Further Assessment of the Efficiency Effects of Internet Use in Home Search

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Abstract   This paper examines Internet usage and the effect on buyer
search efficiency using a two-stage Heckman procedure. Results
indicate that as Internet usage increased, search duration
increased, which differs from earlier research that found that the
Internet had no significant effect on search duration, even though
it increased search intensity. This study finds that the Internet
increased buyer search intensity when market conditions were
favorable for buyers. If the only effect of online search is an
increase in search duration without a commensurate increase in
benefits to buyers, the Internet may slow the market clearing
process and increase seller holding costs.

Over the past several decades, the markets for residential properties have been
impacted by developments in real estate marketing and finance that include
policies of financial deregulation, innovations in information technologies, and
financial innovations in the form of financial derivatives and mortgage contracts.
Financial deregulation rests on the presumption that market competition will
provide efficiency and market discipline will provide a form of natural regulation
that assures a high degree of systemic stability but requires that buyers and sellers
of properties, and lenders, borrowers, and investors are equally able to make
informed decisions. Recent experience has amply demonstrated that financial
innovations in products, mortgages, and derivative instruments, and insufficiently
regulated processes (the originate-to-distribute model of mortgages) have the
potential to destabilize housing markets when information is either asymmetric or
lacking. In contrast, any innovation that increases the availability of information
equally to all participants can be expected to lead to real improvements in
efficiency. Unlike the other innovations that have impacted the housing market,
the Internet as a search tool should increase efficiency in housing markets by
providing information for both buyers and sellers without increasing financial
instability.

The Internet has become a fundamental and indispensable tool in the home
purchasing process. New products and innovations have increased Internet
accessibility, making it easier for individuals to quickly acquire information from
anywhere and at any time. Real estate professionals and their firms now regularly

incorporate Internet use into their daily operations, creating websites with access to property listings, virtual tours, and other sales information, such as neighborhood characteristics. The Internet also allows individuals to find information about houses for sale. It also lets them find financial information about the availability and types of mortgage loans, and even initiate the process of applying for loans online. In 1999, only 37% of buyers searched online for a home.[1] According to the 2009 National Association of Realtors (NAR) Profile of Home Buyers and Sellers, 90% of home buyers used the Internet to search for homes, an increase of 30% over the last six years.

As an economic concept, efficiency has multiple dimensions, with the time involved in searching and the costs incurred in the process being particularly important for potential buyers of residential properties.[2] In fact, as optimal search theory indicates, search occurs over two dimensions. One aspect of search is temporal, the time necessary to complete the search process. The other dimension of search is the intensity with which a search is conducted at any point in time. With optimal search, the buyer must reconcile the cost of sampling within a given period with the temporal costs associated with the extension of search to several periods. Across-period search costs result from the duration of search. Examples would include the out-of-pocket costs of conducting the search and the lost utility by postponing the consumption of the searched for product. Within-period search costs are the marginal costs of search, which includes the expense of information collection and the costs of evaluating properties.

Baryla and Zumpano (1995) found that the use of real estate brokers reduced search duration, exactly what effective market intermediaries should do. Subsequent research by Elder, Zumpano, and Baryla (1999) revealed that brokers, by reducing the costs of within-period search, increased buyer search intensity, which consequently reduced search duration.

Empirical evidence of efficiency gains from the use of the Internet as a search tool in home purchasing was first established by Zumpano, Johnson, and Anderson (2003). Based on 1999 survey data, they found that while the Internet as a search tool had not contributed to any reduction in buyer search time, there had been reductions in search costs, even when broker intermediation was involved in finalizing the sale. Additionally, this reduction in within-period search costs encouraged greater search intensity. The question addressed in this research is whether the continuing evolution of the Internet since the late 1990s has improved the efficiency of the residential real estate market. The expectation is that the expansion of the Internet as a search tool in the real estate sector has had efficiency effects for buyers of homes. Have Internet resources changed buyer search, and if so, in what way? Has the greater availability and increased usage of the Internet actually shortened the home search process in addition to reducing search costs, allowing homes to be on the market for a shorter period of time? Alternatively, has the abundance of information overwhelmed buyers with too many choices, extending the amount of time buyers spend looking for a home? Stated differently, has the Internet actually decreased market efficiency by increasing search costs?

The goal of this research is to further assess the efficiency effects of increased Internet usage and online innovations on the home buying process. Specifically, the objective is to determine if Internet usage in the home search process has reduced or increased the search time, and intensity. In addition, this research explores whether the effectiveness of the Internet as a search tool is dependent upon economic conditions that prevail during the search period. Since the housing market boom and subsequent implosion occurred after the Zumpano, Johnson, and Anderson (2003) paper, this research, which uses more current data, should provide insights into whether or not the Internet as a search tool is more effective during a seller's or buyer's market.

The next section provides an update on Internet use in the housing market, followed by a brief literature review. Description of the data source and discussion of the methodology follow. The empirical findings from the research and the results are then discussed. The paper closes with concluding remarks.

Developments in Internet Use in the Housing Markets

The Internet has dramatically changed how real estate companies conduct their daily business and how consumers purchase and benefit from products and services.[3] Information regarding the real estate sector provided on the Internet has transformed the industry and has proven to be a major tool for home buyers and sellers. Buyers, sellers, borrowers, and lenders are no longer as dependent on real estate service providers when they are able to acquire market information, sometimes cost free, online (Tse and Webb, 2002). Gwin (2004) showed that early on real estate brokers did take the possibility of disintermediation seriously, concerned about how much information to provide on their websites. Gee (2010) suggests that the reduction of some professional real estate broker services is due to the Internet devaluing the services that were once only obtainable through real estate brokers and sales associates.

Real estate professionals, who at first feared the Internet as competition, are now increasingly incorporating information technology into their businesses using websites that allow anyone with a computer or cell phone the ability to access real estate sales information. Although the scope of their services may have narrowed, brokers can still offer valuable services to buyers and sellers by answering technical questions about houses, assisting with buyer financing, offering third-party negotiations, and staging properties.

Internet Search Engines

Many of the activities related to the home buying process have been made easier and more direct with the arrival of the Internet. Home buyers can explore various websites to find a home anywhere in the world. Buyers can also use the Internet to shop for the best type of mortgage loan with the most favorable interest rate,

obtain loan preapproval, and ultimately receive mortgage financing. In addition to mortgage financing, buyers can also access other real estate services and products such as home inspectors, property appraisers, attorneys or escrow agents, and title insurance online. Innovative search engines with customizable searches have allowed prospective buyers to obtain more information about the housing market and to specify price range, location, architectural style or type, and number of bedrooms and bathrooms. These search engines provide pictures of the listed properties, virtual tours, mortgage calculators, neighborhood maps, local schools information, comparative sales data of homes similar to the listed property that were sold recently, property taxes, and possibly the previous sales price paid by the current home owner along with links to home inspectors, title insurance, mortgages, appraisals, and movers. Some websites offer property listings nationally; others only provide information for regional or local areas. Several sites that offer free access require free registration while other sites, offering searchable public records databases, are managed by city and local county governments (Gee, 2010).

Many websites function only as a real estate portal, typically easy-to-navigate with category headings and menu buttons leading to property listings, advice, and other useful tools. Home market valuations may also be offered. Multiple listing service (MLS) websites have listings posted by brokers and agents who are members of the organization that maintains the MLS. These listings have a specific MLS identification number, and the websites frequently require free registration. Sellers attempting to market their properties without broker assistance can advertise their listings on for-sale-by-owner (FSBOs) websites. There are also websites that offer sellers the option to list their homes with limited service brokers, also known as fee-for-service websites, which allows them to choose the amount and type of services they want an agent to do on their behalf on a fee-for-service basis (Gee, 2010). Exhibit 1 provides a list of real estate search engines and websites, along with a brief description of each site.

Review of the Literature

There is an expanding body of literature on the Internet and its impact on the housing market and the real estate brokerage industry. Some of this research (Tse and Webb, 2002; Bristow, Mooney, and Dou, 2004; Benjamin, Chinloy, Jud, and Winkler, 2005; Seiler, Madhavan, and Liechty, 2012) examines the Internet as a marketing and communications tool and its impact on the revenues, net income, and net profit margin of residential real estate brokerage firms.[4]

Other studies have looked at how the Internet has affected the type and amount of services provided by brokers, while other researchers have been examining the related issue of the effectiveness of limited service brokerage (Benefield, Pyles, and Gleason, 2011; Goodwin, Johnson, and Zumpano, 2012). Recent research by Hohenstatt, Kasbauer, and Schafers (2011) has shown how Google data can be

Exhibit 1 | Real Estate Search Engines

Website	Description
U.S. Property Listings	
Domania.com	Regional and local realtor listings; buyer submits contact information and agent contacts the buyer.
Foreclosure.com	Lists properties in pre-foreclosure, foreclosure, and bankruptcy.
HomeGain.com	Listings on resale homes, new construction, and foreclosures; offers free home value estimate and assistance with finding a local real estate agent.
HomePages.com	Provides tips on home selling, home buying, and mortgage loans; searches through independent broker and MLS websites; generates revenues from agents with customer referrals from its site.
Homes.com	Listings of existing homes, new construction properties, and foreclosures along with information on how to buy a home and find a mortgage.
HomeSalez.com	Listings of FSBO and agents in the U.S., Canada, Australia, New Zealand, and the United Kingdom.
Homescape.com	Regional MLS listings and a pathway to local real estate classifieds from websites of newspapers.
HomeSeekers.com	Allows searches in Spanish and French as well as English; provides resources on demographics, family statistics, crime, educational attainment, economic data, climate, and health-related figures.
Move.com	Listings for new construction homes and rentals; articles about getting a mortgage, home equity loans, and refinancing; and many financial calculators.
NeighborhoodScout.com	No property listings; provides interactive maps to find the best school districts, lowest crime areas, and highest rated home-appreciating neighborhoods anywhere in the U.S.
RealEstate.com	MLS property listings are plotted on an interactive map; offers instant home valuation estimate on a single property without contact from an agent.
Realsites.com	Serves as a listing service for properties, real estate services, and classified ads around the world.
RealtyTrac.com	Specializes in foreclosure listings in all 50 states; FSBOs can post listings as well
Rebuz.com	Directory for consumers to find various real estate associations, architects, appraisers, commercial and residential financing, and additional ancillary services and products.
ResidentialNYC.com	Carries listings for condominiums, cooperatives, and houses in New York City.
Trulia.com	Listings for resale, new construction, and foreclosures across the country; contains real estate guides for all cities in all states; provides current and historical average sales prices of properties.
Zillow.com	Listings for new homes, resales, and foreclosures across U.S. with historical sale price and date of last sale records

Exhibit 1 | (continued)

Real Estate Search Engines

Website	Description
MLS Websites	
AtlMLS.com	MLS listings for properties in Atlanta, GA and surrounding areas.
MLSLI.com	MLS listings on Long-Island, NY with neighborhood and school information and searches in many languages.
MLSListings.com	MLS listings in the Silicon Valley and surrounding neighborhoods.
Realtor.com	NAR website; listings for sales and rentals in all 50 states plus Puerto Rico, Guam, and Canada; supplies consumer tips.
Realtor.ca	MLS listings across Canada.
National Chain Franchises	
Century21.com	Listings in U.S., Asia, Africa, Middle East, Europe, and South America with advice on buying, selling, and closing.
ColdwellBanker.com	Listings in U.S., Europe, Australia, Asia, South America, and the Caribbean; offers buying and selling advice in many professionally produced videos.
ERA.com	Listings in U.S., Asia, Middle East, Europe, and the Caribbean searchable in English or Spanish; offers services for mature markets customers and relocation for military clients.
ReMax.com	Listings in U.S., Canada, Mexico, Australia, Europe, Asia, Africa, South America, Central America, Caribbean, and Middle East; searchable in many languages.
For-Sale-By-Owner (FSBO)	
Allthelistings.com	Designed for direct sellers; buyers can browse listings in the U.S. and Canada.
Realestate.Yahoo.com	Listings posted by real estate agents and FSBOs; listings for resale, new construction and foreclosure properties in U.S.; provides many resources for consumers; listing fee is charged.
Craigslist.org	Sale and rental classified ads posted by agents, FSBOs, landlords, and property management companies viewable for 7 days; no-fee to list a property.
ForSaleByOwner.com	Fee-based site for FSBOs; listings in U.S. and Canada; provides articles on market conditions, buying, and selling.
ForSaleByOwnerCenter.com	No-fee FSBO site with only U.S. properties; also contains 26 financial calculators.
FSBO.com	Fee-based site; sellers can advertise properties for up to 9 months; optional flat fee for listing on MLS; listings in U.S., Canada, and Mexico.
FSBOfreedom.com	No-fee for listing; provides resale and foreclosure listings in the 50 states posted by FSBOs.
Owners.com	No-fee for listing; flat fee for listing on MLS; open forum for direct sellers to ask questions and share advice.

Exhibit 1 | (continued)

Real Estate Search Engines

Website	Description
Limited Service and Discount Brokers	
Assist2Sell.com	Discount broker offering low flat fees for full services to sellers; listings in 44 states and Canada; optional MLS.
HouseRebate.com	Full service discount broker based in San Diego, CA; commission rates start at 4.5% to home sellers; buyers can get up to 1% rebate of the purchase price.
Redfin.com	No upfront services; agents are direct employees; requires buyers to browse properties on its site, once a buyer finds homes of interest, agent will take buyer on tours, conduct negotiations, and assist with closing; 2/3 of commission paid to buyer's agent is refunded with a rebate to the buyer upon closing; sellers charged $4000 for MLS listing for marketing, professional photos, conducting a market analysis, and negotiations.
ZipRealty.com	No upfront discounts; sellers can save up to 25% of commission through rebates and buyers can get back about 20%; provides comparables over the past 3 months, date of sale, home age, square footage, and number of bedrooms and bathrooms.

* Information from Gee (2010).

used to better assess consumer sentiment, predict housing market changes, and, in fact, possibly even drive housing prices.

Since our principal concern is the impact of the Internet on the efficiency of buyer search, we direct our principal attention to a review of these studies. Ford, Rutherford, and Yavas (2005) use 48,280 MLS listings of residential properties in Collin, Dallas, Denton, and Tarrant Counties from January 1, 1999 to December 31, 1999 to study the marketing time and price of properties that are listed on both the Internet and MLSs. The authors use a two-stage Heckman procedure with a first-stage probit equation estimating the whether the property is listed on the Internet and a second-stage least squares estimation of marketing time and selling price in a simultaneous framework. They find that properties listed on the Internet take slightly longer to sell, that is an six extra days for marketing time, and also sell for slightly higher prices, with a premium of approximately $2,900 over the average house price.

Zumpano, Johnson, and Anderson (2003) were the first to examine the factors that influence the use of the Internet by buyers as part of the home buying process. They used 1999 data from the National Association of Realtors 2000 Home Buying and Selling Survey, a nationwide survey of recent home buyers and sellers. A Heckman two-stage procedure was employed to model the decision to use the

Internet as a buyer search tool and to assess the resulting impact on search duration and intensity. In the first stage, a probit equation was employed to model Internet use as a function of various buyer characteristics (income, age, ask price, distance of relocation, corporate movers, first-time homebuyers, broker usage, first learned about the property from a broker, and city). In the next stage, ordinary least squares (OLS) was used to estimate the two aspects of buyer search: search duration and search intensity.

The results from the first-stage probit equation of the Zumpano, Johnson, and Anderson (2003) study were consistent with the expectations of search theory. Out-of-town buyers facing higher information costs were found to be more likely to use the Internet to help in the search process than local home buyers. Younger buyers, typically more familiar with computers, were also found to be more likely to use the Internet as part of their search process than were older consumers. The higher the seller's asking price, the more likely the buyers were to rely on the Internet in their home search. The expectation that as income (a proxy for the opportunity cost of search) increased, the probability of Internet use would increase, however, did not hold for every income level. Use of the Internet appeared to be a complement rather than a substitute for employing the services of a real estate broker. First-time home buyers, who could be assumed to be less experienced and less knowledgeable about the home buying process, appeared to be more likely to use the Internet as part of the search process than more experienced home buyers.[5] Employer-mandated relocation did not impact the use of the Internet. Middle-aged buyers also searched longer than younger buyers. The key finding of the Zumpano, Johnson, and Anderson (2003) study was that use of the Internet as a search tool did not lower search time, but Internet use did encourage buyers to search more intensively.

Li and Motiwalla (2009) examined the influence of the Internet on housing prices and its effect on the real estate brokerage industry by analyzing the price difference between houses sold with a broker and those sold by the owner using the Internet. A house was defined as being sold and bought online if the buyer finds sale information directly from the seller's listing posted on the Internet, with the sale and purchase transaction made without broker involvement. A hedonic pricing model was used to investigate the hypothesis that the price of a house sold online should be lower than that of a comparable house sold through a broker because information and transaction costs are lower without the use of a broker. Using a sample set of 188 house records from three towns in Massachusetts, collected from property records maintained in three town halls, they found that the price of a home sold online is, on average, lower than a comparable home sold with a broker; however, this finding was not statistically significant.[6] The authors noted that the common practice in real estate of the buyer's agent and the seller's agent to split the commission implies that the transaction cost for buying and selling the property is about the same in this situation. In contrast, they found an asymmetric distribution of benefits, with sellers receiving a bigger portion of the cost savings derived from homes sold online.

Littlefield, Bao, and Cook (2000) designed a survey that examined consumers' Internet use when searching for a home. The authors used OLS multiple regression to analyze the data and test various hypotheses regarding the home buyers' use of the Internet for real estate related services. Awareness of Internet real estate information, access to Internet, and perceived effectiveness of the Internet in home purchase were found to be important factors in determining consumers' use of the Internet during home search. As was the case in other studies, older buyers were less likely to use the Internet. The same was true for buyers who indicated satisfaction with broker services. The effect of Internet use on the duration of the home search, however, was not studied.

Data and Methodology

Data for the study were taken from large nationwide surveys of recent homebuyers and sellers that were conducted by the National Association of Realtors in 2006, very much a seller's market, and 2009, when the housing market was in decline. Both the boom and subsequent bust were created by a number of contributing factors, structural, institutional, and market-driven changes far too numerous to examine or describe here.[7]

In August 2006, the questionnaire was mailed to 129,500 consumers who purchased a home between July 2005 and June 2006. The NAR received 7,548 completed surveys for 2006. The 2009 survey was mailed in July 2009 to 120,038 consumers who purchased a home between July 2008 and June 2009. The NAR received 9,138 completed surveys. Elimination of incomplete and/or contradictory survey responses left a total of 5,254 completed 2006 questionnaires and 7,062 completed 2009 questionnaires.

The 2006 NAR survey had 101 separate questions, and the 2009 NAR survey had 116 separate questions. Many of these questions are not relevant to the research question at hand. The variables included in this study were based on the Zumpano, Johnson, and Anderson (2003) analysis, which used search theory and the findings of earlier studies to identify potential determinants of buyer search.

Internet Use

Consumers who use the Internet may, because of other characteristics, be predisposed to purchase homes more quickly (or more slowly) than other buyers, even without benefit of the Internet. If sample selection bias is present, it could result in mistaken conclusions regarding the relationship between Internet use and the buyer's search for a home. The appropriate method for testing and correcting selection bias, if present, is the Heckman two-stage procedure. In the first stage, probit estimation is used to model Internet use as a function of various buyer characteristics. Search time and intensity can then be examined using OLS modeling.

Buyer income is used to measure the opportunity cost of search. Earlier research showed that higher income sellers were more likely to list their properties with real estate brokers in the hope of reducing selling time and, hence searches costs (Zumpano, Elder, and Baryla, 1996). Will higher income buyers react in the same way to Internet intermediation, as with real estate professionals to reduce search costs? The data limited the ability to account for buyer income using a continuous variable; therefore, the *IncBtw3585K* and *IncOver85K* variables, which correspond to the middle and upper income buyers, are incorporated into the model with lower income buyers, *IncUnder35K*, as the base case. As earlier research suggests, younger buyers are more familiar with obtaining and using information provided by the Internet, whereas this has not typically been the case with older buyers. *Btw3550* and *Over50* correspond to buyers between the ages of 35 and 49 and buyers over 50 years of age, respectively; *Under35* denotes buyers below age 35, the base case, and is therefore omitted.

Internet usage could also be affected by the price (*AskPrice*) of the home because search theory implies that buyer search increases (both duration and intensity) when faced with higher prices. The Internet can be used to identify lower priced homes without a significant increase in search costs. Out-of-towners have high across period search costs and much less familiarly with local market conditions; hence, we suspect that as the distance between new and previously occupied property increases, so will Internet use. The *Btw16100* variable represents buyers who purchase a new home that is between 16 and 100 miles from their previous home; the *Btw101500* variable represents buyers who purchase a new home that is between 101 and 500 miles from their previous home; and the *Over500* variable represents buyers with new home purchases over 500 miles from their previous home. The base case, *Less15*, represents buyers who purchased a new home less than 15 miles from their previous home; it is excluded from the model. In addition to the distance of the move, buyers that have to move due to job-related circumstances (*EM*) may be less sensitive to search costs and home prices if their employers are paying for the move and subsidizing the purchase. Alternatively, if these search costs are not subsidized and if employees are moving to more expensive markets, use of online search tools may increase. Homebuyers who are purchasing a home for the first time (*Firsthome*) may be more likely to use the Internet to obtain information because they do not have prior home ownership and home purchase experience.

Categorical variables, indicating whether the buyer used a broker to purchase a home (*Broker*), and (*Flbroker*), designating if a buyer first learned of their purchase from a broker, are employed to investigate how real estate broker assistance affects the probability that buyers will use the Internet to search for a home. First contact with a broker to assist in the search could obviate the need for as extensive an Internet search.

Buyer location (*City*) could also affect whether or not the Internet is used in the search process. More available Internet listings are likely for properties in more urban areas than properties in more rural settings. Occupation, sex, and marital

status may also influence Internet usage but these data were not available to include in the analysis. Explicitly, the *Netused* probit model is defined as:

$$Netused = \beta_0 + \beta_1 LnAskPrice + \beta_2 Btw3550 + \beta_3 Over50$$
$$+ \beta_4 IncBtw3585K + \beta_5 IncOver85K + \beta_6 Btw16100$$
$$+ \beta_7 Btw101500 + \beta_8 Over500 + \beta_9 Firsthome$$
$$+ \beta_{10} Em + \beta_{11} Broker + \beta_{12} Flbroker + \beta_{13} City + \varepsilon.$$
$$(1)$$

Duration and Intensity

The buyer's search process is likely to be influenced by many of the same variables that impact Internet use. The inverse Mills ratio (IMR) from the first-stage probit equation is included to test and control for selection bias, if present.

One would anticipate that the further away the new home is from the home buyer's previous home, the greater the across-period search cost due to an unfamiliarity with local market conditions and the additional costs of the search such as hotels or lost pay from taking time off from work. Therefore, search duration should decline the greater the distance from the buyer's home. A household relocating to a distant location that has to travel a longer distance to search for a new home would face higher costs to search over extended periods. This suggests that search intensity should rise as duration costs increase because of the additional costs that would be incurred by having to make more than one and possibly prolonged trips to the new location.[8] If true, the distance variables (*Btw16100, Btw101500,* and *Over500*) should have a negative sign in the duration estimation and a positive sign in the intensity estimation.

Buyers searching for homes in cities are closer in proximity to the homes that are on the market than in more rural locations. This could work to shorten search time, as well as increase search intensity. The Internet (*Netused*) could, at least in part, be a substitute for an actual physical search, serving as a pre-screening device to narrow down search time. If the Internet lowers within-period costs, it should sign positive and significant for search intensity, which could then reduce duration. On the other hand, it is possible that the Internet could also reduce search intensity as it can be conducted at a lower cost and in a more leisurely manner online, which could extend duration.

Employer-mandated moves (*EM*) are expected to be inversely related to search duration because the opportunity costs of relocating workers are usually paid for by the employer; doing so by searching more intensively. As search theory posits,

buyers should search longer when confronted with higher asking prices (*LnAskPrice*) because the they would experience greater savings by searching for a lower priced home.[9] If a buyer first learned about the home purchased through broker intermediation (*Flbroker*), it could reduce the length of search. The same basic argument can be made for the *Broker* variable, which indicates whether the buyer purchased a home with the assistance of a broker. The sign of *Firsthome* will depend on whether less knowledgeable first-time homebuyers search longer than more experienced and savvy home buyers. It is also uncertain whether first-time home buyers will search more intensively than previous owners. If they are not as familiar with the search process, they could actually search less efficiently and, hence, less intensively.

The buyer's income, used as a proxy for the opportunity cost of the search, should be negatively related to search duration. One would also suspect that more affluent buyers will search more intensively as the means of reducing search time. The coefficients for the distance variables and the employer-mandated variable should be positively related to search intensity when buyers are faced with higher across-period costs. Lastly, the *City* variable is included to see if search duration and intensity are sensitive to population density and the proximity of available homes.

The same set of variables is not used in the first and second stage estimations. Methodologically, at least one predictor in the Internet use equation should not appear in the second stage equation, and this variable should be statistically significant in the first stage, but insignificant in stage two following Wooldridge (2000). Therefore, the *IncOver85k* variable has been excluded from the duration and intensity equations because it was statistically significant in the first stage, but insignificant in stage two.[10] The search duration/intensity equation is defined as:

$$
\begin{aligned}
\text{Duration/Intensity} = \ & \beta_0 + \beta_1 LnAskPrice + \beta_2 Btw3550 \\
& + \beta_3 Over50 + \beta_3 Btw3585K \\
& + \beta_4 Over85K + \beta_5 Btw16100 \\
& + \beta_6 Btw101500 + \beta_7 Over500 \\
& + \beta_8 Firsthome + \beta_9 Em \\
& + \beta_{10} Flbroker + \beta_{11} Broker \\
& + \beta_{12} Netused + \beta_{13} City \\
& + \beta_{14} IMR + \varepsilon.
\end{aligned} \tag{2}
$$

Exhibit 2 provides the variable definitions.

Exhibit 2 | Variable Legend

Variable	Definition
TTB	Buyer search time in weeks.
Visits	Number of properties physically visited by buyer prior to final purchase.
Intensity	Visits / TTB, i.e., the average number of properties visited per week.
AskPrice	Asking price of purchased property.
SellPrice	Selling price of purchased property.
Under35	One if the buyer's age is less than 35 years, zero otherwise.
Btw3550	One if the buyer's age is between 35 and 50 years, zero otherwise.
Over50	One if the buyer's age is over 50 years, zero otherwise.
IncUnder35K	Buyers whose annual income is less than $35,000.
IncBtw3585K	Buyers whose annual income falls between $35,000 and $84,999.
IncOver85K	Buyers whose annual income is $85,000 or more.
Less15	One if distance in miles between new and previously occupied property is less than 15, zero otherwise.
Btw16100	One if distance in miles between new and previously occupied property is between 16 and 100, zero otherwise.
Btw101500	One if distance in miles between new and previously occupied property is between 101 and 500, zero otherwise.
Over500	One if distance in miles between new and previously occupied property is over 500, zero otherwise.
Firsthome	One if property purchased is buyers' first, zero otherwise.
Em	One if buyers' move was job related, zero otherwise.
Broker	One if buyers purchased property with the aid of a broker, zero otherwise.
Flbroker	One if the buyers first learned of their purchase via a broker, zero otherwise.
Netused	One if the buyers employed the Internet to aid their search, zero otherwise.
IMR	Inverse Mills ratio from first stage probit.
City	One if buyers purchased property in a city neighborhood, zero otherwise.

Empirical Results

The summary statistics in Exhibit 3 indicate that buyers searched longer and more intensively in 2009 compared to 2006, which is generally considered be a seller's market. These results may reflect, at least in part, differences in both prevailing market conditions and consumer expectations. In 2006, home prices were rising

Exhibit 3 | Summary Statistics

Variable	Entire 2006 Sample			Entire 2009 Sample			Difference in Means	
	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	t-stat	p-value
TTB	13.516	8	16.950	18.450	12	20.480	14.34	<0.0001
Visits	3.963	4	1.702	19.468	15	18.362	61.01	<0.0001
Intensity	0.768	1	1.044	2.306	1.25	3.7636	28.80	<0.0001
AskPrice	284,203	217,700	269,450	257,619	200,000	216,251	-6.07	<0.0001
SellPrice	275,925	210,000	263,595	239,278	190,000	197,320	-8.82	<0.0001
Under35	0.388	0	0.487	0.446	0	0.497	6.44	<0.0001
Btw3550	0.343	0	0.475	0.324	0	0.468	-2.19	0.0288
Over50	0.270	0	0.444	0.230	0	0.421	-5.03	<0.0001
IncUnder35K	0.111	0	0.314	0.096	0	0.294	-2.76	0.0058
IncBtw3585K	0.497	0	0.500	0.486	0	0.500	-1.18	0.2384
IncOver85K	0.392	0	0.488	0.418	0	0.493	2.90	0.0037
Less15	0.556	1	0.500	0.614	1	0.487	6.47	<0.0001
Btw16100	0.229	0	0.420	0.216	0	0.411	-1.78	0.0744
Btw101500	0.077	0	0.268	0.061	0	0.238	-3.68	0.0002
Over500	0.138	0	0.345	0.110	0	0.313	-4.63	<0.0001
Firsthome	0.396	0	0.489	0.499	0	0.500	11.46	<0.0001
Em	0.137	0	0.344	0.098	0	0.297	-6.76	<0.0001
Broker	0.656	1	0.475	0.604	1	0.489	-5.85	<0.0001
Flbroker	0.415	0	0.493	0.381	0	0.486	-3.73	0.0002

Exhibit 3 | (continued)

Summary Statistics

| Variable | Entire 2006 Sample | | | Entire 2009 Sample | | | Difference in Means | |
	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	t-stat	p-value
Netused	0.865	1	0.342	0.931	1	0.254	12.24	<0.0001
City	0.180	0	0.385	0.185	0	0.388	0.62	0.5362
IMR	0.243	0.195	0.165	0.131	0.076	0.148		

Notes: This table reports summary statistics for the variables used in this study. In the 2006 sample, N = 5,254; in the 2009 sample, N = 7,062.

so rapidly that buyers may have reduced their search time and intensity to buy a home before it became prohibitively expensive. In contrast, search intensity and duration increased when facing lower prices in the 2009 buyer's market. There were a lot more homes on the market at the end of the decade, so the probability of finding a less expensive house was higher than during the seller's market in 2006. Where buyers had to act quickly in 2006 to avoid accelerating home prices, in a buyer's market there are many more houses on the market and search can be more leisurely since prices are falling. While search behaviors may be influenced by market conditions, it does not mean search is less efficient.

Internet Use

The estimates from the *Netused* probit equation along with the average marginal effects are found in Exhibit 4.[11] Interestingly, the results are similar for both the seller's market (2006 data) and the buyer's market (2009 data). Older buyers were less likely to use the Internet when searching for a home than were younger house hunters. The marginal effects indicate the probability of Internet use was 18.6 percentage points lower for older buyers in 2006 (and 12.7% lower in 2009). As theorized, out-of-town buyers having higher information and search costs were more likely to use the Internet in their search process. The Internet was more likely to be used in the search the greater the distance between the new and old home. The higher the asking price, the more probable the Internet would be employed to search for lower priced homes, with marginal effects indicating that the probability of Internet use increased 1.5 percentage points in 2006 and 2.1 percentage points in 2009.

As anticipated, as income increases, the likelihood of Internet use increased. Employer-mandated moves as well as broker assistance increased the possibility that the Internet will be used to find a home. Not surprisingly, however, buyers who first learned of their home purchase from a broker were less likely to use the Internet as a search tool. The marginal effects in this case specify a decrease of 6.5 percentage points in 2006 and 5.6 percentage points in 2009 in the probability of Internet usage. Despite differing market conditions, the factors influencing Internet use remained virtually unchanged. The one difference is that in the 2009 buyer's market, first-time buyers were more likely to use the Internet as a search tool than was the case in the 2006 seller's market (the first-time buyer variable was insignificant). These results may reflect the fact that in 2006, buyers had to act quickly to avoid accelerating home prices, working directly with brokers rather than search on their own to expedite the purchase. In the 2009 buyer's market, there were many more houses on the market and search could be undertaken more leisurely whether using a broker or not, since prices were falling and the opportunity costs of search were lower than in 2006.[12]

Search Intensity/Duration

The results from the second stage OLS estimations are found in Exhibits 5 and 6. The duration results were the same in 2006 and 2009 despite differing market

Exhibit 4 | First Stage Probit

Predictor	Coeff.	t-stat	Marginal Effects
Panel A: 2006 Sample			
Constant	0.200	0.39	
LnAskPrice	0.079*	1.84	0.015
Btw3550	−0.358***	−5.64	−0.069
Over50	−0.965***	−14.56	−0.186
IncBtw3585K	0.325***	4.64	0.063
IncOver85K	0.466***	5.51	0.090
Btw16100	0.134**	2.32	0.026
Btw101500	0.253**	2.45	0.049
Over500	0.333***	3.87	0.064
Firsthome	−0.082	−1.38	−0.016
Em	0.309***	3.15	0.060
Broker	0.177***	3.71	0.034
Flbroker	−0.339***	−7.24	−0.065
City	0.094	1.53	0.018
Panel B: 2009 Sample			
Constant	−0.583	−1.04	
LnAskPrice	0.188***	3.99	0.021
Btw3550	−0.457***	−6.07	−0.050
Over50	−1.166***	−15.07	−0.127
IncBtw3585K	0.322***	4.34	0.035
IncOver85K	0.556***	6.15	0.061
Btw16100	0.054	0.83	0.006
Btw101500	0.184	1.58	0.020
Over500	0.431***	4.33	0.047
Firsthome	0.115*	1.74	0.012
Em	0.216*	1.74	0.024
Broker	0.187***	3.61	0.020
Flbroker	−0.513***	−9.92	−0.056
City	0.021	0.31	0.002

Notes: This table reports the first stage probit estimation of equation (1), which examines the factors that influence Internet usage. The dependent variable is *Netused*. All variables are defined in Exhibit 2. The Wald statistic test of differences between the coefficients of the 2006 and 2009 probit estimations is 28.68 (P > ChiSq = 0.0063). The coefficients significantly differ across the two time periods. They all have the same functional relationship with the *Netused* variable. In the 2006 sample, N = 5,254; Log-Likelihood = −1846; for Obs. with Dep. = 1, the value is 4545;

Exhibit 4 | (continued)

First Stage Probit

for Obs. with Dep. = 0, the value is 709.

In the 2009 sample, N = 7,062; Log-Likelihood = −1435; for Obs. with Dep. = 1, the value is 6573; for Obs. with Dep. = 0, the value is 489.

* Significant at the 10% level, based on the corresponding *t*-statistic.
** Significant at the 5% level, based on the corresponding *t*-statistic.
*** Significant at the 1% level, based on the corresponding *t*-statistic.

conditions. Confronted with higher prices, all buyers searched longer whether during a buyer's or seller's market. Not surprisingly, buyers searched for a shorter period of time in 2006 than buyers in 2009, when they could be more selective facing falling prices. First-time home buyers (*FirstHome*) searched longer than experienced home buyers. Older home buyers, who were less likely to use online search tools, also tended to search longer than younger buyers as measured in weeks. Looking at the size of the coefficients for the age variables (*Btw3550* and *Over50*), it also appears that search time differed within these age brackets. It appears that search time was shorter for buyers between 35 and 50 than for those aged over 50 in 2006, but the opposite was the case in 2009. It could be that in 2009 buyers over 50, who are likely more affluent than their younger counterparts, were able to act more quickly and could afford a wider range of home choices.

The higher the home buyer's income, the shorter the time spent searching for a home, but these variables (*IncBtw3585K* and *IncOver85K*) proved to be statistically insignificant. Since income was not a continuous variable, these results may be due to the way these variables were defined. Homes further than 100 miles away (*Btw101500* and *Over500*) decreased search duration. Employer-mandated moves also tended to decrease the search duration. Forced to relocate and given limited time to do so should act to reduce search time. Buyers who first learned of the home they purchased via a broker (*Flbroker*) spent less time searching for a home and buyers who used the Internet (*Netused*) tended to extend the length of their search. These results seem intuitive given that for brokers time is money and the quicker they can expedite a sale, the greater their income. Online search is far less costly for the buyer even if it extends search time.[13]

First-time home buyers searched less intensively in 2006, whereas the number of home visits per week increased in 2009; the latter result, however, was statistically insignificant. Buyers who used the Internet decreased their search intensity in the 2006 seller's market, but the same type of buyers searched more intensively in the 2009 buyer's market than other buyers, indicating that market conditions do impact on some aspects of buyer search behavior. In 2006, an Internet search would have revealed high and rising prices. Rising prices may have actually discouraged these buyers from visiting more properties per week. It is also true

Exhibit 5 | Second Stage OLS/Duration

Predictor	Coeff.	t-stat.	VIF
Panel A: 2006 Sample			
Constant	0.554*	1.76	
LnAskPrice	0.099***	3.99	1.220
Btw3550	0.178***	4.86	1.442
Over50	0.109**	2.58	1.688
IncBtw3585K	−0.038	−1.23	1.117
Btw16100	0.059	1.63	1.097
Btw101500	−0.245***	−3.88	1.352
Over500	−0.354***	−6.72	1.568
Firsthome	0.139***	3.86	1.485
Em	−0.220***	−4.02	1.681
Broker	0.006	0.20	1.008
Flbroker	−0.174***	−5.84	1.033
City	0.055	1.44	1.024
Netused	0.323***	7.29	1.092
Panel B: 2009 Sample			
Constant	0.062	0.22	
LnAskPrice	0.169***	7.70	1.224
Btw3550	0.103***	3.18	1.432
Over50	0.152***	3.86	1.741
IncBtw3585K	−0.018	−0.67	1.146
Btw16100	0.035	1.11	1.077
Btw101500	−0.188***	−3.13	1.297
Over500	−0.411***	−8.36	1.495
Firsthome	0.135***	4.18	1.635
Em	−0.332***	−6.20	1.591
Broker	−0.024	−0.94	1.011
Flbroker	−0.164***	−6.23	1.028
City	−0.031	−0.93	1.026
Netused	0.306***	5.85	1.111

Notes: This table reports the second stage ordinary least squares estimation of equation (2), which examines the factors that influence search duration. The dependent variable is TTB, logged. All variables are defined in Exhibit 2. The IMR was estimated as 0.122 with a p-value of 0.6360, and values were re-estimated excluding IMR. The IMR was estimated as 0.119 with a p-value of 0.5614, and values were re-estimated excluding IMR. In the 2006 sample, $N = 5,254$; $R^2 = 0.0594$; F-Stat. = 25.46. In the 2009 sample, $N = 7,062$; $R^2 = 0.0552$; F-Stat. = 31.70. The

Exhibit 5 | (continued)
Second Stage OLS / Duration

F-statistic for the test of differences between the coefficients of the 2006 and 2009 duration estimations is 1.42 (P > F = 0.1429).
* Significant at the 10% level, based on the corresponding *t*-statistic.
** Significant at the 5% level, based on the corresponding *t*-statistic.
*** Significant at the 1% level, based on the corresponding *t*-statistic.

that Internet use also increased duration at a time when the longer the search, the greater the cost incurred by buyers as prices rose rapidly.

In both years, search intensity decreased as the age of the buyer increased, which is consistent with the longer search duration of older home buyers. Buyer search intensity increased with buyer income, no matter the market conditions, but this variable proved to be statistically insignificant in both 2006 and 2009.

Employer-mandated moves increased search intensity. In particular, employer-mandated moves caused an increase in search intensity of 0.310 in 2006 versus an increase of 0.501 in 2009, a result consistent with shortened search duration. The greater the distance from their previous home, the more intense the search whether during a buyer's or seller's market as these buyers are seeking to avoid high across-period search costs. Furthermore, in 2006, search intensity is smaller for new homes between 101 and 500 miles away from the old home than those in 2009. Buyers who purchased their home with the assistance of a real estate broker were also more likely to look at more homes per week than those who did not use the services of a broker. Search intensity was also higher for buyers who first learned of their purchase from a real estate broker in the 2009, a year of falling prices.

Comparison with Earlier Findings

The estimations from the second stage estimations of the Zumpano, Johnson, and Anderson (2003) paper are found in Exhibit 7. Comparison of the effects of the variables on search duration and intensity from the 1999, 2006, and 2009 data are presented in Exhibit 8. Because of data limitations and slight differences in the form of the answers to the 1999 questionnaire, the 2006 and 2009 variable names are somewhat inconsistent with that of the 1999 variable set. The *Btw4070K* and *Over70K* variables, listed with the 1999 data, represent buyers with incomes between $40,000 and $70,000 and over $70,000, respectively. The 1999 data also allowed distance to be defined as continuous rather than categorical, which was not possible with the 2006 and 2009 data.

Exhibit 6 | Second Stage OLS / Intensity

Predictor	Coeff.	t-stat.	VIF
Panel A: 2006 Sample			
Constant	−0.517*	−1.79	
LnAskPrice	−0.017	−0.75	1.220
Btw3550	−0.144***	−4.28	1.442
Over50	−0.161***	−4.13	1.688
IncBtw3585K	0.002	0.05	1.117
Btw16100	−0.046	−1.39	1.097
Btw101500	0.315***	5.43	1.352
Over500	0.422***	8.72	1.568
Firsthome	−0.152***	−4.57	1.485
Em	0.313***	6.23	1.681
Broker	0.027*	0.98	1.008
Flbroker	0.251	9.13	1.033
City	−0.017	−0.48	1.024
Netused	−0.126***	−3.10	1.092
Panel B: 2009 Sample			
Constant	−1.278***	−3.78	
LnAskPrice	0.085***	3.26	1.686
Btw3550	−0.114***	−3.21	1.696
Over50	−0.288***	−4.18	5.185
IncBtw3585K	−0.030	−1.08	1.146
Btw16100	0.065**	2.02	1.086
Btw101500	0.340***	5.51	1.326
Over500	0.606***	11.42	1.688
Firsthome	0.025	0.75	1.664
Em	0.525***	9.63	1.609
Broker	0.110***	4.01	1.094
Flbroker	0.296***	8.69	1.681
City	0.073**	2.2	1.027
Netused	0.157***	2.92	1.143
IMR	0.364*	1.75	5.786

Notes: This table reports the second stage ordinary least squares estimation of equation (3), which examines the factors that influence search intensity. The dependent variable is intensity, logged. All variables are defined in Exhibit 2. In the 2006 sample, $N = 5,254$; $R^2 = 0.0886$; F-Stat. = 39.18. In the 2009 sample, $N = 7,062$; $R^2 = 0.0999$; F-Stat. = 55.86. The IMR was estimated as 0.032 with a p-value of 0.1768, and values were re-estimated excluding IMR. Panel B reports

Exhibit 6 | (continued)

Second Stage OLS / Intensity

the results for the 2009 data. The F-statistic for the test of differences between the coefficients of the 2006 and 2009 intensity estimations is 65.18 (P > F = 0.0000).
* Significant at the 10% level, based on the corresponding t-statistic.
** Significant at the 5% level, based on the corresponding t-statistic.
*** Significant at the 1% level, based on the corresponding t-statistic.

Exhibit 7 | Results from 1999 Data

Predictor	Coeff.	t-stat.
Panel A: Duration estimation		
Constant	0.899	1.180
LnAskPrice	0.126**	2.050
Btw3550	0.152**	2.030
Over50	0.101	1.050
Btw4070K	0.022	0.220
Over70K	−0.056	−0.680
LnDist	−0.070***	−3.620
Firsthome	0.133*	1.740
Em	−0.434***	−3.580
Broker	−0.245***	−2.740
Flbroker	−0.041	−0.610
Netused	0.052	0.780
Panel B: Intensity estimation		
Constant	−1.537**	−2.070
LnAskPrice	0.095	1.580
Btw3550	−0.019	−0.260
Over50	−0.082	−0.870
Btw4070K	−0.039	−0.390
Over70K	0.073	0.920
LnDist	0.099***	5.220
Firsthome	−0.123	−1.640
Em	0.604***	5.100
Broker	0.229***	2.610
Flbroker	0.258***	3.870
Netused	0.192***	2.930

Exhibit 7 | (continued)

Results from 1999 Data

Notes: This table reports the second stage ordinary least squares estimation of the search duration and intensity equations from the Zumpano et al. 2003 study. Panel A presents the duration estimations with TTB, logged as the dependent variable. Panel B reports the intensity estimations with intensity, logged. *LnAskPrice* is the asking price of the property logged. *Btw3550* is 1 if the buyer's age is between 35 and 50 year, and zero otherwise. Over 50 is 1 if the buyer's age is over 50 years, and zero otherwise. *Btw4070K* is 1 if the buyer's income is between 40,000 and 70,000, and zero otherwise. *Over70K* is 1 if the buyer's income is over 70,000, and zero otherwise. *LnDist* is the distance from the old home to the new home, logged. *Firsthome* is 1 if the buyer is a first time home buyer, and zero otherwise. *Em* is 1 if the move was employer mandated, and zero otherwise. *Broker* is 1 if a broker was used in the transaction, and zero otherwise. *Flbroker* is 1 if the buyer first learned of their purchase from a broker, and zero otherwise. *Netused* is 1 if the buyer used the Internet in the search process, and zero otherwise. In the Duration Estimation, $N = 1,145$; $R^2 = 7.6$; F-Stat. $= 8.41$. In the Intensity Estimation, $N = 1,145$; $R^2 = 17.8$; F-Stat. $= 22.26$.

* Significant at the 10% level, based on the corresponding *t*-statistic.
** Significant at the 5% level, based on the corresponding *t*-statistic.
*** Significant at the 1% level, based on the corresponding *t*-statistic.

Exhibit 8 reveals no major differences in the relationships between the independent variables and search duration in any of the periods. The *Netused* variable had no significant impact on search time in 1999, but it was positive and statistically significant in 2006 and 2009. Asking price was consistently positive and significant in all three years. It is also interesting to note that broker assistance had a greater impact on shortening search duration in 1999 when online real estate search was less well developed, but became less important with the subsequent expansion of the Internet.

Across the different time periods, there were also a few changes in the relationships between some of the regressor variables and search intensity. The asking price positively affected search intensity in 2009, but had no significant impact on search intensity in 2006 or 1999. This suggests that individuals searched more intensively when market conditions were more favorable for buyers; that is, when prices were lower and supply availability was greater. Additionally, there were differences in the *Netused* variable. The use of the Internet increased search intensity in 1999 and 2009. Internet use, however, decreased search intensity in 2006, suggesting that online buyers search less intensively in a seller's market. High and rising prices may encourage buyers to search longer online and visit fewer homes per week. It may also reflect that fewer affordable homes were available to inspect.

Exhibit 8 | Effects on Search Duration and Intensity

Predictor	1999	2006	2009
Panel A: Search duration			
LnAskPrice	Positive**	Positive***	Positive***
Btw3550	Positive**	Positive***	Positive***
Over50	Positive	Positive**	Positive***
Btw4070K	Positive		
Over70K	Negative		
lnBtw3585K		Negative	Negative
IncOver85K			
LnDist	Negative***		
Btw16100		Positive	Positive
Btw101500		Negative***	Negative***
Over500		Negative***	Negative***
Firsthome	Positive*	Positive***	Positive***
Em	Negative***	Negative***	Negative***
Broker	Negative***	Positive	Negative
City		Positive	Negative
Flbroker	Negative	Negative***	Negative***
Netused	Positive	Positive***	Positive***
Panel B: Intensity			
LnAskPrice	Positive	Negative	Positive***
Btw3550	Negative	Negative***	Negative***
Over50	Negative	Negative***	Negative***
Btw4070K	Negative		
Over70K	Positive		
lnBtw3585K		Positive	Positive
IncOver85K			
LnDist	Positive***		
Btw16100		Negative	Positive***
Btw101500		Positive***	Positive***
Over500		Positive***	Positive***
Firsthome	Negative	Negative***	Positive
Em	Positive****	Positive***	Positive***
Broker	Positive****	Positive*	Positive***
City		Negative	Positive**
Flbroker	Positive****	Positive	Positive***
Netused	Positive****	Negative***	Positive***

Exhibit 8 | (continued)

Effects on Search Duration and Intensity

Notes: This table reports a comparison of the effects of the variables on search duration and intensity estimations from 1999, 2006, and 2009. All variables for the 1999 estimations are described in Exhibit 7. All variables for the 2006 and 2009 estimations are described in Exhibit 2. Panel A presents the estimations for the search duration equations with the dependent variable TTB, logged. Panel B presents the estimations for search intensity equations with the dependent variable intensity, logged.

* Significant at the 10% level, based on the corresponding *t*-statistic.

** Significant at the 5% level, based on the corresponding *t*-statistic.

*** Significant at the 1% level, based on the corresponding *t*-statistic.

Conclusion

This study empirically examines whether the evolution of the Internet since the late 1990s has improved the efficiency of the real estate market. The summary statistics indicated, as expected, that search duration is longer in a buyer's market compared to seller's market. Buyers can afford to search longer during periods of falling prices, but reduce search time in the face of rising prices.

The findings from the *Netused* probit model were consistent with earlier research. The same factors that influenced Internet use in 1999 still have the same effect today. The results show that older buyers and buyers who first learned of their home purchase from a broker were less likely to use the Internet in their search process, no matter the state of the market. However, buyers who purchased a home with the assistance of brokers were more likely to engage in online searching. This may reflect the fact the brokers have increased their presence on the Internet since 1999 and often encourage buyers to search their websites. As anticipated, the Internet was more likely to be used by buyers facing higher prices, employer-mandated moves, and by buyers searching over greater distances. These results were not affected by differing market conditions.

In the second stage estimations, the *Netused* variable was positive and statistically significant in both the 2006 and 2009 duration equations. Importantly, this variable was statistically insignificant in the 1999 study, when Internet use was not as widespread. Home buyers using the Internet searched longer whether a buyer's or seller's market.

Buyers using the Internet as a search tool looked at fewer homes per week in 2006, but searched more intensively when conditions were more favorable to buyers. Net use in the intensity equations was positive and significant in both 1999 and 2009. Given the idiosyncratic nature of the housing bubble, the inverse

relationship between intensity and net use in 2006 may not hold in more typical, less extreme seller's markets. In 2009, the Internet enabled buyers to search more intensively, while greater availability and more affordable choices encouraged buyers using the Internet to search longer.

It is interesting to speculate whether the efficiency implications of search duration have been changed by the growing use of the Internet. Earlier research has shown that broker intermediation increased buyer search intensity, which resulted in a reduction in search duration. That search duration is longer with Internet use is not necessarily a measure of market inefficiency to the extent it reduces within-period search costs (information collection and the costs of visiting properties); by increasing search intensity it would act to lower total search costs. This would be efficiency enhancing, so long as the reduction of within period search outweighs the increase in across-period search costs. However, it is possible that consumers do not correctly assess within-period search costs when using the Internet, given that such search can be conducted at their leisure. Failing to adequately account for the time spent online could prolong search. It may also be true that for some buyers surfing the Internet for a home is a source of entertainment, which could work to lengthen search time. This might even be efficient if the satisfaction derived from online search outweighs the opportunity cost of the lost utility associated with delaying consumption of the product for which they are searching. Online search would also be efficiency enhancing if it enables buyers to negotiate lower prices than other search methods.

One last possibility is that there is now so much housing information available on the Internet that buyers may actually be facing rising information and data collection costs. If not sensitive to such an information overload, such search could reduce search efficiency if the only thing Internet search does is prolong search. For example, many buyers use the Internet as a pre-screening device and then contact a broker to physically inspect the most promising properties. If the time spent online by a buyer did not reduce search time or result in the finding a lower priced home, this would be inefficient as the individual undertook work for which she was not compensated, a concept sometimes referred to as "shadow work."[14] If the Internet does prolong search time without a commensurate increase in benefits, it may also be inhibiting the market clearing process, certainly increasing holding costs for sellers. The next research question that needs to be addressed before anything more definitive can be said about the impact of the Internet on the efficiency of search is whether buyers who used the Internet were more satisfied with their purchase than those who used other forms of intermediation, such as real estate brokers, auctions, or, alternatively, dealt directly with sellers.

Appendix

Exhibit A1 | Second Stage OLS/Duration

Predictor	Coeff.	t-stat.	VIF
Panel A: 2006 Sample			
Constant	0.735**	2.35	
LnSellPrice	0.084***	3.42	1.212
Btw3550	0.180***	4.90	1.442
Over50	0.110***	2.58	1.688
IncBtw3585K	−0.043	−1.41	1.112
Btw16100	0.060*	1.65	1.097
Btw101500	−0.246***	−3.89	1.352
Over500	−0.355***	−6.73	1.568
Firsthome	0.134***	3.72	1.484
Em	−0.218***	−3.98	1.681
Broker	0.006	0.20	1.008
Flbroker	−0.173***	−5.80	1.033
City	0.055	1.45	1.024
Netused	0.325***	7.34	1.091
Panel B: 2009 Sample			
Constant	0.577**	2.07	
LnSellPrice	0.128***	5.74	1.216
Btw3550	0.108***	3.35	1.431
Over50	0.151***	3.82	1.743
IncBtw3585K	−0.033	−1.23	1.143
Btw16100	0.036	1.13	1.077
Btw101500	−0.189***	−3.14	1.298
Over500	−0.408***	−8.28	1.495
Firsthome	0.123***	3.82	1.634
Em	−0.325***	−6.06	1.592
Broker	−0.021	−0.8	1.012
Flbroker	−0.164***	−6.25	1.028
City	−0.030	−0.92	1.026
Netused	0.315***	6.01	1.112

Exhibit A1 | (continued)

Second Stage OLS / Duration

Notes: This table reports the second stage OLS of equation (2), which examines the factors that influence search duration including the sell price instead of the ask price. The dependent variable is TTB, logged. All variables are defined in Exhibit 2. The IMR in Panel A was estimated as 0.062 with a *p*-value of 0.8097, and values were re-estimated excluding IMR. The IMR in Panel B was estimated as 0.010 with a *p*-value of 0.9622, and values were re-estimated excluding IMR. In the 2006 sample, $N = 5,254$; $R^2 = 0.0563$; F-Stat. $= 25.12$. In the 2009 sample, $N = 7,062$; $R^2 = 0.0517$; F-Stat. $= 29.58$.

* Significant at the 10% level, based on the corresponding *t*-statistic.
** Significant at the 5% level, based on the corresponding *t*-statistic.
*** Significant at the 1% level, based on the corresponding *t*-statistic.

Exhibit A2 | Second Stage Weibull / Duration

Predictor	Coeff.	Chi-Square
Panel A: 2006 Sample		
Constant	0.260	4.74
LnAskPrice	0.048	25.57
Btw3550	0.062	19.50
Over50	0.059	12.93
IncBtw3585K	−0.005	0.20
Btw16100	0.013	0.87
Btw101500	−0.057	5.25
Over500	−0.084	16.37
Firsthome	0.038	7.42
Em	−0.112	28.26
Broker	−0.013	1.17
Flbroker	−0.071	38.58
City	0.004	0.09
Netused	0.086	24.27
Panel B: 2009 Sample		
Constant	0.455	26.08
LnAskPrice	0.047	45.47
Btw3550	0.041	14.58
Over50	0.058	19.40

Exhibit A2 | (continued)

Second Stage Weibull / Duration

Predictor	Coeff.	Chi-Square
Panel B: 2009 Sample		
IncBtw3585K	−0.014	2.34
Btw16100	−0.002	0.04
Btw101500	−0.067	11.05
Over500	−0.107	41.88
Firsthome	0.022	4.28
Em	−0.122	47.14
Broker	−0.017	4.08
Flbroker	−0.063	52.43
City	−0.015	1.94
Netused	0.031	2.97

Notes: This table reports the second stage Weibull estimation of equation (2), which examines the factors that influence search duration. The dependent variable is TTB, logged. All variables are defined in Exhibit 2. The IMR in Panel A was estimated as 0.0823 with a *p*-value of 0.4096, and values were re-estimated excluding IMR. The IMR in Panel B was estimated as −0.0729 with a *p*-value of 0.2829, and values were re-estimated excluding IMR. In the 2006 sample, $N = 4,845$; Log-Likelihood = −3,027.91. In the 2009 sample, $N = 6,700$; Log-Likelihood = −3,422.77.
* Significant at the 10% level, based on the corresponding chi-square statistic.
** Significant at the 5% level, based on the corresponding chi-square statistic.
*** Significant at the 1% level, based on the corresponding chi-square statistic.

Exhibit A3 | Second Stage OLS / Intensity

Predictor	Coeff.	*t*-stat.	VIF
Panel A: 2006 Sample			
Constant	−0.661**	−2.30	
LnSellPrice	−0.006	−0.25	1.212
Btw3550	−0.145***	−4.30	1.442
Over50	−0.161***	−4.12	1.688
IncBtw3585K	0.005	0.19	1.112
Btw16100	−0.046	−1.39	1.097
Btw101500	0.316***	5.44	1.352
Over500	0.423***	8.72	1.568

Exhibit A3 | (continued)

Second Stage OLS / Intensity

Predictor	Coeff.	t-stat.	VIF
Panel A: 2006 Sample			
Firsthome	−0.148***	−4.45	1.484
Em	0.312***	6.20	1.681
Broker	0.027	0.96	1.008
Flbroker	0.251***	9.11	1.033
City	−0.017	−0.48	1.024
Netused	−0.128***	−3.13	1.091
Panel B: 2009 Sample			
Constant	−1.763***	−5.17	
LnSellPrice	0.125***	4.70	1.688
Btw3550	−0.123***	−3.46	1.688
Over50	−0.317***	−4.59	5.169
IncBtw3585K	−0.020	−0.74	1.143
Btw16100	0.067**	2.08	1.086
Btw101500	0.351***	5.69	1.329
Over500	0.616***	11.63	1.691
Firsthome	0.035	1.05	1.663
Em	0.521***	9.56	1.609
Broker	0.111***	4.07	1.093
Flbroker	0.284***	8.32	1.687
City	0.074**	2.21	1.027
Netused	0.155***	2.89	1.143
IMR	0.487**	2.34	5.822

Notes: This table reports the second stage OLS of equation (2), which examines the factors that influence search intensity including the sell price instead of the ask price. The dependent variable is TTB, logged. All variables are defined in Exhibit 2. The IMR in Panel A was estimated as −0.274 with a p-value of 0.2449, and values were re-estimated excluding IMR. In the 2006 sample, $N = 5,254$; $R^2 = 0.0885$; F-Stat. $= 52.54$. In the 2009 sample, $N = 7,062$; $R^2 = 0.1013$; F-Stat. $= 56.76$.
* Significant at the 10% level, based on the corresponding t-statistic.
** Significant at the 5% level, based on the corresponding t-statistic.
*** Significant at the 1% level, based on the corresponding t-statistic.

Endnotes

[1] See the 1999 article "Realtors See a Decade of Dramatic Development" by the NAR at their official website, realtor.com, which attracts 12 million visits every month.

[2] For search to be optimal, the searcher needs to optimize over the two dimensions, searching sequentially over a number of time periods (across-period search) and to choose an optimal number of observations in each period. See Morgan and Manning (1985) for a detailed discussion of search theory.

[3] Before the Internet, home buyers searched for homes in the classified listings in local newspapers, and/or contacted brokers for assistance in the search process. Buyers relied on references from family members, friends, fellow co-workers, attorneys, or mortgage lenders, and advertisements by a real estate brokerage office when deciding on an agent to use. The agent would then assess the buyer's the affordable price range, type of home desired, and favored neighborhood conditions and locations. The agent would then research property listings on a proprietary MLS database, create a list of suitable properties, and take potential buyers on a tour of listed homes. To finance the purchase of a home, the buyer would apply for a mortgage loan by contacting a bank, which typically would require additional services such as title insurance, property insurance, a home inspection, and an appraisal. To a large extent, the providers of all these services were also found through recommendations.

[4] Benjamin, Chinloy, Jud, and Winkler (2005) using a database from the National Association of Realtors (NAR) 2001 survey and factor loadings find that the use of the Internet is positively related to the financial performance of residential brokerage firms, franchise affiliation, and affiliation with a referral/relocation network and firm size, but it is negatively associated with firm age. Tse and Webb (2002) investigate the effect of monthly Internet page views on the number of transactions for a large brokerage firm in Hong Kong between January 1996 and April 1999, holding constant advertising expenses and the number of firm branches. Their results imply that the firm's total revenues are impacted by a firm's decisions about Internet use. Specifically, they find a 1% increase in the number of page views leads to about a 0.2% increase in the number of transactions per staff member and a 1% increase in page views increases the agent's commission by about 0.4%. Bristow, Bulati, Mooney, and Dou (2004) focus on the relationship between a broker's Internet savvy and performance. Seller, Madhavan, and Liechty (2012) examine how eye movements associated with viewing house photos and textual content influences the effectiveness of Internet marketing.

[5] First-time home buyers typically searched longer and less intensively than experienced home buyers.

[6] Zumpano, Elder, and Baryla (1996) found that after correcting for selection bias, there was no difference in the selling price of comparable homes whether the transaction was broker-assisted or a sale by owner (FSBO).

[7] In 2006, the mean selling price was $275,925 and average search time was 13.5 weeks. In 2009, the mean selling price had fallen to $239,278 and search time was 18.5 weeks. There is also no question that we were dealing with an expanding economy in 2006 and a serious recession in 2009. Fed data indicates that for all of 2006, the rate on the 30-year mortgage ranged from 6.15% to 6.76%, or by 61 basis points. With one

exception, month-to-month changes were very small, with interest rates in January only 1 basis point different from December. In 2009, the 30-year mortgage rate also varied by 61 basis points, from a high of 5.42% to a low of 4.81%. Numbers from the Bureau of Labor Statistics indicate that in 2006, unemployment ranged from a low of 4.3% to 4.7%, less than a half of 1% difference. In 2009, the unemployment rate varied from 8.2% in January, slowing rising throughout the year to a high of 10.9% in September, ending the year at 10.8%.

[8] Ihlanfeldt and Mayock (2012) find that the bargaining power of buyers from outside the local market compared to that of local buyers is weak due to greater search costs and not knowing as much about the local market. Since price expectations are connected to prices previously paid by the buyers, buyers coming from higher priced markets tend to pay more for their new home.

[9] Sound arguments can be made for the inclusion of selling price in duration models and which is the most appropriate specification. We chose asking price for four reasons: (1) it is the variable of choice within the search theory literature; (2) it allows for comparability with earlier research, in particular the 1999 study; (3) the database only includes completed transactions; and (4) we did not use a fitted selling price in the duration equation. We included the duration equation with ln(*SellingPrice*) in Appendix Exhibit A1. The results were the same as the asking price duration equation. Using both asking and selling price in the same model, not surprisingly, resulted in serious multicollinearity problems, and is, therefore, an inappropriate specification.

[10] We also excluded two variables (*Broker* and *IncOver85K*) from the second stage duration equation to further test for the presence of section bias. None of the IMRs were significant. When *Broker* was omitted: 2006: IMR = -0.02940 and the p-value = .9266; 2009: IMR = -0.04153 and p-value = .8594. When *Broker* and *IncomeOver85k* was omitted: 2006: IMR = 0.07165 and the p-value = .8594, 2009: IMR = 0.08547 and the p-value = .6655.

[11] It is well known the parameter estimates from probit models must be transformed to yield meaningful estimates of their marginal effects, that is, the changes in the predicted probability associated with changes in the explanatory variables.

[12] We estimated a bivariate probability model of Internet use where the dependent variables were *Netused* and *Broker*. Coefficient magnitudes cannot be compared between the two models. However, the explanatory variables all had the same signs and were statistically significant in both the OLS and bivariate estimations.

[13] Given the absence of selection bias, we also estimated duration using the Weibull distribution. See Appendix Exhibit A2.

[14] The expression "shadow work" was first coined by Ivan Illich in his book of the same name in 1981. In a real estate context, if buyers do some of the work that a real estate broker would otherwise have undertaken this is shadow work. Open Forum Series from Morgan Boyars Publishers, Ltd., 2000.

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