The Journal of Real Estate Finance and Economics
https://doi.org/10.1007/s11146-021-09841-5

Why Do Buyers Pay Different Prices for Comparable Products? A Structural Approach on the Housing Market

Ralph B. Siebert[1] · **Michael J. Seiler**[2]

Accepted: 20 April 2021
© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2021

Abstract

We focus on the housing market and examine why nonlocal home buyers pay 12% more for houses than local home buyers. We established a database on the residential housing market for Lafayette and West Lafayette, Indiana, that includes house transactions from 2000 to 2020. The dataset contains highly detailed information on individual buyers and house characteristics. We explain the price differential controlling for arguments such as imperfect information on prices, wealth effects, heterogeneous buyer preferences, and differential search and travel costs across buyers, among others. We estimate a housing demand model that returns heterogeneous marginal willingness to pay parameters for housing attributes. Our results show that nonlocal home buyers are willing to pay more for specific housing attributes, especially for house size, school quality, and house age. We also find that arguments such as gratification, reward, and imperfect price information explain the price differential to a large extent. Search and travel cost arguments have an adverse effect on nonlocal buyers' house spending.

Keywords Heterogeneous Preferences · Housing Market · Imperfect Information · School Quality · Search Costs

JEL L13 · L49 · L63

✉ Michael J. Seiler
mjseiler@wm.edu

Ralph B. Siebert
rsiebert@purdue.edu

[1] Purdue University, Department of Economics, Krannert School of Management, 47906 West Lafayette, IN, USA

[2] College of William & Mary, Raymond A. Mason College of Business, 23187 Williamsburg, VA, USA

Published online: 26 April 2021

Introduction

Studies have shown that buyers frequently pay different prices for comparable products. Price variations are observed in a variety of markets, such as health care markets, automobile markets, and retail markets.[1] In the real estate market, an established fact is that home buyers pay different prices for comparable houses (see, for example, Turnbull & Sirmans, 1993; Lambson et al., 2004; Ihlanfeldt & Mayock, 2012; He et al., 2020). This topic receives much attention by policy makers and scholars, especially since households spend large fractions of their income and wealth on purchasing homes.

Several real estate studies (see Clauretie & Thistle, 2007; Ihlanfeldt & Mayock, 2012) examine why home buyers who move into a market from out of town (nonlocal buyers, NLBs) pay more for houses than home buyers with local residential status (local buyers, LBs). Two relevant arguments have been identified to explain part of the observed price differential between NLBs and LBs: imperfect information on home price distributions and differential search costs. Our study builds on these arguments and considers a further aspect: heterogeneous preferences between NLBs and LBs that translate into differential demand for housing and neighborhood attributes and differential prices. The aspect of heterogeneous preferences has not yet received much attention in explaining the price differential.

Houses are characterized by a variety of attributes (such as house size, number of bedrooms, number of bathrooms, etc.) and associated neighborhood attributes (such as school quality, racial composition, etc.). Home buyers make their purchase decisions dependent on their attributes and their preferences for these housing and community attributes. Our study highlights that buyer preferences for housing and neighborhood attributes can be rather different. These heterogeneous preferences determine buyer-specific marginal willingness to pay and demand for housing and neighborhood attributes that translate into different prices paid for houses. More specifically, NLBs and LBs may be characterized by different attributes and preferences for housing and neighborhood attributes that could explain part of the price differential. We also control for other arguments that could explain the price differential between local and nonlocal buyers, including heterogeneous search costs, wealth effects, and imperfect information on local price distributions, and the nonlocal residential status of buyers such as work-related deadlines to move, gratification for leaving their previous social environments, as well as other factors such as family size, income. (More details follow later).

Our study builds on a comprehensive dataset on house transactions that contains highly detailed information on individual buyers and house characteristics. We estimate a housing demand model that enables us to estimate buyer-specific marginal willingness to pay parameters for housing and neighborhood attributes. The goal is

[1] For contributions in the health care markets, see Brown, 2019; Cooper et al., 2019; Grennan, 2013; in the automobile markets, see Goldberg & Verboven, 2001; in the retail markets, see Hitsch et al., 2019; DellaVigna & Gentzkow, 2019.

to estimate individual-specific marginal willingness to pay parameters for specific housing attributes in order to explain the price differential between NLBs and LBs.

Home buyers' preferences can be different for several reasons: First, marginal willingness to pay parameters are determined by demographic characteristics (such as income, reference prices, travel costs, etc.), which can differ across home buyers as well as NLBs and LBs. For example, NLBs and LBs may differ in their demographic characteristics, which explain their differential marginal valuation for housing attributes and this would explain part of their differential home spendings. Second, buyers' marginal willingness to pay is also determined by the buyers' *residential status* per se. For instance, NLBs move into a market from out of town and leave their familiar social environments. As a reward or gratification, they may be willing to spend more on housing attributes such as house size, school quality, etc. Hence, *NLBs' residential status* can exert an effect on marginal willingness to pay and demand for housing attributes. Relatedly, NLBs face specific work-related deadlines to move, while LBs usually do not have this binding moving constraint. The moving deadline leaves NLBs less time and limits their search to find a low-priced house, which can affect their marginal willingness to pay for houses (see also Cheng et al., 2015). The moving deadline also puts pressure on NLBs, which can result in a higher risk aversion strategy and diminish bargaining strength (see Ihlanfeldt & Mayock, 2012; Ehrlich, 2013). The residential status could also be related to other unobserved factors we would not be able to control for in this study, including family size, children, income, etc.

Furthermore, home buyers often have imperfect information on the housing market. One may argue that Internet applications provide fully transparent information about listed houses. In several instances, however, this publicized information can be useful only to a limited extent. For example, while the price is mentioned in house listings, it still remains unclear whether the posted house prices reflect the local market value since comparable houses can be valued very differently across geographic regions.[2] It is argued that, prior to purchasing the home, LBs have more knowledge of local price distributions than NLBs who resided in other areas. NLBs must infer the true market value of a house, while forming expectations on the local price. Some studies show that these expectations are formed and anchored to prices that buyers were accustomed to at their previous residence, which can explain part of the price differential (see Clauretie & Thistle, 2007; Ihlanfeldt & Mayock, 2012; a more detailed literature review is provided later).

The imperfect information aspect is even more of a concern in the housing market (regardless of Internet postings) because some housing and neighborhood features are not mentioned in public listings or they are difficult to convey truthfully. One example is the house condition that is not posted or may be difficult to judge since "false advertising" of attributes is difficult to prove (see Farrell, 1980). As a consequence, buyers will have to evaluate the condition of the house themselves by visiting houses on site. This information acquisition is associated with search and

[2] For example, a house in Beverly Hills, California, is valued and priced differently than a comparable house in Indiana.

travel costs, which differ across buyers. NLBs have higher search costs than LBs since they incur higher travel expenses and more travel time to get on-site.[3] Some studies have shown that buyers with higher search and travel costs have higher reservation prices and search less intensively, which can affect buyers' preferences for housing attributes. Our study takes into consideration that search and travel costs can affect buyers' willingness to pay and their demand for housing and neighborhood attributes.

We use a dataset that encompasses detailed home transaction information on buyers, houses, and neighborhoods in Indiana from 2000 to 2020. The database includes confidential buyer information such as mortgages and residential information prior to purchasing a new home.[4] This information also allows us to distinguish between buyers' local and nonlocal residential status when purchasing their home which then enables us to explain the price differential between both types of buyers. We are especially interested in the estimation of marginal willingness-to-pay for housing attributes as explained by various buyer demographics, including residential buyer status. The matching of the marginal willingness to pay for housing and neighborhood attributes to buyer-level demographics provides valuable insights into explaining the home price differentials between NLBs and LBs. We also control for other buyer-specific arguments including heterogeneous search costs, wealth effects, imperfect information on local price distributions, and other residential arguments to explain the price differential.

We adopt a housing demand model to estimate buyer-specific marginal willingness to pay parameters of housing and neighborhood attributes. The estimates will give information on the spending by NLBs and LBs on specific housing attributes. We address an endogeneity concern that is based on the fact that the consumption on housing amenities varies with observed household and neighborhood characteristics and the household's preference shocks.[5] Since our descriptives show that NLBs buy larger and newer houses in better school districts, we treat house size, school quality, and house age as potentially endogenous regressors (more details follow later). We apply an estimation approach that accounts for the fact that the consumption of specific housing amenities and household characteristics can be endogenous.[6]

Our estimation results show that nonlocal buyers spend $22,546 (12 percent) more on houses than local buyers.[7] The decomposition of the price differential shows that NLBs have a higher marginal willingness to pay for house size, which explains a total extra spending for house size of $9,737. The higher marginal willingness to

[3] Turnbull and Sirmans (1993) and Elder et al. (1999) have shown that NLBs face higher search and travel costs.

[4] We use this information from various sources, such as the Multiple Listing Services, the county assessor, and mortgage documents.

[5] Bartik (1987) and Epple (1987) point out that the endogeneity of amenities can be caused by unobserved household preferences having an effect on the quantity of a characteristic consumed and the hedonic price of that characteristic.

[6] We use the approach by Bishop and Timmins (2019) and we would also like to thank Kelly Bishop for providing valuable insights.

[7] Local buyers pay an estimated average of $187,524 for houses, while NLBs pay $210,070.

pay for house size is explained by several arguments. First, NLBs assign an additional $4.50 per square foot on house size, which is determined by their residential status per se and could possibly be explained by reward and gratification arguments, deadline to move, family size, and income. These arguments explain that NLBs' spending on house size increases by $9,464. Second, we find that imperfect price information increases NLBs' expenses on houses size. Finally, we find that travel and search costs reduce NLBs' marginal willingness to pay for house size by $0.02 for every additional mile that buyers have to travel.

The largest part of the price differential—$14,377 or 8 percent of the house price—is explained by NLBs' higher marginal willingness to pay for better schools. Our results show that NLBs' differential marginal willingness to pay for school quality and house size is largely explained by residential status arguments (reward, gratification, moving deadline, family size, income, etc.), imperfect price information, and search and travel costs.

Finally, NLBs spend an additional $3,895 due to the fact that they purchase more recently built houses. Wealth and bargaining strength arguments result in rather similar house spending between both groups of buyers. Our results show that heterogeneous preferences between LBs and NLBs can explain largely different expenditures on house size, school quality, and house age. Accounting for all heterogeneous willingness to pay arguments results in NLBs paying up to 14 percent more for houses.

The remainder of the paper is organized as follows: Sect. 2 provides an overview of the related literature. Section 3 describes the database sources and provides summary statistics. Section 4 describes our empirical model and the estimation procedure. We discuss the results in Sect. 5 and conclude in Sect. 6.

Related Literature

Our study is related to a large literature on imperfect price information (see Stigler, 1961; Diamond, 1971; Rothschild, 1974). One might think that imperfect price information is not very pronounced in the housing market since Internet applications inform buyers about housing attributes such as prices. However, many nonlocal buyers are uncertain whether a posted price reflects the true local market value. This judgment requires knowledge of the local price distributions, and this differs between LBs and NLBs. Since nonlocal buyers usually have less knowledge of local price distributions prior to purchasing a home, they must form expectations on prices to infer the market value of a house (see Burdett & Judd, 1983). Studies have shown that buyers with imperfect price information form expectations on prices that are based on *anchors or reference prices* (see Tversky & Kahneman, 1974; Northcraft & Neale, 1987; Bucchianeri & Minson, 2013). Several empirical studies on the housing market adopted these anchor and reference price arguments (see Turnbull & Sirmans, 1993; Watkins, 1998). Lambson et al. (2004) and Ihlanfeldt and Mayock (2012) test whether NLBs accustomed to high real estate prices in their home state pay a premium in low-price areas.

One might think that imperfect information is less pronounced in the housing market due to the presence of real estate agents that serve as middlemen between

buyers and sellers. However, the study by Levitt and Syverson (2008) shows that real estate agents act according to their own interests (earning a commission) and do not convey their knowledge of market conditions effectively.[8]

As mentioned earlier, home buyers will have to incur search or travel costs to inspect home conditions. Search costs determine reservation prices, which implies that buyers search less intensively, and this affects home prices (see, for example, Diamond, 1971; Rothschild, 1974). Studies find that differential search costs across buyers can lead to significant price dispersions and elevated prices.[9] In the context of NLBs, Turnbull and Sirmans (1993) and Elder et al. (1999) show that NLBs face higher search and travel costs, often measured by distance to the location.

A further possible explanation of price differentials between NLBs and LBs is that NLBs often face specific deadlines to settle. A moving deadline constrains the search, leaves NLBs less time, and limits their home search. A deadline can affect NLBs' willingness to pay for housing attributes and their spending on housing.[10] The moving deadline can also have implications on home buyers' bargaining strength. To avoid the risk of not being able to move prior to the deadline, NLBs might be more risk averse and submit higher bids than LBs, which increases the likelihood of getting an offer accepted. Ehrlich (2013) has shown that more eager buyers apply more risk-averse bidding strategies and submit higher bids. A related argument that could explain the price differential between NLBs and LBs is that the former leave their familiar social environments and, as gratification for moving, they reward themselves by spending more on housing and neighborhood attributes.

Several related studies focus on the question whether nonlocal buyers pay premia in the real estate market. Myer et al. (1992) find no support for the hypothesis that nonlocal house buyers pay premia due to imperfect price information and search costs. Turnbull and Sirmans (1993) and Watkins (1998) also find that NLBs do not pay significantly more than LBs. In contrast, Lambson et al. (2004) show that relative to LBs, NLBs pay a premium of about 5.5 percent for comparable houses. Ihlanfeldt and Mayock (2012) find that nonlocal buyers pay a premium of around 1.9 percent. Other studies show that imperfect price information can result in uninformed buyers purchasing low-quality goods for low prices (see Chan & Leland, 1982; Chan & Leland, 1986; Dranove & Satterthwaite, 1992).

The following three studies are close to our paper: Ling et al. (2018) consider the commercial real estate market using data on the 15 largest U.S. metropolitan areas from 1997 to 2011. Their data cover commercial property transactions, including industrial buildings, apartment complexes, and office properties. They find that nonlocal investors pay premia of 4 to 15 percent for commercial buildings. Their results show that search costs primarily explain the premia, while imperfect price information plays a less important role. Their study differs from ours in a variety of aspects:

[8] Due to data limitations, our study is not able to include the effect of agencies on house prices. This is certainly an interesting and important topic that will be discussed further at the end of the paper.

[9] See, for example, Salop and Stiglitz (1977), Varian (1980), and Janssen et al. (2005); see also Baye et al. (2006) for an overview.

[10] For further information on search frictions arising from deadlines, see Coey et al. (2019).

They focus on commercial real estate markets, while we consider residential markets. These markets are very different in their institutional and behavioral characteristics. First, in commercial real estate markets, business agents and investors make their purchasing decisions dependent on a variety of factors that include not only the price of the property, but additional business factors that relate to regional profitability, etc. The evaluation of business profitability differs among investors, and this becomes a critically important aspect in purchasing commercial real estate. These features, however, are not of primary importance in our study of the residential real estate market. Second, the commercial real estate market has different features and demand than the residential real estate market. For example, commercial properties sell for much higher prices—in Ling et al. (2018)'s case between $2.1 million and $7.2 million—than the residential houses in our study (with an average transaction price of $189 thousand). Finally, their study concentrates on local status and search cost arguments that are proxied by dummy variables. Our study puts the main focus on heterogeneous housing and neighborhood preferences between local and nonlocal buyers. We explain those preferences based on a set of buyer demographics that include residential status, search and travel costs, wealth effects, and imperfect price information.

The study by Chinloy et al. (2013) also focuses on the commercial real estate market. Their study highlights that the investors' experience explains the price differentials. They argue that buyers' local experience and repeated transactions help build human capital, which reduces search costs. Their results confirm that experienced buyers receive acquisition discounts, while inexperienced local buyers receive no or little discount. Again, our focus—the residential real estate market—is substantially different than the commercial real estate market. Moreover, Chinloy et al. (2013) highlight the relevance of experience when comparing different buyers. Our study relates price differentials to heterogeneous buyer preferences that are explained by buyer demographics.

The study by Holmes and Xie (2018) focuses on the residential real estate market in Johnson County, Indiana, from 2004 to 2010. Their study shows that nonlocals sell at a 21 percent discount compared to local sellers. Their research differs from ours in that they focus mostly on out-of-state sellers, which is explained by the fact that their geographic housing market encompasses a large fraction (12 percent) of nonlocal sellers. Since their study explains why out-of-state owners sell for lower prices, they control for arguments such as foreclosure and rental and vacant properties. In contrast, our market is characterized by a larger fraction of nonlocal buyers, while the fraction of out-of-state sellers is rather small. Therefore, we concentrate on explaining buyer-specific preferences by search and travel costs, wealth, imperfect information on price distributions, and other residential status arguments.

Home buyers' willingness to pay for housing and neighborhood attributes can be determined by a variety of buyer demographics. Several empirical housing studies focus on estimating the willingness to pay across buyers for specific attributes (see Cutler & Glaeser, 1997; Epple, 1987; Epple & Sieg, 1999; Levitt & Syverson, 2008; Nechyba & Strauss, 1998). Studies found that wealthier families have a higher willingness to pay for larger houses in neighborhoods that are safer and have better schools (see also Bayer et al., 2007; Betts, 1995; Black, 1999; Card & Krueger,

1996; Hanushek, 1996). A number of empirical studies show that racial demographics affect sale prices (see, for example, Harding et al., 2003; Yinger, 1978). Studies also show that income, public good preferences, and heterogeneous housing stocks have an effect on buyer preferences (see Epple & Sieg, 1999; Sieg et al., 2002). Our study differs from earlier studies, as we explain the price differentials between local and nonlocal buyers in the residential real estate market while paying special attention to heterogeneous preferences across buyers for housing and neighborhood attributes.

Data Sources and Descriptives

We established a database on the residential housing market for Lafayette and West Lafayette, Indiana, that includes house transactions from 2000 to 2020. The housing market is an appropriate setting for our research since it is characterized by several arguments, including imperfect information on prices, wealth effects, heterogeneous buyer preferences, and differential search and travel costs across buyers. The housing market is also an important market since a home is typically a person's most valuable asset.

The area of Lafayette and West Lafayette is characterized by stable housing prices over time and is generally unaffected by speculation and bubbles.[11] Stable housing prices are an advantage for our purposes, as we explain price differentials by residential arguments and heterogeneous preferences. The Lafayette area is populated mostly by residents that are employed by manufacturing firms and service providers. In West Lafayette, most of associates of Purdue University are resided.

Our database relies on several sources. Information on housing attributes were provided by the Tippecanoe Multiple Listing Services, the Tippecanoe County Assessor's Office and Home Junction. The Multiple Listing Services (MLS) database is a comprehensive database used by real estate agents. It contains detailed information on houses listed in the real estate market, such as the address of the house, the final sale or transaction price, the house size, the number of bedrooms, the number of bathrooms, days on the market, and lot size.[12]

The Tippecanoe County Assessor's Office and Home Junction provided us with home buyer information, partly based on the Home Mortgage Disclosure Act.[13] We received the buyers' residence information; that is, their state of origin prior to buying a house in Lafayette and West Lafayette. Their residential information (prior to

[11] For information on the evolution of housing prices and appreciation rates in different states, see the U.S. Census Bureau at http://www.census.gov/const/www/quarterly starts completions.pdf and OFHEO at http://www.ofheo.gov/media/hpi/2q07hpi.pdf. All monetary values in this study are expressed in 2020 U.S. dollars using the Consumer Price Index.

[12] In comparing our database with the Census of Population and Housing database, the latter database contains self-reported or estimated home values, which are less reliable than the house prices in our database. Moreover, the prices are partitioned into 23 mutually exclusive categories, and this represents a loss of information compared to our pricing data.

[13] The identities and some other information about the home buyers are kept anonymous in the study.

moving) allows us to categorize them into NLBs and LBs. The distinction between NLBs and LBs is appropriate since it captures the fact that some (originally nonlocal) residents may rent a house or apartment before purchasing a home. In this case, these purchasers will appropriately be registered as LBs since they had opportunities to collect local information on neighborhoods during their rental period. We also retrieved buyers' mortgage information, which allows us to control for wealth effects since wealthier home buyers presumably hold smaller mortgage loans. It has also been shown that higher mortgage rates increase sellers' reservation prices (see Genesove & Mayer, 1997). Neighborhood demographics are collected from the census at the disaggregate (tract) level. Finally, we match the data using ArcGIS coding to derive geographic measures. As a result, our database contains detailed information on different housing characteristics, neighborhood demographics, and other buyer sociodemographic attributes that include residential information prior to purchasing the new home, mortgages, travel distance, and reference prices (more details follow later).

Table 1 shows information on the demographics in Lafayette and West Lafayette. The area is populated with 180,952 people, of which 79 percent are White, 5 percent are Black, 8 percent are Hispanic, and 8 percent are Asian. The median household income amounts to $44,161 per year, which is below the national median household income of $63,030. Schools are evaluated on average at 3.18 points on a five-point scale. The average unemployment rate amounts to 2.6 percent.

We consider only residential houses and remove commercial sales and apartments from the database.[14] After removing the bottom and top 1 percent of observations of the *Saleprice*, *Housesize*, and *Baths* distributions and removing houses that have been listed for more than 365 days, we are left with 19,544 house transactions from 2000 to 2020 for our analysis.[15]

NLBs from 40 different U.S. states purchased 510 of the houses of which 299 houses were purchased in Lafayette and 211 houses were bought in West Lafayette.[16] Table 2 shows that most nonlocal buyers come from California (16 percent), Connecticut (13 percent), Illinois (12 percent), Texas (12 percent), Pennsylvania (5 percent), and Ohio (4 percent). The table also displays the average distance (in miles) to Lafayette/West Lafayette, the mortgage rate as measured by the mortgage amount to the sale price, the median house price, and median household income in the corresponding states. Most notably, the mortgage rates are relatively similar across states, while the median house prices and income show large variations.

We consider the following housing, neighborhood, and household characteristics:

[14] Most apartments in Lafayette and West Lafayette are rental properties, so we would not expect any crucial concerns from removing these.

[15] This includes most of the variables that have been provided to us.

[16] We dropped house purchases by non-U.S. residents.

Table 1 Lafayette/West Lafayette Demographics, Census Data

Demographics	Lafayette/West Lafayette
Population	180,952
White (in percent)	78.61
Black (in percent)	5.01
Hispanic (in percent)	8.39
Asian (in percent)	7.99
Income	44,161
Schoolscore	3.18
Houseage	43.29
Unemployed	2.59

Table 1 shows the demographics for Lafayette and West Lafayette, Indiana in 2019 (except household income is from 2015). Sources: https://www.ffiec.gov/census/default.aspx and Multiple Listing Services

Variable Description

(1) *Saleprice*: Final sale price of the house;
(2) *Housesize*: Size of the house in square footage;
(3) *Bedrooms*: Number of bedrooms;
(4) *Baths*: Number of full bathrooms;
(5) *Houseage*: Age of the house;
(6) *DOM*: Days on the market;
(7) *Distance*: Buyer's geographic distance from his/her former home state to the new home. This measure is used to proxy for search and travel costs (see also Turnbull & Sirmans, 1993; Elder et al., 1999);
(8) *Referenceprice*: Median house price in the buyer's former home state. This measure is used to proxy for NLBs' imperfect information on price distributions (see also Clauretie & Thistle, 2007; Ihlanfeldt & Mayock, 2012);
(9) *NLB*: The nonlocal buyer dummy takes a value of one (zero) if a house in Lafayette or West Lafayette was purchased by a buyer with nonlocal (local) resi-

Table 2 Top Origins of Nonlocal Home Buyers

State	Percentage	Distance	Mortgagerate	House Price	Household Income
California	16%	2,217	0.79	614,447	89,313
Connecticut	13%	834	0.83	291,951	93,123
Illinois	12%	167	0.84	248,319	78,215
Texas	12%	1,099	0.86	254,240	73,452
Pennsylvania	5%	574	0.82	227,749	73,298
Ohio	4%	260	0.81	185,355	67,194

Table 2 shows the top origins and demographics of nonlocal buyers. The Median House Prices and the Median Household Income are evaluated at the CPI

dential status prior to purchasing the house. This dummy variable will pick up nonlocal buyer effects that determine the willingness to pay for house size, school quality, and house age (as will be explained later). We expect the nonlocal residential status to have a positive effect on their willingness to pay for housing attributes. The dummy variable will also control for other reasons such as gratification and reward reasons since they leave their familiar social environments. Moreover, nonlocal buyers frequently face strict deadlines to move, which would shorten their search and increase reservation and purchase price. Finally, the variable may also pick up other omitted factors such as family size, children, income, etc.

(10) *WLNLB*: The West Lafayette nonlocal buyer dummy variable takes a value of one if a nonlocal buyer purchased a house located in West Lafayette (opposed to Lafayette). We control for this variable since most Purdue University employees live in West Lafayette while employees in manufacturing and services live in Lafayette. It is reasonable to assume that home buyers associated with Purdue University put special the attention to education of their children and may have a higher willingness to pay for school quality, etc. Hence, the coefficient estimate on the dummy variable *WLNLB* accounts for a deviation from the nonlocal buyer effect as captured by the nonlocal buyer dummy variable (*NLB*).[17]

(11) *Mortgagerate*: This variable measures the mortgage amount divided by the sale price. It is used as a control variable for liquidity and wealth effects, since wealthier home buyers take out smaller mortgage loans;

(12) *Schoolscore*: School scores of public elementary schools (on a scale from 1 to 5, with 5 being the highest quality rating);

(13) *Income*: Household Income information in the (census tract) neighborhood where a house is located;

(14) *Unemployment*: Unemployment in percentage in the (census tract) neighborhood where a house is located;

(15) *White*: Percentage of White residents in the (census tract) neighborhood where a house is located;

(16) *Black*: Percentage of Black residents in the (census tract) neighborhood where a house is located;

(17) *Hispanic*: Percentage of Hispanic residents in the (census tract) neighborhood where a house is located;

(18) *Asian*: Percentage of Asian residents in the (census tract) neighborhood where a house is located;

(19) *Season*: The housing market is characterized by seasonal effects, where most houses are sold from March to September. Therefore, we consider a seasonal dummy that takes on a value of one if a house is sold during this period.

(20) *YearFE*: Year fixed effects;

(21) *TractFE*: Dummy variables that refer to census tracts.

[17] We would like to thank a referee for the suggestion to separately control for education effects of nonlocal home buyers that purchase a home in West Lafayette. This separation allows us to test whether nonlocal buyers that work in academia (as captured by the dummy *WLNLB*) are willing to spend a premium on school quality and the education for their children.

In the following, we provide summary statistics of housing and neighborhood characteristics, as well as buyer-specific information. Tables 3 and 4 show the summary statistics for houses purchased by LBs and NLBs, respectively. LBs spend on average $188,906 for housing, while nonlocal residents spend $205,601. In the following, we provide further details on housing and buyer characteristics that could explain this large sale price difference. One explanatory factor could be that LBs and NLBs have different bargaining strengths. As mentioned earlier, NLBs often face deadlines for moving. To avoid the risk of not being able to move prior to the deadline, an NLB might submit a higher bid than an LB to enhance the chances of getting an offer accepted. In this case, the relative difference between the final list price and the sale price —bargain = ((LastListprice—Saleprice)/Listprice)*100— would be larger for NLBs than for LBs.[18] A mean comparison of the variable shows that the means of the bargaining variables are 3.42 percent for LBs and 3.14 percent for NLBs. The difference in the bargaining spread is rather small and explains only a price difference of 0.3 percentage points or $567. To provide further insight, we applied a simple multivariate regression analysis in which we regressed the bargaining variable on an NLB dummy as well as buyer and neighborhood attributes such as Distance,Referenceprice, Mortgagerate, Income, Schoolscore, Black, Hispanic, Asian, and year fixed effects. The estimation results return an insignificant coefficient estimate on the NLB dummy variable, providing evidence that differential bargaining strengths do not have a significant effect on explaining the house price differential.

Turning to a comparison of housing characteristics between both groups, the houses purchased by NLBs are 10 percent larger (2,101 square feet) than those purchased by LBs (1,911 square feet). Interestingly, accounting for differential house sizes, NLBs and LBs seem to pay about the same average price per foot —$98 and $99, respectively. It should be noted that this comparison is based on an overall average price per square foot across group members. Later, we will address the point that the willingness to pay per square foot is different across house buyers depending on their demographics, including the buyers' residential status prior to purchasing the home.

Houses have about the same number of bedrooms and bathrooms and a similar lot size across both groups. Houses across both groups are different in their ages. LBs buy houses that are significantly older (by 42 percent or 11 years) than the houses purchased by NLBs. This difference will be addressed later.

The neighborhood characteristics for houses purchased by LBs and NLBs are not significantly different with one exception: NLBs choose houses in better school districts. Their school quality measure is 16 percent higher. Hence, education is a more important feature for NLBs than for LBs, which needs to be accounted for when explaining the price difference.

[18] For further information on list price strategies in the housing market, see Beracha and Seiler (2014) and Cardella and Seiler (2016).

Table 3 Housing and Neighborhood Attributes: Local Buyers

Housing and Neighborhood Attributes: Local Buyers, 19,034 obs			
Variable	Mean	Min	Max
Saleprice	188,906	50,061	940,308
Housesize	1,911	750	7,175
Bedrooms	3.31	1	7
Baths	1.91	1	6
Houseage	36.03	0	120
DOM	63	0	365
Bargain	3.42	-19.44	87.03
Distance	7	0	196
Referenceprice	187,872	155,640	238,994
Mortgagerate	0.83	0	0.98
Unemployed	2.59	1.1	13
Income	65,470	9,514	122,360
Schoolscore	3.17	1	5
White	82.44	61.01	98.43
Black	3.71	0	22.54
Hispanic	8.68	0.97	28.30
Asian	5.17	0	33.19

Table 3 presents summary statistics for characteristics of houses purchased by local buyers. Source: Multiple Listing Services and Census

Next, we focus on buyer characteristics. One important aspect to consider is that Indiana has one of the lowest average real estate prices in the U.S. This implies that NLBs possibly sold their previous homes for more than the average house price in Indiana. This wealth effect would allow NLBs to cover part of their home expenditures and to finance their houses on a smaller mortgage. Our data show that the groups have a similar *Mortgagerate* (measured by mortgage amount divided by sale price), around 0.82. This comparison hints toward the fact that wealth does not explain why NLBs spent more on houses. A further argument that supports this notion is that the U.S. government subsidizes mortgage debt in a variety of ways, especially up to an 80% loan-to-value ratio. Therefore, it often is a lucrative option for home buyers to take out large mortgages independent of their wealth status.

As mentioned earlier, home buyers usually go on site to inspect houses. Visiting houses involves a search cost that differs across buyers. Potential buyers have to travel, and they incur travel expenses that vary depending on the distance they travel from their home residence before purchasing a house. Nonlocal buyers have to spend more money and time compared to local buyers. As shown in Table 4, the average travel *Distance* for NLBs is 1,005 miles, and the maximum is 2,217 miles.

Turning to the imperfect price information argument, local buyers had the advantage of gaining information on local market values and prices throughout their

Table 4 Housing and Neighborhood Attributes: Nonlocal Buyers

Housing and Neighborhood Attributes: Nonlocal Buyers, 510 obs			
Variable	Mean	Min	Max
Saleprice	205,601	85,002	940,308
Housesize	2,101	825	6,588
Bedrooms	3.44	2	6
Baths	2.08	1	5
Houseage	25.35	0	119
DOM	49.50	0	310
Bargain	3.14	-14.29	45.96
Distance	1,005	167	2,217
Referenceprice	325,892	131,268	788,964
Mortgagerate	0.82	0.22	0.98
Unemployed	2.65	1.1	6
Income	68,247	26,725	117,130
Schoolscore	3.68	2	5
White	82.55	61.01	98.43
Black	3.18	0	16.22
Hispanic	8.51	0.97	28.30
Asian	5.76	0	33.19

Table 4 presents summary statistics for characteristics of houses purchased by nonlocal buyers. Source: Multiple Listing Services and Census

residency. In contrast, nonlocal buyers faced the challenge that houses are valued differently across geographic regions. Hence, nonlocal residents likely face higher uncertainty in evaluating whether posted prices of homes properly reflect their market values. In order to infer the true market value of a house, NLBs have to form expectations on prices. As mentioned in the introduction, expectations are formed based on *anchors or reference prices*. We follow previous studies and assume that home buyers' price expectations are anchored to prices they were accustomed to at their previous residence (see Lambson et al., 2004; Ihlanfeldt & Mayock, 2012). We assume that the average house price in their state serves as a proxy for forming their price expectations. Tables 3 and 4 show that the average home price in states outside Indiana (*Referenceprice*) is $325,892, which is significantly higher than the average price in the housing market in Lafayette/WestLafayette ($188,906). This gives rise to the fact that NLBs may overestimate local housing prices. We, therefore, consider home prices in states outside Indiana (*Referenceprice*) as a relevant variable to proxy imperfect information on local price distributions to explain the price difference. To summarize, our descriptives show that NLBs pay more for houses than LBs. Our empirical analysis will put special attention to the fact that NLBs buy larger and newer houses in better school districts.

Next, we provide preliminary insights into the implicit prices for various housing and neighborhood characteristics while estimating a pricing equation.[19] We regress the sale price (P) on house, neighborhood, and household attributes (*Bedrooms*, *Baths*, *Lotsize*, *DOM*, *Housesize*, *Schoolscore*, *Houseage*, *Income*, *Unemployed*, *Black*, *Hispanic*, *Asian*, *Mortgagerate*, *Distance*, and *Referenceprice*). All these variables enter the price function in linear and quadratic form. Furthermore, we include a nonlocal buyer dummy variable (*NLB*) to control whether buyers with nonlocal residential status prior to purchasing the house pay a differential amount. We also add a dummy variable (*WLNLB*) to test if nonlocal residential buyers that purchased a house in West Lafayette pay a different amount compared to nonlocal buyers that buy a house in Lafayette. Remember that houses in West Lafayette are mostly purchased by Purdue associates (faculty, staff, and graduate students), while houses in Lafayette are mostly purchased by people working in manufacturing and services. We add further fixed effects such as seasonal effects (*Season*), year fixed effects (*YearFE*), and neighborhood fixed effects (*TractFE*).

We estimate the pricing equation by OLS using 19,544 observations. Table 5, column (1), reports the coefficient estimates, standard errors, significance levels. Column (2) shows the calculated marginal effects. All coefficients (with very few exceptions) are highly significant and most magnitudes of the coefficient estimates and calculated marginal effects appear reasonable. Somewhat unexpectedly, however, the coefficient estimate on the *NLB* dummy variable shows that nonlocal buyers spend $\$15,539$ less than local buyers. This estimate is different to what the summary statistics show. The estimate on the *WLNLB* variable shows that nonlocals buying a house in West Lafayette spend $\$3,326$ more than nonlocals buying a house in Lafayette, which results in a lesser spending of $\$12,213$ compared to local buyers. This effect, however, is not significantly different from zero. There are further estimates that show unexpected signs and rather large price effects. For example, the coefficient estimates on *Bedrooms* and *Mortgagerate* return negative marginal effects, while positive effects would be more consistent with previous studies (see Genesove & Mayer, 1997). The coefficients on *Housesize* return a fairly high marginal effect of $\$74.37$ per square foot. Evaluating this estimate at the average house sizes of local and nonlocal home buyers returns predicted spendings of $\$142,139$ and $\$156,250$, respectively, on house size alone. This predicted spending appears too high. Finally, the average predicted price for local and nonlocal house buyers is $\$286,957$ and $\$314,211$, respectively. Hence, the predicted house prices are about 50 percent higher than the observed prices, see Tables 3 and 4.

While the estimation results provide interesting first insights, we would like to point out that the results need to be interpreted cautiously due to potential endogeneity concerns. As our summary descriptives show, local and nonlocal buyers select houses that differ greatly in characteristics such as *Housesize*, *Schoolscore*, and *Houseage*, see Tables 3 and 4. The consumption of these characteristics presumably vary with unobserved preference shocks and other observable household characteristics as measured by the variables *NLB*, *WLNLB*, *Mortgagerate*, *Distance*, and

[19] We thank a referee for the suggestion to adopt this preliminary regression.

Table 5 Results for Pricing Equation

Endogenous Variable:	Saleprice	Marginal Effects	Saleprice	Adj. Saleprice	Marginal Effects
Regressors	(1)	(2)	(3)	(4)	(5)
Intercept	112,212***		20,616		
	(22,574)		(17,240)		
Bedrooms	12,815***	-1,316.78	45,615***		7,283.09
	(5,109.37)		(5,295.68)		
Bedrooms^2	-2,133.46***		-5,786.93***		
	(708.59)		(744.13)		
Baths	-30,966***	11,209.64	27,015***		27,981.76
	(3,619.64)		(3,391.93)		
Baths^2	11,040***		253.06		
	(782.92)		(760.09)		
Lotsize	27,202***	24,885.50	25,505***		23,466.41
	(1,394.24)		(1,477.98)		
Lotsize^2	-2,139.30***		-1,882.66***		
	(174.78)		(185.80)		
DOM	-74.19***	-47.63	-50.24***		-29.69
	(19.08)		(20.37)		
DOM^2	0.21***		0.16**		
	(0.07)		(0.08)		
Income	0.37***	0.27	-0.05*		0.29
	(0.15)		(0.02)		
Income^2	-7.51E-7		-2.65E-6***		
	(1.04E-6)		(1.04E-6)		
Unemployed	-12,075***	-1,153.33	-4,430.77**		1,365.05
	(2,074.90)		(2,177.61)		
Unemployed^2	2,103.59***		1,116.32***		
	(307.92)		(326.29)		
Black	1,043.62**	47.24	-147.88***		-780.30
	(536.72)		(541.01)		
Black^2	-135.14***		-85.77***		
	(26.58)		(27.49)		
Hispanic	-2,908.29***	-1,242.08	-1,433.92***		-810.09
	(360.53)		(371.39)		
Hispanic^2	96.11***		35.98***		
	(12.31)		(12.67)		
Asian	3,444.66***	2,518.14	3,391.04***		2,464.66
	(272.96)		(284.47)		
Asian^2	-89.07***		-89.05***		
	(8.55)		(8.95)		
Season	1,723.79*	2,919.67	1,293.22		
	(1,052.34)		(1,123.24)		
Housesize	66.78***	74.37		60.36***	34.88

Table 5 (continued)

Endogenous Variable:	Saleprice	Marginal Effects	Saleprice	Adj. Saleprice	Marginal Effects
	(2.79)			(1.31)	
Housesize^2	-0.19E-2***			-0.67E-2***	
	(0.05E-2)			(0.25E-3)	
Schoolscore	-20,539***	2,849.88		20,056***	10,946.79
	(4,175.49)			(1,249.63)	
Schoolscore2	3,675.79***			-1,431.60***	
	(738.30)			(226.43)	
Housesage	-1,428.77***	-682.23		205.24***	-109.50
	(64.27)			(39.67)	
Housesage^2	10.44***			-4.40***	
	(0.66)			(0.41)	
Mortgagerate	-2,547.83	-32,346.74			
	(17,636)				
Mortgagerate2	-17,953				
	(12,592)				
Distance	-6.68	-6.73			
	(14.63)				
Distance^2	-0.97E-3				
	(0.68E-2)				
Referenceprice	0.23**	0.13			
	(0.09)				
Referenceprice^2	-0.26E-06**				
	(0.11E-6)				
NLB	-15,539**				
	(7,167.51)				
WLNLB	3,325.96				
	(4,575.75)				
YearFE	yes***		yes***		
TractFE	yes***		yes***		
Obs: 19,544					

Table 5 shows the estimation results of the pricing Eqs. (10) and (11). The third column shows the marginal effects

*, ** and *** denote 99%, 95%, and 90% levels of significance, respectively

Referenceprice. In the following, we devote special attention to a potential correlation between housing attributes and household characteristics and adopt an estimation approach as proposed by Bishop and Timmins (2019). Based on our summary statistics (Tables 3 and 4) we treat three housing attributes (*Housesize*, *Schoolscore*, and *Houseage*) as potential endogenous regressors since their amount of consumption greatly differed between local and nonlocal buyers. We account for a potential correlation between these housing characteristics and household characteristics. In the next section, we introduce our empirical model, which enables us to disentangle

the price differential while explicitly accounting for buyers' different marginal willingness to pay for housing characteristics.

The Model and Estimation

Our study applies a demand estimation that returns individual-specific preferences for housing and neighborhood characteristics. The heterogeneous preferences will help us explain the price differentials between local and nonlocal buyers. Our housing model follows the estimation approach by Bishop and Timmins (2019). Their estimator is especially appropriate for our purposes, since it enables us to flexibly estimate individual preferences for different characteristics, while allowing for potentially endogenous regressors, that is, *Housesize*, *Schoolscore*, and *Houseage*.[20] We explicitly consider that the endogenous regressors are potentially correlated with household characteristics.

The model relates the price (P) of a house to its characteristics. We distinguish between exogenous housing and neighborhood attributes that enter H (here, *Bedrooms*, *Baths*, *Lotsize*, *DOM*, *Income*, *Unemployed*, *Black*, *Hispanic*, and *Asian*), potential endogenous housing characteristics that are included in Z (here, *Housesize*, *Schoolscore*, and *Houseage*), and unobserved housing and neighborhood attributes that are captured by ϵ. The house price is described by a function (p) that maps the characteristics into the price:

$$P = p\left(Z_i, H_i, \epsilon_i; \beta\right), \tag{1}$$

where the subindex $i = 1, ..., N$ refers to households and β is the parameter of interest, which reflects the implicit prices for housing and neighborhood characteristics.[21]

Consumer utility is a function of Z, H, ϵ, and the consumption of a composite commodity is denoted by C. Consumer preferences depend on the following observed household attributes that enter X: (a) non-residential buyer status per se (measured by the *NLB* and *WLNLB* dummies), (b) search costs (measured by *Distance*), (c) imperfect price information (measured by *Referenceprice*), and (d) wealth effects (measured by *Mortgagerate*). The utility is defined as:

$$U = U\left(Z_i, H_i, \epsilon_i, C_i, X_i, \nu_i; \alpha\right), \tag{2}$$

where α is a parameter vector. The ν refers to unobserved household attributes. After we normalize the price of the composite commodity to 1, the budget constraint is written as:

$$I_i \geq p\left(Z_i, H_i, \epsilon_i; \beta\right) + C_i. \tag{3}$$

[20] We would like to thank an anonymous referee for valuable feedback on this section. We also thank Kelly Bishop for providing support on the estimation algorithm.

[21] For notational simplicity, we suppress time subscripts.

Under that assumption that the budget constraint is binding, we can write utility as:

$$U = U\big(Z_i, H_i, \epsilon_i, \big(I_i - p\big(Z_i, H_i, \epsilon_i; \beta\big)\big), X_i, \nu_i; \alpha\big). \tag{4}$$

We follow the standard assumption in the literature that the utility function is quasi-linear and additively separable in Z, H, and ϵ:

$$U = \alpha_0 + \alpha_1 Z_i + \frac{1}{2}\alpha_2 Z_i^2 + \alpha_3 X_i Z_i + \nu_i Z_i + g\big(H_i, \epsilon_i\big) + \big(I_i - p\big(Z_i, H_i, \epsilon_i; \beta\big), \tag{5}$$

where g is a function of H and ϵ. Taking the first-order condition with respect to Z and solving for p' gives us the following marginal willingness to pay function:

$$p'\big(Z_i; \beta\big) = \alpha_1 + \alpha_2 Z_i + \alpha_3 X_i + \nu_i, \tag{6}$$

where α_2 reflects the slope of the marginal willingness to pay function, the unobserved household attribute ν is treated as a regression error, and $p'(Z;\beta)$ is replaced with the implicit price that we receive from estimating the pricing function.

Since Z presumably varies with observable household characteristics X, unobservable preference shocks, ν, and the parameters of the hedonic price function, β, the estimation of Eq. (6) results in a potentially biased estimate of α_2. We therefore apply a change of variables (from Z to ν) approach and solve Eq. (6) for ν_i:

$$\nu_i = p'\big(Z_i; \beta\big) - \alpha_1 + \alpha_2 Z_i + \alpha_3 X_i. \tag{7}$$

Recovering the implicit price in the first stage, assuming that ν is normally distributed, $\mathrm{N}(0, \sigma^2)$, the likelihood can be written as:

$$\Pi_{i=1}^{N} l\big(\alpha, \sigma; Z_i, X_i\big) = \Pi_{i=1}^{N} \frac{1}{\sigma\sqrt{2\pi}} \exp\{-\frac{1}{2\sigma^2}\big(\nu(\alpha)^2\big)\} \left| \frac{\partial \nu_i(\alpha)}{\partial Z_i} \right| \tag{8}$$

where

$$\left| \frac{\partial \nu_i(\alpha)}{\partial Z_i} \right| = p''\left(Z_i; \widehat{\beta}\right) - \alpha_2. \tag{9}$$

Note that the Jacobian term in the equation above explicitly controls for the correlation between Z and ν, which describes the endogeneity problem of the household when choosing the amount of Z, see also Bishop and Timmins (2019, p. 80).

The Estimation Procedure

We now turn to introducing the estimation procedure, which consists of two stages. In the first stage, we estimate the house price function, see Eq. (1), to get the implicit prices, the β parameters. In the second stage, we estimate the marginal willingness to pay function (6) to retrieve the marginal willingness to pay parameters, the α parameters.

When estimating the house price function, Eq. (1), we need to consider that several housing characteristics in Z (*Housesize*, *Schoolscore*, and *Houseage*)) are potentially correlated with the household characteristics. An estimation of Eq. (1) by OLS can cause a simultaneity bias due to the endogeneity concerns. To circumvent this problem, we adopt a so-called partially-linear model, which involves a two-step estimation procedure. This procedure adopts a polynomial series estimator that returns consistent estimates (see also Robinson, 1988; Andrews, 1991; Olley & Pakes, 1996). In the first step, the parameter estimates of the exogenous regressors are obtained from a partially linear model that allows a polynomial in the endogenous regressors to enter the equation serving the purpose to absorb any variation caused by the potential endogenous regressors (Z). This leaves only the part of variation in prices explained by the exogenous housing and neighborhood attributes (H) and gives consistent parameter estimates for the exogenous housing and neighborhood attributes. More specifically, we estimate the following price function:

$$p\left(Z_i, H_i, \epsilon_i; \beta\right) = H'_i \beta^H + f\left(Z_i; \beta\right) + \epsilon_i, \tag{10}$$

where H includes linear and quadratic functions in each of the following housing and neighborhood attributes: *Bedrooms*, *Baths*, *Lotsize*, *DOM*, *Income*, *Unemployed*, *Black*, *Hispanic*, and *Asian*. To control for potentially correlated unobservables at the neighborhood level, we use a set of neighborhood fixed effects at the census tract level. We also add further fixed effects such as seasonal and year fixed effects. The function f describes a polynomial in the endogenous regressors. After receiving a consistent estimate of $\widehat{\beta}^H$, we turn to the second step that concentrates on the estimation of the β parameters.

In the second step, we move $H'\widehat{\beta}^H$ to the left-hand side of Eq. (10), which results in:

$$p\left(Z_i, H_i, \epsilon_i; \beta\right) - H'_i \widehat{\beta}^H = \beta_{0,i^*} + \beta_{1,i^*} Z_i + \beta_{2,i^*} Z_i^2 + \epsilon_i. \tag{11}$$

The hedonic gradient ($\widehat{\beta}_{1,i^*} + 2\widehat{\beta}_{2,i^*} Z_i$) can then be retrieved at the household-level from the estimation of Eq. (11).[22] In estimating the hedonic price equation, we applied several robustness checks that include the two stage approach by Robinson (1988) with a weighted least squares regression based on different bandwidths that range from 2 to 3 times the standard deviations of the housing characteristics. Similar bandwidths have been used in applications by Bishop and Timmins (2019) and Siebert (2021). For example, Bishop and Timmins (2019) use a weighted least squares estimation approach with a bandwidth of 2.15, while Siebert (2021) uses bandwidths of 3, 2.15, and 2.[23]

The second stage relates to the estimation of the consumers' marginal willingness to pay function for housing attributes — the α parameters in Eq. (6)— which is explained by the consumer demographics (X). The equation is described as:

[22] The i^* indicates that the β coefficients hold locally for each household-level observation in Z.

[23] For further information on choosing the optimal bandwidth and the associated rule of thumb, see Silverman (1986) and Haerdle et al. (2004).

$$p'\left(Z_i;\beta\right) = \alpha_1 + \alpha_2 Z_i + X'_i\alpha_3 + \nu_i. \tag{12}$$

Remember, X_i is comprised of buyer demographics and includes the following variables *NLB*, *WLNLB*, *Distance*, *Referenceprice*, and *Mortgagerate*. We applied several estimation procedures to check for robustness. The equations can be estimated separately as well as simultaneously. A separate estimation is subject to a potential estimation bias of the estimated standard deviation. Alternatively, estimating the equations simultaneously can increase efficiency. Bishop and Timmins (2019) estimate the equations sequentially via maximum likelihood using bootstrapped standard errors based on 250 replications. Bootstrapping is a frequently adopted practical approach to reduce the sequential estimation bias, see Efron (1979). For further information on the number of bootstrap replications, see Efron and Tibsharani (1993, p. 52). Bishop and Timmins (2019, pp. 68–69)) note that the estimation of α_2 can be reduced to a numerical search routine over α_2 and (due to the normal distribution of ν) the parameters α_1 and α_3 can then be recovered from a linear model via maximum likelihood, which is known to be equivalent to an OLS estimation. Given the normality assumption placed on the error terms, it has been shown that the maximum likelihood estimator is also asymptotically equivalent to the two-step and iterative feasible generalized least squares estimator, that is, a two-stage estimation method for seemingly unrelated regression models. Kmenta and Gilbert (1968) have shown that the iterative two-stage estimator and the maximum likelihood estimator lead to identical estimation results.

The Results

This section presents the estimation results of our empirical model. We begin with discussing the estimation results of the price equation, which provides insights into the implicit prices for various housing and neighborhood characteristics. Second, we estimate the heterogeneous marginal willingness to pay parameters across buyers for specific house characteristics. We attribute these heterogeneous preferences to buyer characteristics (such as *NLB*, *WLNLB*, *Distance*, *Referenceprice*, and *Mortgagerate*) and determine their contribution to explaining the price differential between local and nonlocal buyers.

Estimation Results of the Pricing Function

For estimating the pricing Eqs. (10) and (11), we use 19,544 observations in the estimations. Table 5 (columns (3) to (5)) reports the mean coefficient estimates, standard errors, significance levels, and marginal effects.[24] All coefficient estimates (except the estimate on squared baths and season) are highly significant. The average

[24] It should be noted that the estimated coefficients reflect the implicit prices averaged across all buyers. We turn to the estimation of individual-specific marginal willingness to pay parameters in the second stage of our estimation procedure.

predicted sale price is $ 189,452, which is close to the sample average of $ 189,341. Hence, prices are predicted with high accuracy, which confirms the good fit of our regression.

Columns (3) and (4) of Table 5 shows the parameter estimates, and column (5) displays the calculated average marginal effects. The magnitudes of our housing and neighborhood estimates are in line with findings from previous studies on the housing market, which further confirms the reliability of our estimation results. Focusing on the implicit prices for housing attributes, the estimate on the coefficient for bedrooms shows that the home price increases by $ 7,283 per additional bedroom. One additional bathroom adds $ 27,982 to the total sale price. An increase in lot size by one acre raises the house price by $ 23,466. The parameter estimate on days on the market shows that the sale price decreases by $ 30 for an additional day that the house is listed on the market. The sale prices increase with income, and we find positive implicit prices for Asian neighborhoods. Our estimation results return negative implicit prices for Black and Hispanic communities. We also find highly significant year and local fixed effects.

The estimations return an average implicit price of $ 35 for one additional square foot which is lower and more reasonable compared to our preliminary regression results that we reported on earlier. Since nonlocal buyers purchase larger houses than local buyers, this will explain part of the price differential (as will be detailed later). The estimation results also show that a 20 percent improvement in school quality increases the sale price on average by $ 10,947. The coefficient estimate on house age indicates that home buyers spend $ 110 less if house age increases by one year.

In the next step, we predict the price differentials between local and nonlocal buyers based on the estimated average implicit prices. We evaluate the parameter estimates, as shown in Table 5, at the sample means as reported in Tables 3 and 4 to predict the average expenses of nonlocal and local buyers on specific house and neighborhood characteristics. The calculated expenses will provide an idea as to what extent the price differential could be explained by differing realized demands on housing characteristics (as reported in Tables 3 and 4), evaluated at the average implicit prices.

Columns (1) and (2) of Table 6 predict how much local and nonlocal buyers (respectively) spend on average on specific house and neighborhood characteristics. Column (3) shows the corresponding extra expenses (in $) carried out by nonlocals, and column (4) displays these extra expenses in percentages relative to the house sale price. First, Table 6 (column (3)) shows that nonlocal buyers spend an extra $ 6,618 (4 percent of the house price) on purchasing larger houses than local buyers. Moreover, nonlocal buyers pay an additional $ 5,559 (or 3 percent of the sale price) for better school quality. House age is a further characteristic that stresses differential spending between both buyer groups. Nonlocal buyers pay an extra $ 1,169 (or 1 percent of the sale price) due to purchasing newer homes.[25] Income differences explain an extra spending of $ 819 by nonlocal buyers.

[25] Remember that this prediction is evaluated at the average implicit price.

Table 6 Comparison of Home Expenses by Characteristics

	Expenses by	Expenses by	Extra Expenses by	Extra Expenses by
	Locals (in $)	Nonlocals (in $)	Nonlocals (in $)	Nonlocals (in %)
Characteristics	(1)	(2)	(3)	(4)
Housesize	66,657	73,275	6,618	3.53
Schoolscore	34,688	40,248	5,559	2.96
Houseage	-3,945	-2,776	1,169	0.62
Bedrooms	24,097	25,034	937	0.50
Baths	53,318	58,323	5,005	2.67
Lotsize	12,712	12,437	-275	-0.15
DOM	-3,165	-2,487	678	0.36
Income	19,310	20,129	819	0.44
Unemployed	3,540	3,612	71	0.04
Black	-2,896	-2,485	411	0.22
Hispanic	-7,028	-6,895	133	0.07
Asian	12,753	14,185	1,432	0.76
Season	2,191	2,178	-12	-0.01
Saleprice	187,524	210,070	22,546	12.02

Table 6 shows the average home expenses by (observed) home characteristics for nonlocal and local home buyers. The expenses are calculated based on the estimation results of the pricing Eqs. (10) and (11)

The last line in Table 6 shows that local buyers spend in total $ 187,524 on house and neighborhood characteristics, while nonlocal buyers spend a total of $ 210,070. The price differential amounts to $ 22,546 or 12 percent of the house price. The three characteristics alone (*Housesize*, *Schoolscore*, and *Houseage*) already cover a large amount —$ 13,346 (=$6,618+$ 5,559+$ 1,169)— of the total $ 22,546 price differential. The three characteristics (*Housesize*, *Schoolscore*, and *Houseage*) also coincide with the summary statistics that show largely differing sample means across both home buyer groups (see Tables 3 and 4).

Next, we devote special attention to the fact that buyer groups are characterized by heterogeneous (marginal) willingness to pay parameters for housing characteristics.

Estimation Results of Individual's Marginal Willingness to Pay Parameters

We evaluate buyers' heterogeneous preferences for housing characteristics. We focus on the estimation of buyer-specific marginal willingness to pay parameters. More specifically, we estimate heterogeneous marginal willingness to pay parameters for three housing attributes: house size, school quality, and house age. We put special attention to these housing attributes as the consumptions were largely different across local and nonlocal buyers based on the summary statistics (see Tables 3 and 4) and the estimation results reported earlier.

We disentangle the extent to which heterogeneous marginal willingness to pay for the three housing characteristics (explained by buyer-specific demographics) can further predict the price differential. We put special attention on the following buyer-specific demographics: (a) non-residential buyer status per se (measured by the *NLB* and *WLNLB* dummy variables), (b) search costs (measured by *Distance*), (c) imperfect price information (measured by *Referenceprice*), and (d) wealth effects (measured by *Mortgagerate*). These buyer demographics enter the X in Eq. (12).

Table 7, column (1), reports the average coefficient estimates for the marginal willingness to pay parameters on *Housesize*. The negative estimate on *Housesize* reflects the downward-sloping individual demand for house size. The inverse demand has a calculated intercept of around $ 60, and the negatively estimated slope indicates that the (marginal) willingness to pay for an additional square foot decreases by $ 0.01. Evaluating the marginal willingness to pay across local and nonlocal buyers and the buyers' quantity decisions for house size, as shown in Tables 3 and 4, the results predict that locals spend $ 36.3 per square foot, while nonlocals spend $ 33.9 per square foot. Evaluating these prices at the sample means, for nonlocals and locals, shows that locals spend $ 69,301 on house size (Table 7, column (2)), while nonlocals spend $ 71,153 (Table 7, column (3)). Hence, nonlocals spend an extra $ 1,852 (Table 7, column (4)) that is explained by higher quantity demanded on house size.

Focusing on the residential argument of nonlocals moving to Lafayette/West Lafayette, as measured by the *NLB* and *WLNLB* dummies, the estimates show that nonlocals assign a higher marginal willingness to pay of $ 4.5 per square foot (Table 7, column (1)). This explains an additional expense of $ 9,464 for house size (Table 7, column (4)) that nonlocals spend beyond the $ 1,852 that is paid extra for additional demand on house size. This premium of $ 9,464 may be explained by nonlocal status arguments, such as reward, gratification, and the deadline for moving. It may also be related to other factors such as family size and children, income, etc. Nonlocals that purchased a house in West Lafayette, as measured by the *WLNLB* dummy, are willing to pay $ 1.2 less per square foot as compared to other nonlocal home buyers. In comparing the *WLNLB* home buyers to local home buyers, the former have a higher willingness to pay of $ 3.25 per square foot and they pay $ 6,848 more for house size explained by reward, gratification, and deadline arguments.

Turning to the travel and search cost argument, as measured by *Distance*, our results (see Table 7, column (1)) show that the marginal willingness to pay for house size decreases by $ 0.02 for every mile that buyers live farther away from Lafayette/West Lafayette. The estimate provides evidence that travel and search costs reduce the marginal willingness to pay for house size. Evaluating this estimate in terms of price per square foot shows that local buyers' marginal willingness to pay for a square foot decreases from $ 36.3 to $ 36.2, while the corresponding per square foot price for nonlocals drops from $ 33.9 to $ 14. Evaluating the estimate at the sample means for distance and house size shows that nonlocals pay $ 42,636 less on house size (Table 7, column (4)) due to higher search and travel costs.

Regarding the imperfect price information argument, Table 7, column (1) shows that the coefficient on *Referenceprice* is positive. This predicts an extra expense of $ 16 per square foot paid by nonlocals. Evaluating the estimate at the corresponding

Table 7 Marginal Willingness to Pay for House Size

Endog. Var.:	Estimates	Local Buyers	Nonlocal Buyers	Difference
Regressors	(1)	(2)	(3)	(4)
Housesize	-0.013***	69,301	71,153	1,852
	(0.044E-3)			
Schoolscore	1.100***	6,664	8,501	1,836
	(0.029)			
Houseage	0.018***	1,242	960	-281
	(0.001)			
NLB	4.504***	0	9,464	9,464
	(0.350)			
WLNLB	-1.245***	0	6,848	6,848
	(0.347)			
Distance	-0.020***	-272	-42,907	-42,636
	(0.041E-3)			
Referenceprice	0.117E-3***	42,013	80,112	38,099
	(1.724E-6)			
Mortgagerate	10.028***	15,915	17,317	1,402
	(0.237)			
Sum		134,863	144,599*	9,737*
Obs: 19,544				

Table 7 shows the estimation results for the individual preferences as shown in Eq. (12). The dependent variable is the marginal willingness to pay parameters for house size

*indicates that the sum is taken over all nonlocal buyers (NLBs); it excludes West Lafayette nonlocal buyers (WLNLBs) to avoid double counting

***denotes a 99% level of significance

means predicts that nonlocals spend an additional $ 38,099 on house size (Table 7, column (4)) due to imperfect information on prices.

The positive estimate on *Mortgagerate* shows that home buyers with higher mortgages spend more on house size. In general, it is noteworthy that large parts of the extra spending by nonlocals is explained by: (1) residential status arguments (reward, gratification, moving deadline, and possibly other associated factors such as family size and children, income, etc.), which accounts for an extra $ 9,464 spending by nonlocals and an extra spending of $ 6,848 by nonlocals moving to West Lafayette, and (2) reference price arguments, which explains an additional spending of $ 38,099.

Finally, the last line in Table 7 reports the nonlocals' additional willingness to pay for house size accounting for heterogeneous preferences. Overall, nonlocals are paying $ 9,737 more on house size than locals (Table 7, column (4)), which appears to be a reasonable number to explain the total price differential between both buyer groups.

Table 8 Marginal Willingness to Pay for School Quality

Endog. Var.:	Estimates	Local Buyers	Nonlocal Buyers	Difference
Regressors	(1)	(2)	(3)	(4)
Housesize	0.258***	1,757	2,218	462
	(0.014)			
Schoolscore	2,503.99***	25,143	33,849	8,705
	(9.461)			
Houseage	5.885***	672	549	-123
	(0.324)			
NLB	1,469.85***	0	5,404	5,404
	(114.200)			
WLNLB	-406.43***	0	3,910	3,910
	(113.200)			
Distance	-6.631***	-147	-24,503	-24,356
	(0.134)			
Referenceprice	0.038***	22,720	45,727	23,007
	(0.057E-2)			
Mortgagerate	3,272.48***	8,610	9,888	1,278
	(77.432)			
Sum		58,754	73,131*	14,377*
Obs: 19,544				

Table 8 shows the estimation results for the individual preferences as shown in Eq. (12). The dependent variable is the marginal willingness to pay parameters for school quality

*indicates that the sum is taken over all nonlocal buyers (NLBs); it excludes West Lafayette nonlocal buyers (WLNLBs) to avoid double counting

***denotes a 99% level of significance

Table 8 shows the marginal willingness to pay for school quality explained by buyer demographics. Notable is the result that home buyers are willing to pay an additional $ 8,705 for a 20 percent increase in school quality (see Table 8, column (4)). This result confirms that school quality is a highly regarded attribute among home buyers. The estimation results also show that the non-residential status per se predicts that NLBs pay an additional $ 5,404 for better schools, which could partly be explained by reward and gratification arguments. There could be further arguments that might explain the extra pay for school quality. One example would be that nonlocals have more children or earn more income, so they are willing to spend more on school quality. Unfortunately, we do not have data to test this argument. Another aspect could be that nonlocals that move to Purdue University in West Lafayette attach a higher value to education and school quality. The inclusion of the *WLNLB* dummy tests this argument. Table 8 shows while nonlocal buyers that move to West Lafayette are willing to pay an additional $ 3,910 for better schools compared to local home buyers, they spend $ 1,494 less than nonlocals that are not employed by Purdue University. This finding shows that employees at Purdue University do not

have a higher willingness to pay for education compared to other nonlocal buyers that are not employed by Purdue University. The last line in Table 8, column (4), shows that, overall, nonlocal buyers pay an additional $ 14,377 for school quality.

Finally, Table 9 shows the extra expenses for house age. Most noteworthy is the result that the marginal willingness to pay for house age decreases with house age itself, as shown by the estimate for house age. This could be related to the fact that older houses require more maintenance and repairs. Since nonlocals buy newer houses they spend $ 5,730 more, which could possibly be explained by reduced incentives to invest in maintenance, repairs, and renovating older houses. Instead, they may prefer moving into well-maintained homes, which would allow them to concentrate more on their new job, etc. The estimate on the NLB dummy variable shows that nonlocals have a slightly higher marginal willing to pay for house age. Nonlocal house buyers moving to West Lafayette have a slightly lower marginal willing to pay for house age compared to other nonlocal buyers, even though their willingness to pay is still higher when compared with local buyers. The last line in Table 9 shows that nonlocals spend an additional $ 3,895 on more recently built houses.

Table 9 Marginal Willingness to Pay for House Age

Endog. Var.:	Estimates	Local Buyers	Nonlocal Buyers	Difference
Regressors	(1)	(2)	(3)	(4)
Housesize	0.003***	2,360	1,674	-687
	(0.015E-2)			
Schoolscore	3.741***	427	349	-78
	(0.100)			
Houseage	-8.739***	-11,346	-5,616	5,730
	(0.003)			
NLB	15.311***	0	388	388
	(1.189)			
WLNLB	-4.233***	0	281	281
	(1.179)			
Distance	-0.069***	-17	-1,760	-1,743
	(0.001)			
Referenceprice	0.039E-2***	2,694	3,288	594
	(0.059E-4)			
Mortgagerate	34.089***	1,020	710	-310
	(0.806)			
Sum		-4,862	-967*	3,895*
Obs: 19,544				

Table 9 shows the estimation results for the individual preferences as shown in Eq. (12). The dependent variable is the marginal willingness to pay parameters for house age

*indicates that the sum is taken over all nonlocal buyers (NLBs); it excludes West Lafayette nonlocal buyers (WLNLBs) to avoid double counting

***denotes a 99% level of significance

Conclusion

Buyers pay different prices for comparable products in many markets, including health care, food, and housing. The purpose of this study is to explain why nonlocal home buyers (persons who moved from out of town) pay higher prices for houses than local home buyers. Our study shows that nonlocal buyers pay $ 22,546 (12 percent) more for houses. Based on a dataset that encompasses highly detailed and confidential information on individual buyers and house characteristics, we explore the merits of several arguments that explain the price differential. We pay special attention to heterogeneous preferences between buyers while accounting for buyer-specific characteristics including non-residential buyer status per se, search costs, imperfect price information, and wealth effects.

We estimate a housing demand model that allows for the flexible estimation of buyer-specific willingness to pay parameters for housing and neighborhood attributes. The estimation results show that the largest part of the price differential ($ 14,377 or 8 percent of the house price) is explained by their higher marginal willingness to pay and extra expenses for school quality. A further large expenditure ($ 9,737 or 5 percent) is explained by nonlocal buyers' higher willingness to pay for house size. Finally, we find that nonlocal buyers spend an extra $ 3,895 (2 percent of the house price) due to their preference in purchasing less aged houses.

We show that heterogeneous preferences between local and nonlocal buyers can explain a large part of the price differential. It is interesting to note that residential status arguments (such as reward, gratification, and moving deadline) and imperfect price information largely increase nonlocals' marginal willingness to pay for house size, which explains parts of their higher home expenditures. Moreover, a higher search or travel cost reduces buyers' marginal willingness to pay for house size and results in reduced spendings. Finally, bargaining strengths are similar between both groups of buyers.

For future research, it would be interesting to focus on additional sources of imperfect information such as imperfect information on quality (i.e., attributes that are unobserved to the uninformed buyers, but observed by the informed buyers). For example, local home buyers may have an informational advantage over nonlocal home buyers due to better knowledge of neighborhoods, crime rates, infrastructure, etc. In this regard, it would be insightful to examine whether nonlocal and less-informed buyers purchase houses with significantly inferior quality.

It would also be interesting to focus on the role of real estate agents in explaining house prices and price differentials. There is an extensive literature that focuses on the effects of real estate agents on buyers and prices (see Bernheim & Meer, 2008; Genesove & Mayer, 1997; Merlo & Ortalo-Magne, 2004). This research is motivated by real estate markets being characterized by imperfect information on the seller and buyer sides. Real estate agents provide information and they can reduce search costs. They also provide professional services and negotiating skills. Agents are typically involved in many tasks such as advertising, accompanying potential buyers on home visits, conducting open houses, negotiating offers, etc. While they have an information advantage, their effort and quality are difficult to observe, which can result in shirking behavior.

Based on these arguments, studies investigate whether real estate agents can mitigate information asymmetries and eliminate behavioral biases (see also Campbell & Kracaw, 1980; Anand & Subrahmanyam, 2008; Ling et al., 2018). Levitt and Syverson (2008) and Rutherford, Springer, and Yavas (2005, 2007) find that price discounts are larger when sellers are less informed. Similarly, Holmes and Xie (2018) find that homes of out-of-state sellers are sold at a discount.

Price distortions can also be caused by dual agency relationships, defined as the seller and buyer agents being employed by the same real estate firm. In this regard, Kadiyali et al. (2014) and Johnson et al. (2015) investigate the effect of dual agency on sale price. The study by Gardiner et al. (2007) suggests that dual agency reduces sale prices and decreases the time a house is listed on the market.

While the effects of real estate agencies on transaction prices is an important topic that can contribute to explaining the price differential between local and nonlocal buyers, we are not able to focus on this aspect due to data limitations. At this point, we defer to the fact that all our house transactions were listed on the MLS, and a necessary condition to get access to the MLS is that sellers are represented by a broker. Therefore, all house transactions involved a seller's agent, which adds some degree of homogeneity in our study and attenuates major concerns that nonlocal and local home buyers would receive differential agency support. However, the role of real estate agents on explaining the house price differentials is certainly a relevant aspect to consider in future work. We certainly agree that further work on different markets is warranted to test whether the main mechanisms and arguments (such as heterogeneous willingness to pay, imperfect information on prices and qualities, and differential search costs) also apply to different regions and markets.

It would also be interesting to further explore whether non-residential buyer status per se could be further explained by more detailed demographic arguments. In our case, it would be interesting to examine if the nonlocal buyers' higher willingness to pay for school quality could be explained by income, number of children, or other demographics.

On a final note, our study contributes to debates that center on imperfect information and market imperfections, and these topics are of long-standing interest to distinguished scholars and policy makers. In order to diminish this market imperfection problem, information transparency policies are considered that mandate professionals (such as pharmacies, hospitals, physicians, dentists, lawyers, and online providers) to provide more product information. The topic of imperfect information attracted further interest and practical relevance with the introduction of Internet applications. One recent example is the health market, where hospitals in the U.S. are required to publish their charge master prices online from 2019 onward. Proponents of price transparency policies often argue that further price information may be beneficial to consumers, as it can reduce prices. Opponents fight on the grounds that price and quality provisions are not independent, such that more price information can increase quality uncertainty and harm consumers via quality deterioration. Our study suggests that transparency policies targeting markets with imperfect information on price could be beneficial for consumers.

Acknowledgements We would like to thank Stephen Martin, Kelly Bishop, seminar participants, and two anonymous referees for valuable feedback and support. We also thank the Tippecanoe County Assessor's Office, the Board of Realtors in Indiana, the Real Estate Agents Association in Indiana, and Real Estate Agent Amy Junius for support.

References

Anand, A., & Subrahmanyam, A. (2008). Information and the intermediary: Are market intermediaries informed traders in electronic markets? *Journal of Financial and Quantitative Analysis, 43*(1), 1–28

Andrews, D. W. K. (1991). Asymptotic normality of series estimators for nonparametric and semiparametric regression models. *Econometrica, 59*(2), 307–346

Bartik, T. J. (1987). The estimation of demand parameters in hedonic price models. *Journal of Political Economy, 95*(1), 81–88

Baye, M., Morgan J., & Scholten, P. (2006). Information, search, and price dispersion. in *Handbook of Economics and Information Systems*, Amsterdam.

Bayer, P., Ferreira, F., & McMillan, R. (2007). A unified framework for measuring preferences for schools and neighborhoods. *Journal of Political Economy, 115*(4), 588–638

Beracha, E., & Seiler, M. J. (2014). The effect of listing price strategy on transaction selling prices. *Journal of Real Estate Finance and Economics, 49*(2), 237–255

Bernheim, B. D., & Meer, J. (2008). How much value do real estate brokers add? A case study," *NBER working paper*, No. 13796.

Betts, J. R. (1995). Does school quality matter? Evidence from the national longitudinal survey of youth. *Review of Economics and Statistics, 77*(2), 231–250

Bishop, K. C., & Timmins, C. (2019). Estimating the marginal willingness to pay function without instrumental variables. *Journal of Urban Economics,* 109(C), 66–83.

Black, S. E. (1999). Do better schools matter? Parental valuation of elementary education". *Quarterly Journal of Economics, 114*(2), 577–599

Brown, Z. (2019). Equilibrium effects of health care price information. *Review of Economics and Statistics, 101*(4), 699–712

Bucchianeri, G. W., & Minson, J. A. (2013). A homeowner's dilemma: Anchoring in residential real estate transactions. *Journal of Economic Behavior and Organization,* 89(C), 76–92.

Burdett, K., & Judd, K. (1983). Equilibrium price dispersion. *Econometrica, 51*(4), 955–969

Campbell, T. S., & Kracaw, W. A. (1980). Information production, market signalling, and the theory of financial intermediation. *Journal of Finance, 35*(4), 863–882

Card, D. & Krueger, A. B. (1996). Labor market effects of school quality: Theory and evidence. *NBER Working Paper,* No. 5450.

Cardella, E., & Seiler, M. J. (2016). The effect of listing price strategy on real estate negotiations: An experimental study. *Journal of Economic Psychology, 52*, 71–90

Chan, Y. S., & Leland, H. E. (1982). Prices and qualities in markets with costly information. *Review of Economic Studies, 49*(4), 499–516

Chan, Y. S., & Leland, H. E. (1986). Prices and qualities: A search model. *Southern Economic Journal, 52*, 1115–1130

Cheng, P., Lin, Z., Liu, Y., & Seiler, M. J. (2015). The benefit of search in housing markets. *Journal of Real Estate Research, 37*(4), 597–621

Chinloy, P., Hardin III, W., & Wu, Z. (2013). Price, place, people, and local experience. *Journal of Real Estate Research, 35*(4), 477–505

Clauretie, T. M., & Thistle, P. D. (2007). The effect of time-on-market and location on search costs and anchoring: The case of single-family properties. *Journal of Real Estate Finance and Economics, 35*(2), 181–196

Coey, D., Larsen, B. J., & Platt, B. C. (2019). Discounts and Deadlines in Consumer Search. mimeo.

Cooper, Z., Craig, S. V., Gaynor, M., & VanReenen, J. (2019). The price ain't right? Hospital prices and health spending on the privately insured. *Quarterly Journal of Economics, 134*(1), 51–107

Cutler, D., & Glaeser, E. (1997). Are ghettos good or bad? *Quarterly Journal of Economics, 112*(3), 827–872

DellaVigna, S., & Gentzkow, M. (2019). Uniform pricing in U.S. retail chains, *NBER working paper*, No. 23996.

Diamond, P. A. (1971). A model of price adjustment. *Journal of Economic Theory, 3*(2), 156–168
Dranove, D., & Satterthwaite, M. A. (1992). Monopolistic competition when price and quality are imperfectly observable. *RAND Journal of Economics, 23*(4), 518–534
Efron, B. (1979). Bootstrap methods: Another look at the jackknife. *Annals of Statistics, 7*(1), 1–26
Efron, B., & Tibsharani, J. (1993). *An introduction to the bootstrap*. Chapman and Hall.
Ehrlich, G. (2013). Price and time to sale dynamics in the housing market: The role of incomplete information. mimeo.
Elder, H. W., Zumpano, L. V., & Baryla, E. A. (1999). Buyer search intensity and the role of the residential real estate broker. *Journal of Real Estate Finance and Economics, 18*(3), 351–368
Epple, D. (1987). Hedonic prices and implicit markets: Estimating demand and supply functions for differentiated products. *Journal of Political Economy, 95*(1), 59–80
Epple, D., & Sieg, H. (1999). Estimating equilibrium models of local jurisdictions. *Journal of Political Economy, 107*(4), 645–681
Farrell, J. (1980). A model of price and quality choice, with informed and uninformed buyers. mimeo, Department of Economics, M.I.T.
Gardiner, J., Heisler, J., Kallberg, J., & Liu, C. (2007). The impact of dual agency. *Journal of Real Estate Finance and Economics, 35*(1), 39–55
Genesove, D., & Mayer, C. J. (1997). Equity and time to sale in the real estate market. *American Economic Review, 87*(3), 255–269
Goldberg, P., & Verboven, F. (2001). The evolution of price dispersion in the European car market. *Review of Economic Studies, 68*(4), 811–848
Grennan, M. (2013). Price discrimination and bargaining: Empirical evidence from medical devices. *American Economic Review, 103*(1), 145–177
Haerdle, W., Werwatz, A., Mueller, M., & Sperlich, S. (2004). *Density Estimation*. Springer.
Hanushek, E. A. (1996). Measuring investment in education. *Journal of Economic Perspectives, 10*(4), 9–30
Harding, J. P., Rosenthal, S. S., & Sirmans, C. F. (2003). Estimating bargaining power in the market for existing homes. *Review of Economics and Statistics, 85*(1), 178–188
He, X., Lin, Z., Liu, Y., & Seiler, M. J. (2020). Search benefit in housing markets: An inverted u-shaped price and tom relation. *Real Estate Economics, 48*(3), 772–807
Hitsch, G., Hortacsu, A., & Lin, X. (2019). Prices and promotions in U.S. retail markets: Evidence from big data, *NBER working paper,* No. 26306.
Holmes, C., & Xie, J. (2018). Distortions in real estate transactions with out-of-state participants. *Journal of Real Estate Finance and Economics, 57*(4), 592–617
Ihlanfeldt, K., & Mayock, T. (2012). Information, search, and house prices: Revisited. *Journal of Real Estate Financial Economics, 44*(1), 90–115
Janssen, M. C. W., Moraga-Gonzalez, J. L., & Wildenbeest, M. R. (2005). Truly costly sequential search and oligopolistic pricing. *International Journal of Industrial Organization, 23*(5–6), 451–466
Johnson, K., Lin, Z., & Xie, J. (2015). Dual agent distortions in real estate transactions. *Real Estate Economics, 43*(2), 507–536
Kadiyali, V., Prince, J., & Simon, D. H. (2014). Is dual agency in real estate a cause for concern? *Journal of Real Estate Finance and Economics, 48*(1), 164–195
Kmenta, J., & Gilbert, R. F. (1968). Small sample properties of alternative estimators of seemingly unrelated regressions. *Journal of the American Statistical Association, 63*(324), 1180–1200
Lambson, V. E., McQueen, R. G., & Slade, B. A. (2004). Do out of state buyers pay more for real estate? An examination of anchoring induced bias and search costs". *Real Estate Economics, 32*(1), 85–126
Levitt, S. D., & Syverson, C. (2008). Market distortions when agents are better informed: The value of information in real estate". *Review of Economics and Statistics, 90*(4), 599–611
Ling, D. C., Naranjo, A., & Petrova, M. T. (2018). Search costs, behavioral biases, and information intermediary effects. *Journal of Real Estate Finance and Economics, 57*(1), 114–151
Merlo, A., & Ortalo-Magne, F. (2004). Bargaining over residential real estate: Evidence from England. *Journal of Urban Economics, 56*(2), 192–216
Myer, N. F. C., He, L. T., & Webb, J. R. (1992). Sell-offs of U.S. real estate: The effect of domestic versus foreign buyers on shareholder wealth. *Journal of the American Real Estate and Urban Economics Association,* 20(3), 487–500.
Nechyba, T. J., & Strauss, R. P. (1998). Community choice and local public services: A discrete choice approach. *Regional Science and Urban Economics, 28*(1), 51–73

Northcraft, G. B., & Neale, M. A. (1987). Experts, amateurs, and real estate: An anchoring-and-adjustment perspective on property pricing decisions. *Organizational Behavior and Human Decision Processes, 39*(1), 84–97

Olley, G. S., & Pakes, A. (1996). The dynamics of productivity in the telecommunications equipment industry. *Econometrica, 64*(6), 1263–1297

Robinson, P. M. (1988). Root-n consistent semiparametric regression". *Econometrica, 56*(4), 931–954

Rothschild, M. (1974). Searching for the lowest price when the distribution of prices is unknown. *Journal of Political Economy, 82*(4), 689–711

Rutherford, R., Springer, T., & Yavas, A. (2005). Conflicts between principals and agents: Evidence from residential brokerage. *Journal of Financial Economics, 76*(3), 627–665

Rutherford, R., Springer, T., & Yavas, A. (2007). Evidence of information asymmetries in the market for residential condominiums. *Journal of Real Estate Finance and Economics, 35*(4), 23–38

Salop, S., & Stiglitz, J. (1977). Bargains and ripoffs: A model of monopolistically competitive price dispersion. *Review of Economic Studies, 44*(3), 493–510

Siebert, R. B. (2021). Heterogeneous foreclosure discounts of homes. *Journal of Real Estate Research,* forthcoming.

Sieg, H., Smith, V. K., Banzhaf, H. S., & Walsh, R. (2002). Interjurisdictional housing prices in locational equilibrium. *Journal of Urban Economics, 52*(1), 131–153

Silverman, B. W. (1986). *Density estimation for statistics and data analysis*. Chapman and Hall.

Stigler, G. J. (1961). The economics of information. *Journal of Political Economy, 69*(3), 213–225

Turnbull, G., & Sirmans, C. F. (1993). Information, search, and house prices. *Regional Science and Urban Economics, 23*(4), 545–557

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science, 185*, 1124–1131

Varian, H. (1980). A model of sales. *American Economic Review, 70*(4), 651–659

Watkins, C. (1998). Are new entrants to the residential property market informationally disadvantaged? *Journal of Property Research, 15*(1), 57–70

Yinger, J. (1978). The black-white price differential in housing: Some further evidence. *Land Economics, 54*(2), 187–206

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.