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Under What Circumstances do First-time Homebuyers Overpay? – An Analysis Using Mortgage and Appraisal Data

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April 2018 (revised)
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**Under What Circumstances do First-time Homebuyers Overpay?
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Abstract

We study whether first-time homebuyers overpay for their homes and whether the magnitude of overpayment varies with the diligence of appraisers involved. We present a robust result that first-time homebuyers sort into smaller and cheaper houses, but that once observed and unobserved house characteristics are controlled for, they pay a premium compared to their more experienced counterparts. Our analysis additionally suggests that certain appraisals and appraisers might be able to mitigate this overpayment by inducing downward renegotiation. This research is among the first to contribute both theoretically and empirically to the literature on first-time homebuyers' sales transactions.

Keywords: first-time homebuyer, overpayment, appraisal, appraiser, renegotiation, repeat-sales approach

JEL Classification: C33 · D83 · G21 · G23 · L85 · R3

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1 Introduction

According to the 2016 Profile of Home Buyers and Sellers by the National Association of Realtors (NAR), 35 percent of buyers are first-time homebuyers (FTHBs). In November 2016, the FTHB share stood at 43.6 percent and 81.8 percent of Government-sponsored Enterprise (GSE) purchase loans¹ and Federal Housing Administration loans respectively (Urban Institute Monthly Chartbook (February, 2017)). Given the importance of FTHBs to the U.S. economy² and the importance of homeownership in wealth accumulation (Herbert, McCue, and Sanchez-Moyano, 2013) and consumption (Case, Quigley, and Shiller, 2005), numerous efforts have been made to help FTHBs. Such efforts include providing FTHBs with tax credits as additional incentives for homeownership through legislation.³ They also include the creation of a variety of free financial coaching programs⁴ to strengthen FTHBs' skills in assessing their own abilities to make mortgage payments as well as of programs that provide FTHBs with access to better mortgage terms.⁵

Though extensive research has been conducted on FTHB mortgage choices and consequences related to these policy maneuvers (Heath and Soll, 1996; Tong, 2005; Cheema and Soman, 2006; Van Zandt and Rohe, 2006, 2011; Baker, 2012; Collins, Loibl, Moulton, and Samak, 2013; Dynan, Gayer, and Plotkin, 2013; Harris, Steuerle, and Eng, 2013; Moulton, 2013; Patrabansh, 2013, 2015), little has been done on FTHBs and their real estate transaction outcomes. In particular, the lack of data has resulted in little empirical research.

The purpose of this paper is to extend the literature by investigating the sales prices paid by FTHBs in the residential real estate market. Building upon the existing search model, we provide a theoretical framework in which FTHBs pay rent each period in addition to the search cost. This allows us to analyze their search behavior and outcomes. We assume that houses differ only in quantity and price per unit, both drawn independently and identically from two separate uniform distributions. We derive that for any given quantity, the reservation price for FTHBs is strictly greater than the reservation price for repeat buyers. Therefore we propose that for any given quantity, FTHBs pay a higher average sales price than repeat buyers pay.

¹ First-time homebuyer purchase loans constitute only about 5 percent of GSE mortgage loans overall (Patrabansh, 2013).

² It is particularly important that FTHBs make up a significant share of homebuyers. First-time homebuyers form new households; along with the net gain in the number of houses occupied, a home purchase by a first-time buyer starting from scratch results in more supplementary purchases, such as of appliances or furniture.

³ Such legislations include but are not limited to the Housing and Economic Recovery Act, the American Recovery and Reinvestment Act, and the Worker, Homeownership, and Business Assistance Act.

⁴ The GSEs in particular offer both online education, as well as expanded access to credit to those unable to make a substantial down payment (such as 97% loan-to-value options). This, along with the fact that they buy loans from lenders of all sizes, is what makes them especially relevant to FTHBs.

⁵ Such programs include the Home Affordable Modification Program, the Home Purchase Assistance Program, and the Home Affordable Refinance Program.

Using a novel dataset—one that contains appraisal information (including sales concessions) associated with loan applications submitted to the Enterprises from the fourth quarter of 2012 to the first quarter of 2016—we find supporting evidence for our proposition. Specifically, we find that once we control for observed and unobserved house heterogeneity, FTHBs pay significantly more than their more experienced counterparts.⁶ In other words, they “overpay,”⁷ on average by 1.04 percent, which is not an inconsequential amount particularly when the size and the FTHB share of the residential purchase-money mortgage market are considered. We further include sales concession information and confirm the robustness of this result.⁸

We then investigate whether this overpayment can be mitigated. Once a buyer has applied for a loan, an appraiser is tasked by the lender with valuing the property to determine whether it is worthy collateral. The lender will divide the loan amount by the lesser of the contract price and the appraised value to determine the loan-to-value (LTV) ratio, which will be used to accurately price the loan. Therefore, if the appraiser determines that the appraised value equals or exceeds the contract price, the transaction will move forward. If the appraiser determines that the appraised value is lower than the contract price, the buyer/borrower has two options: increase the down payment or attempt to renegotiate the contract price with the seller. If neither option works out, the borrower will have to face elevated interest rate and mortgage insurance costs as a result of departing the targeted LTV range, and the deal will likely fall through; the buyer may get his or her earnest money back depending on whether there is a proper appraisal contingency in the contract. Thus diligent appraisers—those appraisers who cultivate high accuracy standards—may be able to bring about lower transaction prices by identifying overpayment and thereby possibly inducing renegotiation.

We take two steps to test the above theory. First, we examine whether certain types of appraisals and appraisers are associated with a higher propensity for downward renegotiation. Second, we examine whether downward renegotiation has a strong influence on FTHB overpayment.

In order to conduct our study, we construct a variety of appraisal- and appraiser-level quality or diligence measures.⁹ For example, at the appraisal level, we use public records data to

⁶ We also provide evidence that at first glance, FTHBs pay less than repeat buyers, and that this is driven by the sorting of FTHBs into smaller houses.

⁷ Throughout the paper, we use the term “overpay” to refer to cases where FTHBs pay more for the same house compared to repeat buyers. We use the term “overpayment” to refer to the amount by which they overpay.

⁸ In fact, we incorporate sales concession information throughout our analyses and confirm the robustness of all results.

⁹ There are multiple factors that could influence appraiser diligence. For example, these include the amount of effort appraisers put forth, the amount of skill they possess, whether they view themselves more as validators who are tasked with confirming contract price than as evaluators who must provide objective analyses of the market value of subject properties, and (given that they perceive themselves as objective evaluators) how constrained they are by professional ethics concerns. Our main goal in this paper is not to separate these contributing factors in our quality or diligence

check whether the appraiser failed to flag that the subject property had sold within the three years preceding the appraisal date. If there was such a failure, we flag the appraisal as “*failed_to_find*.” Similarly, we flag an appraisal as “*any_wrong*” if it contains mistakes in at least one of three fields (the number of bathrooms, the number of bedrooms, and the square footage), and as “*exactly*” if the appraisal value matches the contract price. In addition, for each appraisal record we calculate the percentage deviation of the appraisal valuation from the contract price and define it as “*gap_p*.” To the extent that *gap_p* is greater than zero, it reflects the percentage by which the valuation exceeds the contract price—this percentage we refer to as the percentage of “overvaluation.” For the cases in which the valuation does not exceed the contract price by more than six percent, we assign a flag “*ne_super_over*.”

Intuitively, flags for mistakes (*failed_to_find* and *any_wrong*) are direct quality measures and to some extent may reflect the effort or skill of the appraiser. Contract price confirmation (*exactly*) to some extent reflects a combination of effort and attitude because the confirmation of contract price takes less cognitive effort and, for cases in which the real value is lower than the contract price, imposes a higher ethical cost—appraisers are incentivized to confirm the contract price because it increases the chances of the deal going through. Thus, “better” appraisers would confirm the contract price with a lower frequency than do other appraisers and appraisals with higher quality would be less likely to be associated with contract price confirmation. This variation in appraisal quality in some cases might mean the difference between a FTHB overpaying and not overpaying for a home.

We then collapse the data to the appraiser level and calculate the averages of these quality measures for each appraiser. We assign flags where the averages exceed certain thresholds (e.g., *often_failed_to_find* equals one if the average of *failed_to_find* is greater than 0.02—i.e., if the appraiser failed to find prior sales in more than two percent of cases) and attach an appraiser’s averages and flags to each of her appraisal records; altogether we construct *often_ff*, *often_anywrong*, *often_exact* and *appraiser_avg_gap*. Thus, in our primary analysis dataset, each appraisal record includes house characteristics and appraisal quality flags, as well as appraiser quality averages and flags.

Finally, we flag cases associated with downward renegotiation. We employ both public and appraisal records and track changes in the contract price as well as the deviation of the final contract price from the final sales price. Despite significant sorting—houses with higher contract prices are more likely to experience downward renegotiation—we find that appraisers prone to making mistakes, confirming the contract price, and/or generally overvaluing the property significantly reduce the probability of downward renegotiation and thus the probability of the buyer getting a better deal. However, though appraisal-level flags confirm, as we expected, that

measures but rather focus on quality/diligence overall. We use the term “quality” and “diligence” interchangeably throughout the paper, often using “quality” at an *appraisal* level and “diligence” at an *appraiser* level.

diligent appraisers are associated with greater chances of downward renegotiation, we found confounding results on the indicators of mistakes—higher quality at the *appraisal* level overall in fact decreases the chances of downward renegotiation, whereas at the *appraiser* level it increases the chances of the same (but insignificantly). Thus, we find only suggestive evidence that appraisers less prone to mistakes, confirmation, and/or overvaluation can help induce a higher probability of downward renegotiation.

We then predict whether downward renegotiation will take place for each transaction based on appraisal and appraiser characteristics, house attributes, and controls for time and cross-sectional effects. We test whether a significant negative relationship exists between this predicted probability of downward renegotiation and the log(sales price), controlling for cross-sectional differences, time trends, local house price appreciation, etc. We find that the predicted probability of downward renegotiation is significantly correlated with lesser overpayment and that this correlation does not differentiate between first-time and repeat homebuyers.

One caveat in our research lies in the factors that drive downward renegotiation. It is possible that downward renegotiation is driven by factors that we do not observe in our dataset—for example, differences in the skills and strategies of the associated real estate agents. Measurement of any appraiser “effects” may be confounding if agent behavior is correlated with the types of appraisers employed—if, for instance, more conservative appraisers (i.e., those more prone to flagging overpayment) tend to be paired with less experienced agents (e.g., agents less inclined to advise renegotiation). Because of this and other issues, further research on the channel through which appraisers and appraisals may mitigate FTHB overpayment is certainly warranted.

Additional caveats in our research lie in the definition of “first-time homebuyer” and in the fact that we do not observe cash transactions in our dataset. Regarding the former, as Patrabanish (2013) points out, the GSEs define a FTHB as an individual who had no ownership interest in a residential property in the three years preceding the purchase date. The data we rely on employ the GSEs’ definition, which is obviously not ideal; optimally, we would flag someone as a FTHB if this person has never purchased a house before. This leads to overestimates of the real FTHB share as well as of the level of experience of the average FTHB. Regarding the latter, experienced buyers may be wealthier and therefore more likely to finance their purchase through cash, which yields a discount compared to financing through a mortgage. Since we do not observe cash transactions, our results underestimate how much FTHBs overpay compared to repeat buyers in the general population. Thus, due to the reasons mentioned above, all our estimates might be viewed as lower-bound estimates of the actual statistical relationships.

It is also worth pointing out that our paper does not speak to asymmetric information in credit markets, i.e., FTHB overpayment in our context only accounts for transaction overpayment and

not overpayment in interest. To the extent that FTHBs overpay in credit markets as well, the overpayment we estimate is a lower bound of the overall FTHB overpayment.

The remainder of this paper is organized as follows. In Section 2, we briefly review the literature. We propose and analyze the model in Section 3 and introduce a unique dataset in Section 4. In Section 5, we test the theoretical proposition that FTHBs overpay and present empirical evidence. In Section 6, we investigate possible overpayment mitigation. Finally, Section 7 provides our conclusions.

2 Literature Review

There is rich theoretical and empirical literature on the seller's search. However, on the buyer's side, there is little theoretical research and even less empirical research due to the lack of data on buyer's search duration, let alone empirical research focusing on FTHBs. Only a few studies focus on FTHBs, and most of these concentrate on their mortgage outcomes and on the effectiveness of programs that promote homeownership.

We begin this section by reviewing studies related to FTHBs, with topics such as mortgage outcomes, neighborhood choices, and the traits that separate these buyers from repeat buyers. We then follow up a brief discussion of the research on homeownership-promotion programs with an overview of the few general buyer search models upon which we base our model. Finally, though we use appraisal data to study a topic that differs from the traditional topics in appraisal literature (these include valuation, information loss, and appraiser compensation), we highlight the main takeaways from these topics.

2.1 First-Time Homebuyers

First-time homebuyers are often low- and middle-income (LMI) homebuyers. Thus much of the literature on LMI homebuyers is relevant for our purposes. Prior studies suggest that LMI homebuyers are more myopic and less skilled with long-term financial decisions in that they often overestimate their own borrowing capacities and underestimate their own mortgage debt (Heath and Soll, 1996; Cheema and Soman, 2006; Van Zandt and Rohe, 2006, 2011). Collin, Loibl, Moulton, and Samak (2013) use data collected from a field experiment of financial planning interventions specifically for LMI FTHBs and find that they are generally overconfident about their finances, which leads to significantly less take-up of financial coaching. They are likely to underestimate their non-mortgage debt and consequently take out large mortgages relative to their income.

Van Zandt and Rohe (2006) employ survey data from the Neighborhood Reinvestment Corporation's Homeownership Pilot Program (which aimed to help first-time LMI buyers) to assess whether such buyers are able to access better quality neighborhoods. Their results indicate that LMI buyers tend to purchase in neighborhoods similar to those in which they rented, whereas continuing renters tend to upgrade to neighborhoods with better quality. In addition, they found that the neighborhoods to which LMI buyers relocate tend to experience slower quality improvement overtime than do other neighborhoods.

First-time homebuyers are different from repeat buyers in many aspects aside from their inflated perceptions of their own borrowing capacities and their conservative neighborhood choices. In addition to lower incomes, FTHBs on average have lower credit scores and higher LTV and debt-to-income (DTI) ratios. They are younger than repeat homebuyers are. The properties they purchase are usually less costly than the properties purchased by repeat buyers (Patrabansh (2013)). Research has found these differences in borrower characteristics to be good explanations for the differences in the default probabilities between first-time and repeat homebuyers (Patrabansh (2015)).

The focus of this study is different from those of previous studies on FTHBs in that we study the relationship between FTHBs and sales price.

2.2 Homeownership Promotion Programs

Despite the debate on the causal relationship between homeownership and household wealth gain (e.g., Engelhardt, 1995; Herbert, McCue, and Sanchez-Moyano, 2013), homeownership is widely believed to be an effective way to increase household wealth and consumption (Case, Quigley, and Shiller, 2005). This belief has led to a number of policy programs aiming to foster homeownership with monetary incentives such as tax credits or mortgage interest rate reductions. Many researchers have assessed such programs (especially tax credit programs) and have developed disparate views of their effectiveness.

Tong (2005) analyzes the District of Columbia First-Time Homebuyer Individual Income Tax Credit program and concludes that the program is effective in increasing homeownership for the targeted population and broadens the District's tax base. However, Baker (2012) argues that the FTHB credit in the 2009 national stimulus package (the American Recovery and Reinvestment Act) was launched when the housing bubble had not fully deflated, thus incentivizing people to buy too early and therefore pay too much. The study further argues that the credit only temporarily delayed the adjustment process and was merely a redistribution of loss from existing homeowners and mortgage borrowers to their new counterparts and to the government. In the middle ground, Dynan, Gayer, and Plotkin (2013) examine nation- and state-level homebuyer tax credit programs. Their results indicate that the American Recovery and Reinvestment Act and Worker,

Homeownership, and Business Assistance Act homebuyer tax credit programs provided a modest but partially reversible boost to home sales and home prices.

Some researchers propose alternative policies and argue that these policies are at least as theoretically well-founded and transparent as the current policy. Harris, Steuerle, and Eng (2013) analyze the economic effects of three proposed tax reforms: a FTHB tax credit, a refundable tax credit for property taxes paid, and an annual flat tax credit for homeowners. They find that these reforms would provide greater incentives for wealth accumulation than the current policy does through mortgage interest rate reductions. Moulton (2013) suggests that such programs should be designed and tailored at state level, as evidenced by the better performance of state Housing Finance Agency loans.

2.3 Buyer Search Literature

Despite the relative scarcity of empirical buyer-side search literature, a consensus exists that FTHBs are relatively inexperienced, and that in real estate transactions, inexperienced consumers tend to have higher search costs and end up paying a premium and/or search for longer.

Consistent with the theoretical literature (Yinger, 1981; Wheaton, 1990; Yavas, 1992; Munneke and Yavas, 2001; Rutherford, Springer, and Yavas, 2005; Genesove and Han, 2012), Lambson, McQueen, and Slade (2004) find that out-of-state buyers tend to pay a premium for real estate compared to their in-state counterparts and that this premium is possibly driven by haste, high search costs, and/or an anchoring effect. Lacking a better source, researchers generally use survey data to study buyer search duration. Employing survey data described in Anglin (1994), Anglin (1997) estimates buyer search duration in terms of time and number of houses and concludes that though the results generally support the existence of a buyer trade-off between time and sales price, many important variables are needed to refine the buyer search model and to produce a better estimate. Barylal and Zumpano (1995) use a cross-section subsample from the 1987 National Association of Realtors (NAR) National Homebuyer Survey to examine buyer search durations with and without brokers' assistance. They find that on average, broker-assisted searches takes less time than self-directed search for all types of buyers—first-time, repeat, or out-of-town. On average, first-time and out-of-town buyers search longer than repeat and local buyers. Barylal, Zumpano and Elder (2000) rely on NAR 1988, 1991, and 1993 survey data and find that broker-assisted searches have a higher probability of resulting in a home being found compared to self-conducted searches.

2.4 Research on Appraisals and Appraisers

Because we employ GSE appraisal data as well as appraisal and appraiser attributes, it is worthwhile to highlight briefly which topics have been studied in the area of residential real estate appraisals and the main findings of these studies.

The use of appraisals in the residential lending process raises many concerns. One concern is that the current institutional incentives (including inadequate appraisal regulation) feed biased and self-serving appraisals (Lentz and Wang, 1998; Murray, 2010). Murray (2010) calls attention to the practice of inflating appraisals, a key factor in the last two financial crises, and the reason behind it: self-interested parties tend to use the insecurity of future business to pressure appraisers.

In addition, Diaz III (1989) studies the behavior of expert appraisers in particular, showing that they deviate significantly from the prescribed appraisal processes, and that clients pressure appraisers to validate the contract price rather than provide an objective opinion of the property's market value (Appraisal Institute, 1997; Smolen and Hambleton, 1997; Wolverton and Gallimore, 1999). Wolverton and Gallimore (1999) suggest that client feedback can significantly affect appraisers' perceptions of their own role in the loan underwriting process. They show that coercive feedback reinforces appraisers' perceptions of themselves as price validators, whereas reiteration of "normative performance criterion" (appraisers' normative goal of estimating market value highlighted in formal training) reinforces appraisers' perceptions of themselves as independent evaluators. Baum et al. (2002) use qualitative interview survey evidence of leading U.K. property managers and owners and their appraisers to show that a significant number of appraisals are unable to reflect some price-sensitive information due to the lack of such information, the lack of appraiser effort in searching for such information, and/or institutional stress that prevents appraisers from searching. Their results show that appraisals are smooth and lag the true levels of price.

Two recent papers expressed concerns about appraisal information loss and property overvaluation. Calem, Lambie-Hanson, and Nakamura (2015) present evidence that appraisals are subject to information loss and that such loss is more common at LTV notches and is associated with higher mortgage default risk. They argue that appraisals sometimes are less informative than automated valuation models and this leads to a lower likelihood of renegotiation and therefore to buyers paying more than they need to pay. Fout and Yao (2016) employ Fannie Mae appraisal data from September 2011 to August 2012 in order to show that a low appraisal dramatically increases the probability of buyer renegotiation and only slightly increases the probability of the contract being delayed or cancelled. They also show that low appraisals are associated with a lack of available comparable properties, forcing the appraisers involved to rely on properties with dissimilar characteristics and on distressed sales. They estimate that low appraisals on average decreased home prices by 0.2 percent and transaction volume by 0.3 percent.

Aside from doubting the objectivity of appraisals and questioning the underlying institutional settings, researchers are dissatisfied with the current situation in which the comparable sales approach remains central to the practice of appraising residential real estate (Jenkins et al., 1999), when in fact many different valuation methods can be used (Pagourtzi, Assimakopoulos, Hatzichristos, and French, 2003; Lins, Novaes, and Legey, 2005).

3 Baseline Model

We develop a standard discrete-time buyer-side search model, built upon the classic search-theoretic models from the labor literature (Rogerson, Shimer, and Wright (2005) provide a detailed review) and the real estate search literature (Yinger, 1981; Wheaton, 1990; Yavas, 1992; Munneke and Yavas, 2001; Rutherford, Springer, and Yavas, 2005; Genesove and Han, 2012; Albrecht, Gautier, and Vroman, 2016).

To keep the analysis simple, we assume that houses only differ in quantity q and price per unit p , and that there are only two types of risk-neutral buyers,¹⁰ first-time and repeat. At the beginning of each period, the buyer pays a fixed search cost $c > 0$ to visit a house with a price per unit p drawn independently and identically from distribution $G(p)$ and a quantity q drawn independently and identically from distribution $H(q)$. For the sake of simplicity, we assume uniform distributions for both $[p, \bar{p}]$ and $[q, \bar{q}]$, respectively. The buyer decides whether she wants to buy this house or continue to search. In the event that the buyer continues to search in the next period, she will pay rent $r > 0$ in addition to the search cost if she is a FTHB; if she is a repeat buyer, she continues to live in her home and does not pay any additional cost ($r = 0$). This assumption simplifies the model without changing the qualitative results.¹¹

The buyer's maximization problem can be represented with the following equations:

$$U_b = V(q) - p * q \tag{1}$$

and

$$U_s = \frac{1}{1+\delta} * (\iint \max\{U_b, U_s\}dG(p)dH(q) - c - r). \tag{2}$$

where U_b is the utility to the buyer if she buys the house at price p , $\frac{1}{1+\delta}$ is the discount factor, $V(q)$ is concave and increasing in q , and U_s is the utility to the buyer if she decides to search. The problem can also be rewritten as

$$U_b = U(p, q) \tag{3}$$

¹⁰ Note that the results would continue to hold for risk-averse buyers.

¹¹ In reality, repeat buyers do pay maintenance fees and property taxes for their houses. Our results hold as long as the rents for the FTHBs are higher than the fees and taxes for the repeat buyers.

and

$$U_S = \frac{1}{1+\delta} * (\int \max\{U_b, U_S\} dF(U(p, q)) - c - r). \quad (4)$$

where $F(U)$ is the cumulative distribution function of U based on p and q . There exists a unique U_r such that the buyer purchases the house if $U(p, q) \geq U_r$, and does not purchase the house if $U(p, q) < U_r$. Equivalently, for any given q , there exists a unique $p_r = \frac{V(q) - U_r}{q}$ such that the buyer purchases the house if $p \leq p_r$, and does not purchase the house if $p > p_r$.

The intuition is as follows. If houses are homogenous in q and the buyer observes the lowest possible price per unit (i.e., \underline{p}) in the current period, the expected cost of continued search is strictly larger than the expected gain even if the lowest possible price per unit will be drawn again in the next period. Therefore the buyer should purchase immediately. Similarly, if the buyer observes the highest possible price per unit (i.e., \bar{p}) in the current period, the expected cost of continued search is strictly smaller than the expected gain in the next period, given that p is drawn randomly and if $c + r$ is low enough.

Lemma 1: If searching is more costly for FTHBs than it is for repeat buyers (i.e., $r > 0$), for any given q , the reservation price per unit for FTHBs is strictly greater than the reservation price per unit for repeat buyers.

The Lemma implies the following proposition.

Proposition 1: For any given q , the average sales price, $\int_{\underline{p}}^{p_r} p * q dG(p)$, is higher for FTHBs than it is for repeat buyers.

Proposition 1 implies that for a given property, a FTHB pays more than a repeat buyer pays.

4 Data

The data used to study the relationship between FTHBs and transaction prices come from the Uniform Appraisal Dataset, gathered by the Enterprises through the Uniform Collateral Data Portal. The dataset consists of active appraisal records associated with loan applications submitted to Fannie Mae from the last quarter of 2012 to the first quarter of 2016 and to Freddie Mac from the second quarter of 2012 to the second quarter of 2016. For subject properties, the dataset contains flags for short sales and foreclosures in addition to detailed information on the contract

(including on any sales concessions), the appraiser certification, and the neighborhood. For both subject and comparable properties,¹² it includes a wide range of house characteristics.

Though the focus of our analysis is on appraisals associated with mortgages used to buy properties (known as purchase-money mortgages), at an early stage we employ Uniform Appraisal Dataset records associated with both purchase-money and refinance mortgages to calculate appraisal and appraiser characteristics. At a later stage, we exclude from the sample comparable sales records as well as appraisal records associated with refinance mortgages.

In the following subsections, we briefly discuss our strategy for identifying purchase-money mortgage-based appraisals, the approaches used to calculate appraisal and appraiser characteristics, and the summary statistics.

4.1 Appraisal Process and Mortgage Outcome Data

We identify an appraisal record as pertaining to a purchase-money mortgage if its contract price is not missing. This identification strategy is well-founded—the common practice in purchase-money mortgage-based appraisals is for appraisers to receive the sales contract and document the contract price,¹³ whereas this is not the case in refinance-based appraisals.

Employing a separate dataset of loan-level data obtained from the Enterprises, we attach to each appraisal record loan outcomes information as well as various loan attributes, such as FTHB status, the LTV ratio, and the borrower credit score. We also attach to each record Federal Housing Finance Agency monthly ZIP Code-level House Price Indices (HPI), merging by appraisal date and ZIP Code.

¹² Comparable properties are chosen and documented by appraisers in the Sales Comparison Approach section of the Uniform Residential Appraisal Report. In the Uniform Appraisal Dataset, for each comparable sale a record containing its documentation is linked to its corresponding subject property record. In our sample there are on average 5.16 comparable sales for every subject record. Unless we specifically refer to comparable sales, we use the term “appraisal record” to refer to the subject property record.

¹³ There is an ongoing debate on the prudence of the common practice in the appraisal industry for appraisers to receive the property sales contract prior to appraisal. The main argument for this practice, supported by the Uniform Residential Appraisal Report guidelines, is that the contract price and the sales concession associated with it reflect the buyer’s willingness to pay and thus the property’s market price, conceivably important information for an appraiser to take into account when conducting analysis. The main argument against providing the contract price to appraisers is that knowledge of the contract price might bias the appraiser’s judgment and consequently the appraisal value of the property.

4.2 Creating Appraisal and Appraiser “Quality” Flags

After restricting the sample to purchase money mortgage appraisals,¹⁴ we create multiple appraisal quality flags. We briefly discuss the approaches used to create the flags in this subsection.

In the Uniform Residential Appraisal Report, appraisers are required to document property attributes for subject and comparable properties, as well as appraisal approaches adopted. Our mistake indicator, *any_wrong*, reflects whether the appraisal contains a mistake in property features. We construct this indicator by tracking property attributes as documented for the same property by various appraisals (including appraisals where the property is in the role of comparable sale) over time and identifying typos and mistakes particularly in the fields of number of bathrooms, number of bedrooms, and square footage. We set *any_wrong* to one if the appraisal contains a mistake in any of these three fields.¹⁵

Appraisers are also required to answer specific questions about their research in the appraisal report. Two such questions ask: 1) whether the appraiser has thoroughly researched the history of the subject property and 2) whether she has found for the subject property any transactions information pertaining to the three years prior to the appraisal. To determine whether the appraisal contains a mistake in property history, we conduct an independent research of sales history; our findings are reflected in the second mistake indicator, *failed_to_find*. For each appraisal record, we attach the sales date (from public records) of the most recent previous transaction of the same property. If this sales date lies within the three years preceding the appraisal date, we flag the appraisal record. We then set *failed_to_find* to one for all appraisal records that are flagged in this way and also possess a flag indicating that the appraiser did not find any transactions information pertaining to the previous three years.

We create another two variables as additional appraisal quality measures: *exactly_flag* and *ne_super_over*. These measures are used to analyze the appraised value in comparison with the contract price. Specifically, they are functions of the percentage difference between the appraised value and the contract price. If the percentage difference, “*gap_p*,” is zero (i.e., the appraised value is equal to the contract price), then the *exactly_flag* variable is set equal to one. Otherwise,

¹⁴ We also exclude appraisals associated with short sales or purchases of foreclosed properties.

¹⁵ We compare the value for a given field to the values for that field in the appraisals associated with the directly preceding and subsequent transactions of the subject property. For example, if the reported number of bathrooms for a subject property is one, but preceding and subsequent appraisals indicated that the number exceeded one, we flag the appraisal as having a mistake in the number of bathrooms. An older version of this paper used a less conservative method to determine if a given field contains a mistake; the change does not materially affect our results.

it is equal to zero. The *ne_super_over* variable is an indicator that is set equal to one if the appraised value is less than six percent or more above the contract price.¹⁶

To establish a crude measurement that might be indicative of appraiser “quality,” we then collapse these data to the appraiser level. In particular, we construct *appraiser_avg_gap*, *often_ff*, *often_exact*, and *often_anywrong*. We define an appraiser *often_ff* (“often fails to find”) if she failed to find one or more prior sales within the three years preceding the appraisal date in more than 2 percent of her average number of appraisals per year, *often_exact* (“often exact”) if she confirmed the contract price for more 20 percent of these, and *often_anywrong* (“often has any wrong”) if, in 2 percent or more of her average annual appraisals, she made a mistake in one or more of the following property attributes: square footage, the number of bathrooms, and the number of bedrooms. For each appraiser, we attach this set of quality indicators to each of her appraisals.

4.3 Summary Statistics

Finally, we refine our sample of purchase-money mortgage-related appraisals by excluding records with certain data anomalies and use this refined sample in conjunction with a set of historical transaction records to construct the repeated sales transaction sample.¹⁷ We then restrict the sample to observations with non-missing FTHB flags.¹⁸ We define this as the “full sample.” We define a “main sample” that consists of the “full sample” restricted to records associated with appraisers whose average number of appraisals per year exceeds 20. Because our sample only includes Enterprise appraisals, the restriction puts a minimum on the number of Enterprise-submitted appraisals per year. While the full sample includes part-time and full-time appraisers, the main sample contains only appraisals done by full-time appraisers. We focus on full-time appraisers so that we have a sufficient number of observations for a given appraiser to derive a reliable measure of the work quality.

Exhibits 1.1 – 1.3 present the summary statistics for the main sample. Among all the appraisals in the main sample, 41.19 percent are associated with FTHBs and 5.72 percent are linked to downward renegotiation. There are 1.35 percent with a positive *failed_to_find* flag, indicating that the appraiser failed to find one or more prior sales that took place within the three years

¹⁶ These quality measures even together may not comprehensively assess the quality of appraisals or appraisers—they are not necessarily indicative of bad appraisals or appraisers. However, we believe they are at least suggestive of quality failures.

¹⁷ We identify houses that have been sold at least twice and calculate their demeaned sales price by subtracting time trends and time-invariant house attributes.

¹⁸ We employ county recorder data to find the relevant sales prices for appraisal records. In total, 63 percent of the purchase-money mortgage appraisals in our sample result in a regular sale. The absence of a sales price does not necessarily indicate that the appraisal did not result in a sale. To the extent that the data we employ are not comprehensive (i.e., do not include every relevant transaction), the unmatched 37 percent is an overestimate of appraisals that did not result in a sale.

preceding the appraisal date. About 1.66 percent have a positive *any_wrong* flag, indicating that the appraiser submitted incorrect information on square footage or the number of bathrooms or bedrooms. About 29 percent have a positive *exactly_flag*, indicating that the appraisal value exactly equals the contract price and 98.7 percent have a valuation “not super over” the contract price (i.e., no more than 6 percent above the contract price). Among all appraisal records, 37.67 percent are associated with positive sales concessions—as negative concessions are rare to the extent of being negligible, appearing to be the result of errors in entry, the remaining records are not associated with sales concessions. About 45 percent of the FTHBs in our sample are associated with positive sales concessions, with an average of \$5,020, compared to 32.65 percent of repeat buyers with an average of \$4,853. Exhibit 1.2 shows the summary statistics of house attributes, transaction price, and borrower characteristics. The main sample comprises 1,743,309 appraisals. The average appraised property in the sample is contracted for \$275,187, appraised for \$279,829, and sold for \$275,021. It is about 16 years old and has around 1,813 square feet, three bedrooms, and two bathrooms. The typical borrower in the sample has a credit score of 749; the average (original) LTV is 83 percent.

Next, we collapse the data to the appraiser level and present summary statistics across all appraisers in Exhibit 1.3. The typical appraiser completes about 99 appraisals each year (taking the full years of our sample, 2013 – 2015) and has completed in total 413 appraisals over all years of the sample. She employs on average 5.2 comparable sales for each appraisal and tends to appraise at 2.50 percent higher than the contract price. For every 100 appraised properties, she appraises 11 properties at exactly their contract prices, fails to find prior sales information for one of them, and for 25 submits incorrect information on at least one field among the number of bathrooms, the number of bedrooms, and the square footage.

Exhibit 1.1: Distribution of Loan-, Appraisal-, and Appraiser-Related Characteristics, Main Sample

<i>Fthb</i>		<i>Often_ff</i>	
First-time homebuyer (%)	41.19	Appraiser often fails to find (%)	17.80
Repeat buyer (%)	58.81	Appraiser does not often fail to find (%)	82.20
N	1,743,309	N	1,743,309
<i>Failed_to_find</i>		<i>Often_anywrong</i>	
Failed to find prior sale(s) (%)	1.35	Appraiser prone to mistakes (%)	14.71
Did not fail to find prior sale(s) (%)	98.65	Appraiser not prone to mistakes (%)	85.29
N	1,743,309	N	1,743,309
		<i>Often_exact</i>	
<i>Any_wrong</i>		Appraiser often confirms CP (%)	18.2
Mistakes in # of baths, bdrms, or sqft (%)	1.66	Appraiser does not often confirm CP (%)	81.8
No mistakes in any above category (%)	98.34	N	1,743,309
N	1,743,309		
		<i>Appraiser_avg_gap (= avg((Val - CP)/CP))</i>	
<i>Exactly_flag</i>		Quartile 1 (least overvaluation) (%)	25.10
Valuation at contract price (%)	28.97	Quartile 2 (%)	25.06
Valuation not at contract price (%)	71.03	Quartile 3 (%)	24.99
N	1,743,309	Quartile 4 (most overvaluation) (%)	24.85
		N	1,743,309
<i>Ne_super_over</i>		<i>Concession</i>	
Valuation Not > 6% above CP (%)	98.70	Sales concession (%)	37.67
Valuation > 6% above CP (%)	1.30	No sales concession (%)	62.33
N	1,743,309	N	1,743,309
		Sales concession among FTHB (%)	44.84
<i>Reneg_down</i>		Absence of sales concession among FTHB (%)	55.16
Downward renegotiation (%)	5.72	N	718,115
No downward renegotiation (%)	94.28	Sales concession among repeat buyers (%)	32.65
N	1,743,309	Absence of sales concession among repeat buyers (%)	67.35
		N	1,025,194

Notes: Exhibit 1.1 reports the total counts and distributions of loan, appraiser-, and appraisal-related characteristics/quality measures. Each observation corresponds to a single appraisal record in the main sample (which is restricted to appraisals associated with appraisers who have performed at least 20 appraisals per year on average), or, in the case of sales concession, in first-time and repeat buyer subsets of the main sample. Each characteristic is listed as a bolded categorical variable followed by its values. For dummy variables, the positive cases are always listed first. “Val” represents appraisal value, “CP” stands for contract price, and “FTHB” stands for first-time homebuyer.

Exhibit 1.2: House Attributes, Prices, and Borrower Characteristics, Main Sample

Variables	N	Mean	SD	Min	Max
Sales Price	1,743,309	275,021	158,506	13,800	999,999
Log(Sales Price)	1,743,309	12.4	0.565	9.53	13.8
Contract Price	1,743,309	275,187	158,641	50,000	1,150,000
Square Footage	1,743,309	1,813	680	500	9,811
Number of Bathrooms	1,743,309	1.88	0.64	0.1	6.3
Number of Bedrooms	1,743,309	3.177	0.750	1	10
Valuation	1,743,309	279,829	159,658	30,000	1,550,000
Age of the House	1,743,309	15.8	9.841	0	180
Credit Score	1,742,309	749	43.8	465	839
LTV	1,743,309	0.829	0.13	0	1.23
Non-zero Sales Concession	656,750	4,935	8,023	100	600,000
Non-zero Sales Concession for FTHBs	321,986	5,020	8,531	100	500,000
Non-zero Sales Concession for Repeat Buyers	334,764	4,853	7,501	100	600,000

Notes: Exhibit 1.2 reports the summary statistics of house attributes, borrower characteristics, and transaction outcomes. Each observation corresponds to a single appraisal record in the main sample. “Valuation” indicates the appraisal value derived using the comparable sales approach. Stats for all sales concession variables are constructed based on positive sales concession amounts.

Exhibit 1.3: Appraiser Characteristics, Collapsed from the Main Sample

Variable	Description	N	Mean	SD	Min	Max
Avg_comps_id	Average number of comparables employed	37,716	5.16	0.999	2.46	11.022
Avg_failed_to_f	Average propensity for failing to find a prior sale of the property	37,716	0.011	0.015	0	0.242
Avg_exactly	Average propensity for valuing property exactly at contract price	37,716	0.112	0.081	0	0.686
Avg_anywrong	Average propensity for incorrectly documenting number of bathrooms, bedrooms, or square footage	37,716	0.013	0.014	0	0.342
Avg_ne_super_over	Average propensity for valuing property at less than 6% above contract price	37,716	0.990	0.016	0.692	1
Avg_ann_apps	Average number of appraisals performed per year, over the full years 2013 – 2015	37,716	99.4	79.9	20	603
Often_ff	Equal to 1 when average of appraiser's failed_to_find flags > 0.02	37,716	0.187	0.390	0	1
Often_exact	Equal to 1 when average of appraiser's exactly_flag flags > 0.20	37,716	0.137	0.344	0	1
Often_anywrong	Equal to 1 when average of appraiser's any_wrong flags > 0.02	37,716	0.180	0.384	0	1
Appraiser_avg_gap	Average percentage gap between valuation of property and its contract price [(Val - CP)/CP]	37,716	0.025	0.022	-0.250	0.437
Tot_appraisals	Total number of appraisals performed in sample overall	37,716	413	349	20	3,273

Notes: Exhibit 1.3 reports the summary statistics of appraiser characteristics for appraisers who have performed at least 20 appraisals per year on average. Each observation corresponds to a single appraiser in the dataset that is collapsed from the main sample to the appraiser level.

5 Empirical Analysis

In this section, we test the theoretical proposition derived from the model that FTHBs pay more than repeat buyers for a given house. We first show that FTHBs, compared to repeat buyers, sort into smaller houses. After controlling for sorting, we find strong evidence that FTHBs pay more than repeat buyers. We use the main sample to derive benchmark results and we additionally incorporate sales concession information in our analysis to confirm that our results are robust to concessions.¹⁹

5.1 FTHB Sorting

We begin with a straightforward hedonic house price regression with a FTHB indicator variable. The regression takes the following form:

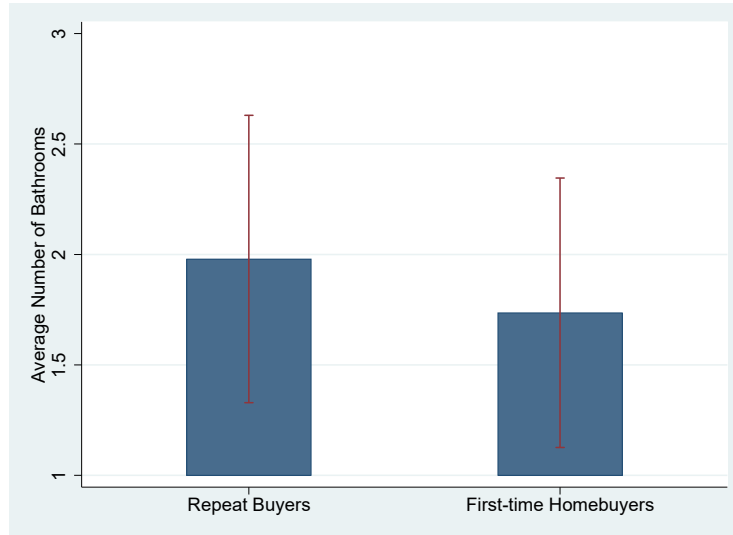
$$\ln(sp)_{izt} = \beta_{FTHB} * FTHB_{izt} + X'_{izt}\alpha + \kappa_{zt} + \sigma_{izt} + c \quad (5)$$

where $\ln(sp)_{izt}$ is the log(sales price) of property i in ZIP Code z and year-quarter t ; β_{FTHB} is the parameter of interest; $FTHB_{izt}$ is the dummy variable indicating whether house i in ZIP Code z was sold to a FTHB at time t ; X_{izt} is a set of basic house characteristics (the square footage, the age of the house, and the number of bedrooms and bathrooms) attributed to property i ; α is a vector of coefficients corresponding to each house characteristic; κ_{zt} are ZIP Code-year-quarter interacted fixed effects; σ_{izt} are the error terms; and c is the constant term.

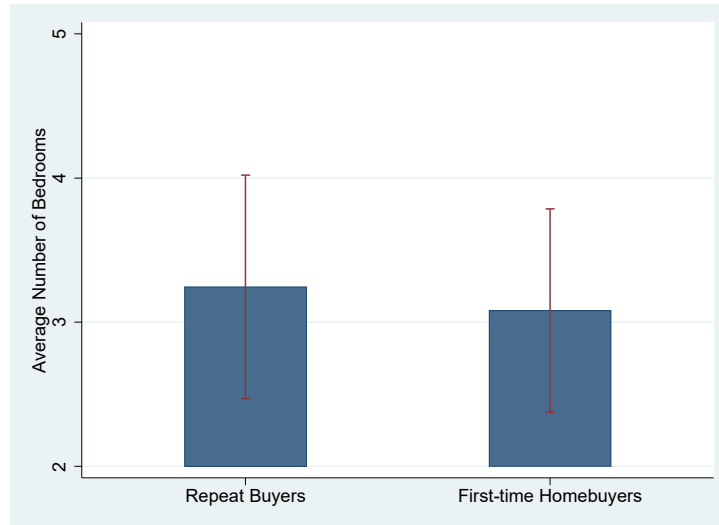
¹⁹ Because our results are indeed robust, we report only benchmark results in this paper.

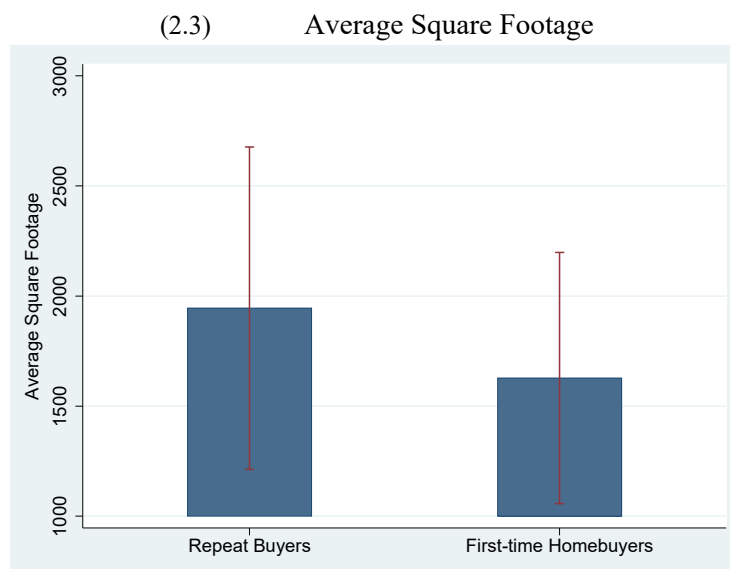
Exhibit 2: Housing Characteristics by Type of Homebuyer

(2.1) Average Number of Bathrooms



(2.2) Average Number of Bedrooms





Notes: Exhibits 2.1 – 2.3 plot average house characteristics for repeat and FTHBs. The lines show one standard deviation from the average. As shown by the figures, FTHBs on average “consume” less of each of the house characteristics.

Column 1 in Exhibit 3 shows that there is a significant negative correlation between *FTHB* and $\log(\text{sales price})$ that is driven by FTHBs sorting into smaller houses with fewer bedrooms and bathrooms (Exhibits 2.1 – 2.3). To take sorting into account, we control for observed house attributes and ZIP Code-year-quarter interacted fixed effects in Exhibit 3, columns 2 and 3. The magnitude of sorting decreases but the effect persists. Thus, we find strong evidence that compared to repeat buyers, FTHBs purchase smaller houses with fewer bedrooms and bathrooms.²⁰

²⁰ Consistent with our model, we rank all houses from better to worse based on the single dimension of size.

Exhibit 3: First-time Homebuyers and Sorting			
Dependent Variable: Log(Sales Price)			
	(1)	(2)	(3)
Fthb	-0.150*** (0.000868)	-0.154*** (0.00128)	-0.0538*** (0.000717)
Constant	12.42*** (0.000553)	12.43*** (0.000529)	12.13*** (0.00153)
Controls:			
House Attributes			X
Zip-Year-Quarter FE		X	X
Observations	1,743,309	1,743,309	1,743,309
R-squared	0.017	0.619	0.801
Adjusted R-squared	0.017	0.613	0.797

Notes: This table reports OLS regression results. Each observation corresponds to a single appraisal record in the main sample. Column 2 controls for zip-year-quarter interacted fixed effects. Column 3 additionally controls for house attributes (the number of bathrooms, the number of bedrooms, the square footage, and the age of the house). A robustness check using the sales price net of sales concessions can be found in Appendix Exhibit 1. Significance levels at the 1%, 5%, and 10% are denoted respectively by ***, **, and *.

5.2 FTHB Overpayment

As the effect is conceivably due to sorting on unobserved time-invariant house characteristics, we must control for house fixed effects. The regression takes the following form:

$$\text{Ln}(sp)_{izt} = \beta_{FTHB} * FTHB_{izt} + X'_{izt} \alpha + h_{iz} + \gamma_t + \sigma_{itz} + c \quad (6)$$

As our sample is quite large, for computational efficiency we take the within form transformation (i.e., demean both house FEs and year-quarter FEs). Specifically, define the unit-specific average for unit i as

$$\overline{\text{Ln}(sp)}_{izt} = \frac{1}{T} \sum_{t=1}^T \text{Ln}(sp)_{izt}, \overline{FTHB}_{izt} = \frac{1}{T} \sum_{t=1}^T FTHB_{izt}, \overline{X}_{izt} = \frac{1}{T} \sum_{t=1}^T X_{izt},$$

$$\overline{h}_{iz} = \frac{1}{T} \sum_{t=1}^T h_{iz} = h_{iz}, \overline{\gamma}_t = \frac{1}{T} \sum_{t=1}^T \gamma_t, \overline{\sigma}_{izt} = \frac{1}{T} \sum_{t=1}^T \sigma_{izt}, \text{ and } \overline{c} = \frac{1}{T} \sum_{t=1}^T c = c.$$

Then define the deviation from the unit-specific mean as

$$\text{Ln}(\ddot{sp})_{izt} = \text{Ln}(sp)_{izt} - \overline{\text{Ln}(sp)}_{izt}, \text{FTHB}_{izt} = FTHB_{izt} - \overline{FTHB}_{izt},$$

$$X_{izt} = X_{izt} - \overline{X}_{izt}, \ddot{h}_{iz} = h_{iz} - \overline{h}_{iz}, \ddot{\gamma}_t = \gamma_t - \overline{\gamma}_t, \ddot{\sigma}_{izt} = \sigma_{izt} - \overline{\sigma}_{izt}, \text{ and } \ddot{c} = c - \overline{c}.$$

The within estimator after demeaning house FEs is based on the following regression:

$$\text{Ln}(\ddot{sp})_{izt} = \beta_{FTHB} * FT\ddot{H}B_{izt} + X_{izt}'' \alpha + \ddot{\gamma}_t + \ddot{\sigma}_{izt} \quad (7)$$

Both the unit term h_{iz} and the constant term c disappear because $\ddot{h}_{iz} = h_{iz} - \overline{h_{iz}} = 0$ and $\ddot{c} = c - \bar{c} = 0$.

Similarly, define the time-specific average for year-quarter t as

$$\overline{\text{Ln}(\ddot{sp})_{izt}} = \frac{1}{N_t} \sum_{i=1}^{N_t} \text{Ln}(\ddot{sp})_{izt}, \overline{FT\ddot{H}B_{izt}} = \frac{1}{N_t} \sum_{i=1}^{N_t} FT\ddot{H}B_{izt}, \overline{X_{izt}''} = \frac{1}{N_t} \sum_{i=1}^{N_t} X_{izt}'' ,$$

$$\overline{\ddot{\gamma}_t} = \frac{1}{N_t} \sum_{i=1}^{N_t} \ddot{\gamma}_t, \overline{\ddot{\sigma}_{izt}} = \frac{1}{N_t} \sum_{i=1}^{N_t} \ddot{\sigma}_{izt}$$

where N_t is the number of units/properties transacted in year-quarter t . Then define the deviation from the year-quarter-specific mean as

$$\text{Ln}(\ddot{sp})_{izt} = \text{Ln}(\ddot{sp})_{izt} - \overline{\text{Ln}(\ddot{sp})_{izt}}, FT\ddot{H}B_{izt} = FT\ddot{H}B_{izt} - \overline{FT\ddot{H}B_{izt}},$$

$$X_{izt}'' = X_{izt}'' - \overline{X_{izt}''}, \ddot{\gamma}_t = \ddot{\gamma}_t - \overline{\ddot{\gamma}_t}, \text{ and } \ddot{\sigma}_{izt} = \ddot{\sigma}_{izt} - \overline{\ddot{\sigma}_{izt}},$$

The within estimator, after demeaning in both unit and time dimensions, is based on the following regression:

$$\text{Ln}(\ddot{sp})_{izt} = \beta_{FTHB} * FT\ddot{H}B_{izt} + X_{izt}''' \alpha + \ddot{\sigma}_{izt} \quad (8)$$

The year-quarter term disappears because $\ddot{\gamma}_t = \ddot{\gamma}_t - \overline{\ddot{\gamma}_t} = 0$. In other words, $\text{Ln}(\ddot{sp})_{izt}$ is the demeaned log(sales price),²¹ of property i in ZIP Code z and year-quarter t , estimated using property i 's multiple transaction records. It reflects the deviation of $\text{Ln}(sp)_{izt}$ from what would be expected given prior and subsequent sales of the same property and given the average house price appreciation in year-quarter t .

After taking the within form transformation, we estimate (8), equivalent to estimating (6), and report our regression results in Exhibit 4.

²¹ In the previous version of this paper, we referred to this as the residual log(sales price), since it is what is left after demeaning the logarithm of sales price.

Exhibit 4: Relationship Between First-time Homebuyers and House Price Residuals

	Dependent Variable: Log(Sales Price)					Dep. Variable: Log(Net Sales Price)	
	(1)	(2)	(3)	(4)	(5)		(6)
	Main Sample	Main Sample	Main Sample	Main Sample	Avg. Annual Appraisals ≥ 30		Main Sample
Fthb	0.00229*** (0.000456)	0.0258*** (0.000439)	0.00960*** (0.000466)	0.0104*** (0.000462)	0.0106*** (0.000470)	Fthb	0.00870*** (0.000461)
Log(Contract Price)		0.157*** (0.000382)	0.107*** (0.00134)	0.110*** (0.00135)	0.110*** (0.00136)	Log(Net Contract Price)	0.115*** (0.00134)
Constant	0.0685*** (0.000293)	-1.879*** (0.00476)	-1.264*** (0.0166)	-1.233*** (0.0171)	-1.235*** (0.0172)	Constant	-1.296*** (0.0169)
Controls:							
ZIP-Year-Quarter FE			X	X	X		X
ZIP-Monthly HPI				X	X		X
Observations	1,743,309	1,743,309	1,743,309	1,743,309	1,693,612		1,743,308
R-squared	0.000	0.088	0.219	0.219	0.220		0.223
Adjusted R-squared	0.000	0.088	0.206	0.206	0.206		0.209

Notes: Columns 1 – 5 of this table report the OLS regression results from regressing Log(Sales Price) on Fthb after manually demeaning both house and year-quarter fixed effects. Columns 2 – 5 use Log(Contract Price) to account for additional unobserved house characteristics associated with upgrades and renovations, and Columns 3 – 5 additionally control for ZIP-year-quarter interacted fixed effects. Columns 4 – 5 further control for monthly house price appreciation at the ZIP Code level. Column 6 resembles Column 4 but, in order to incorporate any sales concessions, we employ Log(Net Sales Price) instead of Log(Sales Price) and Log(Net Contract Price) instead of Log(Contract Price). We define Net Sales (Contract) Price as Sales (Contract) Price less the concession amount. Columns 1 – 4 and 6 employ the main sample, whereas the sample employed in Column 5 is further restricted to appraisals associated with appraisers who have performed at least 30 appraisals per year on average. Each observation in this table corresponds to a single appraisal record. Significance levels at the 1%, 5%, and 10% are denoted respectively by ***, **, and *.

Column 1 in Exhibit 4 shows that there is a significant positive effect of *FTHB* on the $\log(\text{sales price})$, suggesting that a typical first-time homebuyer pays significantly more than a repeat homebuyer does for the same house. In Column 2, we include $\log(\text{contract price})$ to control for two factors that might conceivably weaken the observed overpayment effect: potential renovations and upgrades that could drive additional sorting of *FTHBs* into smaller houses²² and the tendency of larger and potentially better houses to appreciate at a different rate than others. Though general time trends are already subtracted in the process of deriving demeaned sales prices, it is necessary to control for the cross-sectional heterogeneity in house price appreciation that is largely driven by local economic factors orthogonal to *FTHB*. Thus we control for ZIP Code-year-quarter interacted fixed effects in Column 3 and further account for monthly house price appreciation at ZIP code level in Columns 4-6. The effect of *FTHBs* overpaying compared to repeat buyers remains significant as controls are added (Columns 2 – 4), regardless of the sample employed (Column 5). Specifically, a typical *FTHB* pays on average 1.04 percent more than a repeat homebuyer does for the same house (Column 4). Given that the average sales price in the main sample is \$275,021, this translates to about \$2,860 per transaction.

However, this might be an overestimation. If *FTHBs* on average receive more help (e.g., on closing costs) from sellers than repeat buyers receive, and if such help is documented in the sales concession rather than in the sales price, then the magnitude of overpayment should be smaller once we take into consideration the sales concession amount. Indeed, in our sample, we observe that *FTHBs* are more likely to obtain help in sales concessions than are repeat buyers (45 percent versus 33 percent) and that among those who do obtain a concession, *FTHBs* on average obtain a larger concession compared to repeat buyers (\$5,020 versus \$4,853). Thus, we define the net sales (contract) price as sales (contract) price less the concession amount. In Column 6, we regress the $\log(\text{net sales price})$ on a similar set of variables and employ similar controls as in Column 4 in order to check the robustness of our results. Our results remain robust with a small decrease in the magnitude of the coefficient from 0.0104 to 0.0087, suggesting that *FTHBs* would overpay by about \$2,393 rather than by about \$2,860 once we include concession amount.

As an additional robustness check, we further separate our sample by borrower LTV thresholds and find consistent results that *FTHBs* overpay in each threshold. We find that a *FTHB* with a higher LTV tends to overpay by more compared to one with a lower LTV.²³

²² This is a valid concern given that there is a significant positive correlation between demeaned $\log(\text{sales price})$ and $\log(\text{sales price})$. If a house was renovated in the early 2000s and therefore was sold at a premium during our sample period, the constant quality assumption will be violated and there will be a positive correlation between the demeaned $\log(\text{sales price})$ and $\log(\text{sales price})$. One plausible control variable for unobserved changes in house quality due to renovation is the contract price, because the contract price is likely to reflect the overall quality of the house. We also substitute $\log(\text{contract price})$ for $\log(\text{sales price})$ and the result is robust.

²³ For detailed results, please refer to Appendix Exhibit 2.

Overall, we find strong supporting evidence for our proposition that controlling for observed and unobserved house characteristics, FTHBs pay significantly more for a house than repeat buyers.

6 Mitigation of Overpayment

In the previous section, we found strong evidence that FTHBs overpay for houses compared to repeat buyers. Now we consider whether certain types of appraisals and appraisers can help mitigate that overpayment. We suspect that they may be able to do so if they have the ability to induce downward renegotiation. For example, a “better” appraiser is more likely to submit an unbiased value of the property, which (compared to a biased value) is more likely to be lower than the contract price. If it is indeed lower, the borrower would need to either make a larger down payment in order to approach her targeted LTV (which is the loan amount over the lower of contract price and appraisal value) or renegotiate the contract price to lower the borrowing amount. Hence, a chance for the price to be renegotiated downward.²⁴

In order to verify our theory that certain types of appraisers can help mitigate overpayment, we first test (a) whether certain types of appraisals and appraisers are associated with a higher propensity for downward renegotiation, and then (b) whether downward renegotiation has a strong influence on FTHB overpayment.

We identify downward renegotiations by tracking, for a given appraisal record, downward changes in the contract price and/or a negative deviation of the final transaction price from the contract price within a three-month period. Overall, 5.72 percent of our sample is associated with downward renegotiation, a finding consistent with the existing literature (Fout and Yao, 2016;²⁵ Calem, Lambie-Hanson, and Nakamura, 2016).²⁶

Once we identify downward renegotiation, we test part (a) using the following specification:

$$D_{izt} = X'_{izt}\alpha + \eta_{izt} + \lambda_{it} + K_{zt} + \mu_{izt} + c_2 \quad (8)$$

where D_{izt} is the dummy variable indicating whether house i transacted at time t had been renegotiated downward; X_{izt} is a set of basic house characteristics (the square footage, the age of

²⁴ Similar logic follows for high-quality appraisals.

²⁵ In Fout and Yao (2016), the authors find that 7 percent of the potential sales that eventually transacted were associated with downward renegotiation.

²⁶ Calem, Lambie-Hanson, and Nakamura (2016) find that 57 percent of the transactions associated with negative appraisals in their dataset result in downward renegotiation, whereas only 2 percent associated with non-negative appraisals are renegotiated for any reason.

the house, and the number of bedrooms and bathrooms) attributed to property i in ZIP Code z and year-quarter t ; η_{izt} is the log(contract price) of property i ; λ_{it} includes a series of appraisal- and/or appraiser-level characteristics indicating the degree of effort, the level of attention to details, and the level of diligence associated with each appraiser or pertaining to each appraisal; K_{zt} includes controls for local house price appreciation (monthly HPI at the ZIP Code level), and time and cross-sectional effects (year-quarter and state fixed effects); μ_{itz} are the error terms; and c_2 is the intercept.

Exhibit 5 presents the results. Column 1 shows that the more expensive a house is, the higher the possibility of a downward price adjustment through renegotiation. In Columns 2 – 4, we include appraisal and appraiser attributes. Column 2 tests the impact of appraisal-level attributes on the presence of downward renegotiation, and indicates that a downward renegotiation is more likely to happen if the property is not super-overvalued in the appraisal and if the appraiser does not simply confirm the contract price. Mistakes captured by *failed_to_find* do not have a significant impact on the likelihood of renegotiation, whereas mistakes captured by *any_wrong* in fact lead to a higher likelihood of the same.

Exhibit 5: Renegotiation and Appraisal/Appraiser Characteristics, Main Sample

Dependent Variable: Downward Renegotiation

	Appraisal Characteristics		Appraiser Characteristics	Both Appraisal and Appraiser Characteristics
	(1)	(2)	(3)	(4)
Log(Contract Price)	0.351*** (0.00862)	0.450*** (0.00867)	0.290*** (0.00880)	0.370*** (0.00884)
Failed_to_find		0.0255 (0.0292)		0.0311 (0.0294)
Any_wrong		0.0792** (0.0254)		0.0797** (0.0255)
Ne_super_over		1.179*** (0.0441)		1.132*** (0.0442)
Exactly_flag		-1.232*** (0.00987)		-1.294*** (0.0101)
Often_ff			-0.00407 (0.00894)	-0.0107 (0.00905)
Often_anywrong			-0.0109 (0.00990)	-0.0148 (0.00998)
Often_exact			-0.351*** (0.00949)	-0.126*** (0.00969)
Appraiser_avg_gap 2nd quartile (less overvaluation)			-0.321*** (0.00913)	-0.397*** (0.00921)
3rd quartile			-0.389*** (0.00985)	-0.497*** (0.00993)
4th quartile (most overvaluation)			-0.500*** (0.0107)	-0.644*** (0.0108)
Constant	-5.470*** (0.125)	-7.512*** (0.132)	-4.383*** (0.127)	-6.102*** (0.134)
Controls:				
House Attributes	X	X	X	X
Zip-Monthly HPI	X	X	X	X
Year-Quarter FE	X	X	X	X
State FE	X	X	X	X
Observations	1,743,299	1,743,299	1,743,299	1,743,299

Notes: This table reports the logit regression results from regressing the probability of downward renegotiation on appraisal and appraiser attributes when using the main sample, controlling for house characteristics, monthly house price appreciation at the ZIP Code level, and year-quarter and state fixed effects. Each observation corresponds to a single appraisal record. Overall, lower *appraisal* quality (reflected in *Exactly_flag* in Columns 2 and 4) and lower *appraiser* diligence (*Often_exact* and *Appraiser_avg_gap* in Columns 3 and 4) dampen the chance of downward renegotiation, and higher *appraisal* quality (reflected in *Ne_super_over* in Columns 2 and 4) increases the chance of downward renegotiation. Greater *appraiser* diligence captured by the indicator of mistakes *Often_anywrong* does not seem to have a significant impact on the probability of downward renegotiation, but at the *appraisal* level the presence of mistakes in house attributes, reflected in *Any_wrong*, does in fact have a significant impact in increasing the likelihood of downward renegotiation. As mistakes in property history (reflected in *Failed_to_find*) have no significant impact, our analysis is inconclusive as to whether mistakes in appraisals shrink buyers' opportunities for better deals. Significance levels at the 1%, 5%, and 10% are denoted respectively by ***, **, and *.

We then test whether the appraiser-level attributes have a similar impact. In Column 3, we add the quartiles of *appraiser_avg_gap* to the basic regression in addition to *often_ff*, *often_anywrong*, and *often_exact*. *Appraiser_avg_gap* is defined as the average percentage difference of the appraisal value from the contract price for a given appraiser. Thus a higher quartile of *appraiser_avg_gap* represents a greater propensity for overvaluation. Moving from the second-lowest quartile (the median) to the highest quartile of *appraiser_avg_gap*, the monotonic decrease in the regression coefficient in Column 3 reflects a significantly increasing negative effect of overvaluation on the likelihood of downward renegotiation. In other words, the more prone an appraiser is to overvalue a property, the less likely are downward price adjustments through renegotiation for that property. The coefficient in front of *often_anywrong* suggests that appraisers prone to mistakes seem to dampen the likelihood of downward renegotiation (although insignificantly), an effect that is different from the one suggested by the coefficient in front of *any_wrong* in Column 2. We further include appraisal and appraiser attributes in a consolidated regression and report the results in Column 4. All of the effects persist and the effect of overvaluation becomes more salient. We report in Exhibit 6 the marginal effect of the variables in specification Exhibit 5 Column 4.

Exhibit 6: Marginal Effects on Downward Renegotiation	
Variables	Marginal Effects
Log_cp	0.0163*** (0.000387)
Often_ff	-0.000470 (0.000398)
Often_anywrong	-0.000651 (0.000439)
Often_exact	-0.00552*** (0.000426)
Appraiser_avg_gap	
2nd quartile	-0.0175*** (0.000404)
3rd quartile	-0.0219*** (0.000435)
4th quartile	-0.0283*** (0.000474)
Failed_to_find	0.00137 (0.00129)
Any_wrong_avl	0.00350*** (0.00112)
Ne_super_over	0.0497*** (0.00193)
Exactly_flag	-0.0569*** (0.000402)
Observations	1,743,299

Notes: In this table, we report the marginal effect of the variables in specification Exhibit 5 Column 4. Standard errors are in parentheses. Significance levels at the 1%, 5%, and 10% are denoted respectively by ***, **, and *.

Thus far, these results provide evidence that certain appraisals and appraisers might be able to induce downward renegotiation. We now test part (b) of our theory, whether downward renegotiation has a strong influence on FTHB overpayment.

We first calculate the predicted probability of downward renegotiation, \hat{D}_{izt} , based on the regression results in Exhibit 5 Column 4. We then add the predicted probability and the interaction term of FTHB and the predicted probability as independent variables to our main specification (Equation 8; Exhibit 4 Column 4).

Exhibit 7 reports the regression results, with Column 1 employing Log(Sales Price) and Column 2 employing Log(Net Sales Price) as the dependent variables. Confirming our previous finding (in Exhibit 4), the results in both columns consistently demonstrate that FTHBs overpay. Both columns also show that the predicted probability of downward renegotiation has a significant impact on overpayment. Specifically, a 10 percent increase in the predicted probability of downward renegotiation leads to a 0.7 percent reduction in the sales price. However, the interaction term of FTHB and the predicted probability of downward renegotiation is significant in neither column, indicating that the effect of downward renegotiation does not differentiate between FTHBs and repeat buyers.

Overall, we find suggestive evidence that certain types of appraisals and appraisers can induce downward renegotiation and that such downward renegotiation has a significant impact in mitigating overpayment. However, this effect is not unique to FTHBs.

Exhibit 7: Downward Renegotiation and Log(Sales Price), Main Sample

	Dependent Variable: Log(Sales Price)		Dependent Variable: Log(Net Sales Price)
	(1)		(2)
Predicted Reneg_down	-0.0736*** (0.00751)	Predicted Reneg_down	-0.0723*** (0.00752)
Fthb	0.0104*** (0.000462)	Fthb	0.00871*** (0.000461)
Fthb*Predicted Reneg_down	-0.0117 (0.0122)	Fthb*Predicted Reneg_down	-0.0111 (0.0122)
Log(Contract Price)	0.110*** (0.00135)	Log(Net Contract Price)	0.115*** (0.00134)
Constant	-1.226*** (0.0171)	Constant	-1.289*** (0.0170)
Controls:			
ZIP-Year-Quarter FE	X		X
ZIP-Monthly HPI	X		X
Observations	1,743,299		1,743,298
R-squared	0.219		0.223
Adjusted R-squared	0.206		0.209

Notes: This table reports OLS regression results from regressing Log(Sales Price) and Log(Net Sales Price) on the predicted probability of downward renegotiation and its interaction term with FTHB after manually demeaning both house and year-quarter fixed effects, and when employing the main sample. Each observation corresponds to a single appraisal record. Both columns control for ZIP-year-quarter interacted fixed effects and monthly house price appreciation at the ZIP Code level. Significance levels at the 1%, 5%, and 10% are denoted respectively by ***, **, and *.

7 Conclusion

Homeownership is arguably key to fostering wealth and stabilizing neighborhoods and communities. Helping creditworthy, low- and middle-income FTHBs by providing them access to better mortgage terms and by increasing temporary monetary incentives has been a key U.S. policy for decades. So does a typical FTHB pay more than her more experienced counterparts do? Even though this topic is important both academically and for policy matters, prior research has been somewhat limited.

This paper contributes to the literature by filling in the gap between theoretical and empirical literature on FTHBs and their real estate transaction outcomes. We present a theoretical framework in which FTHBs pay rent in addition to the search cost paid by all buyers in each search period and in which quantity and price per unit are drawn i.i.d from a uniform distribution. We propose that for a given house, FTHBs pay a higher average sales price compared to repeat buyers.

We assemble a novel dataset to test our proposition and find that FTHBs do indeed overpay for houses compared to repeat buyers, and that this overpayment is 1.04 percent on average—a substantial amount particularly when considering the size of the residential purchase-money mortgage market and the FTHB share of it.²⁷

We then examine whether certain types of appraisals and appraisers can mitigate this overpayment. We find that certain appraisal and appraiser attributes increase the probability of downward renegotiation, and that downward renegotiation is correlated with lesser overpayment, but that this effect has no consistent discernible connection with FTHB status.

Our research speaks directly to housing affordability. First-time homebuyers are inexperienced house hunters and are more likely to be marginal borrowers. The challenge for policy makers is to help them gain access to sufficient credit while controlling their default risk. However, FTHBs may experience handicaps before credit even comes into the picture. In this paper, we present a robust result that FTHBs are overpaying for their houses²⁸—possibly a result of their inexperience. Our analysis also suggests that certain appraisals and appraisers might be able to mitigate FTHB overpayment.

²⁷ This 1.04 percent translates to roughly \$2,860. Taking sales concessions into consideration, a typical FTHB overpays by 0.87 percent, which is equivalent to \$2,393, per transaction.

²⁸ Without noticeably elevated default rates. In the context of risk management, we have conducted a brief analysis to determine whether FTHB overpayment leads to increased mortgage risk. In other words, given the well-known connection between the LTV ratio of a mortgage and its outcome, one might wonder whether, all else equal, the slightly-higher prices paid by FTHBs lead to elevated default rates. Our empirical work, though not particularly extensive, suggests no discernible increase in default probabilities.

Appendix

Following the set-up in equations (3) and (4), there exists a unique U_r such that the buyer purchases the house if $U(p, q) \geq U_r$, and does not purchase the house if $U(p, q) < U_r$. Equivalently, for any given q , there exists a unique $p_r = \frac{V(q) - U_r}{q}$ such that the buyer purchases the house if $p \leq p_r$, and does not purchase the house if $p > p_r$.

$$\begin{aligned}
 (1 + \delta) * U_r + c + r &= \int_{U_r}^{+\infty} U dF(U) + \int_{-\infty}^{U_r} U_r dF(U) & (9) \\
 &= \int_{V(q) - p * q}^{+\infty} U dF(U) + \int_{-\infty}^{V(q) - p * q} U_r dF(U) \\
 &= \int_{\underline{p}}^{\frac{V(q) - U_r}{q}} [V(q) - p * q] dG(p) + \int_{\frac{V(q) - U_r}{q}}^{\bar{p}} U_r dG(p)
 \end{aligned}$$

The left-hand side describes the cost of search, while the right-hand side describes the expected gain from future search. Calculating the integrals in the final equation above and rearranging the equation:

$$(\bar{p} - \underline{p})(c + r) = \frac{(V(q) - U_r)^2}{2q} - \underline{p}[V(q) - \frac{p * q}{2}] - [(\bar{p} - \underline{p}) * \delta - \underline{p}] * U_r \quad (10)$$

Substituting $V(q) - p_r * q$ for U_r and simplifying the above equation:

$$[(r + c)(\bar{p} - \underline{p}) + \delta(\bar{p} - \underline{p})V(q) - \frac{q * \underline{p}^2}{2}] \frac{2}{q} = p_r^2 + 2[(\bar{p} - \underline{p}) * \delta - \underline{p}] p_r \quad (11)$$

Rearranging equation (11),

$$p_r^2 + 2[(\bar{p} - \underline{p}) * \delta - \underline{p}] p_r - \left[(r + c)(\bar{p} - \underline{p}) + \delta(\bar{p} - \underline{p})V(q) - \frac{q * \underline{p}^2}{2} \right] \frac{2}{q} = 0 \quad (12)$$

Solving equation (12) for p_r ,

$$\begin{aligned}
 p_r &= \frac{-2[(\bar{p} - \underline{p}) * \delta - \underline{p}] \pm \sqrt{4[(\bar{p} - \underline{p}) * \delta - \underline{p}]^2 + 4 \left[(r + c)(\bar{p} - \underline{p}) + \delta(\bar{p} - \underline{p})V(q) - \frac{q * \underline{p}^2}{2} \right] \frac{2}{q}}}{2} & (13) \\
 &= [\underline{p} - (\bar{p} - \underline{p}) * \delta] \pm \sqrt{\Delta}
 \end{aligned}$$

$$\begin{aligned}
 \text{where } \Delta &= [(\bar{p} - \underline{p}) * \delta - \underline{p}]^2 + \left[(r + c)(\bar{p} - \underline{p}) + \delta(\bar{p} - \underline{p})V(q) - \frac{q * \underline{p}^2}{2} \right] \frac{2}{q} \\
 &= \frac{2(\bar{p} - \underline{p})}{q} [r + c + \delta V(q) + (\bar{p} - \underline{p}) \frac{q * \delta^2}{2} - \delta q \underline{p}]
 \end{aligned}$$

The following conditions need to be satisfied such that there exists a unique solution of p_r that lies in $[\underline{p}, \bar{p}]$:

i) $\Delta > 0$

$$\Leftrightarrow (1 + \delta) \left(V(q) - \underline{p}q \right) + r + c + \frac{(\bar{p} - \underline{p})\delta^2 q}{2} > V(q) - \underline{p}q; \quad (14)$$

It is obvious that $\left[\underline{p} - (\bar{p} - \underline{p}) * \delta \right] - \sqrt{\Delta} < \underline{p}$. Therefore $p_r = \left[\underline{p} - (\bar{p} - \underline{p}) * \delta \right] + \sqrt{\Delta}$ is the unique solution if the following two conditions are satisfied:

ii) $p_r = \left[\underline{p} - (\bar{p} - \underline{p}) * \delta \right] + \sqrt{\Delta} > \underline{p}$

$$\Leftrightarrow \Delta > (\bar{p} - \underline{p})^2 * \delta^2 \text{ substitute } \frac{2(\bar{p} - \underline{p})}{q} [r + c + \delta V(q) + (\bar{p} - \underline{p}) \frac{q * \delta^2}{2} - \delta \underline{p}q] \text{ for } \Delta$$

$$\Leftrightarrow c + r > -\delta[V(q) - \underline{p}q]$$

$$\Leftrightarrow c + r + (1 + \delta)[V(q) - \underline{p}q] > V(q) - \underline{p}q \quad (15)$$

iii) $p_r = \left[\underline{p} - (\bar{p} - \underline{p}) * \delta \right] + \sqrt{\Delta} < \bar{p}$

$$\Leftrightarrow \Delta < (\bar{p} - \underline{p})^2 * (1 + \delta)^2, \text{ substitute } \Delta \text{ with its expression}$$

$$\Leftrightarrow c + r < \frac{q}{2} (\bar{p} - \underline{p}) - \delta[V(q) - \bar{p}q]$$

$$\Leftrightarrow c + r + (1 + \delta)[V(q) - \bar{p}q] < V(q) - \frac{\underline{p} + \bar{p}}{2} q \quad (16)$$

Summarizing the above conditions, (15) is a sufficient condition for (14) – other words, ii) is a sufficient condition for i). Therefore, only (15) and (16) need to hold, leading to the following Lemma.

Lemma 2: For any given q , if i) $(1 + \delta) \left(V(q) - \underline{p}q \right) + r + c > V(q) - \underline{p}q$ and ii) $(1 + \delta)(V(q) - \bar{p}q) + r + c < V(q) - \frac{\underline{p} + \bar{p}}{2} q$, then there exists a unique $p_r = \frac{V(q) - U_r}{q} \in [\underline{p}, \bar{p}]$ such that the buyer purchases the house if $p \leq p_r$, and does not purchase the house if $p > p_r$.

Proof for Lemma 1:

For any given q , the left-hand side of equation (11) is fixed. The right-hand side of equation (11), $p_r^2 + 2[(\bar{p} - \underline{p}) * \delta - \underline{p}] p_r$, is obviously monotonically increasing in p_r in $[\underline{p}, \bar{p}]$. Therefore the solution for p_r is greater when $r > 0$ than when $r = 0$.

Proof for Proposition 1:

Following Lemma 1 in the model section, for any given q , the reservation price for FTHBs, p_r_fthb , is strictly greater than the reservation price for repeat buyers, p_r_repeat . Therefore, it is obvious that $\int_{\underline{p}}^{p_r_fthb} p * q dG(p) > \int_{\underline{p}}^{p_r_repeat} p * q dG(p)$.

Appendix Exhibit 1: FTHBs and Sorting			
Dependent Variable: Log(Net Sales Price)			
	(1)	(2)	(3)
Fthb	-0.155*** (0.000868)	-0.159*** (0.00130)	-0.0581*** (0.000723)
Constant	12.42*** (0.000557)	12.43*** (0.000534)	12.13*** (0.00154)
Controls:			
House Attributes			X
Zip-Year-Quarter FE		X	X
Observations	1,743,309	1,743,309	1,743,309
R-squared	0.018	0.618	0.799
Adjusted R-squared	0.018	0.612	0.796

Notes: This table reports OLS regression results. Net sales price is the sales price minus the concession amount. Each observation corresponds to a single appraisal record in the main sample. Column 2 controls for Zip-year-quarter interacted fixed effects. Column 3 additionally controls for house attributes (the number of bathrooms, the number of bedrooms, the square footage, and the age of the house). Significance levels at the 1%, 5%, and 10% are denoted respectively by ***, **, and *.

Appendix Exhibit 2: Relationship Between FTHBs and House Prices by LTV Range, Main Sample							
	Dependent Variable: Log(Sales Price)				Dependent Variable: Log(Net Sales Price)		
	(1)	(2)	(3)		(4)	(5)	(6)
	LTV ≤ 80%	80% ≤ LTV ≤ 90%	90% < LTV		LTV ≤ 80%	80% ≤ LTV ≤ 90%	90% < LTV
Fthb	0.00753*** (0.00125)	0.00849*** (0.000672)	0.0113*** (0.000753)	Fthb	0.00455*** (0.00125)	0.00704*** (0.000672)	0.0104*** (0.000752)
Log(Contract Price)	0.108*** (0.00199)	0.111*** (0.00154)	0.114*** (0.00179)	Log(Net Contract Price)	0.115*** (0.00198)	0.116*** (0.00153)	0.117*** (0.00177)
Constant	-1.198*** (0.0252)	-1.249*** (0.0196)	-1.272*** (0.0225)	Constant	-1.281*** (0.0251)	-1.310*** (0.0194)	-1.322*** (0.0223)
Controls:				Controls:			
ZIP-Year-Quarter FE	X	X	X	Zip-Year-Quarter FE	X	X	X
ZIP-Monthly HPI	X	X	X	ZIP-Monthly HPI	X	X	X
Observations	366,622	811,783	564,904	Observations	366,621	811,783	564,904
R-squared	0.256	0.229	0.225	R-squared	0.258	0.231	0.227
Adjusted R-squared	0.209	0.203	0.19	Adjusted R-squared	0.212	0.205	0.192

Notes: This table reports the OLS regression results from regressing Log(Sales Price) and Log(Net Sales Price) on FTHB for different LTV ranges, after manually demeaning both house and year-quarter fixed effects. Columns 1 – 3 share specifications with Exhibit 4 Column 4, while Columns 4 – 6 share specifications with Exhibit 4 Column 6; all columns control for ZIP-year-quarter interacted fixed effects and monthly house price appreciation at the ZIP Code level. As in Exhibit 4, results show that FTHBs overpay. Results also show that FTHBs in higher LTV ranges tend to overpay by more compared to those in lower LTV ranges. Significance levels at the 1%, 5%, and 10% are denoted respectively by ***, **, and *.

References

- Albrecht, J., Gautier, P. A., & Vroman, S. (2016). Directed search in the housing market. *Review of Economic Dynamics*, 19, 218-231.
- Anglin, P. M. (1994). A summary of some data on buying and selling houses. *University of Windsor, mimeo*.
- Anglin, P. M. (1997). Determinants of buyer search in a housing market. *Real estate economics*, 25(4), 567-589.
- Appraisal Institute, GAO Report Signals FHA Fraud, Mismanagement, and Abuse; Calls for Stricter Review, *Appraiser News in Brief*, 1997, 4:6, 1.
- Baker, D. (2012). First time underwater: The impact of the first-time homebuyer tax credit. Report. Center for Economic and Policy Research, Washington, DC.
- Baryla, E. A., & Zumpano, L. V. (1995). Buyer Search Duration in the Residential Real Estate Market: The Role of the Real Estate Agent. *Journal of Real Estate Research*, 10(1), 1-14.
- Baryla, E. A., Zumpano, L. V., & Elder, H. W. (2000). An investigation of buyer search in the residential real estate market under different market conditions. *Journal of Real Estate Research*, 20(1-2), 75-91.
- Baum, A., Crosby, N., Gallimore, P., McAllister, P., & Gray, A. (2000). The influence of valuers and valuations on the workings of the commercial property investment market. In *Royal Institution of Chartered Surveyors/Investment Property Forum, London*.
- Calem, P. S., Lambie-Hanson, L., & Nakamura, L. I. (2015). Information losses in home purchase appraisals. Federal Reserve Bank of Philadelphia Working Paper 15-11.
- Calem, P. S., Lambie-Hanson, L., & Nakamura, L. I. (2016). Appraising Home Purchase Appraisals.
- Case, K. E., Quigley, J. M., & Shiller, R. J. (2005). Comparing Wealth Effects: The Stock Market versus the Housing Market." *Advances in Macroeconomics*, 5(1): Article 1.
- Cheema, A., & Soman, D. (2006). Malleable mental accounting: The effect of flexibility on the justification of attractive spending and consumption decisions. *Journal of Consumer Psychology*, 16(1), 33-44.
- Collins, J. M., Loibl, C., Moulton, S., & Samak, A. (2013). Borrowing capacity and financial decisions of low-to-moderate income FTHBs. *The Journal of Consumer Affairs*, 47, 375-403.
- Diaz, J. (2009). How appraisers do their work: a test of the appraisal process and the development of a descriptive model. *Journal of Real Estate Research*.
- Dynan, K., Gayer, T., & Plotkin, N. (2013). The recent homebuyer tax credit: Evaluation and lessons for the future. Brookings studies policy brief, Brookings Institution, Washington, DC.
- Engelhardt, G. V. (1996). House prices and home owner saving behavior. *Regional Science and Urban Economics*, 26(3), 313-336.
- Federal Housing Finance Agency. (2008). Home Valuation Code of Conduct. Available at: https://www.fhfa.gov/Media/PublicAffairs/Documents/HVCCFinalCODE122308_N508.pdf
- Fout, H., & Yao, V. (2016). Housing Market Effects of Appraising Below Contract. Working paper, available at: <http://www.fanniemae.com/resources/file/research/datanotes/pdf/fannie-mae-white-paper-060716.pdf>
- Genesove, D., & Han, L. (2012). Search and matching in the housing market. *Journal of Urban Economics*, 72(1), 31-45.
- Harris, B. H., Steuerle, C. E., & Eng, A. (2013). New Perspectives on Homeownership Tax Incentives. *Tax Notes*, 141(12), 1315-32.

- Heath, C., & Soll, J. B. (1996). Mental budgeting and consumer decisions. *Journal of consumer research*, 23(1), 40-52.
- Herbert, C. E., McCue, D. T., & Sanchez-Moyano, R. (2013). Is homeownership still an effective means of building wealth for low-income and minority households? (Was it ever?). Working Paper HBTL-06, Harvard University, Joint Center for Housing Studies, Cambridge, MA.
- Jenkins, D. H., Lewis, O. M., Almond, N., Gronow, S. A., & Ware, J. A. (1999). Towards an intelligent residential appraisal model. *Journal of Property Research*, 16(1), 67-90.
- Lambson, V. E., McQueen, G. R., & 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.
- Lentz, G., & Wang, K. (2009). Residential appraisal and the lending process: A survey of issues. *Journal of Real Estate Research*.
- Lins, M. P. E., de Lyra Novaes, L. F., & Legey, L. F. L. (2005). Real estate appraisal: A double perspective data envelopment analysis approach. *Annals of Operations Research*, 138(1), 79-96.
- Moulton, S., & Quercia, R. (2013). Access and Sustainability for First Time Homebuyers: The Evolving Role of State Housing Finance Agencies. Working Paper HBTL-10, Harvard University, Joint Center for Housing Studies, Cambridge, MA.
- Munneke, H. J., & Yavas, A. (2001). Incentives and performance in real estate brokerage. *The Journal of Real Estate Finance and Economics*, 22(1), 5-21.
- Murray, J. K. (2009). Issues in Appraisal Regulation: The Cracks in the Foundation of the Mortgage Lending Process. *Loy. LAL Rev.*, 43, 1301.
- National Association of Realtors. 2016 Profile of Home Buyers and Sellers. Available at: <https://www.nar.realtor/sites/default/files/reports/2016/2016-profile-of-home-buyers-and-sellers-10-31-2016.pdf>
- Pagourtzi, E., Assimakopoulos, V., Hatzichristos, T., & French, N. (2003). Real estate appraisal: a review of valuation methods. *Journal of Property Investment & Finance*, 21(4), 383-401.
- Patrabansh, S. (2013). A study of FTHBs. Mortgage Market Note 13-1, Federal Housing Finance Agency, Washington, DC.
- Patrabansh, S. (2015). The Marginal Effect of First-Time Homebuyer Status on Mortgage Default and Prepayment. Federal Housing Finance Agency Working Paper 15-2.
- Reid, C. K. (2007). Locating the American dream. *Chasing the American Dream*, 233-267.
- Rogerson, R., Shimer, R., & Wright, R. (2005). Search-theoretic models of the labor market: A survey. *Journal of economic literature*, 43(4), 959-988.
- Rutherford, R. C., Springer, T. M., & Yavas, A. (2005). Conflicts between principals and agents: evidence from residential brokerage. *Journal of financial Economics*, 76(3), 627-665.
- Smolen, G.E. and D.C. Hambleton (1997). Is the Real Estate Appraiser's Role too Much to Expect? *The Appraisal Journal*, LXV:1, 9-17.
- Tong, Z. Y. (2005). Washington, DC's First-Time Homebuyer Tax Credit: An Assessment of the Program. Fannie Mae Foundation Special Report.
- Urban Institute Monthly Chartbook (2017). Housing Finance at a Glance: A Monthly Chartbook, February 2017. Available at: http://www.urban.org/sites/default/files/publication/88431/february_chartbook_final.pdf
- Van Zandt, S. & Rohe, W. M. (2006). Do first-time home buyers improve their neighborhood quality? *Journal of Urban Affairs*, 28, 491-510.

Van Zandt, S. & Rohe, W. M. (2011). The Sustainability of Low-income Homeownership: The Incidence of Unexpected Costs and Needed Repairs among Low-income Home Buyers. *Housing Policy Debate*, 21 (2): 317–341.

Wheaton, W. C. (1990). Vacancy, search, and prices in a housing market matching model. *Journal of Political Economy*, 98(6), 1270-1292.

Wolverton, M., & Gallimore, P. (2009). Client Feedback and the Role of the Appraiser. *Journal of Real Estate Research*.

Yavaş, A. (1992). A simple search and bargaining model of real estate markets. *Real estate economics*, 20(4), 533-548

Yinger, J. (1981). A search model of real estate broker behavior. *The American Economic Review*, 71(4), 591-605.