THE INFLUENCE OF MARKET TRANSACTION PHENOMENA ON RESIDENTIAL PROPERTY VALUES

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By
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* * * * *

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CHAPTER I
INTRODUCTION

Objectives of the Dissertation

The objective of this dissertation is to investigate the influence of market transaction factors on residential property values. Market transaction factors are essentially the methods and mechanisms by which information is communicated and exchange if facilitated between buyers and sellers.

Numerous models have been developed over the past decade which estimate and explain residential property values. Each succeeding model typically improved the predictive powers of the model or provided a better understanding of specific factors which influence property value. Improvements by these past studies have emphasized attributes of property value which are directly related to site, housing quality and quantity, location or environment. Recent studies have generally concentrated on environmental factors or locational influences on property values.¹

Even after accounting for site, improvement, locational

and environmental characteristics a non-random variation in the selling price of residential property may still exist that could be related to a major set of variables left unexplored. These variables are related to the transaction process operating in the housing market or market transaction phenomena. Some work has recently begun to emerge which has centered on the market transaction process. However, no known empirical studies to date have attempted to directly relate market transaction phenomena to resulting property selling prices.

In this study it will demonstrate that, as a result of market transaction costs and housing market imperfections, there is a range of prices at which a given property might clear the market. This range of price dispersion is affected by the various buying or searching costs and selling costs of the particular housing market participants. Whenever

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2Studies which utilize aggregate data in the investigation of general value relationships have no need to account for market transaction phenomena which may affect property values if they assume the average effect on aggregate data to be offsetting with a mean of zero. Such studies include Ridker and Henning (1967), Oates (1969), Anderson and Crocker (1970) and many others. Studies utilizing individual property data cannot as readily assume market transaction phenomena have a mean zero effect on value.

transaction costs are different among participants in the market, the potential exists for a given type of property to clear the market over a range of various selling prices. The transaction costs are affected by the availability, quality and reliability of the information circulating in the market. The less active a particular market, for any good, the greater one would expect the transaction costs to be. The level of activity in a housing market depends upon the supply and demand for property of the relevant submarket. The "number of buyers considering a particular property as a viable purchase defines the demand, and the number of other properties for sale that appeal to the same group of buyers defines the supply." 

With respect to market price variation within a given submarket, Belkin, Hempel and McLeavey state:

If all the buyers who search in a particular submarket possess the same indifference curves in the multidimensional space defined by all the attributes of the property including price, then, through appropriate pricing, homogeneity could be achieved among many properties. Of course, it is not very likely that any two prospective homebuyers have the same indifference curves. Further, even if one were to conceive of an average indifference curve, it is, of course, impossible

---


5 Belkin, et al, op cit, state: "The objective of the submarket definition activity is to isolate groups of competing properties."

6 Ibid.
for a broker/seller pair to define that curve so accurately that they could assign to a property a price that would make that property identical with other available properties in the eyes of prospective buyers. 7

Systematic relationships between market transaction phenomena and selling prices of residential property are analyzed in this study. The empirical analysis will focus on the relation of four market transaction processes to selling price: first, the buyer's search process; second, the time a property is on the market; third, the method of sale (owner versus broker and broker-alone versus broker-co-operative sale); and fourth, the seller's price setting policy.

Utilizing a sample of ninety-one properties sold during the last half of 1976 in Columbus, Ohio, a regression model is developed which builds upon past attempts to control the significant influences of site, locational or environmental, and improvement attributes. Specific hypotheses and variables related to the market transaction process are added and tested for significant associations with selling prices. This study does not take the viewpoint that significant relationships between market transaction related variables and selling price implies that properties sell above or below their 'true' market value, however defined. A theoretical demonstration in Chapter II suggests that, as a result of different transaction costs for buyers and sellers, the selling price of a property can be optimal and rational for

7 Ibid.
both buyer and seller, even though it is above or below the mean market price for similar property.

Outline of the Dissertation

The remainder of the dissertation is broken down into three major chapters. In Chapter II, some of the theoretical concepts and rationale are discussed which support the hypothesized effects of the market transaction phenomena on property value. In particular, different transaction costs for different market participants are demonstrated to give sufficient cause for selling price dispersion on a given product. This assumes a market of less than perfect competition with less than perfect information. Past research which applies to the market transaction process is discussed. At the end of Chapter II four propositions of market transaction related phenomenon, which are to be empirically investigated, are outlines.

Chapter III includes the empirical analysis of the propositions. Past empirical work as it applies to developing a model which controls the significant influences of non-market influences on value is discussed. The sample, theoretical model, variables, units of measurement, and sources are discussed. After the development of a control model, the propositions are investigated and results discussed. Chapter IV summarizes some of the results, discussed further research, and ends with a concluding statement. The Appendix includes statistical information related to the variables and date collected in the sample.
CHAPTER II

CONCEPTUAL ANALYSIS

MARKET TRANSACTION PHENOMENA AND PROPERTY VALUES

Introduction

This chapter reviews the theoretical concepts and relationships between market transaction phenomena and property values. Four general areas of discussion will concentrate on: the effects of buyer search costs and purchase price; the effects of selling costs on selling price and method of sale; the relationship of time and selling price; and the effect of the seller's price setting strategy on selling price. The final section summarizes propositions to be investigated through the testing of specific hypotheses.

The Effects of Buyer Search Costs on Purchase Price

Once a person has perceived the need or desire for a home, he becomes a potential buyer.

To gain information about housing alternatives and to gather the knowledge necessary to evaluate these alternatives, the buyer must begin an active search process. The nature and extent of this information-seeking behavior is influenced by many factors, including the buyer's previous home buying experience, his perception of the quality and quantity of information available from various sources, and the costs he associates with the acquisition of this information.  

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The more information a buyer has about the prospective housing submarket within which he is searching for a home, the less likely the buyer will be to pay a price above the minimum possible price for such a home.\textsuperscript{9} In determining the costs and benefits of information, Hirshleifer makes an important distinction between foreknowledge and information discovered through search.\textsuperscript{10} This study will assume all buyers are equally naive at the point when they begin their search process, with the exception of distinguishing in-town and out-of-town buyers who may significantly differ in their foreknowledge of the prospective housing submarket.

From the buyer's viewpoint, the problem is when to stop collecting information. John McCall (1965) developed a model addressing the problem of optimal stopping time.\textsuperscript{11} "The decision problem is whether to accept a known investment opportunity or to collect more information and wait until at least one more opportunity is uncovered . . . the investment decision depends on the cost of additional

\textsuperscript{9}Conversely, the more information a seller has about the prospective housing submarket within which he is selling, the less likely he will sell at a price below the maximum possible price for such a home given normal marketing time.


information relative to its expected value."\textsuperscript{12} The criterion used to evaluate alternative investment opportunities is the "net" present value of the investment, that is, the present value of the investment less the cost of the information needed to make the investment decision. McCall designs a probability model, where one collects more information as long as the expected value of the information equals or exceeds its costs.\textsuperscript{13}

With respect to home search, information which could be collected by a prospective buyer includes all of the site, location, and improvement characteristics as well as the seller's asking price. What the buyer does not know is the actual price the seller would accept. This increases the uncertainty and informational cost in the home buying process. The marginal benefits of each additional search are less in a market where the asking prices are not final purchase prices, as compared to a market where asking prices are identical to or nearly identical to selling price. In the Columbus housing market, one cannot even expect the asking price to be

\textsuperscript{12}\textit{Ibid.}, p. 301.

\textsuperscript{13}Armen A. Alchian (1969) suggests that the "ideal" market from an efficiency point of view is not always a market of perfect information. Due to the high costs of information in some markets, it may be optimal to collect less than full information, even if this means paying a price for a product above the best possible price that could be achieved with additional searching. The existence of brokers or middle-men in a market provides evidence that market information is not easy to obtain for buyers and sellers. See Armen A. Alchian, "Information Costs, Pricing, and Resource Unemployment," \textit{Western Economic Journal}, June 1969, Vol. 7, pp. 109-128.
proportional to the final sales price for any random sample of properties. This makes the evaluation of marginal benefits from search more difficult for a potential home buyer.

George Stigler uses the same rule as McCall; that is, collect information as long as the expected marginal benefit exceeds the expected marginal cost, in developing an optimal stopping rule model. Stigler states: "Price dispersion is a manifestation--and, indeed, it is the measure--of ignorance in the market." At any one point in time, there will exist a frequency distribution of prices quoted by sellers of a similar good. If the dispersion of prices asked by sellers on property similar from the view of a prospective buyer is at all large relative to the cost of search, it will pay on the average to search several properties. Consider the following primitive example: let sellers be equally divided between asking prices of $2 and $3. The distribution of minimum prices, as search is lengthened, is shown on the following page. The buyer who accepts the first seller canvassed has an expected purchase price of $2.50, the market's average price. The buyer who canvasses two sellers

---

14 In some preliminary research, a random sample of one hundred properties sold during 1976 through Columbus Realtors was collected. The average or mean decline from list price to selling price was 3.58%. The range was from 0% to a 18.9% reduction in price, with a variance of 13.5 and a standard deviation of 3.09. This indicates sellers are very inconsistent with respect to asking price and acceptable price.

instead of one has an expected savings of twenty-five cents per unit, with marginally decreasing savings with each succeeding search, as shown in Table 1.

<table>
<thead>
<tr>
<th>No. of Prices Canvassed</th>
<th>Probability of Minimum Price of:</th>
<th>Expected Minimum Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$2.00</td>
<td>$3.00</td>
</tr>
<tr>
<td>1</td>
<td>.5</td>
<td>.5</td>
</tr>
<tr>
<td>2</td>
<td>.75</td>
<td>.25</td>
</tr>
<tr>
<td>3</td>
<td>.875</td>
<td>.125</td>
</tr>
<tr>
<td>4</td>
<td>.9375</td>
<td>.0625</td>
</tr>
<tr>
<td>$\infty$</td>
<td>1.0</td>
<td>0.</td>
</tr>
</tbody>
</table>

A normal distribution is assumed for the dispersion of prices available on the item for sale, with a standard deviation of $\sigma$ and a mean of $M$. Whatever the precise distribution of prices, normal or skewed, it is certain that increased search will yield diminishing returns as measured by the expected reduction in the minimum asking price. For any buyer, the expected savings from an additional unit of search will be equal to the quantity $(q)$ he wishes to purchase times the expected reduction in price, $P$, as a result of the $n + ith$ search, or:

$$q\left(\frac{P_{\text{min}}}{\sigma}\right)$$

On the first search the expected minimum purchase price is $M$, the market's average price for a given property.
The expected minimum purchase price with an additional search is:

\[ M - q \frac{\partial P_{\text{min}}}{\partial n} \]

In the same manner as the expected minimum prices were calculated in the two-price case, the methodology can be applied to the multi-price case with normal distribution. The expected minimum price for the first search is \( M \), derived from the weighted sum of the price distribution times each price's respective probability (or weighted frequency). The expected minimum price derived from the second search is equal to the probability of finding each of the available prices in one or two searches times their respective prices. The results for ten searches are given in Table 2, with a normal distribution assumed.

<table>
<thead>
<tr>
<th>Search</th>
<th>Expected Minimum Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>( M )</td>
</tr>
<tr>
<td>2</td>
<td>( M - .564 \sigma )</td>
</tr>
<tr>
<td>3</td>
<td>( M - .846 \sigma )</td>
</tr>
<tr>
<td>4</td>
<td>( M - 1.029 \sigma )</td>
</tr>
<tr>
<td>5</td>
<td>( M - 1.163 \sigma )</td>
</tr>
<tr>
<td>6</td>
<td>( M - 1.267 \sigma )</td>
</tr>
<tr>
<td>7</td>
<td>( M - 1.352 \sigma )</td>
</tr>
<tr>
<td>8</td>
<td>( M - 1.423 \sigma )</td>
</tr>
<tr>
<td>9</td>
<td>( M - 1.485 \sigma )</td>
</tr>
<tr>
<td>10</td>
<td>( M - 1.539 \sigma )</td>
</tr>
</tbody>
</table>
Table 3 applies the results in Table 2 to a hypothetical housing submarket with an assumed mean of $50,000 and a standard deviation of $1,000.

<table>
<thead>
<tr>
<th>Search</th>
<th>Expected Minimum Price</th>
<th>Marginal Savings from Search</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$50,000 - 0(1,000) = $50,000</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>$50,000 - .564(1,000) = $49,436</td>
<td>$564</td>
</tr>
<tr>
<td>3</td>
<td>$50,000 - .846(1,000) = $49,154</td>
<td>282</td>
</tr>
<tr>
<td>4</td>
<td>$48,971</td>
<td>133</td>
</tr>
<tr>
<td>5</td>
<td>48,837</td>
<td>134</td>
</tr>
<tr>
<td>6</td>
<td>48,733</td>
<td>104</td>
</tr>
<tr>
<td>7</td>
<td>48,648</td>
<td>85</td>
</tr>
<tr>
<td>8</td>
<td>48,577</td>
<td>71</td>
</tr>
<tr>
<td>9</td>
<td>48,515</td>
<td>62</td>
</tr>
<tr>
<td>10</td>
<td>48,461</td>
<td>54</td>
</tr>
</tbody>
</table>

The optimal number of searches depends upon the cost of each search and expected benefits. If each search has a cost of $60 for a household seeking a property such as the type represented in Table 3, then the optimal number of searches would be nine, since the additional expected benefit of a tenth search is $54, less than the cost of the search. As the lag time between searches or acceptable properties coming on the market increases, the probability of the minimum price property remaining on the market declines. Thus, additional search costs are not the buyer’s only direct
costs; the lost opportunities that reduce the probability of achieving an expected minimum price also are a cost.\(^\text{16}\)

If the standard deviation of selling prices is reduced, in the example from $1,000 to $500, the optimal number of searches drops from nine to five. The reverse also holds true, where as the standard deviation increases, the optimal number of searches increases.

The primary purpose of this example is not to demonstrate optimal stopping rule behavior, where one continues searching as long as the expected marginal benefit from search exceeds the expected marginal cost. However, with the application of rational optimal search policies, the resulting expected purchase prices can differ significantly. The difference in the expected minimum purchase prices, in the example, is a function of the difference in search costs among different buyers.\(^\text{17}\) Consider the case where one buyer has an average cost of $300 per search (they may have a job with high time demands, or be an out-of-town buyer who must make special trips in), while another buyer has an average search cost of $50. Applying optimal search behavior implies

\(^{16}\) This does not discount the possibility of a continuous inflow of new properties coming on the market. However, the more intensive home searchers are more likely to continuously remove from the market the lower priced substitutable properties.

\(^{17}\) One could develop a similar example from the seller's point of view, where differences in selling costs result in different acceptable selling prices. Again the key point is that differences in transaction costs can produce a dispersion of selling prices for identical, or equal utility producing homes.
the expected minimum purchase price for the buyer with higher search costs is $49,436, and $48,461 for the buyer with lower search costs. The difference in expected minimum purchase prices is $975. The optimal number of searches would be ten for the low-search-cost buyer and only two for the high-search-cost buyer. If the high-search-cost buyer had decided to search a third time, the expected marginal savings of $282 would not have been as large as his expected search cost. Such behavior may help to explain some of the price dispersion in the housing market even when controlling for all the characteristics of site, location, and improvements.

The costs of searching for a property include the opportunity costs of lost work time and/or leisure activity time as well as other psychological related costs (i.e., aggravation) which may differ from person to person. If such costs are very similar for buyers of similar property (by price and area) then one would not expect to find systematic differences in the relationship of purchase price to search costs. Also, if the marginal costs of search are very low for the average buyer in a given submarket then systematic differences, if they exist, between the price paid by such buyers may be so small as to be insignificant and not testable. For this reason the probability of finding systematic differences between search costs and purchase price are greatest in housing submarkets where the greatest variance of search costs are likely to be found (i.e., higher price range submarkets).
Since the actual costs of searching for each buyer are not easily identifiable, assumptions must be made in order to relate search costs to purchase prices. If optimal search behavior is assumed, then marginal costs must be equal to or less than the marginal benefit of the final search for each buyer. Then, if systematic differences are found between purchase prices and the number of homes searched, one must conclude the buyer who searched a greater number of properties did so because of lower search costs or greater marginal benefits from search. Even without the assumption of optimal search behavior, a testable question is whether additional searches, on the average, aid buyers in discerning between relative property values. That is, an examination of the marginal benefits from the search process may be made by seeking relationships between variables identifiable within the search process and purchase prices for each buyer.\(^\text{18}\)

The Effects of Selling Costs on Selling Price and Selling Method

A second market transaction phenomena to be investigated includes the question of selling costs on selling price and the method of sale. In the same manner as the expected minimum purchase price was developed in Table 3 of the last section, one could develop an expected maximum selling price,

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\(^\text{18}\) Several measurements of the search process may be used in testing similar hypotheses, such as the number of properties searched per unit of time (a measure of the intensity of search). These will be discussed in the empirical analysis.
taking the seller's point of view. Rather than additional searches, we would have additional potential buyers who have seen the property or made offers. As the number of potential buyers increased the expected maximum selling price would increase at a marginally declining rate. Differences in selling costs could thus be used to demonstrate the potential for price dispersion on similar property. However, rather than demonstrate such an example and to avoid repetition, this section will concentrate on the relation of selling costs and price to the selling method.

Selling costs are a result of disseminating information about the property, through advertising or other promotion, and the acquisition of potential buyers. The seller's cost to sell a property can be affected by the method of sale chosen. Three possible methods of sale include: (1) an owner selling his own home; (2) a property listed for sale and sold by the listing broker; and (3) a property listed for sale and sold by another broker (a "co-op" sale). A seller who chooses to sell his own property will have selling costs in proportion to the time required for the property to sell. The bulk of the selling costs are advertising and showing or presentation costs which vary directly with the time a property is on the market. A seller who chooses to list his property with a broker is shifting a large portion of the variable costs to the broker in exchange for a commitment to pay a percentage of the purchase price as a commission upon a sale. The risk that the selling costs
will exceed a given percent of the purchase price (or will not sell at all) is then partially borne by the broker. In exchange for this potential risk, most brokers receive the same commission even when their selling costs are substantially higher or lower. The percentage commission paid is generally the same whether the listing broker or another broker sells the property.

Each of the three methods of sale have certain identifiable selling costs. The rational seller chooses the method of sale which maximizes the present value of his net selling price. The benefits of choosing one method of sale over another may be in the form of a higher selling price or a quicker sale. Four types of selling costs can be identified. The first set includes the costs of disseminating information and acquiring potential buyers. These costs are borne by the owner in the form of advertising expenditures, signs or other types of promotional costs. When a property is listed these costs are entirely borne by a broker in exchange for a commission to be paid upon a completed sale. The second set of selling costs include the personal costs of inconveniences incurred in allowing prospective buyers to enter a home. These costs are incurred whether the property is listed with a broker or not, and thus should not affect the decision on the method of sale selected. The third distinct cost is the opportunity costs created by the difference between the selling price brokers may be capable of achieving and the selling price an owner is capable of achieving. The
issue here is whether brokers can increase effective demand through advertising, promotional or negotiating skills. Even with a higher actual selling price the net selling price received by an owner may be equal to, more or less, than the net selling price to be expected when the owner sells his own property. The comparison a seller must make is whether he expects the first set of selling costs (promotional costs) to be equal to or less than the opportunity costs in the form of a higher potential selling price a broker may be able to achieve. The final cost which can be identified is the opportunity cost in the form of the time value of money. That is, the net present value of a given sale price is maximized the quicker the sale. The additional costs of a particular method of sale may be offset by the benefit of a quicker sale.

The decision of a seller to list his property with a broker or try to sell on his own depends upon his perceptions regarding: (1) the marketability of the property, a judgment which compares the commission costs to the expected promotional costs if not listed, and (2) the ability of a broker to achieve a higher selling price or a quicker sale than the seller alone could compared to the additional selling costs which might be incurred. The net selling price received by various selling methods are not identifiable. However, it is possible to investigate the relationship between the owner or broker sale and the actual selling price or average time to sell residential property.
A comparison of a listed property sold by the listing broker and a listed property sold by a cooperating broker or a "co-op" sale, and commission splitting practices has some important implications with respect to expected selling price. When a listing is sold by a co-op broker, the commission is usually split; that is, three percent of the purchase price goes to the co-op broker. Unless the selling costs of the listing broker are reduced by an equal amount (an unlikely case) the profit, if any, is substantially reduced for the listing broker. For this reason, brokers have an incentive to encourage sellers to consider direct-buyer offers more seriously than offers brought by a co-op broker. Even with a strong incentive to try and sell one's own listing, co-operative transactions are very common in most typical used-housing markets. These sales may occur because co-operative brokers increase effective demand or reduce selling time. Without co-operative sales many listing contracts would probably expire and thus co-operative sales avoid a loss situation for the listing broker. In addition, given the all or nothing commission payment system, a buyer provided by a co-operative broker may reduce the profit of the listing broker or create a cost which causes a net loss but avoids the larger loss of the listing broker which may occur without that particular buyer.
The Relationship of Time and Selling Price

Given that supply and demand are held constant, the
time required to sell a property must be a function of its
attractiveness relative to other properties which are con-
sidered potential substitutes in the mind of the typical
buyer for such property. Potential substitutes implies the assumption that
no property has greater or lesser attractiveness with respect
to taste preferences.

Relative attractiveness must then
be primarily a function of the seller's asking prices, and
expectations regarding selling price, compared to the typical
buyer's estimation of value for such property. Selling a
house can be viewed within an auction type of framework. This
viewpoint and concept is suggested by Professor William B. Brueggeman of Ohio State University in
discussions with the author July, 1977.

Sellers price high to preclude missing a potential highest
bid. Since the market does not clear instantaneously,
sellers receiving bids over time, must determine if the price
expected to be realized is too high. Over time the gap
between list or asking price and selling price should
increase, reflecting the seller's lower price aspirations.

The empirical relationship expected is that the larger the
list price/selling price gap, the longer the average time on
the market. This relationship has been tested and verified
by Belkin, Hempel, and McLeavey in a recent study.

Potential substitutes implies the assumption that
no property has greater or lesser attractiveness with respect
to taste preferences.

This viewpoint and concept is suggested by
Professor William B. Brueggeman of Ohio State University in
discussions with the author July, 1977.

The Belkin, Hempel and McLeavey study is one of the first investigations of submarket housing market activity and the significance of time on the market. It states:

A very important reason for studying time on the market is that it can serve as a supplementary measure of value ... In this use as a supplementary value variable, time on the market considerations bear most heavily upon questions of pricing and price discounting. An examination of time on market data should allow an analyst to isolate instances of over- or underpricing. This would not be possible with price data alone, since the 'true price' of a property is never known. A study of time on the market is thus an indirect study of pricing behavior which allows an analyst to avoid the quagmire of determining the 'true price'.

In examining the relation of time on the market and selling price, the time value of money must be considered in terms of its effects on "real" selling price. A higher selling price on a property requiring a relatively long time on the market must be discounted in order to make valid comparisons of selling prices on similar properties. It is standard practice for appraisers to apply some type of discount rate to selling prices in order to compare prices on a same-time basis. A major component of the discount rate is a result of general price inflation. Inflationary pressures imply that selling prices will increase over time. Most cross sectional studies have not felt the necessity to control for inflationary effects. While an appropriate discount rate

\(^{22}\text{Ibid.}, \ p. \ 57\text{.}\)
may be difficult to estimate, conservative discount rates can easily be applied to selling prices to determine real or deflated selling prices. Such a procedure will be employed in the empirical investigation.

To the extent that the average time a property is on the market is a reflection of selling costs (urgency to sell) per unit of time, further implications regarding selling price are possible. Sellers with very high selling costs, per unit of time, who are in need of a quick sale, must select a price which is immediately attractive to potential buyers. Their pricing behavior may preclude the highest potential bids; however, their opportunity costs could be so high that a lower price achieved quickly may be equivalent to a discounted higher price which may take a longer marketing period. Sellers with no immediate urgency to sell (low selling costs per unit of time) have the opportunity to select higher asking prices and wait until the highest potential bidders (those with high buying costs per unit of time) come along. Of course, given enough time, inflationary pressures may aid the seller in achieving a higher price rather than a high buying cost, per unit of time, - buyer actually bidding a higher price for the property.

In addition, there is no reason to assume different housing submarkets will have equal average time on the market, even when all submarkets are in equilibrium. Higher price ranges of properties may require longer average time on the market because higher priced properties are more complex
products which require more time to evaluate. Therefore, caution must be taken in evaluating price and time on the market when several submarkets are contained in a sample.

The method by which a property is sold may have effects upon the time a property is on the market or price (as discussed within the last section) and may represent a potential indirect test to relate selling costs, per unit of time, to selling price. Assume the price achieved by brokers and owner-sellers are equal. Then, if broker sales require less time due to greater promotion or other selling skills, the higher selling costs of using the broker may be offset by the lower opportunity cost of a quicker sale. Any given price is worth more in real dollars the sooner it is received, due to the time value of money. The selling price/time tradeoff should prove consistent with the method of sale chosen in the empirical analysis, if the use of brokers is correlated with sellers who have greater selling costs, per unit of time. For the added cost of the broker some service in the form of a higher price or a quicker sale must be provided.

Two studies have been published to date which explore time on the market and selling price, although in an indirect manner. John Cubbins (1974) attempted to develop a model of selling time based primarily on price related factors.23 His procedure involved eighty-three sample sales from Coventry, England. Data on site, improvements, and location as well as

selling time were collected. In a two-step process, Cubbins first developed a regression model to predict selling price. Then in the second step, Cubbins hypothesized: "the greater the difference between the actual selling price and the model predicted selling price the longer should be the required selling time." His reasoning suggests that the model predicted selling price is an average expected selling price; to achieve something above this is to catch someone paying more than they had to if they had searched more or bargained harder. Cubbins did not attempt to control for information or transaction costs which may explain part of the residual price variation in his selling price model.

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**FIGURE 1**

Selling Price Distribution for a Given Property

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Figure 1 represents a normal distribution of selling prices for properties yielding a given amount of housing utility or service units (see Olsen). Cubbins' first step is to develop a model which predicts selling price. The model develops an expected selling price, A, in Figure 1. If a property then has an actual selling price of B, Cubbins
expects it took longer to sell than one selling at a price closer to A.

Cubbins reasoned that the probability of a buyer showing up willing to pay B is less than one willing to pay A. He does not support this reasoning with the economic theory used to support optimal stopping models. The difference between point A and B in Figure 1 is part of the unexplained (selling price) residual of Cubbins' model. Rather than trying to directly test the theory behind the intuition in the model of selling time, he is trying to explain the residual of his regression model of selling price.

Cubbins' selling time model uses the log of selling time, \( T \), in days as the dependent variable. The basis for using \( \log T \) rather than \( T \) is to insure \( T > 0 \), and to deal with the problem of heteroscedacity. "The longer the expected value of the time taken to sell, the greater is the margin of error in predicting actual time taken." The following model is developed, where \( Q \) is a simple weighted summary measure of the house's characteristics developed from coefficients of Cubbins' model which has log of selling price as the dependent variable, or simply the model predicted log of selling price. \( R \) is an attempt to measure the gap between the model expected selling price and the actual selling price where \( R = \log (P/P) \). The model results are:

\[
\log T = 5.66 - 1.98R - 1.11Q + u \\
(4.28) (-2.38) (-3.10)
\]

\[ R^2 = .156 \]

All of the coefficients were significant at the .05 level.

\(^{24}\)Ibid.
"The coefficient on Q indicates that the higher the objective characteristics of the house, the faster the turnover, on the assumption that a fair price is being asked." The negative coefficient on R was unexpected by Cubbins. He states that: "It implies that a given house could be sold faster the higher the price put on it."\textsuperscript{25}

The implication by Cubbins that $\hat{P}$ is a better indication of true value (he actually called this "the estimated true value") than what a buyer deems the property worth is unacceptable. In an earlier example different transaction (search) costs were sufficient to demonstrate that different buyers may have different optimal purchase prices. Thus, $\hat{P}$ in Cubbins' model may be called the mean market value for such a property given the characteristics controlled by the model, but one cannot say the actual price paid, P, is not the true value of the property. Unless the regression model predicting P controlled 100 percent of the variation in P, then R or log ($P/\hat{P}$) would tend to represent some of the characteristics not included in the P model. The negative coefficient on R is consistent with the negative coefficient on Q, and only indicates a higher demand for the higher value market. It does not imply, as Cubbins suggests, that a given property would sell faster the higher the price placed on it.

\textsuperscript{25}Ibid.
This study is important to review for several reasons. First, it points out one of the dangers in using multiple regression, that is, allowing the results to be interpreted in a manner which may or may not be consistent with sound economic theory. Secondly, Cubbins' study reveals one of the problems in dealing with several housing submarkets. The faster turnover of property at higher price levels probably misled Cubbins into interpreting the regression results as meaning any given property would sell faster if higher priced. These methodological problems must be considered carefully in the analysis of any similar empirical work.

Belkin, Hempel and McLeavey's choice to attack the problem of pricing and time on the market, without attempting to control for other significant determinants of value, is a constraining but pragmatic approach. They suggest that time on the market can serve as a supplementary measure of value. The only way they could ever give direct statistical support to this hypothesis would be to directly test the relationship between time on the market and selling price. The approach taken by Belkin, et al., was to use only time on the market geographically, contained in a sample to be analyzed. The natural extension of their work would be to develop a

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list price, and the ratio of selling price to list price, identified by the community in which the property was located. Their sample of nearly one thousand transactions, from nine communities, was obtained from Realtor Multiple Listing data in 1970 and 1973. Their data was segmented by community, price range, time on the market and ratio of selling price to list price, and then the means and variances of each distribution were analyzed.

In addition, they set up a simple regression equation with time on the market as the dependent variable and the selling price/list price ratio as the independent variable. The multiple R square value was .268 and .203 for 1970 and 1973 respectively, with results as follows:

<table>
<thead>
<tr>
<th></th>
<th>Constant</th>
<th>Coefficient</th>
<th>F-Value</th>
<th>S E Est.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>TOM = .649</td>
<td>-.541 SP/LP</td>
<td>36.14</td>
<td>.120</td>
</tr>
<tr>
<td>1973</td>
<td>TOM = .526</td>
<td>-.430 SP/LP</td>
<td>19.29</td>
<td>.115</td>
</tr>
</tbody>
</table>

Their results for each submarket varied significantly over each of the variables collected. They concluded that different supply and demand conditions which influenced the pricing behavior and time required to market each property existed in each of the submarkets. Furthermore, their results indicated that the proportion of list price realized by the seller diminished with time on the market.

The results of Belkin, Hempel and McLeavey's study are consistent with the basic relationships discussed within this study. Their study points out the importance of limiting the range of submarkets, defined by price range or
valuation model with the effects of pricing and time on the market built in. This study will utilize a regression model to attempt to control for the significant influences on value and directly test for the relationship of the price setting policy, time on the market, and selling price. The next section will delve more deeply into the question of pricing strategies and selling price.

The Effect of the Seller's Pricing Strategy on Selling Price

Some research in the fields of psychology and marketing seem to indicate that asking prices may actually influence the final sales prices. Numerous marketing experiments have been performed to investigate the effects of pricing on consumer behavior. These studies take the point of view of the buyer in evaluating the value of a product, and are discussed below. The final discussion of this topic will focus on the seller's ability to determine appropriate asking prices.

27 From an economist's point of view, asking prices can only affect selling prices through their effects on information cost or through the monopolistic type of power present in an imperfectly competitive market where the potential for above normal profit exists.
Price and the Buyer's Evaluation of Value

Price reliance is the degree to which consumers rely on prices as an indicator of quality or value. Buyers may expect a higher price to indicate higher quality, even though they cannot differentiate between the actual quality, simply because they have a certain degree of trust in the seller (or broker). This phenomena has been tested by several researchers.

Benson P. Shapiro (1968) separated six hundred adult respondents into eleven groups. The respondents were asked to rate two similar but different products. Several products were rated, such as stockings, cologne, carpeting, sweaters and chairs. The two items in each product category would normally have retailed at the same price. For the experiment, the price of one product was raised 20 percent and the price of the other product decreased about 20 percent. Prices were switched with alternating respondent groups so that each item appeared equally at the high and low prices. The data revealed that price consistently tended to be a communicator of quality, especially on the carpeting and chair, which were the most expensive items in the group. Shapiro concluded that buyers tend to trust the seller's integrity and expect a higher price to be related to higher quality even if such quality difference is not apparent to them.28

Numerous other studies have had similar results, such as Leavitt,\textsuperscript{29} Olander,\textsuperscript{30} McConnel,\textsuperscript{31} and Newman and Beckness,\textsuperscript{32} to name a few.

Monroe (1971) has investigated price thresholds, which are "latitudes of acceptance of various prices on a given product."\textsuperscript{33} Monroe varied the prices on several products and surveyed the respondents as to the most acceptable price range. The hypothesis that the subjects would have an acceptable range of prices for a considered purchase was confirmed. The median quantity demanded for the products tested increased as the price increased, and as price continued to increase demand began to decline, as shown in Figure 2.


The most acceptable price range is from A to B. As prices continued to increase beyond B, buyers replaced their reliance on price as an indicator of value with other information which was available to them about the product.

Residential properties provide potential buyers a multitude of information by which they may make comparisons beyond the asking price of the property. And, of course, a home represents a much larger purchase in dollars than items like carpet or chairs. But, to the degree that buyers are uncertain in their comparisons and to the degree that they place reliance on opinions of brokers or sellers, there may be some price reliance as an indicator of quality in the housing market. The potential influence of deliberate over-pricing on buyers' evaluations of property must be considered very limited. However, it is a very interesting question
of the implications it has on the issue of the degree of imperfections in the housing market.

This study will look into variables which can be identified as proxies for pricing strategy and test for any systematic relationships with selling price. Due to the high correlation of list price to selling price, direct tests are not possible in a regression framework model. These tests will be discussed further in the empirical analysis.

The Seller's Ability to Determine Price

The discussion so far has centered on the influence price has on a buyer, if any, in the evaluation of a product. An equally important question deals with the ability of a seller to know what a product is worth. One article, published in 1954 by Kish and Lansing, dealt specifically with the ability of an owner to estimate the value of his home.34

In a 1950 survey home owners in Michigan were asked to estimate the market value of their homes. Estimates for these same homes were later made by professional appraisers. These two estimates for each of 569 homes were analyzed. The proportion of discrepancies between the two estimates is large: only 37 percent of the estimates by respondents were within plus or minus ten percent of the appraisers' estimates. However, the errors tended to be offsetting, with the mean

respondent estimate only three percent over the appraisers' mean estimate.

One would expect some of the respondents' error in judging value to be eliminated when they are about to put their home up for sale. However, the size of the error is so large that it might not be uncommon (even in 1977 in Columbus, Ohio) to see a significant degree of under- or overpricing as a result of misjudged values. Brokers who do not want to waste advertising funds and time would probably resist a high degree of overpricing. On the other hand, they have the incentive to allow for some degree of underpricing because of the possibility of a quick and easy sale.

The difficulty of sellers to determine appropriate prices has several implications. In order to avoid missing the highest price-bidding buyer, sellers will tend to overprice more than they will underprice. Hence, the typical buyer expects the typical seller to accept a selling price below the list or asking price. To the extent buyers realize that asking prices are not equivalent or even necessarily proportional to expected selling prices, they may give greater reliance to independent value estimation in order to appropriately bid on the property. This would reduce the type of price reliance or influence found in lower price consumer good markets investigated in past studies.
Summary of Propositions to be Investigated

The following is a summary of the propositions or questions which have been raised in previous discussions. The purpose of this summary is not to state actual testable hypotheses, but to organize the conceptual questions into four primary areas to be investigated empirically. These propositions will be re-stated as testable hypotheses within the empirical analysis of Chapter Three to follow.

Proposition One will focus on the relationship of selling price to the buyer's search process.

The duration, intensity and number of properties examined in the search process will be related to selling price in an attempt to measure the benefits of information provided by searching. Optimal search behavior implies the lower a buyer's search cost, the longer or more intense the search process. Those buyers with lower search cost, per unit of time, have lower expected minimum purchase prices for a given property. An additional indirect test relating search costs and purchase price is possible with the assumption that out-of-town buyers, on the average, have higher search costs, per unit of time, than in-town buyers. The question is whether or not out-of-town buyers systematically pay higher prices for property than their in-town counterparts.

Proposition Two will focus on the relationship of time on the market to selling price.
This proposition is an attempt to relate relative selling costs through time on the market to the selling price. The crucial assumption is that sellers with high selling costs, per unit of time, must sell their homes more quickly; to achieve a faster sale, they set and/or accept lower prices on their properties. Thus, a positive relation between time on the market and selling price is expected. Because of the opportunity costs the discounted selling prices may be equivalent for two sellers, while their actual selling prices and times are different.

Additionally, sellers with high expected price aspirations and low selling costs, per unit of time, who over time lower their price expectations, should create a larger list price/selling price differential, the longer the average time on the market.

The major problem in the investigation of proposition two concerns the effects of inflation on selling prices with a sample assumed to be cross-sectional. To determine whether real (deflated) selling price increases or decreases with time on the market a discount rate must be applied to sales prices in making comparisons of properties which required various time periods on the market. The influences of inflation may also be minimized if the sample collection period is limited to the extent possible. The assumption that the sample is cross-sectional will also be aided by inflation

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36 A multi-based deflation index is used to deflate selling prices. This index development is discussed in the empirical analysis.
control through indexed discounting.\textsuperscript{36}

**Proposition Three** will focus on the relation of selling price and time on the market to the method of sale.

Three distinct methods of selling a property are to be examined: (1) a sale by the owner; (2) a sale by a listing broker; and (3) a sale by a co-operative broker of a listed property. This proposition is an attempt to relate the benefits of one method of sale over another to their respective costs. The benefits of one method of sale over another may be in the form of either a higher selling price or a quick sale. The rational seller chooses the method which maximizes his net discounted selling price, taking into consideration both direct costs and the opportunity costs associated with time. Assuming sellers who choose to use brokers have higher selling costs, per unit of time, than owner-sellers, brokers must provide either quicker sales or higher actual selling prices, through promotional and/or other sales skills, in order for the seller to achieve an equal or higher net discounted selling price. In a similar manner co-operative brokers, who charge listing brokers a rather large portion of their commission, must provide benefits in return for their costs. This may be in the form of either providing a buyer (effective demand) where none

\textsuperscript{36}A multi-based deflation index is used to deflate selling prices. This index development is discussed in the empirical analysis.
existed before and possibly avoiding a loss situation for the listing broker or lessening the required time on the market and thus reducing the listing broker's costs equal to or greater than the commission lost.

**Proposition Four** focuses on the relation of the price setting policy to selling price.

This proposition is an attempt to determine whether the listing price chosen by a seller (and broker) can actually influence the final sales price. Of course, on the down side one can always influence the selling price by asking a ridiculously low price for a property. Of greater interest is the extent of influence upward, if any, the seller's pricing strategy has on price. The issue is whether there is a discernable optimal pricing strategy for a seller, such that setting too low an asking price or too high an asking price may not result in a maximized selling price. The major problem in the investigation of this proposition is the extent to which the pricing strategy of the seller reveals itself through time rather than price. The inclusion of time on the market will be one approach to try and control for this effect. Otherwise this proposition becomes a modified test of proposition two which relates selling costs, per unit of time, to selling price. With selling costs, per unit of time, a primary influence on the price setting decision the pricing influence, independent of time, on selling price may be an inseparable test using regression analysis. However, methodologies utilizing controlled environments are not possible in studies of residential property value.
CHAPTER III
EMPIRICAL ANALYSIS

Introduction

Within the last two decades a proliferation of studies have appeared which analyze property values. The theoretical and empirical studies which have used aggregate data, such as census tract variables, have resulted in an aggregate market solution to value; that is, the aggregate supply and demand relationship determines value. Only within the last decade have models moved from aggregate data and mean property value estimations to individual property data and individual property value estimations. Each succeeding work analyzing residential property value has generally improved upon the quality of the sample data, which in turn has marginally improved the explanatory power of the models.

The general descriptive model suggests that single family residential property value is a function of three primary sets of variables: (1) the direct bundle of housing service, which is related to site, location and improvements; (2) financial conditions which may affect housing markets; and (3) market transaction factors. A general descriptive diagram is shown in Figure 3 on page 41. Market transaction factors, which include the methods and mechanisms by which information is communicated between potential buyers and
sellers and by which exchange is facilitated, have largely been ignored. Most published studies have concentrated on the first set of variables. Data have generally been cross-sectional, or assumed to be, and financial conditions which may influence value have been assumed stable.

The following section of this chapter will review some of the significant empirical results in past studies. These results have been integrated into the development of a sample procedure and model which will try to control for some of the significant influences on value. The general operational form of the model is discussed briefly, as well as the symbols, units of measurement, and sources of data. The sample procedure and characteristics will be followed by the development of a control model before the investigation of propositions begins. The remainder of this paper will be devoted to the results and analysis of the empirical investigation.

Control of Site, Locational, and Improvement Characteristics Which Influence Value

Site and Value

Site characteristics have been interpreted to mean many things. Kain and Quigley called landscaping a quality variable while other studies have labeled landscaping a site feature.\(^37\) In addition, several studies have interpreted

RESIDENTIAL PROPERTY VALUE

Transaction Factors

- Cost of Transaction
  - selling costs
    - method of sale
    - price setting strategy
  - search costs
    - information costs
    - price bid strategy

- Time on Market
  - pricing
  - level of promotion
  - market activity

- Imperfect Information

Financial Factors

assume stable

Bundle of Housing Services

- Site
  - lot
  - amenities

- Improvements
  - quantity
    - size sq. ft.
    - rooms
  - quality
    - age
    - condition
    - construction

- Location
  - accessibility
    - work
    - schools
    - shopping
  - environment
    - fiscal services
    - property taxes
    - neighborhood
    - externalities
    - pollution
    - noise, etc.

FIGURE 3

General Descriptive Diagram
characteristics such as neighborhood landscaping as site characteristics. This paper will view site characteristics as attributes directly related to the lot upon which a unit sits, not attached to the dwelling unit.

Site characteristics could also be broken down into quantity and quality measures such as Olsen suggests for the dwelling unit. Lot size would be the quantity measure, and trees, landscaping, fences and such would be quality measures.

The size of a property lot measured in square feet has been found a significant determinant of property value by Kain and Quigley (1970), and Massell and Stewart (1971). Emerson (1972) found log of lot size measured in square feet to be a more significant explanatory variable. It was reasoned that once a lot event went beyond typical lot size, the added size increased utility at a marginally decreasing rate.

Quality measures of a site have generally been omitted due to the difficulty in gathering such data. One might assume that there is a correlation between lot size and

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38 Ibid.


quality as one moves up the value distribution, but this assumption has not been tested.

This study uses two independent variables related to site: one to measure the quantity of site, and one to measure the quality of site. The quantity variable is the square feet of lot size of the property. The mean square feet of property in the neighborhood plus the log of the difference between the square feet of lot of the sample property and the mean square feet of lot for the neighborhood was tried without increasing the significance of the results. The quality variable used is a dummy variable, which indicates whether the lot is well landscaped or not.

Location and Value

Each household's locational decision is the result of two general influences: (1) the desired characteristics of the improvements and their sites, and (2) the features of an urban area that make it a desirable or undesirable place in which to live. Urban area features include (1) accessibility to work, shopping and recreation, and (2) positive or negative effects on property values created by private or public facilities and services and their costs, including property taxes. Both of the two general influences have been investigated by several empirical studies.

Empirical evidence has repeatedly demonstrated that the journey to work is the most important criteria for determining the residential location of most households. The
central hypothesis suggested by John Kain is: "that households substitute journey-to-work expenditures for site expenditures." 41 Kain's hypothesis assumes that as a result of transportation costs, site values decline on a per unit basis with distance from centers of employment. With respect to the journey to work trip and location choice, Kain concluded:

Workers employed in higher-income occupations tended to make longer journeys to work . . . The smallest and largest families were found to make the shortest journeys to work. For the smallest families, I attributed this to low space preferences; the shorter journeys to work by the largest families, I attributed to a capita income constraint. 42

Richard Muth's empirical analysis of the determinants of the intrametropolitan distribution of households by income uncovered no significant partial correlation between household income and distance from the central business district (CBD) after housing age had been taken into consideration. 43 His explanation involved the effects of job locations outside the CBD. As a result of a growing number of jobs located outside the CBD, recent empirical investigations into the determinants of residential property value

42 Ibid.
have used an employment accessibility index as an independent location variable. This employment accessibility index (EAI) represents multiple job sites weighted by their approximate employment percentage of the total employment at the indexed sites. Brigham (1965), Pascai (1967), and Apps (1971) have had statistically significant results with such indices; however, in Columbus, Ohio, Robert Zerbst (1974) applied a gravity employment accessibility variable in the explanation of property values without achieving any significant coefficients. In the Columbus, Ohio area less than 30 percent of the city's employment is in the CBD. One rationalization for the result in Zerbst's study is presented by A. Winger (1970). Winger states: "The failure to perceive the full burden of commuting costs will bias the residential location decision in favor of distant locations." Winger


reasoned: "that the more distant sites are a 'novel' alternative within the feasible set of alternatives," and "for a large number of households the commuting costs incurred at a number of alternative sites are not really visible at the time a housing decision is made which involves the selection of a site."\(^{49}\) Winger's reasoning has not as yet received any empirical support.

Other accessibility factors that have been empirically tested include: the distance to schools, convenience to buslines, and distance to freeway entrance.\(^{50}\) Both Emerson and Zerbst achieved marginally significant positive coefficients on the variable of distance from schools. One explanation given was that negative externalities were generated by exposure to schools. Closeness to busline did not prove significant in Zerbst's model. Emerson, Ridker and Henning did not achieve significant results on the variable indicating closeness to a freeway entrance. However, Zerbst did achieve a very significant coefficient for higher-priced property within one-half mile of a freeway entrance.

Accessibility measures collected in this study include (1) the distance in miles to the CBD; (2) the

\(^{49}\) Ibid.

distance in blocks to the nearest school; and (3) the proximity to freeway entrance. Within the Columbus area, gravity employment type indices have not yielded results significant enough to warrant their continued use.

The second general locational influence on value includes all of the non-accessibility features of an urban area, such as the effects of fiscal services, schools, property taxes, parks, air pollution, and aircraft noise, to mention a few.

In analyzing the effects of a fiscal package (public services or goods and their related costs or property taxes) on residential property values, substantial work has been done by Oates,51 Sabella,52 Orr,53 Coen and Powell.54


Pollakowski,55 Kohlhepp,56 and Ragas.57 In Oates' study he used public school expenditure per pupil as an independent variable and property value as the dependent variable. He concluded that:

for an increase in property taxes, unaccompanied by an increase in the output of local public services, the bulk of the rise in taxes will be capitalized in the form of reduced property values. On the other hand, if a community increases its tax rates and employs the receipts to improve its school system, the coefficient indicates that the increased benefits from the expenditures side of the budget will roughly offset (or perhaps more than offset) the depressive effects of the higher tax rates on local property values.

W. Oates also concluded his results were consistent with the Tiebout model which allows consumers to weigh the benefits of public services against the cost of their tax liability in choosing a community of residence.

Benefits from public services and costs created by property taxes gain additional significance with respect to property values when the costs and benefits are not distributed in an equitable manner. Inequitable distributions of


57Wade Ragas, "The Effects of Property Tax Induced Fiscal Disparities on Suburban and Center-City Housing Values," Ph.D. dissertation, Ohio State University, 1976.
benefits and costs between government jurisdictions create positive and negative externalities: positive externalities for areas said to receive more benefits than they pay for, such as suburbs, and negative externalities for areas said to pay for more services than they actually receive, such as central cities. Recently, Kohlhepp tested the hypothesis that: "a community's average residential property value is positively related to the amount of positive interjurisdictional externalities it consumes from the city."\(^{58}\) This hypothesis was not statistically supported, which supports the conclusion that the central city is probably not exploited by its suburbs, at least in Columbus, Ohio.

Externalities, in addition to being created by fiscal inequities, may be created directly, positively or negatively, by public or private facilities, such as parks, airports, factories or other. Weicher and Zerbst,\(^{59}\) Bloomquist,\(^{60}\) Ridker and Henning,\(^{61}\) Anderson and Crocker,\(^{62}\) and Lyon,\(^{63}\)

\(^{58}\)Daniel Kohlhepp, op cit.


\(^{61}\)R. Ridker and J. Henning, op cit.


have analyzed the effects of such externalities on residential property value. Weicher and Zerbst did achieve statistically supported evidence that positive externalities were capitalized into higher property values for certain properties facing city parks. Bloomquist hypothesized a negative value effect on property near an electric utility plant, decreasing in effect with distance. Bloomquist concluded "that within 11,500 feet of the power plant a typical property value increased .9% as it moves away from the plant by 10%." Ridker and Henning set out to provide evidence of the detrimental effect of air pollution on residential property values. Using a multiple regression technique on a sample of properties in St. Louis, the air pollution variable (a measure of sulfur dioxide) explained 1.2 percent of the variance in the mean property value. Anderson and Crocker in a broader study on the effects of air pollution on residential property values achieved similar marginally significant results.

David Lyon attempted one of the more comprehensive empirical works of the impact of public facilities on urban land values. His investigation included three schools, three parks and one combination school-park. Lyon theorized: "there are two components of the impact a facility might have on housing sale prices. One is the accessibility of the property to the site . . . The second impact would be the more intangible visual effect of the lower density provided
by the park or school." All seven schools or parks revealed negative coefficients of property value with distance from the facility, with four areas showing significant effects at the .01% level. Lyon estimated the average effect on property values from the parks or schools in his study at nine percent.

Percent non-white population has been one of the most common social variables included in property value models. Due to a significant positive coefficient for percent black, Kain and Quigley concluded there was price discrimination against blacks.\(^{64}\) Ridker and Henning found a similar result, also in St. Louis.\(^ {65}\) Emerson found a highly significant negative coefficient on the percentage black variable indicating lower values in black areas; however, there was no control for income level in Emerson's model.\(^ {66}\) In a 1952 study by Laurenti in San Francisco, two similar neighborhoods were compared, one in a three-year black transition period.\(^ {67}\) Laurenti concluded the results revealed no evidence that non-white entry depresses value. Muth concluded blacks or other minority groups do not have a depressing value upon property

\(^{64}\) John Kain and J. M. Quigley, *op cit.*

\(^{65}\) Ron Ridker and John Henning, *op cit.*

\(^{66}\) Frank Emerson, *op cit.*

once income level is accounted for. 68 Other variables used as social measures include income level, median schooling, and population density; however, all have had a high correlation with the percentage of non-white residents.

There are two ways to attempt to control the second general locational influences of an urban area upon property value: (1) they can be avoided; or (2) variables can be included which measure such influences. The primary strategy used in this study is that of avoidance. The entire southern part of the city will be eliminated from the sample of property data collected because of the influence of air pollution. Similarly, the urban areas within one-half mile of the Columbus Airport will be avoided because of the influence of airport noise. In addition, all properties chosen will be at least one block or more away from major intersections, commercial or industrial areas, public parks, schools, golf courses, and at least one-half mile away from Ohio State University. This procedure is discussed in the section on sample selection.

The variables included for other locational influences on value, not included in accessibility measures, include a dummy variable for the community of the property, and a measure of the relative property taxes charged to sample

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68 Richard Muth, op cit.
property. The dummy variable for area is meant to control for most of the fiscal package differences between areas of the sample, and social influences such as neighborhood prestige. The relative property tax variable is a measure of the difference between the actual property tax dollars paid and the average effective property tax rate in dollars for the area of the property (the average effective property tax rate is found by taking the average property tax in dollars paid for an area over the average selling price for properties in that area; this average effective tax rate is then applied to the selling price of the sample property to determine the average effective property tax in dollars). This type of approach is an attempt to control for the influence of relative differences in property tax costs which may reflect inequitable assessments. While no specific hypothesis has been set forth here, this is a test of the influence of differences in effective property tax burdens. Whether such differences in relative property tax burdens are large enough to be perceived and have an influence on property values is questionable.

Improvements and Value

Olsen presented a theoretical formulation for a competitive theory of housing markets, through the concept of

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69 The entire sample will only involve three communities, Upper Arlington, Worthington, and Clintonville.
"housing service units."\textsuperscript{70} Olsen abstracted from the land in dealing with housing improvements. Each dwelling unit was stated as providing a given level of housing service per unit of time. Housing service units were stated as a function of the quality and quantity of housing stock. Olsen viewed quality and quantity as variables which could be traded off in the provision of a given level of housing service units. Accepting Olsen's view implies that houses of different size or different quality (some newer, some older) may actually compete with each other. The closer Olsen's view is to reality, the more essential it is to separate variables of quality and quantity in developing a model of property value with meaningful coefficients. However, that is not the primary purpose of the control model to be developed here.

Quantity variables measure the amount of livable space in units such as square feet, number of rooms, number of bedrooms, or other objective measures. Quality measures relate to the condition and level of utility that can be generated from a given quantity of housing stock.

Scaling techniques have successfully measured housing quality at the lower end of the value distribution. The American Public Health Association technique involved scoring penalty points for dwellings which lacked facilities such as

heating or plumbing. However, such techniques do not discriminate well among properties with common facilities.

Kain and Quigley used factor analysis in discriminating for quality in a St. Louis study of 1,103 units. Two factors were developed which explained forty-seven percent of the total variance of thirty-nine original variables. The first factor included variables which measured exterior unit conditions, such as landscaping, trash on lot, and condition of drives and walks. This exterior quality factor explained 38.8 percent of the total variance of the thirty-nine original variables. An additional 8.2 percent of the variance was explained by structural or interior quality measures, such as condition of walls, ceilings and floors.

Robert Zerbst in his Columbus, Ohio study grouped three scale variables, eleven dummy variables and the year built into three factors as measures of quality. The first factor, called basic quality, contained the year built and heating and plumbing measures, and was highly significant in explaining the variance of selling price. The second factor contained non-essential items, such as air conditioning,

73 Robert Zerbst, op cit.
disposal and dishwasher, and was significant. The third factor involved scaled variables on the condition of walls, ceilings, and the exterior and also was significant.

The major problem with quality variables is the subjective nature of measurement and the very arbitrary definition of quality. In the future, with the potential electronic wizardry and gadgetry that can be built into homes, it will become even more difficult to determine where housing quantity stops and quality begins.

In this study several measures to represent the quality of the improvements are used. In particular, the several significant and easily accessible quality measures used in Zerbst's study in the Columbus area. Nearly every regression model of property value included either the number of rooms or square feet of floor area as quantity measures, always with significant coefficients. In fact, the primary explanatory variable in most property valuation models has been the quantity variable, which often accounts for up to eighty percent of the variance explained by the model. This study uses the square feet of livable housing area as a single quantity variable measure, which has proved satisfactory in many studies.

\[74\] Ibid. For example: Age of house, construction materials, fireplaces, utility type, kitchen equipment, etc. Note that multicollinearity is not a concern between such measures since their purpose is only to control the variation in selling price, and no interpretation is given to their regression coefficients.
The Operational Form of the Model

The dependent variable, selling price, SP, is estimated through a multiple regression model, with the same assumptions and general methodology used in all such models.

Methodological Assumptions

The general form of the least squares regression model is

\[ y = b_0 + b_1 x \ldots b_n x + u \]

where \( y \) is the predicted value of \( Y \), the dependent variable \( b_0 \) is the estimated intercept, \( b_1 \ldots b_n \) are the estimated coefficients which relate the corresponding dependent variable \( x \), to \( y \), and \( u \) is the error of the estimate. The method of estimation is to minimize the sum of the square deviations of the estimated line from the actual sample data line. \( R^2 \) is a measure of the precision of the line equal to the \((\text{Sum of Squares due to regression}) \) divided by the \((\text{Sum of Squares about mean}) \). The closer \( R^2 \) is to unity the greater the precision of the model over the sample from which it was derived.

The assumptions of the model include:

1. \( E(U) = 0 \), or the expected value of the error term is zero.
2. \( E(u_i^2) = \sigma \) for all \( i \), or each \( U \); has a constant variance (homoscedasticity).
3. With repeated sampling the sole source of variation in \( Y \) is variation of \( u \).
4. The number of observations must exceed the number of parameters to be estimated and no exact linear relations exist between the independent variable parameters.
The problems of non-linearity and multicollinearity are discussed in the empirical analysis as they affect the results. However, it is important to point out that multicollinearity between independent variables used to control for the influence of site, location and improvement characteristics is not a major problem in this study. No interpretation is given to any of the regression coefficients on any of the non-market transaction influences on value. Their function is only to control the variation in selling price which relates to non-market transaction factors. Multicollinearity among or between the market transaction variables and other variables is of concern in this study, and such problems are dealt with as they occur.

Variables, Symbols, Units of Measurement and Source

To control for the site, locational and improvement influences on value, the following variables will be used:

<table>
<thead>
<tr>
<th>Independent Variable (Symbol)</th>
<th>Units of Measurement</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Site Quantity (SQ)</td>
<td>Square Feet</td>
<td>Courthouse Records</td>
</tr>
<tr>
<td>2. Site Quality (SL)</td>
<td>0, 1</td>
<td>Inspection</td>
</tr>
<tr>
<td>3. Employment Accessibility (EA)</td>
<td>Distance Miles</td>
<td>Map or Survey</td>
</tr>
<tr>
<td>4. Area (A)</td>
<td>Dummy Variables</td>
<td>Maps</td>
</tr>
<tr>
<td>5. Relative Property Taxes (PT)</td>
<td>Dollars</td>
<td>MLS or Courthouse</td>
</tr>
<tr>
<td>6. Housing Quantity (HQ)</td>
<td>Square Feet</td>
<td>Courthouse Records</td>
</tr>
<tr>
<td>7. Housing Quality (HL)</td>
<td>Age - Years and Dummy Variables</td>
<td>MLS, Courthouse, Owner Survey</td>
</tr>
</tbody>
</table>
The site, locational and improvement influences theoretically relate to selling price (SP) in the following form:

\[ SP = f(SQ + SL - EA \mp A_{1,2,3} \pm PT + HQ + HL) \]

Hypotheses to be Tested

The hypotheses stated below are organized by the proposition number which they relate to. They are stated by the form of measure which is used in the model.

Hypothesis 1a: Residential property selling price is negatively related to the number of properties entered and searched by the purchasing buyer.

Hypothesis 1b: Residential property selling price is negatively related to the number of properties entered and searched per week of active search by the purchasing buyer.

Hypothesis 1c: Residential property selling price is negatively related to the number of properties upon which the purchasing buyer has made offers on other than the home purchased.75

Hypothesis 1d: Residential property selling price tends to be higher when purchased by an out-of-town buyer than when purchased by an in-town buyer.76

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75 The assumption involved in hypothesis 1c is that buyers willing to make offers on homes which are unacceptable to the sellers and forego the purchase have lower search costs, per unit of time, than buyers who make fewer or no offers which are unacceptable.

76 As in 1c there is an assumption that out-of-town buyers have greater search costs, per unit of time, than in-town buyers.
Hypothesis 2: Residential property selling price is directly related to the time a property is on the market (both actual and deflated selling prices are used).

Hypothesis 3a: Residential property selling price tends to be higher when sold through a broker than when sold by an owner.

Hypothesis 3b: Residential property sells faster, at a given price level, when sold by a broker, than when sold by an owner.

Hypothesis 3c: Residential property selling price tends to be higher when a listed property is sold through a co-operative broker than when the listing broker sells the property.

Hypothesis 3d: Residential property sells faster, at a given price level, when sold by a co-operative broker than when sold by a listing broker.

Hypothesis 4: Residential property selling price is directly related to the difference of the percentage decline from list price to sales price for a given property and the mean percentage decline from list price to sales price for the area in which the property is located.

All of the hypotheses which involve potential differences with respect to time on the market utilize both actual and deflated selling prices in their respective tests. The dependent variable involved is identified within the following sections, which analyze test results.
The following symbols and variable names correspond to specific hypotheses:

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Hypothesized Sign</th>
<th>Units of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(H1a) No. Properties Searched (PS)</td>
<td>-</td>
<td>Interval</td>
</tr>
<tr>
<td>(H1b) (PS)/Weeks of Search (PSW)</td>
<td>-</td>
<td>Ratio</td>
</tr>
<tr>
<td>(H1c) No. Offers Made (NO)</td>
<td>-</td>
<td>Interval</td>
</tr>
<tr>
<td>(H1d) Out-of-Town Buyer (OT)</td>
<td>+</td>
<td>Dummy</td>
</tr>
<tr>
<td>(H2) Time on Market (TOM)</td>
<td>+</td>
<td>Days</td>
</tr>
<tr>
<td>(H3a) Broker Sale (B)</td>
<td>$SP_B &gt; SP_O$</td>
<td>Dummy</td>
</tr>
<tr>
<td>(H3b) Broker Sale (B)</td>
<td>$TOM_B &lt; TOM_O$</td>
<td>Dummy</td>
</tr>
<tr>
<td>(H3c) Broker Co-op (CO)</td>
<td>$SP_{CO} &gt; SP_B$</td>
<td>Dummy</td>
</tr>
<tr>
<td>(H3d) Broker Co-op (CO)</td>
<td>$TOM_{CO} &lt; TOM_B$</td>
<td>Dummy</td>
</tr>
<tr>
<td>(H4) Pricing Strategy (PS)</td>
<td>+</td>
<td>Ratio</td>
</tr>
</tbody>
</table>

The theoretical form of the model with hypothesized relationships as well as the control model variables (in parentheses) are as follows:

$$SP^* = f(SQ + SL - FA \pm A_{1,2,3} \pm PT + HQ + HL) - PS, - PSW, - NO, + OT, + TOM, + B, + CO, + PS + \text{error residual},$$

and for time on the market as a dependent variable:

$$TOM = K - B, - CO, + \text{error residual}.$$
The Sample

The sample under study consists of ninety-one residential single-family properties. All of the properties sold between July and December of 1976; their time on the market varied from one day to nearly a year. The majority of the observations were from the Upper Arlington and Worthington areas, with a small number selected from Clintonville—all within the Columbus metropolitan area. A general cross-classification of the sample by area, method of sale, or type of buyer is shown below in Table 4.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>TOTALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Location - Upper Arlington</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>2. Location - Worthington</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Location - Clintonville</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Realtor Sale</td>
<td>10</td>
<td>21</td>
<td>40</td>
<td>71</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Sale by Owner</td>
<td></td>
<td>20</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Realtor - Non-Co-op</td>
<td>34</td>
<td>4</td>
<td>9</td>
<td>21</td>
<td>34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Realtor - Co-op</td>
<td>37</td>
<td>6</td>
<td>12</td>
<td>19</td>
<td>37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Buyer - In-Town</td>
<td>27</td>
<td>24</td>
<td>17</td>
<td>51</td>
<td>10</td>
<td>14</td>
<td>44</td>
</tr>
<tr>
<td>9. Buyer - Out-of-Town</td>
<td>10</td>
<td>10</td>
<td>3</td>
<td>20</td>
<td>7</td>
<td>16</td>
<td>23</td>
</tr>
</tbody>
</table>

The selection of the greater portion of the sample from the Upper Arlington area allowed for several empirical tests to be performed without the need for extensive control over locational influences on property values. Worthington
was selected because of the similarity of demographic characteristics with Upper Arlington. Clintonville was selected, on a very limited basis, to develop greater price stratification within the sample. The use of only three geographical areas enabled the development of a model with fewer independent variables.

In addition to limiting the geographical range of the sample, great care to avoid significant locational influences on property values was taken. The following areas were avoided in the collection of the sample: properties on heavily traveled streets and properties within one block of commercial areas, schools, parks, golf courses or multifamily units. The three areas selected also enabled the aversion of significant air pollution, air traffic noise, and industrial areas. The severe constraints in the sample collection process greatly reduced the need to collect locational related variables and enabled a model to be developed which controls a large proportion of the variation in selling price with fewer independent variables. With the limited number of observations, this was an important consideration.

The sources of the sample information include Realtor multiple listing records, SREA appraisal records, and courthouse property records, as well as direct buyer and seller contact and personal inspection. Deed transfer records were utilized to identify properties which had sold during the last half of 1976. Only conventionally financial properties
with twenty or twenty-five percent down payments were selected with a market mortgage interest rate of around \(8\frac{1}{2}\) percent. This procedure constrained the influence of financing on value. The initial selection of sold properties included well over three hundred observations from Upper Arlington and Worthington. However, after eliminating properties which violated the locational constraints or typical financing assumptions, two-thirds of the initial sample remained. A complete set of data was especially difficult to collect on the properties sold by owners. The sellers and buyers of such property tended to be very suspicious of the use of the information they revealed. The type of property data collected is included in Appendix A.

**The Development of a Control Model**

Before any testing of hypothesized effects on property value began, a model which would take into account the effects of site and improvements on value had to be developed. This model will be referred to as the "control model," since it attempts to control for the variation in selling price related to site, improvement and location characteristics. Symbolically, the control model will be described by \([x \ldots x_n]\) in conjunction with the testing of non-control variables for their effects upon selling price.

The objective of the control model is only to control for the variation in selling price which results from location, site and improvement characteristics with as few
independent variables as necessary to avoid spurious correlation given the limited sample size. Multicollinearity within the group of control variables is not important since no interpretation of the size of their respective regression coefficients is made. The approach of allowing multicollinearity within the control group achieves some of the same goals as factor analysis. That is, some control variables become proxies for much of the information contained in other omitted variables with which they are highly correlated. Therefore, one cannot associate any meaning to the regression coefficient on several of the variables in the control model.

Control models were developed for the sample as a whole, by area, and by other subgroups as needed, and for comparison of important attributes. The full sample control model, used for most tests, is shown below:

\[
\text{Selling Price} = 2422 + 0.54x_3 + 26.8x_4 - 189.5x_5 + 2924.4x_{12} \\
\hspace{1cm} (0.55) \hspace{1cm} (9.99)** \hspace{1cm} (12.32)** \hspace{1cm} (2.47)* \hspace{1cm} (1.17) \\
\hspace{1cm} + 4305.2x_{13} + 7122.5x_{16} + 5172.8x_{17} + 3429.0x_{19} \\
\hspace{1cm} (2.52)* \hspace{1cm} (1.64) \hspace{1cm} (1.10) \hspace{1cm} (1.60)
\]

The t-statistics are given below the regression coefficients. ** indicates significant at the .01 level, and * indicates significant at the .05 level.

\[
R^2 = .902 \hspace{1cm} \text{Adjusted } R^2 = .891 \hspace{1cm} F\text{-ratio} = 94.4
\]

\[x_3\] = lot size in square feet \\
\[x_4\] = living area in square feet \\
\[x_5\] = age in years
\( x_{12} \) = construction type dummy variable for brick or stone, stucco, frame

\( x_{13} \) = number of fireplaces

\( x_{16} \) = located in cul de sac

\( x_{17} \) = swimming pool

\( x_{19} \) = located in Upper Arlington

Nearly eighty-five percent of the variation in selling price controlled by the control model can be attributed to \( x_3, x_4, \) and \( x_5 \) (lot size, living area, and age). The large regression coefficient on \( x_{13} \) is primarily a result of multicollinearity with the number of car spaces and air conditioning, both variables which could not enter with \( x_{13} \) already in the model. While \( x_{19} \) entered as a positive value for Upper Arlington property over Worthington and Clintonville, one should not assume the model is not controlling for differences between Worthington and Clintonville, both represented by dummy variables. Upon closer examination, it was found that \( x_5 \) with a negative sign is highly related to Clintonville where properties on the average are much older than in Worthington. Thus, \( x_5 \), within the model, acts not only as a quality proxy, but also to separate the lower values within Clintonville. In such manner, the control model controls for the variation in selling price due to location, site or improvement attributes. However, it cannot be over-emphasized that no direct interpretation can be made of the regression coefficients within the control model. The control model will be specified as: \( SP = [x \ldots x_n] \)
Inflation and Selling Price

A common assumption in studies in which sample data are collected to develop models of residential property value is that the sample is cross-sectional. However, some elements of time series data are unavoidable in acquiring samples of sufficient size. The result is an inflationary price effect which distorts the development of a time static price model. In order to check for a violation of the cross-sectional sample assumption, to control for inflationary bias, an inflation index is developed based on construction cost indices reported bi-monthly by the U.S. Department of Commerce. 77 Monthly averages may be developed through interpolation. Then, for each property, by taking the index for the month of the initial listing date as the base, and dividing by the index for the month of the selling date, a general deflation index is developed which only applies to the period for which the property was on the market. The appropriate deflation index is applied to the selling price of each respective property to develop a deflated selling price. The deflation index applied to the sample averaged nine percent on an annual basis. Because expected inflation rates may differ from actual cost increases, both nine percent and four

and one-half percent annual inflation rates were tried. The models which resulted using only highly significant independent variables on actual selling price, at nine percent and four and one-half percent assumed inflation rates were as follows:

\[
Selling\ Price = 2166.7 + .45x_3 + 23.85x_4 - 216.5x_5 + 5626.5x_7 \\
\text{(Actual)} \quad (0.45) \quad (8.73) \quad (10.21) \quad (2.73) \quad (2.93) \\
+ 8452.5x_{11} = 5001.0x_{19} \\
\text{(3.78)} \quad (2.51)
\]

\[R^2 = .883 \quad \text{Adjusted } R^2 = .875 \quad F\text{-ratio} = 104.8\]

\text{Selling Price Deflated at an Average Annual Rate of Nine Percent} = 2105.7 + .45x_3 + 23.45x_4 - 201.7x_5 + 5437.9x_7 \\
\text{(0.45) \quad (8.94) \quad (10.38) \quad (2.63) \quad (2.93) } \\
+ 8759.5x_{11} + 4689.7x_{19} \\
\text{(4.04) \quad (2.43)}

\[R^2 = .887 \quad \text{Adjusted } R^2 = .878 \quad F\text{-ratio} = 108.5\]

\text{Selling Price Deflated at an Average Annual Rate of Four and One-Half Percent} = 2132.8 + .45x_3 + 23.67x_4 - 209.3x_5 \\
\text{(0.45) \quad (8.83) \quad (10.32) \quad (2.68) } \\
+ 5527.3x_7 + 8596.8x_{11} = 4848.0x_{19} \\
\text{(2.93) \quad (3.91) \quad (2.47)}

\[R^2 = .886 \quad \text{Adjusted } R^2 = .877 \quad F\text{-ratio} = 107.1\]

In each of the above models the same independent variables were used. It is extremely significant that the overall correlation coefficient, \(R^2\), actually increased, although very marginally, with the inflation adjusted models.
The F-ratios, indicating the significance of the regression models, also marginally increased. The individual variable regression coefficients remained extremely stable with very marginal value fluctuations. The results indicate that the cross-sectional sample assumption is acceptable with respect to the control model used in further empirical tests. The stability of the regression coefficients indicates that the marginal increase in R-square was derived from a reduction in the residual variation of the unexplained variance of selling price. Some properties within the sample which required a long period on the market were adjusted some five to ten percent. With such a large price adjustment it is significant that the overall residual variation of the dependent variable, selling price, declined, especially since the adjustments made were based on rough estimations of the rate of inflation. Given a larger sample, taken over a longer period, the inflationary price effects would certainly interfere with any selling price model development that did not make appropriate adjustments.

For the remainder of this paper, "Deflated SP" will refer to selling price deflated at the average annual inflation rate of nine percent, unless noted otherwise.

The Investigation of the Propositions

This section of the paper will delve into the examination of specific hypotheses related to the market
transaction process. However, an important question should be discussed first: how significant can the market transaction related variables be when the control model is already explaining nearly ninety percent of the variation in selling price for the sample? To answer this, one must first look deeper at the meaning of an $R^2$ value near .90. While the average unexplained variation in selling price is near ten percent, the range of error on a percentage basis of selling price was sixty percent. Thus, on an individual property basis, variations in selling price much larger than the average ten percent unexplained might be related to unexplored variables. The average increase in the $R^2$ value may be very minimal, but this should never be a rationale given for not pursuing new sets of theoretically important variables for their relationships with property values.

**Proposition One**

Proposition One is an attempt to relate the costs and benefits of the home search process to the price actually paid. Four variables were collected which can be directly related to the search process:

$x_{22} = $ the number of homes entered and searched  
$x_{23} = $ the number of weeks spent in active home search  
$x_{25} = $ the number of homes offers were made on other than the one purchased  
$x_{31} = x_{22}/x_{23} = $ the number of homes searched per week
<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Correlation Coefficient and Selling Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>$x_{22}$</td>
<td>18.5</td>
<td>15.80</td>
<td>-.04</td>
</tr>
<tr>
<td>$x_{23}$</td>
<td>8.9</td>
<td>12.44</td>
<td>.08</td>
</tr>
<tr>
<td>$x_{25}$</td>
<td>.48</td>
<td>1.35</td>
<td>-.11</td>
</tr>
<tr>
<td>$x_{31}$</td>
<td>4.23</td>
<td>4.76</td>
<td>-.04</td>
</tr>
</tbody>
</table>

Hypothesis 1a. Residential property selling price is negatively related to the number of properties entered and searched ($x_{22}$) by the purchasing buyer.

a) $x_{22}$ Alone Results (t-statistic)

$$SP = 63.704 - 68.6x_{22}$$

N = 91

$$R^2 = 0$$

(14.3) (.37)

b) $x_{22}$ Results with Control Model

$$SP = [x \ldots x_n] - 195x_{22}$$

N = 91

Adjusted $R^2 = .90$ F-ratio = 121.9

For $x_{22}$ the t-statistic is significant at the .01 level.

c) Deflated SP Control Model and $x_{22}$ Results

$$D-SP = [x \ldots x_n] - 139x_{22}$$

Adjusted $R^2 = .90$ F-ratio = 116.9

For $x_{22}$ the t-statistic is significant at the .05 level.
d) $x_{22}$ Results with Control Model

Grouped by the Number of Searches

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of Observations</th>
<th>Mean SP</th>
<th>Mean Time on Market of Property Bought</th>
<th>% Out-of-Town Buyers</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 or less Searches</td>
<td>37</td>
<td>73,209</td>
<td>97</td>
<td>37.8</td>
</tr>
<tr>
<td>11 - 25 Searches</td>
<td>26</td>
<td>58,356</td>
<td>45</td>
<td>26.9</td>
</tr>
<tr>
<td>26 or more Searches</td>
<td>18</td>
<td>62,489</td>
<td>34</td>
<td>11.1</td>
</tr>
</tbody>
</table>

10 or Less Searches

Correlation Coefficient of $x_{22}$ with SP = -.265
Correlation Coefficient of $x_{22}$ with time on market = -.391

$$SP = [x \ldots x_n] - 1188.4x_{22}$$

$$\text{Adjusted } R^2 = .944$$
$$\text{F-ratio} = 77.4$$
The t-statistic for $x_{22}$ is significant at the .05 level.

11 - 25 Searches

Correlation Coefficient of $x_{22}$ with SP = .244
Correlation Coefficient of $x_{22}$ with time on market = -.255

$$SP = [x \ldots x_n] - 315.6x_{22}$$

$$\text{Adjusted } R^2 = .89$$
$$\text{F-ratio} = 50.4$$
The t-statistic for $x_{22}$ is not significant.
26 or More Searches

Correlation Coefficient of $x_{22}$ with $SP = .417$
Correlation Coefficient of $x_{22}$ with time on market = -.136

$$SP = [x \ldots x_n] + 136.4x_{22}$$

(1.1)

Adjusted $R^2 = .91$  \hspace{1cm} F-ratio = 36.5  \hspace{1cm} The t-statistic for $x_{22}$ is not significant.

Whenever any degree of multicollinearity is present among key variables in a model, one must be very cautious in the interpretation of regression coefficients. In examining the correlation matrix there are no correlation coefficients between $x_{22}$ and the control model variables over .15, with most under .1. Therefore, hypothesis 1a. will be accepted since the t-statistic in the full sample results is significant at the .01 level, and there is sufficient probability the regression coefficient on $x_{22}$ is negative. However, with further investigation some qualifications and cautions must be placed on the above conclusion. In breaking down the sample into groups of low search, medium search and high search, the regression coefficient is respectively -1188 for each search in the low search group, -316 for each search in the middle search group, and +136 for each search in the high search group. The regression coefficient in the three groups indicates not only a nonlinear relationship with marginally decreasing benefits from search, but a positive regression coefficient indicates a penalty for those who search too much.
The extremely large regression coefficient in the low search group called for greater scrutiny with further insights revealed. The low search group is made up of nearly forty percent of out-of-town buyers. In later empirical tests the out-of-town buyers tended to pay more for a given type of property than in-town buyers. The \( x_{22} \) variable is highly related in the low search group of out-of-town buyers who have searched less properties than their in-town counterparts. Thus, the large regression coefficient is a result of \( x_{22} \) becoming in part a proxy for in-town or out-of-town buyers.

In examining further the high search group with a positive regression coefficient, one can see a high correlation between the weeks spent searching and the number of searches. This suggests a potential inflation bias in the regression coefficient loading onto \( x_{22} \). However, the results with deflated SP continue to support a significant negative relationship between \( x_{22} \) and selling price (see model c).

In later empirical tests a positive regression coefficient consistently loaded onto the number of weeks spent in home search. This result is consistent with the notion of an opportunity cost for those buyers who search so long that many of the homes searched earlier become sold. In addition, those buyers who searched over twenty-five properties may have been attempting to satisfy rather specific
taste in a home. Such taste-oriented buyers may be willing to pay a premium to be sure they would not lose a property which was so difficult to find.

The non-linear and positive regression coefficient on $x_{22}$ in the extreme suggests that a measure of the intensity of the search process may be a worthwhile test.

Hypothesis 1b. Residential property selling price is negatively related to the number of properties entered and searched per week of active search ($x_{31}$) by the purchasing buyer.

a) $x_{31}$ Results with Control Model

\[
SP = [ x \ldots x_n ] - 415x_{31} \\
(2.01)
\]

Adjusted $R^2 = .89$ \hspace{1cm} F-ratio = 92.5

For $x_{31}$ the t-statistic is significant at the .05 level.

The resulting negative regression coefficient on $x_{31}$ suggests that, on the average, buyers who search more intensely will pay lower prices for a given home than those less intensive searchers. This does not imply that some buyers would not benefit by being patient and waiting for additional properties to come on the market. Within small submarkets of scarce supply, buyers who can search for long periods may be better off.
Hypothesis 1c. Residential property selling price is negatively related to the number of properties upon which a buyer has made offers other than the home purchased \( (x_{25}) \).

\[ x_{25} \text{ Results with Control Model} \]

\[ N = 91 \]

\[ SP = \left[ x \ldots x_n \right] - 1706.7x_{25} \]

\[ (2.54) \]

Adjusted \( R^2 = .904 \), F-ratio = 123

For \( x_{25} \) the t-statistic is significant at the .05 level.

Approximately twenty percent of the buyers in the sample made offers on properties other than the one purchased. Most of these buyers made offers on only one other house, with one buyer making offers on as many as five homes. The number of offers made on other homes may be an excellent proxy for search costs or for value-oriented buyers as opposed to taste-oriented buyers. A buyer who will not raise his offer to the level necessary for an agreement is constraining his offer to an opinion on the value of the property. The lack of multicollinearity between the number of other homes upon which offers were made and the other market transaction related variables adds to the significance of the test. In fact, when all of the other market transaction variables were added into the same model, the regression coefficient on \( x_{25} \) changed only a fraction, from -1706.7 to -1716.5, with the t-statistic remaining significant at the .05 level. Hypothesis 1c. is accepted.
An additional proxy for search costs may be whether a buyer is an in-town or out-of-town buyer. The reasoning is that out-of-town buyers incur higher search costs, on the average, and it may be optimal for them to search less even though they may pay slightly more for a given home. Furthermore, to the extent out-of-town buyers move from cities where property values tend to be higher than the Columbus area, they may be biased in determining an opinion on the value of a home they are considering purchasing. Twenty-five percent of the entire sample consists of out-of-town buyers ($x_{24}$). The correlation coefficient between $x_{24}$ and selling price is .2439.

Hypothesis 1d. Residential property selling price tends to be higher when purchased by an out-of-town buyer than when purchased by an in-town buyer.

$x_{24}$ Results with Control Model, Full Sample $N = 91$

$$SP = [x \ ... \ x_n] + 5179x_{24}$$

($2.45$)

Adjusted $R^2 = .908$ \hspace{1cm} F-ratio = 127.6

For $x_{24}$ the t-statistic is significant at the .05 level.

$x_{24}$ Results with Control Model, Upper Arlington Only $N = 60$

$$SP = [x \ ... \ x_n] + 6515x_{24}$$

($2.41$)
Adjusted $R^2 = .89$  \hspace{1cm} F-ratio = 59.4
For $x_{24}$ the t-statistic is significant at the .05 level.

The size of the regression coefficient of $x_{24}$ is rather large relative to the average selling price of homes in the full sample or in Upper Arlington alone. It suggests that out-of-town buyers pay on the average nearly ten percent more for property than their in-town counterparts. One reason for such a large regression coefficient is multicollinearity where $x_{24}$ is acting as a proxy for other variables. In examining the out-of-town and in-town buyer selling price distributions, one finds that out-of-town buyers purchased property with an average selling price nearly fifteen thousand dollars over in-town buyer property. While the control model adjusts for a large portion of this difference, some multicollinearity does appear and suggests the regression coefficient is biased upwards. As an attempt to counter the general purchase price differential, a less biased sample was developed. First, Clintonville, where all buyers were from Columbus, was omitted. Next, a distribution of in-town buyer property was selected such that the control model computed mean selling price matched the mean computed selling price for the distribution of out-of-town buyer property. Residual bias was kept as close to zero as possible. With this less biased sample another test was performed.
Results with Control Model

and Unbiased Sample

\[ SP = [x \ldots x_n] + 6215.2 x_{24} \]

\[ (2.64) \]

Adjusted \( R^2 = .86 \)

F-ratio = 73.2

The t-statistic for \( x_{24} \) is significant at the .05 level.

The regression coefficient in the less biased run was only reduced some three hundred dollars. The problem of multicollinearity was reduced but not eliminated. \( x_{24} \) and living area in square feet were correlated at .10. No other correlation coefficients over .10 existed, however.

Still baffled by the size of the regression coefficient, one must ask that if a seller can achieve a selling price on the average nearly ten percent higher from an out-of-town buyer than an in-town buyer, then why not wait for an out-of-town buyer to come along? It is unlikely that all sellers realize, if it is true, that on the average out-of-town buyers will pay more for comparable property. Even with such knowledge, not all sellers may be able to wait for such a buyer to come along. By examining the average time on the market of property purchased by in-town and out-of-town buyers, it is apparent that a significant number of sellers do wait for buyers with the characteristics, and perhaps search costs, of the out-of-town buyers in the sample. The average time on the market of property purchased by in-town buyers was 49.9 days compared to 100.5 days for the out-of-
town buyers.

The large differential in the average time on the market for properties purchased by in-town compared with out-of-town buyers suggests part of the regression coefficient is due to an inflationary bias. As a check for this the model run is repeated using deflated selling price, as shown below. The expected positive bias should approximate:

\[
\frac{100.5 - 49.9}{365}(0.09)(62,438) = 779
\]

where .09 is an assumed inflation rate and 62,438 is the average selling price of the sample.

**Deflated SP and x_{24} Results**

\[
SP = [x \ldots x_n] + 5191.5x_{24}
\]

(2.45)

The regression coefficient on \( x_{24} \) is reduced from 6215.2 to 5191.5, suggesting a positive inflationary bias of 1023.7. The results remain significant and continue to suggest a premium is paid by out-of-town buyers for residential property.

**Summary of Results Investigating the Buyer Search Process and Selling Price**

Of all the propositions investigated, the strongest statistical support was revealed in empirical tests related to the buyer search process and characteristics. Demonstrated as beneficial was additional property search as well as more intensive property search. However, the search benefits in terms of the reduction in purchase price per
search did not appear as a linear relationship. Additional investigation of buyer characteristics aided in the interpretation of the non-linear relationship. Out-of-town buyers, who on the average search much less than in-town buyers, tended to pay more for property deemed to be of equivalent value by the control model. The large size of the differential between what in-town and out-of-town buyers pay must be attributed in part to multicollinearity. Also, significant is the fact that buyers from out-of-town tended to purchase properties which had been on the market longer than average. Such property may be from sellers with lower than average selling costs or with low urgency to sell, who can afford to wait for higher search cost buyers to come along. Even if out-of-town buyers did not have above average search costs, their perceptions of relative property values may be biased because of the area from which they have moved.

Buyers who searched over twenty-five properties tended to actually pay more for a given property with every search. Such results may be related to greater importance placed on finding a property compatible with their taste than finding a property to which the general market would attribute a given value. The results indicate that there may be a continuum of buyers, where at one extreme taste is all that matters and at the other extreme value is all that matters. The value-oriented buyer attempts to purchase at a price which he feels is low relative to what the general market
would pay for such a property. A proxy for the value-oriented type of buyer may be the identification of buyers who placed offers on homes other than the one purchased, which were obviously not accepted. The buyers who made offers on other properties tended to pay less than those buyers who made no other offers on properties given equivalent values by the control model.

Proposition Two

Proposition Two is an attempt to relate the urgency of selling or selling costs to the selling price of a property. The crucial assumption is that on the average, the longer the time a property is on the market, the lower is the selling cost. Sellers who can leave their property on the market for a relatively long period, it is reasoned, will have a greater probability of achieving a selling price above what they would have received in a shorter time period.

Variable Description

\( x_{30} \) = the number of days the property was on the market measured from the initial listing day to the date a contract for sale was signed.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>( x_{30} ) Mean</th>
<th>Standard Deviation</th>
<th>Correlation Coefficient with Selling Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Sample</td>
<td>91</td>
<td>65.0</td>
<td>56.1</td>
<td>.29</td>
</tr>
<tr>
<td>Low Price Range</td>
<td>37</td>
<td>52.4</td>
<td>44.4</td>
<td>-.24</td>
</tr>
<tr>
<td>Mid Price Range</td>
<td>28</td>
<td>61.6</td>
<td>55.0</td>
<td>.00</td>
</tr>
<tr>
<td>High Price Range</td>
<td>26</td>
<td>90.2</td>
<td>71.6</td>
<td>.145</td>
</tr>
</tbody>
</table>
Hypothesis 2: Residential property selling price is directly related to the time a property is on the market.

\[ x_{30} \] Results with Control Model, Full Sample  \( N = 91 \)

\[ SP = [ x \ldots x_n] + 55.2x_{30} \]
\[ (2.95) \]

Adjusted \( R^2 = .91 \)  \( \text{F-ratio} = 111.1 \)
For \( x_{30} \) the t-statistic is significant at the .05 level.

Deflated \( SP \) and \( x_{30} \) Results with Control Model

Full Sample

\[ D-SP = [ x \ldots x_n] + 34.9x_{30} \]
\[ (2.68) \]

Adjusted \( R^2 = .90 \)  \( \text{F-ratio} = 119.6 \)
For \( x_{30} \) the t-statistic is significant at the .05 level.

\[ x_{30} \] Results with Control Model  \( N = 37 \)

Low Price Range

\[ SP = [ x \ldots x_n] + 6.6x_{30} \]
\[ (.35) \]

Adjusted \( R^2 = .63 \)  \( \text{F-ratio} = 9.7 \)
For \( x_{30} \) the t-statistic is not significant.

\[ x_{30} \] Results with Control Model  \( N = 28 \)

Middle Price Range

\[ SP = [ x \ldots x_n] + 9.5x_{30} \]
\[ (.73) \]
Adjusted $R^2 = .70 \quad F\text{-ratio} = 8.7$

For $x_{30}$ the t-statistic is not significant.

$x_{30}$ Results with Control Model \hspace{1cm} N = 26

High Price Range

\[ SP = [x_1 \ldots x_n] + 23.5x_{30} \]

\[ (.60)^7 \]

Adjusted $R^2 = .83 \quad F\text{-ratio} = 21.7$

The t-statistic for $x_{30}$ is not significant.

The regression coefficient on $x_{30}$ appears significant in the full sample models. The use of the deflated selling price as a dependent variable reduced the regression coefficient on $x_{30}$ from 55.2 to 34.9, demonstrating a positive inflation bias of some 37 percent. However, the regression coefficient remains positive and significant.

In examining the average time on the market of three price range groups, it is obvious that the higher priced properties generally require more time on the market. This is further evidenced by examining the Multiple Listing Service Data for 1976 for the Columbus Metropolitan area. Over four quarters the average percentage of total residential properties which were for sale at $\$70,000$ and over equaled 37 percent. However, the average percentage of total residential property which was sold at over $\$70,000$ equaled only 21 percent. This indicates the equilibrium average time on the market for higher priced properties may be longer than for lower priced properties. If this is true, then one would
need a regression model which accounted for nearly one-
hundred percent of the variation in selling price to make a
test which relates time on the market to selling price. This
is because as the site, locational and physical attributes
such as size increase, average time on the market may increase
(at least in the Columbus market). Some of the site, loca-
tional and physical attributes may show their effects on
value through the variable, time on the market, because of
their high correlation (one cannot conclude that having more
time on the market will always result in a higher selling
price from tests with a model developed over several price
ranges). A valid investigation of time on the market and
selling price may require a test sample over a very limited
price range.

In order to limit to the greatest degree possible the
price range of a test sample, those price ranges with the
largest concentration of properties in the total sample were
subdivided. Deflated selling price is used as the dependent
variable on the following tests.

<table>
<thead>
<tr>
<th>Deflated SP and $x_{30}$ Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 22</td>
</tr>
<tr>
<td>$40 - 50,000$ Price Range Only</td>
</tr>
</tbody>
</table>

\[
SP = [x \ldots x_n] - 2.8x_{30} \\
\quad (1.3)
\]

Adjusted $R^2 = .42$ \hspace{2cm} F-ratio $\approx 6.0$
Deflated SP and $x_{30}$ Results  

$50 - 70,000$ Price Range Only  

$N = 24$

$SP = [x_{1} \ldots x_{n}] - 9.8x_{30}^{(0.7)}$

Adjusted $R^2 = 0.41$  

F-ratio = 5.1

Neither of the above models represent valid tests since the overall regression model is not even close to minimum significance levels. The lack of a positive regression coefficient, however, is interesting. While not a valid test for rejecting or accepting an hypothesis, the results point out the problems in making such a test. What is required is a fairly large sample within a rather limited price range. A highly significant control model is needed to avoid the problems of multicollinearity that result from higher priced properties being on the market longer, on the average, than lower priced groups. Without such a cautious approach serious misinterpretation of market behavior may result.

Hypothesis 2 cannot be accepted or rejected based on the results of this study.

Proposition Three

Proposition three is an attempt to relate the method by which a property is sold to the selling price and selling time. Two comparisons are of interest: (1) broker sold property vs. owner sold property; and (2) among broker sales, co-operative sales with a seller's and buyer's broker vs.
non-co-operative sales where the listing broker actually sells the property.

Hypothesis 3a: Residential property selling price tends to be higher when sold through a broker than when sold by an owner.

To try and avoid some of the spurious associations which may occur between owner or Realtor sales and selling price as a result of the generally higher average price of the broker sales, a less biased sample was selected. This sample included a distribution of broker sales with a mean control model computed selling price set equal to the mean control model computed selling price of owner sales.

Results with $x_{26}$, Owner Sales vs. Realtor Sales $N = 39$

on an Unbiased Price Sample with Control Model

$$SP = [x \ldots x_n] + 2048.3x_{26}$$

$$\text{(1.04)}$$

Adjusted $R^2 = .88$ \hspace{1cm} F-ratio = 140.9

The t-statistic for $x_{26}$ is not significant.

The resulting positive regression coefficient on $x_{26}$ is exactly the opposite of the hypothesized result for owner sales. However, the regression coefficient is not significant. In examining the correlation coefficient matrix for correlation between $x_{26}$ and the control model variables, several problems were apparent. Of greatest concern was the direct correlation of $x_{26}$ with lot size, living area, and
age. The regression coefficient for lot size actually became negative, -.242. Thus, $x_{26}$ may be acting as a proxy for some of the control model variables. To try and correct this problem, variables other than lot size, living area and age were tried as control variables, such as the number of bedrooms, baths and car spaces in garage. However, a significant model at even the .10 level did not result. The use of deflated selling price as the dependent variable increased positively the size of the regression coefficient on $x_{26}$. This is because the average time on the market of owner sales for the sample is less than that for the broker sales (opposite the hypothesized result). The use of deflated selling price did not reduce the problems of multicollinearity with control model variables, and thus a satisfactory test of hypothesis 3a is improbable with the given sample and data collected. If anything, the results tend to confirm the owners' ability to sell their own property at prices similar to those found with broker sales.

Before going too far in acclaiming the owners' success at selling property, a note of caution is necessary. Within the given sample, only those owner sales which were successful could be collected. Those who did not or could not sell their property after some time period of attempting to do so and ended up listing with brokers are not revealed by the information available on this sample. Such persons, who attempted but failed to sell their own property at satis-
factory prices, may even far outnumber the successful selling owners. Brokers then, may increase effective demand, in the form of a potential buyer, where none existed before. Furthermore, to the extent owner-sellers become frustrated sooner than would experienced brokers, and end up listing with brokers, a negative bias can also be expected in the average time on the market of the successful owner sales collected in the sample. This may be evidenced by the results in the testing of hypothesis 3b, following.

Hypothesis 3b: Residential property sells faster, at a given price level, when sold by a broker than when sold by an owner.

\[ x_{26} \text{ Results with Time on the Market } N = 91 \]

as the Dependent Variable

\[
\text{TOM} = 68.9 - 20.1x_{26} \\
(2.41)
\]

Adjusted \( R^2 = .20 \) \hspace{1cm} F-ratio = 15.2

The t-statistic on \( x_{26} \) is significant at the .10 level.

The regression model is significant at the .10 level.

The results above indicate that owner sales within the sample on the average required less time to sell by some twenty days than did broker sold property. A comparison of the mean time on the market for owner sales to broker sales in the sample bears out a similar result. Either a strong negative bias is contained within the sample of owner sales.
for time on the market, or the hypothesis must be rejected. The opinion of the author is that the bias argument is the probable case.

Hypothesis 3c: Residential property selling price tends to be higher when a broker-sold property is sold through a co-operative broker than when the listing broker sells the property (x_{27} = Co-op).

\[ SP = [x \ldots x_n] + 1235.7x_{27} \]
\[ (.49) \]

Adjusted \( R^2 = .87 \)  
F-ratio = 119.5  
For \( x_{27} \) the t-statistic is not significant.

\[ SP = [x \ldots x_n] + 627.3x_{27} \]
\[ (1.76) \]

Adjusted \( R^2 = .931 \)  
F-ratio = 118.8  
The t-statistic is significant at the .10 level.

Using the standard control model the inclusion of \( x_{27} \) did little to aid in explaining the variation of selling price. The regression coefficient never came close to significant levels. When the control model was varied to allow for the maximization of \( R^2 \), the regression coefficient became only marginally significant. The result of a positive regression coefficient on \( x_{27} \) lends some credibility to the
control model when one examines the price range distributions of non-co-op and co-op sales. The average price on non-co-op sales in the sample is several thousand dollars over the average price for co-op sales. Thus, if multicollinearity is to be a problem it would most likely create a negative regression coefficient for co-op sales.

The results are not strong enough to support hypothesis 3c.

Hypothesis 3d: Residential property sells faster, at a given price level, when sold by a co-operative broker than when sold by the listing broker.

\[ x_{27} \text{ Results with Time on the Market } N = 91 \]

as the Dependent Variable

\[
\text{TOM} = 57.9 - 16.8x_{27} \\
(1.4)
\]

Adjusted \( R^2 = .1 \) \hspace{2cm} F-ratio = 2.9

The t-statistic and the overall model are insignificant. When combined with \( x_{26} \), owner sales, a marginally significant model is possible, as below:

\[
\text{TOM} = 98.9 + 6.5x_{27} - 33.6x_{26} \\
(1.6) \hspace{1cm} (2.4)
\]

Adjusted \( R^2 = .23 \) \hspace{2cm} F-ratio = 16.2

The t-statistic on \( x_{27} \) is not significant.
The statistical tests indicate that sales by brokers, either co-operatively or alone, within the sample, are not likely to be significantly different on the basis of either price or selling time. Both hypothesis 3c. and 3d. cannot be accepted.

Proposition Four

Proposition four is an attempt to relate the seller's price setting policy to selling price. It has been demonstrated that the proportion of list price realized by the seller diminishes with time on the market, or that price concessions are inversely related to time on the market.\textsuperscript{78} However, what has not been tested is whether the asking or list price can affect selling price, independent of time. If two groups of properties with equal appraisal values or mean model predicted values, all sell in two months time period, and one group selected asking prices five percent higher than the other group, should we expect any systematic significant difference in their selling prices? The economist assuming a rational man would say No. But, marketing researchers and psychologists, based on studies discussed earlier, would say (based on trust in the opinions on value of seller/brokers) that there may be some reliance on asking prices by potential buyers as they formulate their own opinions of value. This

\textsuperscript{78}See Belkin et.al., \textit{op cit.}, p. 68.
may bias their price bids upward or downward, depending on the relation of the asking price to the mean market value for such property.

The question is whether there is an optimal pricing strategy for a seller, such that setting too low or too high an asking price will not result in a maximized selling price, independent of time. Hypothesis four is written in the literal form of the variable, \( x_{33} \), to be tested. This variable, called "pricing strategy," compares the typical pricing spread (list to selling price on a percentage basis) to the pricing spread for each property. The variable is regressed on selling price to see if over- or under-typical pricing spreads add to the explanation of the variance of selling price.

The variable described in hypothesis 4, below, is in the following form:

\[
x_{33} = \frac{LP_i - SP_i}{LP_i} - \frac{LP_a - SP_a}{LP_a}
\]

LP = list price
SP = selling price
i = refers to each property individually
a = refers to sample area average

Hypothesis 4: Residential property selling price is directly related to the difference of the percentage decline from list price (LP) to selling price (SP) of a sample property (i) and the mean percentage decline of list price to selling price for the entire sample in the area (a).
This mathematical form of $x_{33}$ converts the difference of the initial asking price to selling price on a percentage basis into a positive or negative value. The value becomes positive when the initial asking price is above the typical initial pricing spread for the area within which the sample property is located. The value is negative whenever the initial pricing spread is below the average for the area. Initially, the mean value of $x_{33}$ will be set to zero. However, there is no reason to believe that the typical pricing spread is optimal, and a lower or higher mean could be selected.

The variable $x_{33}$ is multiplied by 100 to convert the observations to percentage figures. This eases the interpretability and reduces the size of the regression coefficients.

Before developing a test run, an examination of the correlation matrix suggests multicollinearity would occur between control variables and $x_{33}$. Also, the correlation coefficient between $x_{33}$ and selling price equals .384, which indicates that higher priced properties tend to have larger pricing spreads even on a percentage basis. This is demonstrated in Table 5. The correlation coefficient between $x_{33}$ and time on the market equals .5183. Again, this may in part be because of a greater pricing spread on higher priced properties which generally take longer to sell. However, one would expect properties which ask a larger pricing spread
above the mean market value for such property to require more
time to sell. Properties with larger asking prices relative
to their mean values may be reflective of lower selling costs
(a lower urgency to sell), and this along with a longer aver-
age time on the market, would reinforce the hypothesized
result. Thus, time on the market is a necessary control
variable to be included in tests relating pricing strategy
to selling price; otherwise, time related factors, rather than
the pricing strategy, may be influencing the selling price.

TABLE 5

Percentage Decline from List Price
to Selling Price by Price Range

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>List Price</th>
<th>Selling Price</th>
<th>SP/LP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Sample</td>
<td>91</td>
<td>66,118</td>
<td>62,438</td>
<td>.944</td>
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<tr>
<td>Low Price Group</td>
<td>37</td>
<td>41,747</td>
<td>40,055</td>
<td>.959</td>
</tr>
<tr>
<td>Mid Price Group</td>
<td>28</td>
<td>64,329</td>
<td>61,477</td>
<td>.956</td>
</tr>
<tr>
<td>High Price Group</td>
<td>26</td>
<td>102,727</td>
<td>95,635</td>
<td>.931</td>
</tr>
</tbody>
</table>

$x_{33}$ Results with Control Model and $x_{30}$

$SP = [x \ldots x_n] + 36.8x_{30} + 899.2x_{33}$

(1.73) (3.5)

Adjusted $R^2 = .917$  \hspace{1cm} F-ratio = 39

The $x_{33}$ t-statistic is significant at the .01 level.
The $x_{30}$ t-statistic is significant at the .10 level.
Interpreting the results literally, the regression coefficient on $x_{33}$ indicates that by raising the list price one percent higher, one could increase the expected selling price by nearly nine hundred dollars (more than one percent of the average selling price). Part of the inflationary bias should load onto $x_{30}$ however, multicollinearity is evident between $x_{30}$ and other control variables. Therefore, deflated selling price is tried in the next test run.

Also, an attempt is made to reduce some of the upward bias and multicollinearity created by a larger pricing spread in the high price range by setting the means of the percentage spread between list and selling price equal for the three price groups.

$x_{33}$ Results with Control Model and $x_{30}$ on Sample with Less Bias with Respect to Pricing Spread and Deflated SP

$$D-SP = [x \ldots x_n] + 211.7x_{33}$$

(1.23)

Adjusted $R^2 = .86$ \hspace{1cm} F-ratio = 61.8

The $x_{33}$ t-statistic is not significant.

The results with the less biased sample and deflated selling price indicate the relative pricing spread, between list and selling price, is not significantly related to the final selling price. If the regression coefficient on $x_{33}$ was significant, then it would imply an average increase in
the asking price of $620 would increase the final sales price by $212 on the average, or a decrease in the asking price of $620 would decrease the final sales price on the average by $212. However, the results tend to confirm fairly independent formulations of value estimation by potential buyers, with very little reliance on asking prices. In addition to the regression results, some general statistical averages indicate the awareness of the general market of current property values.

In thirty-seven of ninety-one observations the list or initial asking price on the property was below that of the computed selling price via the control model. In these cases the average decline from the asking price to selling price was only 2.89 percent. The remainder of the sample had an average decline from list to selling price of 7.1 percent. This indicates the average buyer will bid a price which is closer to the asking price if their opinion of value indicates such a value. Also, the large 7.1 percent decline from list to selling price on the properties selling above the computed selling price indicates the market constrains unrealistic price expectations in list prices. The results also indicate that because buyers have come to expect some price concessions, some sellers may underprice their properties and not achieve even average selling prices for their property. Buyers may be hesitant to pay the asking price on a property for fear they will overpay.
Simultaneous Test of Several Market Transaction Variables with Control Model

The purpose of including several of the previously tested variables in one regression model is to examine the stability, or lack of multicollinearity, in the values. Another aim of such a test is to identify stable and consistent variables to use as proxies for market related phenomena in further research. Brief variable descriptions are:

\[ x_{22} = \text{the buyer's number of searches} \]
\[ x_{23} = \text{the number of weeks spent searching} \]
\[ x_{24} = \text{out-of-town buyer} \]
\[ x_{25} = \text{the number of homes other offers were made on} \]
\[ x_{26} = \text{owner sale (as opposed to broker sale)} \]
\[ x_{30} = \text{time of property on market in days} \]

Results with Control and \( x_{22}, x_{23}, x_{24}, x_{25}, x_{26}, x_{30} \), \( N = 91 \)

\[
SP = [x \ldots x_n] - 164.3x_{22} + 274.2x_{23} + 4135.9x_{24} + 1785.8x_{25} + 1600x_{26} + 14.4x_{30} \\
(1.92)** (2.43)** (1.55)* (2.02)** (1.60)** (.62)
\]

Adjusted \( R^2 = .923 \)    \( F\)-ratio = 42.5

T-statistics:  ** = significant at the .05 level  
*** = significant at the .01 level  
* = significant at the .10 level
Results with Control Model and \( x_{22}', 23', 24', 25', 26 \) N = 91

\[
SP = [x \ldots x_n] - 179.5x_{22} + 276.2x_{23} + 5393.8x_{24} - 1716.5x_{25} + 2200x_{26}
\]

\[
(2.46)*** \quad (2.71)*** \quad (2.36)**
\]

\[
(2.16)** \quad (1.95)**
\]

Adjusted \( R^2 = .928 \)

The high degree of multicollinearity between \( x_{22}', x_{23} \) and \( x_{24} \) does reduce both the size and significance of their respective regression coefficients. In no cases are the signs reversed. The significant positive regression coefficient on \( x_{23} \), the number of weeks spent searching, indicates a penalty for the average buyer who searches over a long period, independent of the number of searches made. The size of the regression coefficient on \( x_{24} \), out-of-town buyer, is overstated because of multicollinearity with \( x_{30} \), time on the market. The influences of time on the market such as inflationary pressures load onto \( x_{24} \), and with \( x_{24} \) in the model \( x_{30} \) is reduced to insignificant levels. The number of homes offers were made on, \( x_{25} \), shows surprisingly low correlation with any other of the buyer related variables. The regression coefficient on \( x_{25} \) remains very stable and fairly significant even with the other buyer related variables in the model. This implies a fairly high degree of independence in \( x_{25} \) and adds credibility to its use as a variable for buyer related phenomena. Repeating simultaneous tests with \( x_{22}', x_{23}', \) and \( x_{24} \) replaced by only \( x_{25} \) results as follows:
\[ SP = [x \ldots x_n] = 1701.1x_{25} + 1842.7x_{25} + 18.9x_{30} \]
\[ \text{(2.01)\textsuperscript{**} (1.40)\textsuperscript{*} (.88)} \]

\[ SP = [x \ldots x_n] = 4175.4x_{24} - 1756.8x_{25} + 1803.7x_{26} + 17.7x_{30} \]
\[ \text{(1.69)\textsuperscript{*} (2.10)\textsuperscript{*} (1.55)\textsuperscript{*} (.90)} \]

Again the stability of \( x_{25} \) suggests it is a good proxy for a buyer search related variable with low multicollinearity with time or other market phenomena. Some twenty to twenty-five percent of the regression coefficient which loads onto \( x_{24} \) is a result of correlation with time and thus, also, inflation. This points out the necessity of putting a time variable into a model which tests for the effects of several market related variables on value.
CHAPTER IV
SUMMARY AND CONCLUSIONS

Summary of Hypotheses and Results

The following is a summarized listing of all of the hypotheses which have been statistically investigated within this study through multiple regression techniques. To summarize the statistical tests of the hypotheses three types of conclusions will be stated after each hypothesis arbitrarily as follows:

   Supported = Consistent and significant results at .01 level.
   Cautiously Supported = Results were consistent and significant at .05 level or higher; however, minor problems were encountered in the elimination of multi-collinearity or non-linearity.
   Not Supported = Results were not consistently significant at .05 level or higher.

Hypothesis 1a: Residential property selling price is negatively related to the number of properties entered and searched by the purchasing buyer. Cautiously Supported.

Hypothesis 1b: Residential property selling price is negatively related to the number of properties entered and searched per week of active search by the purchasing buyer. Supported.
Hypothesis 1c: Residential property selling price is negatively related to the number of properties upon which a buyer has made offers other than on the home purchased. Supported.

Hypothesis 1d: Residential property selling price tends to be higher when purchased by an out-of-town buyer than when purchased by an in-town buyer. Cautiously Supported.

Hypothesis 2: Residential property selling price is related to the time a property is on the market. Not Supported—with use of deflated selling price.

Hypothesis 3a: Residential property selling price tends to be higher when sold through a broker than when sold by an owner. Not Supported.

Hypothesis 3b: Residential property sells faster, at a given price level, when sold by a broker than when sold by an owner. Not Supported.

Hypothesis 3c: Residential property selling price tends to be higher when a listed property is sold through a co-operative broker than when the listing broker sells the property. Not Supported.

Hypothesis 3d: Residential property sells faster, at a given price level, when sold by a co-operative broker than when sold by a listing broker. Not Supported.
Hypothesis 4: Residential property selling price is directly related to (the seller's pricing strategy defined by) the difference of the percentage decline from list to selling price for a sample property and the mean percentage decline from list to selling price for the area in which the property is located. Not Supported.

**Summary and Conclusions**

This study has continued the investigation of the housing market transaction process and its effects upon property values. The selective sample process combined with the control model including site, location and improvement characteristics accounted for 90.2 percent of the variation in selling price for the sampled properties. The inclusion of all of the market transaction related variables, except for the pricing strategy and time on the market, resulted in an increase of the R-square value to 94.4 percent.\(^79\) Thus, an additional 4.2 percent of the selling price variation within the sample was statistically related to market transaction phenomena.\(^80\) This is not to imply that the model including market transaction-related variables would be a

\(^{79}\)Time on the market would not enter given the other variables in the model.

\(^{80}\)An R-square increasing 4.2 percent means that the average increase in the explanation of selling price variation is 4.2 percent. On individual properties the range of additional explanatory power may be far above and below 4.2 percent.
better, more accurate or reliable model on a new sample than the control model. Further testing would be necessary to confirm such results. However, the results do indicate the potential for market transaction phenomena to explain a significant degree of variation in the selling prices of residential properties.

The most consistent, stable and significant results were obtained in the investigation of the buyer search process. The goal in identifying variables related to the buyer search process was twofold: (1) measurement of the search cost of the buyer; and (2) measurement of the benefits of the knowledge gained by searching. The assumption that less active searchers or buyers who search few homes have higher search costs seems to have been borne out by the results. One of the more interesting proxies for search cost was the number of offers made on homes other than the one purchased. This variable may have identified not only buyers with lower search costs, but also buyers who were very value-oriented.81 The buyer willing to make offers on property unacceptable to sellers, and forego the purchase rather than raise his bid price, tended to purchase property, of equal

81 A "value-oriented" buyer was defined as a buyer who placed the primary emphasis on the general market's opinion on value in formulating his own estimation of value. A "taste-oriented" buyer was defined as a buyer who placed the greatest emphasis on personal taste in formulating his estimation of value.
model estimated value, at a lower price than did average buyers.

The average out-of-town buyer tended to pay more for property than in-town buyers. Out-of-town buyers also purchased property which had been on the market much longer than in-town buyers. Within the sample, out-of-town buyers purchased property which had been on the market over an average of one hundred days, as compared to around fifty days for the in-town buyers. This large difference implies that out-of-town buyers may purchase property more difficult than average to sell. "The probability that an out-of-towner will see properties, which are turned over quickly, is less than for an in-town buyer who may continuously scan the market." \(^{82}\) This is because the properties which are more difficult to sell represent a larger than proportional amount of the total number of properties on the market at a given point in time. The out-of-town buyers tend to purchase after weekend long searching trips, and thus must choose from a cross-sectional type of sample of available properties.

As with the out-of-town versus in-town buyer case, the buyers who searched a greater than average number of properties tended to buy property which had been on the market a less than average length of time. A non-linear rela-

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\(^{82}\) This argument was presented by Dr. William B. Brueggeman of Ohio State University in discussions on the empirical results of this study, July 1977.
tionship between the number of searches and the benefits of the search process is apparent in the size and direction of the regression coefficient. In a three group breakdown, the group with the lowest number of searches received the greatest benefit from each additional search with the largest regression coefficient. The benefits of search decline, and the group with the greatest number of searches receive little or negative benefits from continued search. This is consistent with economic theory which suggests marginally decreasing returns from search, and also suggests there may be an opportunity cost which penalizes buyers who search over too long a period of time.

The investigation of time on the market and selling price did not suggest that a seller could achieve a significantly higher real price by allowing the property to be on the market longer. If very low inflation rates are assumed, such as below five percent annually, then a significant positive value could be attributed to longer selling periods. However, when inflation rates are assumed equal to the average annual building cost increases for residential property in the Columbus area, sellers do not benefit from longer time on the market. Beyond low selling costs or high selling costs, per unit of time, general marketability factors such as current tastes, style preferences, cleanliness, and interior decoration along with pricing must dominate the determination of time on the market. Certain housing
features may attract numerous potential buyers and reduce the average time the property remains on the market. If pricing decisions were perfect the initial listing prices of properties with such features would be increased, and the average time to sell such property would be similar to that for property without such features.\textsuperscript{83}

The method of sale investigation, comparing owner to broker sales, and broker co-operative sales to broker non-co-operative sales, did not reveal consistent significant differences on the basis of price or selling time. According to the proposition that a higher cost to sell through one method must result in a corresponding benefit of a higher price or quicker sale, the net discounted selling prices through any method should be similar under competitive market conditions. If the selling costs are different for the different methods of sale, then either the net selling prices are also different or the tests or sample were biased. The only owner sales included in the sample are those which were successful. No statistics were collected or are known to be available which indicate how many owners try but fail, to sell their own properties. Bias, favoring the price and time measurements is likely on the owner sales. Not as surprising are the results comparing co-operative to non-co-operative sales. A co-operative broker, while reducing the commission

\textsuperscript{83}A similar conclusion was reached by Belkin, \textit{et al.}, \textit{op. cit.}, p. 71.
collected by the listing broker, may represent an effective demand in the form of providing a potential buyer where none existed before. If the listing broker does not sell a listed property no commission is collected and a sizable loss in the form of advertising funds and time costs will occur. The comparison is thus, not just one of cost versus benefits, but also small cost versus large loss.

The question of an optimal pricing strategy is one of the most difficult to investigate. The general statistical results indicated that the market does impose constraints, to some degree, on sellers' pricing policies. The lack of a significant regression coefficient on the proxy for pricing strategy indicates fairly independent price estimations are formulated by interested buyers. However, the question of an optimal pricing policy must remain unresolved because a direct test is impossible. One can never say that a person overpaid or underpaid for a property, since every individual cannot be assumed to have the same set of preference functions as every other person. One can only say that a buyer paid more or less than the average market value for such a property, via some regression model which controls for some of the influences on value. But without a model which explains nearly one hundred percent of the variance in selling price, one cannot claim the price setting policy is responsible for differences in property selling prices.
Future Research

This study has begun to examine some of the theoretical interrelationships between the housing market transaction process and price. The market transaction process is characterized by a complexity which makes modeling of cause and effect difficult, if not impossible. Multiple regression as a useful technique also must be questioned for application to further investigations into the determinants of residential property value. Perhaps it has been an overworked tool. New techniques must be developed because of the complexity of the problem. For example, the influence of a market related phenomena may be revealed either by changes in selling time, price, or both. Therefore, a technique which simultaneously looks at all three phenomena is necessary.

One such technique may be canonical regression, which simultaneously solves for two dependent variables. The problem in using canonical regression is that the two dependent variables must be placed in an assumed functional relationship, a trial and error process which may not always be theoretically interpretable.

Future research on the housing market transaction process will undoubtedly be difficult, but certainly worthwhile. The last frontier in the investigation of residential

property values must delve into the psychology, tastes, preferences, behavior and characteristics of the housing market participants. Data will be increasingly difficult and costly to acquire as reliance on survey data increases. Sample bias is nearly unavoidable in the housing market, as it is in most non-controlled research. But with cautious and thorough research the housing market may become a theoretically consistent and interpretable process as it relates ultimately to value.
BIBLIOGRAPHY


Emerson, Frank C. "The Determinants of Residential Value With Special Reference to the Effects of Aircraft Nuisance and Other Environmental Features." Ph.D. Dissertation, University of Minnesota, 1969.


APPENDIX A

Property, Buyer and Seller Data

The following is an outline of the information collected on each observation in the sample.

Property Data

General: Street address of property; Annual property taxes.

Location: Neighborhood; School system; Number of blocks to nearest schools; Distance to downtown in miles; Distance to freeway entrance; Distance to shopping center.

Site: Lot size in square feet; Landscaping rating of fair, good, excellent.

Improvements: Living area in square feet; Basement; Number of bedrooms; Number of baths; Number of car spaces in garage; Age of house; Construction materials; Number of fireplaces; Central air conditioning; Utilities type; Kitchen equipment or appliances included in home.

Market Related and Seller Data

Listing broker; Selling broker; MLS number; Date first put on market; Date of contract for sale; Initial asking price; Selling price; Owner or Realtor sold.
Buyer Related

The number of homes examined by the buyer before purchase; The number of offers made on other homes; Whether the buyer lived in Columbus area while searching for home and for how long; The time spent in weeks in active search; Marital status; Number of children; Approximate income in three groups of up to $15,000, $15 - 25,000, and $25,000 or more; General comments about reason for searching for a new home; and general comment on whether continued search was primarily a result of taste or not being satisfied with values of other homes seen.
<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
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<td>(X)1 Sales Price</td>
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<td>27355.20</td>
</tr>
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<td>(X)2 List Price</td>
<td>66118.12</td>
<td>30751.68</td>
</tr>
<tr>
<td>(X)3 Lot Size</td>
<td>14200.91</td>
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<tr>
<td>(X)4 Living Area</td>
<td>1787.64</td>
<td>599.74</td>
</tr>
<tr>
<td>(X)5 Age</td>
<td>20.46</td>
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<td>(X)6 No. Bedrooms</td>
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</tr>
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<td>(X)7 No. Full Baths</td>
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<td>.75</td>
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<tr>
<td>(X)8 No. Half Baths</td>
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<td>.52</td>
</tr>
<tr>
<td>(X)9 Car Garage</td>
<td>1.63</td>
<td>.68</td>
</tr>
<tr>
<td>(X)10 Basement</td>
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<td>.23</td>
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<tr>
<td>(X)12 Construction Quality</td>
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<td>(X)13 No. Fireplaces</td>
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<td>(X)14 Heat - Gas</td>
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<td>(X)16 Cul De Sac</td>
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<td>(X)17 Swimming Pool</td>
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<td>(X)18 Air Conditioned</td>
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<td>(X)20 Worthington</td>
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<td>(X)21 Clintonville</td>
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<td>(X)22 Buyer No. Search</td>
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Table 6 continued

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<tr>
<td>(X)27 Co-op Sale</td>
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<td>(X)28 Non Co-op Sale</td>
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<td>.50</td>
</tr>
<tr>
<td>(X)29 Property Taxes</td>
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<td>296.95</td>
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<td>(X)30 Time on Market</td>
<td>64.75</td>
<td>56.14</td>
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### TABLE 7
APPENDIX C
CORRELATION MATRIX

<table>
<thead>
<tr>
<th>Variable Name</th>
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<td></td>
<td></td>
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</tr>
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<td>(X) 2 List Price</td>
<td></td>
<td>0.746</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(X) 3 Lot Size</td>
<td>0.740</td>
<td></td>
<td>0.643</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(X) 4 Living Area</td>
<td>0.978</td>
<td>0.970</td>
<td></td>
<td>0.722</td>
<td></td>
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<td>(X) 5 Age</td>
<td>0.670</td>
<td>0.658</td>
<td>0.436</td>
<td></td>
<td>0.313</td>
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<td>(X) 6 Bedrooms</td>
<td>0.398</td>
<td>0.404</td>
<td>0.254</td>
<td>0.384</td>
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<td>(X) 7 Full Baths</td>
<td>0.959</td>
<td>0.954</td>
<td>0.656</td>
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<td>0.669</td>
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<td>0.500</td>
<td>0.767</td>
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<td>(X) 9 Car Garage</td>
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<td>0.920</td>
<td>0.611</td>
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<td>0.690</td>
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<td>(X) 10 Basement</td>
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<td>(X) 13 Fireplaces</td>
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<td>(X) 14 Heat</td>
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<td>0.891</td>
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<td>(X) 15 Kitc. Equip.</td>
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<td>(X) 16 Cul De Sac</td>
<td>0.394</td>
<td>0.415</td>
<td>0.245</td>
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<td>0.051</td>
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<td>(X) 17 Swim. Pool</td>
<td>0.373</td>
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<td>0.247</td>
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<td>(X) 18 Air Cond.</td>
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<td>0.383</td>
<td>0.485</td>
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<td>(X) 19 Upper Arling</td>
<td>0.763</td>
<td>0.776</td>
<td>0.507</td>
<td>0.781</td>
<td>0.667</td>
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<td>(X) 21 Clintonville</td>
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<tr>
<td>(X)27 Co-op Sale</td>
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<td>(X)28 Non-Co-op</td>
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<td>(X)29 Prop. Tax</td>
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