Appraisal Inflation and Private Mortgage Securitization

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March 31, 2021

PRELIMINARY DRAFT; NOT FOR CIRCULATION

Abstract

This paper examines adverse selection based on appraisal inflation in private securitization using jumbo refinance loans as a laboratory. Combining a nationwide mortgage data set with real estate transaction data, we find that mortgages with higher appraisal inflation have a higher probability of securitization. Ex post, securitized loans have more than 3% higher appraisal inflation than similar portfolio loans. The effects are statistically and economically significant at key LTV notches. Inflated appraisals on sold notch loans are associated with higher default. However, the additional credit risk is not priced in mortgage rates. Lenders likely exploit their informational advantage about appraisal quality to benefit themselves or affiliated parties in the secondary market. The results are robust to various model specifications. These findings indicate the existence of adverse selection in private securitization based on property appraisal values.

JEL Classifications: G21, G24, R3
Keywords: Appraisal Inflation, Securitization, Non-Agency Market, Adverse Selection, Information Asymmetry

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1 Introduction

The recent U.S. housing downturn that started in 2007 and the ensuing severe economic recession have highlighted the importance of sound housing finance in maintaining a healthy financial system.[1] As the devastation from the housing market meltdown rolled through the U.S. economy, spilling over to the rest of the world, academics and policymakers started exploring the main causes of the housing market boom and underlying mortgage credit expansion, and proposing policy remedies to incentive problems in the current housing finance model. Several narratives have been proposed as potential causes of the housing bubble that led to the Great Recession.[2] Proponents of the securitization narrative argue that the originate-to-distribute mortgage lending business model skewed the incentives of lenders toward the origination of risky mortgage products to financially-constrained borrowers that were then repackaged and sold to unsuspecting mortgage-backed security (MBS) investors (Mian and Sufi, 2009; Keys et al., 2010; Demyanyk and Van Hemert, 2011; Keys et al., 2012; Nadauld and Sherlund, 2013; Elul, 2016; Griffin et al., 2020; Ding and Nakamura, 2016). Some of these studies further argue that securitization enabled lenders and MBS issuers and underwriters to deliberately obfuscate and/or misrepresent the quality of securitized mortgages to investors.[3]

Among documented mortgage misrepresentations, appraisal inflation, the object of this study, has been identified as one of the most consequential.[4] Appraisals play a critical role in housing finance. Appraisals are used to calculate loan-to-value (LTV) ratios, a key determinant of mortgage default and loss severity, thus mortgage interest rates and private mortgage insurance (PMI) premia, if any. Therefore, a property's appraisal value is a key determinant of financing. Appraisals are typically required in home mortgage underwriting. Purchase loans

[1] The amount of residential mortgage debt outstanding in the U.S. increased by 50% from \$7.47 trillion in 2004Q1 to \$11.25 trillion at the peak of the mortgage credit expansion in 2007Q4 (Federal Reserve Board's Flow of Funds). A significant portion of the growth was in non-prime lending.

[2] Proposed explanations include subprime lending and securitization, lax monetary policies, and government policies aimed at increasing homeownership, among others (Mian and Sufi, 2009; Obstfeld and Rogoff, 2009; Keys et al., 2010; Campbell, 2013; Moulton, 2014; Griffin et al., 2020).

[3] The assumption underlying this argument is that MBS investors are generally less informed regarding the quality of mortgages in collateral pools than lenders and deal sponsors by not having access to relevant soft information about the mortgage collected during underwriting.

[4] Appraisal inflation consists of the overstatement of property values, which lowers loan-to-value ratio, thus improving the chance of the loan getting approved. Borrowers were not necessarily the victims of appraisal inflation, for it may allow them to receive more favorable borrowing terms. Other mortgage frauds documented in the literature include income misrepresentation, owner occupancy misreporting, and unreported second liens.

are based on the lower of the property's sale price or appraisal value, whereas refinance loans are based only on the appraisal value. An inflated appraisal leads to over-lending against the collateral. There is a growing body of evidence suggesting widespread appraisal inflation during the housing market boom and directly linking it to the massive foreclosure crisis (Cho and Megbolugbe, 1996; Chinloy et al., 1997; Calem et al., 2015; Piskorski et al., 2015; Shi and Zhang, 2015; Ding and Nakamura, 2016; Kruger and Maturana, 2020; Eriksen et al., 2019; Conklin et al., 2020).

The purpose of appraisal is to provide an independent assessment of the fair market value of a property, thus normally allowing the lender to provide an appropriate level of lending against the property. However, with the desintegration of housing finance, shortsighted lenders may have strong incentives to seek or tolerate inflated appraisals for loans meant for securitization to boost short-term profits by growing origination volumes. For the same down payment, an inflated appraisal increases the chance of the loan being approved due to the lower LTV ratio and perceived lower credit risk. If the mortgage is intended for sale, the lower quality associated with the inflated appraisal has no direct impact on the lender's balance sheet.

Appraisal inflation is a potential source of information asymmetry between lenders and MBS investors that could lead to adverse selection in mortgage securitization. A lender is likely to know more about a subject property, the comparables used in the appraisal, and local market trends and conditions than MBS investors. In addition, if the first appraisal is too low, it is not uncommon for lenders or borrowers to request a second appraisal, a practice not observable to MBS investors. As a result, lenders are likely to have superior information about appraisal quality than MBS investors. Griffin et al. (2020) estimate that over 45 percent of privately securitized loans have inflated appraisals. Furthermore, Kruger and Maturana (2020) document that privately securitized mortgages with inflated appraisals are more likely to default and cause higher losses to mortgage security investors.

Despite extensive evidence of appraisal inflation in securitized loans, it remains unclear the relation between securitization and appraisal inflation. For example, if portfolio loans (loans held on the banks' books) show similar magnitudes of appraisal inflation as sold (securitized) loans, then it would not be adequate to draw any inference between appraisal inflation and securitization from the previous findings based solely on sold loans. Furthermore, a direct comparison of appraisal inflation on sold and portfolio is unlikely to yield the true effect because of unobservable differences between the two groups. As a contribution to the literature, this study proposes innovative empirical technique allowing identification of potential adverse selection in private securitization based on the incidence of appraisal inflation.

To investigate the relation of appraisal inflation and securitization in the non-agency market, we use refinance jumbo mortgages as a laboratory.[5] By focusing on this category of loans, we can avoid any econometric issues related to the choice of securitization channels (agency vs private label), since jumbo loans do not qualify for purchase by the government-sponsored enterprises (GSEs). We specifically target refinance loans because appraisal quality is more critical for the underwriting of these loans, given there is no purchase price that could be used as an alternative reference point. For purchase loans, on the other hand, the smaller of the appraised value or the purchase price forms the basis for LTV calculations. Therefore, a change in appraised value has an impact on loan terms only when the appraised value is less than the purchase price, which is a rare occurrence (Conklin et al., 2020). Furthermore, the incidence of appraisal inflation is likely to be more pronounced on refinance mortgages because the absence of a transaction price leaves more room for subjective value adjustments by appraisers.

Our main analysis employs two complementary approaches. First, we develop a model of mortgage securitization decision that astutely controls for reverse causality between appraisal inflation and the securitization decision. This model takes an ex-ante approach to the securitization decision by turning off potential reverse causality channels linking securitization to appraisal inflation. We also control for potential measurement errors due to varying property appreciations between sold and portfolio loans. Our second approach uses a difference in difference (DID) design by comparing the appraisal values of portfolio and sold refinance jumbo loans relative to the average price appreciations on properties securing portfolio and securitized purchase loans. We use the purchase properties as a "*control group*" to remove property price appreciations from our appraisal inflation measure, and control for other unobservable differences, which enhances identification of appraisal inflation on securitization.[6] The methodology

[5]Jumbo mortgage loans are conventional mortgages that exceed the maximum loan amount set by the government-sponsored enterprises Fannie Mae and Freddie Mac and that are therefore kept by the lenders or securitized in the non-agency market.

[6]Appraisal inflation and appraisal bias have the same meaning in this paper and are used interchangeably throughout the paper.

section gives a detailed presentation of both estimation approaches.

In addition to documenting the average effect of appraisal inflation on securitization, we also explore the effect at specific LTV notches (i.e., 80, 85, 90, 95, and 97% LTV ratios) where appraisal bias is likely to have the most impact on mortgage underwriting and pricing. For example, mortgages with LTV ratio greater than 80 percent generally require private mortgage insurance and/or carry higher interest rates. Therefore, appraisal inflation at LTV notches likely possibly benefit borrowers in the form of lower financing costs and lenders by improving the chance of the loan being originated.

We implement our empirical strategies using mortgage origination and performance data from McDash, and property transaction and characteristics data from RealtyTrac. Our ex-ante analysis shows that appraisal inflation is not a driving factor of securitization on average, except at key LTV notches. At those notches, a one standard deviation increase in appraisal inflation increases the likelihood of securitization by 1.8 to 3.6% depending on the model specification used. Our DID framework confirms these findings. We find that securitized loans have more than 3.1% higher appraisal bias at the LTV notches than portfolio loans. The effect remains when we restrict our sample to loans with non-distress subsequent sale to avoid the potential effect of servicing on realized sales values. Furthermore, we find that the effect comes largely from cash-out refinance mortgages. While cash-out refinance mortgages show a large and significant securitization effect, securitization has no effect on appraisal bias for rate and term refinance mortgages. This supports our thesis that equity extraction was likely a determining factor of appraisal inflation during the study period.

Next, we show that at those notches, securitized refinance mortgages are significantly more likely to default, both in absolute and relative terms, compared to portfolio refinance mortgages, which establishes a direct link between appraisal bias and poor mortgage performance. Finally, we find no evidence indicating that the pricing (interest rate) of securitized at-notch mortgages reflects the additional credit risk associated with appraisal inflation at those LTV thresholds. However, we are unable to confirm that lenders were not compensated for the additional risk by other means (points and other fees) because we only observe interest rates in our data. Nonetheless, any such compensation would likely be kept by lenders, rather than passed through to investors in securitized mortgage products. Consequently, we can confidently assert that our findings, which remain when we control for lender effects or use hedonic home value estimates as an alternative measure of fair market value in our appraisal inflation measure, represent strong evidence of adverse selection in securitization based on appraisal inflation.

This study contributes to the vast literature documenting substantial appraisal bias in the residential mortgage market (Cho and Megbolugbe, 1996; Chinloy et al., 1997; Calem et al., 2015; Kruger and Maturana, 2020; Eriksen et al., 2019; Conklin et al., 2020). Furthermore, we add to the literature establishing a causal relationship between appraisal bias and mortgage default. Ben-David (2011), LaCour-Little and Malpezzi (2003), Piskorski et al. (2015), Calem et al. (2017), and Kruger and Maturana (2020) show that appraisal inflation is associated with higher mortgage default due to the understatement of true LTVs, a key determinant of mortgage credit risk. Our findings confirm that result. We extend that literature by showing that appraisal inflation was more significant in securitized refinancing mortgages and that the effect was localized and more pronounced at specific LTV notches. Furthermore, we isolate the impact of securitization on appraisal inflation to cash-out refinancing mortgages. In conclusion, we present evidence suggestive of adverse selection in securitization based on appraisal bias. There is ample evidence linking appraisal inflation to the recent financial crisis (Ben-David, 2011; Kruger and Maturana, 2020). There is also evidence that the surge in private label mortgage securitization prior to the financial crisis fueled a large expansion in mortgage credit supply (Mian and Sufi, 2009). The findings of this paper highlight a critical connection between appraisal inflation and private mortgage securitization, and point to the need for proper policies or innovative security designs to reduce asymmetric information in appraisal inflation and the perverse incentives created by securitization.

The paper proceeds as follows. The next section describes our empirical methodologies. Section 3 discusses data used in this study and describes our sample. Section 4 discusses our empirical findings and robustness checks. Finally, Section 5 concludes.

2 Empirical Methodologies

The main focus of this study is on assessing appraisal inflation on properties securing jumbo refinance loans, determining whether portfolio refinance loans carry significantly different appraisal inflation than privately securitized refinance loans, and exploring for potential explanations. One reason why we focus on refinance mortgages is that appraisal plays a more important role in mortgage refinancing than home purchase financing because the property valuations of refinance loans are solely based on appraised values whereas purchase loans use the lower of appraised values and transaction prices.[7] More importantly, lack of transaction price makes it more difficult for outside parties to detect appraisal inflation on refinancing loans, which could lead to more severe information asymmetry in the secondary mortgage market. For purchase loans, the availability of sale prices limits the incidence and, likely, the severity of appraisal inflation. We further limit our analysis to refinance jumbo loans because, unlike conforming home loans, jumbo loans are either retained by lenders or sold to the private securitization market. In contrast, conforming loans can also be sold to GSEs or the agency MBS market. Therefore, jumbo loans provide a cleaner platform to investigate the impact of appraisal inflation on private mortgage securitization.[8] This section discusses our main measure of appraisal inflation and the two empirical approaches we develop to gauge the impact of securitization on appraisal inflation.

2.1 Measuring Appraisal Inflation

To measure appraisal inflation, we need to relate a property's appraised value at loan origination to its fair market value at that date. For the purposes of this study, we define appraisal inflation as the ratio of appraisal value to market value – we interchangeably use the terms appraisal inflation, appraisal quality, and appraisal bias in this paper. Even though we observe appraised values at loans origination, property values are not directly observable since refinance loans do not involve a transfer of property rights (thus no transaction prices). Since we do not directly observe property values for refinance loans to serve as an anchor to gauge the severity of appraisal inflation, we adopt a "repeat-sale" approach.

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[7] Therefore, property appraisals for purchase loans are conditioned on observed sale prices whereas appraisals for refinance loans are unconditional estimates of property values.

[8] The relationship between appraisal inflation and securitization is complex because appraisal inflation is not necessarily exogenous to the decision to securitize the associated loan. Although appraisal inflation may affect lenders' choice of which loans to securitize, the reverse could also be true because lenders may tolerate or initiate appraisal inflation for business purposes if those loans will be securitized. To the best of our ability, we try to shut the reverse causation in order to accurately estimate the effect of appraisal inflation on security. This is the one of the main contributions of this study.

To estimate property values at the origination of the refinance loans ($Time_0$), we identify the subsequent sale of the same property ($Time_1$) and then adjust that the subsequent sale price, which we refer to as $Price_1$, back to the preceding refinancing date ($Time_0$) using the change in local HPI between $Time_0$ and $Time_1$. This HPI-adjusted price from $Time_1$ back to $Time_0$ (Adj_Price_{10}) is computed as follows: $Adj\_Price_{01} = Price_1 \times HPI_0/HPI_1$, where HPI_0 and HPI_1 are the values of the local house price index at $Time_0$ and $Time_1$, respectively. We use this HPI-adjusted subsequent sale price as our measure of the property's fair market value at the origination of the associated refinance loan. Finally, we compute appraisal inflation on that property ($AppraisInfl$) as the ratio of the property's observed appraisal value at $Time_0$ ($Appraisal_0$) to the HPI-adjusted subsequent sale price (Adj_Price_{01}).[9]

2.2 Ex-Ante Analysis of the Securitization Decision

First, we explore the potential effect of appraisal inflation on lenders' decision to securitize loans using the following model:

$$\begin{aligned} Pr(Sec_i = 1) &= \alpha + \beta_1 \times AppraisInfl_i + \beta_2 \times LoanChars_i + \beta_3 \times PropChars_i \\ &\quad + Lender + LocationTime_0 + \eta_i \, . \end{aligned} \tag{1}$$

In this model, the dependent variable, Sec_i is a 1/0 variable that takes the value 1 if loan i is securitized and 0 if it is kept in the lender's loan portfolio. The estimated value of β_1, the slope of our variable of interest ($AppraisInf_i$), normally gives the average effect of appraisal inflation on the securitization decision if the relationship is well identified. To isolate the effect of appraisal inflation, our model includes loan characteristics ($LoanChars_i$), property characteristics ($PropChars_i$), and lender fixed effects to control for lender heterogeneity, and location-time fixed effects to account for local time-variant factors at origination affecting lenders' decisions to securitize loans. As common in the mortgage literature, we use OLS to

[9] $AppraisInfl = Appraisal_0/Adj\_Price_{01} = Appraisal_0/(Price_1 \times HPI_0/HPI_1)$. Treating the subsequent sale price of the same property as its fair market value when the property was refinanced is a reasonable assumption as long as the subsequent sale was an arm-length transaction. However, we recognize that Adj_Price_{01} is potentially a noisy measure of property value at the refinancing of the property because changes in market conditions may not be fully reflected in the HPI. Furthermore, this adjustment process does not take care of property-specific price changes. We address these potential identification challenges in our empirical analyses that follow and later test the robustness of our results using hedonic price estimates.

estimate equation (1), which produces linear probability estimates.[10]

As we alluded to earlier, a straight estimation of Equation (1) would not yield the true effect of appraisal inflation on the likelihood of securitization for the following two reasons. The first challenge is endogeneity due to reverse causality. This ex-ante examination of the impact of appraisal inflation on lenders' decisions to securitize originated loans requires that the appraisal occur prior to the securitization decision. Unfortunately, the timing of these decisions is not observable by the econometrician, which renders identification challenges because a lender's intention to securitize a loan might affect the appraisal. Secondly, errors in our measure of appraisal inflation could affect $\hat{\beta}_1$, the estimated value of β_1, because our adjustment of subsequent sale prices using changes in local HPIs may not fully account for price changes at the property level. Property-specific price changes will likely be missed by the HPI adjustment process, causing measurement errors.[11]

We develop two empirical techniques that allow us to generate two variants of our appraisal inflation measure that address these potential estimation problems. First, we refine our appraisal inflation measure to account for potential measurement errors due to property-level price appreciations missed by our HPI adjustment method. To address this potential problem, we first calibrate a property-level price appreciation model using only purchase transactions and then use our calibrated model to estimate property-specific price appreciations on properties securing refinance loans – since it is possible that properties backing securitized loans do not appreciate at the same rate as properties backing portfolio loans, we control for securitization status in our price appreciation model.[12] We then use estimated property appreciations, which we refer to as $\widehat{Appreciation}$ in our analysis, to deflate our original appraisal inflation measure. This new adjusted appraisal inflation measure, referred to as $Adj\_AppraisInfl$, normally takes care of property-specific price appreciations affecting our estimation results.[13]

We also produce a second variant of our original appraisal inflation measure that mitigates potential endogeneity from reverse causality and also adjusts for property-specific price appre-

[10] We use OLS regressions throughout this paper despite the binary nature of several dependent variables. The OLS model has an important advantage over probit or logit models as the estimates in probit or logit models are generally inconsistent when sample size is large with many fixed effects (Wooldridge, 2010).

[11] It is also possible that some lenders are more informed about future property-specific price changes and use that information to their advantage in the secondary market.

[12] Table A.1 of the appendix reproduces our property appreciation model.

[13] $Adj\_AppraisInfl = Appraisal_0/Adj\_Price_{01} - \widehat{Appreciation}$, where $Adj\_Price_{01} = Price_1 \times HPI_0/HPI_1$

ciations. This is accomplished by first predicting appraisal inflation that is independent of the securitization status and then adjusting our predictions downward for property-specific price appreciations in a manner almost similar to method described above. To predict appraisal inflation, we randomly split our sample into two. We calibrate an appraisal inflation model using one of the sub-samples and then use the calibrated model to generate the out-of-sample predictions for the loans in the other sub-sample.[14] Since the appraisal inflation data used to form predictions only adjust for local house price changes, we then estimate property-specific price appreciations using a model calibrated using observed sale prices of properties backing purchase loans. Unlike in the model used to predict price appreciations and used to compute our previous appraisal inflation measure ($Adj\_AppraisInfl$), we exclude securitization status from this price appreciation model and our appraisal prediction model, to ensure that securitization status has no direct impact on the predicted appraisal inflation. The resulting expected appraisal inflation measure ($E[ApppraisInfl]$) thus mitigates endogeneity from reverse causality and also takes care of property-specific price deviations affecting $AppraisInfl$, our original appraisal inflation measure consisting of ratio $Appraisal_0$ to Adj_Price_{01}.

Rather than estimating Equation (1) using $ApppraisInfl$, our original appraisal inflation measure, to be able to better interpret the resulting coefficient estimate due to the econometric issues discussed earlier, our ex-ante analysis of the impact of appraisal bias on securitization will rely on these improved measures, namely, $Adj\_AppraisInfl$ and $E[ApppraisInfl]$, that will be more informative on the effect of appraisal bias on securitization. In the next section, we propose a different empirical design relying our original appraisal inflation measure and a difference-in-differences approach to confirm the results from our ex-ante analysis of the impact of appraisal inflation on securitization.

In addition to exploring the average effect of appraisal inflation on the choice of which loans to securitize, we also examine the effect at critical LTV cutoffs (notches) above which mortgage pricing and private mortgage insurance (PMI) premiums go up.[15] Inflating an appraisal in

[14] Table A.2 of the appendix reports our appraisal prediction model.

[15] For example, Fannie Mae loan-level pricing adjustment matrix shows that the required minimum mortgage insurance coverage for a borrower with a credit score more than 740 is 0.125%, 0.375%, 0.5% and 1% for mortgages with LTV ratio equaling 80.01% to 85.00%, 85.01% to 90.00%, 90.01% to 95.00%, and 95.01% to 97.00%, correspondingly. Calem et. al., (2017) presents an informative graph in Figure 4 illustrating how private mortgage insurance changes to a higher category right above those LTV notches. These LTV notches are also critical cutoff points for mortgage pricing purposes. For example, Fannie Mae uses the same LTV categories

order to lower the LTV ratio to the notch or below would reduce financing costs, i.e., PMI premium and mortgage pricing. Therefore, the incidence of appraisal bias at LTV notches is likely to be more severe than at non-notches. Lenders are likely aware of lower appraisal quality at LTV notches and may use that to their advantage by selling loans with worst appraisal quality to secondary market and keeping on their books loans with lower appraisal inflation.

2.3 Ex Post Difference in Appraisal Inflation: Difference-In-Differences Design

To complement our ex-ante analysis of the effect of appraisal inflation on securitization decisions, we conduct additional analyses by investigating ex-post whether portfolio loans have different appraisal inflation than securitized loans. Our empirical design relies on the following DID framework. To identify whether securitized refinance loans and portfolio refinance loans have different appraisal inflation, we utilize new purchase loans as a control group to capture the potential difference in price appreciation between portfolio and securitized loans. By comparing the intensity of appraisal inflation on portfolio and securitized refinance loans relative to price appreciations on portfolio and securitized properties securing purchase loans, this allows us to difference out price appreciations clouding our primary appraisal inflation measure.[16] Our DID model specification is as follows:

$$\begin{aligned} AppraisInfl_i/Appreciation_i &= \alpha + \beta_1 \times Sec_i + \beta_2 \times Refi_i + \beta_3 \times Sec_i \times Refi_i \\ &\quad + \beta_4 \times LoanChars_i + \beta_6 \times PropChars_i \\ &\quad + LocationTime_0 + LocationTime_1 + \omega_i \,. \qquad (2) \end{aligned}$$

Our dependent variable takes two forms depending on the loan type. For refinance loans, it takes the value of our original appraisal measure, $AppraisInf$, the ratio of appraisal value at $Time_0$ ($Appraisal_0$) to Adj_Price_{01}, the HPI-adjusted $Time_1$ subsequent sale price of the same property. For loans belonging to our control group of purchase loans, our dependent

mentioned above to price individual mortgages.

[16] For the sake of clarity, whenever we mention appraisal inflation on loans, we are referring to the appraisal of the properties securing those loans.

variable is the ratio of the price of the property at origination, $Price_0$, to the HPI-adjusted subsequent sale price of the same property, Adj_Price_{01}. For refinance loans, our dependent variable captures appraisal inflation and property price appreciation not removed through the HPI adjustment, which will be removed through differencing using appreciations on purchase loans. Our DID design using purchase loans as a control group thus allows use to remove the appreciation from our appraisal inflation measure in a manner similar to the method used in the previous ex-ante analysis. The validity of the DID design needs the assumption that the difference in appreciation between refinance and purchase portfolio loans is on average similar to the difference in appreciation between refinance and purchase securitized loans. This should be a reasonable assumption.

In Equation (2), Sec identifies securitization status and is set to 1 for securitized loans and 0 for portfolio loans. $Refi$ is also a 1/0 variable indicating loan purpose that is equal to 1 for refinance loans and 0 for purchase loans. The interaction of these two variables, $Sec \times Refi$, is our variable of interest. Therefore, β_3, the coefficient of the interaction term, which measures the average appraisal inflation on securitized over portfolio refinance loans, is our main estimate of interest. Again, the inclusion of portfolio and securitized purchase loans in our DID estimation as a control group allows us to directly estimate appraisal inflation on portfolio and securitized refinance loans while controlling the potential difference in price appreciation between the different investor groups. As in our ex-ante analysis, we also control for loan characteristics ($LoanChars$) and property characteristics ($PropChars$) in Equation (2). Our model also include location-time fixed effect at origination ($LocationTime_0$) and at subsequent sale date ($LocationTime_1$). In addition to documenting the average difference in appraisal inflation between portfolio and securitized refinance loans, that is attributable to securitization, we also apply our DID method to loans at key LTV notches where appraisal inflation is likely to be more significant for the reasons discussed in the previous section.

3 Data

This section discusses the various data sources we use in this study and how we construct our sample. We also discuss the main variables used in our analysis and relevant descriptive statistics.

3.1 Sample Construction

This study combines two data sets: McDash and RealtyTrac. The McDash data set is from Black Knight Financial Service (BKFS), a Fidelity National Financial company.[17] The McDash data set contains U.S. home mortgages serviced by nine of the ten largest mortgage servicers and covers more than 60% of home mortgages. The data include mortgages kept by lenders as investment assets (portfolio loans) and those sold to secondary mortgage market investors (privately securitized mortgages). The data contain detailed loan origination information, such as borrower credit scores, property appraised values, loan-to-value (LTV) ratios; and subsequent loan performance data, such as payments and delinquency records. RealtyTrac collects U.S. residential real estate transaction (lien) information from county recorder offices (recorder data) and real estate property information from county assessors (assessor data). The recorder data include transaction types (e.g., loan refinance or home purchase), transaction dates, transferred values, and associated mortgage information. In addition to property asset values for tax purposes, the assessor data record property characteristics, such as property type, total square footage, number of rooms and bathrooms, and property age. We also use FHFA quarterly MSA-level house price index (HPI) data.

To construct the study sample, we first match the McDash data to the RealtyTrac recorder data. To ensure high quality matching, a critical requirement for the accuracy of our analysis, we match the two data sets along property type (e.g., single family), property zip code, transaction year and month, loan amount (in thousands of dollar), transaction purpose (refinance or purchase loan), and interest rate type (fixed or adjustable rate mortgage).[18] We require that properties be classified as single-family residence in both data sets and only keep unique matches, which yield a match rate is 30.3%. Next, for each mortgage in our McDash-RealtyTrac matched transaction sample, we identify the first subsequent sale of the same property from the RealtyTrac recorder data from the loan origination date until 2014 when our recorder data

[17] The data set was previously called LPS data. Fidelity National Financial acquired LPS Applied Analytics, the previous owner of the data, and established BKFS in 2014.

[18] Unlike RealtyTrac, McDash reports loan amounts in $ '000s and transaction year and month, instead of specific transaction dates.

end. We then keep mortgages with registered subsequent sale of the property as our initial sample.

Mortgages are heterogeneous products and underwriting standards evolve over time, particularly during prolonged lending expansions. For the sake of homogeneity in order to improve identification, we restrict our sample to conventional, single-family, first lien, jumbo loans originated in 2005 and 2006 on properties located in metropolitan statistical areas (MSAs).[19] We restrict the study to jumbo loans because, unlike conforming loans, they are either kept by lenders as investment assets or sold to private (non-agency) securitization shops. Conforming loans, on the other hand, can be retained by lenders, sold to government-sponsored enterprises (GSEs) and put into agency securitization deals, the most likely outcome, or sold to the private securitization market. By focusing on jumbo loans, we are able to shut off the agency securitization outlet, which allows us to compare and contrast lenders' portfolio and private securitization decisions. Therefore, jumbo loans provide a cleaner setting to investigate the effect of securitization, more specifically private market securitization, on property appraisal. Furthermore, we clean the remaining loan sample by excluding observations with missing values and, to avoid potential data error and ensure that only residential properties are included in the study, we limit loan amounts to $1.5 million and restrict LTVs between 0.3 and 1.05. Furthermore, we require that the loans entered into the McDash data within four months of their origination month to limit survival bias.

Both equations (1) and (2) require that we accurately identify each loan's securitization status. We use the investor status variable in McDash to identify securitization status. A mortgage may enter the McDash data as a portfolio loan and later switch to securitized loan because it may take a few months before the lender has amassed enough loans for securitization. Higgins et al. (2020) show that over seventy-five percent of securitized mortgages are sold within six months after origination. Therefore, we identify a mortgage's securitization status as its investor status six months after origination – we check that our results remain similar if we change our securitization status identification window to nine or twelve months.

[19]The McDash data poorly cover the period pre 2005. Variables key to this study, such as combined LTV (CLTV), documentation status, and debt-to-income (DTI) ratio, are missing for that period. We exclude 2007 from the study due to structural changes of the private securitization market. Following the mortgage crisis, lenders were no longer able to get rid of loans they initially intended to securitize, which makes it difficult to identify their intention to securitize loans originated that year.

In order to accurately capture lenders' initial intention to securitize originated loans, these two additional adjustments to our sample. Mortgages that default too early cannot be securitized and consequently remain on the lenders' books. Lenders may be forced to purchase back securitized loans due to misrepresentation and/or violation of warranty clauses. Neither early default loans, nor repurchased loans were initially destined to be keep as portfolio loans. Therefore, to better capture lenders' securitization intentions, we drop early default loans and repurchased mortgages from our sample. After these various data selection and cleaning steps, we end with a final sample of 21,106 loans, consisting of 13,298 refinance loans, the main focus of this study, and 7,808 purchase loans .

3.2 Summary Statistics

Table 1 presents the summary statistics of refinance loans, the focus of this study – Table A.4 in Appendix reports the same information on purchase loans, for comparison purpose. At loan origination, properties securing portfolio refinance loans are on average 4% more expensive than those securing securitized loans, despite having similar average property size, with the difference widening to 9% following the housing market meltdown. As far as appraisal inflation is concerned, on average, the two groups look very similar, with securitized loans showing a slightly higher level of appraisal inflation.[20] Furthermore, sold loans have lower average borrower credit score, higher CLTV ratio, higher DTI ratio, a higher percentage of mortgages with exotic features, and higher mortgage rates, which together suggests that they are of lower quality than loans kept by lenders, as evidenced by their higher default rates and level of distressed sales. However, the percentage of loans with fixed interest is higher for sold loans. The descriptive statistics of purchase loans in Table A.4 yield similar conclusions regarding characteristic differences between securitized and portfolio purchase loans.

Table 1 shows no significant difference in appraisal inflation between securitized and portfolio refinance loans. But as noted earlier, appraisal inflation is likely to be more pronounced at LTV notches. Table 2 compares the descriptive statistics of notch and non-notch portfolio and securitized refinance loans.[21] As predicted, portfolio and securitized notch loans show

[20] Exotic loans features include teaser rate, interest only, and balloon structure.

[21] As noted earlier, appraisal bias at LTV notches is likely to be more severe than at non-notches. Again, notches are the cutoff points above which PMI premiums increase. They are also critical cutoff points for

significantly higher appraisal inflation than corresponding non-notch loans. The difference in appraisal inflation between notch and non-notch loans is 4.95% for portfolio loans and 8.77% for securitized loans. More importantly in the context of this study, Table 2 shows significantly appraisal inflation on securitized notch loans than on portfolio notch loans, with could be indicative of adverse selection in securitization based on appraisal value. Whereas non-notch loans have similar levels of appraisal inflation, the level of appraisal inflation on notch securitized loans is 3.13% higher than that on portfolio notch loans. Furthermore, we find this difference in appraisal inflation to be economically meaningful because securitized notch loans subsequently defaulted at a much higher rate than notch portfolio loans – 3.53% and 8.4% with 12 and 24 months after origination, respectively.

It is possible that servicers approach differently the servicing of securitized and portfolio loans during default and loss mitigation, which could differently affect subsequent transaction prices of distressed securitized and portfolio loans. Therefore, excluding distressed sales from our DID analysis removes potential valuation differences between sold and portfolio loans that are due to differences in loan servicing. Our previous findings obtain when we exclude distressed loans with appraisal inflation being 3.2% higher on notch securitized loans than that on notch portfolio loans.

These observations provide initial evidence that securitized loans might carry higher valuation bias than portfolio loans at notches. Though the difference in the valuation ratios between portfolio loans and sold loans might be due to different loan/housing characteristics. The next section controls for loan/housing characteristics using a regression analysis investigating appraisal bias between sold and portfolio loans.

mortgage pricing – Fannie Mae uses the same LTV thresholds to price individual mortgages. Lenders most likely are aware of the lower appraisal quality at LTV notches and may choose to sell worse appraisal quality notch loans to the private market, while keep better appraisal quality notch loans on their books. Notch equals one if LTV ratio equals 80%, 85%, 90%, 95% or 97% or zero, otherwise.

4 Empirical Evidence

4.1 Ex-Ante Analysis: Appraisal Inflation on Lenders' Decision to Securitize

The most direct approach to examine how appraisal inflation affects the decision to securitize mortgage loans is from an ex-ante perspective, assuming that a lender knows the appraisal inflation when making securitization decision and the appraisal inflation is independent of the lender's intention to securitize the loan or not. We present results from such an analysis following the methodology developed in Section 2.2. As discussed in that section, an ordinary regression estimation of Equation (1) could yield inconsistent results because of the potential issues with measurement errors and everse causality. To overcome the challenges, we come up with two more robust measures of appraisal inflation, $Adj\_AppraisInfl$ and $E\{Appprais Infl\}$, in order to accurately estimate the effect of appraisal inflation on securitization using the empirical specification in Equation (1).[22]

Table 3 reports results from our ex-ante analysis of the effect of appraisal inflation on securitization using a linear probability model (LPM). Our dependent variable captures the loans' securitization status six months after origination.[23] Our measure of appraisal inflation in Model (A) is $Adj\_AppraisInfl$, the ratio of appraisal value to the HPI-adjusted subsequent sale price minus the predicted property appreciation based on the model in Table A.1. For the full sample, column (1) shows no statistically significant relationship between appraisal inflation and securitization, as the descriptive statistics in Table 1 indicate. This finding is not surprising because appraisal is unlikely to have a significant effect on average because, as discussed earlier, it normally only matters at specific LTV thresholds. To confirm this intuition, we divide our sample into notch and non-notch loans and re-estimate our model on each sub-sample. As expected, column (2) shows that appraisal inflation has no effect on securitization decision on non-notch loans since appraisal inflation is unlikely to have a significant pricing effect on those loans. In contrast, on our relatively small sub-sample of notch loans, appraisal

[22]As explained in Section 2.2, $Adj\_AppraisInfl$ is $Appraisal_0/Adj\_Price_{10} - \widehat{Appreciation}$ and $E[ApppraisInfl]$ is $\widehat{AppraisInf} - \widehat{Appreciation}$.

[23]For the sake of brevity, Table 3 only shows our main variable of interest. The full table is available at request.

inflation has a strong effect on lenders' decision to securitize those loans. Column (3) indicates that a one standard deviation increase in appraisal inflation on notch loans increases the likelihood of a notch loan being securitized by 1.8% or 2.3% in relative terms.[24] This effect is not only statistically significant, but also of economically meaningful. Though not reported to save space, the explanatory variables included in our model reported in Table A.3 behave appropriately.

As noted earlier, our previous measure of appraisal in Model (A) could be marred by potential reverse causality. To address this potential concern, Model (B) relies on our second measure of appraisal inflation, the expected appraisal inflation that is computed regardless of the securitization status as discussed in the methodology section. Columns (1'), (2'), and (3') report our ex-ante examination of the effect of expected appraisal inflation on securitization for the full sample, and non-notch and notch loans, separately – the smaller number of observations is due to the splitting of our sample into an estimation subsample and a prediction subsample. Again, we find no significant effect of expected appraisal inflation on securitization for the full sample and non-notch loans. However, lenders' decisions to securitized notch loans appear to be partly driven by the level of appraisal inflation on those loans. Based on the coefficient estimate in column (3'), a one-standard deviation increase in appraisal inflation increases the likelihood of a notch loan being securitized by 2.7%, or 3.5% in relative terms.[25] Again, unreported explanatory variables show no inconsistency.

It is comforting that the results from Model (B) align well with those derived from the other appraisal inflation measure used in Model (A). Not only are these results not shocking given the prevalence of appraisal inflation during the period covered by the study (e. g., Kruger and Maturana (2019)), they are also in line with other forms of adverse selection based on information asymmetry on mortgage quality documented in the literature (e. g., (Agarwal et al., 2012).

[24] 0.0627*0.284(not tabulated)= 1.8% or 1.8%/(10,242/13,298)=2.3% in relative terms.

[25] 0.1516*0.175(not tabulated)= 2.7% or 2.7%/(10,242/13,298)=3.6% in relative terms

4.2 Ex Post Difference in Appraisal Inflation : Difference-In-Differences Analysis

The previous section documents that lenders likely factor appraisal inflation in their securitization decisions. This section investigates ex post whether securitized loans and portfolio loans have different appraisal inflation. We present the findings of the DID estimation results based on the methodology described in Section 2.3. In this analysis, we use purchase loans to control for unobservable factors leading to differences in property appreciation between portfolio and securitized loans, and other potential confounding factors. This ex-post analysis allows us to identify the effect of securitization on appraisal inflation by comparing average appraisal inflation on securitized and portfolio mortgages after controlling for average property appreciation using properties backing purchase mortgages. This analysis directly uses our original appraisal inflation measure on refinancing loans, that is the ratio of appraisal value at loan origination to the HPI-adjusted subsequently sale price of the same property.

Table 4 reports DID regression results following Equation (2). Again, our dependent variable takes two forms. For refinance loans, the subject of this study, we use the ratio of the property appraisal value at loan origination to the HPI-adjusted subsequent sale price of the same property. For purchase loans, which are used to difference out price appreciation from securitized loans, our dependent value equals the property sale price at origination divided by the HPI-adjusted subsequent sale price of the same property. The variable of interest in Equation (2) is the interaction term $Sec \times Refi$, the interaction of our binary securitization variable (*Sec*) and refinancing variable (*Refi*). Its coefficient estimate β_3 for $Sec \times Refi$ captures the impact of securitization on appraisal inflation on securitized refinancing loans.

Column (1) reports DID results for the full sample. As in the corresponding ex-ante estimation, $\widehat{\beta}_3$ is positive but insignificant (0.2%), which indicates that there is no discernible difference in appraisal inflation between portfolio and securitized securing refinancing loans, although the level of appraisal inflation on portfolio loans is 6.1%. Similarly, the insignificant coefficient of *Sec* suggests that properties backing portfolio purchase loans and those backing securitized purchase loans appreciated at the same rate. We find similar results when we restrict our sample to non-notch loans in column (2). In line with previous ex-ante analysis results, column (3) shows, at the key LTV notches, securitized refinancing loans are associated with significantly higher appraisal inflation than corresponding loans kept by lenders. The level of appraisal level on refinancing securitized loans is 3.1%. In fact, column (3) shows that the level of appraisal bias on securitized refinancing loans is almost 2.7 times as large as on similar portfolio loans (4.9% vs. 1.8%). The negative coefficient of Sec indicates that properties backing securitized purchase loans experienced smaller value appreciation than those securing portfolio purchase loans.

As discussed, the dependent variable used in the above analysis compares property appraisal value or sale price at loan origination to the HPI-adjusted subsequent sale price. If a subsequent sale is a distressed sale, the mortgaged property may be sold at below market value. Thus, we control for distressed sale in the regressions. As a robustness check, we exclude loans with subsequent distressed sale and rerun our analysis. Columns (1'), (2'), and (3') of Table 4 report the results based on the restricted sample excluding loans associated to subsequent distress sales.[26] Not only do these results confirm those based the full sample, but they also document a significantly higher additional appraisal inflation on securitized relative to portfolio loans – 5.3% in column (3') compared to 3.1% in column (3).

The above estimations include a battery of loan and borrower characteristics to account for other differences between portfolio and securitized loans among refinancing and purchase loans. We also add house tenure and housing characteristics to increase the statistical power of the regression. Lending standards and real estate market conditions change over time and over space. We include MSA times loan origination year-quarter and subsequent sale year-quarter fixed effects to control for variations in property valuation over time and by location. We also control for whether the subsequent sale is a distress sale using a distress sale dummy in the full sample estimations.[27]

Given that the evidence gathered so far indicate that the effect of appraisal inflation on securitization largely concentrates on notch loans, the remainder of our analysis focuses on

[26] These are loans backed by properties whose subsequent sales were foreclosure, REO sale, or short sales. Distress property sales typically have noticeably lower transaction price than normal market sale. Servicers also play an important role in distress sales and may adopt different loss mitigation strategies for portfolio loans and sold loans.

[27] Table 4 omits the coefficient estimates of the explanatory variables since we do not any strong basis to make predictions on how they should affect the incidence and/or intensity of appraisal inflation.

those loans. But before exploring the effect of appraisal inflation on loan performance and further evidence of adverse selection based on information asymmetry about appraisal values, we first explore whether appraisal bias is in any way related to the vary by mortgage product types, which could inform us on the potential source of appraisal bias. Since it is possible that borrowers' motivations for seeking refinancing may create incentives for borrowers and/or lenders to influence appraisers, we explore differences between cash-out and term refinance loans.[28]

The evidence presented in this section consistently shows that sold notch loans have higher appraisal bias than portfolio notch loans. Higher appraisal bias could negatively affect mortgage investors due to mortgage under-insurance and possibly higher default risk.[29] Furthermore, the higher default risk associated with inflated appraisals may not be fully priced in the mortgage rates. The next section investigates these issues.

4.3 Loan Performance and Pricing Differences

Having documented that securitized refinancing loans had higher appraisal inflation, which appears to be a deliberate decision on the part of lenders, we now consider whether these loans were more likely to default because of their higher appraisal bias and whether this additional risk was properly priced. Unlike in Section 4.2 where we combine purchase loans to refinancing loans in order to accurately estimate the effect of securitization on appraisal inflation, our default analysis uses only refinance loans. We define default as the first occurrence of 90-day default, bankruptcy, or foreclosure within 12 and 24 months after origination – we use these two measures of default as the dependent variable to ensure that the results are robust to our definition of default. We adopt a conventional mortgage default model that identifies notch loans and securitization status, and controls for known mortgage default factors, such as borrower credit score (FICO), combined LTV, income documentation, DTI, loan amount, and interest rate type – our default specification is in Table 6. The explanatory variable of

[28] Cash-out refinance mortgages allow homeowners who have paid down their mortgages and/or whose properties appreciated to extract part of the built up equity by getting a new mortgage for a larger amount than the existing loan. The amount of equity that the borrower can extract will depend on the property's appraised value. For a term refinance loan, the borrower is generally wants to take advantage of more favorable mortgage rates to lower financing costs.

[29] A 2% to 5% appraisal bias could lower the required coverage for PMI by one or even two categories, and will therefore lead to significant under-insurance of the mortgage.

interest is the interaction term *Sec* x *Notch*. Its coefficient measures the difference in default between securitized and portfolio notch loans. Other control variables include securitization status, notch, other loan characteristics at origination, and lender fixed effects. In addition to borrower characteristics and mortgage variables, we control for changes in local market conditions by including time-varying location (MSA) fixed effects. Due to the large number of fixed effects included in our model, we adopt a linear probability model (LPM) to estimate the intensity of default on notch portfolio and securitized refinance loans.

Table 6 reports 12- and 24-month estimation results. In line with our previous results showing that properties securing securitized notch loans have higher appraisal inflation, column (1) shows that those loans are also more likely to default. Average 12-month default rate on securitized notch loans are 2.3% higher than on portfolio notch loans and 3.6% (i.e., 2.3%+1.3%) higher than on portfolio non-notch loans – these estimates are statistically and of significant magnitude compared to average 12-month default of 2.7% and 4.4% on portfolio and securitized refinance loans, respectively (Table 1). After we divide our sample into cash-out and term refinancing loans in columns (1) and (2), we find that the documented increase in 12-month default on notch loans is restricted to cash-out refinancing. While securitized cash-out notch loans default at a much higher rate than portfolio notch loans (by 2.72%), portfolio and securitized term refinance notch loans have statistically similar average default rates. Twenty-four month default regressions in column (1'), (2,), and (3') confirm these findings. As expected, 24-month default estimates are higher due to the longer observation period. Confirming the validity of our results, the effects of most control variables included in our model are relatively intuitive. For example, lower FICOs, higher CLTVs, and higher loan amounts are associated with likelihoods of default. Our analysis suggests that higher appraisal inflation on securitized notch loans may have contributed to the higher default rate observed at those notches. Compared with lenders, MBS investors ended up holding under-insured mortgages with higher probability of default.

The previous sections show that sold notch loans have higher appraisal bias and that the higher appraisal bias most likely caused the observed higher default rate. This may indicate adverse selection in mortgage securitization as worse quality loans were sold to the MBS investors. However, if the additional credit risk associated with the higher appraisal bias in sold notch loans is priced in the mortgage rates and MBS prices, then the previous findings is not sufficient to claim adverse selection in private securitization. It could just be due to differences in lenders' and investors' risk preferences. Though we do not have access to MBS pricing, this section attempts to investigate whether the additional risk at sold notch loans is priced in mortgage contract rate.

To address this question, we regress mortgage rates on the same set of variables as in our previous default. Table 7 reports regression results for the full sample in the first three columns and fixed-rate mortgages (FRMs) in the last three columns.[30] Whether we examine all refinancing loans in column (1) or restrict our analysis to cash-out and term loans in columns (2) and (3), respectively, we find no significant difference in mortgage rates charged on securitized and portfolio notch loans – the same is true when we restrict the analysis to FRMs.[31] This indicates that the additional risk for sold notch loans is not priced in mortgage rates, therefore not passed through MBS investors. Therefore, this finding evidences adverse selection in private securitization based on appraisal inflation.[32] Table 7 also shows that, compared to portfolio loans, securitized non-notch loans pay higher interest rates, which compensates investors for the higher default rate found in Table 6.

4.4 Lenders' Informational Advantage and Adverse Selection

First, we test for information asymmetry among lenders and next explore for evidence of adverse selection in securitization. The existence of adverse selection in mortgage securitization based on appraisal inflation relies on lenders having some information advantage about property values over MBS investors. Although this may be true for local lenders, since property values are largely driven my local factors, outside lenders may not be better informed than security investors about property values. To test this hypothesis, we explore differences in appraisal inflation between loans originated by small lenders, who tend to be local, and those originated

[30] We separately examine FRMs because they have more homogeneous loan terms and pricing than adjustable rate mortgages.

[31] Since McDash reports servicing data, it does not contain mortgage origination pricing information, such as annual percentage rates (APRs) or points. Consequently, we cannot not affirmatively conclude that the additional appraisal inflation on securitized notch loans is not priced outside of interest rates.

[32] However, this does not mean that borrowers do not face higher financing costs. The insignificant coefficient of *Notch* in Table 7 only indicates that there is no major rate difference between notch securitized and portfolio loans. Lenders may charge more points on average on notch securitized loans, which most likely would not be passed through to investors.

by big (national) lenders.[33]

Table 8 reports our tests of asymmetric information investigating whether the difference in appraisal inflation between securitized and portfolio refinancing loans documented in Table 4 varies with lenders' local market knowledge. For this exercise, we estimate the same model as in Table 4, except for the addition of lender fixed effects in Table 8 to control for lender heterogeneity. Therefore, we are capturing within-lender average differences in appraisal inflation between securitized and portfolio refinance loans. Columns (1) and (2) of Table 8 show no difference in appraisal inflation between securitized and portfolio notch or non-notch loans originated by large banks. This result aligns with the idea that big banks lack the local market knowledge to cherry-pick which loans to securitize based on appraisal inflation.[34] In contrast, small lenders appear to take advantage of their local market knowledge when securitizing originated loans. Column (1') finds no significant difference in the level of appraisal inflation on securitized and portfolio non-notch loans but column (2') shows that securitized notch loans have higher appraisal inflation than non-sold loans. These results suggest that the impact of securitization on appraisal inflation found in our previous analyses largely confines to notch loans originated by small banks, who appear to take advantage of their familiarity with local housing markets.

Next, we cursorily explore the role of lender-MBS issuer affiliation on lenders' propensity to take advantage of information asymmetry about appraisal quality when selecting which mortgages to sell to MBS issuers. To identify lender-issuer affiliation, we need both lender and issuer identities. But although the RealtyTrac data contain lender information, neither McDash nor RealtyTrac has issuer information. Following Yavas and Zhu (2021), we identity lender-issuer affiliation using changes in investor status in McDash. We can observe in McDash whether a mortgage enters into the database as a portfolio or a securitized loan and can use that information to infer whether the lender and issuer are likely to be affiliated. If a mortgage enters the McDash data as a portfolio loan and its investor status later changes to sold loan, which implies that the same servicer likely handles the loan before and after securitization,

[33]We arbitrarily classified as big lenders those who originated at least thirty mortgages in our sample and small lenders as those with less than thirty loans.

[34]It is also possible that large banks deliberately refrain from using appraisal inflation when deciding which loans to securitize due to reputational concerns.

then it is safe to assume that the lender is likely to be affiliated with the issuer. If, however, a mortgage enters the data set directly as a sold loan, then it is likely that the servicer took over when the loan was sold and is therefore less likely to be affiliated with the lender, which implies that the lender and the issuer are less likely to be affiliated.[35]

The rationale for checking issuer-lender relationship relies on the assumption that affiliated lenders should be more motivated to conduct additional screening during underwriting in order to accurately assess mortgage risk and pricing, and servicing rights. After identifying affiliation for securitized loans, we divide them into two subgroups: affiliated and unaffiliated loans. We then add portfolio loans to each subgroup in order to assess differences in appraisal inflation between portfolio and securitized loans within each subgroup. Table 9 reports the regression results for the affiliated and unaffiliated sub-samples. For affiliated non-notch loans, we find no difference in appraisal inflation between portfolio and securitized loans. In contrast, securitized unaffiliated notch loans show significantly higher levels of appraisal inflation than portfolio unaffiliated portfolio loans. These results suggest that lenders may exploit their informational advantage about appraisal quality to benefit themselves and related parties in the secondary market.

4.5 Additional Robustness Tests

This section conducts additional tests on the relationship between securitization and appraisal inflation for the purposes of confirming the robustness of our previous results. We first look at how appraisal inflation correlates with borrowers' mortgage product choices and next consider alternative property valuation measures.

4.5.1 Variations in Appraisal Inflation by Mortgage Types

The importance of appraisal inflation certainly varies with borrowers' financial situation because financially-constrained borrowers may gain more from appraisal inflation than borrowers who are in a stronger financial situation. This may lead to heterogeneity in appraisal inflation across mortgage product types. For example, financially constrained borrowers may

[35] This classification method is not perfect. For this reason, we think of lender-issuer affiliation as likely affiliation and unaffiliation as unlikely affiliation.

have more difficulty meeting mortgage downpayment requirements or may have a greater need to extract equity through refinancing, thus creating an added incentive to seek high property valuations – this could also lower mortgage financing costs. So, we explore these questions from two perspectives: mortgage interest types (FRM vs. ARM) and combined LTV. For this analysis, we use the same model as in column (1) of Table 4 with the addition of lender fixed effects, but we restrict our sample to notch loans given that the effect of securitization on appraisal inflation concentrates on those loans. As in Table 4, we include purchase loans to control for price appreciations.

Table 10 summarizes our findings. When we divide our sample between FRM and ARM loans in columns (1) and (2), the effect of securitization on appraisal bias is only significant for the ARM subgroup. Whereas FRM securitized and portfolio notch refinance loans have similar appraisal bias, the level of appraisal inflation on ARM securitized notch refinance loans is 4.44% than on corresponding portfolio notch loans. There are a number of possible explanations for this finding. ARM loans are generally riskier than FRM loans and ARM borrowers during the 2005-06 period may have been more financially constrained, thus providing lenders additional motivation to adversely select against holding loans with high appraisal inflation in their portfolios. It is also possible that ARM loans were predominantly used by borrowers refinancing their mortgages in order to extract equity from their homes. Columns (3) and (4) restrict our previous regression model to loans at 80% LTV and those at above 80% LTV, which would require private mortgage insurance in most cases. For the 80%-LTV loans, we find no difference in appraisal inflation between securitized and portfolio notch refinance loans. In contrast, the average appraisal bias on loans with LTV greater than 80% is 9.74% higher on securitized than comparable portfolio refinance loans. Although this figure seems large, it is not surprising because this group of loans may be more likely to experience substantial appraisal inflation to bring down LTV, thus increasing the chance of loan approval and reducing financing costs for borrowers.

4.5.2 Using Hedonic Property Values

Our main appraisal inflation measure uses the adjusted subsequent sale price of the same property as anchor value. However, it is possible that the requirement of a repeat sale biases our sample because properties with subsequent sales may be characteristically different from those that did not sell during the same period. To address this potential issue and check the robustness of our previous findings, we construct hedonic property prices, which do not require repeat sales. We develop hedonic price estimates for each property in our sample using the RealtyTrac recorder and assessment data and then use those estimates as alternative estimates of fair market value to generate new measures of appraisal inflation. Since we only use these hedonic price estimates to check the accuracy of our results, we limit the analysis to Los Angeles County, California, the most populated county in the U.S. We estimate the hedonic property prices at loan origination using recent nearby property transactions, for only that information is available to the appraisers when they conducted the appraisals. We estimate hedonic prices using previous three-month transactions and six-month transactions.[36] We exclude loans with valuation ratio (appraisal/hedonic price) in the top and bottom one percentile of the sample to eliminate data errors and make sure that our results are not driven by outliers. We treat these hedonic price estimates as fair property values and then generate new measures of appraisal inflation as the ratio of appraised value of hedonic prices.

As before, we restrict this analysis to jumbo refinancing loans. Since hedonic property values are computed at loan origination, there is no need to identify subsequent property sales in order to estimate property values at the time of loan origination, which eliminates the need to control for price appreciations using purchase loans. Consequently, this analysis does not adopt the DID framework laid out in Equation 2.

Table 11 presents our model specification comparing appraisal inflation on securitized and portfolio notch and non-notch loans based on our 3-month hedonic price estimates. The dependent variable in these regressions is the property's appraisal value at loan origination divided by its hedonic value estimate at that date. As in our appraisal inflation estimations in Table 4, the estimations in Table 11 include an extensive set of loan characteristics at origination and housing characteristics. We also include zip code and loan origination quarter fixed effects. Again, we are interested in the coefficient of the interaction term, Sec x $Notch$. As before, the regressions in columns (1), (2), and (3) document a significant amount of appraisal in-

[36] Our hedonic model includes an extensive set of property characteristics, location fixed effects, and time trends – see Table 11 notes.

flation (2.2%) on securitized notch loans compared to notch portfolio loans, that significantly affects cash-out refinancing loans. Among cash-out refinancing loans, securitized notch loans have around 2.5% higher appraisal than the corresponding portfolio loans. The results are unchanged when we add lender fixed effects in the next three columns or when we use 6-month hedonic price estimates in Table A.5. These results are strongly consistent with the findings from previous analysis using our repeat sale appraisal inflation measure.

To sum up, the main finding of this study that sold refinance loans have higher appraisal than corresponding portfolio loans is robust to various model specifications. This result does not appear to be driven by omitted systematic differences between sold and portfolio loans, differences in servicing between the two loan groups, or lender heterogeneity. We find that inflated appraisals on sold notch loans are associated with higher default. However, the additional credit risk is not priced in mortgage rates, which adversely affect MBS investors. These results evidence the presence of adverse selection in securitization based on property appraisal values.

5 Conclusions

Residential MBS investors suffered heavy losses as a result of the housing market meltdown that led to the Great Recession. Inflated appraisal, which conveys misleading information regarding collateral value to mortgage investors, has often been cited as one main reason of the foreclosure crisis and resulting massive MBS losses. However, due to data constraints, critical questions such as whether lenders sell loans with higher appraisal inflation to the MBS investors and whether sold loans have different appraisal inflation than portfolio loans have not been fully investigated by academic research. This paper investigates adverse selection as of appraisal inflation in securitization in the years leading to the mortgage crisis. Understanding the exact relation between securitization and appraisal inflation is of importance for the future of private securitization.

Combining a nationwide mortgage data set with a nationwide real estate transaction data set, we conduct both ex ante analysis investigating whether lenders factor appraisal inflation in their securitization decision, and ex post analysis examining whether sold loans have different appraisal inflation than similar portfolio loans. Our empirical methodologies minimize the potential measurement errors and reverse causality issues in the ex ante analysis. The ex post analysis adopts a difference-in-difference design and controls for unobservable difference between sold and portfolio loans using the new purchase loans as a control group.

The results show that loans with higher appraisal inflation have a higher probability of sale into MBS pools. Ex post, sold loans carry significantly higher appraisal inflation than similar portfolio loans. The effect centers on loans with LTV ratios locating on the critical notches. In addition, despite of the significant worse performances of sold notch loans, we find no difference in pricing between sold and portfolio notch loans. Lenders likely exploit their informational advantage about appraisal quality to benefit themselves or their affiliations in the secondary market. The results are robust after controlling the potential impact of servicer and lender effects, and hold when we when we infer appraisal inflation from repeat sale transactions or hedonic price estimates. These findings indicate the existence of adverse selection in securitization based on appraisal inflation with lenders choosing to keep mortgages with lower appraisal inflation and selling those with higher appraisal inflation, without compensating MBS investors for the additional risk. Appraisal inflation is a crucial concern for the stability of mortgage markets. Proper polices/regulations or innovative security designs are called for in order to reduce asymmetric information in appraisal inflation and the perverse incentives created by securitization.

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Table 1: Sample Summary Statistics

	Portfolio		Securitized	
Variable	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*
Appraisal_0 (in $1000)	784.675	238.644	753.711	228.381
Price_1 (in $1000)	587.030	281.259	536.897	263.909
Appraisal Inflation (Appraisal_0/Adj_Price_1)	1.173	0.293	1.181	0.296
Notch	0.292	0.455	0.341	0.474
FICO (in 100)	7.039	0.554	6.969	0.595
CLTV (in %)	74.632	10.039	75.889	10.992
LowDoc	0.580	0.494	0.519	0.500
DTI (in %)	35.054	14.615	37.803	11.910
FRM	0.093	0.291	0.223	0.416
Exotic	0.361	0.480	0.403	0.490
OwnerOccupied	0.866	0.341	0.915	0.279
Term (in months)	382.068	49.776	371.347	41.961
Interest (in %)	4.722	2.557	5.806	2.193
LoanAmount (in $100K)	5.666	1.547	5.463	1.406
Tenure (in months)	50.898	27.134	54.172	26.754
LotSize (in 1000)	17.611	37.839	17.738	38.515
SQFT (in 1000)	2.194	1.450	2.157	6.996
PropertyAge (in months)	28.895	25.845	29.397	25.605
Bedroom	2.971	1.611	3.030	1.522
Bath	2.381	1.225	2.345	1.771
Distress	0.323	0.468	0.400	0.490
Default12	0.027	0.161	0.044	0.206
Default24	0.104	0.306	0.162	0.368
Default	0.326	0.469	0.497	0.500
N of Obs	3,056		10,242	

Notes: Our study sample is made up of refinancing jumbo loans originated in 2005 and 2006. This table reports the summary statistics for portfolio and securitized refinancing loans separately. The property valuation at time 0 (Value t=0) is the appraised value at loan origination. The valuation of the same property at t=1 (Price1) is the transaction price of the subsequent sale. Price1_Adj is the HPI-adjusted subsequent transaction price. Appraisal Inflation is the ratio of Value0 to Price1_Adj. Notch equals one if LTV ratio equals 0.8, 0.85, 0.9, 0.95 or 0.97. Otherwise, notch equals zero. If the subsequent sale is a distressed sale, distress equals 1. Otherwise distress equals zero. If a borrower defaults within 12 months or 24 months or the sample time period, default12m/default24m/default equals 1 correspondingly, otherwise equals zero.

Table 2: Summary Statistics - Notch=0 versus Notch=1

		Portfolio		Securitized	
Variable	*Sample*	*Notch=0*	*Notch=1*	*Notch=0*	*Notch=1*
Appraisal_0/Adj_Price_1	Full Sample	1.1581	1.2076	1.1512	1.2389
Appraisal_0/Adj_Price_1	Distress=0	1.0881	1.1085	1.0729	1.1406
Default12m		0.0204	0.0415	0.0272	0.0777
Default24m		0.0718	0.1829	0.1076	0.2670

Notes: This table reports summary statistics for refinance loans. The sample is divided into loans with LTV at notches versus those not at notches. We report the summary statistics for portfolio loans and securitized loans separately. The property valuation at time 0 (Value0) is the appraised value for a refinance loan at origination. The valuation of the same property at t=1 (Price1) is the transaction price of the subsequent sale. Price1_Adj is the HPI-adjusted later transaction price. Notch equals one if LTV ratio equals 0.8, 0.85, 0.9, 0.95 or 0.97. Otherwise, notch equals zero. We report the Value0/Price1_Adj for the overall refinance sample and the sample excluding those with subsequent distressed sales.

Table 3: Securitization Decision and Appraisal Inflation

	Model (A)			**Model (B)**		
	(1)	*(2)*	*(3)*	*(1')*	*(2')*	*(3')*
Dep. Var: Securitization Dummy	*All Loans*	*Notch=0*	*Notch=1*	*All Loans*	*Notch=0*	*Notch=1*
Appraisal Inflation	0.0060	-0.0125	0.0627***	-0.0274	-0.0089	0.1516**
	(0.0132)	(0.0167)	(0.0230)	(0.0449)	(0.0523)	(0.0695)
Control Variables	Y	Y	Y	Y	Y	Y
MSA*YYQQ Orig. FE	Y	Y	Y	Y	Y	Y
Lender FE	Y	Y	Y	Y	Y	Y
R-Square	0.1871	0.1904	0.2566	0.2049	0.2142	0.3133
N. Obs.	13,298	8,912	4,386	5,308	3,551	1,757
Appraisal Inflation	$\mathbf{AppraisInf} - \widehat{\mathbf{Appreciation}}$			$\widehat{\mathbf{AppraisInf}} - \widehat{\mathbf{Appreciation}}$		

Notes: This table investigates whether appraisal inflation has any impact on lender's securitization decision. It reports the coefficient estimates and standard errors of the OLS regressions of securitization decision. Refinance loans are included in the analysis. Appraisal inflation in Model A is measured as the difference of the valuation ratio and the estimated property appreciation rate ($\widehat{Appreciation}$). Valuation ratio is the ratio between appraisal at origination and the subsequent sale price (HPI-adjusted) of the same property. Property appreciation rate of refinance loans is estimated in two steps: (1)estimate the new purchase loan appreciation equation, and (2)apply the coefficient estimates from (1) to the refinance loans to have the $\widehat{Appreciation}$. Since the valuation ratio for refinance loans contains property appreciation information, Model A intends to extract the property appreciation from the valuation ratio to have a measure of appraisal inflation. Appraisal inflation in Model B is measured by taking the difference of the estimated valuation ratio ($\widehat{Ratio}$) and the estimated property appreciation rate ($\widehat{Appreciation}$). $\widehat{Ratio}$ is estimated in three steps: (1)divide the refinance loans into a random 60% estimation sample and a 40% holdout sample; (2) use the estimation sample to run regression of valuation ratio regardless of the securitization status; and (3)apply the coefficient estimates from (2) to the holdout sample to have $\widehat{Ratio}$. Property appreciation rate is estimated with securitization status in Model A and regardless of the securitization status in Model B. The purpose of model B is to not only extract property appreciation from the valuation ratio to infer appraisal inflation but also eliminate potential reverse causality between securitization and appraisal inflation. Other control variables include loan characteristics at origination, MSA*origination quarter fixed effects and lender fixed effects. Standard errors are clustered by MSA. *** $p<0.01$,** $p<0.05$, * $p<0.10$.

Table 4: Securitization and Appraisal Inflation – DID Regression Overall Sample Results

	Full Sample			Excluding Distress Sales		
	(1)	*(2)*	*(3)*	*(1')*	*(2')*	*(3')*
Variable	*All loans*	*Notch=0*	*Notch=1*	*All Loans*	*Notch=0*	*Notch=1*
Sec x Refi	0.0018	-0.0076	0.0312**	-0.0047	-0.0140	0.0529**
	(0.0088)	(0.0113)	(0.0158)	(0.0108)	(0.0133)	(0.0224)
Sec	-0.0064	0.0003	-0.0248**	0.0009	0.0082	-0.0308*
	(0.0070)	(0.0094)	(0.0119)	(0.0087)	(0.0112)	(0.0164)
Refi	0.0609***	0.0853***	0.0179	0.0596***	0.0763***	0.0130
	(0.0079)	(0.0100)	(0.0145)	(0.0095)	(0.0117)	(0.0201)
Control Variables	Y	Y	Y	Y	Y	Y
MSA*YYQQ Orig FE	Y	Y	Y	Y	Y	Y
MSA*YYQQ LaterSale FE	Y	Y	Y	Y	Y	Y
R-Square	0.4036	0.4182	0.4896	0.3173	0.3444	0.5069
N. Obs.	21,072	13,182	7,890	12,978	9,000	3,978

Notes: This table reports the coefficient estimates and standard errors of the DID regressions of appraisal inflation. The focus is the interaction term that indicates the difference in valuation bias between portfolio and securitized refinance loans. New purchased loans are included as a control group to account for the unobservable differences between the two groups. The table reports the results of the overall samples and the sub samples excluding loans where the subsequent transaction is a distressed sale such as short sale or foreclosure sale. The dependent variable (Value0/Price1_Adj) is the ratio between valuation at origination and the subsequent sale price (HPI adjusted) of the same property (appraisal at origination versus later sale price for refinance loans, and sale price at origination versus later sale price for new purchase loans). The property valuation at orignation (Value0) is the appraised value for a refinance loan and the sale price for a new purchase loan. Price1_Adj is the HPI-adjusted subsequent transaction price. Notch equals one if the LTV ratio equals 0.8, 0.85, 0.9, 0.95 or 0.97. Otherwise, notch equals zero. Standard errors are clustered by MSA. *** $p<0.01$,** $p<0.05$, * $p<0.10$.

Table 5: Securitization and Appraisal Inflation on Notch Loans – Cash-Out and Term Refinance

	Full Sample		Excluding Distress Sales			
	(1)	*(2)*	*(1')*	*(2')*	*(1")*	*(2")*
Variable	*Cash-Out*	*Term*	*Cash-Out*	*Term*	*Cash-Out*	*Term*
Sec*Refi	0.0346**	0.0366	0.0572**	0.0572	0.0580**	0.0652*
	(0.0166)	(0.0237)	(0.0231)	(0.0359)	(0.0234)	(0.0365)
Sec	-0.0256**	-0.0205	-0.0259	-0.0184	-0.0347**	-0.0255
	(0.0120)	(0.0129)	(0.0165)	(0.0183)	(0.0167)	(0.0186)
Refi	0.0154	0.0142	0.0072	0.0187	0.0078	0.0147
	(0.0151)	(0.0213)	(0.0206)	(0.0309)	(0.0208)	(0.0312)
Controls	Y	Y	Y	Y	Y	Y
MSA*YYQQ Orig FE	Y	Y	Y	Y	Y	Y
MSA*YYQQ LaterSale FE	Y	Y	Y	Y	Y	Y
Lender FE	N	N	N	N	Y	Y
R-Square	0.5026	0.5490	0.5214	0.5865	0.5396	0.6116
N. Obs.	7,233	4,716	3,721	2,446	3,721	2,446

Notes: Notes: This table divides the notch loans into cash out refinance and term refinance sub samples. We report the results of the full samples and the sub samples excluding loans where the subsequent transaction is a distressed sale such as a short sale or a foreclosure sale. Loans included are those at LTV ratio notches. It reports the coefficient estimates and standard errors of the DID regressions of valuation bias. The main interest is the difference in the valuation bias between portfolio refinance and securitized refinance loans. New purchased loans are included as a control group to account for the unobservable difference between sold and portfolio loans. The dependent variable (Value0/Price1_Adj) is the ratio between valuation at origination and the subsequent sale price (HPI-adjusted) of the same property. The property valuation at origination (Value0) is the appraised value for a refinance loan and the sale price for a new purchase loan. Price1_Adj is the HPI-adjusted subsequent transaction price. Notch equals one if LTV ratio equals 0.8, 0.85, 0.9, 0.95 or 0.97. Other model specifications and control variables are the same in Table 3. Otherwise, notch equals zero. Standard errors are clustered by MSA. *** $p<0.01$,** $p<0.05$, * $p<0.10$.

Table 6: Appraisal Inflation and Mortgage Performance – Are Sold Notch Loans More Likely to Default than Portfolio Notch Loans?

	12-Month Default			24-Month Default		
	(1)	*(2)*	*(3)*	*(1')*	*(2')*	*(3')*
Variable	*All Loans*	*Cash-Out Refi*	*Term Refi*	*All Loans*	*Cash-Out Refi*	*Term Refi*
Sec * Notch	0.0230**	0.0272***	-0.0028	0.0413***	0.0505***	-0.0227
	(0.0101)	(0.0095)	(0.0164)	(0.0148)	(0.0146)	(0.0299)
Sec	0.0130***	0.0128***	0.0052	0.0450***	0.0453***	0.0302**
	(0.0042)	(0.0042)	(0.0077)	(0.0048)	(0.0051)	(0.0115)
Notch	-0.0066	-0.0108	0.0129	0.0049	-0.0082	0.0762**
	(0.0082)	(0.0087)	(0.0179)	(0.0132)	(0.0131)	(0.0311)
FICO	-0.0596***	-0.0542***	-0.0677***	-0.1197***	-0.1124***	-0.1359***
	(0.0045)	(0.0044)	(0.0076)	(0.0059)	(0.0062)	(0.0115)
CLTV	0.0008***	0.0007**	0.0004	0.0044***	0.0041***	0.0029***
	(0.0002)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0006)
LowDoc	-0.0035	-0.0072*	0.0012	0.0203***	0.0079	0.0198**
	(0.0038)	(0.0040)	(0.0062)	(0.0062)	(0.0056)	(0.0098)
DTI	0.0003**	0.0003***	-0.0001	0.0004*	0.0004*	0.0001
	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0005)
FRM	-0.0193***	-0.0211***	-0.0120	-0.0492***	-0.0486***	-0.0618***
	(0.0047)	(0.0045)	(0.0122)	(0.0084)	(0.0089)	(0.0185)
Exotic	-0.0065	-0.0063	-0.0032	-0.0237***	-0.0204***	-0.0314**
	(0.0046)	(0.0053)	(0.0089)	(0.0059)	(0.0066)	(0.0128)
OwnerOccupied	-0.0024	-0.0087	0.0116	-0.0528***	-0.0601***	-0.0122
	(0.0067)	(0.0080)	(0.0122)	(0.0131)	(0.0140)	(0.0295)
Term	0.0002***	0.0002***	0.0002**	0.0004***	0.0003***	0.0004***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
LoanAmount	0.0025**	0.0022**	0.0003	0.0056**	0.0041	0.0086**
	(0.0011)	(0.0010)	(0.0020)	(0.0026)	(0.0025)	(0.0040)
MSA*YYQQ Orig FE	Y	Y	Y	Y	Y	Y
Lender FE	Y	Y	Y	Y	Y	Y
R-Square	0.1270	0.1341	0.1759	0.2375	0.2349	0.2951
N Obs	13,275	11,361	3,987	13,275	11,361	3,987

Notes: This table investigates whether sold notch loans have different default probability than portfolio notch loans. Refinance loans are included in the analysis. This table reports the coefficient estimates and standard errors of the OLS regressions of default. The dependent variable, default, equals one if a borrower missed at least three mortgage payments or was in foreclosure or bankruptcy status within twelve or twenty-four months after origination (Default12m and Default24m), and equals zero otherwise. Independent variables include loan characteristics at origination, MSA*origination quarter fixed effects, and lender fixed effects. Standard errors are clustered by MSA. *** p<0.01,** p<0.05, * p<0.10.

Table 7: Appraisal Inflation and Mortgage Pricing – Are Sold Notch Loans Priced Higher than Portfolio Notch Loans?

	Full Sample			FRM		
	(1)	*(2)*	*(3)*	*(1')*	*(2')*	*(3')*
Variable	*All Loans*	*Cash-Out Refi*	*Term Refi*	*All Loans*	*Cash-Out Refi*	*Term Refi*
Sec x Notch	0.0505	0.0427	0.0108	-0.1235	-0.1724	-0.1634
	(0.1356)	(0.1442)	(0.1613)	(0.1316)	(0.1621)	(0.1231)
Sec	0.5616***	0.4767***	0.4477***	0.0045	0.0381	0.0260
	(0.0465)	(0.0463)	(0.0671)	(0.0669)	(0.0782)	(0.0956)
Notch	-0.0485	0.0078	-0.1006	0.1512	0.1902	0.1816
	(0.1332)	(0.1410)	(0.1347)	(0.1434)	(0.1681)	(0.1422)
FICO	-0.5492***	-0.5839***	-0.1000*	-0.2673***	-0.2756***	-0.1457***
	(0.0441)	(0.0471)	(0.0534)	(0.0238)	(0.0240)	(0.0434)
CLTV	0.0083***	0.0106***	0.0040	0.0067***	0.0068***	0.0048
	(0.0023)	(0.0020)	(0.0039)	(0.0013)	(0.0011)	(0.0031)
LowDoc	-0.4029***	-0.3508***	-0.3933***	0.0788**	0.0637*	0.0785
	(0.0560)	(0.0596)	(0.0716)	(0.0334)	(0.0338)	(0.0606)
DTI	0.0034	0.0039	0.0056**	-0.0005	0.0000	-0.0014
	(0.0024)	(0.0027)	(0.0027)	(0.0015)	(0.0018)	(0.0016)
FRM	0.7490***	0.6351***	0.9956***	0.0000***	0.0000***	0.0000***
	(0.0666)	(0.0658)	(0.0700)	(0.0000)	(0.0000)	(0.0000)
Exotic	0.8480***	0.7537***	0.9724***	-0.0035	-0.0029	0.0447
	(0.0620)	(0.0723)	(0.0468)	(0.0314)	(0.0329)	(0.0524)
OwnerOccupied	-0.0096	-0.0923	0.2219	-0.2272**	-0.2937**	-0.3504***
	(0.0609)	(0.0599)	(0.1442)	(0.1001)	(0.1162)	(0.1301)
Term	-0.0033***	-0.0021***	-0.0059***	0.0011***	0.0010***	0.0009*
	(0.0007)	(0.0007)	(0.0013)	(0.0003)	(0.0003)	(0.0005)
LoanAmount	-0.0324**	-0.0237	-0.0491**	0.0013	0.0004	0.0155
	(0.0143)	(0.0178)	(0.0220)	(0.0073)	(0.0080)	(0.0139)
MSA*YYQQ Orig FE	Y	Y	Y	Y	Y	Y
Lender FE	Y	Y	Y	Y	Y	Y
R-Square	0.4440	0.4624	0.4433	0.5736	0.5859	0.6472
N. Obs.	13,275	11,361	3,987	2,565	2,311	847

Note: This table investigates whether the additional default risk associated with inflated valuation for sold notch loans is priced in the mortgage rates. Refinance loans are included in the analysis. It reports the coefficient estimates and standard errors of the OLS regressions of mortgage rate. Independent variables include loan characteristics at origination, MSA*origination quarter fixed effects and lender fixed effects. Standard errors are clustered by MSA. *** p<0.01,** p<0.05, * p<0.10.

Table 8: Asymmetric Information and Adverse Selection Based on Appraisal Inflation – Small versus Big Lenders

	Big Lenders		Small Lenders	
	(1)	*(2)*	*(1')*	*(2')*
Variable	*Notch=0*	*Notch=1*	*Notch=0*	*Notch=1*
Sec * Refi	0.0015	0.0266	-0.0308	0.1101**
	(0.0126)	(0.0180)	(0.0349)	(0.0505)
Sec	-0.0154	-0.0361***	0.0290	-0.0133
	(0.0107)	(0.0135)	(0.0286)	(0.0389)
Refi	0.0802***	0.0294*	0.0855***	-0.0223
	(0.0109)	(0.0164)	(0.0317)	(0.0465)
Controls	Y	Y	Y	Y
MSA*YYQQ Orig FE	Y	Y	Y	Y
MSA*YYQQ LaterSale FE	Y	Y	Y	Y
Lender FE	Y	Y	Y	Y
R-Square	0.4493	0.5284	0.6207	0.6812
N. Obs.	10,682	6,327	2,520	1,577

Notes: This table investigates the role of asymmetric information and the adverse selection in property valuation. We divide the sample by the size of lender. Big lender sample includes loans by lenders who originated more than thirty mortgages in the sample. Small lender sample includes loans by lenders with less than thirty loans originated in the sample. Small lenders are likely to be local lenders who possess more private information on property valuation. Large lenders are likely to be national lenders who have less amount of private information in property valuation. Notch equals one where the LTV ratio equals 0.8, 0.85, 0.9, 0.95 or 0.97. The dependent variable (Value0/Price1_Adj) is the ratio between valuation at origination and the subsequent sale price (HPI-adjusted) of the same property (appraisal at origination versus later sale price for refinance loans, and sale price at origination versus later sale price for new purchase loans). The property valuation at origination (Value0) is the appraised value for a refinance loan and the sale price for a new purchase loan. Price1_Adj is the HPI-adjusted subsequent transaction price. Other model specifications and control variables are the same as in Table 4. Standard errors are clustered by MSA. *** $p<0.01$,** $p<0.05$, * $p<0.10$.

Table 9: Lender-MBS Issuer Affiliation and Adverse Selection Based on Appraisal Inflation

	Unaffiliated		Affiliated	
	(1)	*(2)*	*(1')*	*(2')*
Variable	*Notch=0*	*Notch=1*	*Notch=0*	*Notch=1*
Sec * Refi	0.0040	0.0469**	-0.0125	0.0288
	(0.0147)	(0.0199)	(0.0129)	(0.0189)
Sec	-0.0134	-0.0419**	0.0050	-0.0257*
	(0.0140)	(0.0184)	(0.0108)	(0.0139)
Refi	0.0703***	0.0179	0.0850***	0.0257
	(0.0108)	(0.0166)	(0.0106)	(0.0162)
Controls	Y	Y	Y	Y
MSA*YYQQ Orig FE	Y	Y	Y	Y
MSA*YYQQ LaterSale FE	Y	Y	Y	Y
Lender FE	Y	Y	Y	Y
R-Square	0.5158	0.5524	0.4594	0.5586
N. Obs.	6,918	4,346	9,229	4,976

Note: This table investigates one potential channel of adverse selection in property valuation, lender-MBS Issuer affiliation. Affiliated sample includes sold loans that lender and MBS issuer are likely to be affiliated. Unaffiliated sample includes sold loans that lender and MBS underwriter are unlikely to be affiliated. Portfolio loans are included in both samples. Notch equals one where the LTV ratio equals 0.8, 0.85, 0.9, 0.95 or 0.97. The dependent variable (Value0/Price1_Adj) is the ratio between valuation at origination and the subsequent sale price (HPI adjusted) of the same property (appraisal at origination versus later sale price for refinance loans, and sale price at origination versus later sale price for new purchase loans). The property valuation at orignation (Value0) is the appraised value for a refinance loan and the sale price for a new purchase loan. Price1_Adj is the HPI-adjusted subsequent transaction price. Other model specifications and control variables are the same as in Table 4. Standard errors are clustered by MSA. *** $p<0.01$,** $p<0.05$, * $p<0.10$.

Table 10: Additional Tests – Variations Across Mortgage Types

	(1)	*(2)*	*(3)*	*(4)*
	FRM	ARM	CLTV=80%	CLTV>80%
Sec x Refi	-0.0513	0.0444***	0.0279	0.0974***
	(0.0856)	(0.0170)	(0.0198)	(0.0351)
Sec	-0.0154	-0.0388***	-0.0262*	-0.0586**
	(0.0615)	(0.0129)	(0.0147)	(0.0269)
Refi	0.0869	0.0097	0.0369**	-0.0430
	(0.0833)	(0.0155)	(0.0177)	(0.0337)
Controls	Y	Y	Y	Y
MSA*YYQQ Orig FE	Y	Y	Y	Y
MSA*YYQQ LaterSale FE	Y	Y	Y	Y
Lender FE	Y	Y	Y	Y
R-Square	0.8097	0.5081	0.5449	0.6195
N. Obs.	1,029	6,875	5,120	2,784

Note: This table conducts sub sample analysis to investigate where the adverse selection in appraisal inflation is more likely to occur. Notch loans are included in the analysis where the LTV ratio equals 0.8, 0.85, 0.9, 0.95 or 0.97. The dependent variable (Value0/Price1_Adj) is the ratio between valuation at origination and the subsequent sale price (HPI adjusted) of the same property (appraisal at origination versus later sale price for refinance loans, and sale price at origination versus later sale price for new purchase loans). The property valuation at orignation (Value0) is the appraised value for a refinance loan and the sale price for a new purchase loan. Price1_Adj is the HPI-adjusted subsequent transaction price. Other model specifications and control variables are the same as in Table 4. Standard errors are clustered by MSA. *** $p<0.01$,** $p<0.05$, * $p<0.10$.

Table 11: Robustness Checks – Using Hedonic Property Values (3-Month Prediction Window)

Variable	*(1)* *All Loans*	*(2)* *Cash-Out Refi*	*(3)* *Term Refi*	*(1')* *All Loans*	*(2')* *Cash-Out Refi*	*(3')* *Term Refi*
Sec x Notch	0.0206***	0.0247***	0.0026	0.0200**	0.0259***	0.0058
	(0.0076)	(0.0083)	(0.0163)	(0.0083)	(0.0093)	(0.0200)
Sec	0.0008	0.0006	0.0104	-0.0011	-0.0024	0.0118
	(0.0050)	(0.0053)	(0.0098)	(0.0054)	(0.0059)	(0.0131)
Notch	-0.0107	-0.0129	-0.0023	-0.0082	-0.0116	-0.0003
	(0.0076)	(0.0082)	(0.0147)	(0.0081)	(0.0090)	(0.0178)
Controls	Y	Y	Y	Y	Y	Y
Zip FE	Y	Y	Y	Y	Y	Y
Closing Quarter FE	Y	Y	Y	Y	Y	Y
Lender FE	N	N	N	Y	Y	Y
R-Square	0.5102	0.5128	0.5964	0.5644	0.5682	0.6953
N. Obs.	4,748	4,227	1,111	4,748	4,227	1,111

Note: This table uses the hedonic estimate of property value at loan origination as an alternative market valuation of the property. The dependent variable measures valuation bias as the ratio between appraised value and the hedonic estimate. We estimate the hedonic property prices at loan origination using recent nearby property transactions, for only that information is available to the appraisers when they conducted the appraisals. We estimate hedonic prices using previous three-month transactions. Loans included are refinance mortgages. Independent variables include loan characteristics at origination, Zip code and closing quarter fixed effects, and lender fixed effects. Standard errors are clustered by zip. *** $p<0.01$,** $p<0.05$, * $p<0.10$.

A Appendix

Table A.1: First-Stage Regression - House Price Appreciation

Variable	Full Sample *Estim.*	Full Sample *Std. Err.*	Notch=0 *Estim.*	Notch=0 *Std. Err.*	Notch=1 *Estim.*	Notch=1 *Std. Err.*
Intercept	0.9791***	(0.3099)	1.1807***	(0.3687)	0.9107**	(0.4254)
Securitization	-0.0147**	(0.0067)	-0.0047	(0.0082)	-0.0299***	(0.0112)
FICO	-0.0344***	(0.0056)	-0.0292***	(0.0071)	-0.0456***	(0.0089)
CLTV	0.0014***	(0.0003)	0.0021***	(0.0004)	0.0008	(0.0007)
LowDoc	0.0160***	(0.0059)	0.0131*	(0.0076)	0.0107	(0.0093)
DTI	0.0005**	(0.0002)	0.0003	(0.0003)	0.0004	(0.0004)
FRM	-0.0342***	(0.0093)	-0.0160	(0.0108)	-0.0670***	(0.0174)
Exotic	-0.0191***	(0.0066)	-0.0107	(0.0083)	-0.0207*	(0.0108)
Notch	0.0363***	(0.0059)				
OwnerOccupied	-0.0104	(0.0080)	-0.0161	(0.0105)	-0.0092	(0.0123)
Term	0.0004***	(0.0001)	0.0004***	(0.0001)	0.0003***	(0.0001)
Interest	0.0098***	(0.0016)	0.0058***	(0.0020)	0.0130***	(0.0025)
LoanAmount	-0.0294***	(0.0021)	-0.0224***	(0.0026)	-0.0487***	(0.0040)
Tenure	0.0006	(0.0025)	-0.0035	(0.0032)	0.0043	(0.0039)
Default	0.0756***	(0.0074)	0.0846***	(0.0100)	0.0496***	(0.0111)
Distress	0.1573***	(0.0075)	0.1600***	(0.0103)	0.1565***	(0.0110)
LotSize	0.0009***	(0.0001)	0.0009***	(0.0001)	0.0009***	(0.0002)
SQFT	0.0002	(0.0011)	-0.0014	(0.0036)	-0.0007	(0.0014)
PropertyAge	-0.0006***	(0.0001)	-0.0010***	(0.0001)	-0.0003*	(0.0002)
Bedroom	-0.0041	(0.0025)	-0.0022	(0.0031)	-0.0060	(0.0045)
Bath	-0.0011	(0.0020)	-0.0006	(0.0019)	0.0004	(0.0062)
MSA*YYQQ Orig FE	Y		Y		Y	
MSA*YYQQ LaterSale FE	Y		Y		Y	
R-Square	0.5289		0.5869		0.5907	
N Obs	7,808		4,290		3,518	

Notes: This table reports the first-stage regressions of housing appreciation. New purchase loans are included in the analyses. Dependent variable is house appreciation (HPI-adjusted). Standard errors are clustered by MSA. *** p<0.01,** p<0.05, * p<0.10.

Table A.2: First-Stage Regression - Appraisal Inflation

	Full Sample		Notch=0		Notch=1	
Variable	*Estim.*	*Std. Err.*	*Estim.*	*Std. Err.*	*Estim.*	*Std. Err.*
Intercept	1.7397***	(0.4210)	2.0454***	(0.4689)	1.0607***	(0.3432)
FICO	-0.0367***	(0.0053)	-0.0410***	(0.0065)	-0.0263***	(0.0092)
CLTV	0.0010***	(0.0003)	0.0006*	(0.0004)	0.0017*	(0.0009)
LowDoc	0.0286***	(0.0061)	0.0311***	(0.0077)	0.0108	(0.0100)
DTI	0.0007***	(0.0002)	0.0006**	(0.0003)	0.0008**	(0.0004)
FRM	-0.0500***	(0.0081)	-0.0509***	(0.0098)	-0.0365**	(0.0147)
Exotic	-0.0050	(0.0064)	-0.0039	(0.0081)	-0.0101	(0.0102)
Notch	0.0121*	(0.0070)				
OwnerOccupied	-0.0291***	(0.0094)	-0.0307**	(0.0120)	-0.0248*	(0.0150)
Term	0.0002***	(0.0001)	0.0002***	(0.0001)	0.0001	(0.0001)
Interest	0.0018	(0.0013)	0.0032*	(0.0017)	-0.0021	(0.0021)
LoanAmount	-0.0321***	(0.0022)	-0.0315***	(0.0026)	-0.0466***	(0.0045)
Tenure	-0.0020	(0.0025)	-0.0059*	(0.0031)	0.0049	(0.0040)
Default	0.0492***	(0.0074)	0.0372***	(0.0096)	0.0356***	(0.0115)
Distress	0.1641***	(0.0074)	0.1969***	(0.0098)	0.1122***	(0.0112)
LotSize	0.0008***	(0.0001)	0.0007***	(0.0001)	0.0013***	(0.0002)
SQFT	-0.0031	(0.0040)	-0.0044	(0.0049)	0.0143*	(0.0084)
PropertyAge	-0.0002*	(0.0001)	-0.0007***	(0.0002)	0.0001	(0.0002)
Bedroom	-0.0105***	(0.0028)	-0.0142***	(0.0034)	0.0085	(0.0055)
Bath	0.0065***	(0.0018)	0.0067***	(0.0019)	-0.0210**	(0.0083)
MSA*YYQQ Orig FE	Y		Y		Y	
MSA*YYQQ LaterSale FE	Y		Y		Y	
R-Square	0.4481		0.4883		0.5937	
N Obs	7,992		5,303		2,689	

Notes: This table reports the first-stage regressions of valuation ratio for refinance loans. Refinance estimation sample is included in the analyses. Dependent variable is the valuation ratio (Value0/Pric1_Adj). The valuation of the property at t=0 (Value0) is the appraised value for a refinance loan. The valuation of the same property at t=1 (Price1)is the transaction price of the subsequent sale. Price1_Adj is the HPI-adjusted subsequent transaction price. Standard errors are clustered by MSA. *** p<0.01,** p<0.05, * p<0.10.

Table A.3: Securitization Decision and Appraisal Inflation

	Model (A)			**Model (B)**		
	(1)	*(2)*	*(3)*	*(1')*	*(2')*	*(3')*
Dep. Var: Securitization Dummy	*All Loans*	*Notch=0*	*Notch=1*	*All Loans*	*Notch=0*	*Notch=1*
Appraisal Inflation	0.0060	-0.0125	0.0627***	-0.0274	-0.0089	0.1516**
	(0.0132)	(0.0167)	(0.0230)	(0.0449)	(0.0523)	(0.0695)
FICO	0.0076	0.0153*	-0.0213*	0.0161	0.0217	-0.0068
	(0.0070)	(0.0090)	(0.0129)	(0.0115)	(0.0150)	(0.0228)
CLTV	-0.0007*	-0.0016***	0.0009	-0.0011*	-0.0017**	0.0005
	(0.0004)	(0.0005)	(0.0013)	(0.0006)	(0.0008)	(0.0023)
LowDoc	0.0186**	0.0214**	0.0067	0.0206	0.0270	0.0196
	(0.0082)	(0.0108)	(0.0144)	(0.0137)	(0.0183)	(0.0255)
DTI	0.0010***	0.0015***	0.0006	0.0014***	0.0014**	0.0037***
	(0.0003)	(0.0004)	(0.0006)	(0.0005)	(0.0006)	(0.0010)
FRM	0.1133***	0.1230***	0.0910***	0.1065***	0.1127***	0.1059***
	(0.0110)	(0.0141)	(0.0218)	(0.0185)	(0.0240)	(0.0392)
Exotic	0.0298***	0.0320***	0.0377***	0.0369***	0.0298	0.0379
	(0.0086)	(0.0114)	(0.0146)	(0.0142)	(0.0194)	(0.0253)
OwnerOccupied	0.0528***	0.0913***	-0.0338	0.0528**	0.0839***	-0.0012
	(0.0123)	(0.0164)	(0.0212)	(0.0209)	(0.0288)	(0.0363)
Term	-0.0007***	-0.0007***	-0.0008***	-0.0007***	-0.0006***	-0.0012***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0003)
Interest	0.0274***	0.0281***	0.0223***	0.0264***	0.0284***	0.0241***
	(0.0020)	(0.0026)	(0.0034)	(0.0033)	(0.0045)	(0.0061)
LoanAmount	-0.0059**	-0.0020	-0.0101*	0.0017	0.0058	-0.0091
	(0.0027)	(0.0035)	(0.0057)	(0.0047)	(0.0060)	(0.0100)
LotSize	-0.0000	-0.0000	0.0003	0.0002	0.0001	0.0005
	(0.0001)	(0.0001)	(0.0003)	(0.0002)	(0.0002)	(0.0007)
SQFT	0.0001	-0.0064	0.0001	0.0001	-0.0085	-0.0066**
	(0.0006)	(0.0051)	(0.0005)	(0.0006)	(0.0097)	(0.0032)
PropertyAge	0.0002	0.0002	-0.0001	0.0004	0.0005	-0.0003
	(0.0002)	(0.0002)	(0.0003)	(0.0003)	(0.0004)	(0.0006)
Bedroom	-0.0036	-0.0024	-0.0009	0.0025	0.0012	0.0030
	(0.0034)	(0.0044)	(0.0073)	(0.0065)	(0.0084)	(0.0132)
Bath	-0.0005	0.0015	-0.0043	0.0011	0.0107	0.0070
	(0.0025)	(0.0028)	(0.0104)	(0.0088)	(0.0115)	(0.0195)
MSA*YYQQ Orig. FE	Y	Y	Y	Y	Y	Y
Lender FE	Y	Y	Y	Y	Y	Y
R-Square	0.1871	0.1904	0.2566	0.2049	0.2142	0.3133
N. Obs.	13,298	8,912	4,386	5,308	3,551	1,757
Appraisal Inflation	**AppraisInf − $\widehat{\text{Appreciation}}$**			**$\widehat{\text{AppraisInf}}$ − $\widehat{\text{Appreciation}}$**		

Notes: This table investigates whether appraisal inflation has any impact on lender's securitization decision. It reports the coefficient estimates and standard errors of the OLS regressions of securitization decision. Refinance loans are included in the analysis. Appraisal inflation in Model A is measured as the difference of the valuation ratio and the estimated property appreciation rate ($\widehat{Appreciation}$). Valuation ratio is the ratio between appraisal at origination and the subsequent sale price (HPI-adjusted) of the same property. Property appreciation rate of refinance loans is estimated in two steps: (1)estimate the new purchase loan appreciation equation, and (2)apply the coefficient estimates from (1) to the refinance loans to have the $\widehat{Appreciation}$. Since the valuation ratio for refinance loans contains property appreciation information, Model A intends to extract the property appreciation from the valuation ratio to have a measure of appraisal inflation. Appraisal inflation in Model B is measured by taking the difference of the estimated valuation ratio ($\widehat{Ratio}$) and the estimated property appreciation rate ($\widehat{Appreciation}$). $\widehat{Ratio}$ is estimated in three steps: (1)divide the refinance loans into a random 60% estimation sample and a 40% holdout sample; (2) use the estimation sample to run regression of valuation ratio regardless of the securitization status; and (3)apply the coefficient estimates from (2) to the holdout sample to have $\widehat{Ratio}$. Property appreciation rate is estimated with securitization status in Model A and regardless of the securitization status in Model B. The purpose of model B is to not only extract property appreciation from the valuation ratio to infer appraisal inflation but also eliminate potential reverse causality between securitization and appraisal inflation. Other control variables include loan characteristics at origination, MSA*origination quarter fixed effects and lender fixed effects. Standard errors are clustered by MSA. *** $p<0.01$,** $p<0.05$, * $p<0.10$.

Table A.4: Summary Statistics of Purchase Loans

	Portfolio		Securitized	
Variable	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*
Price_0 (in $1000)	743.050	243.769	692.302	201.172
Price_1 (in $1000)	609.479	301.753	531.865	258.391
Appreciation (Price_0/Adj_Price_1)	1.124	0.307	1.164	0.308
Notch	0.373	0.484	0.476	0.499
FICO (in 100)	7.215	0.538	7.076	0.569
CLTV (in %)	80.537	9.965	82.443	9.850
LowDoc	0.462	0.499	0.536	0.499
DTI (in %)	33.777	15.304	37.447	12.287
FRM	0.126	0.332	0.173	0.378
Exotic	0.365	0.482	0.439	0.496
OwnerOccupied	0.813	0.390	0.859	0.348
Term (in months)	382.811	50.670	381.316	48.749
Interest (in %)	5.224	2.180	6.025	1.958
LoanAmount (in $100K)	5.786	1.713	5.409	1.409
Tenure (in months)	52.229	26.979	51.356	27.010
LotSize (in 1000)	15.703	33.850	14.996	33.004
SQFT (in 1000)	2.264	5.056	1.960	1.065
PropertyAge (in months)	32.677	28.221	33.867	27.706
Bedroom	2.864	1.647	2.820	1.599
Bath	2.348	1.303	2.194	1.727
Distress	0.307	0.461	0.414	0.493
Default12	0.030	0.171	0.076	0.265
Default24	0.099	0.298	0.203	0.402
Default	0.291	0.454	0.494	0.500
N of Obs	1,928		5,880	

Notes: This table reports the summary statistics for portfolio and securitized purchase jumbo loans originated in 2005 and 2006, used to control for property appreciation on our corresponding sample of refinance loans. The property valuation at time 0 (Price_0) is the sale price for a new purchase loan. The valuation of the same property at t=1 (Price1) is the transaction price of the subsequent sale. Price1_Adj is the HPI-adjusted subsequent transaction price. Value appreciation is the ratio of Price0 to Price1_Adj. Notch equals one if LTV ratio equals 0.8, 0.85, 0.9, 0.95 or 0.97. Otherwise, notch equals zero. If the subsequent sale is a distressed sale, distress equals 1. Otherwise distress equals zero. If a borrower defaults within 12 months or 24 months or the sample time period, default12m/default24m/default equals 1 correspondingly, otherwise equals zero.

Table A.5: Robustness Checks – Using Hedonic Property Values (6-Month Prediction Window)

Variable	*(1)* *All Loans*	*(2)* *Cash-Out Refi*	*(3)* *Term Refi*	*(1')* *All Loans*	*(2')* *Cash-Out Refi*	*(3')* *Term Refi*
Sec x Notch	0.0216***	0.0254***	0.0063	0.0216***	0.0274***	0.0092
	(0.0074)	(0.0082)	(0.0160)	(0.0081)	(0.0091)	(0.0195)
Sec	0.0023	0.0019	0.0127	-0.0003	-0.0015	0.0120
	(0.0049)	(0.0051)	(0.0098)	(0.0053)	(0.0057)	(0.0129)
Notch	-0.0133*	-0.0155*	-0.0064	-0.0119	-0.0148*	-0.0064
	(0.0073)	(0.0080)	(0.0147)	(0.0079)	(0.0088)	(0.0178)
Controls	Y	Y	Y	Y	Y	Y
Zip FE	Y	Y	Y	Y	Y	Y
Closing Quarter FE	Y	Y	Y	Y	Y	Y
Lender FE	N	N	N	Y	Y	Y
R-Square	0.5192	0.5239	0.5984	0.5732	0.5791	0.6989
N. Obs.	4,748	4,227	1,111	4,748	4,227	1,111

Note: This table uses the hedonic estimate of property value at loan origination as the fair valuation of the property. The dependent variable measures valuation bias as the ratio between appraised value and the hedonic estimate. We estimate the hedonic property prices at loan origination using recent nearby property transactions, for only that information is available to the appraisers when they conducted the appraisals. We estimate hedonic prices using previous six-month transactions. Loans included are refinance mortgages. Independent variables include loan characteristics at origination, Zip code and closing quarter fixed effects, and lender fixed effects. Standard errors are clustered by zip. *** p<0.01,** p<0.05, * p<0.10.