

The impact of non-disclosure laws on the single-family housing market: Appraisal bias and mortgage default

Sergio Gárate*
Charles Hilterbrand†
Anthony Pennington-Cross‡

Abstract

We investigate the implications of non-disclosure laws on single-family housing markets. States regulate the amount of information disclosed from real estate transactions, and disclosure is significantly restricted in some states. We find evidence that appraisals are more biased, and mortgages are more likely to default for financially constrained borrowers in states that heavily restrict public disclosure of house prices. We also observe higher prepayments on probabilities for all borrowers, independent of their financial constraints.

JEL Codes: D8, R3, L85, K25, G21 and G28

Keywords: Information, Knowledge, Uncertainty, Housing, House Price and Liquidity, Real Estate Market, Real Estate Law

*Emory University, sergio.garate@emory.edu

†The University of Mississippi, chilterbrand@bus.olemiss.edu

‡Marquette University, anthony.pennington-cross@marquette.edu

1 Introduction

Information available to the public about real estate transactions varies from state to state, depending on non-disclosure laws. At one extreme, some states prohibit any disclosure in the public record of property sale prices; at the other end, some states require full disclosure and transparency in the public record. In jurisdictions that prohibit disclosure, some real estate professionals will still have access to proprietary databases, such as the Multiple Listing Service (MLS), and may opt to share data with clients. But this information is not as complete as a fully disclosed public record and is not available to all market participants equally.

This varying environment offers a rich comparative opportunity to explore how differences in disclosure affect markets. In particular, this paper examines how a lack of public access to information about home sale prices impacts appraisal bias and mortgage defaults.

Several studies focus on the effects of biased information at loan origination on loan performance (Griffin and Maturana, 2016; Jiang et al., 2014; Piskorski et al., 2015; Garmaise, 2015). In particular, appraisals tend to overstate the value of property (Agarwal et al., 2015; Griffin and Maturana, 2016). This can lead to the origination of loans where the actual Loan to Value (LTV) ratio is much higher than it appears, which increases default probabilities. Despite attempts to reduce appraisal bias through the Home Valuation Code of Conduct of May 2009 and the Dodd-Frank Act of 2010, appraisal bias continues to be a problem (Eriksen et al., 2019).

We hypothesize that in low information environments (where public disclosure of sale prices is restricted), appraisals will be even more inaccurate because less information is available to inform and bound the appraisal process. As a result, we anticipate that there will be larger over-appraisals in non-disclosure states. Additionally, when a borrower is financially constrained (low equity or low income) the importance of an appraisal is heightened. In weaker loan applications changes in the appraised value can determine if the loan is accepted or rejected. Therefore, we expect appraisal bias will be the largest in low information environments when the borrow is financially constrained. When appraisal bias exists, we also anticipate that these biased loans will have a higher rate of default. To assess these impacts, we focus on metropolitan areas that encompass both non-disclosure and disclosure states.

This article contributes to the literature on information asymmetries and appraisal bias. We identify and categorize state laws and rules that regulate information disclosure from real estate transactions. We use that framework to provide an empirical analysis of appraisal bias and loan default.

2 Background on Public Disclosure

Public price disclosure, which involves the publication of transaction prices in the public record as part of the transfer of real estate, is required in some regions and prohibited in others. This section provides a broad categorization of public price disclosure for the

50 states and the District of Columbia. Figure 1 shows the states and their respective disclosure requirements.

2.1 Full disclosure states that require a transfer tax

Twenty-nine states plus the District of Columbia require full disclosure of the transaction price in public records and require a transfer tax. The sales price is disclosed at the time of recording or soon thereafter, primarily for the purpose of paying a percentage tax on the transaction. Most of these states require a transaction disclosure form. This form is usually an affidavit that includes the transaction price, the parties to the transaction, and a statement indicating whether the transaction was arms-length. Acceptance of this form often allows the local official to stamp the deed with the amount charged for the tax and allows it to be recorded. A few of the states in this group require taxes to be paid within a period of time after the transaction. Generally, the local auditor or tax assessment office maintains the sales transaction information in a database and the public is able to access this information.

2.2 Full disclosure states that do not require a transfer tax

There are four states that do not have a transfer tax, but still require disclosure of the value of a sales transaction. Indiana, which until 1999 was a non-disclosure state, requires a “Sales Disclosure Form” to be presented to the local county assessor before a deed is filed¹. Arizona, which is constitutionally mandated not to collect a transfer tax², requires an “Affidavit of Legal Value” to be recorded with each transaction³. That document is similar to the form used in full disclosure jurisdictions with a transfer tax, but this affidavit is affixed to the deed and recorded as a part of the deed. This information is readily available to the public. Oregon has one county, Washington County, with a transfer tax; the remainder of the state does not. In the State of Oregon, the transaction price has to be stated on the face of the deed or instrument of conveyance⁴.

The most recent addition to this group is North Dakota, which also requires the full amount of consideration to be placed on the face of the transfer deed⁵. Effective April 8, 2013, the North Dakota Century Code §11-18-02.2 was changed to mandate grantees of a property to certify the consideration for the transaction on the face of the granting deed⁶. This statute, which once specifically required the state board of equalization to “guard the secrecy of information” was amended to penalize as a class B misdemeanor any person who “willfully falsifies the consideration paid for the transferred property”⁷.

¹*Indiana General Assembly*, Indiana Code 6-1.1-5.5

²2009 Constitutional Amendment - Article IX, Section 24

³*Arizona Revised Statutes*, A.R.S. §11-1133

⁴*Contracts to Convey, Instruments of Conveyance and Related Memoranda to State Consideration*, O.R.S. § 93.030

⁵*North Dakota Century Code Chapter 11-18*, N.D.C.C. §11-18-02.2

⁶*North Dakota Century Code Chapter 11-18*, N.D.C.C. §11-18-02.2

⁷*North Dakota Century Code Chapter 11-18*, N.D.C.C. §11-18-02.2

2.3 Limited disclosure states that require a transfer tax

Six states (Alabama, Arkansas, North Carolina, Oklahoma, Rhode Island, and Tennessee) require a transfer tax but not the disclosure of the purchase price to the public. Although these states do not require that the transaction price be placed on public record, the price can be ascertained because the amount of the transfer tax charged by the local jurisdiction is shown on the face of the deed. For example, Tennessee charges a “Recordation Tax” of \$3.70 per \$1,000.00⁸ on property value. This is collected by the local Registrar of Deeds based on an “Affidavit of Value”⁹ that is presented at recording. Although the transaction price is not recorded or otherwise disclosed, the amount collected by the Registrar of Deeds as a conveyance tax is shown on the face of the deed, and thus the transaction price can be determined.

2.4 Non-disclosure states that require an affidavit of value

There are four states (Kansas, Montana, New Mexico, and Wyoming)¹⁰ that require an affidavit of value to be presented to the local jurisdiction’s assessor for tax valuation purposes, but these states prohibit local government offices from disclosure of this information to the public.

2.5 Full non-disclosure states

There are five states that do prohibit governmental disclosure of sales prices and do not charge a transfer tax that can be used to calculate the value of a transaction. These states include Alaska, Idaho, Mississippi, Texas, and Utah.

Louisiana is a special case that often falls into this category based on local parish discretion. An “act of sale”, which is the document that serves as a deed in Louisiana, is required to have a purchase price stated in the document. There is no enforcement of this provision. Unlike North Dakota, a grantee is not required to certify the consideration for the property transfer. Additionally, Louisiana does not collect a transfer tax. In fact, to insure that a transfer tax was not later imposed by local jurisdictions, this sentiment was codified as Louisiana Constitution Amendment 1, Article VII §2.3 which prohibits the collection of a transfer tax on property sales. The act of sale can have any value stated on the document, including the line “for 10 dollars and other valuable consideration” and the document still satisfies the recording requirements of the state. However, if the act of sale does state an amount, the local parish tax assessor may state the value on the county records, but there is no requirement to disclose the amount to the public.

2.6 State where disclosure varies by county

Missouri neither requires nor prohibits price disclosure by statute. There is a constitutional amendment that was passed in 2010 to prohibit transfer taxes¹¹. Price disclosure

⁸ *Tennessee Code Annotated*, Tenn. Code § 67-4-409

⁹ *Tennessee Code Annotated*, Tenn. Code § 67-4-409(a)(6)(A)

¹⁰ *Kansas Statutes, Chapter 79*, KS Stat §79-1437c; *Montana Code Annotated, Chapter 7*, MCA §15-7-305; *New Mexico Statutes, Section 7*, NM Stat §47-13-4 and NM Stat §7-38-4; and, *Wyoming Statutes*, WY Stat §34-1-142

¹¹ *Constitution State of Missouri*, Missouri Const art X §25

in the state is for tax valuation purposes and the practice varies by county. A majority of the state’s 114 counties do not require sales price disclosure. Three of the largest counties – St. Louis, St. Charles, and Jackson – along with the City of St. Louis, require that a “Certificate of Value” be submitted to the county recorder at the time the deed is recorded. The document is not recorded but is forwarded to the county tax assessor. The purchase price information can be found on the assessor’s websites of these respective counties.

2.7 Practical consequences of the variations in state law

For both full disclosure states that require a transfer tax and those that do not, the public has access to real estate transaction values. For example, sales prices can generally be found at auditor, assessor, circuit court, tax collector or similar offices that maintain sales price for valuation and equalization data for tax assessment. In those states where a transfer tax is required but the state does not post prior sales information, that information is still available by using the transfer tax information on the face of a deed and dividing that amount by the local tax assessment rate. We treat these three categories as being disclosure states, because websites like Zillow, Redfin and Realtor.com use this information to post prior sales information on their web sites and apps. The lone exception to the is North Dakota which recently became a disclosure state in 2013. We do address this change later in the paper.

For the non-disclosure states that require an affidavit of value and full non-disclosure states, sales information is not provided to the public. A review of Zillow shows that sales information in these states as well as Missouri, which is primarily a non-disclosure state with four local exceptions, is omitted from their web sites and apps. Prior sales price information is not readily available to the public.

For the purposes of this paper, we identify a state’s disclosure status in a binary manner. We treat those states where information is made publicly available, listed in sections 2.1, 2.2, and 2.3, as disclosure states. We treat states listed in sections 2.4 and 2.5 of this paper as non-disclosure states. Missouri is treated as either disclosure or non-disclosure based on the location of the property examined. North Dakota is treated as a non-disclosure state until April 8, 2013, and as a disclosure state for all times after that date.

3 Establishing prices in non-disclosure states

In non-disclosure states, there are three common approaches that can be used to establish prices: 1. Work with someone who has Multiple Listing Service (MLS) access; 2. Use a “cost per square foot” approach to estimate prices; and 3. Look at the assessed value of a property (Williams, 2020).

3.1 Multiple Listing Service (MLS)

Price information can be obtained through MLS platforms, which are used by realtors to share listings, purchase prices, and other information relating to a home. Licensed realtors are generally required to input and update information on the platform. This

information is proprietary and held by respective local boards, and those local boards are protective of the information (Berrens and McKee, 2004). Generally, a person cannot access MLS information unless they are a real estate agent or broker, or they are working with one. Even with access to the MLS, information is incomplete. Transactions that do not rely on real estate agents, such as sales by private parties and sales by an owner, will not be include in MLS databases.

3.2 Cost per square foot

In non-disclosure states, it is common to discuss the going cost per square foot for homes in an area. MLS agents have access to sales price information; they can sample recent closing prices and divide those prices by the square feet of properties sold to come up with a dollar per square foot estimate. This approach does not control for quality and is typically used to estimate the cost of new construction, where material costs can be estimated in linear formulas.

Those without access to MLS who wish to establish a price per square foot must make a guess with less information. Such parties can identify list prices of properties that have recently sold, apply a discount (or premium) factor to the list price, and arrive at an estimated price per square foot for similar properties.

3.3 Assessed value

Using assessed value to determine property value includes errors of both omission and commission (Berrens and McKee, 2004). The mission of the local tax assessors and their respective tax equalization boards is not to establish a market value; rather, it is to equitably distribute assessments across a tax district. To reduce their tax liability, property owners prefer to keep their assessed values low. Property owners are also voters who can influence the process and appeal their assessed values. Local jurisdictions often attempt to set values below the true market value to reduce appeals and political push-back. This approach reduces the number of valuation appeals and may promote harmony within a community, but it makes the use of assessed values less accurate when determining market value.

4 Literature review

Our academic literature review has found only two articles, as far as we are aware, that directly discuss state sales price non-disclosure policies. Both papers conclude that there are substantial costs associated with low or poor information environments created by non-disclosure of prices. The first reviews the effective tax rates based on sales price data between 1993 and 2001 within the Albuquerque, New Mexico Public School District. The authors concluded that the lack of sales price disclosure resulted in inequities in tax rates and a reduction in tax revenues. They found that areas within the district had different tax rates on similar houses (Berrens and McKee, 2004). The second article (Ling et al., 2021) found that for Real Estate Investment Trusts (REITs), local investor have a larger and more positive impact on investment returns in non-disclosure states.

4.1 Information asymmetry

Non-disclosure of house prices in public records reduces the amount and quality of information overall, but it also creates information asymmetries. In particular, buyers not using an agent and non-local buyers have much less access to information about market trends and comparable sales.

Buyers and sellers are frequently reliant on realtors with access to an MLS database to help determine the value of a home, and this is even more true in non-disclosure states. This information asymmetry exacerbates existing principal-agent (owner/buyer-real estate agent) problems, which manifest as moral hazard issues. For example, when the agent is an owner, homes tend to sell slower and at a price premium (Agarwal et al., 2019).

Asymmetries also exist between buyers and sellers, and local and non-local market participants. As in the case of used cars, often the seller has more information than the buyer (Akerlof, 1970). In general, residential property sellers are more informed about neighborhood characteristics and structural conditions than buyers, though local knowledge can be used to at least partially mitigate the asymmetry (Kurlat and Stroebel, 2015). As a result, non-local buyers tend to pay price premiums (Neo et al., 2008).

Innovations and interventions that reduce information asymmetry are found to decrease the price of properties with defects, increase average prices, and reduce price dispersion (Broxterman and Zhou, 2023).

4.2 Appraisal bias in residential real estate

Residential real estate appraisal valuations tend to have an upward bias. This bias is exacerbated when there is a lack of information or where the appraiser may not be independent (Nakamura et al., 2010). In response to the subprime lending crisis and global recession, Fannie Mae created standards for appraisal valuation called the Home Valuation Code of Conduct of 2009 and the Appraisal Independence Requirement in 2010. These documents helped form the appraisal requirement statutes found in the Dodd-Frank legislation of 2010. The main requirements of this legislation are that neither the contract price nor the LTV were to be disclosed by a party with a financial interest in a mortgage loan transaction to an appraiser in advance of their service.

Despite these legislative efforts, there is clear evidence that appraisers do not determine the value of property independent of the selling price. In fact, according to the Uniform Standards of Professional Appraisal Practice (USPAP) at Standard Rule 1-5(a) an appraiser must “analyze all agreements of sale, options, and listings fo the subject property current as of the effective date of the appraisal and (b) analyze all sales of the subject property that occurred within three (3) years prior to the effective date of the appraisal.” A practical effect of this standard is that the appraiser cannot receive a purchase agreement directly from a lender, appraisal standards require getting a copy of the purchase contract from a real estate agent or similarly situated non lending party.

This idea that Standard Rule 1-5(a) appears to be followed by appraisers is supported by literature. Thirty percent of appraisals exactly match the transaction price and only

ten percent fall below a transaction price (Agarwal et al., 2015). Appraisers who are aware of the contract price are more than twice as likely to reach an appraised value at least equal to the contract price (Eriksen et al., 2020). When the LTV on a loan is close to a conventional underwriting cutoff, the magnitude of the appraisal bias increases (Agarwal et al., 2015). This contract price support leads to a greater incidence of mortgage delinquency and default, potentially exaggerates boom and bust cycles in the housing market, and results in information loss (Eriksen et al., 2019; Calem et al., 2021; Garmaise, 2015).

5 Empirical Strategy

We test for the impact of price non-disclosure on appraisal bias and mortgage defaults. To identify appraisal bias, we follow the empirical strategy of Agarwal et al. (2015). We use data from the Home Affordable Refinance Program (HARP) so we can compare the appraised value of a property to the same property’s earlier transaction value. To aid identification, we use a border discontinuity design that limits the analysis to metropolitan areas that include states both with and without disclosure. To support the appraisal analysis we also study the impact that non-disclosure has on mortgage defaults. We explain each empirical approach in the following sections.

We employ a border discontinuity design to assess the impact of non-disclosure on residential mortgage default in Metropolitan Statistical Areas (MSAs) with multiple disclosure types. For example, the Memphis MSA covers Arkansas, Tennessee, and Mississippi. Arkansas and Tennessee require some disclosure via a deed or transaction tax payment, while Mississippi does not allow any price disclosure. Figure 3 illustrates reported prices from transactions for the Memphis area. The area of Memphis that is in Mississippi is almost completely devoid of reported property price transactions. Figure 2 shows the transaction price information available on Zillow when searching for recent sales. The bubbles for prices only include “-” in Mississippi and include values in Tennessee. Our analysis covers 5 cities that either have variability in disclosure within the MSA, namely: Cape Girardeau, MO-IL; Lewiston, ID-WA; Memphis, TN-MS-AR; Fargo/Moorhead, ND-MN; and Texarkana, TX-AR. In the non-disclosure portion of these metropolitan areas transaction prices are not publicly available. As shown in the figures, price information was not available on Zillow. Redfin.com and Realtor.com do report a price estimate or last listing price.

5.1 Appraisal Bias

To estimate the bias in property appraisal, we pair a purchase loan with a subsequent HARP refinance loan. Both observations have the same property and owner. The purchased value is from a time period before the loan enters HARP; the appraised value is the estimated value when the loan enters HARP. The 2009 HARP was designed to help constrained borrowers refinance their loans and take advantage of lower interest rates. Eligibility depended on having a mortgage owned by Freddie Mac or Fannie Mae, being current on mortgage payments, and having a loan-to-value ratio (LTV) of 80% or higher.

As noted above, residential real estate appraisals associated with sales tend to have an upward bias. Lenders typically require private mortgage insurance (PMI) if the LTV at origination is greater than 80%; this additional cost increases the debt-to-income ratio (DTI). Thus, for loans that are very close to the 80% LTV limit, small changes in appraised value can have meaningful impacts on monthly debt servicing. As a result, we anticipate that the appraisal bias will be larger when loans are originated very close to underwriting limits such as the 80% LTV standard (Agarwal et al., 2015; Griffin and Maturana, 2016).

By contrast, qualification for HARP loans required an LTV of 80% or more. In that case, artificially lowering the value of a property would make it easier to qualify for a loan. Therefore, we anticipate a downward appraisal bias in the HARP loan appraisals.

We expect the magnitude of these biases to be greater in both directions in non-disclosure states, because lack of access to actual price data limits information available to appraisers and limits the ability of market participants to evaluate the quality and accuracy of appraisals. If appraisals are biased in this way, then we expect that the difference between the purchase value of a home and the subsequent HARP appraisal will be larger in non-disclosure states.

We test this hypothesis using the following regression:

$$\text{Log}(V_{izt+n}/P_{izt}) = \alpha_0 + \alpha_1 \text{Disc}_i + \alpha_2 \text{MC}_{izt} + \alpha_N \text{Log}(\text{Ind}_{zt+n}/\text{Ind}_{zt}) + \nu_m \varrho_q \tau_t + \varepsilon_{izt} \quad (1)$$

P_{izt} is the smaller of the transaction price or the appraisal value for property i in 3-digit zip code z and time period t . V_{izt+n} is the HARP refinance appraisal value for the same property at time $t+n$. Disc_i is a binary variable indicating whether property i is subject to non-disclosure (1) or disclosure (0) of transaction information. MC_{izt} is a vector of building, loan, and borrower characteristics, such as Property Type, Debt to Income, Credit Score, Loan to Value, ARM Indicator, and Loan Term among others. $\text{Log}(\text{Ind}_{zt+n}/\text{Ind}_{zt})$ is the log of the ratio of the values of a repeated sales index for the 3-digit zip code z between times t and $t+n$. ν_m represents metropolitan area fixed effects, ϱ_q represents quarterly fixed effects, and τ_t represents yearly fixed effects. $\nu_m \varrho_q \tau_t$ represent the interaction of all these fixed effects. ε_{izt} is the error term.

These control variables account for many factors that can impact house appraisal and prices. The fixed effects control for unobservables that vary by metropolitan area, year and quarter. The $\text{Log}(\text{Ind}_{zt+n}/\text{Ind}_{zt})$ controls for price changes of the local market at the 3-digit zip code level. Since zip codes typically do not cross state boundaries, $\text{Log}(\text{Ind}_{zt+n}/\text{Ind}_{zt})$ provides control for different house price trends on each side of the state boundaries. MC_{izt} , controls for property, borrower and loan characteristics.

5.2 Mortgage Default and Prepayment

Artificially high valuation of property at origination should lead to higher than anticipated default rates, and this effect should be greater in non-disclosure states.

To test our hypothesis we estimate the conditional probability of default or prepayment using a competing risks proportional hazard framework in a multinomial logit specification. In each month a loan can be current, prepaid, or default. We define default as any loan that is 90 days or more delinquent. Specifically we model the probabilities as follows:

$$\pi_{Default} = \pi_{Default}(Disc, MC, Year_O, Year_C, MSA, Serv, \pi_{Ppmt}) \quad (2)$$

$$\pi_{Ppmt} = \pi_{Ppmt}(Disc, MC, Year_O, Year_C, MSA, Serv, \pi_{Default}) \quad (3)$$

The variable of interest, *Disc*, is an indicator of whether property *i* is subject to non-disclosure (1) or disclosure (0) of transaction-level information. The vector *MC* includes mortgage controls at origination and over time as the loan ages, such as the borrower’s credit score, the ratio between the current and original national average of the 30-year mortgage, the debt-to-income ratio at origination, the property type indicator, the loan-to-value ratio using an estimated current market value, loan age, and loan age squared. To control for other unobservable underwriting standards at the moment of origination, a year of origination fixed effect (*Year_O*) is included. The model also includes servicer fixed effects (*Serv*), year of the observation fixed effects (*Year_C*) and a metropolitan area fixed effects (*MSA*). Table 2 provides a detail description of the variables.

6 Data

We use Freddie Mac’s Single-Family Loan-Level Datasets, covering the 5 metro areas identified above, for our mortgage default and prepayment analysis. The data includes performance level data on purchase and refinance loans held in Freddie Mac’s portfolio that were originated from 1999 through 2022. We use subsets of this data for each of the two distinct analyses, as described below.

6.1 Appraisal Bias

We identify approximately 56,700 properties for which there are both an original purchase loan and a subsequent HARP refinance loan. In other words, we identify a matched pair of loans for which the property and borrower remain constant. If a variable name ends in HRP, this indicates that the observation is at the time period when the HARP refinance occurred.

Table 3 describes summary statistics. The average value of the properties used as collateral for the purchase loans was \$215,335. The average appraised value in the HARP refinance loans was \$198,251, indicating that the average home values declined.

6.2 Mortgage Default and Prepayment

The Freddie Mac dataset records the status of a loan in each month that the loan exists. We are able to observe the monthly performance of approximately 1.4 million loans. Of

these, approximately 58,000 ended in default (which we define as 90 days or more delinquent) during the time period covered by the dataset, and over a million were prepaid. Table 6 provides summary statistics for the monthly loan observations.

7 Results

In this section, we present the results of different parts of our empirical strategy. First, we discuss the results of the appraisal bias analysis. Second, we present the results for prepayment and default probabilities using the multinomial logit approach on the loan performance data.

7.1 Appraisal Bias

Table 4 Column I presents the first set of appraisal bias results. While we do not have strong priors for the signs for many of the control variables, when house prices in the area (measure by *hpiq*) are going up the observed or paired house prices should also go up. However, since these loans do self select into the HARP program we anticipate and show evidence that the appreciation is be less than market appreciation.

Table 4 Column I includes fixed effects controls for city, quarter, and year unobservables that may be correlated with the appraisal bias. While we do not have strong priors for the signs for many of the control variables, when house prices in the area (measured by *hpiq*) are going up the observed or paired house prices should also go up. The point estimate for *ndisc* although negative was not statically significant.

One potential issue with the empirical strategy is the possibility of differences in characteristics between houses and borrowers on each side of the border (Disclosure vs. Non-Disclosure). This could introduce a confounding factor that leads to appraisal bias. To address this concern, we conducted a matched sample analysis as shown in Column II of Table 4. We employed a coarsened exact matching procedure, matching on variables such as house prices and borrower’s income. Through this matching process, we obtained a sample size of 6,144 observations. However, despite the matching efforts the impact of non-disclosure remains insignificant.

Following Agarwal et al. (2015) we would expect that the appraisal bias will be more pronounced for financially constrained borrowers. We define financially constrained borrowers to be those with an LTV greater than 79 percent and a DTI greater than 40 percent. Table 5 shows that the valuation bias become statistically significant at the 5% level for constrained borrowers.

7.2 Mortgage Default and Prepayment

Table 7 shows the results for the multinomial model of prepayment and default. We define a loan as in default when it first becomes 90 days delinquent and as prepaid when the load is paid off prior to full term (before the scheduled end of the loan’s life). The results indicate that loans in non-disclosure states prepay at a higher rate. However, there is no statistically significant impact on defaults. The variable *credit* coefficient estimate indicates that higher credit scores lead to lower defaults and increase prepayment

probabilities. The *rate_ratio* coefficient estimate indicates that if interest rates decline, the probability of prepaying the loan increases. This is likely because households tend to refinance mortgages when interest rates decline. The channel used to originate loans also matters. Loans that were originated by a third party (*channel*) default more than retail loans.

In Table 8 we continue the analysis using only 30-year mortgages to facilitate interpretation and remove potential bias introduced by more exotic loan types (misspecification error). The point estimate for the impact of non-disclosure is similar to the prior table.

To address potential confounding factors or selection bias, we conducted matching on observable variables. We employed Coarsened Exact Matching (CEM) and matched on house value, borrower’s income, spread at origination, and credit score. The summary statistics of the treated and untreated variables are presented in Table 9. The means of each variable appear similar for both treated and untreated observations, falling within one standard deviation of each other. This suggests that borrowers and houses on each side of the border do not differ significantly after matching on observables previously described.

In Table 10, we present the analysis of default-prepayment for the matched sample. The results yield a similar point estimate for the impact of non-disclosure on default and prepayment compared to the previous analysis. Following Agarwal et al. (2015), we investigate if non-disclosure laws have disparate effects depending on financial constraints. Table 11 shows the impact that financial constraints have on the default and prepayment probabilities in non-disclosure states. The results show that as borrowers become more financially constrained, the probability of default in a non-disclosure location increases more than in disclosure states.

The predicted probabilities for constrained and non-constrained borrowers are illustrated in Figure 5. It indicates, indicates that for constrained borrowers (top row) the predicted probability of defaults goes from 0.107% to 0.121% when shifting from Disclosure to Non-Disclosure. The predicted probability of prepayment for constrained borrowers went up from 1.265% to 1.394% when shifting from Disclosure to Non-Disclosure. For non financially constrained borrowers (bottom row), there is no statistically significant difference between Disclosure and Non-Disclosure predicted probabilities of default. The predicted probability of prepayment are still statistically significant different between Disclosure and Non-Disclosure.

7.3 Fargo-Moorhead Event Study

In an effort to provide a more robust analysis we conducted an event study around the time that North Dakota changed their disclosure laws. The Fargo MSA includes Fargo, ND and Moorhead, MN. The Moorhead side of Fargo MSA has been a disclosure state during the whole time window of this analysis. On April 8th 2013, the state of North Dakota changed from a Non-Disclosure to a Disclosure state. The newer statute requires the disclosure of transaction prices on the Deeds and certification by the grantee under

penalty of law¹. To avoid confounding factors affecting our estimates we used a time window after Home Valuation Code of Conduct of 2009 has come into effect. Our analysis started in 2010 and ended in 2016.

Table 14 shows the results for the event study. We defined the post treatment as the period where disclosure came into effect and price information became easily available to appraiser and market agents on the North Dakota side. Mortgages that were originated during the post period (Post Disclosure Treatment) experienced a lower default rate than the prior treatment (Non-Disclosure). This is further evidence that Disclosure helps mitigate mortgage misrepresentation.

To provide a more complete picture of this event study we also conducted a parallel trend analysis. Table 15 shows that there is no significant trend difference between control and treatment group before the law came into effect. After the law is in effect, the coefficients becomes negative and is statistically significant in two of three years.

7.4 Recourse

In some states the borrower is personally liable for all losses associated with a default. In these states, the lender has the ability to take the property backing the mortgage and other forms of wealth or income. These states are often referred to as recourse states. In other states, the borrower is not personally liable for all losses. These states are often referred to as non-recourse states. In these states the lender can only take the property back in an attempt to recover default losses. The lender cannot access the borrowers personal wealth or income stream to cover default losses. Therefore, in non-recourse states the cost to the borrower of defaulting is potentially lower than in recourse states.

Of the states included in our analysis, Oregon¹², Idaho¹³, Texas¹⁴ and Washington¹⁵ are non-recourse states.

The remaining states do have some form of recourse. The states of Arkansas¹⁷, Missouri¹⁸, Mississippi¹⁹ and Tennessee²⁰ are non-judicial foreclosure states that allow for a separate suit to be brought for a deficiency judgment in the event that the property auction does not offset the debt. The state of Illinois²² is a judicial foreclosure state that grants deficiency judgments as a part of the process of foreclosure without requiring a separate action. Table 12 provides a description of all states recourse type.

In order to be able to separate the impact of non-disclosure from the potential impact

¹*North Dakota Century Code Chapter 11-18*, N.D.C.C. §11-18-02.2 made Non-Disclosure a class B misdemeanor.

¹²Or. Rev. Stat. § 86.797

¹³Idaho Code § 6-108

¹⁴Tex. Const. Art. 16, §50

¹⁵Rev. Code Wash. § 61.24.100

¹⁷Ark. Code Ann. § 18-50-112

¹⁸Mo. Rev. Stat. § 443.24

¹⁹Miss. Code Ann. § 15-1-23

²⁰Tenn. Code Ann. § 35-5-118

²²735 Ill. Comp. Stat. §§ 5/15-1508

of recourse, we tested the results using the Memphis metropolitan area. Memphis includes Arkansas, Tennessee and Mississippi. All three are recourse states but they require a separate filing. As a result within Memphis there is variation in disclosure but no variation in lender recourse. Table 13 shows that the impact of disclosure is still statistically significant independent of the respective state's recourse laws. Prepayments are still higher in Non-Disclosure states and financially constrained borrowers default more in Non-Disclosure states after controlling for the recourse laws.

8 Conclusion

Not all states require that property transaction prices be recorded and made publicly available. In fact, some states do not allow the governmental disclosure of a transaction price (Alaska, Idaho, Kansas, Mississippi, Montana, New Mexico, Texas, Utah, and Wyoming).

In locations where transaction prices are not publicly known, appraisals are determined in a low information environment. This provides the opportunity for appraisals to be manipulated to help loan applications get approved. The bias in appraisals is most consequential when the borrower is close to or exceeds rules if thumb used in underwriting. For those loans originated with biased appraisals we also expect elevated rates of default.

This paper conducts two empirical tests. The first examines the impact of non-disclosure of housing transaction prices on appraisal bias. Using Freddie Mac Single-Family Loan-Level Dataset, we examine MSAs that include both disclosure and non-disclosure states. The results indicate that appraisal bias is exacerbated in non-disclosure states when borrowers are constrained. To do this, we looked at houses with conventional loan origination, which required LTV values of 80% or less, and compared that same house with a subsequent distressed loan, through HARP, that required an LTV of over 80%. As hypothesized, the difference in property values between appraised value of the conventional loan and the appraised value of the HARP loan was greater in non-disclosure states than in disclosure states only when the borrower was financially constrained. Using fixed effects, we found that there was 1.5% larger appraisal difference in non-disclosure states for financially constrained borrowers.

The second empirical test examines the impact of non-disclosure on mortgage default and prepayment. Consistent with the appraisal bias results, financially constrained borrowers experience a higher probability of default in non-disclosure states.

For robustness, we also compare states with similar loan recourse statutes. The Memphis metropolitan area includes three states that are all recourse states but have variation in disclosure requirements. In Mississippi, which is a non-disclosure state, defaults rates were higher for constrained borrowers. In our final robustness test we conducted an event study in the Fargo MSA. The results indicate that after disclosure legislation became effective in one state, mortgages experienced a lower default rate.

In summary, non-disclosure of house prices adversely impacts mortgage markets by

increasing the prevalence of appraisal bias and mortgage default when the borrower is financially constrained.

References

- Agarwal, S., Ben-David, I. and Yao, V. (2015), ‘Collateral valuation and borrower financial constraints: Evidence from the residential real estate market’, *Management Science* **61**(9), 2220–2240.
URL: <https://doi.org/10.1287/mnsc.2014.2002>
- Agarwal, S., He, J., Sing, T. F. and Song, C. (2019), ‘Do real estate agents have information advantages in housing markets?’, *Journal of Financial Economics* **134**(3), 715–735.
- Akerlof, G. A. (1970), ‘The market for “lemons”: Quality uncertainty and the market mechanism’, *The quarterly journal of economics* **84**(3), 488–500.
- Arizona Revised Statutes* (n.d.). A.R.S. § 11-1133.
URL: <https://www.azleg.gov/ars/11/01133.htm>
- Berrens, R. P. and McKee, M. (2004), ‘What price nondisclosure? the effects of nondisclosure of real estate sales prices’, *Social Science Quarterly* **85**(2), 509–520.
- Broxterman, D. and Zhou, T. (2023), ‘Information frictions in real estate markets: Recent evidence and issues’, *The Journal of Real Estate Finance and Economics* **66**(2), 203–298.
- Calem, P., Kenney, J., Lambie-Hanson, L. and Nakamura, L. (2021), ‘Appraising home purchase appraisals’, *Real Estate Economics* **49**(S1), 134–168.
- Constitution State of Missouri* (n.d.). Missouri Const art X §25.
URL: <https://www.sos.mo.gov/CMSImages/Publications/CurrentMissouriConstitution.pdf>
- Contracts to Convey, Instruments of Conveyance and Related Memoranda to State Consideration* (n.d.). O.R.S. § 93.030.
URL: https://oregon.public.law/statutes/ors_chapter_93.html
- Eriksen, M. D., Fout, H. B., Palim, M. and Rosenblatt, E. (2019), ‘The influence of contract prices and relationships on appraisal bias’, *Journal of Urban Economics* **111**, 132–143.
URL: <https://www.sciencedirect.com/science/article/pii/S0094119019300294>
- Eriksen, M. D., Fout, H. B., Palim, M. and Rosenblatt, E. (2020), ‘Contract price confirmation bias: Evidence from repeat appraisals’, *The Journal of Real Estate Finance and Economics* **60**(1-2), 77–98.
- Garmaise, M. J. (2015), ‘Borrower misreporting and loan performance’, *The Journal of Finance* **70**(1), 449–484.
URL: <https://onlinelibrary.wiley.com/doi/abs/10.1111/jofi.12156>
- Griffin, J. M. and Maturana, G. (2016), ‘Who Facilitated Misreporting in Securitized Loans?’, *The Review of Financial Studies* **29**(2), 384–419.
URL: <https://doi.org/10.1093/rfs/hhv130>

- Indiana General Assembly* (n.d.). Indiana Code 6-1.1-5.5.
URL: <https://iga.in.gov/legislative/laws/2020/ic/titles/006#6-1.1-5.5>
- Jiang, W., Nelson, A. A. and Vytlačil, E. (2014), ‘Liar’s Loan? Effects of Origination Channel and Information Falsification on Mortgage Delinquency’, *The Review of Economics and Statistics* **96**(1), 1–18.
URL: https://doi.org/10.1162/REST_a_00387
- Kansas Statutes, Chapter 79* (n.d.). KS Stat § 79-1437c.
URL: <https://www.ksrevenue.gov/pdf/PVDRSStatutes.pdf>
- Kurlat, P. and Stroebel, J. (2015), ‘Testing for information asymmetries in real estate markets’, *The Review of Financial Studies* **28**(8), 2429–2461.
- Ling, D. C., Naranjo, A. and Scheick, B. (2021), ‘There is no place like home: Information asymmetries, local asset concentration, and portfolio returns’, *Real Estate Economics* **49**(1), 36–74.
- Montana Code Annotated, Chapter 7* (n.d.). MCA § 15-7-305.
URL: https://leg.mt.gov/bills/mca/title_0150/chapter_0070/part_0030/section_0050/0150-0070-0030-0050.html
- Nakamura, L. I. et al. (2010), ‘How much is that home really worth? appraisal bias and house-price uncertainty’, *Business Review* (Q1), 11–22.
- Neo, P. H., Ong, S. E. and Tu, Y. (2008), ‘Buyer exuberance and price premium’, *Urban Studies* **45**(2), 331–345.
- New Mexico Statutes, Section 7* (n.d.). NM Stat §47-13-4 and NM Stat § 7-38-4”.
URL: <https://www.nmlegis.gov/sessions/03%20Regular/FinalVersions/HB0299.html>
- North Dakota Century Code Chapter 11-18* (n.d.). N.D.C.C. § 11-18-02.2.
URL: <https://www.ndlegis.gov/cencode/t11c18.pdf>
- Piskorski, T., Seru, A. and Witkin, J. (2015), ‘Asset quality misrepresentation by financial intermediaries: Evidence from the rmbs market’, *The Journal of Finance* **70**(6), 2635–2678.
URL: <https://onlinelibrary.wiley.com/doi/abs/10.1111/jofi.12271>
- Tennessee Code Annotated* (n.d.). Tenn. Code 67-4-409.
URL: <https://capitol.tn.gov/bills/102/Bill/HB3014.pdf>
- Williams, S. (2020), ‘A map of every non-disclosure state in the u.s. - and how real estate investors can deal with them’.
- Wyoming Statutes* (n.d.). WY Stat 34-1-142.
URL: <https://wyoleg.gov/statutes/compress/title34.pdf>

Table 1: States by Disclosure Type

Disclosure Type	States
Full disclosure states that require a transfer tax	Alabama, California, Colorado, Connecticut, District of Columbia, Florida, Georgia, Hawaii, Illinois, Iowa, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Nebraska, Nevada, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, South Carolina, South Dakota, Vermont, Virginia, Washington , West Virginia , Wisconsin
Full disclosure states that do not require a transfer tax	Arizona, Indiana, North Dakota (Switched in 2013 from Nondisclosure), Oregon
Limited disclosure states that require a transfer tax	Alabama, Arkansas, North Carolina, Oklahoma , Rhode Island, Tennessee
Nondisclosure states that require an affidavit of value	Kansas, Montana, New Mexico, Wyoming
Full nondisclosure states	Alaska, Idaho, Louisiana, Mississippi, Texas, Utah
State where disclosure varies by county	Missouri

Table 2: Variables Description

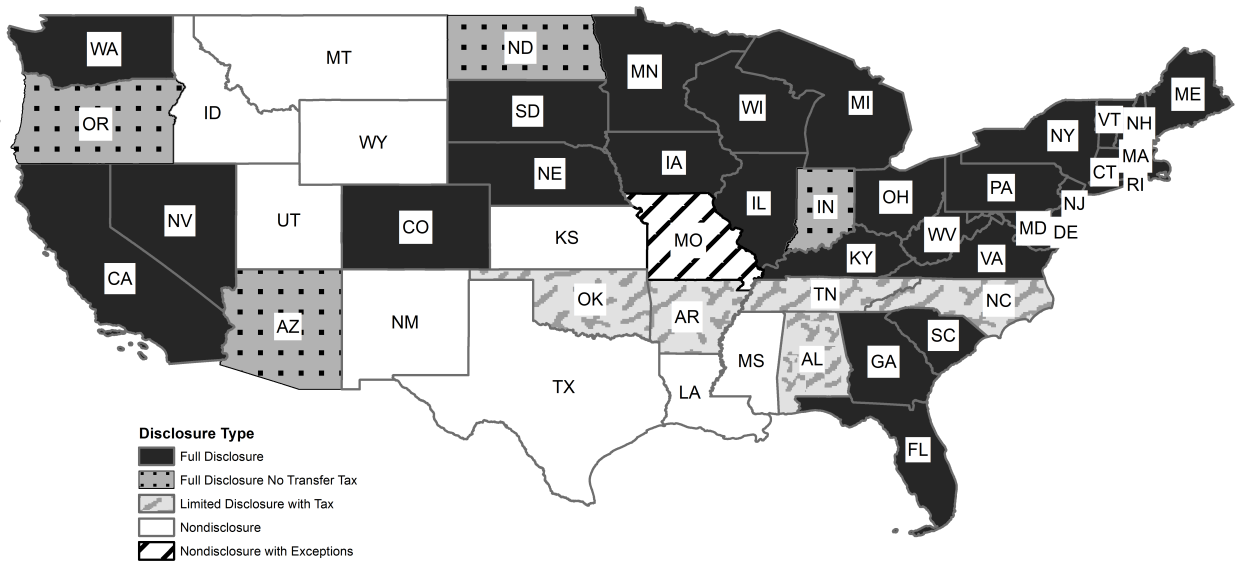
Variable Name	Description
ndisc	A dummy variable indicating whether or not the property is in a non disclosure state.
credit	Credit Score at the moment of loan origination divided by 100.
hpig	House price appreciation from first origination to HARP origination using the FHFA 3-digit Zip code price index.
rate ratio	This represents the ratio of the national average 30-years fixed mortgage rate for the current month divided by the national average of the 30-years fixed mortgage rate for the month at origination.
ispread	The spread represents the difference between origination interest rate and the national average 30-years fixed mortgage rate at origination.
dti	This represent the ratio between the monthly debt payment (including monthly housing expenses) and the monthly income used to underwrite the loan and observed at loan origination.
loan size	The size or balance of the mortgage at origination divided by 100,000.
ltv	Estimated Loan to Value ratio using FHFA 3-digit zip code price index to update the price and the observed outstanding balance of the loan.
term	Indicates the loan term. In our sample we use 10-year, 15-year and 30-year fixed rate mortgages. term15 indicates that the mortgage has a term that is less than 30 years.
owner	This indicates whether the owner indicated that the property is owner occupied.
single	This indicates whether the property type is a single family house or not.
otherpt	This indicates whether the loan has a Planned Unit Development or Manufactured House as collateral.
channel	Dummy variable indicating whether the loan was originated by a third party.
loan age	Number of scheduled payments since the loan was originated in years. We include age in the analysis. loan age2 is loan age squared.
finconst	indicates if a loan has a DTI at origination greater than 40% and a LTV at origination greater than 79%.
year	The calendar year for the observed time period. year orig is the year the mortgage is originated.

Table 3: Summary Statistics for Valuation Model

Variable	Mean	Std.	Min	Max
loan size_hrp	198,251	106,272	16,250	1,540,000
loan size	215,335	116,133	21,111	1,813,044
hpig	-0.085	0.158	-0.779	0.535
ndisc	0.513	0.499	0	1
condo	0.032	0.177	0	1
otherpt	0.232	0.422	0	1
term15_hrp	0.248	0.432	0	1
term	349.156	43.168	120	360
dti	33.913	12.216	1	65
credit	730.438	53.755	300	850
ltv_hrp	75.821	20.342	4	192
term_hrp	292.657	81.022	96	360
Number of Observations	56,760			

Note: This table shows the summary statistics for the variables used in the valuation model. Variables with the hrp extension are observed at the HARP refinance time period. For a complete description of the variables refer to Table 2.

Figure 1: Disclosure Types Map



This map shows the real estate disclosure type in each state. The full nondisclosure states are Alaska(not shown), Idaho, Louisiana, Mississippi, Texas, and Utah. Five states that require disclosure to the local assessor, but not to the public, are Kansas, Montana, New Mexico and Wyoming. Missouri is primarily a nondisclosure states with a few counties that require sales price disclosures that may be made public.

Table 4: Basic Valuation Model for HRP Loans

	I	II
	Complete Sample	Matched Sample
ndisc	-0.003 (0.003)	-0.002 (0.003)
hpig	0.476*** (0.068)	0.459**** (0.067)
condo	-0.025**** (0.004)	-0.001 (0.006)
otherpt	0.005 (0.007)	0.006 (0.007)
term15_hrp	-0.016**** (0.002)	-0.017**** (0.003)
ltv_hrp	-0.003**** (0.000)	-0.003**** (0.000)
credit_hrp	-0.000** (0.000)	-0.000** (0.000)
constant	0.262**** (0.039)	0.265**** (0.042)
MSA-Quarter-Year FE	Yes	Yes
N	6,496	6,144
R2	0.598	0.510

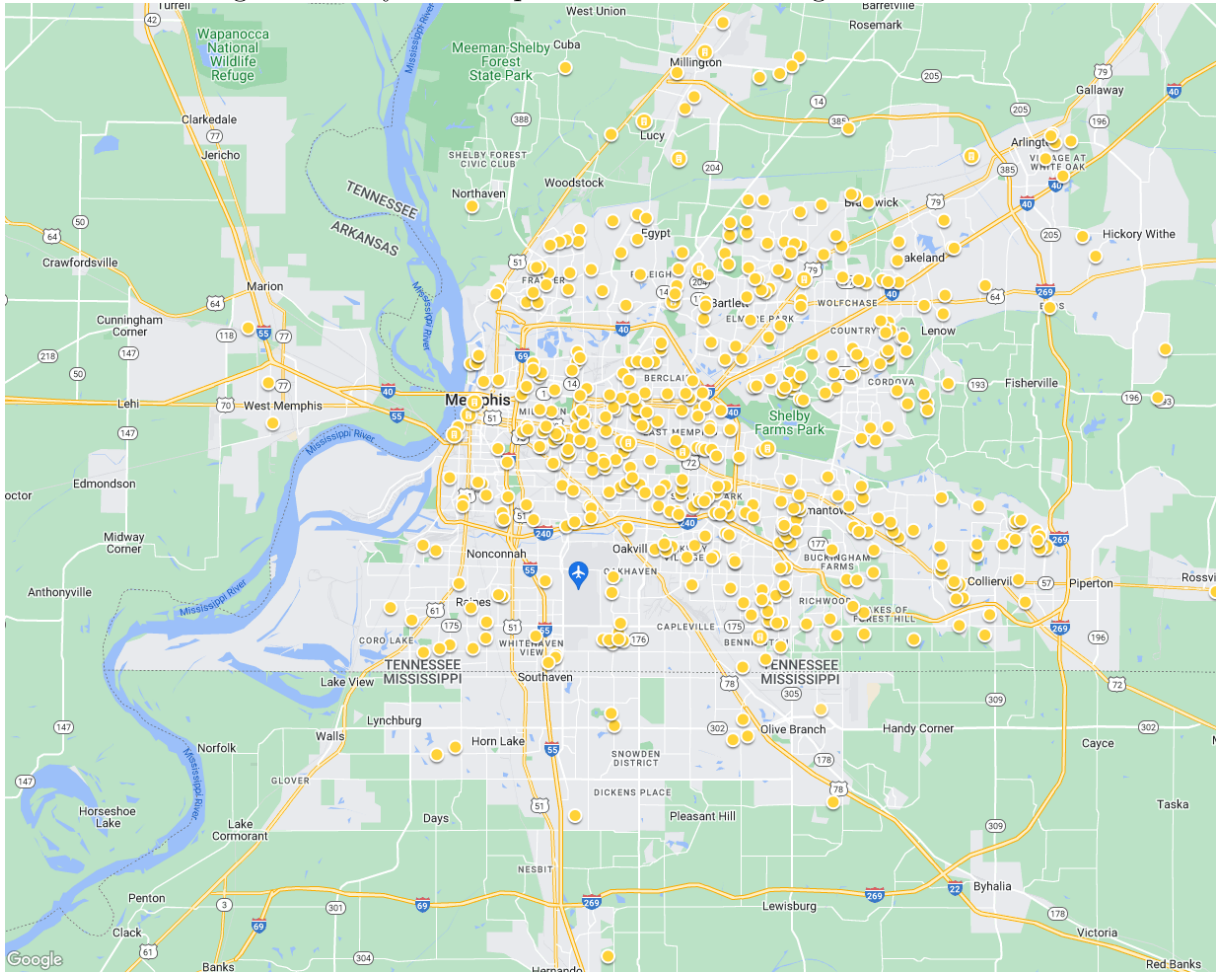
Note: The dependent variable is the log of the ratio of the appraised value of the property at HARP refinancing divided initial origination value. ndisc indicates that the property is in a non-disclosure state. Variables with the hrp extension are observed at the HARP refinance time period. Column I is the model including all observations and includes fixed effects at the MSA, year, and quarter level. Column II includes fixed effects, but we match treated and untreated observations using House Value and borrowers income. For a complete description of the variables refer to Table 2. Coefficients are statistically significant at the **** 0.1%, *** 1%, ** 5% and * 10% levels. Standard Errors clustered robust at the state level.

Table 5: Basic Valuation Model for HRP Loans Financially Constrained

	Matched Sample
ndisc	0.000 (0.004)
finconst	0.039**** (0.006)
ndisc * finconst	-0.015** (0.005)
hpig	0.458**** (0.067)
condo	-0.007 (0.009)
otherpt	0.006 (0.007)
term15_hrp	-0.016**** (0.002)
ltv_hrp	-0.004**** (0.000)
credit_hrp	-0.000** (0.000)
constant	0.253**** (0.037)
MSA-Quarter-Year FE	Yes
N	6,144
R2	0.603

Note: The dependent variable is the log of the ratio of the appraised value of the property at HARP refinancing divided initial origination value. ndisc indicates that the property is in a non-disclosure state. Variables with the hrp extension are observed at the HARP refinance time period. This regressions includes fixed effects at the MSA, year, and quarter level and we use a matched sample. We use an indicator for that are financially constrained and interacted that variable with a non disclosure indicator. We define the loan to be constrained if the LTV is greater than 79% and the DTI is greater than 40%. For a complete description of the variables refer to Table 2. Coefficients are statistically significant at the *** 1%, ** 5% and * 10% levels. Standard Errors clustered robust at the state level.

Figure 2: City of Memphis Observed Housing Transactions



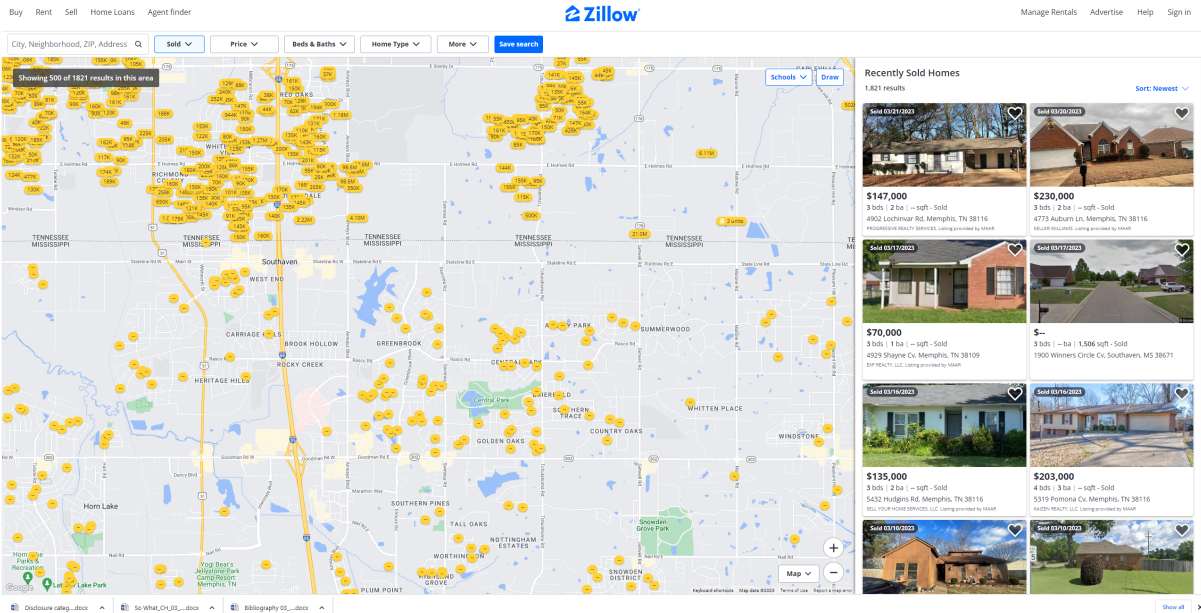
The Metropolitan Statistical Area of Memphis covers 3 States, Tennessee, Arkansas and Mississippi. This map shows the state lines and the area the city covers. Each dot reflects a reported transaction that was available on Zillow.com in April 2023.

Table 6: Summary Statistics Default-Prepayment Model

Variable	Mean	Std. Dev.	Min.	Max.
ndisc	0.329	0.4701	0	1
credit	7.419	0.5089	3	8.42
rate ratio	0.949	0.2275	0.3319	2.0368
ispread	-0.023	0.5493	-3.3911	3.2542
dti	0.326	0.1096	0.01	0.65
loan size	1.619	0.8878	0.08	6.47
ltv	0.629	0.1923	0.0000	1.3430
owner	0.907	0.2903	0	1
single	0.851	0.3554	0	1
chnl_tp	0.541	0.4983	0	1
finconst	0.147	0.3541	0	1
loan age	3.412	3.2021	0	23.5833
loan age2	21.896	40.8226	0	556.1736
term	322.109	74.7253	120	360
year	2014.028	5.9042	1999	2022
year orig	2010.667	6.1674	1999	2022
Number of Observations	61,645,323			

Note: Mortgages are observed monthly from origination until default, prepayment or censoring (still alive at the last observed date). For a complete description of the variables refer to Table 2.

Figure 3: Disclosure Types Map



This maps shows how the metropolitan statistical area of Memphis connects to a Non-Disclosure state like Mississippi. The image shows how the transaction prices are reported at each side of the border. Mississippi does not report transaction prices as shown by the bubbles with “-” in them instead of a number. This figure was downloaded from Zillow.com in April 2023.

Table 7: Default and Prepayment Model

	default	prepaid
ndisc	-0.023 (0.042)	0.075**** (0.009)
credit	-1.002*** (0.038)	0.155**** (0.008)
rate ratio	-2.713**** (0.275)	-2.285**** (0.051)
ispread	0.654**** (0.042)	0.367**** (0.010)
dti	1.663**** (0.153)	-0.054 (0.035)
loan size	0.088**** (0.025)	0.297**** (0.005)
ltv	2.902**** (0.168)	-1.054**** (0.030)
owner	-0.152*** (0.055)	0.381**** (0.015)
single	0.095* (0.054)	-0.060**** (0.011)
channel	0.176**** (0.036)	0.051**** (0.008)
loan age	0.148**** (0.019)	0.275**** (0.008)
loan age2	-0.017**** (0.001)	-0.016**** (0.000)
constant	-2.065* (1.094)	-4.460**** (0.187)
Loan Term FE	Yes	Yes
Loan Purpose	Yes	Yes
MSA FE	Yes	Yes
Servicer FE	Yes	Yes
Year of Observation FE	Yes	Yes
Year of Origination FE	Yes	Yes
N		6,362,706
Pseudo R2		0.0551

Note: This table includes all 10-years, 15-years and 30-years fixed rate mortgages. The model specification allows for 3 categorical outcomes: current, default and prepayment. A loan is considered to be on default if it is 90 or more days delinquent. ndisc indicates that the property is in a non-disclosure state. For a complete description of the variables refer to Table 2. Coefficients are statistically significant at the **** 0.1%, *** 1%, ** 5% and * 10% levels. Standard Errors clustered robust at the loan level. Total loans 126,867

Table 8: Default and Prepayment Model: 30-years Fixed Rate Mortgages

	default	prepaid
ndisc	-0.027 (0.045)	0.071**** (0.010)
credit	-0.992**** (0.039)	0.183**** (0.009)
rate ratio	-2.673**** (0.275)	-2.499**** (0.060)
ispread	0.654**** (0.044)	0.377**** (0.011)
dti	1.582**** (0.160)	-0.053 (0.039)
loan size	0.112**** (0.026)	0.311**** (0.006)
ltv	3.057**** (0.184)	-0.938**** (0.033)
owner	-0.210**** (0.058)	0.408**** (0.017)
single	0.084 (0.056)	-0.053**** (0.012)
channel	0.195**** (0.038)	0.054**** (0.009)
loan age	0.141**** (0.020)	0.321**** (0.009)
loan age2	-0.016**** (0.001)	-0.019**** (0.000)
constant	-2.940*** (1.083)	-4.815**** (0.192)
Loan Purpose	Yes	Yes
MSA FE	Yes	Yes
Servicer FE	Yes	Yes
Year of Observation FE	Yes	Yes
Year of Origination FE	Yes	Yes
N		5,083,453
Pseudo R2		0.0592

Note: This table includes only 30-years fixed rate mortgages. The model specification allows for 3 categorical outcomes: current, default and prepayment. A loan is considered to be on default if it is 90 or more days delinquent. ndisc indicates that the property is in a non-disclosure state. For a complete description of the variables refer to Table 2. Coefficients are statistically significant at the **** 0.1%, *** 1%, ** 5% and * 10% levels. Standard Errors clustered robust at the loan level. Total loans 104,462

Table 9: Summary Statistics Matched Sample

Variable	Untreated		Treated	
	Mean	Std. Dev.	Mean	Std. Dev.
credit	7.401	0.509	7.357	0.531
rate ratio	0.951	0.233	0.934	0.211
ispread	-0.012	0.585	-0.0523	0.516
dti	0.333	0.103	0.336	0.106
loan size	1.672	0.923	1.463	0.736
ltv	0.640	0.189	0.628	0.192
owner	0.883	0.321	0.936	0.243
single	0.893	0.309	0.883	0.321
channel	0.561	0.496	0.524	0.499
loan age	3.361	3.187	3.665	3.357
	N = 3,214,436		N=1,252,516	

Note: Mortgages are observed monthly from origination until default, prepayment or censoring (still alive at the last observed date). For a complete description of the variables refer to Table 2.

Table 10: Default and Prepayment Model: CEM Matched 30yr Sample Sample

	default	prepaid
ndisc	-0.037 (0.048)	0.068**** (0.012)
credit	-0.980**** (0.045)	0.169**** (0.011)
rate ratio	-2.337**** (0.308)	-2.474**** (0.073)
ispread	0.654**** (0.049)	0.368**** (0.013)
dti	1.365**** (0.185)	0.065 (0.051)
loan size	0.097*** (0.031)	0.323**** (0.007)
ltv	3.166**** (0.219)	-1.019**** (0.042)
owner	-0.175*** (0.065)	0.425**** (0.020)
single	0.008 (0.076)	-0.052*** (0.017)
channel	0.199**** (0.044)	0.034*** (0.011)
loan age	0.152**** (0.023)	0.319**** (0.011)
loan age2	-0.015**** (0.001)	-0.020**** (0.000)
constant	-3.036*** (1.107)	-4.790**** (0.240)
Loan Purpose	Yes	Yes
MSA FE	Yes	Yes
Servicer FE	Yes	Yes
Year of Observation FE	Yes	Yes
Year of Origination FE	Yes	Yes
N		3,484,392
Pseudo R2		0.0593

Note: This table includes only 30-years fixed rate mortgages. The model specification allows for 3 categorical outcomes: current, default and prepayment. This include only loans matched using CEM on borrower's income, loan spread at origination, credit score and house values. A loan is considered to be on default if it is 90 or more days delinquent. ndisc indicates that the property is in a non-disclosure state. For a complete description of the variables refer to Table 2. Coefficients are statistically significant at the **** 0.1%, *** 1%, ** 5% and * 10% levels. Standard Errors clustered robust at the id loan level. 70,633 loans

Table 11: Default and Prepayment: Non Disclosure - Financial Constraints

	Default	Prepayment
ndisc	-0.102* (0.055)	0.069**** (0.011)
finconst	0.154*** (0.053)	0.056**** (0.015)
ndisc*finconst	0.220** (0.095)	0.030 (0.021)
Controls	Yes	Yes
MSA FE	Yes	Yes
Term FE Servicer FE	Yes	Yes
Year of Observation FE	Yes	Yes
Year of Origination FE	Yes	Yes
N		4,334,319
R2		0.0556
Loans		85,516

Note: All the results include only 30-years, 15-years and 10-years fixed rate mortgages, the first column includes all mortgage purposes: Purchase, Refinance and Cash-Out loans. The model allows for 3 categorical outcomes: current, default and prepayment. A loan is considered to be on default if it is 90 or more days delinquent. Nondisclosure indicates the loan is in a nondisclosure state. Constrained indicates that the loan is financial constrained (DTI at origination greater than 40% and LTV at origination greater than 79%). Not Constrained indicates the loan was not financially constrained at origination. Coefficients are statistically significant at the **** 0.1%, *** 1%, ** 5% and * 10% levels. Standard Errors clustered robust at the state level.

Table 12: Recourse versus Non-Recourse states

Recourse Type	State
Outright Ban	ID
	WA
	ND
	MN
Ban if homestead	TX
Recourse Separate Filing	AR
	MO
	MS
	TN
Recourse Likely	IL

Table 13: Default and Prepayment: Memphis MSA - Non Disclosure - Financial Constraints

	default	prepaid
ndisc	-0.041 (0.061)	0.029** (0.015)
finconst	0.129** (0.058)	0.037** (0.018)
ndisc*finconst	0.253** (0.108)	-0.016 (0.035)
Controls	Yes	Yes
Loan Term FE	Yes	Yes
Servicer FE	Yes	Yes
Year of Observation FE	Yes	Yes
Year of Origination FE	Yes	Yes
Loan Purpose	Yes	Yes
N		2,970,463
R2		0.0564
Loans		59,033

Note: All the results include 30-years, 15-years and 10-years fixed rate mortgages; and, Purchase, Refinance and Cash-Out loans. All the states in the metropolitan area are recourse states. The specification allows for 3 categorical outcomes: current, default and prepayment. Constrained indicates that the loan is financial constrained (DTI at origination greater than 40% and LTV at origination greater than 79%). Not Constrained indicates the loan was not financially constrained at origination. A loan is considered to be on default if it is 90 or more days delinquent. Coefficients are statistically significant at the **** 0.1%, *** 1%, ** 5% and * 10% levels. Standard Errors clustered robust at the loan level.

Table 14: Default and Prepayment: Fargo MSA - Pre and Post of Disclosure

	default	prepaid
North Dakota Side	0.437 (0.384)	0.099** (0.039)
Post Disclosure * North Dakota Side	-0.931** (0.389)	0.063 (0.046)
Controls	Yes	Yes
Trend (Year Observation)	Yes	Yes
Loan Term FE	Yes	Yes
Servicer FE	Yes	Yes
Loan Purpose	Yes	Yes
N		530,236
R2		0.0466
Loans		8,189

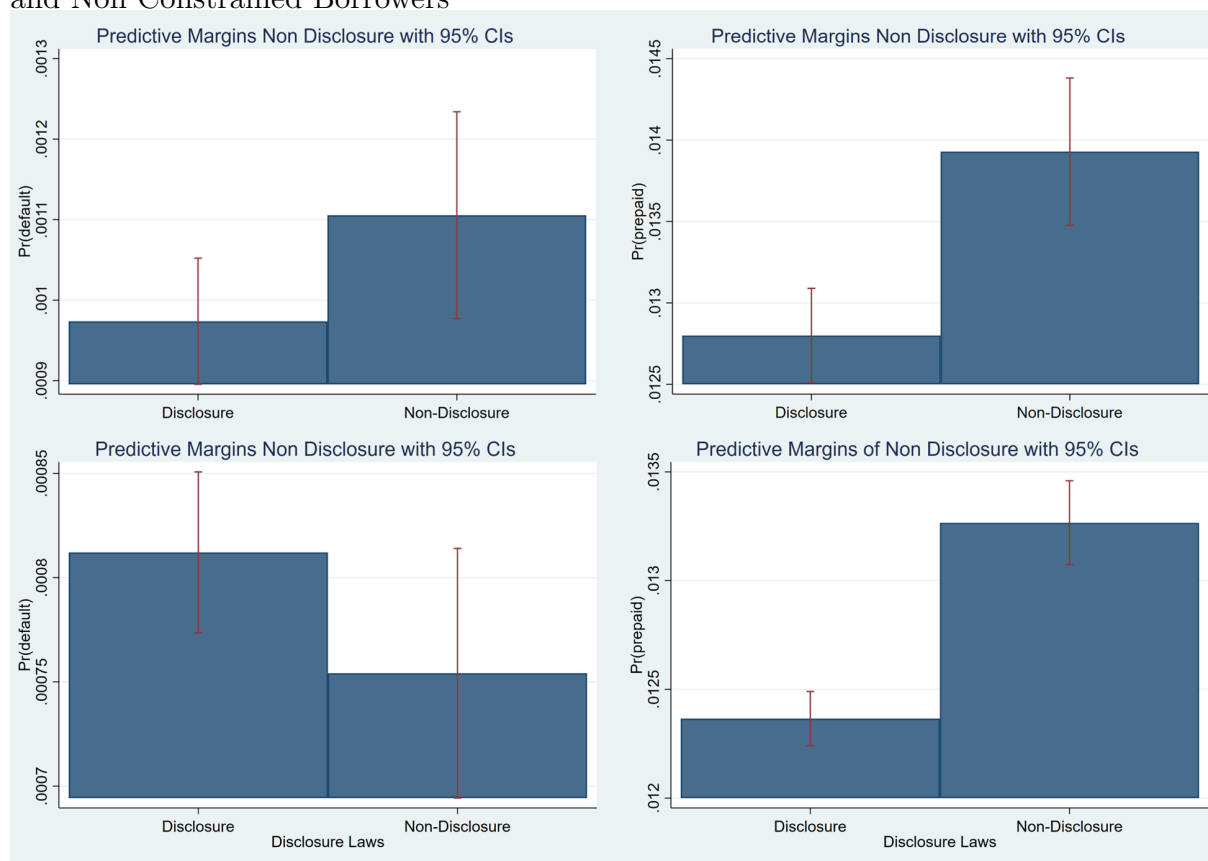
Note: This table shows the post treatment effect. North Dakota changed from Non-Disclosure to a Disclosure State in April of 2013. The Post period indicates that it switched to a Disclosure state. All the results include 30-years, 15-years and 10-years fixed rate mortgages; and, Purchase, Refinance and Cash-Out loans. The specification allows for 3 categorical outcomes: current, default and prepayment. A loan is considered to be on default if it is 90 or more days delinquent. Coefficients are statistically significant at the **** 0.1%, *** 1%, ** 5% and * 10% levels. Standard Errors clustered robust at the loan level.

Table 15: Default and Prepayment: Fargo MSA - Parallel Trends

	default	prepaid
Pre-treatment		
treatment side * year origination 2010	0.276 (0.720)	0.106* (0.060)
treatment side * year origination 2011	0.585 (0.554)	-0.034 (0.059)
treatment side * year origination 2012	0.139 (0.517)	0.066 (0.049)
Post-treatment		
treatment side * year origination 2014	-0.699** (0.342)	0.123*** (0.047)
treatment side * year origination 2015	-0.314 (0.272)	0.076 (0.049)
treatment side * year origination 2016	-0.740*** (0.278)	0.209**** (0.058)
Controls	Yes	Yes
Trend (Year Observation)	Yes	Yes
Loan Term FE	Yes	Yes
Servicer FE	Yes	Yes
Year of Observation FE	Yes	Yes
Year of Origination FE	Yes	Yes
Loan Purpose	Yes	Yes
N		530,236
R2		0.0466
Loans		8,189

Note: This table show the parallel trends. North Dakota changed from Non-Disclosure to a Disclosure State in April of 2013. All the results include 30-years, 15-years and 10-years fixed rate mortgages; and, Purchase, Refinance and Cash-Out loans. All the states in the metropolitan area are recourse states. The specification allows for 3 categorical outcomes: current, default and prepayment. A loan is considered to be on default if it is 90 or more days delinquent. Coefficients are statistically significant at the **** 0.1%, *** 1%, ** 5% and * 10% levels. Standard Errors clustered robust at the loan level.

Figure 5: Predicted Probabilities of Default and Prepayment for Financially Constrained and Non Constrained Borrowers



Using the model from Table 11 we estimate the Default and Prepayment probabilities with respect to whether is financially constrained. Probabilities are estimated at the means of the other variables. The graphs on the top row show financially constrained borrowers and the bottom row show non constrained borrowers. On the left we have default and on the right prepayment predicted probabilities.