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Determinants of Buyer Search in a Housing Market

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Using data collected from specially-designed questionnaires, the duration of search by a house buyer is estimated. Duration is measured in two ways: in terms of time and in terms of the number of houses seen. To explain this data, several features must be added to a simple model when search models are applied to a housing market. Many of the statistically significant variables, such as prior information and the quality of information provided by a newspaper or a real estate agent, deal with the provision of information. The type of agency that employs the agent and the characteristics of the buyer have little effect.

It is widely believed that a seller faces a trade off between the sale price and the expected time-till-sale. Many theories support this conclusion and there is lots of data (*e.g.*, Haurin 1988; and Yavas and Yang 1995) on the behavior of sellers that could be used to prove it. However, few articles analyze the behavior of buyers which creates this trade off. This article seeks to fill the gap. The data used here shows that, on average, a buyer took about ten weeks to find a house and inspected about sixteen houses before buying. To complement this measure of average duration, Table 1 reports the unconditional probability of purchase at any given stage.[1] Of course, this table overlooks the differences between buyers while this article estimates the effect of these differences.

Other articles have considered related problems. Most existing theory concentrates on identifying a reservation criterion to show what type of house is considered minimally acceptable. Some theoretical models, such as Yavas (1992), consider the choice of effort but, with the exceptions of Barron and Mellow (1979, 1981) and Holzer (1988) who study a labor market, such

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[1] These calculations implicitly assume that buyers face a constant arrival rate for houses to inspect, within each stage. They also assume that the difference between one month and two months is four weeks and that the difference between two months and four months is nine weeks. For purposes of comparison, the Canada Mortgage and Housing Corporation (1993) reported that there were on the order of 2000 houses offered for sale, so that an average buyer inspected less than 1% of the stock of housing for sale.

Table 1 ■ Hazard rates.

Panel A: Probability of purchase (%)	
During week 1	8.2
During week 2	5.9
During weeks 3 and 4	10.3
Between 1 and 2 months	9.7
Between 2 and 4 months	6.6
Panel B: Probability of purchase (%)	
1–5 inspections	6.0
6–10	7.6
11–20	5.9
21–30	6.3
31–40	4.4
41–50	3.9

models have not been estimated. Two other papers (Baryla and Zumpano 1995; and Baryla, Elder and Zumpano 1995) take a different approach to this problem. The next section supposes that there are two margins of choice: the level of search effort and the reservation criterion. It also discusses features that are especially relevant to search in a housing market but have not yet been analyzed carefully. Some of these features are the facts that buyers may differ in their prior knowledge of the market, their experience, their use of real estate agents and the option of buying a newly-built house. The discussion of these features tends to focus on how each affects either the productivity of search or the information, or perceived information, used to make search decisions.

The second section describes the data. Readers who are interested in the methodology used to collect the data are directed to Anglin (1994); the shortest summary indicator of the reliability of the data is that 66.0% of buyers responded. The third section shows how certain econometric puzzles are resolved. In particular, the nature of survey data means that the dependent variable is not continuous and that nontraditional, econometric methods are used here.

The fourth section presents the results. A number of variables are shown to be important in explaining a buyer's behavior. Most of these variables, such as prior information and the quality of information provided by a newspaper or a real estate agent, deal with the provision of information. Personal characteristics of a buyer play, at best, a minor role. The evidence suggests that buyers who avoid using an agent do so in spite of higher search costs.

Search Behavior

A typical search model assumes that there exists a distribution of "opportunities" waiting for a buyer.[2] To a house buyer, these opportunities are sellers with a particular type of house to sell at a particular price. A buyer must decide which houses to inspect and which one to buy. Search costs deter buyers from inspecting all available houses. Further, these costs make it prohibitively expensive for a buyer to locate the best available house, measured according to his own tastes. Therefore, a reservation utility criterion describes the minimum criterion that a house must pass in order for it to be rationally purchased. Opportunities are assumed to flow according to a random (usually poisson) process. This simple model is added to here by assuming that buyers can increase the expected arrival rate of opportunities by searching harder at an increased cost. Maximizing the net benefit of search generates a rule for the optimal choice of effort.

This simple model is incomplete because both the optimal reservation criterion and the optimal choice of effort depend on observed or unobserved variables. For example, knowing the cost of search or the productivity of search precisely would help to explain the error terms in the regression equations. In this model, unobserved variables may cause joint variation in the number of houses inspected and effort because a lower (marginal) search cost increases search effort and decreases the probability of acceptance at any point in time.[3]

Common sense suggests that many observable variables also affect a house buyer's decision. Some variables lead to obvious predictions. For example, a more patient buyer should search for a longer time and inspect more houses before finding one of them acceptable. Other variables have less obvious predictions because the existing literature has not considered them as carefully. These variables include prior knowledge, experience, whether the

[2] Many authors (*e.g.*, Diamond 1971) have noted that buyer search may not be necessary in a market equilibrium if sellers exploit the market frictions facing buyers. There exist models (*e.g.*, Reinganum 1979; and Arnott 1989) which derive a dispersed distribution of equilibrium utility payoffs. Identifying this distribution is unimportant in this paper because the behavior of different buyers for a given equilibrium is compared. With additional data, an equilibrium model of behavior could provide more precise estimates.

[3] There are at least two ways to describe this outcome: as a longer duration or as a lower probability of purchase after any given duration. While a theory of reservation prices and the econometrics focus on the probability of acceptance, the exposition is clearer if the expected duration is used. This is especially true when comparing the findings for the different measures of duration.

buyer is considering a new house, the effects of real estate agents, the number and choice of neighborhoods and the price range. The following conjectures are based on insights from the analysis of related problems.

Learning and Prior Information

Search is supposed to identify opportunities. Classic search models assume that the searcher knows only the *distribution* of opportunities but not which of the available houses are worth buying before inspection. Other models note that buyers use the information acquired during search to revise their decisions while searching. Morgan (1985) and Burdett and Vishwanath (1988) provide general models of learning to show how searchers alter their behavior. Slonim (1994) considers the effects of learning in an experimental setting.

The measure of prior information used here is "unfamiliarity." Buyers who are less familiar with an area have less accurate expectations of the distribution of opportunities. A buyer who knows that they are unfamiliar can be expected to compensate by obtaining more information before buying because such a buyer recognizes the added advantages of extra time (Kohn and Shavell 1974). A learning effect should also increase the marginal benefit of effort since seeing more houses increases the set of information available to a buyer. Therefore there is a tendency for these buyers to search longer and use more effort.[4]

Experience

Experience should play a role and over 40% of buyers in the sample were first time buyers. More experienced buyers have the advantage of having gone through a search process at least once. For this reason, and even though they are not trying to buy the same type of house as before, they may understand the implications of a given set of information better than an inexperienced buyer. Therefore, they can be expected to search for less time, ceteris paribus. An alternative explanation of why experience affects behavior relies on differences in search productivity rather than on

[4] This argument applies only to the average buyer. A more complete argument would note that buyers may have one of two kinds of inaccurate beliefs: excess optimism and excess pessimism. When more data becomes available, a more complete argument should also be able to identify a variable that recognizes the source of a buyer's expectation. This would explain why the average buyer's expectations differs from place to place or time to time.

differences in information processing skill. If an experienced buyer can search more productively, then they should exert more effort and inspect more houses. These effects should combine for a lower time till purchase. Because these explanations offer the same prediction, the available data is not able to distinguish them.

Understanding the impact of experience is significant for a reason other than predicting behavior. Turnbull and Sirmans (1993) have shown that first-time buyers and buyers who are moving to a city from out-of-town do not pay higher prices for houses. Jud and Winkler (1994) reach a similar conclusion by finding that the characteristics of the real estate firm and agent do not affect the sale price. They suggest that the various institutions, such as a Multiple Listing Service which distributes information broadly, can offset any inherent disadvantage of such buyers. If this argument is correct then experience, as well as being unfamiliar with an area, should not affect behavior when selecting a house, ceteris paribus.

Real Estate Agents

The interaction of real estate agents and buyers is important because agents compile most of the information used by buyers when searching and because of more controversial reasons. Controversy arises because an agent usually works for the seller but many buyers are confused about this fact. Working for the seller means providing information to buyers to reduce their search costs. For this article, it is important to note that a good agent would not knowingly waste a buyer's time by showing him houses that are unsuitable, while a bad agent is unable to avoid wasting the buyer's time. Therefore, if an agent knows the buyer's tastes then the expected duration of search, in terms of time and the number of houses seen, should fall.[5]

Having an agent who knows the buyer's tastes very well means that the agent is a perfect substitute for a buyer's own effort. In contrast, if the agent does not know the buyer's tastes then it is little different from randomly searching. Therefore, a buyer who has an agent who knows his tastes should decrease their personal effort. This article also considers the behavior of buyers who do not rely on an agent.

[5] Anglin (1993, 1997) showed that recognizing this ability has important insights when characterising equilibrium in the market for agents. The controversial aspect of agency (*i.e.*, how agency contracts distort the behavior of agents toward buyers) is not relevant to this article if all agents have a common contract and there are no buyer brokers, as seems reasonable.

As an aside, it is unclear how the contribution of real estate agents should be recognized in theory. Buyer brokerage was virtually non-existent in the Windsor market at the time of this study. This fact implies that the monetary cost of the agency is born entirely by seller. Therefore, all buyers should use real estate agents to the maximum. Explaining why a buyer chooses to use an agent at less than full intensity requires a theory identifying the implicit cost of using an agent.

Usefulness of Newspaper Ads

Real estate agencies also contribute, in a general fashion, to the transaction process by compiling the information that others use. This effect differs from the effect of a single agent on a single buyer but can be expected to affect a buyer's behavior. By making some information available in the local newspaper, the local real estate board should make a buyer's personal efforts more productive. This effect differs across buyers according to whether the information in the newspaper is useful. If a buyer believes that the newspaper provides useful information then they should read it more often. They should also be less dependent on the information provided directly by an individual agent and be able to buy a house in less time, ceteris paribus.

Market Segments

Ordinary search theory supposes that houses are located on a featureless plain and that all houses are distinguished by their idiosyncratic building characteristics. This theory needs to be modified when buyers inspect houses in a limited number of well-defined neighborhoods. Buyers often have strong preferences concerning their location. The decision to search in more than one neighborhood in a given time reveals that the buyer considers the neighborhoods to be close substitutes, at the market prices. Thus, the buyer should search longer than someone who wants to search in only one neighborhood. This discussion has no implication for effort.

A more complex argument recognizes that collecting information on a house in one neighborhood means that some information is being obtained about other houses in the same neighborhood. Weitzman (1979) provided a model of consumer selection in a nonequilibrium model while, in a model of selection generated by racial segregation, Courant (1978) found the equilibrium. Over time, a buyer may inspect houses in other neighborhoods if the set of opportunities in one neighborhood is exhausted but only if doing so is preferred to waiting for other houses to become available in the most preferred neighborhood.

Market can also be divided into segments according to criteria other than location, such as price. Sale price is used as a separate regressor because search behavior for low-priced goods often differs from that in high price markets. The interpretation of this variable is unclear when prices and search behavior are related by the equilibrium conditions. In equilibrium, all buyers face the same market conditions, but different buyers make different choices. Rosen's (1974) model shows how buyers' choices determine the equilibrium prices and how a buyer's choice could be affected by a change in prices. Therefore, some forms of heterogeneity in the housing stock are irrelevant because market forces should offset the direct effect if there is scarcity. The question posed here is whether there is some feature of high-priced segments that is not considered in Rosen's model but has an observable effect on individual behavior. Based on this argument, price should be interpreted as a crude measure of market segmentation.

Newly-built Houses

An important contrast to the behavior of *searchers* is to consider the behavior of buyers who avoid the search decision plus the randomness of the matching process by buying a newly-built house. The National Association of Realtors (1992) found that people who bought new houses searched for a longer time, on average, before buying a house. This finding is corroborated by the data used in this study and is surprising because, in principle, buyers who buy a newly-built house need not search at all.

Empirically, it is better to consider the behavior of buyers who think about buying a newly-built house than to consider the behavior of buyers who actually buy one because buying one depends partly on the random outcome of the search process that this article is trying to explain. Respondents to this survey also reported whether they thought about buying a newly-built house. It was not possible to collect data on whether a new house would be custom designed to the buyer's tastes or designed by a developer. Only about 1/4 of buyers who thought about it actually bought a newly-built house.

All buyers face the same two alternatives: to buy a newly-built house or a resale house. Following Rosen (1974) and assuming that the construction market is perfectly competitive, any buyer should be able to satisfy their tastes if they are willing to pay the cost. Costly delays in finding a willing builder should not persist because that would indicate that the market is not in equilibrium. This article assumes that the resale market differs from the construction market because search costs in the resale market exist and they prevent inspection of the entire market. These search costs are irrelevant to

buying a custom designed house because they represent the costs of locating a house that has a desirable mix of amenities.

Obviously buyers who think about buying a new-built house think that they will not find an acceptable resale house before they inspect the entire market. Buyers with low search costs are more likely to buy a resale house since they are willing to inspect a larger fraction of available houses before buying. In contrast, buyers who know that they have high search costs search for less time, inspect fewer houses, and exert less effort at any point in time if they decide to search for a resale house. Thus, these buyers are more likely to say that they would consider buying a newly-built house. For this reason, buyers who think about buying a newly-built house spend less time searching regardless of the type of house that they buy.

Income

The effects of various demographic variables, including a buyer's annual income, are also considered. Many people conjecture that a buyer with higher income has a higher search costs due to a higher cost of time. This argument is sensible but its conclusion should not be accepted unconditionally. Anglin (1988) showed that, in a retail market, an increase in income increases the buyer's demand curve and increases the benefits of search for a low price. Determining which of these effects is more important for explaining the duration of search is an empirical question. It is also complicated by the fact that the negotiations between buyer and seller concern the price of a house as an indivisible unit. The complication is important because if a buyer's income is reasonably well known, perhaps with the insight of an agent, then any anticipated effect of income on search cost could be captured by the seller through appropriate bargaining over price. Therefore, increases in a buyer's income should have no discernible effect on the time-till-purchase or the number of houses inspected. Because of the higher marginal cost, higher income buyers should expend less effort.

General Description of the Data

The previous section identified a number of variables that might reasonably affect search effort or duration. Testing this model uses two measures of search effort and two measures of duration. The data were provided by 265 buyers involved in "arms-length" sales of residential houses in Windsor, Tecumseh, St. Clair Beach or LaSalle in Ontario, Canada which "closed" during the first half of 1993. It includes transactions assisted by an agent as well as those in which no agent was involved. The buyers responded to a

mail survey and the response rate was 66.0%. This response rate is high compared to other surveys but it is not impervious to response bias. Anglin (1994) provides additional details on how the data was collected and offers evidence showing that the data is a reasonably accurate reflection of arm's length transactions of residential houses for this time and place.

The local economy was not exceptionally strong during this time, having above average unemployment rates, but there were some indications of a turnaround in the major local industries. And, while the numberof sales in the first quarter of 1993 was substantially below the previous year's levels, the number of sales in the second quarter was not as far below (Canada Mortgage and Housing Corporation 1993). There were no major events, such as a sudden spike in interest rates or a major local layoff, that might obviously distinguish the behavior of buyers who bought earlier from those that who bought later.

This study uses two types of dependent variables and each is measured in two ways.

Measuring Duration

To measure the time-till-purchase, buyers were asked the following question, "How many weeks or months did you actively look at houses or condominiums before you bought your home?" The response choices were: (1) less than 1 week; (2) more than 1 week but less than 2 weeks; (3) 2 weeks to 1 month; (4) 1 to 2 months; (5) 2 months to 4 months; and (6) more than 4 months.

They were also asked a similar question about the number of houses inspected before buying their house. The answers produce the data for *TTB* and *NVISIT* that were used in Table 1 and summarized in Table 2.

Measuring Effort

To measure search effort, buyers were asked, "How often did you read [the local newspaper], and ask your agent, to learn about houses for sale?" Five possible choices were provided. The buyers' answers produce the data for *OFTENWS* and *OFTENAG* shown in Table 2.

This question has two unavoidable conceptual flaws. First, it fails to recognize "passive" search, where buyers are made aware of opportunities

Table 2 ■ Data summary.

Variable	Mean	Std. Dev.
TTB	4.2	1.5
OFTENWS	2.4	1.4
OFTENAG	3.0	1.5
NVISIT	2.8	1.7
NBHD	2.3	1.5
UNFAM	1.9	0.9
PB	10.9	4.1
FRAN	0.2	0.4
LARGE	0.4	0.5
KNOWT	2.5	1.5
BWA	0.2	0.4
THINK	0.4	0.5
USENEWS	2.1	1.4
RTPB	0.1	1.1
RTPBUYER	0.1	0.2
EXPB	2.3	1.6
SEXB	1.5	0.3
ANNINCB	3.1	2.0

but do not actively seek them.[6] Second, it ignores the fact that effort varies over time. The fundamental problem in designing the questionnaires is that it is not possible to systematically gather information on all aspects of a buyer's search behavior.

Some readers may be concerned that these measures of effort are conceptually weak because it seems fairly costless to read the newspaper. This measure has the advantage that nearly all buyers read the newspaper to identify houses for sale (or open houses) at one time or another but may vary their intensity. This measure of effort is correlated with other measures of effort that are harder to clearly define on a mailed questionnaire.

Baryla, Elder and Zumpano (1995) used a related variable called search "intensity": the number of houses seen per week. This variable is closely related to the output of search, not the input of search effort, and is inappropriate for this study. If there were a one-to-one relationship between

[6] The distinction between passive search and low search effort is important but untestable because buyers are presumed to declare themselves as buyers before beginning to search, whereas some people buy a house because they were made aware of the house which causes them to think about buying a house.

input and output, this difference would not matter. The fact that a more productive searcher can be expected to choose a higher search effort and a higher reservation criterion makes it important to distinguish input and output.

Measuring the Rate of Time Preference

An important parameter describing a buyer is their rate of time preference. Ideally, each potential respondent would be presented with some theoretical models of consumer preference before asking them to quantify this parameter. Few people were expected to be willing to agree to this. Instead, buyers provided an ordinal rating concerning their interest in various dimensions of the buying process such as low time-till-purchase and paying a high price. On a scale of 1 to 5, they were asked to rate the importance of each concern. Many respondents said that everything was *very* important but the theoretically relevant measure of patience is one that reflects the *relative* importance of purchasing quickly and paying a low price.[7] Therefore, I use the difference in ratings as a measure of patience where more patient buyers have higher values of *RTPB*.[8] Some respondents did not provide the necessary information and, for those few people, a dummy variable was created (*RTPBUYER*).

[7] Some people have commented that it might have been better to gather information on why buyers decided to buy. For example, a buyer who is expecting a child in three months differs from someone who is buying a retirement home. While distinguishing between an expectant couple and a retiree is often spoken of, not all expectant parents are equally impatient and the proposed measure is more theoretically appropriate. Similarly, the effect of job relocation on buyer search should depend on whether that relocation is being subsidized.

[8] Specifically, a buyer who values a low price more than finding a house quickly might rate "obtaining a low price" as a 1, on a 1 to 5 scale, and might rate "finding a home quickly" as a 3. In this case, *RTPB* = 2. If a buyer rated a low price and quick purchase both as a 1 or both as a 3, then *RTPB* would equal 0. Both of these responses imply roughly the same trade off when making a decision.

Following a question by a referee, *RTPB* and *RTPBUYER* were replaced by the unadjusted measure of the value of "finding a house quickly." With the exception of the intensity of using an agent, none of the conclusions changed.

Measuring Other Variables

Table 2 summarizes the data. *UNFAM* indicates the degree of unfamiliarity with the neighborhood where the buyer bought their house.[9] *NBHD* indicates the number of neighborhoods considered by the buyer. *THINK* = 1 if the buyer thought about buying a new house even if they ultimately bought an existing house and equals 0 otherwise.

LARGE = 1 if the buyer reported that their agent worked for one of the largest six agencies (which represent about 40% of the purchases in the sample); *FRAN* = 1 if the agent worked for a franchise brokerage (Century 21, Coldwell Banker, and Re/Max). Many buyers reported that they did not use an agent to look for a house. Buyers without agents are represented by *BWA* = 1, otherwise BWA= 0. The omitted category is "all other agencies." *KNOWT* indicates on a scale from 1 to 5 whether the buyer felt that the agent understood the buyer's tastes (5 indicating the highest level of understanding).

EXPB represents the number of houses that the buyer has previously bought in their lifetime. *PB* is the sale price divided by 10,000. *SEXB* is the average gender[10] of the buyer (male = 1, female = 2). *ANNINCB* represents a buyer's annual income.[11]

Econometric Methodology

The previous section suggested that a number of variables should be included to explain duration and effort. Thus, it is possible to construct a reduced form model to explain each variable separately. However, estimation of the regression equations is complicated by the different types of dependent

[9] The city was divided into nine neighborhoods. Buyers were offered a choice of four categories when answering this question where 4 indicated the greatest unfamiliarity. This question was worded to emphasize knowledge of the neighborhood *prior* to search.

[10] The measure of gender equals 1 if the buyer were a man or a pair of men, equals 2 if the buyer were a woman or a pair of women and equals 1.5 for a man and a woman. Constructing the variable in this way implies that, if men and women behave differently, then a mixed couple would search using a mixture of these behaviors and the mixture would be not be overlooked. Testing each equation showed that the behavior of a buyer who was a single person was statistically indistinguishable from the behavior of a buyer who was more than one person but the same gender.

[11] Table 2 shows that the average response of buyers for the income variable was *category* 3.00. This corresponds to an income level of C$50,000 to C$60,000. There is some censoring because the highest category is "over C$100,000" and the lowest is "less than C$30,000."

variables. Duration, measured in either time or number of inspections, is measured in stages. Estimating this variable requires that something like a hazard function be estimated. On the other hand, the measure of effort should be regarded as an ordinal ranking and requires an ordered probit. Some of these estimation techniques require more explanation.

Estimating a Hazard Function Using Categorical Data

The interesting question is: What is the probability that the buyer will buy a house in the next unit of time, given that they have not yet bought a house? Using a logit, it is possible to estimate this probability in the following way. Construct a sequence of "risk sets" each of which includes the set of buyers still "at risk," (*i.e.*, have not purchased at the beginning of each stage). The data are duplicated selectively so that only those buyers still at risk are included in subsequent sets and a dummy variable *Hi*, where $i = 1, 2, 3, 4, 5$, distinguishes the i^{th} duplication. *PURCH* = 0 if the buyer buys a house during the current stage and 1 otherwise. This approach implies a hazard function is being estimated where the hazard rate is free to vary between stages.[12]

Estimating the relationship using a logit is convenient for a couple of reasons. A logistic density function implies that if P_i = *Probability* (*purchase X*, $Hi = 1$, $Hj = 0$, $i \neq j$), then

$$\frac{P_i}{1 - P_i} = exp(-X\beta + Hi\ \alpha_i). \tag{1}$$

where the independent variable is X, and α_i and β are coefficients to be estimated. This odds ratio is the most natural counterpart to a hazard function because if the length of a stage were h units, and if the instantaneous hazard rate were λ_i then, as h approaches 0, the odds ratio approaches $\lambda_i h$.

[12] To summarize, for a buyer who purchased in the third stage, *PURCH* would equal 1 for the first two duplications, when $H1 = 1$ and $H2 = 1$, but *PURCH* = 0 when $H3 = 1$. This buyer would not appear in the duplicated data when $H4 = 1$ or $H5 = 1$. This specification enables a convenient interpretation; a positive coefficient for any variable means that an increase in that variable increases the expected time-till-purchase.

As a point of interpretation, this discussion uses the word *stages* rather than *time* because the same technique is used to estimate duration in terms of weeks or months and duration in terms of the number of houses inspected. In the second estimation, the variables *Hi* and *PURCH* are replaced by *Si* and *FIND*. Elapsed time is replaced by the elapsed number of inspections if appropriate.

The logistic specification also has the advantage that the results can sometimes be interpreted as a special case of the proportional hazard specification commonly used in estimating duration models; an increase in X has no effect on

$$\frac{P_i/(1 - P_i)}{P_j/(1 - P_j)}$$

the relative odds of purchase during stage i compared to stage j.[13]

One weakness of this technique is that it ignores unmeasured heterogeneity which can introduce bias into the baseline hazard rate. This bias is unavoidable.[14] Therefore, coefficients are not discussed (*i.e.*, α_i, that might show whether the baseline hazard rate changes as the duration increases).

There has been a great deal of discussion about eliminating spurious duration dependence. Heckman and Singer (1983) argued that results are sensitive to the type of correction used, while Lancaster (1990) and Han and Hausman (1990) argued to the contrary. Keifer (1988, p. 671) has identified the unmeasured variable as "spunk." The data set used here offers two advantages. First, unlike many data sets used to study unemployment searches, this data set contains only completed searches. Thus, the data do not suffer from the censoring caused by the data being truncated at a point in time. Second, the most natural definition of spunk is search effort. This data set provides information on effort and the section entitled Search Effort explains the variation in this variable.

The use of a logit model with discrete stages simplifies one aspect of the estimation. The theory presented above hypothesized that elapsed time

[13] The author is indebted to Dan Black for pointing this out. See Ryu (1994) for a more precise discussion. The fact that the regression equation actually estimates the probability of survival instead of the probability of purchase is unimportant because, algebraically, changing the dependent variable changes only the sign of the reported coefficients. As explained above, the reported results and discussion use the convention that a positive coefficient implies that an increase in the variable increases the expected duration.

[14] Han and Hausman (1990) present an alternate solution to the problem of estimation of duration models with categorical data. The data set used here is relatively small compared to the data sets commonly used in labor market studies and, for this reason, their method is not used. Ryu (1994) notes that the numerical optimization techniques commonly used in maximum likelihood estimation may produce unstable estimates or may not converge after a reasonable number of iterations. In contrast, logit regressions have been studied for more years.

should interact with some of the regressors in X. In contrast, the coefficients α_i can only capture differences in the hazard rates between stages that are not related to the regressors. Estimating the probability of purchase in each stage separately confirms that there are large changes in the magnitude of a few coefficients between stages. This effect can be captured by creating two variables for *elapsed* time, *ET*, and the *elapsed* number of inspections, *EI*. *ET*(*EI*) is defined as the time (number of inspections) at the beginning of a stage. Additional regressors can be created by multiplying *ET* or *EI* and the variables described. Elapsed time differs from the time-till-purchase, which is essentially the dependent variable, and *ET* is an exogenous variable, as defined by Lancaster (1990). In this way, it is possible to estimate nonproportional hazard functions.

The techniques for estimating an ordered probit are well known (Maddala 1983) and do not need to be reviewed here.

Results

Time-till-Purchase and Number of Inspections

These two measures of duration should be closely related since, in theory, the reason that a buyer takes more time to buy a house is that none of the previously visited houses was deemed acceptable. Table 3 explains the time till purchase. The pseudo-R^2 provides a simple summary of goodness of fit. It is calculated according to the method proposed by Cragg and Uhler (see Maddala 1983).

A buyer who looked in more neighborhoods took significantly longer to buy a house. This result is consistent with the ideas presented above where it was argued that the buyer considered the neighborhoods to be close substitutes. This effect varied with elapsed time because, as elapsed time increases, the expected time remaining fell.

The effect of variations in information is shown by three variables: (1) prior unfamiliarity; (2) the ability of a real estate agent to provide specific information; and (3) the usefulness of information provided by the newspaper. A buyer who was more unfamiliar with the neighborhood in which they bought took significantly less time to buy. Having an agent that knew more about a buyer's tastes decreased the time-till-purchase and this effect became more pronounced as elapsed time increased. Information provided by the newspaper had a statistically insignificant effect on the time-till-purchase.

Table 3 ■ Explaining time-till-purchase.

Independent Variable	Coef	*t*-Stat
H2	0.75	1.6
H3	−0.72	−2.0
H4	−0.85	−2.0
H5	−0.62	−0.8
NBHD	0.41	2.9**
NBHD × *ET*	−0.04	−1.9*
UNFAM	−0.35	−2.8**
PB	0.90	2.5**
FRAN	0.13	0.4
LARGE	−0.40	−1.5
KNOWT	−0.01	−0.1
KNOWT × *ET*	−0.04	−2.2**
BWA	−1.15	−1.9*
THINK	0.13	0.6
USENEWS	0.10	1.2
RTPB	0.87	0.9
RTPBUYER	−0.26	−0.6
EXPB	−0.13	−1.8*
SEXB	−0.41	−1.1
ANNINCB	−0.08	−1.1
CONSTANT	2.75	3.0
Observations	794	
pseudo-R^2	0.26	

* Significance according to a 5% one-sided test.
** Significance according to a 5% two-sided test.

Attempting to buy without an agent had a large and statistically significant effect relative to employing an agent from one of the small nonfranchise agencies. The type of agency, shown by *LARGE* and *FRAN*, had no significant effect on the time-till-purchase.

The effects of demographic variables are generally small, once other characteristics of the buyer are accounted for. There is no evidence that patient buyers took more time to purchase a house, although the coefficient has the anticipated sign. This finding could also be interpreted as showing that patience has only a small effect in explaining the differences between buyers because buyers are often making a once-in-a-lifetime decision.

More experienced buyers took significantly less time to purchase than less experienced buyers. Thus, in contrast to Turnbull and Sirmans' (1993) conjecture, institutions within a housing market were not able to fully offset

any disadvantages of inexperience in terms of a buyer's behavior. Unfortunately, additional testing is not able to shed additional light on the nature of this effect. Adding *EXPB* × *EXPB* to the regression equation produces no evidence of a diminishing marginal effect. Developing more powerful tests should provide more insight into the competing ideas.

The positive coefficient on *NBHD* in Table 4 shows that a buyer who looked in more neighborhoods looked at more houses. It confirms the idea that these buyers are more fussy. A buyer who was more unfamiliar with a neighborhood inspected the same number of houses even though Table 3 showed that they searched for less time.

Buyers of higher priced homes inspected the same number of houses even though they took a longer time to purchase, ceteris paribus. This pair of coefficients suggests that segmentation of a housing market is a important

Table 4 ■ Explaining the number of houses inspected.

Independent Variable	Coef	*t*-Stat
S2	−0.32	−1.2
S3	−0.93	−3.0
S4	−0.72	−1.7
S5	−0.10	−0.2
S6	0.66	0.8
NBHD	0.50	4.3**
NBHD × *EI*	−0.02	−3.5**
UNFAM	−0.06	−0.5
PB	0.03	0.9
FRAN	0.33	1.1
LARGE	0.29	1.2
KNOWT	−0.40	−3.2**
BWA	−2.32	−3.7**
BWA × *EI*	0.07	2.7**
THINK	0.39	1.8*
USENEWS	0.19	2.4**
RTPB	−0.04	−0.4
RTPBUYER	−0.20	−0.5
EXPB	−0.14	−1.8*
SEXB	0.37	1.0
ANNINCB	0.03	0.5
CONSTANT	1.67	2.0
Observations	575	
pseudo-R^2	0.20	

* Indicates significance according to a 5% one-sided test.
** Indicates significance according to a 5% two-sided text.

characteristic even within the equilibrium supposed in the model. Simple theory suggests that higher-priced houses have more amenities, but that markets should adjust to equate supply and demand within each segment. If, as seems likely, there are fewer houses offered for sale at any one time in a high-priced segment then it is not surprising that these buyers should take longer to find an acceptable one. And, once a buyer finds an acceptable house, the market power of a seller of a high-priced houses should be greater than that of a seller of a low-priced house. If true, then Rosen's (1974) theory of competition may be an incomplete justification of hedonic price regressions.

The type of agency had no significant effect, again, but an individual agent who knew the buyer's tastes well was able to get the buyer to buy after seeing fewer houses. This result may not be surprising since Day and Nourse (1991) have already argued that, in the case of sellers and seller's agents, the characteristics of the individual agent affect the transaction process.

Buyers who bought without an agent inspected fewer houses. Interestingly, checking the specification of the regression equation revealed that this effect gets smaller as the number of houses inspected increases. Thus, it appears these buyers acquired certain skills over time that reduced their handicap.

Buyers who thought about buying a new house inspected more houses, whereas Table 4 indicates that *THINK* has no discernible effect on the time-till-purchase. On the other hand, if *THINK* is replaced by a dummy variable that equals 1 if the buyer actually bought a new house, then the variable has a statistically significant effect on the time-till-purchase ($t = -2.3$) but negative. The same variable has a nearly significant effect on the number of inspections ($t = -1.6$). This change in regressors also raises the coefficient on the sale price in both tables since new houses tend to be high priced. It has little effect on other coefficients. These results suggest that theoretical models of search which include a new house segment will have interesting features as well as recognizing a cyclically sensitive part of the economy.

Search Effort

Adding a measure of effort to the previous regressions produces a significant coefficient. Unfortunately, these variables are likely to be correlated with the unobserved characteristics of the buyer. Thus the t-Statistics and the estimated coefficients are unreliable evidence for the effect of effort. Two measures of behavior are offered: (1) the frequency that the buyer reads the local paper to learn about houses for sale; and (2) the frequency that they contacted their real estate agent. An increase in either variable means that

they were consulted more often. Table 5 indicates how changes in the independent variables cause changes in effort. Table 5 also shows the estimated breakpoints, μ_i, used to convert the ordinal measure of effort reported by buyers into the cardinal measure of effort used in the regression equation.

The coefficients on *UNFAM* in Table 5 are small and insignificant. This fact and the fact that *UNFAM* affects the duration of search confirms the idea that unfamiliarity is related to the stock of information, as suggested earlier, instead of search costs. Surprisingly, buyers who knew that they were unfamiliar with a neighborhood did not adjust their behavior by using agents more intensively.

The variables measuring the effect of real estate agency (*FRAN*, *LARGE*) are insignificant although the skill of the agent (*KNOWT*) was, again, important. As expected, an agent who knew the buyer's tastes better was

Table 5 ■ Explaining search effort.

	Newspaper		Real Estate Agents	
Independent Variable	Coef	*t*-Stat	Coef	*t*-Stat
NBHD	0.09	1.4	0.11	1.7
UNFAM	−0.04	−0.4	−0.00	−0.0
PB	−0.05	−1.7	−0.01	−0.4
FRAN	0.05	0.2	0.13	0.5
LARGE	0.10	0.5	−0.20	−1.0
KNOWT	−0.19	−1.5	0.23	2.6
BWA	−0.76	−1.5	−0.70	−1.7
THINK	0.12	0.6	0.07	0.3
USENEWS	0.43	6.8	0.14	2.3
RTPB	−0.08	−0.9	−0.07	−0.8
RTPBUYER	−0.37	−0.9	−0.19	−0.4
EXPB	0.12	2.0	0.01	0.1
SEXB	0.12	0.4	0.07	0.2
ANNINCB	−0.01	−0.2	−0.08	−1.4
CONSTANT	1.04	1.7	0.16	0.3
μ_1	0.32	3.2	0.54	5.4
μ_2	0.67	5.2	1.01	8.5
μ_3	1.78	11.0	2.00	13.2
Observations	191		183	
pseudo-R^2	0.28		0.27	

* Indicates significance according to a 5% one-sided test.
** Indicates significance according to a 5% two-sided test.

used more intensively. This finding explains why, in Table 4, these buyers inspected fewer houses. The sizable t-Statistic ($t = -1.5$) on *KNOWT*, when explaining a buyer's personal effort, provides some support for the idea that a buyer with a good agent substituted personal effort and the agent's effort. However, the two positive coefficients on *USENEWS* raise some doubts about the substitution hypothesis. As expected, a buyer who found newspaper listings more useful used the newspaper more intensively. However, these buyers also used real estate agents more intensively.

The fact that the coefficients on *BWA* are negative with sizable t-Statistics shows that buyers without an agent tended to exert less effort. This fact suggests that these buyers have higher search costs. Thus, the previous findings of a shorter duration of search are not surprising. This combination of results yields one further insight. A buyer who had high search costs, but choose not to use the "free" alternative of using a real estate agent must have thought that the real cost of using an agent was even higher.[15]

Demographic variables had little influence in the choice of effort, although there is a small bit of support for the idea that higher income buyers used agents less intensively, ceteris paribus. It is more surprising that the sale price, which is strongly correlated with an agent's commission, had no significant effect on the use of an agent.

Conclusion

A number of variables were shown to be important in explaining a buyer's behavior. Generally, the results support the conjectures posed earlier and suggest that the conjectures should be refined. Many of the statistically significant variables, such as prior information, and the quality of information provided by a newspaper or a real estate agent, deal with the

[15] Following a question by a referee, *RTPB* and *RTPBUYER* were replaced by a different variable that also shows impatience: on a scale of 1 to 5, where 1 was the highest rating, how highly did a buyer rate the value of buying a house quickly. Although this variable was statistically insignificant in the other equations, it was significant when explaining the use of an agent: $\beta = -0.18$ ($t = -2.8$). Thus, a buyer who wanted to buy more quickly used an agent more intensively. Making this change lowered the magnitude of several other coefficients in this equation, especially that of *KNOWT* and reduced its t-Statistic to 1.6.

This specification offers a question for future study, but the reported specification is preferred for two reasons. First, *RTPB* tries to recognize opportunity cost, subject to the restrictions noted when the variable was first defined, and especially the trade off between time and money. Second, the amended estimates suggest that agents were used most intensively by a buyer who wanted to find a house quickly, but that their use was not affected by a buyer's concern with price or by a buyer's tastes.

provision of information. The type of agency that employs the agent had little effect on the buyer. Personal characteristics, other than experience, played a minor role at best. Two other variables were repeatedly shown to affect behavior: (1) the number of neighborhoods inspected; and (2) whether the buyer thinks about buying a new house.

There is another variable that is important but is not included in these regressions. As a matter of arithmetic, a simple model implies that failing to buy the first house that passes the reservation utility criterion doubles the total time taken to buy a house. About 1/4 of buyers in the sample tried to buy a different house before acquiring the house that they bought. Of those buyers, 49.2% searched for more than four months compared to 26.4% of all buyers. There would be two problems with using this variable to explain behavior. First, this variable is unsuitable without a great deal of care (Lancaster 1990) because it is not exogenous. Second, since these buyers search for so long, their answer was often uninformative; the answers fail to distinguish between five months, ten months and fifteen months of searching. Thus, if this study were repeated, it would be better to provide a finer distinction between the longer durations. If this study leads to more careful theory, explaining why bargaining fails and its consequences for time-till-purchase would seem to be an overlooked topic of research.

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