates that the cost and efficiency of broker's search can also be a critical factor.

Of particular interest is the result of Example 3, in which the price of a house is lower when it is sold through a broker than when it is sold by the seller himself. The intuition here is that when the seller lists the house with a broker, he has to consider the impact of his price choice on the broker's search effort level. An increase in the seller's price has two opposing effects on the broker's search intensity: one is that a higher price means a higher commission fee in the event of a sale. Hence, it gives more incentives to the broker to search harder. The other effect is that a higher price means a smaller probability that the buyer will purchase the house. Hence, it reduces the broker's incentives to search more. The above result demonstrates that there exist markets where the second effect dominates the first one (equation 12 implies that this will happen whenever the price is bigger than .5). This result also indicates that the seller reduces his price in order to procure a quicker sale.

It should be noted that a broker does more than simply bring the buyer and the seller together. Among other things, she also provides the parties information on mortgage rates, tax advantages/disadvantages connected with the sale, and recent transaction prices of similar houses. These additional services can cause the seller's price to move either direction, depending on how they affect the sellers's search costs, and on how much the buyer values these services. In order to keep the analysis tractable, however, we confined our attention here on the matching role of the brokers.

The dynamic search model of Salant (1991) provides another possible explanation for

the result of Example 3. Salant shows that the seller's ask price declines monotonically throughout time (due to a finite search horizon for the seller), with the exception that it may jump up at the point when the seller decides to employ a broker. Assume that sellers decide to search for buyers themselves until period t, and list their houses with a broker if they cannot sell the house themselves before period t. This implies that the houses sold directly by the sellers are sold before period t, while the houses sold through a broker are sold after period t. Since the seller's ask price is monotonically decreasing throughout time (even though the price may jump up in period t), it becomes possible to observe lower prices for the houses sold through brokers.

Although our model is a static model, it offers two contributions over Salant's model. First, it provides an additional insight for the possibility of observing lower prices under brokerage: the seller may reduce the price to increase the broker's search effort level in order to procure a quicker sale. Thus, it demonstrates that Salant's result holds even if we assume away monotonically decreasing reservation prices due to a finite time horizon. Second, the data in our model as well as in other empirical studies on this issue is a "static" data. It neither captures the seller's asking/reservation prices throughout time nor the jump/fall in the price when the seller quits trying to sell the property himself and employs a broker.

The above model can also be applied to study price differences between houses sold through MLS and non-MLS brokers. Under the MLS system, member brokers share their listings and a member can sell the listing of another member and share the brokerage commission. Therefore, the seller benefits from the search efforts of the other member brokers as well as the listing broker. As pointed out in Yavaş (1994), in addition to affecting the total search effort level expended on the seller's house, the MLS can also yield a more efficient matching technology. These aspects of the MLS can be captured in the above model by using a new matching technology and adding an additional variable for the search efforts of the other MLS brokers (other than the listing broker) in equations (6) through (8a). Therefore, the comparison of MLS sales to non-MLS sales is similar to the comparison of brokered sales to FSBO sales. Thus, qualitatively similar results can be obtained for the impact of MLS to those found in Examples 1–3 above.

Empirical Evidence

This part of the paper provides empirical evidence for the impact of MLS services on housing prices. We first describe the data.

Data

The data for this study consists of 125 observations of residential real estate transactions. Each of the observations include numerous observable variables of the transaction, as well as observable characteristics of the residential property. Several data sources were utilized. Information on all sales in the designated area under study was obtained for a two-year period, January 1, 1977 to December 31, 1978, from the assessor's office. The MLS "comp" books were used to identify which sales were MLS sales. The active non-MLS brokers at the time of the study provided a list of properties sold by them. It is assumed that all other sales were FSBOs. The property characteristics came from the

property appraisal cards in the Supervisor of Assessments' office or, in the case of MLS sales, they came from the MLS "comp" books.

The area studied is a section in the southwest corner of Champaign, Illinois. The area is bounded by Kirby Street and Windsor Road on the north and south, respectively, and by Mattis Avenue and Duncan Road on the east and west, respectively. The legal description is Section 22, T 19 N R 8 E, Champaign County, Illinois.

The mean lot size and living area of the properties were approximately 7,230 and 1,370 square feet, respectively. The homes on average had three bedrooms, one and a half baths, and a one and a half car garage. Each home had an average age of approximately 10.5 years and had an average sales price of approximately $47,600. Furthermore, the data sample can be divided into two subsamples. The first subsample would include the home-owners who sold their property with the aid of a multiple listing service (MLS), and the second group would be those who did not use a multiple listing service (non-MLS). Of all the transactions, 77.6% of the transactions involved a MLS and the remaining 22.4% share were non-MLS transactions. Summary statistics of the two subsamples and the entire sample are provided in the Appendix. An examination of the descriptive statistics reveal that all three groupings have very similar attributes and that neither of the two subsamples appear to differ significantly from the entire sample.

We are interested in the price differential of residential real estate transactions that exists due to the seller's choice of whether to use a MLS or not. Since we are ultimately interested in the price differential between MSL and non-MLS properties, it will be necessary to estimate several regressions where the sales price of the transaction will be the dependent variable. For this particular study, the variable LnP, the natural logarithm of the sales price, will be used as a dependent variable. The explanatory variables that will be included in the regressions will be observable property attributes. The variable Ln$LVAR$ is the natural logarithm of the living area, where the natural log transformation is used to allow for a nonlinear relationship. The variable BTH represents the number of bathrooms in the house. $BSMT$ is a dummy variable that takes on the value of 1 if a particular observation has a basement, and a value of 0 if no basement is present. The variables CR and $DETCR$ are closely related to one another. The variable CR represents the size of the garage with respect to how many cars can fit inside, while the variable $DETCR$ is the multiplicative transformation of the dummy variable DET and CR. The indicator variable DET takes on a value of 1 if the garage is detached from the house, and assumes a value of 0 if the garage is attached. Intuition would lead to the conclusion that a larger garage is more desirable; however a detached garage is not as desirable as an attached garage. This leads to the anticipation of the variable CR to have a positive coefficient, while the variable $DETCR$ has a negative coefficient. The variable AGE refers to the age of the house and is expected to have a negative coefficient. Finally, the variable MOS refers to an indexed number of the month of sale where it has a value of 1 if the property is sold in January 1977, 2 if it is sold in February 1977, and so on.

Methodology

Having examined the data set and explanatory variables, the methodology of this study will now be discussed. Examination of the impact of MLS on sale price requires the use of a two-stage estimation procedure due to possible sample selection bias. We are able to

observe the price of a house sold with the use of a multiple listing service, but we are unable to observe what price that same house would have sold for if it were a non-multiple listing service sale. This creates a problem when we want to examine the price differential for an individual observation because this difference will not be able to be observed. The two-stage estimation procedure that we use has been developed by Lee (1978) and Lee and Trost (1978).[6] We provide a brief description of the procedure below.

Since we are interested in the price differential between MLS and non-MLS transactions, we start the analysis by separating the data into the two subsamples and then estimating separate hedonics for the dependent variable. The regressions would take the form

$$\ln P_i^n = \beta^n x_i^n + u_i^n \ , \tag{13}$$

and

$$\ln P_i^m = \beta^m x_i^m + u_i^m \ , \tag{14}$$

where $\ln P_i^n$ is the natural logarithm of non-MLS house prices for observation i, x_i^n is a vector of explanatory variables for the non-MLS house sales, β_n is the vector of coefficients for the correponding variables, and u_i^n is the normal error term for the ith observation. Equation (14) contains the analogous explanatory variable vector, coefficient vector, and normal error term for the subsample of homes that were sold with the aid of a MLS. From the estimated coefficients, predicted values for the natural log of sales price for MLS and non-MLS transactions can be calculated for all observations. The price differential can then be simply calculated by taking the difference between the predicted values. Alternatively, as has been done by previous studies (e.g., Doiron et al., 1985; Frew and Jud, 1987; Tirtiroĝlu, 1994; Jud, 1983; and Kamath and Yantek, 1982), one can use dummy variable regressions where sale prices are regressed on several housing attributes and a dummy variable that assumes the value of 1 for those houses sold through a MLS and 0 for others. However, these procedures are susceptible to sample selection bias. This occurs because the MLS and non-MLS subsamples are mutually exclusive, hence the MLS price and the non-MLS price cannot be observed simultaneously for any one property. In other words, it could be that the MLS (non-MLS) subsample consists of properties with attributes such that the price for that property was particularly favorable using the MLS (non-MLS) system. As a result some sellers *choose* to use a MLS and others do not and thus the dummy variable for MLS cannot be treated as exogenous. Consequently, although the unconditional mean of the error terms in equations (13) and (14) may be equal to zero, $E(u_i^n)=E(u_i^m)=0$, their conditional expectations (conditional on a MLS being used or not) may be greater or less than zero. To see this, consider the seller's choice of whether or not to use a MLS-broker. His choice can be represented through the use of a probit equation with MLS as the limited dependent variable.

$$MLS_i = \beta(\ln P_i^n - \ln p_i^m) - u_i \ , \tag{15}$$

where MLS_i is the limited dependent variable taking on a value of 0 or 1, β is a vector of coefficients for the corresponding variables, and u_i is the standard normal error term. The seller will choose to use an MLS if $MLS_i < 0$, and will not use an MLS if $MLS_i > 0$.[7] Substituting (13) and (14) into (15) yields the reduced-form probit equation:

$$MLS_i = \beta(\beta^n x_i^n - \beta^m x_i^m) - \beta(u_i^n - u_i^m) - u_i . \tag{16}$$

Rewriting gives:

$$MLS_i = \Theta_i z_i - \eta_i , \tag{17}$$

where Θ_i is a vector of coefficients, z_i is the union of the explanatory variables x_i^n and x_i^m, and $\eta_i = u_i - \beta(u_i^n - u_i^m)$. Given (17), the conditional expectation of the error terms can be shown to equal:

$$E(u_i^n | MLS_i > 0) = -\sigma_{uu^n} \frac{\Phi(\Theta_i z_i)}{\Psi(\Theta_i z_i)} \tag{18}$$

and

$$E(u_i^m | MLS_i < 0) = -\sigma_{uu^m} \frac{\Phi(\Theta_i z_i)}{1 - \Psi(\Theta_i z_i)} , \tag{19}$$

where σ_{uu^n} is the covariance between u and u^n, σ_{uu^m} is the covariance between u and u^m, Φ is the standard normal density function, and Ψ is the cumulative normal density function. Now, the conditional expectations of the hedonic equations become:

$$E(\ln P_i^n | MLS_i > 0) = \beta^n x_i^n - \sigma_{uu^n} \frac{\Phi(\Theta_i z_i)}{\Psi(\Theta_i z_i)} , \tag{20}$$

and

$$E(\ln P_i^m | MLS_i < 0) = \beta^m x_i^m - \sigma_{uu^m} \frac{\Phi(\Theta_i z_i)}{1 - \Psi(\Theta_i z_i)} . \tag{21}$$

Clearly, since the conditional expectations of the error terms may not be equal to zero, this may introduce some bias into the vectors of coefficient estimates β_n and β_m in (20) and (21). If bias is introduced into the vectors of coefficients, the predicted sales prices of the non-MLS and MLS transactions will be biased, and that would ultimately lead to a bias in the price differential. In order to solve this problem, we need to adjust the conditional error terms in (20) and (21) so that they will have zero means. This can be achieved by redefining the error terms as:

$$\varepsilon_i^n = u_i^n + \sigma_{uu^n} \frac{\Phi(\Theta_i z_i)}{\Psi(\Theta_i z_i)} , \tag{22}$$

and

$$\varepsilon_i^m = u_i^m - \sigma_{uu^m} \frac{\Phi(\Theta_i z_i)}{1 - \Psi(\Theta_i z_i)} \ . \tag{23}$$

Substituting into the hedonic equations yields:

$$\ln P_i^n = \beta^n x_i^n - \sigma_{uu^n} \frac{\Phi(\Theta_i z_i)}{\Psi(\Theta_i z_i)} + \varepsilon_i^n \ , \tag{24}$$

and

$$\ln P_i^m = \beta^m x_i^m + \sigma_{uu^m} \frac{\Phi(\Theta_i z_i)}{1 - \Psi(\Theta_i z_i)} + \varepsilon_i^m \ . \tag{25}$$

Now, we have $E(\varepsilon_i^n | MLS_i > 0) = E(\varepsilon_i^m | MLS_i < 0) = 0$, and this provides us with consistent estimates of the coefficients in the hedonic equations. The terms Φ/Ψ and $\Phi/(1-\Psi)$ are the selectivity variables,[8] and are treated as additional explanatory variables. In computing the selectivity variables, we use the estimated values of Θ_i from the reduced-form probit equation (17). It is important to note that the explanatory variables used in each one of the hedonics do not have to be the same variables as those used in the probit, but the union of the variables in the two subsamples must have the same variables as the probit.

Results

The results of the hedonics for the non-MLS and MLS transactions can be found in the first Appendix table. We report the coefficient estimates and the t-statistics with and without including the selectivity variables (*SELECT*) variable. It is interesting to note that in both of the hedonics that include the selectivity variables, *SELECT*, this variable is not significantly different from zero. This is important because the coefficient on the selection variable is a test of the existence of sample selection bias. Since the coefficient is not significant, there is no sample selection bias present in either of the hedonics. This suggests that the difference between the housing prices obtained in MLS and non-MLS markets is not random and that there is a consistent pricing policy *within* each marketing system.

In the absence of selectivity bias, the regressions are run once again excluding the *SELECT* variables. The coefficients estimated in the regressions that exclude the *SELECT* variable are consistent and do not introduce bias into the prediction of the natural log of sales price. Furthermore, when comparing the regressions with and without the selection variables, one can observe that the R^2 statistic essentially remains constant, suggesting that the removal of the variable did not change the fit to any great degree. In addition, when comparing the two non-MLS and the two MLS hedonics, one can see that the signs of the coefficients remained the same even with the removal of the selection variables, suggesting that the impact of the remaining variables is consistently in the same direction.

Having established that sample selection bias was not present, the remainder of the

analysis will concentrate on the non-MLS and MLS regressions that exclude the selection variable. In both of the hedonics, all of the variables are significant at the 10% level of significance with the exception of *CR* and *DETCR* in the non-MLS transactions. Furthermore, using the 5% level of significance, one can see that all of the variables remain significantly different from zero with the exception of *BTH* in the MLS regression.

The variable Ln*LVAR*, the natural log of living area, is significant and positive in both regressions, suggesting that more living area is a desirable characteristic that adds value to a property. This result is intuitively appealing. The variable *BTH*, the number of bathrooms, is consistently significant at the 10% level and the coefficient is positive. This result was anticipated from the generalization that a greater number of bathrooms is preferred to a lesser number. The variables *AGE* and *MOS*, the age of the property and the indexed month of sale, behave in similar manners in both hedonics. Once again, following intuition, the *AGE* variable has a negative coefficient suggesting that a property's value decreases as it gets older. This is consistent with the ideas of simple wear and tear and the various forms of depreciation that a property may experience as it ages. Finally, the variable *MOS* had a positive impact on the estimation of the natural log of sales price.

While many of the estimated coefficients appeared to perform consistently in both the non-MLS and MLS transactions, several variables did not. Included among these variables are *BSMT*, *CR* and *DETCR*. First, the variable *BSMT*, the indicator variable that tells of the existence of a basement in the house, is found to be significantly different from zero in both of the hedonics. Although the magnitudes of the estimated coefficients are similar, the signs of the parameters are different. For the non-MLS subsample the presence of a basement appears to enhance the sales price, while the presence of a basement detracts from sales price in the MLS subgroup. The negative coefficient for the *BSMT* variable in the MLS subgroup may seem peculiar, but it may not be peculiar in the study area. The area was once a swamp. It has been tiled and drained for many years, but the water table remains high. Thus, all but the most carefully damp-proofed, backfilled-with-gravel, and tiled basements with sump pumps are wet from time to time. So this result is not particularly surprising given prior knowledge of these local conditions. Secondly, the behavior of the variables *CR* and *DETCR* appear to differ. As mentioned earlier, the anticipation was that *CR*, the number of spaces in the garage, and *DETCR*, the multiplicative variable that represents that size of the garage and whether or not the garage is attached, would realize a positive and negative coefficient, respectively. This relationship was observed in both regressions; however, both variables were not significantly different from zero in the non-MLS hedonic. Observing these relationships, it is obvious that *CR* and *DETCR* have a significant influence on sales price in MLS transactions; however, their effect is essentially zero in non-MLS transactions.

Having discussed the impact of the independent variables, the next step of the methodology is to estimate the "reduced-form" probit equation in (17) where the only explanatory variable is the predicted price differential, Ln*PDIF* (the difference between the predicted natural log of sales price under MLS and the predicted natural log of sales price under non-MLS for each property). This equation enables us to estimate the direction of the effect of the expected price difference on the seller's choice between MLS and non-MLS systems. The results are reported in Appendix Table 2. Price difference has a significant impact on the choice of marketing strategy and, as expected, higher price

differential raises the probability that the seller chooses MLS. In other words, as the expected price under MLS increases relative to the expected price under non-MLS, the seller is more likely to use a MLS broker. Note that the estimated constant term is significant and has a value exceeding .5. This indicates that the seller is more likely to use a MLS even when the expected price under MLS is the same as the expected price under non-MLS. One potential reason is that MLS reduces the time it takes to sell the property. Unfortunately, we have not been able to obtain the data on the duration each property (especially FSBO sales) stayed in the market before it was sold.

Another indiction that there must be non-price factors affecting sellers' choice of MLS is that MLS generates a smaller price than non-MLS system in our sample. In comparing the expected prices under the two systems we followed the approach taken by Lee (1978) and used the following formula:

$$\frac{100}{N}\sum_{i\varepsilon N}\left(\frac{e^{(\ln \hat{P}^m)}\left(\frac{1}{2}(\hat{\sigma}_m^2 - \hat{\sigma}_n^2)\right) - e^{(\ln \hat{P}^n)}}{e^{(\ln \hat{P}^n)}}\right),$$

where $\hat{\sigma}_m$ and $\hat{\sigma}_n$ are the standard errors of the estimated prices in MLS and non-MLS sales and N is the total sample size. This formula measures the average percentage increment of the price for the MLS sales compared with the non-MLS sales (see Lee, 1978: 426–27, for a derivation of the formula). The estimated average percentage increment in our sample is -5.7%.[9] Given the widespread use of MLS services, this result indicates that there must be non-price benefits to using a MLS. As we mentioned earlier, one such potential benefit is that MLS shortens the time it takes to sell a property. This is also the intuition we provided for our theoretical result in section two that a seller might *choose* to set a lower price under MLS in order to obtain a quicker sale. Another possible reason for the negative price impact of MLS is that brokers have a tendency to pressure the seller to reduce the asking price. The reason is that by getting a lower price brokers give up a much smaller amount (the percentage of the price foregone as commission revenue) than the sellers in return for a quicker sale. Furthermore, the incentives for MLS brokers is bigger than non-MLS brokers because a MLS broker is likely to share the commission with another MLS broker.

Conclusions

This paper has two parts. The first part of the paper develops a bilateral search model where a seller and a buyer search for each other to trade. The seller has two options. He can either search for the buyer through his own efforts (FSBO), or list the house with a broker and utilize the additional search efforts provided by the broker. If he chooses to list the house with a broker, he has to pay a commission fee to the broker. In the event that the seller chooses to use a broker, he considers the two opposing impacts of his price choice on the broker's search effort level: one is that a higher price means a higher commission fee in the event of a sale. Hence, it gives more incentives to the broker to search harder. The other effect is that a higher price means a smaller probability that a buyer will purchase the house. Hence, it reduces the broker's incentives to search more. It is shown that, depending on the magnitudes of these two effects, the seller's valuation of

the house, and on the cost and efficiency of broker's search, the price of a house sold by FSBO can be lower, the same, or higher than the price of a similar house sold through a broker. Using the same approach, it is argued that the price of a house sold through a MLS broker can be lower, the same, or higher than the price of a similar house sold through a non-MLS broker.

The second part of the paper provides empirical evidence of the impact of the MLS on the housing prices. This impact was measured by the price differential that exists between non-MLS and MLS transactions. In order to avoid possible sample selection bias, a two-stage estimation procedure was utilized. The results of this procedure showed that sample selection bias did not exist in this particular sample of non-MLS and MLS transactions. Finally, it is found that expected price difference has a significant impact on the choice of marketing strategy and, as expected, higher price differential raises the likelihood of MLS choice. When calculating the effect of the MLS decision on the price differential, it is concluded that the decision to use a multiple listing service decreases the sale price of a property.

Our results indicate that while expected price under alternative marketing strategies is a significant determinant of the marketing choice, it is not enough to explain the choice of marketing strategy alone. In particular, it cannot explain the widespread use of MLS. Therefore, the current study can also be interpreted as a call for future research to explore other factors that affect the seller's marketing strategy. Another interesting extension would be to make a distinction between brokered sales and non-brokered sales and compare the performance of MLS brokered sales with non-MLS brokered sales by excluding FSBO from the non-MLS subsample. This comparison in our sample yielded similar results to those reported in the current study (the results are available from the authors upon request). However, we have not included the analysis of FSBO because of the small size of the FSBO subsample in the study area. Also, the FSBO segment of the market is smaller than surveys generally indicate (e.g., 7% versus 15% in a 1981 NAR® survey). This latter problem casts some doubt on the representativeness of the FSBO subsample.

Appendix

The following is a summary of statistics of the variables utilized in this study.

Total Sample				
(N = 125)	Mean	Std Dev.	Min.	Max.
MOS	12.0160	6.4608	1	23
LVAR	1367.1040	317.3414	912	2180
AGE	10.5040	17.6720	0	99
BTH	1.6200	.4769	1	2.5
BSMT	.0640	.2457	0	1
CR	1.5280	.5052	0	2.5
DETCR	.1680	.3754	0	1
MLS	.7760	.4186	0	1
NONMLS	.1520	.3605	0	1
FSBO	.0720	.2595	0	1
PRICE	47605.96	11708.37	22500	70450

MLS Sample

(N = 97)	Mean	Std Dev.	Min.	Max.
MOS	12.1546	6.5469	1	23
LVAR	1369.8454	339.1109	912	2180
AGE	11.1959	19.7546	0	99
BTH	1.5722	.4787	1	2.5
BSMT	.0206	.1428	0	1
CR	1.5670	.5236	0	2.5
DETCR	.1649	.3731	0	1
MLS	1.0000	.0000	1	1
NONMLS	.0000	.0000	0	0
FSBO	.0000	.0000	0	0
PRICE	46966.96	12116.66	22500	70450

Non-MLS Sample

(N = 28)	Mean	Std Dev.	Min.	Max.
MOS	11.5357	6.2449	1	22
LVAR	1357.6071	231.3091	925	1861
AGE	8.1071	6.2500	2	21
BTH	1.7857	.4395	1	2.5
BSMT	.2143	.4179	0	1
CR	1.3929	.4163	1	2
DETCR	.1786	.3900	0	1
MLS	.0000	.0000	0	0
NONMLS	.6786	.4756	0	1
FSBO	.3214	.4756	0	1
PRICE	49819.64	10051.25	25300	64500

Table 1

Subsample	Const	LnLVAR	BTH	BSMT	CR	DETCR	AGE	MOS	SELECT	R^2	$\bar{R}^2$
Non-MLS	3.571	.465	.062	.103	.074	−.048	−.013	.010	.054	.92	.88
	(11.23)	(1.84)	(.29)	(.44)	(.46)	(−.96)	(−1.95)	(2.53)	(.27)		
MLS	3.331	.548	.094	−.188	.084	.044	−.003	.009	−.031	.87	.86
	(54.11)	(5.31)	(1.00)	(−1.11)	(1.40)	(−1.72)	(−4.48)	(4.62)	(−.20)		
Non-MLS	3.496	.408	.116	.164	.033	−.037	−.015	.009	—	.92	.89
	(24.58)	(3.16)	(2.33)	(3.85)	(.78)	(−1.23)	(−3.20)	(2.99)	—		
MLS	3.326	.561	.077	−.219	.095	−.048	−.003	.009	—	.87	.86
	(58.29)	(7.03)	(1.79)	(−2.96)	(3.47)	(−2.47)	(−5.37)	(−5.21)	—		

Table 2

Dependent Variable	Constant	LnPDIF	R^2	$\bar{R}^2$
MLS	.77864	.47406	.06	.053
	(21.359)*	(2.8085)*		

*Since ln*PDIF* is an estimated variable, these *t*-ratios may be misleading. As in Lee (1978) and Brueckner and Follain (1988), we choose to ignore this problem rather than attempt to conduct the complex process to correct it.

Notes

[1]The intensity of search can be interpreted as the amount of advertising (size and frequency of ads, number of newspapers in which they appear), amount of neighborhood search for houses for sale, or the effort expended in spreading the word through friends and relatives, etc.

[2]This differs from the bargaining solution in Yavaş (1992) where the price of the house is determined through negotiations between the buyer and the seller after they meet each other. This difference in modelling the determination of price is critical. While the impact of brokerage on the price has been found to be always positive in Yavaş (1992), it will be shown that the impact here could be negative as well as positive.

[3]The choice of upper limit of one third has been made for the following reason: When we introduce a search intensity for the broker in the next section, the sum of the search intensities by the buyer, seller and the broker can take a maximum value of 3. Then, $\lambda \leq \frac{1}{3}$ becomes a sufficient condition for $\theta \leq 1$.

[4]It is possible that the price, P, is set by the seller and the broker together, or by the broker alone. Since a higher P affects the seller and the broker in the same direction (higher surplus from a trade, but lower probability of selling the house), it can be shown that the qualitative results of the paper will be independent of who sets the price.

[5]Solving equation (8a) for P^{**} involves very tedious algebra. Using a mathematical package program, such as Mathematica, Maple or MathCad, will be useful.

   Note that $P^* > P_s$, $P^{**} > P_s$, and $P^{**} - kP^{**} > P_s$ in all three examples. One can also show that there exists a set of parameters λ and Δ such that the seller's expected gain from listing the house with a broker (even at a lower price as in Example 3) exceeds his expected gains from searching for a buyer himself.

[6]Earlier applications of this procedure to real estate can be found in Brueckner and Follain (1988) who study the mortgage choice problem between adjustable and fixed-rate mortgages, and in Munneke (1994) who examines the redevelopment decisions for commercial and industrial properties.

[7]The choice of marketing system can also affect the time it takes to sell the property as well as the price of the property. Due to lack of data, this issue has not been explored here.

[8]Φ/Ψ is the inverse of Mill's ratio, and in reliability theory it is known as the *hazard rate*.

[9]Given the absence of selectivity bias in our sample, we have also run a regression equation where we have regressed the sale prices on the housing attributes in Appendix Table 1, and an MLS dummy variable that assumes the value of 1 for those houses sold through a MLS and 0 for others. The estimated coefficient on the MLS dummy was negative and significant at 10% level; MLS reduces the price by 4.67%.

References

Brueckner, J. K. and J. R. Follain, The Rise and Fall of the ARM: An Econometric Analysis of Mortgage Choice, *Review of Economics and Statistics*, 1988, 70, 93–102.

Doiron, J. C., J. D. Shilling and C. F. Sirmans, Owner versus Broker Sales: Evidence on the Amount of the Brokerage Commission Capitalized, *Real Estate Appraisal and Analyst*, 1985, 44–48.

Frew, J. and G. D. Jud, Who Pays the Real Estate Broker's Commission?, *Research in Law and Economics*, 1987, 10, 177–87.

Jud, G. D., Real Estate Brokers and the Market for Residential Housing, *AREUEA Journal*, 1983, 11, 69–82.

Kamath, R. and K. Yantek, The Influence of Brokerage Commissions on Prices of Single-family Homes, *Appraisal Journal*, 1982, 63–70.

Lee, L., Unionism and Wage Rates: A Simultaneous Equations Model with Qualitative and Limited Dependent Variables, *International Economic Review*, 1978, 19, 415–33.

——— and R. P. Trost, Estimation of Some Limited Dependent Variable Models with Application to Housing Demand, *Journal of Econometrics*, 1978, 8, 357–82.

Maddala, G. S., *Limited-Dependent and Qualitative Variables in Econometrics*, Cambridge: Cambridge University Press, 1983.

Munneke, H. J., Redevelopment Decisions for Commercial and Industrial Properties, *Journal of Urban Economics*, 1996, 39, 229–53.

Salant, S. W., For Sale by Owner: When to Use a Broker and How to Price the House, *Journal of Real Estate Finance and Economics*, 1991, 4, 157–73.

Tirtiroĝlu, D., Capitalization of Brokerage Commissions: The Case of Non-Local Buyers and Sellers, *Journal of Housing Economics*, 1996, 5, 193–206.

Wu, C. and P. F. Colwell, Equilibrium of Housing and Real Estate Brokerage Markets Under Uncertainty, *AREUEA Journal*, 1986, 14:1, 1–23.

Yavaş, A., A Simple Search and Bargaining Model of Real Estate Markets, *AREUEA Journal*, 1992, 20:4, 533–48.

———, Economics of Brokerage: An Overview, *Journal of Real Estate Literature*, 1994, 2, 169–95.

Zumpano, V. L., H. W. Elder and E. A. Baryla, Buying a House and the Decision to Use a Real Estate Broker, mimeo, The University of Alabama, 1995.