That Dog Won't Hunt? The Sale Price and Time-On-The-Market of For-Sale-By-Owner Properties

by Leigh Ann Coates

B.S./B.A. in Finance/Economics, May 1988, Rockhurst College
M.S. in Finance, August 2000, The George Washington University

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Dissertation directed by

Richard Green
Professor, School of Policy, Planning and Development and Marshall School of Business
Director, USC Lusk Center for Real Estate

Robert Savickas
Associate Professor of Finance, School of Business, The George Washington University

The School of Business of The George Washington University certifies that Leigh Ann Coates has passed the Final Examination for the degree of Doctor of Philosophy as of May 7, 2009. This is the final and approved form of the dissertation.

Leigh Ann Coates

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Dissertation Research Committee:

Richard Green, Professor, School of Policy, Planning and Development and Marshall School of Business; Director, USC Lusk Center for Real Estate, Dissertation Co-Director

Robert Savickas, Associate Professor of Finance, Dissertation Co-Director

Paul Carrillo, Assistant Professor of Economics, Committee Member

Eric Rosenblatt, Vice President, Fannie Mae, Committee Member

Refik Soyer, Professor of Decision Sciences, Committee Member

Ann Schnare, Partner, Empiris, LLC, Committee Member

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CHAPTER I

INTRODUCTION

That dog won't hunt is a Southern expression denoting a seemingly implausible situation. The phrase is an appropriate designation to an evaluation of the price and time-on-the-market of For-Sale-By-Owner (FSBO) transactions. Can such transactions consummate at a price comparable to brokered-transactions? Do FSBO transactions have the same time-on-the-market?

To date, the debate over whether FSBO sales can transact at closing prices and time-on-the-market durations that rival or perhaps even outmatch brokered transactions continues. The academic literature, as detailed later, is mixed on this issue. Conventional wisdom is that FSBO transactions cannot complete with brokered transactions on either closing price or time-on-the-market. The National Association of Realtors (NAR) espouses a similar view, citing its *2007 National Survey of Home Buyers and Sellers* finding that the median home price for agent-brokered transactions was $60,000 higher than FSBO transactions. An important caveat to the NAR's finding, however, is the comparison's failure to control for property characteristics. Indeed, the survey ultimately acknowledges:

> Unassisted sellers were more likely to be in a small town or rural area, the home was more likely to be a mobile or manufactured home, and the owner's income was lower than that of sellers using agents – suggesting homes sold without professional assistance may be worth less than homes in agent-assisted transactions, or that sellers of more expensive homes choose to seek professional assistance.

This paper begins with taxonomy of the real estate brokerage process. Real estate agents are the intermediary in the process, state-licensed to represent buyers or sellers in transacting the sale of real property and working either independently or through a real estate brokerage firm. While distinctions among the various types of agents are important to certain studies, this paper uses the terms ,"real estate agents", "agents" and "brokers", interchangeably[1], unless otherwise noted.

Real estate brokers structure their services as a bundle of individual services. Schnare and Kulick (2008) observe that sellers and buyers are now typically under separate representation, with a "listing agent" assisting the seller and a "buy-side", or buyer agent, assisting the buyer. The bundle of services proffered by buyer agents, as enumerated in Schnare et al. (2008), include helping to secure financing, assisting in the buyer's search process, advising the buyer on an optimal bid price, arranging home inspections, and preparing paperwork and legal documentation.

Bernheim and Meer (2008) unbundle the services traditionally provided to sellers into six distinct tasks. First, brokers provide advertising services. They make recommendations on how to stage the house for a successful sale, circulate flyers, place Internet and print advertisements, host open houses, and recommend the house to their buying clients and other brokers. Second, brokers assist in negotiating the sales contract, either directly with the buyer or with the buyer's broker. Third, brokers screen potential buyers (Salant 1991). Fourth, brokers can list the house on the Multiple Listing Service. Fifth, they should advise the seller on an "optimal" selling price that both minimizes

[1] The interested reader is referred to the joint 2007 Department of Justice/Federal Trade Commission Study and to Nadel (2006).

time-on-the-market and maximizes sale proceeds. Lastly, brokers assist sellers with paperwork and legal documentation.

Nadel (2006) observes that the bundling of services in the real estate brokerage industry resembles an earlier time in the funeral services industry as described by Mitford in *The American Way of Death*. Prior to the 1982 passage of the FTC "Funeral Rule", consumers were required by the funeral industry to purchase services in a bundled package, whether some of the individual services were desired or not. With the passage of the FTC rule, the funeral industry was required to provide consumers with an itemized listing of services from which to choose. Nadel (2006) notes that the real estate brokerage industry appears to be on a similar regulatory trajectory as befell the funeral services industry.

Levitt and Syverson (2005) observe that specialization causes a heavy reliance "…on the advice of experts when making decisions." Before the widespread usage of the Internet, the services provided by travel agents, stockbrokers, even lawyers to some extent were almost exclusively specialized fields. The Internet has tipped the scales of information asymmetry in these fields and disseminated their specialization. Nadel (2006) notes that Internet access to travel information significantly altered the travel agent industry. He observes a similar change in the stock brokerage industry, where again consumer access to information and the technology to execute trades has largely diminished the role of the stockbroker. Levitt et al. (2005) note that even the law and accounting professions have experienced some dissemination of their services, and the same is true for accounting services such as income tax preparation. With specialized software, consumers can now prepare their own tax returns; with Internet access, they can download and draft an array of legal documents including wills, leases, etc.

Broker services are not so specialized that they need to remain bundled. Nor are the services inextricably linked by economies of scale, as demonstrated by the proliferation of cottage industries in online real estate appraisals, property listings, closing documentation preparation, and so on. Indeed, the extant literature, suggests that broker services remain largely bundled because of real or perceived information asymmetries. Anglin and Arnott (1999) observe that such asymmetries are pervasive down to even the fundamental pricing of the commission, such that "…the significant minority of sellers do not realize -- and are not informed -- that the commission rate is negotiable."

Rutherford, Springer, and Yavas (2005) note that brokers and agents (hereinafter, "brokers") usually are more informed about the local real estate market and the process of a real estate transaction than most homebuyers and sellers. Their study examined the impact of a broker's information advantage on sales price and time-on-the-market. The dataset consists of 306,869 MLS listings in several Texas counties over the period 1999 to 2002. The authors find, along with Levitt et al. (2005), that brokers sell their own homes at a 4.5% premium relative to non-broker listings. Unlike Levitt et al. (2005), the authors do not find a statistically significant difference in time-on-the-market between broker-owned homes versus non-broker homes.

Levitt et al. (2005) examine this information asymmetry over a number of dimensions, two of which directly relate to this paper. First, the agent has observed a significantly larger number of transactions than the seller, who perhaps has only observed the sale of houses he owned and that of other houses in his neighborhood. This implies that to the extent that houses are heterogeneous, the broker has an informational advantage, not in his access to sales information, but in his experience of observing a large number of sales transactions. Thus, one would expect to find greater reliance on broker-assisted transactions, the greater the degree of house heterogeneity. Second, brokers have traditionally held an informational advantage over sellers in terms of sheer access to residential transactions. As the Internet has disseminated this information to consumers in various forms, including automated property valuations, online listings, closing documentation software, etc. one would expect to observe a decline in agent-assisted transactions over time as Internet usage became more prominent.

At least a few publications have attempted to quantify in dollars or opportunity cost the information asymmetries described above. Levitt et al. (2005) find that agent sales of their own homes sell for approximately 3.7 percent more than the general market. This higher price is at least partly linked to the agents' willingness to keep their own home on the market by an additional 9.5 days, suggesting that they may persuade sellers to sell their home too quickly, before the best offer has arrived. The authors' finding is also suggestive of the motivational differences— both among sellers themselves and between sellers and brokers—observed in the literature and detailed in Chapter II.

Bernheim et al. (2008) pursue a similar line of inquiry in asking how much the bundle of services provided by agents is worth. Summing the incremental market values of the individual services provides an estimated market value for the bundled package of services. The authors observe that discount brokers offer MLS access for as low as $300. Property marketing and appraisal services cost approximately $350 each. Attorney fees for preparing legal documents attenuate to a home sale average $700. Thus, "The total market value of the fourth, fifth, and sixth benefits…is roughly $1,400—enough to justify a 6% commission on only the first $23,000 of proceeds from the sale of a home." While their conclusion is interesting, it is incomplete in failing to include what might be the most valuable services the broker provides, that of marketing, negotiating, and screening.

A 2007 report by the Federal Trade Commission (FTC) and the Department of Justice (DOJ) does not explicitly calculate a cost. Rather, the study finds that commission rates are relatively inelastic to house prices or housing market conditions. As a result, the study concludes, "Inflation-adjusted commission fees per transaction appear to follow closely movements in home sales prices….and that the price consumers paid for brokerage services rose considerably during the recent run-up in housing prices."

Schnare et al. (2008) observe that studies such as Nadel (2006) and the FTC/DOJ report frame their critique of commission structure largely on "anecdotal grounds." Using a nationally representative dataset spanning the period January 2000 to June 2007, the authors find that commission rates are far from inelastic. Rather, Schnare et al. (2008) demonstrate that "…commission rates vary within markets, across markets and over time", as well as with "…the strength of the local housing market, the value-added of real estate agents, and other factors underlying demand and supply of brokerage services."

Commission structure aside, empirical research to date on the impact of the seller's choice of transaction mechanism on sales price is limited, and the evidence is mixed. Bernheim et al. (2008), Hendel, Nevo, and Ortalo-Magne′ (2007), and Jud

(1983), for example, find that “for sale by owner” (FSBO) transactions sell for a higher price than those brokered by a real estate agent. By contrast, other studies, including Doiron, Shilling, and Sirmans (1985) and Frew and Jud (1987) conclude brokered transactions sell for higher prices. Still others determine either that the choice of sales platform has no meaningful impact on transaction price (Kamath and Yantek (1982) and Colwell et al. (1992)) or that “…the price of a house sold by FSBO can be lower, the same or higher than the price of a similar house sold by a broker.” (Yavas and Colwell (1995)).

The purpose of this paper is to examine the directional impact of the transaction mechanism (FSBO or broker) on the sale price and time-on-the-market of single family home in Arlington County, Virginia. Research results should determine whether the 5%-6% commissions charged by real estate agents translate into commensurately higher sale prices when compared to similar, FSBO-transacted properties in Arlington County, Virginia. Results will also attempt to determine whether, and to what extent, FSBO sales extend time-on-the-market as an ancillary consequence. The research has meaningful implications to the return-maximizing choice of sales platform on the part of property owners, particularly at a time when substantial home price depreciation is already narrowing potential sales price proceeds in the Washington, D.C. metropolitan area.

The data for this paper consists of (1) Arlington County Tax Assessor’s real estate sales data for the fiscal years March 31, 2000 through March 31, 2007 and (2) MLS records for the same period. After merging the two datasets, this paper identifies FBSO transactions by their presence in the Arlington County tax data and coincident absence from the MLS data. This identification process required a merge of the tax and MLS data, with many key fields in the MLS data either missing or incorrect. This paper employs a variety of matching and fuzzy matching algorithms that considerably mitigate the possibility of incorrectly labeling a brokered transaction as a FSBO transaction. This paper specifies a hedonic model of sales price, with fixed effects controlled for with year and seasonal dummies, as well as location and property-specific characteristics. Chapter IV tests for the presence of selectivity bias, controlled for, as needed, in subsequent model iterations.

The remainder of this paper proceeds as follows. Chapter II surveys the literature on residential real estate transactions. Chapter III describes the data and methodology. Chapters IV and V present the empirical results and conclusions.

CHAPTER II

LITERATURE REVIEW

Studies by Belkin (1976), Miller (1978), and Yinger (1981) were among the first to identify real estate brokerage as a research topic. Since that time, research on the real estate brokerage process has proliferated along several dimensions. As of the writing of this paper, the body of work on residential real estate transactions is expansive and a number of natural delineations of the literature emerge.

This paper's exposition proceeds along three broad categories of research. The largest and oldest body of work concerns itself with the principal-agent conflicts inherent in brokered transactions and the role of commission structure in either aggravating or ameliorating this conflict. A second, more diffuse body of work sets aside the principal-agent conflict and focuses directly on the price and time-on-the-market dimensions of these transactions. Green and Vandell's (1998) work on optimal price setting in residential real estate transactions highlights the simultaneity problem between price and time-on-the-market: an inextricable linkage exists between sales price and time-on-the-market. Thus, a review of this work must acknowledge this linkage. Finally, a small number of recent empirical papers directly examine directly the seller's choice of transaction mechanism, or sales platform, and its impact on sale price and time-on-the-market.

Choice of Sales Platform

A few recent empirical studies relate directly to this paper. Hendel, Nevo, and Ortalo-Magne′ (2007) compare FSBO versus broker-assisted transactions along a number of performance criteria, including sales price, time-on-the-market, and probability of sale. The data consists of 15,606 single-family home sales in Madison, Wisconsin over the period January 1998 to December 2004.

Hendel et al. (2007) present seven different model specifications of sales price (in log form) to choice of platform. The simplest model specifies sale prices as solely a function of sales platform and reveals an approximate 11% premium on FSBO-transacted sales. A second model includes time effects to account for increased prevalence of FSBOs in later years of the study, which narrows the FSBO premium to approximately 4%. The remaining model specifications account for fixed effects (time and property) and platform switches between initial listing and ultimate sale (e.g. initially listed FSBO, switched to broker or initially MLS-listed, switched to FSBO, or no change in platform). Across model specifications, the authors arrive at the "…surprising result [that] sellers on FSBO are able to sell their houses at a premium relative to MLS. In addition, sellers that initially list their houses on FSBO but then move to MLS also command a significant premium relative to initial MLS listings." This second result is suggestive of a self-selection bias regarding platform choice, which Hendel et al. (2007) appropriately addresses later in their analysis.

Hendel et al. (2007) also compare the time-on-the-market of FSBO and brokered transactions. They do not find a statistically significant difference in time-on-the-market between the two platforms. However, an important caveat is in order. Very few transactions started as MLS-listed and then switched to FSBO for sale. At the same time, roughly 25% of FSBO listings ended as brokered sales. Thus, results would suggest that time-on-the-market is shorter for brokered-transactions as "…the FBSO average represents the luckiest draws, in terms of time to sell, while MLS the whole population."

Lastly, Hendel et al. (2007) frame the comparison between FSBO and brokered transactions in terms of probability of sale, conditional on a sale execution in two, three, and six months. The authors observe a similar pattern as in their time-on-the-market analysis, concluding, "…within a fixed interval of time a FSBO property is less likely to sell [and that] although FSBO listings are somewhat more likely to eventually sell, their initial success is lower than MLS." A discussion missing from Hendel et al. (2007) is a distillation of their results into a dollar impact of platform choice on sales price. This dollar impact would factor in the combined results of sales price and time-on-the-market, as well as payment of commissions (in the case of brokered transactions). Levitt et al. (2005) conclusions are more compelling because they translate their results into a dollar impact to the consumer. This paper's objective is to frame conclusion(s) in a similar manner.

Contemporaneously with the Hendel et al. 2007, Bernheim and Meer (2008) examine the relationship between sale price and FSBO versus broker-assisted transactions. Their unique data consists of approximately 680 sales of homes on the Stanford University campus over the period January 1980 to December 2005. Like Hendel et al. (2007), the authors confine their study to a small suburban area and as such, the representativeness of their findings to other markets is not clear. Similar to the previous study, Bernheim et al. (2008) find no evidence that broker-assisted sales yield a higher sales price than FSBO. They also find that FSBO properties endure a longer time-on-the-market than broker-assisted properties. In the paper's conclusion, Bernheim et al. (2008) note that based on the average home value in their sample, "…a six percent sales commission totals $34,000, a steep price for the value rendered." Here, while the authors do cite a dollar impact, the impact is incomplete, failing to factor in, for example, the added holding costs to the seller from the longer-time-on-the-market of FSBO transacted properties. A holistic impact of sale platform on price would consider sales price, commissions rendered, and holding costs for time-on-the-market.

Sales Price and Time-on-the-Market

Real estate literature has examined the inter-relationship of time-on-the-market and sales price along numerous dimensions. Ferreira and Sirmon (1989) study the relationship of time-on-the-market and sales price for properties purchased by assuming the existing mortgage versus issuance of a new mortgage. The data consisted of sales of single-family dwellings in Greenville, South Carolina over the period 1975-1980. The results showed that properties sold with assumption of the mortgage shortened time-on-the-market. Moreover, these properties commanded a premium over like properties sold with the issuance of a new loan.

Kang and Gardner (1989) study the relationship of time-on-the-market to listing price, property characteristics, and housing market conditions. Their data consists of 1,877 single-family home sales in McLean County, IL over the period January 1982 to December 1986. The study is one of the first to empirically document that time-on-the-market varies inversely with housing market conditions, as estimated by prevailing mortgage rates. The study also finds that most property characteristics do not influence time-on-the-market, with the exception of new homes having a significantly shorter time-on-the-market.

Asabere, Huffman, and Mehdian (1993) study the relationship of time-on-the-market to list price over- and under-pricing. A standard hedonic model estimates the degree of mispricing by comparing expected sale price from the model to actual list price. Their data consists of 337 residential home sales in Philadelphia and Montgomery and Chester Counties, PA over the period December 1986 to June 1990. The study provides empirical support for the convention that time-on-the-market should vary inversely with the degree to which a property is over-priced. Their results are also consistent with search theory that posits the longer the time-on-the-market, the higher the probability of the seller matching to a borrower at the seller's reservation price.

Yavas and Yang (1995a) study the relationship between time-on-the-market and brokerage- and agent-specific characteristics. Firm-specific characteristics include the size of the listing firm and the level of commission charged. Agent-specific characteristics include the number of listings per year and the number of houses sold per year. The authors specify a two-stage regression, with a hedonic model in the first stage to predict property sale price and a second stage regression of time-on-the-market predicted, rather than observed, sales price. Specification in this manner, with different explanatory variables in the first and second stages, avoids the simultaneity problem identified in Green et al. (1998) inherent in price and time-on-the-market relationships.

That is, time-on-the-market affects ultimate sales price at the same time that sale price affects ultimate time-on-the market. The dataset for the study is sales of 388 single-family homes in State College, Pennsylvania during 1991. The authors find that no firm-specific characteristics significantly affect time-on-the-market. Agent-specific characteristics, however, do influence time-on-the-market. Agents with more listings increase time-on-the-market, while agents with more sales decrease time-on-the-market.

A second paper by Yavas et al. (1995b) examines the impact of over-pricing on time-on-the-market. They define over-pricing as the ratio of actual listing price to predicted property sales price from a hedonic model. The authors specify a two-stage regression, with a hedonic model in the first stage to predict property sale price and a second stage regression of time-on-the-market against over-pricing. This specification again diffuses the simultaneity problem between price and time-on-the-market. The dataset for the study consists of 270 MLS-listed residential properties that sold in 1991. Yavas et al. (1995b) estimate their model on the full sample of sales, as well as on sales price bracketed by quartiles. The empirical results diverge from earlier studies that had found a consistently negative relationship between time-on-the-market and over-pricing, a difference the authors ascribe to the failure in prior studies to address the above mentioned simultaneity problem. In specific, Yavas et al. (1995b) find that over-pricing influences time-on-the-market only in the mid-price ranges (second and third quartiles). For the entire sample, as well as the low- and high-price quartiles, there is no statistically significant relationship between time-on-the-market and over-pricing.

Jud, Seaks, and Winkler (1996) study the relationship between time-on-the-market to brokerage firm characteristics, agent expertise, list price over-pricing, and property characteristics. The number of sales completed over the period proxies for agent expertise. Sales volume and the number of franchise offices proxy for brokerage firm characteristics. The authors also employ a hedonic model to identify over-priced listings by comparing expected sale price to actual list price. The data consists of 2,285 residential sales in Greensboro, NC over the period September 1991 to September 1993. Similar to Yavas et al. (1995a), the authors find no statistically significant relationship between brokerage firm characteristics and time-on-the-market. They also observe no statistically significant relationship between time-on-the-market and agent characteristics. The study provides additional empirical support for Asabere, Huffman, and Mehdian's (1993) result that time-on-the-market varies inversely with the degree to which a property is over-priced. The study is one of the first to examine the impact of heterogeneity in house price characteristics on time of the market. Using an index of atypicality as developed in Haurin (1988) to measure home price heterogeneity, the authors find that the more atypical house characteristics are to local market characteristics, the shorter the time-on-the-market.

Anglin, Rutherford, and Springer (2003) extend the study of list price and time-on-the-market with the inclusion of an additional variable to capture the degree of list price variation by market segments. The authors posit that over-priced listings signal conflicting information to potential buyers. On the one hand, the over-pricing might signal unobserved property characteristics appropriately factored in the price. On the hand, it might signal a seller with an inordinately high reservation price. The extent to which the information content of one signal outweighs the other, and thereby either dissuades or encourages the potential buyer, depends on the list price variation of similar properties. Thus, Anglin, et al. (2003) conjecture, “The types of houses with a higher variance of list prices have greater ‘noise’ and a given change in list price can be expected to have less effect on the behavior of a group of potential buyers.”

A second extension in Anglin, et al. (2003) is an expansion of the dataset to include not only properties listed and sold, but also properties listed and subsequently withdrawn from the market. The authors posit that omission of withdrawn properties from the estimation dataset exerts a downward bias on time-on-the-market in prior studies. Anglin et al. (2003) construct market segments according to property characteristics. The residuals from the first stage hedonic model of list price are regressed against a vector of property characteristics to identify property-specific drivers of variation. The data consists of all single family homes listed in the Arlington, Texas MLS in 1997 for 3,685 listings, of which 2,022 terminated with a sale and the balance withdrew from the market. The key result of their study is that the extent to which time-on-the-market varies with over-priced listings depends on the variation in the market segment to which the house belongs. That is, “Given a group of homogenous houses with a narrow range of list prices, a seller who lists his house above the other can expect a much longer marketing period that if the group of houses had more divergent prices.”

In a prior work, Knight, Sirmans, and Turnbull (1994) also examine the information content of list prices and its relationship to sale price. The authors observe, “The information content of list prices for selling prices remains an empirical question. To answer this question, it is helpful to understand the sequence over which listing price information is incorporated into eventual selling prices.” Their model has the seller setting the listing price in the first stage as a function of his reservation price and his observation of prior listings. In the second stage, buyers respond to the list price. The seller then makes future shifts in list price in response to the buyer reaction. This information exchange iterates until a sale is culminated. Implicit in their model construction is the premise that list price bears a causal relationship to sale price. Thus, they test for Granger Causality using a dataset of 12,308 sales of single-family homes in Baton Rouge, LA over the period October 1984 to December 1992, a period they observe as capturing a period of housing market decline, followed by recovery. Their empirical results over the full estimation period indicate that list price granger causes sale price, not vice versa. Knight et al. (1994) acknowledge a number of caveats to their study, but at least one is missing. Namely, their dataset excludes properties listed but not ultimately sold (withdrawn). Such an omission could conceivably place an upward bias on the Granger Causality observed between list price and sale price.

Jud and Winkler (1994) study the relationship between brokerage firm and agent-specific characteristics on sales price. They also examine the relationship between the heterogeneity of house price characteristics and sale price. The study consists of 2,630 residential sales in Greensboro, NC over the period September 1991 to September 1993. Jud et al. (1994) compare actual sales prices to predictions from a hedonic model to determine the premium or discount at which sales occurred. They find that neither firm- nor agent-specific characteristics induce statistically significant price premiums or discounts. However, the authors do find that house heterogeneity, as measured by Haurin's index of atypicality, results in premiums on sale.

Black and Nourse (1995) study the impact of buyer brokerage representation on the split of cash closing costs between buyer and seller and sales price. Buyer brokerage, in which an agent independent of the seller represents the buyer, was a relatively new phenomenon at this time and their impact on sale transactions was ambiguous and not yet subject to broad empirical examination. Arguments could be advanced for either positive or negative effects to the buyer of such representation. On the one hand, as an exclusive agent to the buyer, rather than to buyer and seller, aligns their efforts more centrally to the buyer's interest and negotiate a lower price. On the other hand, their compensation remains tied to the sales price, with the buyer and seller agents splitting the percentage commission. Thus, a potentially strong disincentive existed for buyer brokerage to negotiate the lowest price on behalf of their client. The data consists of 80 sales of single-family dwellings in Atlanta, GA over the period January 1989 to August 1990. Empirical results failed to support the notion that buyer brokers negotiate a lower sales price for the buyer. At the same time, however, buyers absorbed a smaller share of cash closing costs when under separate representation. This shift in closing costs to the seller becomes increasingly more prominent "…when house prices rise above a low level at which the seller absorbs most closing costs regardless of the mode of brokerage."

Zumpano, Elder, and Baryla's (1996) results of buyer brokerage impact on price run counter to those cited in Black and Nourse. The authors find that buyer brokers do achieve a slightly lower sales price for their clients, although they couch this result as conditional to model specification. A critical element in their study, which was missing from Black and Nourses', is the control for selectivity bias in the buyer's decision of whether or not to use a buyer broker. The basis for their empirical study is 2,552 responses from a 1987 NAR survey. Zumpano et al. (1996) find that buyers self-select into the choice of a buyer broker based on such factors as higher income, employerassisted purchases, and non-local relocation, "…all factors that lead them to pay more for a house, but also to make them more likely to use a broker in purchasing their home." However, the questionable integrity of NAR survey results, highlighted in other studies, represents a limitation to their findings.

Principal-Agent Relationships

One of the earliest and largest bodies of work concerns itself with the principal-agent relationship of the broker and the homebuyer or seller. Jud (1983) was one of the first to examine the problem of aligning the broker to work in the best interests of the homebuyer or seller in the presence of information asymmetries. According to Jud, "…the cost of accurately evaluating the productivity of his broker is usually very high." Thus, percentage commissions affect a form of profit sharing between seller and broker that encourages self-policing of the agent's efforts. The authors test the proposition of percentage commissions as a self-policing mechanism using a random sample of 529 residential sale transactions in Charlotte, Greensboro, and Raleigh, North Carolina during the 3rd quarter of 1980. Although brokers influence the level of demand among housing buyers, they do not significantly affect price. In specific, broker-assisted sales were not at statistically different prices than sales by owner.

Zorn and Larsen (1986) compare incentives under a flat-fee versus percentage commission structure. Their search model produces the result that when the seller imposes a minimally acceptable price (MAP), incentives under the flat fee and commission structures are identical. Imposition of a seller floor on reservation price, the MAP, serves only to differentiate between potential outcomes. Absent a floor, consummation of a sale is certain, but the sale price is not. Conversely, imposing a floor would guaranty a sales price, but not the sale itself.

Zumpano and Hooks (1988) adopt a higher-level examination, focusing on the market microstructure of the brokerage industry. Their inquiry seeks to align the relative uniformity in commission rates with a cartel, oligopoly, or monopoly market structure. Zumpano et al. (1988) cite academic research that suggests none of the above structures can explain the uniformity in commission rates. Barriers to entry are low, market participants are numerous, and evidence of collusion is lacking. The authors conclude that the "…apparent lack of variation in gross percentage commissions is not sufficient evidence…." to support any of the market structures posited above, suggesting "…alternative theoretical approaches to the explanation of real estate brokerage behavior and performance…should be evaluated."

Larsen and Park (1989) find similarly ambiguous results in examining the impact of percentage commissions on time-on-the-market. Their model specifies probability of sale as a function of the commission rate and the seller's reservation price. Higher commissions induce a higher effective reservation price, thus decreasing the probability of sale. Conversely, higher commission rates increase the broker's incentive, thereby increasing the probability of sale. The empirical section of their paper is devoted to determining "…which of these terms dominate." The data consisted of 669 single-family listings, 433 of which consummated in a sale, in Lancaster County, Nebraska in the first three quarters of 1986. Results showed that the commission rate's impact on reservation price dominates, such that the probability of sale increases when the reservation price is lower, despite less intensive search efforts by the broker.

Arnold (1992) extends the one-period search model of Zorn et al. (1986) to a multi-period framework. This extension allows Arnold to factor in the costs and benefits to the seller of continuing to own the house as the search moves from one period to the next. The authors evaluate three alternative compensation structures on their ability to best align the agent's incentives with the principal: fixed-percentage commissions, flat-fee arrangements, and consignment. They demonstrate that the flat-fee structure is suboptimal because it causes the broker to conserve his efforts and seek the sale price that results in the fastest sale (and lowest expenditure of effort). The consignment structure essentially reverses this incentive, causing the broker to set a high reservation price that extends time-on-the-market and thus the costs to the seller of holding the home.

Yavas (1996) sets aside the impact of compensation structure on broker search intensity and instead focuses on its impact on the efficiency of the broker's matching of buyer and seller. The author assumes a fixed pool of buyers and sellers already exists. The broker's task is an optimal matching of buyer and seller. Yavas (1996) defines optimal matching in terms of the number of sales transactions and the joint surplus to the buyer and seller. He defines surplus as the difference between the buyer and sellers' reservation prices and assumes that the buyer and seller split any surplus equally. The author compares three alternate compensation structures: percentage commission, flat-fee, and net listing. The one-period search model demonstrates that a net-listing arrangement maximizes the potential surplus to the buyer and seller, but yields the minimum number of sales transactions. By contrast, percentage and flat-fee contracts generate the highest number of sale transactions, but minimize buyer and seller surplus.

Colwell and Yavas (1999) examine the incentive impacts of a percentage commission structure on the interests of both the buyer and the seller when separate agents represent each. A principal departure of their search model from ones previously specified is the dual-sided search of a buyer agent and a seller agent. Counter-balancing incentives affect to align seller and buyer interests with their respective agents, such that "A large class of commission structures, including percentage commission…can perfectly align the interests of the principal and the agent."

Zietz and Newsome arrive at somewhat different results from Colwell et al. (1999) in their 2001 study. The authors look squarely at the potentially strong disincentive of the buyer broker to negotiate a lower price for his client in the presence of a commission structure based on percentage of sale price. In specific, Zietz et al. (2001) pose the question of whether buyer agents achieve the lowest possible price for their clients "…or do they try to influence [their clients], in various ways, to buy a possibly less suitable house at an unnecessarily high price in order to receive a higher commission." Their empirical results, based on 592 home sales in Orem, Utah, for the period 1990 through 1997, suggest that the buyer broker's disincentive is present, but only in sales of lower-priced homes. However, this result points to an important omission in the model specification: buyer self-selection into buyer brokerage representation. Zumpano et al. (1996) demonstrate that such buyers directly affect price through specific characteristics separate and apart from any impact of buyer brokerage.

Zietz and Newsome (2002) apply a similar approach to their study of the relationship between sales price and type of agency designation. While their approach continues to suffer from buyer and seller self-selection into the various designations, the breadth of their study over different agency designations merits discussion. Absent separate representation, the authors observe that many buyers incorrectly presume that the listing agent works for the mutual best interests of the buyer and seller. Rather than disclose this information and risk a commission share with a broker subsequently enlisted by the buyer, the authors conjecture that there is strong incentive for the agent "…to obfuscate rather than clarify the agency representation issue to the borrower." There is the additional incentive for the broker to urge the seller to accept a lower selling price rather than risk a commission split with another buyer who might employ a separate agent. The same disincentives to the buyer and seller exist in limited dual broker arrangement, magnified by the brokerage firm's desire to retain the buy and sell sides of the transaction and avoid an external split on the commission. The final scenario, with the buyer and seller represented by agents of different brokers fosters the smallest disincentive, which the authors limit to the potential for the percentage commission split to dissuade the buyer agent from negotiating a lower sales price for the client. The results of their study, using 1,344 home sales in Orem/Provo, Utah over the period 1999 to 2000, suggest that the type of agency designation influences price "…only for very small and large properties."

Zumpano et al. (2000) also take up buyer brokerage effects in an earlier study. Using data from a 1996 National Association of Realtor's survey, the authors compiled 894 geographically dispersed sale transactions during 1995. Their analysis reverses the results of their 1996 study, finding no support for the premise that buyer brokers can affect a lower sales price for the clients. This finding would indeed seem to suggest that the authors' 1996 results were "particularly" sensitive to model specification. However, buyer brokers did reduce search time for their clients.

In a related line of inquiry, Yavas and Munneke (2001) examine incentive impacts of percentage commission under traditional and full commission structures. Traditional commission structures award the agent "…a predetermined ratio (usually 40 to 60 percent) of their commission revenue", with the brokerage firm funding the agent's physical fixed costs for office space and administrative support. Full commission structures compensate agents at 100% of the property sale price, less franchising fees and fixed costs. Yavas et al. (2001) develop a simple search model for empirically testing two hypotheses. Namely, neither sales price nor time-on-the-market will materially vary with commission structure. The data consisted of sales of 615 single-family homes in Athens, Georgia over the period July 1994 to March 1997. Empirical results supported both hypotheses, finding no statistical difference between sales price and time-on-the-market for traditional versus full commission compensation arrangements.

Rutherford, Springer, and Yavas (2001) also examine the role of contract specifications. In this case, the authors compare broker performance under exclusive agency versus exclusive-right-to-sell contracts. Rutherford et al. (2001) pose four research questions:

- Does the contract type influence time-on-the-market?
- Does the contract type affect sale price?
- For exclusive agency contracts, is time-on-the-market affected by whether seller or the broker ultimately consummates the sale?

- For exclusive agency contracts, is sales price influenced by whether seller or the broker ultimately consummates the sale?

The data consisted of 49,219 single family homes sold in Dallas-Fort Worth, Texas over the period January 1994 to December 1997. Empirical results demonstrated that time-on-the market was slightly shorter for exclusive agency contracts and sales price was only negligibly smaller than exclusive-right-to-sell contracts. Results for owner- versus broker-consummated sales under exclusive agency contracts were consistent with their hypothesis. Namely, owner-consummated transactions sold at a higher price, but sustained a longer time-on-the-market.

Rutherford, Springer, and Yavas (2004) extend their analysis above to broker performance under exclusive agency versus exclusive-right-to-sell contracts, segmented by sales price. The authors posit the same four testable hypotheses against a dataset identical to their 2001 work. Rutherford et al. (2004) derive an empirical breakpoint of $87,500 to delineate lower- and upper-price homes. Their results are consistent with the hypothesis that "Exclusive agency contracts create a race between buyer and broker." For both price brackets, exclusive agency contracts decrease time-on-the-market and sales price, a result "…completely in line with the expected tradeoff between price and time-on-the-market." Results for owner- versus broker-initiated showed that brokered sales reduced time-on-the-market for both price brackets. At the same time, brokers achieved a slightly higher sales price than owner-initiated sales of lower-priced homes. There was no significant price impact for brokered sales in the higher-priced bracket.

Rutherford et al. (2005) examine the percentage commission structure's role in ameliorating, or alternatively, inducing a misalignment of the broker's incentives with that of the seller. The authors develop a simple search model for empirically testing two hypotheses. First, the reservation price a broker sets for his own property will be higher than that set for a property not owned by the broker. Second, the interaction of the broker's higher reservation price with the higher search intensity employed in the sale of his own property will determine time-on-the-market. Thus, time-on-the-market will not necessarily be shorter for broker-owned properties. The data consisted of sales of 306,869 single-family dwellings in several Texas counties over the period January 1999 to December 2002. Empirical results supported both hypotheses: broker homes sold for a 4.5% premium over homes they did not own and (2) broker homes stayed on the market for approximately the same, not less, time as homes not owned by brokers.

Johnson, Springer, and Brockman (2005) focus on the asymmetric information element of the principal-agent relationship on the reservation prices of buyers and sellers. The authors isolate the impact of asymmetric information by comparing properties listed and sold on the MLS to properties sold and only reported by the broker on the MLS ex-post. Johnson et al. (2005) submit two opposing hypotheses. Not listing on the MLS could result in a higher sales price to the extent that the listing mechanism serves to educate uninformed buyers of the market value of the property listed. Alternatively, the same force could work against uninformed sellers, who with benefit of MLS-listed sale prices, will permit the agent to set the listing at a low reservation price to execute a faster sale. The data consisted of sales in 1998 of 1,549 single-family dwellings in

Montgomery, Alabama. Empirical results showed that properties sold by a broker but not MLS-listed sold at a 6% premium over MLS-listed sales.

Rutherford, Springer, and Yavas (2007) extended their 2005 examination of principal-agent problems to the sale of condominiums. They specify an analogous search model to test the price premium and time-on-the-market hypotheses introduced in the 2005 paper. The data consisted of 11,551 sales of condominiums in several Texas counties over the period January 1999 to December 2004. Empirical results again confirmed that broker condominiums sold at a premium relative to condominiums not owned by brokers, in the current study by a margin of 3% to 7%, depending on model specification. Their findings are consistent with Levitt et al. (2005). Results also confirmed that time-on-the-market for broker-owned condominiums would vary as a function of higher reservation price interacted with higher search intensity.

In summary, this chapter has reviewed three broad categories of the real estate brokerage literature. The earliest and largest category examines the problem of aligning the broker to work in the best interests of the homebuyer or seller in the presence of information asymmetries. While not a central focus of this paper, principal-agent conflicts are inherent in the real estate transactions under examination. This chapter has also surveyed literature on time-on-the-market and choice of sales platform. The data and methodology discussion in Chapter III, as well as the empirical results and conclusions in Chapters IV and V, respectively address both of these topics.

CHAPTER III

DATA AND METHODOLOGY

Hedonic Pricing Methodology

In their simplest form, hedonic pricing models estimate the value of a property through a summation of its individual, tangible property characteristics. Real estate literature on residential brokerage makes abundant use of such models. While the exact characteristics included the hedonic specification vary from work to work, almost all specifications include the size of the house, age, the number of bedrooms, and the number of bathrooms. To this base list, the various papers add an assortment of property amenities, depending on available data and modeler judgment. These amenities include the number of half-bathrooms, the number of fireplaces, pool, central air conditioning, flooring type, roof grade, the presence and size of a garage, etc.

Hedonic models are generally specified as linear, thereby permitting ordinary least squares (OLS) estimation of the property price. Log transformations remedy nonlinearity in either the independent or dependent variable(s). Using OLS estimation of prices from sale (or tax assessment) transaction against the property characteristic coefficients yields the incremental value to the house per unit of housing characteristic. Thus, in general terms, the hedonic model is:

$$Ln(\Pr ice) = \beta_0 + \sum_{j=1}^{n} \beta_j P_j + \varepsilon$$

Where sale price in log form is the dependent variable and P is a vector of property structural characteristics.

The empirical literature of the effect of sales platform on sales price use hedonic models, with some variation of the aforementioned physical property characteristics included. The literature also observes a number of fixed effects. These fixed effects include seasonality, economic conditions, and property location. Fixed effects can be controlled for by either estimating separate regressions for each fixed effect (e.g. by location) or more commonly, by the use of dummy variables. Thus, with this expanded specification, the hedonic model is:

$$Ln(\Pr ice) = \beta_0 + \sum_{j=1}^{n} \beta_j P_j + \sum_{k=1}^{n} \beta_k L_k + \sum_{l=1}^{n} \beta_l T_l + \varepsilon$$

Where the dependent variable and P are as defined previously, *L* is a vector of property location characteristics, and *T* is a vector of time coefficients.

Fitting the above hedonic model to the research focus of this paper, the initial model specification is:

$$\begin{aligned} Ln(\Pr ice) = \beta_0 + \beta_1 Lot + B_2 SF + \beta_3 Age + \beta_4 Age^2 + \beta_5 Bath + B_6 HalfBath \\ + \beta_7 Fireplace + \beta_8 Zip + \beta_9 Qtr + \beta_{10} Year + \beta_{11} Bro\ker + \varepsilon \end{aligned}$$

The model captures structural property characteristics in parameters one through seven. Lot size (Lot) and square footage (SF) is specified in log form. The model includes the square of property age (Age^2) to control for the nonlinear effect of age on price. Bath, half-baths, and fireplaces are the counts of these amenities. The model captures location fixed effects with the zip code of the property sold (Zip). Seasonality and housing market fixed effects are accounted for with dummy indicator variables of the quarter and year of sale, respectively. Finally, the dummy indicator, BROKER, signals that a broker sold the house.

A preliminary OLS specification with the dummy variable, as well as a vector of property characteristics, and time and location controls, yields a positive and statistically significant parameter estimate for this coefficient. This early result, before controlling for any selectivity bias or time-on-the-market, is consistent with the conventional wisdom that broker-assisted transactions yield a higher selling price. It would also augment the National Association of Realtors' claim that the "…average seller who uses a real estate professional makes 16 percent more on the sale of their home than do sellers who go it alone." The positive direction of the BROKER coefficient is also consistent with Zumpano et al. (2000) result before correcting the pricing equation for sample selection bias. Their study, which examined the impact of buyer brokers on sale price, found a positive and statistically significant coefficient on the real estate agent dummy, as well.

Self Selection Bias

Kennedy (1992) notes, "When the dependent variable is qualitative in nature and must be represented by a dummy variable, special estimation problems may arise." In particular, the choice of using a broker may be subject to self-selection bias. The choice of using a broker, as specified, is a binary variable limited in its range to zero or one and is thus termed a limited choice dependent variable. Econometric theory divides limited choice dependent variables into two broad categories: truncated or censored. In the truncated case, when the dependent variable is not observed (i.e. equal to zero), the independent, or x values, are also not observed. In the censored case, the dependent variable is not observed, however, the independent variables are observed. A classic example of the censored case is Mroz (1987). Here, the dependent variable is the choice of labor force participation among women. This choice is specified as a function of independent variables observable across both labor force participants and non-participants, namely, age, education, work experience, work experience squared, number of years in the workforce, spouse's income, number of children five years or younger, and the number of children ages six to eighteen.

While the functional form of the limited choice dependent variable, y, must be known or specified, the value(s) for which y is observed (i.e. equal to one) are typically not known. In the simplest case, Kennedy notes that y is observed for all values $y < k$, where k is a distinct number. Specifying the observance of y in such a manner motivates the discussion of how the unobserved values of y present the special estimation problems that Kennedy (1992) notes.

Heckman (1976) proposed a two-step procedure to estimate and correct for self-selection bias. In the first step, the procedure models a probit regression of the binary choice variable against its independent variables. This regression obtains an estimate of bias that the second stage regression uses as an additional, independent variable. Fitting this procedure to the research question at hand, consider z^* to be a latent selection variable that determines whether the seller chooses to enlist a broker in the sale transaction. Jud and Seaks (1994) observe, "Generally, z^* cannot be observed; rather, only the sign of z^* can be inferred." In the case of the seller opting to select a brokered platform, then z^* would take the value of one. Then, the seller not selecting a brokered platform would cause z* to take the value of zero. Thus, a probit model can generalize the probability of the seller selecting a brokered platform as:

$$z* = \gamma ' \omega + u, u \sim N[0,1]$$
$$\therefore \Pr ob(z* = 1) = \Phi(\gamma ' \omega)$$

Where Φ denotes the cumulative normal distribution and the second stage OLS regression is:

$$E[saleprice \mid z = 1] = \beta ' x + \rho\sigma\lambda(\gamma ' \omega)$$

Where $\lambda(\gamma ' \omega)$ gives the inverse mill's ratio, or measure of bias, and ρ is the correlation between sales price and z.

Selectivity bias is a pervasive issue in residential real estate research, affecting, for example, models of property valuation, time-on-the-market, and foreclosure rates (Lin, Rosenblatt, and Yao, 2007). Regarding estimated property values, the potential for selection bias in estimating property valuation models (both repeat-sales index and hedonic) was raised by Haurin and Hendershott (1991), among others. The authors observe that property valuation models may be subject to self-selection bias in that the models are estimated "…based on samples of only sold properties, not all houses." Hauren et al. (1988) note that factors influencing the choice of selling or not selling the house might include the relative health of the housing market. Housing price research widely acknowledges selection bias, although the form it assumes varies in the literature. For example, Glower et al.'s (1998) study finds that seller motivation influences sale price and time-on-the-market. In this case, seller motivation, rather than housing market conditions, censors some homes from selling. In specific, "Censoring could occur because the seller is not motivated to sell and the property remains on the market an unusually long time, in which case, bias is possible."

The research question at hand, the impact of platform choice on sale price and time-on-the-market, may also be subject to selectivity bias. The few research papers that address this research question also observe the potential for selectivity bias. Hendel et al. (2007) study the impact of this discrete choice on sales price and time-on-the-market for single-family residences in Madison, Wisconsin. The authors note two potential sources of bias in the choice of sales platform (traditional agent or FSBO). First, unobserved house characteristics may compel sellers to self-select into one platform or the other. At the same time, these unobserved characteristics might affect price and time-on-the-market. Not accounting for these unobserved characteristics imparts a similar bias on the OLS estimators as omitted variable(s).

A second potential source of bias observed by Hendel et al. (2007) is unobserved seller characteristics. They note that sellers that are more confident and more patient may choose to sell by FSBO. However, patience would not only affect the platform choice, but also time-on-the-market itself. Again, not accounting for these unobserved seller characteristics would impart an omitted variable bias on the OLS estimators.

Following Bernheim and Meer (1996), another seller characteristic that may influence the choice of sale platform is the length of time the seller occupied the house before sale. Longer tenure may proxy for larger wealth, older sellers, and more accumulated equity in the house. Longer tenure may also proxy for the seller's affinity to the home. The directional impact of this characteristic is unclear. On the one hand, wealthier clients may have higher opportunity costs associated with their time and thus prefer a broker platform. Larger accumulated equity would also support the notion that the seller can better afford an agent. These considerations would point to a positive value on the parameter estimate of this coefficient. On the other hand, longer tenure might be associated with greater seller affinity with their home, an attachment that could conceivably translate to the seller preferring to sell the house on his own. These considerations would point to a negative parameter estimate for this coefficient.

A final source of selection bias cited by Bernheim et al. (2008) is that "…44% of all FSBO homes were never placed on the open market, as the buyer and seller knew each other in advance (Evans, 2003)." Thus, they surmise that even controlling for property characteristics would not "…reliably identify the effect of using a broker." However, the data source for their study did not encompass local jurisdiction tax records. This paper effectively controls for this source of selection bias in that even if the sale did not occur "on the open market", the sale still required a transfer of property title and would thus appear in the Arlington County Tax Assessor's records.

This paper considers the potential sources of bias noted above. To the extent that either unobserved property or seller characteristics are constant over time, their influence can be addressed by including property fixed effects and/or seller fixed effects. To estimate seller fixed effects would require identifying sellers who sold more than one home in the estimation dataset (Bernheim, 2008). Likewise controlling for property fixed effects, would require multiple sales of the same property in the dataset. For the potential bias induced into sale prices by unobserved home price characteristics, an index of atypicality might be an appropriate consideration.

For the potential bias on sale price induced by unobserved seller characteristics, this paper considers three characteristics: equity in the property, tenure in the residence and financial sophistication. Length of time in the property might provide a suitable approximation for seller wealth and equity in the property. Arlington County maintains a deed history of all residential sales. Using this history, this paper measures the time in the house and the equity accumulated between sale dates. To avoid inherent endogeneity in using sale price as of the sale year, this paper estimates seller equity as the difference between the property's tax assessed value as of the sale year and the seller's original purchase price of the property. Additionally, the time in the house might approximate the seller's affinity with the house, which, in turn, could proxy for the seller's patience in selling the house.

Data

The data for this paper consists of 6,730 residential sales transactions in Arlington County, Virginia for the period April 1, 2000 to March 31, 2007. Property characteristics, property type, address, date of sale, and sales price were obtained from the Arlington County Department of Real Estate Assessments. This data contains a roster of 63,141 unique residential and commercial properties. Each year, the county publishes this data for its fiscal year ended March 31. The data include yearly tax assessed values, property characteristics as of the assessed year, transfer history, address, and the name of the property owner. Property characteristics included in the dataset are the style of house, the number of stories, a grade quality, condition code, year constructed, year remodeled, effective construction year, roof type, air conditioning, number of full bathrooms, number of half bath rooms, count of fireplaces, the total square feet of main dwelling, finished square feet of main dwelling, and the number of bedrooms. Using the effective year constructed proxies for the property's age after any remodeling.

The paper uses MLS data for the same period to identify the properties sold with a real estate broker. Because Arlington County records all sales, but only brokered sales appear in the MLS data, the non-union of the County and MLS data identifies FSBO transactions. A number of exclusions are applied to the raw data, including eliminating newly constructed properties, as well as any property type not listed as a Single Family Dwelling. Other exclusions applied primarily to the MLS data, which is not subject to the same data scrubbing techniques and integrity standards as the County data. These exclusions would include missing or incomplete data that could not be in-filled with the County data set using various match and fuzzy-match techniques. These would encompass the following data fields in the MLS dataset: property address, listing agent, selling agent, closing date, and sales price.

There are no audit controls over MLS data and no requirements that the data be consistent, complete, or even accurate, in some cases. Completeness of the MLS information, particularly with respect to the tax identification numbers, closing date, and address key fields needed to merge the MLS data with the tax assessor's data, is particularly problematic. The tax identification number is a seven or eight digit field. In more than 20% of the MLS data, however, the field is zero or missing, less than seven digits, more than eight digits, or filled in with sequential numbers (e.g. 999999) or phrases such as TBD or N/A. MLS closing dates, while not in a standardized date format, were usually included. The problem here is that in many cases, the dates are incongruent with the official tax record of closing. A couple of likely sources for the incongruence are simple data entry errors in the MLS or cases where the broker entered the expected closing data in advance of the date the transaction actually closed. Lastly, addresses in the tax data conform to a prescribed order of street number, street number suffix (e.g. A, B, etc), street name, street name suffix (for numbered street name, this would designate North or South), street type (e.g., lane, avenue), street direction (e.g. North, South), unit number, city, state, and zip code. However, these same conventions are universally absent the MLS data set, necessitating a variety of fuzzy address matching techniques that positively identify matches between the tax and MLS datasets.

This paper imposes a number of restrictions on the data. First, the MLS data must match the tax data through exact match on tax identification number (tax ID) and closing date or through an array of fuzzy matches. Second, due to pervasive problems in the MLS data on condominium sales— the unit number was either missing or incomplete— condominium transactions are eliminated. Third, the tax records were restricted to coded sales transactions and do not include rate-term or cash-out re-financings, undeveloped land sales, and other types of transactions not considered arms-length sales, such as estate and divorce settlements, foreclosures, auctions, bankruptcy sales, property exchanges, and sales or gifts of property to relatives. Fourth, this paper eliminates new home sales from the dataset because builders, not brokers, typically sell such homes. Fifth, the paper identifies and removes discount brokers from the analysis in Chapter IV, unless otherwise indicated. Some discount brokerages were self-identified by their company name in the listing office field provided in the MLS data. This paper identified the remainder with an Internet search on the listing office name, a field provided in the MLS data. An additional 23 observations are eliminated after merging the datasets due to missing, zero, or negative sale prices in the tax dataset. Finally, the paper deletes two observations based on extremely high values.[2]

In addition to the above restrictions, this paper makes some assumptions to place the MLS and tax data on equally footing. The most important of these involves seller subsidies, which only the MLS data reports. To the extent that non-MLS transactions simply deducted such subsidies in negotiating a final (and tax-recorded) closing price, the case can be made for also deducting these subsidies from the MLS closing price. In addition, given the data issues observed in the MLS dataset in general, the accuracy of this field is equally suspect and may have not always been completed or completed accurately. As such, this paper deducts any seller subsidies from the closing price reported in the MLS dataset. Table 1 shows the percentage of broker transactions with seller subsidies. Of interest is that the percentage of seller-subsidized sales fell over the 2001 to 2005 period of intense buyer demand and rapid home price appreciation. As demand has faltered since the 2005 peak in the real estate market, seller subsidies show increased prominence in brokered transactions for 2006 and 2007. The pattern suggests that seller subsidies serve as an important pricing concession in weakening markets. Table 2 indicates that, with the exception of 2003, the dollar amount of subsidy, normalized by sale price, also fell as the housing market strengthened, only to reverse course in the wake of 2006 and 2007 market weakening.

The raw data supports a number of casual observations that can help guide the analytical review in Chapter IV. Table 3 presents the proportion of sales for the full sample period and across the years 2000 to 2007. The market share of FSBO sales

[2] One observation reported 43 bedrooms; another reported a 61,674 square foot lot.

approximates 19% for the entire period, in line with the 20% reported by Hendel, et al. (2007), but far higher than the 13% share imputed from the NAR's 1996 Survey of Home Buyers and Sellers. One important caveat to Hendel, et al. 2007 is that the results may not be transferable to other markets because the Madison, Wisconsin FSBO platform is of a size and scope unparalleled in any other part of the country. As a result, the proportion of FSBO sales should conceivably align closer to the NAR-reported results.

Location and structural attributes of the property may influence the choice of sales platform. Table 4 presents a zip code distribution of sales types for the full sample period. For zip codes with smaller number of transactions, FSBO sales assume an increasing proportion of total transactions. For the zip codes with an abundance of transactions, the proportion of FSBO sales aligns more closely to the 13% reported by the NAR.

Table 5 lists property characteristics for the entire sample population by year and across the sample period. The average Arlington, Virginia house that sold between 2000 and 2007 has three bedrooms, two full baths, and one fireplace. It is 36 years old with a finished square footage of 1,490, a square foot lot size of 7,351, and an average sales price of approximately $515,000. Table 6 compares the property characteristics of FBSO and brokered-transactions over the sample period and by year. Casual inspection finds a similar divergence in property characteristics as noted in Schnare et al. (2008): FSBO properties are somewhat smaller and slightly older. Table 6 also shows a marked difference in average sales price, with FSBO properties averaging a discount of roughly $85,000.

Table 7 presents t-tests for uncontrolled differences in property characteristics and closing price[3] between FSBO and broker sales and demonstrates that statistically significant differences exist for each attribute.

A notable limitation in the estimation dataset is that MLS data only report the buyer agent commission. Given that a 50/50 commission split remains the predominant sharing between buyer and seller agents, this paper approximates the full commission by doubling the buyer agent commission. Schnare et al. (2008) encounter the same problem with the MLS data, cautioning, "While one could estimate total commissions by simply doubling the buy-side agent's fee, this approach would be inappropriate with many nontraditional brokerage models." However, this paper excludes discount brokers, thereby mitigating the concern raised by Schnare et al. (2008).

Another limitation of the estimation dataset is that time-on-the-market is only available in the MLS data. A small fraction of FSBO listings, however, is included in the MLS data as comparable sales. An obvious self-selection problem with the reported FSBOs is the incentive for agents to report comparable FSBO sales only when they transact for a lower price than that generated by the agent. Nonetheless, the FSBO listing do facilitate a limited, albeit imperfect, comparison of time-on-the-market between FSBO

[3] A difference in population mean t-test evaluates a null hypothesis of zero difference in population means against the alternative hypothesis of a statistically non-zero difference in population means. The test is sensitive to the assumption of equality of variances between the two populations, and as such, the table presents a test of variance equality.

and brokered-transactions. Table 8 reports t-tests of the difference in mean time-on-the-market and closing price between FSBO and broker-transacted prices. Before controlling for any property or time fixed effects, the results report a statistically significant difference for time-on-the-market, but not price. A mean time-on-the-market of just two days for FSBO transactions renders this data extremely suspect.

The above time-on-the-market comparisons are restricted to MLS records that matched the County tax records. In the full set of MLS records, there are 85 FSBO records with complete information. Using these observations produces more sensible, but still very preliminary, results, with a mean FSBO time-on-the market of 113 days over the period 2000 to 2007. Thus, lack of time-on-the-market information on the full set of FSBO transactions does not deal a coup de grace to this line of inquiry. Indeed, this paper considers two tractable approaches for a time-on-the-market comparison in Chapter IV. First, the paper generalizes the FSBO time-on-the-market from the MLS data to all FSBO transactions by matching the observations on comparable property characteristics. Second, should FSBO sale prices exceed brokered prices (net of commission), the paper can solve for the mean time-on-the-market needed to equate the prices of brokered transactions to FSBOs.

In summary, this chapter has presented the data and methodological framework needed to generate Chapter IV's empirical results. The paper specifies a hedonic model to compare the sales prices of FSBO and broker-transacted properties, after controlling for property, time, and location fixed effects. The paper also incorporates the time-on-the-market element of the transactions through one or both of the approaches described in the previous paragraph. Lastly, the paper tests and appropriately controls for the various sources of selection bias described earlier in this chapter.

CHAPTER IV

EMPIRICAL RESULTS

This chapter provides the empirical results of the model specifications described in Chapter III. Table 9 provides a variable legend for the hedonic model specifications, as well as variables used to match properties between the tax and MLS datasets. Table 10 lists the results of this paper's preliminary hedonic sales price specification, which controls for fixed effects with year and seasonal dummies, as well as location and property-specific characteristics. The explanatory power of the model is strong, with an R^2 of 86.6%. An F-statistic of 1,605 (p-value < .0001) indicates that the specification is highly significant. The majority of explanatory variables are of the expected sign and significance, with the exception of number of bedrooms (BEDRM) and closing years (CLOSE_YR) 2005 and 2006. Rapidly accelerating home price appreciation in years 2005 and 2006, similar to the 2007 reference year, is a plausible candidate for the insignificance of these two-year's effects. No obvious explanation arises for the insignificance of BEDRM in the model. Of particular interest is the parameter estimate on FSBO transactions (BROKER = 0). The estimate is highly significant (p-value < .0001) and negative, suggesting that FSBO transactions carry an approximate 11% discount on price, relative to brokered transactions.

Self Selection Bias, Seller Characteristics

Absent, the preliminary hedonic specification above, however, are any controls for unobserved seller or property characteristics. As noted in Chapter III, this paper proposes tests for potential selectivity bias in the sales price model induced by three unobserved seller characteristics: equity in the property, tenure in the residence, and financial sophistication. In all three cases, this paper also includes the year and quarter of sale, as a proxy for the relative strength of the housing market and thus, seller confidence. This paper reasons that a larger equity stake in the property renders the seller more likely to select a broker because broker commission as a percentage of equity proceeds is smaller. To avoid inherent endogeneity in using sale price as of the sale year, this paper estimates seller equity as the difference between the property's tax assessed value as of the sale year and the seller's original purchase price of the property.

The potential impact of tenure in the residence is ambiguous. On the one hand, it is a surrogate measure of accumulated equity. This might increase the likelihood of enlisting a broker. On the other hand, it is also a proxy for affinity with the residence, which this paper posits as a link to patience in selling the house and therefore increased likelihood of FSBO selection (Hendel et al. (2007)).

Lastly, financial sophistication (prime versus subprime) acts as a surrogate for confidence, which the literature identifies as an unobserved seller characteristic favoring FSBO selection. Following Gerardi et al. (2008), this paper categorized a subset of sellers as prime versus subprime according to the seller's lender identified in Arlington

County's historical registry of deeds records. Again, following Gerardi et al. (2008), matching lender name to the yearly list of subprime mortgage lenders issued by the Department of Housing and Urban Development (HUD) identified prime versus subprime loans, which, in turn, served as a proxy for seller sophistication. Unlike Gerardi et al. (2008), however, the matching process was unsuccessful in producing a sufficient number of observations (less than 25) and was therefore abandoned.

This paper follows Heckman's two-step procedure (Heckman (1979)) to test and correct for the presence of selection bias due to seller characteristics. Table 11 presents the results from the first-stage probit and second-stage OLS equations, where the probit models the binary response variable, BROKER, against seller tenure (Model 1). Seller tenure is highly significant in explaining sales platform selection, with a Chi-Square statistic of 40.3 (p-value <= 0.001). Year of sale is also significant, with a Chi-Square statistic of 15.7 (p-value <= 0.001); however, the quarter of sale is not. In the second stage OLS, the majority of explanatory variables are of the expected sign and significance, with, again, the exception of number of bedrooms (BEDRM) and closing years (CLOSE_YR) 2005 and 2006. Of particular interest is the parameter estimate on FSBO transactions (BROKER = 0). The estimate is significant (p-value < .0001) and positive, suggesting that FSBO transactions carry a surprising 20% premium on price, relative to brokered transactions. If tenure is a surrogate measure of seller patience in selling the house, then the positive coefficient on BROKER is consistent with the hypotheses of prior works such as Hendel et al (2007) that seller patience influences choice of sales platform. The existence of a premium is consistent with the prior studies by Bernheim et al. (2008), Hendel et al. (2007), and Jud (1983). However, the magnitude of the premium is larger than observed previously.

Table 12 presents the results from the first-stage probit and second-stage OLS equations, where the probit models the binary response variable, BROKER, against seller equity (Model 2). Seller equity and the year of sale are also significant in explaining sales platform selection, with Chi-Square statistics of 15.2 (p-value < 0.0001) and 14.6. (p-value < 0.0001), respectively. In the second stage OLS, the majority of explanatory variables are again of the expected sign and significance, except for those previously noted. The parameter estimate on FSBO transactions (BROKER = 0) remains significant—albeit, marginally with a p-value of 0.0035—and positive, suggesting that FSBO transactions carry a 26% premium on price, relative to brokered transactions. If equity were either a surrogate measure of seller patience or financial sophistication, then the positive coefficient would again comport with the hypotheses of prior works such as Hendel et al (2007) that seller patience and sophistication influence choice of sales platform.

Self Selection Bias, Property Characteristics

The extant literature routinely considers property atypicality in models of sale price and time on the market. Carrillo (2008), for example, computes "…an atypicality index that measures the absolute deviations of a home's observed attributes from typical levels in the area (zip code)." This paper employs the same measure as an unobserved property characteristic that may influence choice of sales platform. Table 13 presents the results from the first-stage probit and second-stage OLS equations, where the probit models the binary response variable, BROKER, against property atypicality (Model 3). Atypicality and the year of sale are also significant in explaining sales platform selection, with Chi-Square statistics of 6.2 (p-value = 0.0126) and 12.2 (p-value = 0.0005), respectively. In the second stage OLS, the majority of explanatory variables remain of the expected sign and significance, except for those previously noted. The prominent exception is the parameter estimate on FSBO transactions (BROKER = 0), which negative but statistically insignificant (p-value = 0.3355). This result is consistent with Hendel et al. (2007), which finds "…no support for the hypothesis that the MLS delivers a higher sale price than FSBO."

<u>Time-on-the Market</u>

The existing literature examines time-on-the-market under a variety of methodologies and covariates. Regarding methodologies, the three predominantly employed are Ordinary Least Squares (OLS), hazard functions, and two-stage least squares (2SLS). OLS bears the advantage of ease of interpretation and a more customary measure of model fit (R^2). Bernheim et al. (2008) and Hendel et al. (2007) are among recent works adopting an OLS methodology for time-on-the-market.

Hazard functions of time-on-the-market allow for censored data and time-dependent covariates, as well as specification of the error term under non-normal distributions, with the following generalized form:

$$\text{Log(TOM)} = X\beta + \sigma e$$

where TOM is the time to the event, in this case, the time until the property sells, X is a vector of factors explaining the time to the event, σ is a scale parameter, and e is the random disturbance term. Huang et al. (2007) exemplifies recent works adopting this methodology.

The 2SLS methodology allows for the inherent endogeneity between sales price and time-on-the-market. That is, sales price influences time-on-the-market, but time-on-the-market also influences sales price. Carrillo (2008) and Goodwin et al. (2008) are recent works employing 2SLS.

Considerably more variability exists in the literature regarding the selection of covariates. Prominent use is made of standard explanatory variables in the hedonic model of sales price, as well as the atypicality index, including works by Allen et al. (2005), Haurin et al. (2006), Carrillo (2008), and Goodwin et al. (2008). The literature also extensively employs the degree of over-pricing, including papers by Genosove et al. (1997), Green (1988), and Salter et al. (2007). Gardiner et al. (2007) considers the seller's equity stake in the property. Other typical covariates include tenure (Bernheim et al. (2008)), seller motivation (Carrillo (2008)), and the strength of the housing market (Bourassa et al. (2007)).

This paper examines time-on-the-market under the OLS, hazard function, and 2SLS methodologies. As noted in Chapter 3, time-on-the-market information is fully available only for brokered sales. However, a time-on-the-market analysis for this subset is an instructive step in assessing model fit and the explanatory power of potential covariates. In addition, the parameter estimates from these models could be generalized to the time-on-the-market for FSBO properties, which lack such data.

In all specifications, this paper uses time-on-the-market as reported in the MLS variable, Days-on-the-Market-Property (DOMP). DOMP reports the total number of days a property has been marketed, irrespective of its listing number. By contrast, the MLS variable, Days-on-the-Market-MLS (DOMM) reports the total number of days a specific listing number has been on the market. The latter is subject to manipulation in that re-listing the property restarts DOMM to zero, thereby understating the actual time on the market.

Table 14 reports the OLS results for time-on-the-market (log form) as function of the same covariates in the earlier hedonic model. The explanatory power of the model is low (R^2 = 16.5%), but within the range of recent works such as Carrillo (2008). The majority of covariates are statistically insignificant, with the exception of square footage, age, the number of full baths, and the year and quarter of closing.

Tables 15 and 16 present the results of hazard models specified with lognormal and Weibull distributions, respectively. While the variables are not censored (all the houses sold) and not time dependent[4], the alternate specifications are robustness checks to the above OLS results. Indeed, variables with statistical significance in the OLS model are robust to these alternate model specifications. Additionally, as Huang et al (2007) observe, "…using a semi-log model to estimate the DOM [days on market] is equivalent to throwing away 39% of the data if the true model is exponentially distributed and 43% of the data if a Weibull distribution is more appropriate."

[4] Haurin (1988) notes that time dependent covariates could be present in the form of the seller's opportunity cost varying through the marketing period; "for example, another house might be purchased and two mortgages have to be paid simultaneously." Like Haurin (1988), the data set used in this paper does not contain this information.

Table 17 reports results from the 2SLS estimation. The first stage regresses the log of sales price against the property, time, and location characteristics employed in the hedonic model. The regression also includes the endogenous time-on-the-market and the instrumental variable, atypicality. The second stage regresses time-on-the-market (log form) against atypicality, as well as year and quarter of sale on the basis that both atypicality and the relative strength of the housing market factor prominently in explaining time-on-the-market. First stage results resemble those of the hedonic model presented earlier in this chapter, with the addition of time-on-the-market as a statistically significant predictor of sales price. Second stage results support the premise that atypicality and the relative strength of the housing market (as approximated by the year and quarter of sale) influence the duration of marketing time.

As noted in Chapter III, there are options for generalizing the MLS time-on-the-market data to FSBO transactions. A tractable approach taken in this chapter is to match each FSBO transactions to a comparable brokered transaction and solve for the mean difference in time-on-the-market needed to equate the FSBO premiums observed after controlling for selection bias induced by unobserved seller characteristics (tenure and equity in the property). In other words, it estimates the excess length of time FSBO properties would need to stay on the market to make the selling price between the two platforms equivalent. In the case of selection bias induced by unobserved property characteristics (atypicality)—where no price differential is found— the approach solves for the time-on-the-market difference that would be needed to recoup a 2.5% commission to the selling agent. [5] The approach bears two assumptions worthy of note: namely, that sales price is strictly a linear function of time and that the seller's opportunity costs are constant over time.

This paper evaluated two options for constructing a comparable brokered property for each FSBO property. The first option matched each FSBO to a brokered property with the smallest absolute difference in atypicality, controlling for zip code and sale year and quarter. The second approach constructed comparables by considering the tax-assessed value preceding the sale date. This option excluded properties flagged as remodeled in the same year as sale to avoid assessed values no longer relevant to current property characteristics. It also controlled for location and time characteristics, as above.

Table 18 presents results for comparables constructed according to atypicality for Models 1, 2, and 3. Model 1, which corrects for selection bias in the form of seller tenure, has a mean FSBO premium of $86,202, translating to an additional 5.6 days on the market for a total of 33.6 days. Including a 2.5% commission to the buyer agent increases the imputed FSBO marketing time to 34.3 days. Model 2, which corrects for selection bias in the form of seller equity, has a mean FSBO premium of $112,062, translating to an additional 7.3 days on the market for a total of 35.3 days. Including a 2.5% commission to the buyer agent increases the imputed FSBO marketing time to 36 days. Model 3, which corrects for selection bias in the form of atypicality, has no FSBO premium. Here, adding a 2.5% commission to the buyer agent increases the imputed FSBO marketing time by less than one day to 28.7 days.

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[5] Assumes that FSBO and brokered transactions both pay a 2.5% commission to the buyer agent.

Table 19 presents results for comparables constructed according to tax assessed values for Models 1, 2, and 3. Model 1 has a mean FSBO premium of $77,290, translating to an additional 5.4 days on the market for a total of 32.4 days. Including a 2.5% commission to the buyer agent increases the imputed FSBO marketing time to 38.5 days. Model 2 has a mean FSBO premium of $100,477, translating to an additional 7 days on the market for a total of 34 days. Including a 2.5% commission to the buyer agent increases the imputed FSBO marketing time to 41.7 days. For Model 3, adding a 2.5% commission to the buyer agent again increases the imputed FSBO marketing time by less than one day (to 27.7 days).

The relative differences in time-on-the-market between FSBO and brokered transactions reported in tables 18 and 19 are smaller than in recent studies. Bernheim et al. (2007), examining 26 years of transactions, found that time-on-the-market was from 35% to 42% higher in FSBO transactions. By contrast, results from this paper suggest FSBO time-on-the-market is longer by approximately 19% to 29%. One explanation for the smaller difference in this paper could be the extremely strong housing market from 2000 to 2006. It is also possible, however, that the imputation to arrive at FSBO time-on-the-market simply understates their actual duration.

CHAPTER V

CONCLUSION

This is the first paper in more than ten years to examine the marketing performance of FSBO versus brokered residential sales, using MLS and tax assessment records to identify FSBO transactions. Yavas and Colwell (1995) laid the groundwork for this analysis, finding in their study that after controlling for selectivity bias in the data, "…the decision to use a multiple listing service decreases the sale price of a property."

Since 1995, information technology has effectively unbundled the services provided by a realtor, making it easier for a seller to market his property without, or with limited use, of a realtor. Two more recent papers—Bernheim et al. (2007) and Hendel et al. (2007)—also examine the relative performance of FSBO transactions, however, both acknowledge that the data examined is from specialized markets with firmly established infrastructures for FSBO transactions and the generalization of their findings to more typical markets, lacking such infrastructure, is unknown.

The empirical evidence presented in this paper generalizes the existence of a FSBO premium to a more homogenous market. Controlling for various sources of selectivity bias, results suggest a FSBO premium of 20% to 26%, higher than in previous studies. The lack of FSBO time-on-the-market data required an imputation to comparable brokered sales and suggested that FSBO transactions extend the marketing period from approximately 5 to 8 days, without including a 2.5% commission and depending on the control for selection bias and the method for constructing comparables.

While this paper's results provide additional support to earlier works, they do carry a number of limitations and extensions for future research. First, the data is limited to a single county. What is needed is a dataset spanning a larger geography in order for the results to be readily generalized. Second, the period examined, 2000 to 2007, witnessed the highest home price appreciation rates on record. It would be instructive to replicate this analysis under alternate housing market conditions. Third, alternative methods for obtaining FSBO time-on-the-market should be considered. Lastly, the paper excludes limited service, or discount, brokers from the analysis. A natural extension of this paper would include these transactions in the analysis.

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APPENDIX A

TABLES

Table 1. Brokered transactions, percent seller subsidized

Year	Seller Subsidy	Frequency	Percent
	0	410	68.91
2000	**1**	185	31.09
	0	522	74.36
2001	**1**	180	25.64
	0	668	79.05
2002	**1**	177	20.95
	0	666	76.73
2003	**1**	202	23.27
	0	726	83.45
2004	**1**	144	16.55
	0	689	86.34
2005	**1**	109	13.66
	0	414	58.72
2006	**1**	291	41.28
	0	54	60.67
2007	**1**	35	39.33
	0	4,149	75.82
2000-2007	**1**	1,323	24.18

Table 2. Brokered transactions, percentage seller subsidy to closing price

Year	Percent
2000	0.46
2001	0.28
2002	0.23
2003	0.34
2004	0.15
2005	0.14
2006	0.71
2007	0.72
2000-20007	0.32

Table 3. Sale type distribution of estimation data set

Year	Sale Type	Frequency	Percent
	FSBO	162	21.4
2000	**Broker**	595	78.6
	FSBO	206	22.69
2001	**Broker**	702	77.31
	FSBO	174	17.08
2002	**Broker**	845	82.92
	FSBO	187	17.73
2003	**Broker**	868	82.27
	FSBO	197	18.46
2004	**Broker**	870	81.54
	FSBO	182	18.57
2005	**Broker**	798	81.43
	FSBO	130	15.57
2006	**Broker**	705	84.43
	FSBO	20	18.35
2007	**Broker**	89	81.65
	FSBO	1,258	18.69
2000-2007	**Broker**	5,472	81.31

Table 4. Zip code distribution of estimation data set

Zip code	Sale type	Frequency	Percent
22101*	Broker	1	100
	FSBO	162	24.77
22201	Broker	492	75.23
	FSBO	76	17.35
22202	Broker	362	82.65
	FSBO	86	17.06
22203	Broker	418	82.94
	FSBO	358	22.83
22204	Broker	1,210	77.17
	FSBO	195	15.98
22205	Broker	1,025	84.02
	FSBO	63	29.58
22206	Broker	150	70.42
	FSBO	277	14.39
22207	Broker	1,648	85.61
	FSBO	9	40.91
22209	Broker	13	59.09
	FSBO	32	17.3
22213	Broker	153	82.7

*This paper eliminates zip code 22101 is eliminated from model estimations because of too few observations.

Table 5. Average property characteristics and closing price

Year	Lot Size	Finished Square Footage	Half Baths	Full Baths	Age	Bedrooms	Fireplaces	Close Price
2000	7,564	1,507	0	2	35	3	1	319,634
2001	7,598	1,505	0	2	36	2	1	370,673
2002	7,499	1,479	0	2	36	3	1	427,026
2003	7,243	1,474	0	2	37	3	1	473,087
2004	7,050	1,437	0	2	36	3	1	543,912
2005	7,341	1,506	0	2	37	3	1	673,046
2006	7,299	1,543	0	2	36	3	1	673,604
2007	7,764	1,492	0	2	41	3	1	655,882
2000-2007	7,351	1,490	0	2	36	3	1	514,282

Table 6. Average property characteristics and closing price by sale type

Year	Type	Lot Size	Finished Square Footage	Half Baths	Full Baths	Age	Bedrooms	Fireplaces	Close Price
2000	FSBO	7,247	1,447	0	2	37	2	1	291,576
2000	Broker	7,639	1,521	0	2	34	3	1	326,340
2001	FSBO	7,731	1,512	0	2	38	2	1	347,370
2001	Broker	7,564	1,503	0	2	35	3	1	376,786
2002	FSBO	6,542	1,312	0	2	39	3	1	353,298
2002	Broker	7,670	1,509	0	2	36	3	1	440,171
2003	FSBO	6,591	1,378	0	2	42	2	1	409,239
2003	Broker	7,369	1,492	0	2	35	3	1	485,425
2004	FSBO	6,619	1,371	0	2	40	3	1	476,455
2004	Broker	7,132	1,449	0	2	35	3	1	556,776
2005	FSBO	7,384	1,378	0	2	40	2	1	620,228
2005	Broker	7,333	1,528	0	2	36	3	1	682,285
2006	FSBO	6,660	1,424	0	2	40	3	1	575,409
2006	Broker	7,404	1,563	0	2	36	3	1	689,665
2007	FSBO	6,697	1,188	0	1	50	2	1	524,072
2007	Broker	7,955	1,546	0	2	40	3	1	679,420
2000-2007	FSBO	6,959	1,398	0	2	40	3	1	442,655
2000-2007	Broker	7,428	1,508	0	2	35	3	1	528,255

Table 7. T-tests of difference in property characteristic and closing pricing means

Variable	Method	Variances	DF	t Value	Pr > |t|
Lot Size	Pooled	Equal	6,728	-2.88	0.004
Lot Size	Satterthwaite	Unequal	1,766	-2.71	0.0067
Finished Square Footage	Pooled	Equal	6,728	-6.81	<.0001
Finished Square Footage	Satterthwaite	Unequal	1,964	-7.08	<.0001
Half Baths	Pooled	Equal	6,728	-6.29	<.0001
Half Baths	Satterthwaite	Unequal	2,021	-6.68	<.0001
Full Baths	Pooled	Equal	6,728	-7.80	<.0001
Full Baths	Satterthwaite	Unequal	1,933	-8.00	<.0001
Age	Pooled	Equal	6,728	10.73	<.0001
Age	Satterthwaite	Unequal	1,883	10.76	<.0001
Bedrooms	Pooled	Equal	6,728	-3.94	<.0001
Bedrooms	Satterthwaite	Unequal	1,843	-3.88	0.0001
Fireplaces	Pooled	Equal	6,728	-7.30	<.0001
Fireplaces	Satterthwaite	Unequal	1,934	-7.48	<.0001
Close Price	Pooled	Equal	6,728	-12.53	<.0001
Close Price	Satterthwaite	Unequal	1,914	-12.74	<.0001

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Lot Size	Folded F	1257	5,471	1.21	<.0001
Finished Square Footage	Folded F	5471	1,257	1.13	0.0066
Half Baths	Folded F	5471	1,257	1.21	<.0001
Full Baths	Folded F	5471	1,257	1.08	0.0771
Age	Folded F	5471	1,257	1.01	0.8865
Bedrooms	Folded F	1257	5,471	1.06	0.1985
Fireplaces	Folded F	5471	1,257	1.08	0.0744
Close Price	Folded F	5471	1,257	1.05	0.2371

Table 8. T-tests of difference in time-on-the-market and closing price means

Variable	Sale type	N	Mean
Days on market	FSBO	49	2
Days on market	traditional	5,472	22
Days on market	Diff (1-2)		-19
Close price	FSBO	49	488,020
Close price	traditional	5,472	523,120
Close price	Diff (1-2)		-35,101

T-Tests

Variable	Method	Variances	t Value	Pr > |t|
Days on market	Pooled	Equal	-4.24	<.0001
Days on market	Satterthwaite	Unequal	-9.04	<.0001
Close price	Pooled	Equal	-1.04	0.2985
Close price	Satterthwaite	Unequal	-1.06	0.2929

Equality of Variances

Variable	Method	F Value	Pr > F
Days on market	Folded F	4.74	<.0001
Close price	Folded F	1.05	0.8793

Table 9. Alphabetic List of Variables and Attributes

Variable	Type
ABC	Character
AC	Numeric
ADDITIONALCOMPENSATION	Character
ADDRESS	Character
AGE	Numeric

Variable	Type
AGE2	Numeric
ATYPICALITY	Numeric
AV_CLOSE	Numeric
BEDRM	Numeric
BROKER	Numeric
BUYERAGENTCOMMISSION	Numeric
BUY_DATE	Numeric
BUY_MONTH	Numeric
BUY_PRICE	Numeric
BUY_YR	Numeric
CITY	Character
CLOSEDATE	Numeric
CLOSEPRICE	Numeric
CLOSE_MONTH	Numeric
CLOSE_QTR	Numeric
CLOSE_YR	Numeric
COOL	Character
COUNTY	Character
DEED_BOOK	Character
DEED_PAGE	Character
DESIGNATEDREPRESENTATIVE	Numeric
DISCOUNT	Numeric
DOMM	Numeric
DOMP	Numeric

Variable	Type
DUALAGENCY	Numeric
EFFYR	Numeric
FINSQFT	Numeric
FIREPL	Numeric
FSBO	Numeric
FULL_BATHS	Numeric
HALF_BATHS	Numeric
HOUSETYPE	Character
SELLER EQUITY	Numeric
LEGAL_DESC	Character
LISTBROKERCODE	Character
LISTDATE	Numeric
LISTINGTYPE	Character
LISTOFFICENAME	Character
LISTPRICE	Numeric
LOTSIZE	Numeric
NEWCONSTRUCTION	Numeric
ORIGINALLISTPRICE	Numeric
OWNER1	Character
OWNER2	Character
OWNERSHIP	Character
OWN_CITY	Character
OWN_STATE	Character
OWN_STREET	Character

Variable	Type
OWN_ZIP	Character
PARCEL_ID	Character
PCC	Numeric
PCTCOMP	Numeric
PRIME_ADDR	Character
PROPERTYTYPE	Character
PROPERTY_CLASS	Character
Q1	Numeric
Q2	Numeric
Q3	Numeric
Q4	Numeric
RATE	Numeric
REMODL	Numeric
RPCMSTR	Character
SALETYPE	Character
SALE_CODE	Character
SALE_CODE_DESCRIPTION	Character
SELLBROKERCODE	Character
SELLERSUBSIDY	Numeric
SNUMSUFX	Character
STATE_CLASS	Character
STORIES	Character
STRTDIR	Character
STRTNAME	Character

Variable	Type
STRTNUM	Numeric
STRTSUFX	Character
STRTTYPE	Character
STRTZIP	Character
STYLE	Character
TAXID	Numeric
TAX_STATUS	Character
TAX_UNITNUM	Character
TENURE	Numeric
TOTALTAXES	Numeric
TYPE	Character
TYPECODE	Numeric
UNITNUM	Character
Y2000	Numeric
Y2001	Numeric
Y2002	Numeric
Y2003	Numeric
Y2004	Numeric
Y2005	Numeric
Y2006	Numeric
Y2007	Numeric
YEARBUILT	Numeric
YRBUILT	Numeric
ZIP	Numeric

Variable	Type
ZONING	Character

Table 10. Preliminary Hedonic Model of Sale Price

Source	R-Square	F Value	Pr > F
Model	0.866223	1604.88	<.0001

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	9.297071754	0.07954521	116.88	<.0001
LLOT	0.212790392	0.00619556	34.35	<.0001
LSQFT	0.300968005	0.00985192	30.55	<.0001
HALF_BATHS	0.053644233	0.00450685	11.90	<.0001
FULL_BATHS	0.043442977	0.00374996	11.58	<.0001
AGE	-0.005283968	0.00054780	-9.65	<.0001
AGE2	0.000039446	0.00000670	5.89	<.0001
BEDRM	0.001892102	0.00170431	1.11	0.2670
FIREPL	0.058096967	0.00357663	16.24	<.0001
CLOSE_YR 2000	-0.811313666	0.01831544	-44.30	<.0001
CLOSE_YR 2001	-0.651135972	0.01783455	-36.51	<.0001
CLOSE_YR 2002	-0.509430046	0.01769746	-28.79	<.0001
CLOSE_YR 2003	-0.378715952	0.01766754	-21.44	<.0001
CLOSE_YR 2004	-0.198640452	0.01769688	-11.22	<.0001
CLOSE_YR 2005	-0.021056333	0.01778043	-1.18	0.2364

Parameter	Estimate	Standard Error	t Value	Pr > |t|
CLOSE_YR 2006	-0.024777890	0.01786172	-1.39	0.1654
CLOSE_YR 2007	0.000000000	.	.	.
CLOSE_QTR 1	-0.070720166	0.00664433	-10.64	<.0001
CLOSE_QTR 2	-0.038444647	0.00580835	-6.62	<.0001
CLOSE_QTR 3	-0.014636643	0.00594337	-2.46	0.0138
CLOSE_QTR 4	0.000000000	.	.	.
ZIP 22201	0.236514121	0.01450406	16.31	<.0001
ZIP 22202	0.080121703	0.01526692	5.25	<.0001
ZIP 22203	0.082876930	0.01489048	5.57	<.0001
ZIP 22204	-0.110133033	0.01368001	-8.05	<.0001
ZIP 22205	0.065520769	0.01363534	4.81	<.0001
ZIP 22206	-0.207233186	0.01780732	-11.64	<.0001
ZIP 22207	0.118386369	0.01331213	8.89	<.0001
ZIP 22209	0.112336478	0.03872774	2.90	0.0037
ZIP 22213	0.000000000	.	.	.
BROKER 0	-0.109947366	0.00542039	-20.28	<.0001
BROKER 1	0.000000000	.	.	.

Table 11. Hedonic Model of Sale Price - Selectivity Correction for Seller Tenure

Type III Analysis of Effects			
Effect	DF	Wald Chi-Square	Pr > ChiSq
TENURE	1	40.2778	<.0001
CLOSE_YR	1	15.6599	<.0001
CLOSE_QTR	1	2.3477	0.1255

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	8.948685540	0.10295022	86.92	<.0001
LLOT	0.217983793	0.00682868	31.92	<.0001
LSQFT	0.303317152	0.01081477	28.05	<.0001
AGE	-0.004445192	0.00062696	-7.09	<.0001
AGE2	0.000032188	0.00000761	4.23	<.0001
FULL_BATHS	0.042598526	0.00408626	10.42	<.0001
HALF_BATHS	0.054676976	0.00492637	11.10	<.0001
FIREPL	0.057194022	0.00387981	14.74	<.0001
BEDRM	0.000467467	0.00189372	0.25	0.8050
CLOSE_YR 2000	-0.785003265	0.02089249	-37.57	<.0001
CLOSE_YR 2001	-0.627345251	0.02032080	-30.87	<.0001
CLOSE_YR 2002	-0.491935344	0.02004427	-24.54	<.0001
CLOSE_YR 2003	-0.367813751	0.01993701	-18.45	<.0001
CLOSE_YR 2004	-0.187968552	0.01991318	-9.44	<.0001
CLOSE_YR 2005	-0.020037690	0.01992511	-1.01	0.3146

Parameter	Estimate	Standard Error	t Value	Pr > |t|
CLOSE_YR 2006	-0.023465394	0.01997706	-1.17	0.2402
CLOSE_YR 2007	0.000000000	.	.	.
CLOSE_QTR 1	-0.062378058	0.00739612	-8.43	<.0001
CLOSE_QTR 2	-0.027981494	0.00641028	-4.37	<.0001
CLOSE_QTR 3	-0.012260194	0.00651677	-1.88	0.0600
CLOSE_QTR 4	0.000000000	.	.	.
ZIP 22201	0.236628967	0.01601044	14.78	<.0001
ZIP 22202	0.077676398	0.01681136	4.62	<.0001
ZIP 22203	0.082822348	0.01629886	5.08	<.0001
ZIP 22204	-0.111226465	0.01506810	-7.38	<.0001
ZIP 22205	0.062682825	0.01504980	4.17	<.0001
ZIP 22206	-0.196405081	0.01931659	-10.17	<.0001
ZIP 22207	0.123471940	0.01475237	8.37	<.0001
ZIP 22209	0.109391175	0.04459830	2.45	0.0142
ZIP 22213	0.000000000	.	.	.
BROKER 0	0.203788549	0.04880600	4.18	<.0001
BROKER 1	0.000000000	.	.	.
LAMBDA	0.172917503	0.02691074	6.43	<.0001

Table 12. Hedonic Model of Sale Price - Selectivity Correction for Seller Equity

Type III Analysis of Effects			
Effect	DF	Wald Chi-Square	Pr > ChiSq
Seller Equity	1	15.1547	<.0001
CLOSE_YR	1	14.6356	0.0001
CLOSE_QTR	1	1.4181	0.2337

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	8.941163092	0.12285594	72.78	<.0001
LLOT	0.215867540	0.00686672	31.44	<.0001
LSQFT	0.300352788	0.01091124	27.53	<.0001
AGE	-0.004767829	0.00063213	-7.54	<.0001
AGE2	0.000036274	0.00000771	4.70	<.0001
FULL_BATHS	0.043150355	0.00412763	10.45	<.0001
HALF_BATHS	0.054309227	0.00496705	10.93	<.0001
FIREPL	0.056205661	0.00392236	14.33	<.0001
BEDRM	-0.000066493	0.00191082	-0.03	0.9722
CLOSE_YR 2000	-0.779153864	0.02258449	-34.50	<.0001
CLOSE_YR 2001	-0.625528360	0.02165625	-28.88	<.0001
CLOSE_YR 2002	-0.489919428	0.02104519	-23.28	<.0001
CLOSE_YR 2003	-0.365991568	0.02065657	-17.72	<.0001
CLOSE_YR 2004	-0.185753796	0.02044323	-9.09	<.0001
CLOSE_YR 2005	-0.019116965	0.02028408	-0.94	0.3460

Parameter	Estimate	Standard Error	t Value	Pr > |t|
CLOSE_YR 2006	-0.022932315	0.02025019	-1.13	0.2575
CLOSE_YR 2007	0.000000000	.	.	.
CLOSE_QTR 1	-0.060417022	0.00774639	-7.80	<.0001
CLOSE_QTR 2	-0.026015032	0.00660388	-3.94	<.0001
CLOSE_QTR 3	-0.011855206	0.00661423	-1.79	0.0731
CLOSE_QTR 4	0.000000000	.	.	.
ZIP 22201	0.238911021	0.01618110	14.76	<.0001
ZIP 22202	0.080052492	0.01696902	4.72	<.0001
ZIP 22203	0.086548190	0.01648880	5.25	<.0001
ZIP 22204	-0.107289164	0.01522542	-7.05	<.0001
ZIP 22205	0.065337516	0.01519308	4.30	<.0001
ZIP 22206	-0.193141901	0.01946263	-9.92	<.0001
ZIP 22207	0.127434628	0.01491200	8.55	<.0001
ZIP 22209	0.105292967	0.04417626	2.38	0.0172
ZIP 22213	0.000000000	.	.	.
BROKER 0	0.262847975	0.08991544	2.92	0.0035
BROKER 1	0.000000000	.	.	.
LAMBDA	0.204770691	0.04994237	4.10	<.0001

Table 13. Hedonic Model of Sale Price - Selectivity Correction for Property Atypicality

Type III Analysis of Effects			
Effect	DF	Wald Chi-Square	Pr > ChiSq
ATYPICALITY	1	6.2190	0.0126
CLOSE_YR	1	12.1961	0.0005
CLOSE_QTR	1	3.4313	0.0640

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	9.307620913	0.14602029	63.74	<.0001
LLOT	0.212700009	0.00620461	34.28	<.0001
LSQFT	0.300772729	0.00994916	30.23	<.0001
AGE	-0.005278644	0.00054913	-9.61	<.0001
AGE2	0.000039383	0.00000671	5.87	<.0001
FULL_BATHS	0.043398840	0.00375732	11.55	<.0001
HALF_BATHS	0.053606138	0.00451548	11.87	<.0001
FIREPL	0.058099402	0.00357933	16.23	<.0001
BEDRM	0.001905552	0.00170445	1.12	0.2636
CLOSE_YR 2000	-0.812009414	0.02151689	-37.74	<.0001
CLOSE_YR 2001	-0.651416807	0.02017979	-32.28	<.0001
CLOSE_YR 2002	-0.509890788	0.01937548	-26.32	<.0001
CLOSE_YR 2003	-0.379066574	0.01873585	-20.23	<.0001
CLOSE_YR 2004	-0.198910280	0.01826120	-10.89	<.0001

Parameter	Estimate	Standard Error	t Value	Pr > |t|
CLOSE_YR 2005	-0.021132737	0.01803551	-1.17	0.2413
CLOSE_YR 2006	-0.024731679	0.01790675	-1.38	0.1673
CLOSE_YR 2007	0.000000000	.	.	.
CLOSE_QTR 1	-0.071252060	0.00820065	-8.69	<.0001
CLOSE_QTR 2	-0.038847388	0.00661195	-5.88	<.0001
CLOSE_QTR 3	-0.014931110	0.00615353	-2.43	0.0153
CLOSE_QTR 4	0.000000000	.	.	.
ZIP 22201	0.236487177	0.01450408	16.30	<.0001
ZIP 22202	0.080084405	0.01526689	5.25	<.0001
ZIP 22203	0.082818404	0.01489295	5.56	<.0001
ZIP 22204	-0.110319908	0.01376492	-8.01	<.0001
ZIP 22205	0.065489985	0.01363656	4.80	<.0001
ZIP 22206	-0.207405573	0.01785888	-11.61	<.0001
ZIP 22207	0.118391353	0.01331241	8.89	<.0001
ZIP 22209	0.123751702	0.03956249	3.13	0.0018
ZIP 22213	0.000000000	.	.	.
BROKER 0	-0.119516366	0.12407624	-0.96	0.3355
BROKER 1	0.000000000	.	.	.
LAMBDA	-0.005330914	0.06995177	-0.08	0.9393

Table 14. OLS Model of Time-on-the-Market (TOM)

R-Square	Coeff Var	Root MSE	LTOM Mean
0.165328	44.91705	1.159935	2.582394

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	1.030263433	0.62033151	1.66	0.0968
LLOT	0.040619086	0.04845492	0.84	0.4019
LSQFT	0.369527349	0.07627926	4.84	<.0001
AGE	-0.017963212	0.00424385	-4.23	<.0001
AGE2	0.000225429	0.00005238	4.30	<.0001
FULL_BATHS	0.142509423	0.02883807	4.94	<.0001
HALF_BATHS	0.080741409	0.03424644	2.36	0.0184
FIREPL	-0.017671094	0.02746692	-0.64	0.5200
BEDRM	0.007937609	0.01316147	0.60	0.5465
CLOSE_YR 2000	-1.541731344	0.14029007	-10.99	<.0001
CLOSE_YR 2001	-1.512269356	0.13657292	-11.07	<.0001
CLOSE_YR 2002	-1.467664596	0.13493048	-10.88	<.0001
CLOSE_YR 2003	-1.251140491	0.13453174	-9.30	<.0001
CLOSE_YR 2004	-1.400229068	0.13501001	-10.37	<.0001
CLOSE_YR 2005	-1.364736535	0.13563152	-10.06	<.0001
CLOSE_YR 2006	-0.551982306	0.13595202	-4.06	<.0001
CLOSE_YR 2007	0.000000000	.	.	.
CLOSE_QTR 1	-0.079307808	0.05117877	-1.55	0.1213

Parameter	Estimate	Standard Error	t Value	Pr > |t|
CLOSE_QTR 2	-0.528035833	0.04505469	-11.72	<.0001
CLOSE_QTR 3	-0.279388184	0.04555652	-6.13	<.0001
CLOSE_QTR 4	0.000000000	.	.	.
ZIP 22201	0.096212086	0.11182380	0.86	0.3896
ZIP 22202	0.184780923	0.11681882	1.58	0.1138
ZIP 22203	-0.165281207	0.11356935	-1.46	0.1456
ZIP 22204	0.133324404	0.10449543	1.28	0.2021
ZIP 22205	-0.076458200	0.10381179	-0.74	0.4615
ZIP 22206	0.249518428	0.14157041	1.76	0.0780
ZIP 22207	-0.051387324	0.10128324	-0.51	0.6119
ZIP 22209	0.481855855	0.38064479	1.27	0.2056
ZIP 22213	0.000000000	.	.	.

Table 15. Hazard Model of Time-on-the-Market (TOM), Lognormal Distribution

Analysis of Parameter Estimates								
Parameter		DF	Estimate	Standard Error	95% Confidence Limits		Chi-Square	Pr > ChiSq
Intercept		1	3.6108	0.2053	3.2083	4.0132	309.19	<.0001
LOTSIZE		1	0.0000	0.0000	-0.0000	0.0000	1.17	0.2795
FINSQFT		1	0.0002	0.0000	0.0002	0.0003	36.24	<.0001
HALF_BATHS		1	0.0767	0.0336	0.0108	0.1427	5.20	0.0226
FULL_BATHS		1	0.1283	0.0286	0.0724	0.1843	20.19	<.0001

Analysis of Parameter Estimates								
Parameter		DF	Estimate	Standard Error	95% Confidence Limits		Chi-Square	Pr > ChiSq
AGE		1	-0.0144	0.0043	-0.0229	-0.0059	10.97	0.0009
AGE2		1	0.0002	0.0001	0.0001	0.0003	11.94	0.0006
BEDRM		1	0.0083	0.0131	-0.0173	0.0339	0.40	0.5252
FIREPL		1	-0.0258	0.0271	-0.0789	0.0273	0.91	0.3405
CLOSE_YR	2000	1	-1.5372	0.1397	-1.8110	-1.2633	121.04	<.0001
CLOSE_YR	2001	1	-1.5082	0.1360	-1.7748	-1.2416	122.95	<.0001
CLOSE_YR	2002	1	-1.4635	0.1344	-1.7269	-1.2001	118.61	<.0001
CLOSE_YR	2003	1	-1.2445	0.1340	-1.5071	-0.9819	86.27	<.0001
CLOSE_YR	2004	1	-1.3952	0.1345	-1.6588	-1.1317	107.65	<.0001
CLOSE_YR	2005	1	-1.3626	0.1351	-1.6274	-1.0979	101.76	<.0001
CLOSE_YR	2006	1	-0.5463	0.1354	-0.8117	-0.2809	16.28	<.0001
CLOSE_YR	2007	0	0.0000	.	.	.	.	.
CLOSE_QTR	1	1	-0.0788	0.0510	-0.1787	0.0211	2.39	0.1223
CLOSE_QTR	2	1	-0.5253	0.0449	-0.6133	-0.4374	137.09	<.0001
CLOSE_QTR	3	1	-0.2774	0.0454	-0.3663	-0.1885	37.40	<.0001
CLOSE_QTR	4	0	0.0000	.	.	.	.	.
ZIP	22201	1	0.1038	0.1111	-0.1139	0.3215	0.87	0.3501
ZIP	22202	1	0.1900	0.1159	-0.0372	0.4172	2.69	0.1013
ZIP	22203	1	-0.1602	0.1130	-0.3816	0.0612	2.01	0.1562
ZIP	22204	1	0.1271	0.1036	-0.0758	0.3301	1.51	0.2195
ZIP	22205	1	-0.0669	0.1034	-0.2696	0.1359	0.42	0.5179
ZIP	22206	1	0.2250	0.1394	-0.0482	0.4983	2.61	0.1065

Analysis of Parameter Estimates								
Parameter		DF	Estimate	Standard Error	95% Confidence Limits		Chi-Square	Pr > ChiSq
ZIP	22207	1	-0.0531	0.1007	-0.2505	0.1444	0.28	0.5983
ZIP	22209	1	0.4433	0.3789	-0.2993	1.1859	1.37	0.2420
ZIP	22213	0	0.0000	.	.	.	.	.

Table 16. Hazard Model of Time-on-the-Market (TOM), Weibull Distribution

Analysis of Parameter Estimates								
Parameter		DF	Estimate	Standard Error	95% Confidence Limits		Chi-Square	Pr > ChiSq
Intercept		1	3.7076	0.2036	3.3085	4.1067	331.48	<.0001
LOTSIZE		1	0.0000	0.0000	0.0000	0.0000	9.24	0.0024
FINSQFT		1	0.0002	0.0000	0.0001	0.0003	27.89	<.0001
HALF_BATHS		1	0.0819	0.0344	0.0146	0.1493	5.68	0.0172
FULL_BATHS		1	0.1803	0.0285	0.1244	0.2362	39.97	<.0001
AGE		1	-0.0149	0.0043	-0.0234	-0.0065	12.14	0.0005
AGE2		1	0.0002	0.0001	0.0001	0.0003	13.20	0.0003
BEDRM		1	0.0312	0.0125	0.0068	0.0556	6.28	0.0122
FIREPL		1	-0.0721	0.0278	-0.1266	-0.0176	6.72	0.0095
CLOSE_YR	2000	1	-1.1382	0.1407	-1.4141	-0.8623	65.39	<.0001
CLOSE_YR	2001	1	-1.1966	0.1366	-1.4643	-0.9289	76.77	<.0001
CLOSE_YR	2002	1	-1.2407	0.1351	-1.5056	-0.9759	84.33	<.0001
CLOSE_YR	2003	1	-1.1339	0.1346	-1.3976	-0.8701	70.98	<.0001
CLOSE_YR	2004	1	-1.3694	0.1355	-1.6349	-1.1038	102.12	<.0001

Analysis of Parameter Estimates								
Parameter		DF	Estimate	Standard Error	95% Confidence Limits		Chi-Square	Pr > ChiSq
CLOSE_YR	2005	1	-1.3366	0.1363	-1.6038	-1.0694	96.15	<.0001
CLOSE_YR	2006	1	-0.4521	0.1369	-0.7204	-0.1837	10.90	0.0010
CLOSE_YR	2007	0	0.0000	.	.	.	.	.
CLOSE_QTR	1	1	0.1077	0.0516	0.0066	0.2089	4.36	0.0368
CLOSE_QTR	2	1	-0.4799	0.0453	-0.5688	-0.3910	111.99	<.0001
CLOSE_QTR	3	1	-0.2600	0.0461	-0.3504	-0.1697	31.81	<.0001
CLOSE_QTR	4	0	0.0000	.	.	.	.	.
ZIP	22201	1	0.3006	0.1117	0.0816	0.5195	7.24	0.0071
ZIP	22202	1	0.3446	0.1167	0.1159	0.5733	8.72	0.0031
ZIP	22203	1	-0.0528	0.1139	-0.2761	0.1705	0.21	0.6432
ZIP	22204	1	0.2805	0.1045	0.0757	0.4853	7.21	0.0073
ZIP	22205	1	0.0836	0.1042	-0.1207	0.2878	0.64	0.4226
ZIP	22206	1	0.4163	0.1402	0.1416	0.6910	8.82	0.0030
ZIP	22207	1	0.0534	0.1016	-0.1458	0.2526	0.28	0.5992
ZIP	22209	1	0.5455	0.3816	-0.2024	1.2933	2.04	0.1529
ZIP	22213	0	0.0000	.	.	.	.	.

Table 17. Two-Stage Least Squares Estimation

Model 1: log(Sale Price) **R-Square 0.82818**

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
INTERCEPT	-72.7674	26.99106	-2.70	0.0070
LLOT	0.253556	0.008138	31.16	<.0001
LSQFT	0.368576	0.013122	28.09	<.0001
AGE	-0.00626	0.000750	-8.34	<.0001
AGE2	0.000057	9.216E-6	6.20	<.0001
FULL_BATHS	0.057896	0.004888	11.84	<.0001
HALF_BATHS	0.060657	0.005827	10.41	<.0001
FIREPL	0.076969	0.004589	16.77	<.0001
BEDRM	0.001810	0.002256	0.80	0.4224
CLOSE_YR	0.136911	0.001471	93.07	<.0001
CLOSE_QTR	0.025251	0.002642	9.56	<.0001
ZIP	-0.00871	0.001214	-7.18	<.0001
LTOM	-0.02167	0.002284	-9.49	<.0001
ATYPICALITY	-0.14645	0.013314	-11.00	<.0001

Model 2: log(Time on Market) **R-Square 0.06704**

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
INTERCEPT	-303.029	18.98625	-15.96	<.0001
ATYPICALITY	0.647628	0.084793	7.64	<.0001
CLOSE_YR	0.152359	0.009475	16.08	<.0001
CLOSE_QTR	0.058018	0.017662	3.28	0.0010

Table 18. Imputed FSBO Time-on-the-Market, Atypicality-Constructed Comparables

	Model 1, Atypicality Comparable Construction	Model 2, Atypicality Comparable Construction	Model 3, Atypicality Comparable Construction
Mean FSBO Property Price (2000-2007)	$431,008	$431,008	$431,008
FSBO premium /discount	20%	26%	0%
Mean $ premium	$86,202 (431,008*20%)	112,062 (431,008*26%)	0
Brokered Comparable's Mean Time on the Market (days)	28	28	28
Price / Mean Time on the Market (price per day)	$15,393 (431,008 / 28)	$15,393 (431,008 / 28)	$15,393 (431,008 / 28)
Days to recoup premium	5.6 (86,202/15,393)	7.3 (112,062/15,393)	0
Implied FSBO TOM	33.6	35.3	28

	Model 1, Atypicality Comparable Construction	Model 2, Atypicality Comparable Construction	Model 3, Atypicality Comparable Construction
Premium + 2.5% agent commission	96,977 (86,202+10,775)	122,837 (112,062+10,775)	10,775
Days to recoup premium	6.3 (96,977/15,393)	8 (122,837/15,393)	0.7 (10,775/15,393)
Implied FSBO TOM	34.3	36	28.7

Model 1 corrects for selection bias in the form of seller tenure.
Model 2 corrects for selection bias in the form of seller equity in the property.
Model 3 corrects for selection bias in the form of property atypicality.
FSBO comparables constructed according to atypicality index.
Mean FSBO price and comparable TOM calculated from dataset of matching comparables.

Table 19. Imputed FSBO Time-on-the-Market, Tax Assessed Value-Constructed Comparables

	Model 1, Tax Assessed Value Comparable Construction	Model 2, Assessed Value Comparable Construction	Model 3, Assessed Value Comparable Construction
Mean FSBO Property Price (2000-2007)	386,449	386,449	386,449
FSBO premium /discount	20%	26%	0%
Mean $ premium	77,290 (386,449*20%)	100,477 (386,449*26%)	0

Brokered Comparable's Mean Time on the Market (days)	27	27	27
Price / Mean Time on the Market (price per day)	14,313 (386,449 / 27)	14,313 (386,449 / 27)	14,313 (386,449 / 27)
Days to recoup premium	5.4 (77,290/14,313)	7 (100,477/14,313)	0
Implied FSBO TOM	32.4	34	27
Premium + 2.5% agent commission	86,951 (77,290+9,661)	110,138 (100,477+9,661)	9,661
Days to recoup premium	6.1 (86,951/14,313)	7.7 (110,138/14,313)	0.7 (9,661/14,313)
Implied FSBO TOM	38.5	41.7	27.7

Model 1 corrects for selection bias in the form of seller tenure.
Model 2 corrects for selection bias in the form of seller equity in the property.
Model 3 corrects for selection bias in the form of property atypicality.
FSBO comparables constructed according to tax assessed values.
Mean FSBO price and comparable TOM calculated from dataset of matching comparables.