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To Securitize or to Price Credit Risk?

Danny McGowan
University of Birmingham
d.mcgowan@bham.ac.uk (corresponding author)

Huyen Nguyen
Halle Institute for Economic Research (IWH) and Friedrich Schiller University Jena
huyen.nguyen@iwh-halle.de

Abstract

Do lenders securitize or price loans in response to credit risk? Exploiting exogenous variation in regional credit risk due to foreclosure law differences along U.S. state borders, we find that lenders securitize mortgages that are eligible for sale to the government-sponsored enterprises (GSEs) rather than price regional credit risk. For non-GSE-eligible mortgages with no GSE buyback provision, lenders increase interest rates as they are unable to shift credit risk to loan purchasers. The results inform the debate surrounding the GSEs' buyback provisions, the constant interest rate policy, and show that underpricing regional credit risk increases the GSEs' debt holdings.

I. Introduction

How do lenders manage credit risk? Where insurance markets are incomplete (Bhutta and Keys (2018), Ahnert and Kuncl (2020), and Kahn and Kay (2020)), a financial institution can protect itself against credit risk using loan pricing and securitization (Parlour and Winton (2013)). While a vast literature documents the determinants of securitization (Pennacchi (1988), Gorton and Pennachi (1995), Loutskina and Strahan (2009), Loutskina (2011), and Han, Park, and Pennacchi (2015)), much less is known about when and to what extent lenders choose securitization as a credit risk management device over risk-based pricing. Understanding this phenomenon has implications for the design of securitization markets.

In this paper, we study how financial intermediaries manage credit risk in the U.S. mortgage market. We conjecture that lenders offset credit risk differently depending on whether a loan is eligible for sale to the government-sponsored enterprises (GSEs), namely Fannie Mae and Freddie Mac. The GSEs absorb the credit risk of the loans they purchase through their buyback provisions. However,

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the pricing of GSE-eligible loans is subject to the GSEs' constant interest rate policy (CIRP) that allows lenders to vary interest rates based on a borrower's leverage, creditworthiness, and some other borrower characteristics, but excludes factors that systematically affect credit risk across regions (Hurst, Keys, Seru, and Vavra (2016)). A borrower in an area where the probability of default is high thus pays the same interest rate as an observationally equivalent borrower in a low default probability location.[1] For GSE-eligible loans, lenders therefore cannot use pricing to manage region-specific credit risk but may instead exploit the GSEs' buyback provisions by securitizing loans at higher rates to pass credit risk to the GSEs. In the non-GSE-eligible market, where no such policies exist and secondary market participants are private institutions with loss avoidance incentives, lenders may adjust interest rates to reflect credit risk.

To answer these questions we exploit a specific source of regional credit risk: foreclosure law. There exist predictable ex ante differences in credit risk according to a property's location depending on whether its state uses Judicial Review (JR) or Power of Sale (PS) law. In JR states, to foreclose a mortgage, a lender must provide evidence of default to a court and every step of the process requires judicial approval. In contrast, in PS states, upon default, lenders can immediately notify a borrower about the foreclosure and begin liquidation of the property without judicial oversight. Thus, while mortgage default is costly to lenders across locations, credit risk is systematically higher in JR states compared to PS states because borrowers have greater incentives to default, and lenders incur higher administrative and legal costs during foreclosure (Gerardi, Lambie-Hanson, and Willen (2013), Demiroglu, Dudley, and James (2014)).

We hypothesize that in JR states, lenders manage credit risk by securitizing GSE-eligible loans more frequently rather than adjusting interest rates. In the non-GSE-eligible market, where loan buyers are private institutions and the CIRP does not apply, lenders price credit risk by setting higher interest rates rather than using securitization.

We evaluate these predictions using a regression discontinuity (RD) design that exploits exogenous variation in foreclosure law along U.S. state borders. We find evidence that such incentives are operative and economically important. Despite systematically higher ex ante credit risk on the JR side of the state border, GSE-eligible interest rates are equal across locations. However, JR law increases the probability that a GSE-eligible loan is securitized by 5.3% relative to the control group (i.e., relative to an equivalent GSE-eligible loan in a PS state). Among non-GSE-eligible loans, we find that JR law provokes a significant 8 basis point increase in interest rates (a 1.7% increase relative to the control group), but has no effect on securitization. Further tests using subsamples reinforce the mechanisms: lenders' reactions to JR law are more pronounced among loans with greater credit risk.

Diagnostic checks show that socioeconomic conditions as well as loan, lender, and borrower characteristics are observationally equivalent across treatment and

[1]Hurst et al. (2016) show that GSE loans' interest rates do not vary with historic mortgage default rates in a region despite default being predictable and serially correlated through time within a region. Recourse laws, bankruptcy laws, and the concentration of lenders that influence regional credit risk also have no effect on GSE interest rates.

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control groups. The data also show that neither lenders nor borrowers manipulate treatment status. Our findings are therefore unlikely to be attributable to omitted variables.

Our research is important for three reasons. First, it illustrates the costs of failing to price regional credit risk due to the GSEs' buyback provisions and CIRP. Underpricing regional credit risk leads to more and riskier mortgage originations, and increases the GSEs' debt holdings. We calculate that JR law adds approximately $79.5 billion to the GSEs' debt holdings each year.[2] In addition, since the GSEs' entry into conservatorship in 2008, taxpayers ultimately bear additional costs of default through their GSE holdings. The net effects of the CIRP likely exceed the values we calculate because the policy prevents pricing of any factor that systematically affects regional credit risk. In contrast, in the non-GSE-eligible market where securitizers are privately capitalized and the CIRP does not apply, the credit risk of JR law is priced into mortgage contracts. We therefore contribute to the recent debate on phasing out the GSEs by providing empirical insights on an issue that has received mainly theoretical attention (Elenev, Landvoigt, and Van Nieuweburgh (2016), Gete and Zecchetto (2018)).[3]

Second, our results highlight potential legal reforms that may eliminate the distorting effects of JR law on credit markets. JR law contributes to credit risk by amplifying lenders' foreclosure costs during the foreclosure process, and by prolonging the duration of the process. As borrowers cease making mortgage payments during foreclosure, their returns to default are greater the longer the process lasts. We find securitization and interest rates respond to both channels, but the duration effect is relatively more important. JR law therefore mainly influences credit risk by creating moral hazard and provoking strategic default by borrowers. Initiatives that speed up court procedures and shorten the foreclosure process may help address regional credit risk in the mortgage market.

Finally, our findings inform recent changes in the design of securitization markets in the European Union (EU). In 2019, the Securitization Regulation introduced the simple, transparent, and standardized (STS) label for securitizations across EU member states. STS certification indicates a security's underlying assets are safe and grants originators capital relief. However, the STS criteria do not differentiate according to where loans are originated despite observable differences in credit risk between locations. STS certification may create incentives for originators and sponsors to pass regional credit risk to third parties without adequately pricing it into loan contracts.

Our work relates to two strands of literature. Prior research on the determinants of securitization highlights the importance of deposit funding costs (Pennacchi (1988), Gorton and Pennacchi (1995), Loutskina and Strahan (2009), McGowan

[2]Approximately 600,000 GSE eligible mortgages are securitized each year in PS states with a mean loan amount of $250,000. Our estimates show that JR law increases the probability of securitization in JR states by 5.3% compared PS states. This implies the GSEs purchase mortgages worth approximately $79.5 billion (5.3% × $250,000 × 600,000) because of JR law and the regional credit risk it exposes lenders to.

[3]Recent legislative initiatives such as the Corker–Warner 2013 and Johnson–Crapo 2014 Senate bills have proposed radical reforms including eliminating the GSEs' CIRP. A key objective of these efforts is to reduce the GSEs' debt holdings and lower taxpayers' mortgage market costs.

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and Nguyen (2021)), and corporate tax rates (Han et al. (2015)). Loutskina (2011) shows that securitization enables banks to convert illiquid loans into liquid funds which improve their lending ability. Purnanandam (2010), Keys, Mukherjee, Seru, and Vig (2010), and Keys, Seru, and Vig (2012) show that securitization reduces financial intermediaries' screening and monitoring incentives. Our findings complement this literature by providing evidence that securitization responds to elements of the legal and regulatory environment. Moreover, we find that in the non-GSE-eligible market, lenders respond to credit risk by pricing it into interest rates rather than strategically unloading debt to third parties. Whereas this pattern exists for banks, it is stronger for nonbanks, consistent with the literature on the differences in business models and risk-taking behavior of banks and nonbanks (Demyanyk and Loutskina (2016), Buchak, Matvos, Piskorski, and Seru (2018)).

A separate area of research documents the effects of foreclosure law on credit supply. Pence (2006) finds that JR law causes a reduction in mortgage loan amounts. Dagher and Sun (2016) extend Pence's work by examining whether foreclosure law influences the probability of being granted a mortgage. Our paper complements these studies by illustrating that the effects of JR law extend beyond credit supply responses. In contrast to these articles, we provide novel evidence on the pricing and securitization effects of foreclosure law and examine these outcomes in the GSE-eligible and non-GSE-eligible markets. Our results suggest that limiting credit supply does not fully address the costs of JR law to lenders, and that lenders use pricing and securitization as complementary devices, albeit to different extents across markets.

The paper proceeds as follows: Section II presents the institutional background, and Section III describes the data set. We outline the identification strategy, discuss the empirical results, and robustness tests in Sections IV–VI, respectively. Section VII draws conclusions.

II. Institutional Background

A. Judicial Review, Default, and Foreclosure Costs

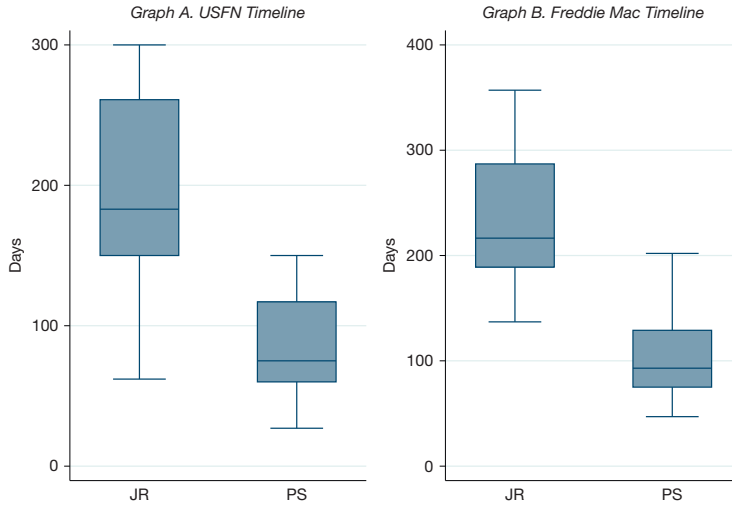
Foreclosure law governs the process through which creditors attempt to recover the outstanding balance on a loan following mortgage default. Typically, this entails repossessing the delinquent property. In the USA, 23 states regulate this process using JR law whereas the remaining 27 states and the District of Columbia use PS law. JR foreclosure proceeds under the supervision of a court and mandates that lenders present evidence of default and the value of the outstanding debt. A judge then issues a ruling detailing what notices must be provided and oversees the procedure. In contrast, upon default lenders in PS states can immediately notify a borrower in a letter of the pending foreclosure and begin liquidation of the property. A trustee handles the process and there is no need for judicial oversight (Ghent (2014)).

Part of the credit risk that JR law creates stems from a higher financial burden on lenders compared to PS law in case of default. Each step of the process requires judicial approval meaning the foreclosure process is more protracted. Figure 1

FIGURE 1

Foreclosure Timelines

Figure 1 presents the mean and range of the foreclosure timeline across states. Graph A uses data from the U.S. Foreclosure Network which provides an estimate of the number of days it takes to foreclose a property based on state regulations (i.e., the values do not include process delays). Graph B uses data provided by Freddie Mac through the National Mortgage Servicers' Reference Dictionary.



shows that for the median state the duration of the foreclosure process (the timeline) is between 80–90 days longer in JR states, although for some JR states the duration is substantially longer.

Owing to the greater legal burden, lenders in JR states incur substantially higher legal expenses through attorney and court fees. Moreover, during the foreclosure process, the lender bears property taxes, hazard insurance, and other indirect costs, and receives no mortgage payments (Clauretie and Herzog (1990), Schill (1991), and Gerardi et al. (2013)). Delinquent borrowers typically do not make investments to maintain the property because they do not expect to capture the returns to those investments, resulting in lower re-sale values (Melzer (2017)). These costs are increasing in the foreclosure timeline. Figure 2 shows that the median cost of foreclosing a property is approximately $6,500 in JR states versus $4,000 in PS states. However, in many JR states lenders' foreclosure costs exceed $10,000 per property.

JR law also contributes to credit risk by increasing borrowers' strategic default incentives. As delinquent borrowers cease making mortgage payments, they effectively live in the property for free during the foreclosure period (Seiler, Seiler, Lane, and Harrison (2012)). The returns to default therefore depend on the foreclosure timeline such that borrowers have greater default incentives in JR states (Gerardi et al. (2013)). Indeed, Demiroglu et al. (2014) show the probability of mortgage default is 40% higher in JR compared to PS states. Consistent with this finding, Supplementary Figure A1 shows a higher rate of mortgage default in JR relative to PS states every year since 2000. Supplementary Table A1 presents econometric

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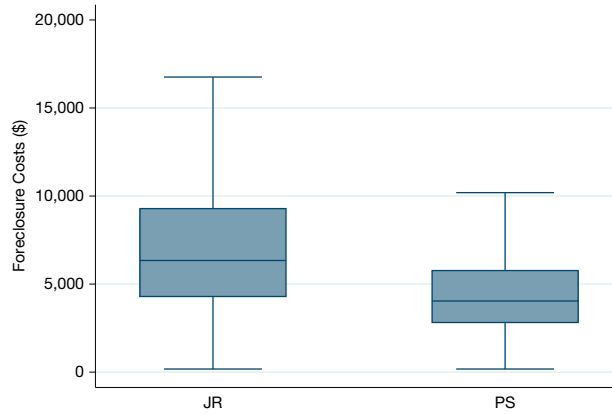
FIGURE 2

Foreclosure Laws and Foreclosure Costs

Figure 2 presents the mean and range of foreclosure costs per property in US$ incurred by lenders in JR and PS states. Information on foreclosure costs is taken from the Fannie Mae Single Family Loan database.



estimates showing JR law raises the probability that a borrower defaults by 35%, and increases lenders' costs of default by 65%.[4]

B. The Securitization Market and GSE Policies

1. GSE Eligibility and Buyback Provisions

After origination, approximately 70% of conventional mortgages in the USA are sold in a secondary market rather than remain on lenders' balance sheets. The GSEs only purchase loans that conform to their underwriting criteria.[5] Following Bayer, Ferreira, and Ross (2018), a loan is eligible for sale to a GSE if the loan amount is less than the county conforming loan limit, the debt-to-income (DTI) ratio is less than or equal to 45% of the borrower's stable monthly income for manually underwritten loans, or a maximum 50% DTI ratio for nonmanually underwritten loans, and the loan-to-value (LTV) ratio is less than or equal to 97% for fixed rate mortgages and 95% for adjustable rate mortgages.[6] We refer to these loans as GSE-eligible throughout the paper. Post origination, GSE-eligible loans are

[4]For foreclosure costs, the JR coefficient in column 1 of Supplementary Table A1 is 0.5033 and the dependent variable is in logarithms. The economic magnitude of the effect is therefore $100\% \times (e^{0.5003} - 1) = 65\%$. For the probability of default, the JR coefficient in column 3 of Supplementary Table A1 is 0.0021. This is equivalent to a 35% increase in the probability of default relative to the mean default rate in PS states.

[5]A loan may be originated to conform to the GSEs' underwriting criteria, but not be securitized. Loan sales also depend on market forces. For example, GSE demand for loans may be influenced by their liquidity and capital levels, and by investor demand for GSEs' MBS securities. GSE-eligible loans that are not securitized may reflect either insufficient GSE demand, or a lenders' liquidity and funding needs. If the lender has sufficient liquidity it may not need to securitize loans (Loutskina (2011)).

[6]These criteria are shown in the Fannie Mae Selling Guide that is available from https://singlefamily.fanniemae.com/originating-underwriting/mortgage-products/eligibility-pricing.

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largely sold to a GSE, and in some cases to a private buyer, or held on the lender's balance sheet.

Loans sold to the GSEs are purchased, packaged, and insured against loss of principal and interest in the resulting mortgage-backed securities (MBS). This feature is known as the GSEs' buyback provision. The costs of default are thus borne by the GSEs which fully insure MBS securities holders against credit risk. The GSEs therefore directly bear the costs of mispricing credit risk. Ultimately, since the GSEs' entry into government conservatorship in 2008, it is taxpayers who bear the costs of default on the loans the GSEs purchase.

For loans that do not meet the GSEs' underwriting criteria (that is non-GSE-eligible loans), a lender can either sell them to private buyers or hold them on its balance sheet. Private purchasers include banks, hedge funds, and insurance companies. Unlike GSE-backed MBS, private institutions do not provide insurance against the loss of principal or interest in the securities they issue. From an investor's perspective, they are liable for the costs of default on their private MBS holdings but not on GSE-backed MBS securities. This creates incentives for lenders to adjust interest rates to reflect the credit risk.

Non-GSE-eligible loans include jumbo loans and subprime loans. Jumbo loans are those with a loan amount greater than the county conforming loan limit. Subprime loans are those to borrowers whose creditworthiness does not meet the GSEs' underwriting criteria. The interest rate on subprime loans is therefore higher than the average prime offer rate (APOR; i.e., the interest rate for comparable transactions of prime loans on the date the interest rate is set). This rate difference is referred to as the rate spread in the Home Mortgage Disclosure Act (HMDA) database. Following Purnanandam (2010), Chan, Haughwout, and Tracy (2015), Ferreira and Gyourko (2015), Antoniades (2016), and Bayer et al. (2018), we classify a subprime loan as one with a rate spread greater than or equal to 3%.

2. The Constant Interest Rate Policy

The GSEs provide guidelines on the pricing of loans they purchase. For example, Fannie Mae's loan-level price adjustment (LLPA) matrix allows GSE-eligible loans' interest rates to vary depending on a borrower's creditworthiness, leverage, and some other borrower-level characteristics. However, the LLPA does not allow lenders to differentiate interest rates based on factors that influence credit risk across regions.[7] GSE-eligible interest rates can therefore differ based on factors such as a borrower's LTV ratio but they cannot vary according to the region where the property is located despite systematic ex ante differences in the probability of default (i.e., credit risk) between regions. The latter feature is the CIRP: lenders cannot set GSE-eligible interest rates differently across regions in response to JR law or other factors that systematically influence the probability of default. Hurst et al. (2016) show that GSE loans' interest rates do not vary with historic mortgage default rates in a region despite default being predictable and serially correlated through time. Recourse laws, bankruptcy laws, and the concentration of lenders that influence regional credit risk also have no effect on GSE interest rates.

[7]See https://singlefamily.fanniemae.com/media/9391/display.

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When determining the interest rate on a GSE-eligible loan application, lenders typically adhere to the GSE pricing guidelines because failure to do so prevents a lender from selling a loan to the GSEs, reducing loan portfolio liquidity (Loutskina (2011)). Moreover, when setting interest rates on GSE-eligible loans most lenders use underwriting software provided by the GSEs that follows their pricing guidelines (e.g., Fannie Mae's Desktop Underwriter and Freddie Mac's Loan Prospector programs). The CIRP therefore applies regardless of whether a GSE-eligible loan is subsequently securitized or held on the balance sheet. Consistent with the CIRP, Hurst et al. (2016) present evidence that the interest rate on GSE-eligible loans with observationally equivalent borrower characteristics is equal across locations despite systematically different default probabilities and economic conditions.[8] The Consumer Financial Protection Bureau highlights that the CIRP exists to help prevent discrimination in lending by financial institutions.[9]

III. Data

The data set contains loan-level information from the 2018 vintage of the HMDA database. We focus exclusively on this year because previous editions did not contain several variables such as interest rates and leverage. The HMDA data contain approximately 95% of mortgage applications in the USA. Each observation corresponds to a unique mortgage loan and provides information on the characteristics of the loan, borrower, and lender at the point of application. For example, the loan type (purchase, refinance, home improvement), the borrower's characteristics (ethnicity, gender, income, coapplicant status), the originating financial institution, the interest rate, loan amount, term to maturity, the LTV ratio, the DTI ratio, the loan-to-income (LTI) ratio, the lender's decision on the application (acceptance or rejection), the census tract where the property is located, property type (single- or multi-family), the rate spread (the difference between the loan's interest rate and the APOR), whether the loan is manually or non-manually underwritten, whether the loan is subsequently securitized and the type of loan purchaser (a GSE or a private institution), and if it is eligible for sale to a GSE. Non-GSE-eligible loans include jumbo and subprime loans.[10]

A. Sampling

To sharpen identification, we restrict the sample to observations within a 10-mile distance of the border between states that use different types of foreclosure laws. We also include only observations of conventional single-family home purchases to ensure a homogeneous unit of observation.[11] The sample contains loans

[8]The Department of Housing and Urban Development and the Federal Housing Finance Agency regulate GSE-eligible mortgages.

[9]See https://www.consumerfinance.gov/data-research/hmda/.

[10]HMDA provides an indicator that shows whether a loan is a jumbo or nonjumbo loan. We follow the classification method of Purnanandam (2010), Chan et al. (2015), Ferreira and Gyourko (2015), Antoniades (2016), and Bayer et al. (2018) and identify subprime loans as those with an interest rate of 3% and above the APOR (the rate spread).

[11]There are no observations of refinancing, home improvement, or unconventional loans in the data set. Among GSE-eligible loans the data set includes only loans eligible for sale to Fannie Mae or Freddie

originated by banks and nonbanks. As securitization is only possible following acceptance of a loan, we exclude rejected loan applications. These screens leave a sample of 327,549 GSE-eligible loan observations. The non-GSE-eligible sample contains 135,181 observations.[12]

B. Dependent Variables

We construct separate securitization variables for GSE-eligible and non-GSE-eligible loans. As GSE-eligible loans can be sold to the GSEs, private purchasers, or held on a lender's balance sheet, we have three securitization indicators to capture all possible loan outcomes. GSE_SEC is a dummy variable equal to 1 if a GSE-eligible loan is sold to a GSE during 2018, 0 otherwise.[13] PRIVATE_SEC is a dummy variable equal to 1 if a GSE-eligible loan is sold to a private buyer during 2018, 0 otherwise. SEC is a dummy variable equal to 1 if a GSE-eligible loan is securitized irrespective of whether the buyer is a GSE or a private institution during 2018, 0 otherwise. We mainly focus on the GSE_SEC variable as literature shows the GSEs dominate this market and influence all market participants. We later complement our main findings with an analysis of overall securitization and private securitization among GSE-eligible loans.

Non-GSE-eligible loans may only be sold to private institutions. For non-GSE-eligible loans, the main dependent variable is NSEC which equals 1 if the loan is securitized during 2018, 0 otherwise.

The other key dependent variable is IR, the loan's interest rate at the point of origination. We regress IR separately for GSE-eligible and non-GSE-eligible loans. Table 1 shows that 70% of GSE-eligible loans are securitized with 43% sold to a GSE and 27% to a private buyer. 36% of non-GSE-eligible loans are securitized. The rate of securitization in the data set is comparable to other recent studies (Bhutta (2011), Buchak et al. (2018)). The mean interest rate on GSE-eligible and non-GSE-eligible loans is 4.69% and 5.33%, respectively.

C. Explanatory Variables

The key explanatory variable is a dummy variable that captures the type of foreclosure law used in the state where the property is located. We read the citations to foreclosure law in each state's constitution to ascertain which processes are available. Next, we retrieve data from foreclosure auction listings on Realtytrac.com, Ghent (2014), and interview attorneys to confirm our classification. Supplementary Material Section C provides this data. Figure 3 shows the type of law used

Mac because Ginnie Mae, a separate GSE, purchases unconventional loans insured by the Veterans Association and the Federal Housing Administration. We exclude these unconventional loans.

[12]Supplementary Table A2 illustrates the geographical spread of the observations in the data set. While some state borders contain more observations than others, there are typically thousands of observations in each state pair. It is therefore unlikely our findings are due to idiosyncrasies in a limited number of states.

[13]While loans may be sold in subsequent calendar years, this is relatively uncommon. Data for 2018 show 91% of the mortgages Fannie Mae purchases are originated during the same calendar year. For Freddie Mac the figure is 97%.

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TABLE 1

Summary Statistics

Table 1 provides descriptive statistics for the variables used in the empirical analysis. Interest rates (IR) are measured in percent (%). FORECLOSURE_COST is measured in US$. OUT_OF_STATE is a dummy variable equal to 1 if a loan is originated outside a lender's home state, 0 otherwise. LENDERS_PER_CAPITA and APPLICATIONS_PER_CAPITA are measured per 1,000 population. 'Ln' denotes that a variable is measured in natural logarithms. 'Source' denotes the data provider. BEA denotes the Bureau of Economic Analysis. FDIC denotes the Federal Deposit Insurance Corporation. FFIEC denotes the Federal Financials Examination Council. FHFA denotes the Federal Housing Finance Agency. HMDA denotes the Home Mortgage Disclosure Act database. NY Fed denotes the Federal Reserve Bank of New York. SFLD denotes the Fannie Mae Single Family Loan database. USFN denotes the U.S. Foreclosure Network.

Variable	Mean	Std. Dev.	Min	Max	No. of Obs.	Source
SEC (GSE eligible)	0.70	0.45	0	1	327,549	HMDA
GSE_SEC (GSE eligible)	0.43	0.49	0	1	327,549	HMDA
PRIVATE_SEC (GSE eligible)	0.28	0.45	0	1	327,549	HMDA
NSEC (non-GSE eligible)	0.36	0.48	0	1	135,181	HMDA
IR (%) (GSE eligible)	4.69	0.53	2.74	7.17	327,549	HMDA
IR (%) (Non-GSE eligible)	5.33	1.62	2.99	10.94	135,181	HMDA
JR	0.37	0.48	0	1	462,730	Supplementary B
ASSIGNMENT	−0.98	4.97	−9.99	9.99	462,730	Authors' calculation
GSE_ELIGIBLE	0.71	0.45	0	1	462,730	HMDA
LOAN_AMOUNT (ln)	11.97	0.86	9.62	13.48	462,730	HMDA
APPLICANT_INCOME (ln)	11.44	0.67	9.47	13.20	462,730	HMDA
LTV (%)	80.42	17.35	13.85	108.30	462,730	HMDA
MALE	0.31	0.46	0	1	462,730	HMDA
MINORITY	0.22	0.41	0	1	462,730	HMDA
LENDERS_PER_CAPITA	11.8	17.6	1.5	37.45	462,730	Authors' calculation
LTI (%)	2.45	1.19	0.20	5.36	462,730	HMDA
CO_APPLICANT	0.45	0.50	0	1	462,730	HMDA
APPLICATIONS_PER_CAPITA	17.54	17.50	0.09	263.41	462,730	HMDA
REFINANCING_RATE	0.33	0.10	0	0.60	462,730	HMDA
HOUSE_PRICES (ln)	12.44	0.67	10.46	14.17	462,730	HMDA
RENTER_OCCUPIED_HOUSING (%)	33.27	8.54	14.88	57.72	462,730	US Census
ARRANGEMENT_FEE (%)	0.75	0.66	0	3.59	462,730	FHFA
LOAN_TERM (months)	337.79	62.98	1	3630	462,730	HMDA
MORTGAGE_INSURANCE (%)	23.94	0.59	22.58	26.04	462,730	SFLD
DTI (%)	34.82	10.63	10	70	462,730	HMDA
FICO	719	5.14	696	728	462,730	SFLD
RIGHT_OF_REDEMPTION	0.63	0.48	0	1	462,730	Ghent and Kudlyak (2011)
DEFICIENCY_JUDGMENT	0.94	0.24	0	1	462,730	Ghent and Kudlyak (2011)
HOMESTEAD_EXEMPTION (ln)	8.95	0.30	8.10	9.50	462,730	Corradin et al. (2016)
NON_HOMESTEAD_EXEMPTION (ln)	10.40	0.42	8.61	11.42	462,730	Corradin et al. (2016)
ZONING_INDEX	25.97	13.18	1	50	462,730	Calder (2017)
FORECLOSURE_COST (USD)	4,553	1,839	2,214	14,810	462,730	SFLD
TIMELINE (Days)	108	69	27	445	462,730	USFN
RENEGOTIATION_RATE (%)	0.03	0.06	0	1.47	462,730	SFLD
STATE_CORPORATE_TAX (%)	6.90	1.68	0	9.99	462,730	Tax Foundation
STATE_PERSONAL_TAX (%)	5.41	2.57	0	9.85	462,730	Tax Foundation
AUTO_DELINQUENCY (%)	4.36	1.39	1.99	8.60	462,730	NY Fed
CREDIT_CARD_DELINQUENCY (%)	7.01	1.07	4.68	9.87	462,730	NY Fed
ADJUSTABLE_RATE_LOAN	0.12	0.32	0	1	462,730	FHFA
HHI (ln)	5.39	1.09	3.47	7.66	462,730	Author's calculation
NON_BANK	0.48	0.50	0	1	462,730	Authors' calculation
BANK_SIZE (Ln)	16.55	2.76	12.06	21.48	271,326	FFIEC
Z_SCORE (Ln)	3.22	0.15	2.59	3.96	271,326	FFIEC
CAPITAL_RATIO (%)	10.61	2.34	6.52	20.08	271,326	FFIEC
NII_RATIO (%)	0.20	0.18	0	1.20	271,326	FFIEC
COST_OF_DEPOSITS (%)	0.81	0.34	0.16	2.67	271,326	FFIEC
OUT_OF_STATE	0.64	0.50	0	1	462,730	HMDA
UNEMPLOYMENT_RATE (%)	5.31	3.33	0	14	462,730	BEA
PER_CAPITA_INCOME (ln)	10.45	0.38	7.62	11.95	462,730	BEA
URBAN	0.91	0.28	0	1	462,730	US Census
POVERTY_RATE (%)	11.57	4.92	2.80	40.80	462,730	US Census
BLACK_POPULATION (%)	6.62	11.60	0	71.43	462,730	US Census
HISPANIC_POPULATION (%)	5.11	8.30	0	60.61	462,730	US Census
VIOLENT_CRIME_RATE (%)	0.40	0.16	0.12	1.20	462,730	US Census
DEGREE (%)	36.59	10.34	11.50	63.70	462,730	US Census
NET_MIGRATION	0	0.13	−19.14	11.49	462,730	US Census
TRACT_POPULATION (ln)	8.46	0.46	2.30	10.28	462,730	HMDA
RMBS	5.75	1.15	1.90	9.13	43,943	Bloomberg

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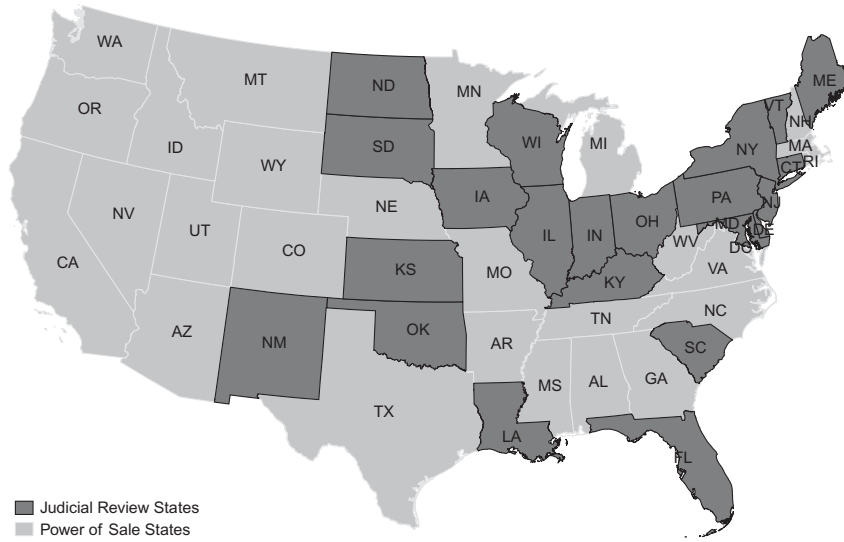
FIGURE 3

Foreclosure Laws in Each State

Figure 3 reports the type of foreclosure law used in each of the contiguous U.S. states. See Supplementary Material Section B for the reasons behind each state's legal classification. Alaska uses PS law. Hawaii used PS law until 2011 but has used JR law since 2011.



in each state. We construct JR, a dummy variable, that equals 1 if a property is in a JR state, 0 for PS states.

As our empirical strategy relies on an RD design, we construct the assignment variable using the distance between the midpoint of the property's census tract and the nearest JR–PS border coordinate. Following prior literature, the assignment variable takes a negative value for observations in the control group (PS states) and positive values for observations in the treatment group (JR states).

We merge the loan-level data with several additional variables from other sources. To capture other characteristics of state law, we generate dummy variables for whether a state allows the right of redemption, deficiency judgments (Ghent and Kudlyak (2011)), the annual state homestead and nonhomestead bankruptcy exemptions levels, and retrieve a single-family home zoning restrictiveness index from Calder (2017).

We incorporate county-level information on the unemployment rate (Bureau of Economic Analysis), the share of the population living in poverty (U.S. Census), the delinquency rate on automobile and credit card loans (NY Fed and CFPB), violent crime rates (U.S. Census), the share of the population with a college degree (U.S. Census), the average FICO score of borrowers at the point of origination, and the rate of successful renegotiation on delinquent loans (SFLD).[14] We approximate competition in the local mortgage market using a county-level

[14]The renegotiation rate is the percentage of mortgages that default and successfully renegotiate terms with the securitizer.

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Herfindahl–Hirschman Index (HHI).[15] The FHFA provides census tract-level data on arrangement fees (the ratio of arrangement fees to loan amount). We measure access to credit using the number of lender branches per 1,000 population in each census tract. To capture credit demand we use the number of mortgage applications per 1,000 population in each census tract. We calculate the census tract-level mortgage refinancing rate as the ratio of mortgage refinancing applications to total applications.

Finally, each HMDA loan provides an identifier for the originating institution that is also present in Condition and Income Reports provided by the Federal Deposit Insurance Corporation (FDIC). We therefore merge bank-level data from this source into our data set for the loans that are originated by banks.[16] This allows us to incorporate information on the bank's size (the natural logarithm of assets), net interest income ratio, Z-score, capital ratio, cost of deposits (the ratio of deposit interest expenses to deposit liabilities), and an out-of-state dummy variable that equals 1 if a loan is originated by a bank headquartered in state s to a borrower outside state s, 0 otherwise.[17] Table 1 provides a list of the variables in the data set, summary statistics, and the source. The Appendix provides definitions of each variable.

IV. Identification Strategy and Diagnostic Tests

Our econometric strategy utilizes a parametric RD design. We estimate

$$y_{ilrs} = \alpha + \beta \mathrm{JR}_s + \gamma f(X_{ilrs}) + \varphi \mathbf{W}_{ilrs} + \delta_r + \delta_l + \varepsilon_{ilrs}, \tag{1}$$

where y_{ilrs} is a dependent variable (either IR or a securitization indicator) for loan i originated by lender l in region r of state s; JR_s defines treatment status and is equal to 1 if a property is in a JR state, 0 for PS states; $f(X_{ilrs})$ contains first-order polynomial expressions of the assignment variable and an interaction between JR_s and the assignment variable; $\mathbf{W}_{ilrs}$ is a vector of control variables; ε_{ilrs} is the error term.

Equation (1) includes region fixed effects, δ_r. We define a region as an area 20 miles long by 10 miles wide that overlaps the threshold. There are 1282 regions in the sample. As an example, Figure 4 illustrates the regions along a section of the Arkansas–Louisiana border. The region fixed effects eliminate local and aggregate unobserved heterogeneity and also sharpen identification. Specifically, the local average treatment effect (LATE) is computed by comparing outcomes to the left and right of the threshold within the same region. As the source of identification is confined to small, economically homogeneous areas at the same point in time, omitted variables are unlikely to drive our inferences. Focusing on regions close to

[15]We calculate the HHI index using lenders' market shares where market share is the ratio of the total value of mortgage loans originated by lender l relative to the total value of mortgage loans originated by all institutions in the county. The HHI then is calculated as the sum of the squares of the market shares of all financial institutions in each county.

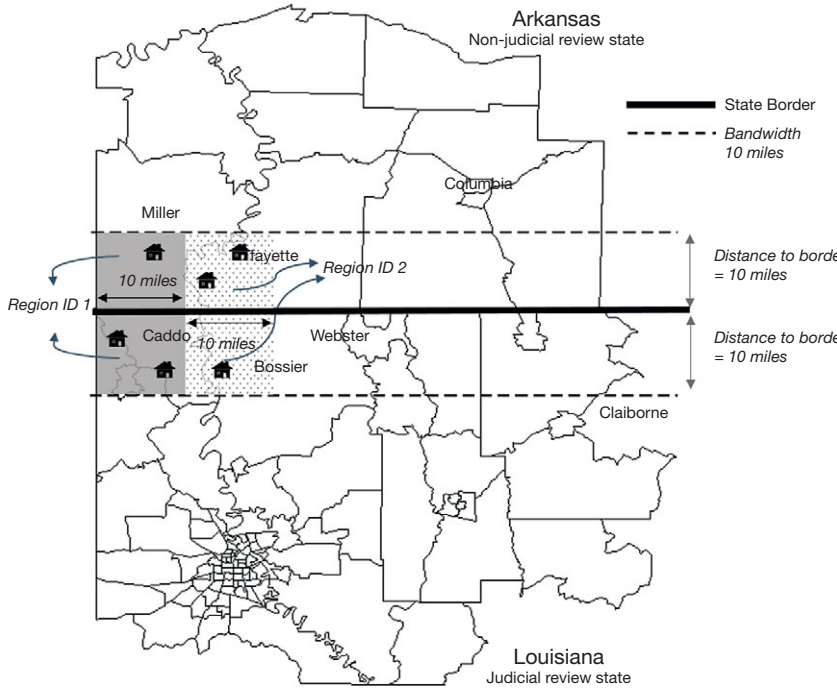
[16]Nondeposit taking lenders that are present in the HMDA data do not appear in Call Reports.

[17]The Z-score is calculated using the equation: $Z_l = (\mathrm{ROA}_l + \mathrm{ETA}_l)/\mathrm{ROASD}_l$ where ROA_l, ETA_l, and ROASD_l are return on assets, the ratio of equity to total assets, and the standard deviation of return on assets over the four quarters of 2018 for bank l, respectively.

FIGURE 4

Region Fixed Effects

Figure 4 provides an illustration of the region fixed effects we use in equation (1). The map plots census tracts along a section of the Arkansas–Louisiana border. The sample includes only loans made to purchase single-family homes that lie within 10 miles of the border (threshold). We define regions as arbitrary geographical areas that span the border and measure 10 miles wide by 20 miles long. Each region is assigned an identifier (e.g., Region ID 1 and Region ID 2).



the border is similar to the approach of Pence (2006) who considers MSAs that overlap state borders.

We also include lender fixed effects, δ_l. These capture all lender-specific factors such as risk preferences, managerial quality, or business models that may impact securitization and pricing decisions. Lender fixed effects also purge cross-sectional regulatory differences. For example, nonbanks are regulated at the state level whereas domestic banks with national charters and foreign banks are regulated by the OCC, while state-chartered banks are supervised by the state regulator in conjunction with the FDIC or Federal Reserve.

A. Exogeneity

Critical to our identification strategy is the exogeneity of foreclosure law. Ghent (2014) reports that foreclosure law is exogenous with respect to contemporary economic conditions and lenders' behavior because most states' foreclosure law was determined by idiosyncratic factors during the pre-Civil War period. For example, the original 13 states inherited JR law from England. PS law developed during the early eighteenth century in response to British lenders asking courts to

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agree to a sale-in-lieu of foreclosure. As the laws governing foreclosure were determined in case law they have largely endured to the present day. This is because once there is precedent, the law rarely changes substantially. Indeed, Ghent (2014) is explicit in her assessment, stating,

> Given the extremely early date at which I find that foreclosure procedures were established, it is safe to treat differences in some state mortgage laws, at least at present, as exogenous, which may provide economists with a useful instrument for studying the effect of differences in creditor rights.

Other recent articles that treat foreclosure law as exogenous with respect to lender behavior and contemporary economic matters include Pence (2006), Gerardi et al. (2013), and Mian, Sufi, and Trebbi (2015).

B. Diagnostic Checks

While treatment status is exogenous in equation (1), the validity of our econometric strategy rests upon two identifying assumptions. First, the balanced covariates assumption states that all other predetermined factors that affect securitization and interest rates must be continuous functions across the threshold. If this assumption is violated, estimates of β will capture both the effect of JR law as well as the discontinuous factor leading to biased estimates.

Following previous studies, Table 2 presents t-tests that inspect whether the balanced covariates assumption holds in our data. Panel A of Table 2 examines socioeconomic factors that are common irrespective of loan type between the JR and PS regions. We find no significant differences in macroeconomic conditions (reflected by income per capita and unemployment rates), state tax rates, urbanization, the incidence of poverty, ethnic composition, and educational attainment. Housing markets are strongly similar on either side of the threshold in terms of house prices, the share of the housing stock that is rented, and zoning regulations. The rate of renegotiation on delinquent mortgages and the rate of default on other types of debt are also insignificantly different. The characteristics of financial intermediaries operating in the regions are highly similar. For example, nonbanks originate an equal share of mortgages in JR and PS regions while banks have similar capital ratios and Z-scores. There is no significant difference in the share of loans originated by banks to borrowers outside their headquarters state.

Panel B in Table 2 presents results for a number of variables related to the GSE-eligible loan sample. We find no significant differences between the treatment and control groups in terms of applicant income, gender and ethnic composition of borrowers, LTV and DTI ratios, term to maturity, mortgage insurance, and FICO scores. While we have somewhat fewer variables available for non-GSE-eligible loans, Panel C of Table 2 shows no significant differences in the characteristics of these loans on either side of the threshold.

The second assumption is that neither borrowers nor lenders have precise control over treatment status (Lee (2008)). This assumption is likely to hold because housing availability, lifestyle concerns (e.g., commuting and school access), and budget constraints prevent borrowers from perfectly choosing where they live.

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TABLE 2

Balanced Covariates Tests

Table 2 reports the results of *t*-tests for differences in the average level of each covariate between the JR and PS regions on either side of the threshold. JR and PS denote the mean of each variable on the JR and PS side of the threshold, respectively. Diff. is the difference between JR and PS. *t*-stat is the *t*-statistic from a two-tailed test of the null hypothesis that difference is equal to zero. Panel A reports estimates for socioeconomic variables that are common across mortgage market segments. Panel B reports estimates for GSE-eligible loans' variables. Panel C reports estimates for non-GSE-eligible loans' variables.

Variable	JR	PS	Diff.	*t*-Stat
Panel A. Socioeconomic Conditions				
PER_CAPITA_INCOME (ln)	10.16	10.17	−0.01	−0.65
UNEMPLOYMENT_RATE (%)	5.99	5.89	0.09	0.85
STATE_CORPORATE_TAX (%)	6.38	6.74	−0.36	−1.54
STATE_PERSONAL_TAX (%)	5.39	5.00	0.39	1.30
URBAN	0.81	0.81	0	0.04
POVERTY_RATE (%)	12.04	11.22	0.82	0.85
BLACK_POPULATION (%)	5.81	6.24	−0.42	−0.81
HISPANIC_POPULATION (%)	5.49	5.50	−0.01	−0.87
DEGREE (%)	24.34	25.03	−0.69	−1.15
HOUSE_PRICE	11.90	11.91	−0.02	−1.58
REFINANCING_RATE	0.34	0.34	0.01	1.52
RENTER_OCCUPIED_HOUSING (%)	33.01	33.26	−0.25	−1.32
RENEGOTIATION_RATE (%)	0.04	0.04	0	−0.11
AUTO_DELINQUENCY (%)	4.36	4.34	0.02	0.35
CREDIT_CARD_DELINQUENCY (%)	7.12	7.18	−0.05	−1.06
VIOLENT_CRIME_RATE (%)	0.39	0.40	−0.01	−1.41
HHI (Ln)	5.22	5.29	−0.06	−1.16
LENDERS_PER_CAPITA	12.0	11.9	0.10	0.88
NON_BANK	0.46	0.47	−0.01	−0.33
Z_SCORE (ln)	3.22	3.22	−0.01	−0.63
CAPITAL_RATIO (%)	10.68	10.63	0.05	1.36
OUT_OF_STATE	0.65	0.67	−0.02	−1.24
NET_MIGRATION	0	0	0	−0.02
Panel B. GSE-Eligible Loans				
APPLICANT_INCOME (ln)	11.23	11.21	0.02	1.25
MALE	0.32	0.32	0	0.23
MINORITY	0.14	0.14	0	−0.85
LTI	2.08	2.11	−0.04	−1.60
TERM_TO_MATURITY	333	331	2	1.61
DTI (%)	34	34	0.07	0.54
LTV (%)	82	82	0.39	1.32
FICO	718	719	−0.96	−1.28
ARRANGEMENT_FEE (%)	0.94	0.95	−0.01	−0.56
MORTGAGE_INSURANCE (%)	23.94	24.06	−0.11	−1.26
Panel C. Non-GSE-Eligible Loans				
APPLICANT_INCOME (ln)	11.20	11.20	−0.01	−0.21
MALE	0.33	0.33	−0.01	−0.48
MINORITY	0.18	0.17	0.01	0.57
LTI	1.96	1.97	−0.02	−0.56
TERM_TO_MATURITY	297	298	−1	−0.53
DTI (%)	34	35	−1	−1.25
LTV (%)	79	80	−0.34	−1.56

Following McCrary (2008), we test for strategic manipulation by estimating whether the density of mortgage applications and lender branches per 1,000 population are continuous functions of the threshold. Manipulation by borrowers (lenders) would be consistent with a higher application (lender) density within JR (PS) states. We estimate the equation

$$y_{cr} = \alpha + \beta \mathrm{JR}_c + \gamma \mathbf{X}_{cr} + \delta_r + \varepsilon_{cr}, \tag{2}$$

where y_{cr} is either the number of mortgage applications or lenders per 1,000 population within census tract c in region r; JR_c is equal to 1 if an observation is

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TABLE 3

Tests for Manipulation of Treatment Status

Columns 1 to 6 and 8 of Table 3 report estimates of equation (2). In columns 1 to 3, the dependent variable is the natural logarithm of the number of mortgage applications per 1,000 population in a census tract. In columns 4 to 6, the dependent variable is the natural logarithm of the number of lenders per 1,000 population in a census tract. Column 7 presents estimates of the equation $m_{cj} = \alpha + \beta \mathrm{JR}_c + \varepsilon_{cj}$, where m_{cj} is the net flow of migrants per 1,000 population into county c from county j between 2013 and 2017; JR_c is a dummy variable equal to 1 if county c is in a JR state, 0 otherwise; ε_{cj} is the error term. The sample in column 7 contains information on bilateral net migration flows between each U.S. county over the period of 2013 to 2017 provided by the U.S. Census Bureau. In column 8, the dependent variable is the ratio of GSE-eligible loan applications to total loan applications in the census tract. PAR indicates that parametric estimation is used to estimate the equation. NPAR indicates that non-parametric estimation is used to estimate the equation. Control variables include mean of applicant income, mean LTV ratio, share of minority applicants, share of male applicants in census tract c. Standard errors are clustered at the state level and the corresponding t-statistic is reported in parentheses.

	Dependent Variable							
	APPLICATIONS_PER_CAPITA			LENDERS_PER_CAPITA			NET_MIGRATION	GSE_ELIGIBLE
Estimator	PAR	PAR	NPAR	PAR	PAR	NPAR	PAR	PAR
	1	2	3	4	5	6	7	8
JR	−0.2234	−0.2091	−0.3520	−0.0001	0.0001	0.0017	−0.0002	0.0053
	(−1.03)	(−1.02)	(−1.22)	(−1.01)	(0.28)	(0.72)	(−0.29)	(0.28)
Control variables	No	Yes	No	No	Yes	No	No	No
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
No. of obs.	13,241	13,241	13,241	13,241	13,241	13,241	232,315	13,241
R^2	0.19	0.21	–	0.57	0.58	–	0.02	0.29

from a JR state, 0 otherwise; $\mathbf{X}_{cr}$ is a vector of control variables; δ_r are region fixed effects; ε_{cr} is the error term.[18]

We present the results of this test in Table 3. We find no evidence of strategic manipulation by either borrowers or lenders. Estimates of β are statistically insignificant throughout columns 1 to 6 of Table 3, irrespective of whether we include control variables, or estimate equation (2) parametrically or nonparametrically. Graph A of Figure 5 presents corresponding graphical evidence showing that the density of loan applications is continuous across the threshold.

To further inspect whether borrowers manipulate treatment status, we examine net migration flows between US counties because borrower manipulation would be consistent with significant inflows into JR counties. In column 7 of Table 3, we find no significant differences in net migration to JR counties relative to PS counties. Another danger is that borrowers try harder to obtain GSE-eligible status in JR states. However, Graph B of Figure 5 shows no discontinuity in the GSE-eligible share of loan applications at the threshold. The corresponding econometric test in column 8 of Table 3 shows no significant effects.

V. Empirical Analysis

We begin by examining securitization and pricing patterns in the raw data at the JR-PS threshold using non-parametric methods. Following Lee and Lemieux (2010), we calculate the optimal bin width to be 0.4 miles, group the loan-level data into bins, and fit local regression functions to the data on the left and right of the threshold.

[18]We conduct these tests at the census tract level because we require information on the rate of applications or the density of lenders.

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FIGURE 5

Manipulation Checks

Graph A of Figure 5 shows the number of loan applications per 1,000 population in each 0.4 mile wide bin within 10 miles of the threshold. Graph B illustrates the ratio of GSE-eligible loan applications to total loan applications in each 0.4 mile wide bin within 10 miles of the threshold.

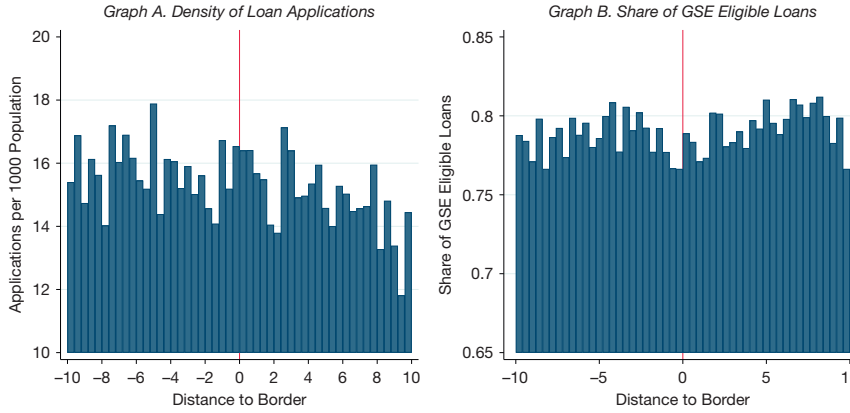

Figure 6 shows that JR law elicits heterogeneous securitization and pricing responses across markets. Consistent with our hypotheses, we find that in the GSE-eligible market, JR law causes a jump in GSE securitization (Panel A) but not in Interest Rates (Panel B), consistent with the CIRP preventing lenders from pricing the credit risk of JR law into mortgage contracts. In the non-GSE-eligible market, JR law has no effect on securitization (Panel C) but increases interest rates (Panel D).

A. Securitization and Pricing Results

To pin down precise estimates of the LATE we turn to regression analysis. Column 1 of Table 4 presents linear regression estimates of equation (1) using GSE_SEC as the dependent variable. The LATE is estimated to be 0.0217 and is statistically significant at the 1% level. To understand the economic magnitude, we compare the estimated coefficient with the mean of the probability of securitization in PS states. This implies that JR law causes a 5.3% increase in the probability of securitization, relative to the counterfactual.[19] The effect is large given that around 600,000 GSE-eligible loans are securitized in PS states each year. Our estimate implies an additional 31,800 loans are securitized due to JR law each year. With a mean loan amount of $250,000, these 31,800 mortgages translate into an additional $79.5 billion debt holdings for the GSEs.

Among the control variables, we estimate that a 10% increase in applicant income significantly lowers the probability of a GSE-eligible loan being securitized by 0.22 percentage points. A 10-percentage-point increase in the LTV ratio significantly reduces the probability of securitization by 0.8 percentage points. Lower applicant income and higher LTV ratios therefore increase the likelihood that a loan

[19]To calculate the treatment effect relative to the counterfactual we compare the LATE to the mean rate of securitization within the control group which is 41%. Hence, $(0.0217/0.41) \times 100 = 5.3\%$.

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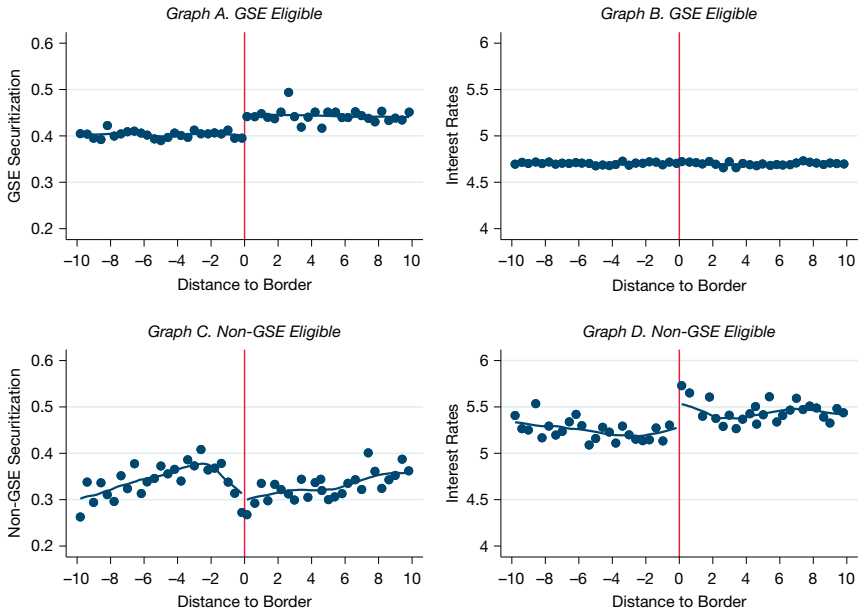
FIGURE 6

Regression Discontinuity Plots at the Threshold

Figure 6 shows nonparametric RD estimates of how securitization and interest rates are influenced by JR law at the threshold during the sample period. Distance to border is the distance between the midpoint of each 0.4 mile wide bin and the nearest JR-PS border coordinate. Distance to border = 0 defines the border (threshold) between JR and PS states. A negative (positive) distance to border value indicates an observation is from the control group (treatment) group. We calculate the optimal bin width following Lee and Lemieux (2010). We then calculate $\overline{s}_j$, the mean of either the securitization variables or IR within bin j using all mortgage applications within that bin. Next, we plot $\overline{s}_j$ against its midpoint. We fit local regression functions on either side of the threshold using a rectangular kernel. In Graph A, the sample contains GSE-eligible observations and the dependent variable is GSE_SEC. In Graph B, the sample contains GSE-eligible observations and the dependent variable is IR (%). In Graph C, the sample contains non-GSE-eligible observations and the dependent variable is NSEC. In Graph D, the sample contains non-GSE-eligible observations and the dependent variable is IR (%).



is securitized. Both effects are consistent with lenders securitizing loans with higher credit risk. For example, Piskorski, Seru, and Vig (2010), Agarwal, Chang, and Yavas (2012), and Krainer and Laderman (2014) show the likelihood of securitization is positively correlated with LTV ratios and negatively with borrower income. A higher number of lenders per 1,000 population in a census tract also significantly raises the probability of securitization while loans to minority borrowers are less likely to be securitized. The probability of securitization is not significantly different between loans to male and female applicants. The assignment variable and its interaction with the JR indicator are statistically insignificant, consistent with the relatively flat local regression functions shown in Graph A of Figure 6.[20]

To ensure the findings are not a product of the linear probability model, we estimate equation (1) using a logit model. The logit estimates in column 2 of Table 4 are similar.

[20]Supplementary Table A5 shows that JR law has a similar effect on securitization of loans eligible for sale to Ginnie Mae.

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TABLE 4

Securitization and Pricing in the GSE and Non-GSE Markets

Table 4 presents parametric estimates of equation (1). In columns 1 and 2, the dependent variable is GSE_SEC. In columns 3 and 4, the dependent variable is NSEC. In columns 5 and 6, the dependent variable is IR, measured in percent (%). GSE (non-GSE) indicates the sample includes GSE-eligible (non-GSE-eligible) loans. OLS (Logit) indicates that equation (1) is estimated using an OLS (logit) estimator. The sample includes all loans within 10 miles of the threshold. Standard errors are clustered at the state level and the corresponding *t*-statistics are reported in parentheses. *, **, and *** indicate the statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable					
	GSE_SEC		NSEC		IR (%)	
Market	GSE		Non-GSE		GSE	Non-GSE
Estimator	OLS	Logit	OLS	Logit	OLS	OLS
	1	2	3	4	5	6
JR	0.0217***	0.1532***	−0.0052	−0.1023	0.0140	0.0823***
	(3.82)	(6.48)	(−1.55)	(−1.40)	(1.33)	(5.26)
ASSIGNMENT	0.0010	0.0082***	0.0001	−0.0011	0.0010	0.0025
	(1.68)	(3.04)	(0.24)	(−0.18)	(0.68)	(1.39)
JR * ASSIGNMENT	0.0011	0.0077*	−0.0002	−0.0004	−0.0022	0.0060
	(1.04)	(1.84)	(−0.31)	(−0.04)	(−1.18)	(1.41)
APPLICANT_INCOME	−0.0218***	−0.1689***	−0.0329***	−0.5872***	−0.0824***	−0.2196***
	(−4.24)	(−18.75)	(−6.16)	(−9.32)	(−8.97)	(−19.43)
LTV	0.0008***	0.0059***	0.0011***	0.0201***	0.0044***	0.0044***
	(3.91)	(18.99)	(5.09)	(5.74)	(14.54)	(5.95)
LENDERS_PER_CAPITA	0.0008***	0.0066***	0.0002	0.0018	−0.0008***	−0.0033***
	(4.90)	(6.38)	(0.88)	(0.54)	(−2.98)	(−3.62)
MINORITY	−0.0125***	−0.0960***	−0.0024	−0.0560	−0.0127**	0.0389**
	(−3.58)	(−7.37)	(−0.85)	(−1.01)	(−2.34)	(2.16)
MALE	0.0018	0.0155	0.0014	0.0358	−0.0048	0.0193***
	(0.85)	(1.39)	(0.82)	(0.99)	(−1.59)	(2.71)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	327,549	327,549	135,181	135,181	327,549	135,181
R^2	0.49		0.80		0.29	0.64
Pseudo-R^2		0.40		0.57		

The effects of JR law on securitization of non-GSE-eligible loans are quite different. In column 3 of Table 4, the JR law coefficient is economically close to zero and statistically insignificant.

The control variables' coefficients are statistically insignificant except for applicant income and the LTV ratio. We estimate a 10% increase in applicant income reduces the probability of securitization by 0.33 percentage points, whereas increasing the LTV ratio by 10 percentage points raises the probability of securitization by 1.1 percentage points. The logit estimates in column 4 of Table 3 show similar results.

Lenders could also respond to JR law's credit risk by charging higher interest rates. In the remainder of Table 4, we investigate whether JR law elicits pricing effects across the two markets. We implement this test using IR as the dependent variable in equation (1). Column 5 of the table reports estimates using the GSE-eligible sample. Consistent with the patterns in the raw data, the JR coefficient is insignificant. In contrast, in the non-GSE-eligible market JR law provokes significant pricing responses. The LATE in column 6 of Table 3 indicates JR law causes interest rates to jump by 0.0823 percentage points (8.23 basis points) at the threshold. Given the mean interest rate of non-GSE-eligible mortgages in PS states is 4.9%, the economic magnitude of the effect is equivalent to a 1.7% increase relative to the counterfactual.

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Are 8.23 basis points sufficient compensation for the additional costs that JR law induces? Our back-of-the-envelope calculation shows that for an average non-GSE-eligible 30-year fixed rate mortgage (the most common type of loan in the data), this value implies a borrower pays approximately $2,880 more in interest payments in a JR state compared to a PS state over the loan's lifetime. Given the difference in average foreclosure costs to lenders between JR and PS states is approximately $2500, the additional interest appears to be adequate compensation for the extra credit risk of JR law.[21,22]

Together the evidence shows that in the GSE-eligible market the CIRP prevents lenders from pricing credit risk due to JR law, which induces lenders to use securitization to transfer credit risk to the GSEs. In the non-GSE-eligible market, purchasers demand a premium for holding securities that have exposure to JR law. As private purchasers also have incentives to minimize the costs of JR law, lenders cannot use securitization to unload credit risk. Rather, informed parties adjust interest rates to reflect the costs of JR law.

To ensure that our findings are not due to the choice of functional form of the local regression functions, in Supplementary Table A9, we report estimates from models with higher-order polynomial expressions of the assignment variable. Supplementary Table A10 presents results using 5 and 2.5 mile bandwidths to show the findings are not driven by bandwidth considerations. In both tables, the findings are similar to our baseline estimates.

B. Private Securitization in the GSE-Eligible Market

Lenders also have the option to sell GSE-eligible loans to private buyers. Unlike the GSEs, private buyers provide no buyback provisions but lenders' pricing decisions remain constrained by the CIRP. JR law therefore has potentially different effects on private loan sales within the GSE-eligible market. We first ask how JR law affects the likelihood that GSE-eligible loans are securitized, irrespective of the buyer's identity. In column 1 of Panel A in Supplementary Table A11, JR law causes a 2.0% increase in the probability of securitization, and the coefficient is significant at the 10% level. The smaller LATE compared to the baseline result is consistent with the findings in column 2 of Panel A showing JR law significantly decreases the probability that a lender sells a GSE-eligible loan to a private institution.

[21]The majority of loans the GSEs purchase have a DTI ratio of 36% or lower. Supplementary Table A6 shows the results are robust to constraining the sample to including either only GSE-eligible loans with a DTI ratio of 36% or less or a DTI ratio greater than 36%. Supplementary Table A7 shows the findings are highly similar using data from the period 2000 to 2017. We focus on 2018 because earlier HMDA vintages did not include information on interest rates or other important loan characteristics. The 2000 to 2017 sample therefore relies on information drawn from multiple data sources.

[22]Residential mortgage-backed securities (RMBS) provide another window into the pricing effects of JR law. Intuitively, yields at issue on RMBS should be an increasing function of the deal's exposure to JR law as investors demand a premium to hold a security with credit risk. To preserve space, details on the RMBS data set and results are provided in Supplementary Material Section E.2. Supplementary Table A8 reports estimates that relate a security's initial yield to the JR share of the deal value. The table shows a 1-percentage-point increase in the JR share of the deal is associated with a 0.08-percentage-point increase in the yield.

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A negative relationship between private securitization and JR law in the GSE-eligible market is consistent with our earlier results. The CIRP governs the pricing of GSE-eligible loans regardless of whether a loan is subsequently securitized or the buyer's identity. When purchasing a GSE-eligible JR loan, private institutions assume the credit risk of JR law without compensation through higher interest rates. Private institutions are thus less willing to purchase a GSE-eligible loan if the property is located in a JR state.[23]

C. Credit Risk Mechanism

Underpinning our tests is the hypothesis that JR law amplifies credit risk. We therefore conduct subsample analyses to validate this mechanism. Intuitively, the effects of JR law should be more pronounced within samples comprising riskier borrowers where JR law has the largest effect on borrowers' default incentives.

Consistent with these conjectures, columns 1 to 6 in Panel A of Table 5 show the LATE is larger for loans originated to riskier borrowers. Column 1 in Table 5 illustrates that JR law increases the probability that a GSE-eligible loan from a higher-income applicant is securitized by only 3.27% compared to the counterfactual. Column 2 in Table 5 shows that the effect is much larger at 6.53% for mortgages from lower-income applicants. The difference in the likelihood of securitization due to the law between lower and higher-income applicants is therefore 3.36%. Similarly, GSE-eligible mortgages without coapplicants are 2.92% more likely to be securitized due to JR law. This is consistent with the fact that loans to borrowers with co-applicants are potentially less prone to default because multiple income streams help smooth negative economic shocks.

Next, we split the sample based on socioeconomic conditions in the area where the property is located. In columns 7 and 8, we find that the probability of securitization in response to JR law is substantially larger for loans originated to borrowers who live in high relative to low unemployment areas. We obtain similar results in columns 9 and 10 of the table when we split the sample based on the poverty rate.

The Chow test F-statistics verify that the JR coefficients are significantly different between the subsamples except for the comparison between securitization of mortgages from low and high DTI applicants where the difference is insignificant. Hence, in all but one instance, the economic magnitude of JR law on the probability of securitization among GSE-eligible loans is significantly larger within the riskier relative to less risky subsample.

[23]The negative relationship could be attributable to a higher probability that lenders successfully renegotiate terms with delinquent borrowers (Agarwal, Amromin, Ben-David, Chomsisengphet, and Evanoff (2011)). Column 3 of Panel A in Supplementary Table A11 shows this is not the case. Panel B in Supplementary Table A11 shows our findings for securitization in the GSE-eligible market are robust to using a multinomial logit estimator. Lenders may hold ex ante information on whether a loan will be sold and the type of buyer. JR status could, in principle, therefore lead to higher interest rates on GSE-eligible loans where a lender wishes to make a loan attractive to a private buyer. Panel C of Supplementary Table A11 refutes this conjecture. Irrespective of whether a loan is unsold (column 1) sold to a GSE (column 2) or private buyer (column 3), JR law has no effect on GSE-eligible interest rates. This is consistent with the CIRP preventing foreclosure law-based pricing of GSE-eligible loans.

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TABLE 5

Subsample Tests

Table 5 presents parametric estimates of equation (1). In Panel A, the dependent variable is GSE_SEC. In Panels B and D, the dependent variable is IR, measured in percent (%). In Panel C, the dependent variable is NSEC. The sample in Panels A and B (C and D) contains GSE-eligible (non-GSE-eligible) loans. The sample includes all loans within 10 miles of the threshold. The control variables are ASSIGNMENT, JR × ASSIGNMENT, APPLICANT_INCOME, LTV, LENDERS_PER_CAPITA, MINORITY, and MALE. Where the JR coefficient is statistically significant, LATE (%) is the local average treatment effect expressed in percent relative to the mean value of the dependent variable within the control group. The Chow test *F*-stat is the *F*-statistic from a Chow test for equality of the JR coefficient between the two subsamples. Standard errors are clustered at the state level and the corresponding *t*-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Splitting Variable									
	APPLICANT_INCOME		DTI		COAPPLICANT		UNEMPLOYMENT_RATE		POVERTY_RATE	
Sample	≥ Mean	< Mean	< Mean	≥ Mean	Yes	No	< Mean	≥ Mean	< Mean	≥ Mean
	1	2	3	4	5	6	7	8	9	10
Panel A. GSE Securitization										
JR	0.0134**	0.0288***	0.0213***	0.0231***	0.0147**	0.0290***	0.0207***	0.0256**	0.0187*	0.0240***
	(2.44)	(4.23)	(3.86)	(3.60)	(2.48)	(4.41)	(3.23)	(2.13)	(1.79)	(2.89)
Control variables, region FE, lender FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	159,683	167,866	129,622	197,927	172,749	154,800	218,622	108,927	167,825	159,724
R^2	0.51	0.50	0.51	0.49	0.50	0.50	0.50	0.50	0.50	0.50
LATE (%)	3.27	6.52	4.95	5.46	3.67	6.59	4.92	5.95	4.67	5.91
Chow test *F*-stat	4.62		1.58		5.69		7.72		4.82	
Panel B. GSE Interest Rates (%)										
JR	0.0007	0.0176	0.0057	0.0105	0.0119	0.0079	0.0051	0.0303	0.0249	0.0161
	(1.58)	(1.46)	(1.47)	(1.33)	(1.22)	(1.21)	(1.17)	(1.35)	(1.11)	(1.45)
Control variables, region FE, lender FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	159,683	167,866	129,622	197,927	172,749	154,800	218,622	108,927	167,825	159,724
R^2	0.26	0.26	0.28	0.24	0.24	0.27	0.24	0.28	0.25	0.26
Panel C. Non-GSE Securitization										
JR	−0.0022	−0.0050	0.0014	−0.0053	−0.0037	−0.0056	−0.0085	0.0031	−0.0097	−0.0064
	(−0.62)	(−1.06)	(0.38)	(−1.38)	(−0.85)	(−1.41)	(−1.12)	(0.49)	(−1.60)	(−1.38)
Control variables, region FE, lender FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	63,726	71,455	26,693	108,488	69,806	65,375	88,810	46,371	70,417	64,764
R^2	0.82	0.82	0.88	0.80	0.81	0.81	0.80	0.82	0.82	0.80
Panel D. Non-GSE Interest Rates (%)										
JR	0.0824***	0.0840***	0.0810***	0.1042***	0.0736***	0.0915***	0.0861***	0.1683***	0.0808**	0.0816***
	(2.97)	(4.73)	(5.28)	(3.85)	(3.48)	(4.17)	(2.96)	(5.17)	(2.56)	(5.52)
Control variables, region FE, lender FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	63,726	71,455	26,693	108,488	69,806	65,375	88,810	46,371	70,417	64,764
R^2	0.49	0.71	0.75	0.62	0.65	0.66	0.59	0.70	0.54	0.70
LATE (%)	1.67	1.82	1.52	1.96	1.28	1.75	1.66	2.99	1.43	1.69
Chow test *F*-stat	12.05		10.61		7.91		8.75		4.99	

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Panels B and C of Table 5 repeat the subsample tests for GSE-eligible interest rates and non-GSE-eligible securitization, respectively. Consistent with the evidence in Table 4, the LATE is statistically insignificant in all cells. Panel D reports estimates for non-GSE-eligible interest rates. A consistent pattern emerges: the LATE of JR law on interest rates is consistently larger among the riskier subsamples. The Chow test F-statistics indicate that these differences in JR coefficients for interest rates are statistically significant.[24]

D. Which Channel Matters the Most?

Does JR law create credit risk by raising lenders' foreclosure costs, or by increasing borrowers' default incentives, or both margins?

We therefore estimate equation (1) using the average state-level foreclosure cost to lenders and foreclosure timeline as control variables. The identifying assumption in these tests is that foreclosure cost and timeline vary exogenously. This appears plausible as both variables are functions of exogenous foreclosure law. To enable comparability of economic magnitudes we use standardized foreclosure cost and timeline variables. Column 1 in Table 6 shows a standard deviation increase in lenders' foreclosure costs leads to a 0.10-percentage-point increase in the probability that a GSE-eligible loan is securitized, but the coefficient is insignificant. However, GSE-eligible securitization is more responsive to increasing the foreclosure timeline. The standardized timeline coefficient is equivalent to a 1.61-percentage-point increase in the probability of securitization. In column 2 of Table 5, we find a standard deviation increase in foreclosure costs raises non-GSE-eligible interest rates by 0.0313 percentage points. This is equivalent to a 0.59% increase relative to the mean. In contrast, a standard deviation increase in the foreclosure timeline raises non-GSE-eligible interest rates by 0.0793 percentage points which equates to 1.49% higher interest rates relative to the mean. Both coefficients are significant at conventional levels.

Hence, while both aspects of JR law contribute to credit risk, the effect of the law on securitization and interest rates is primarily transmitted through increasing borrower moral hazard. JR law extends the foreclosure timeline which increases the returns to default. Initiatives that speed up court procedures and shorten the foreclosure process may help reduce the distorting effects of JR law on credit markets.

VI. Robustness Checks

In this section, we conduct sensitivity checks to rule out that confounding factors drive our findings.

[24]We also follow the approach used by Agarwal et al. (2012) to calculate the predicted probability of default for each loan. We then split the sample according to whether the probability of default lies above or below the mean. The results in Supplementary Table A12 show that the JR coefficient is positive and statistically significant in both subsamples for GSE-eligible securitization and non-GSE-eligible interest rates. However, in both cases, the effect of JR law is more pronounced for loans with default probabilities above the mean.

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TABLE 6

Identifying Foreclosure Cost and Timeline Effects

Table 6 reports estimates of the equation $y_{ilrs} = \beta C_{ilrs} + \varphi \mathbf{W}_{ilrs} + \delta_l + \delta_r + \varepsilon_{ilrs}$, where all variables are defined as in equation (1) except C_{ilrs} which contains FORECLOSURE_COST and TIMELINE. GSE (non-GSE) indicates the sample includes GSE-eligible (non-GSE-eligible) loans. IR is measured in percent (%). The sample includes loans within 10 miles of the threshold. Data on lenders' foreclosure costs are taken from the Fannie Mae Single Family Loan database. Data on the foreclosure timeline is taken from the U.S. Foreclosure Network. Standard errors are clustered at the state level and the corresponding *t*-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable	
Sample	GSE	Non-GSE
	GSE_SEC	IR (%)
	1	2
FORECLOSURE_COST	0.0010	0.0313*
	(0.27)	(1.81)
TIMELINE	0.0161***	0.0793***
	(4.45)	(8.58)
APPLICANT_INCOME	−0.0247***	−0.2157***
	(−4.77)	(−18.86)
LTV	0.0008***	0.0041***
	(3.95)	(5.25)
LENDERS_PER_CAPITA	0.0007***	−0.0031***
	(3.99)	(−3.78)
MINORITY	−0.0119***	0.0388**
	(−3.16)	(2.36)
MALE	0.0028	0.0185***
	(1.30)	(2.79)
Region FE	Yes	Yes
Lender FE	Yes	Yes
No. of obs.	327,549	135,181
R^2	0.50	0.63

A. Placebo Tests

Placebo tests provide insights into whether JR law rather than omitted variables drives the behavior we observe in the data. Specifically, in samples where foreclosure law is the same on either side of the threshold, we should not observe discontinuities in securitization or interest rates. We therefore estimate the equation

$$y_{ilrs} = \beta \text{PLACEBO}_s + \gamma f(D_{ilrs}) + \varphi \mathbf{W}_{ilrs} + \delta_r + \delta_l + \varepsilon_{ilrs}, \tag{3}$$

where all variables are the same as in equation (1) except PLACEBO_s which is a dummy variable equal to 1 on the right of the placebo threshold, 0 on the left of the placebo threshold; and D_{ilrs} contains the distance to the placebo threshold and an interaction between the placebo assignment variable and PLACEBO_s.

We first estimate equation (3) using observations within 10 miles of a placebo threshold which lies 10 miles to the right of the actual threshold. In this sample, JR law regulates the foreclosure process on both sides. The results reported in Panel A of Table 7 show that neither the likelihood of securitization nor interest rates in the GSE-eligible and non-GSE-eligible markets are discontinuous at the placebo threshold. Next, we repeat the procedure using observations within 10 miles of a placebo threshold which lies 10 miles to the left of the actual threshold. In this sample, PS law regulates the foreclosure process on both sides. In Panel B of Table 7, the placebo LATEs are again insignificant.

TABLE 7

Falsification Tests

Table 7 reports parametric estimates of equation (3). GSE (non-GSE) indicates the sample includes GSE-eligible (non-GSE-eligible) loans. In column 1 (2), the dependent variable is GSE_SEC (IR). In column 3 (4), the dependent variable is NSEC (IR). IR is measured in percent (%). In Panel A, the sample includes observations within 10 miles of the placebo threshold located 10 miles to the right of the actual threshold (ASSIGNMENT = 10). In Panel B, the sample includes observations within 10 miles of the placebo threshold located 10 miles to the left of the actual threshold (ASSIGNMENT = −10). In Panel C, the sample includes observations within 10 miles of the border between states that both use JR law. In Panel D, the sample includes observations within 10 miles of the border between states that both use PS law. The unreported control variables are the PLACEBO_ASSIGNMENT, JR × PLACEBO_ASSIGNMENT, APPLICANT_INCOME, LTV, LENDERS_PER_CAPITA, MINORITY, and MALE. Standard errors are clustered at the state level and the corresponding *t*-statistics are reported in parentheses.

	Dependent Variable			
Sample	GSE		Non-GSE	
	GSE_SEC	IR (%)	NSEC	IR (%)
	1	2	3	4
Panel A. +10 Miles Border				
PLACEBO	−0.0213	0.0368	−0.0351	−0.0127
	(−1.29)	(1.12)	(−1.38)	(−1.05)
Control variables	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes
No. of obs.	186,829	186,829	47,156	47,156
R^2	0.02	0.01	0.01	0.01
Panel B. −10 Miles Border				
PLACEBO	0.0063	0.0729	−0.0479	0.0709
	(0.52)	(0.73)	(−0.22)	(1.22)
Control variables	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes
No. of obs.	248,898	248,898	65,783	65,783
R^2	0.02	0.02	0.01	0.01
Panel C. JR-JR Border				
PLACEBO	−0.0054	0.0154	0.0704	0.0511
	(−0.58)	(0.91)	(1.19)	(1.20)
Control variables	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes
No. of obs.	228,623	228,623	61,694	61,694
R^2	0.11	0.13	0.19	0.19
Panel D. PS-PS Border				
PLACEBO	−0.0096	0.0158	−0.0109	0.0870
	(−1.28)	(1.10)	(−1.09)	(0.06)
Control variables	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes
No. of obs.	118,405	118,405	33,210	33,210
R^2	0.26	0.32	0.27	0.24

To affirm our baseline estimates do not capture border effects, other aspects of the legal environment, or political economy considerations, we use samples within 10 miles of the border between states that use the same foreclosure law. We randomly assign states to placebo treatment and placebo control status and estimate equation (3). Panel C (D) of Table 7 provides results from JR–JR (PS–PS) borders. The Placebo coefficient estimates are again statistically insignificant.

If an omitted variable drives our main findings, the placebo LATEs should be similar in magnitude and statistical significance as the baseline estimates. Throughout Table 7 this is not the case. Overall, the results show securitization and interest

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rates only jump at the actual threshold where foreclosure law is discontinuous. There are no discontinuities in the outcome variables at placebo thresholds where there is no discontinuity in foreclosure law. These findings reinforce our argument that the effects we observe are not driven by observable or unobservable omitted variables.

B. The Legal Environment

Next, we ask whether other aspects of the state-level legal environment confound our inferences. For example, right of redemption (ROR) law allows borrowers to redeem their property within 12 months of foreclosure, potentially amplifying lenders' costs. Lenders may pursue delinquent borrowers' future income to cover unpaid foreclosure debts using deficiency judgments. Prior research documents a link between mortgage default and bankruptcy exemptions (Lin and White (2001)).[25] Single-family home zoning restrictions may also influence lenders' choices (Gyourko, Hartley, and Krimmel (2019), Gokmen, McGowan, and Zhao (2021)).

We therefore append equation (1) with controls for whether a state has ROR law, allows deficiency judgments, homestead and nonhomestead exemptions, and the single-family home zoning restrictiveness index. Throughout Panels A and B of Table 8 our inferences endure.[26]

C. Lending Industry Conditions

Approximately half the loans in our sample are originated by banks with the remainder supplied by nonbanks. Nonbanks typically rely on short-term wholesale market funding and are thus more likely to securitize loans to ensure repayment (Demyanyk and Loutskina (2016), Buchak et al. (2018)). To avoid that our findings reflect a higher concentration of different lender types on either side of the threshold, we split the sample and estimate equation (1) using nonbanks and banks separately. The results in Table 9 show that the JR law has a positive and statistically significant effect on the probability of GSE securitization within both subsamples. Both types of

[25]Homestead exemptions are the most important bankruptcy exemption and evidence shows that mortgage default is more likely the more generous are homestead exemptions (Lin and White (2001), Corradin, Gropp, Huizinga, and Laeven (2016)). Nonhomestead exemptions allow individuals to maintain wealth in other asset categories but tend to be set at low levels. For example, the mean homestead exemption across U.S. states is $122,754 whereas the mean nonhomestead exemption (comprising automobile, other property (clothing, jewelry, and tools), and wildcard exemptions) is $19,685.

[26]Supplementary Table A13 presents further legal robustness tests. We test the sensitivity of our findings to excluding observations from Delaware and Pennsylvania which use *scire facias*, a creditor-friendly form of JR law. *Scire facias* places the onus on the borrower to provide a reason why the lender should not be able to foreclose (Ghent (2014)). Despite its perceived creditor-friendly nature, *scire facias* is neither expedient nor cheap for lenders. Data from the Fannie Mae Single Family Loan database show the foreclosure timeline is longer and average foreclosure cost to lenders is higher in Delaware and Pennsylvania relative to other JR states (see Supplementary Table A3). Second, we exclude Texas as it is the only state that limits the LTV ratio of mortgages to 80%. Third, we exclude Louisiana from the sample on the grounds that it is the only Civil Law state, and finally we exclude Massachusetts which undertook reforms to speed up the foreclosure timeline during earlier years (Gerardi et al. (2013)). Throughout Panels A and B of Supplementary Table A13, the JR law coefficient remains robust.

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TABLE 8

Legal Environment Robustness Tests

Table 8 presents parametric estimates of equation (1). In Panel A (B), the sample contains GSE-eligible (non-GSE-eligible) loans. In columns 1 to 4 of Panel A (B), the dependent variable is GSE_SEC (NSEC). In columns 5 to 8 of both panels, the dependent variable is IR, measured in percent (%). The sample includes all loans within 10 miles of the threshold. The unreported control variables are ASSIGNMENT, JR × ASSIGNMENT, APPLICANT_INCOME, LTV, LENDERS_PER_CAPITA, MINORITY, and MALE. Standard errors are clustered at the state level and the corresponding *t*-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable							
	GSE_SEC				IR (%)			
	1	2	3	4	5	6	7	8
Panel A. GSE-Eligible Loans								
JR	0.0185**	0.0208***	0.0202***	0.0240***	0.0082	0.0096	0.0173	0.0134
	(2.36)	(3.53)	(3.51)	(4.29)	(0.79)	(0.85)	(1.20)	(1.36)
RIGHT_OF_REDEMPTION	0.0027				0.0158*			
	(0.24)				(1.88)			
DEFICIENCY_JUDGMENT		0.0094				0.0084		
		(1.10)				(0.43)		
HOMESTEAD_EXEMPTION			0.0357				−0.0290	
			(1.32)				(−1.07)	
NONHOMESTEAD_EXEMPTION			0.0218				0.0285	
			(1.45)				(1.03)	
ZONING				−0.0009***				−0.0009**
				(−3.47)				(−2.31)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	327,549	327,549	327,549	327,549	327,549	327,549	327,549	327,549
R^2	0.51	0.51	0.51	0.51	0.24	0.24	0.24	0.24
Dependent Variable	NSEC				IR (%)			
Panel B. Non-GSE-Eligible Loans								
JR	−0.0083	−0.0062*	−0.0070	−0.0040	0.0846***	0.0838***	0.0827***	0.0771***
	(−1.51)	(−1.99)	(−1.28)	(−1.19)	(4.82)	(5.65)	(4.55)	(4.36)
RIGHT_OF_REDEMPTION	0.0017				−0.0051			
	(0.45)				(−0.28)			
DEFICIENCY_JUDGMENT		0.0150**				−0.0218		
		(2.15)				(−0.47)		
HOMESTEAD_EXEMPTION			−0.0103				0.1519**	
			(−1.08)				(2.68)	
NONHOMESTEAD_EXEMPTION			−0.0015				0.0707	
			(−0.16)				(1.57)	
ZONING_INDEX				−0.0003				0.0000
				(−1.65)				(0.03)
				(−0.02)				(−1.14)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	135,181	135,181	135,181	135,181	135,181	135,181	135,181	135,181
R^2	0.80	0.80	0.80	0.80	0.64	0.64	0.64	0.64

financial intermediaries respond to JR law by setting significantly higher interest rates on non-GSE-eligible loans but the results are stronger for nonbanks.

We examine the sensitivity of our findings to conditions within the banking industry. Bank characteristics such as size, profitability, soundness, and capitalization may influence securitization and pricing decisions. Theory and evidence show the cost of deposits affects how banks fund loans (Pennacchi (1988), Gorton and Pennacchi (1995), and Loutskina and Strahan (2009)). In addition, banks may lend across state borders. A state regulator may be more lenient on out-of-state activities compared to lending at home (Ongena, Popov, and Udell (2013)). This may pose a problem when the PS state is more often the lender's home state and the regulator

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TABLE 9

Lending Industry Robustness Tests

Table 9 presents parametric estimates of equation (1). IR is measured in percent (%). Columns 1 to 4 show estimates where the sample includes only nonbanks. Columns 5 to 8 show estimates where the sample includes only banks. GSE (non-GSE) indicates the sample includes only GSE-eligible (non-GSE-eligible) loans. The sample includes all loans within 10 miles of the threshold. The unreported control variables are ASSIGNMENT, JR × ASSIGNMENT, APPLICANT_INCOME, LTV, LENDERS_PER_CAPITA, MINORITY, and MALE. Standard errors are clustered at the state level and the corresponding *t*-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Financial Intermediary							
	Nonbanks				Banks			
Sample	GSE		Non-GSE		GSE		Non-GSE	
Dependent Variable	GSE_SEC	IR (%)	NSEC	IR (%)	GSE_SEC	IR (%)	NSEC	IR (%)
	1	2	3	4	5	6	7	8
JR	0.0271***	0.0223	−0.0075	0.0716**	0.0118***	0.0080	−0.0050	0.0491***
	(3.41)	(1.28)	(−0.68)	(2.63)	(2.67)	(0.63)	(−0.78)	(3.17)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	No	No	No	Yes	Yes	Yes
No. of obs.	165,521	165,521	53,913	53,913	162,028	162,028	81,268	81,268
R^2	0.56	0.19	0.42	0.60	0.47	0.25	0.48	0.50

dislikes the originate-to-distribute (OTD) model. Furthermore, banks are subject to different regulators depending on their charter, and regulators may hold different views on securitization. The estimates in columns 1 to 5 and 7 to 11 of Supplementary Table A14 allay these concerns.[27]

Furthermore, we check whether banks' business models drive our results. A concern is that banks operating OTD models are highly dependent on selling loans. If such institutions are disproportionately clustered on the JR side of the threshold, our estimates will conflate banks' business models with the effect of JR law. To address this concern, we focus exclusively on banks that rely less on securitization (low OTD), defined as banks that securitize less than 50% of the mortgage loans they originate. The results in columns 6 and 12 of Supplementary Table A14 are similar to before.

D. Loan Quality

A question is whether the LATEs capture differences in the characteristics of borrowers or loans on either side of the threshold. While the estimating equation already includes covariates to capture such factors, we add further controls for the LTI ratio, DTI ratio, term to maturity, house prices, the average FICO score, and the share of borrowers with mortgage insurance in the county the property is located. Despite including these controls, in column 1 of Table 10, we continue to find JR law elicits a significant increase in the securitization of GSE-eligible loans. In column 2 of the table, the JR law coefficient is insignificant when GSE-eligible interest rates are the dependent variable. Data constraints prevent us from including the FICO and mortgage insurance variables in the corresponding tests using non-GSE-eligible loans. However, when we add further controls for other borrower

[27]We must exclude the lender fixed effects from (1) to include the bank-level control variables.

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TABLE 10

Loan Quality and Loan Characteristics

Table 10 reports parametric estimates of equation (1) with further control variables that capture loan quality. GSE (non-GSE) indicates the sample includes GSE-eligible (non-GSE-eligible) loans. In column 1 (2) the dependent variable is GSE_SEC (IR). In column 3 (4) the dependent variable is NSEC (IR). IR is measured in percent (%). The sample includes all loans within 10 miles of the threshold. The unreported control variables are ASSIGNMENT, JR× ASSIGNMENT, APPLICANT_INCOME, LTV, LENDERS_PER_CAPITA, MINORITY, and MALE. Data for FICO and MORTGAGE_INSURANCE are from the Single Family Loan database. Data limitations mean we do not have information for the variables FICO and MORTGAGE_INSURANCE for non-GSE-eligible loans. Standard errors are clustered at the state level and the corresponding *t*-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable			
Sample	GSE		Non-GSE	
	GSE_SEC	IR (%)	NSEC	IR (%)
	1	2	3	4
JR	0.0172***	0.0135	−0.0080	0.0641***
	(2.81)	(1.56)	(−1.54)	(4.42)
LTI	0.0723***	−0.0356**	−0.0068*	−0.0740***
	(13.09)	(−2.41)	(−1.78)	(−5.03)
DTI	−0.0009***	0.0076***	−0.0022***	0.0076***
	(−4.31)	(20.67)	(−15.93)	(21.66)
LOAN_TERM	0.0496***	0.7019***	0.0951***	0.0267
	(3.67)	(19.42)	(4.20)	(0.61)
HOUSE_PRICES	−0.1842***	−0.2301***	0.0381***	−0.2899***
	(−17.21)	(−7.70)	(7.03)	(−9.41)
FICO	−1.1901**	−0.4892		
	(−2.68)	(−0.63)		
MORTGAGE_INSURANCE	−0.0321***	−0.0050		
	(−4.67)	(−0.58)		
Control variables	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes
Border FE	Yes	Yes	Yes	Yes
No. of obs.	327,549	327,549	135,181	135,181
R^2	0.52	0.32	0.58	0.59

and loan characteristics, we find JR law has no effect on the probability of securitization among non-GSE-eligible loans but provokes a significant increase in their interest rate.

E. Miscellaneous Sensitivity Checks

We conduct additional robustness tests to rule out further threats to the identification. For brevity, we report the estimates in Supplementary Table A15. We append equation (1) with controls for delinquency rates on auto and credit card loans to capture differences in the general riskiness of the population. In addition, we control for the renegotiation rate on delinquent mortgages to ensure the estimates do not capture potential differences in borrowers' propensity to self-cure in JR states due to the longer foreclosure timeline. As lenders' profitability expectations are influenced by pre-payment risk and changes in interest rates we control for the refinancing rate and whether a loan has an adjustable interest rate. Han et al. (2015) report evidence that tax rates can motivate securitization. The findings reported in Supplementary Table A15 demonstrate our findings are stable despite adding these controls.

Finally, in Supplementary Table A16 we sequentially focus on specific US regions to ensure local conditions do not drive our inferences. Panel A (B) of the table reports estimates using observations from the most (least) populous border

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regions. In Panels C to G of Supplementary Table A16, we focus on samples drawn from within the northeast, midwest, west, and southern states. Our findings remain remarkably stable. Only in the western subsample is the LATEs insignificant, although this is mainly due to the small sample size.

VII. Conclusions

We show that financial institutions manage credit risk stemming from JR law using securitization or loan pricing. In the GSE-eligible market, lenders exhibit an excessive propensity to securitize loans in the face of credit risk embodied in JR law. This behavior stems from the GSEs' CIRP and buyback provisions that create incentives for lenders to unload credit risk to the GSEs rather than price credit risk into mortgage contracts. In contrast, in the non-GSE-eligible market lenders set higher interest rates to cover expected losses because secondary market participants also have loss avoidance incentives.

These findings have policy implications. Legislators have proposed changes to the GSEs' CIRP in the Corker–Warner 2013 and Johnson–Crapo 2014 Senate Bills. At heart, these efforts aim to reduce the GSEs' debt holdings and lower mortgage market costs to taxpayers. We show that lenders strategically transfer loans worth approximately $79.5 billion to the GSEs each year because of the credit risk JR law embodies. Ultimately, the GSEs absorb losses that accrue on these loans, which happens more often compared to PS loans. Tackling these issues may involve reforming the GSEs' policies or introducing private capitalization. However, our findings demonstrate that policy interventions that speed up judicial procedures may help limit the credit risk that JR law creates by reducing borrowers' default incentives.

Second, during the foreclosure crisis of 2010 to 2012, at least 230,000 and potentially many more mortgage loans were improperly foreclosed due to mortgage servicers' use of robo-signing which violates the Statute of Frauds in most states and federally (Levitin (2013)).[28] In response, policy initiatives have sought to extend greater protections to borrowers including introducing JR law in all states. Our research illustrates such measures involve a trade-off. Protecting borrowers' rights imposes greater credit risk on lenders but for GSE-eligible loans, the costs are borne by taxpayers.

Finally, our paper has implications beyond the US securitization market. A notable example is the European Union's STS market. The 2019 Securitization Regulation aims to integrate European capital markets by assigning STS labels to deals where the underlying assets are safe and transparent. The STS label specifies a set of criteria assets must conform to but does not differentiate according to which country the loans are originated in despite observable differences in credit risk between European countries. This raises the possibility that STS deals are mispriced in terms of regional credit risk which potentially creates a moral hazard among lenders and exposes purchasers to losses.

[28]Robo-signing is the signing of foreclosure documents using software through the Mortgage Electronic Registration Systems to transfer ownership interests in mortgage loans.

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The mechanisms we document may be present in all secondary markets for loan sales where risk transfer incentives exist. Studying how lenders respond to credit risk in these environments is an exciting avenue for future research.

Appendix

Variable Definitions

SEC (GSE-eligible): A dummy variable equal to 1 if a GSE-eligible loan is securitized, 0 otherwise.

GSE_SEC (GSE-eligible): A dummy variable equal to 1 if a GSE-eligible loan is securitized through sale to Fannie Mae or Freddie Mac, 0 otherwise.

PRIVATE_SEC (GSE-eligible): A dummy variable equal to 1 if a GSE-eligible loan is securitized through sale to a private securitizer, 0 otherwise.

NSEC (Non-GSE-eligible): A dummy variable equal to 1 if a non-GSE-eligible loan is securitized, 0 otherwise.

IR (GSE-eligible): The interest rate on a GSE-eligible loan, measured in percent (%).

IR (Non-GSE-eligible): The interest rate on a non-GSE-eligible loan, measured in percent (%).

JR: A dummy variable equal to 1 if loan *i* is on a property located in a Judicial Review state, 0 if the property is located in a Power of Sale state.

ASSIGNMENT: The distance in miles between the midpoint of the census tract that loan *i* is located and the nearest JR-PS border coordinate.

GSE_ELIGIBLE: A dummy variable equal to 1 if loan *i* is eligible for sale to Fannie Mae or Freddie Mac, 0 otherwise.

LOAN_AMOUNT: The origination amount on loan *i*.

APPLICANT_INCOME: The annual income of the borrower on loan *i*.

LTV: The loan-to-value ratio on loan *i*.

MALE: A dummy variable equal to 1 if the applicant on loan *i* is male, 0 otherwise.

MINORITY: A dummy variable equal to 1 if the applicant on loan *i* is from an ethnic minority, 0 otherwise.

LENDERS_PER_CAPITA: The number of lenders per 1,000 population in the census tract where loan *i* is located.

LTI: The ratio of the loan amount to applicant income on loan *i*.

COAPPLICANT: A dummy variable equal to 1 if there is a coapplicant on loan *i*, 0 otherwise.

APPLICATIONS_PER_CAPITA: The number of mortgage applications per 1,000 population in the census tract where loan *i* is located.

HOUSE_PRICES: The FHFA house price index in the census tract where loan *i* is located.

RENTER_OCCUPIED_HOUSING: The ratio of rented properties to total properties in the county where loan *i* is located.

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ARRANGEMENT_FEE: The mean of the ratio of the arrangement fee to loan amount in the county where loan *i* is located.

LOAN_TERM: Term to maturity (in months) on loan *i*.

MORTGAGE_INSURANCE: The share of GSE-eligible loans with mortgage insurance in the county where loan *i* is located.

DTI: The debt-to-income ratio of applicants on loan *i*.

FICO: The mean FICO score of GSE-eligible mortgages in the county where loan *i* is located.

RIGHT_OF_REDEMPTION: A dummy variable equal to 1 if loan *i* is located in a state that permits right of redemption within 12 months of foreclosure, 0 otherwise.

DEFICIENCY_JUDGMENT: A dummy variable equal to 1 if loan *i* is located in a state that permits deficiency judgment, 0 otherwise.

HOMESTEAD_EXEMPTION: The maximum value of property that is exempt from bankruptcy in the state where loan *i* is located is located.

NONHOMESTEAD_EXEMPTION: The sum of automobile, other property, and wildcard exemptions that is exempt in bankruptcy in the state where loan *i* is located.

ZONING_INDEX: An index measuring the intensity of restrictions on building single-unit homes in the state loan *i* is located.

FORECLOSURE_COST: The mean cost to lenders of foreclosing a loan in the state loan *i* is located. This cost includes legal costs associated with obtaining title to property, valuing the property, and maintaining utility services to the property and other costs and fees associated with bankruptcy and foreclosure.

TIMELINE: The mean duration of the foreclosure process (excluding process delays) in the state loan *i* is located.

RENEGOTIATION_RATE: The ratio of delinquent borrowers that successfully renegotiate terms with the mortgage servicer to total delinquent loans in the county loan *i* is located.

REFINANCING_RATE: The ratio of refinancing loan applications to total mortgage applications in the census tract where loan *i* is located.

STATE_CORPORATE_TAX: The top marginal state corporate income tax rate in the state loan *i* is located.

STATE_PERSONAL_TAX: The top marginal state personal income tax rate in the state loan *i* is located.

AUTO_DELINQUENCY_RATE: The ratio of auto loans that are at least 90 days delinquent to total auto loans in the county loan *i* is located.

CREDIT_CARD_DELINQUENCY_RATE: The ratio of credit card loans that are at least 90 days delinquent to total credit card loans in the county loan *i* is located.

ADJUSTABLE_RATE_LOAN: The ratio of adjustable rate loans to total mortgage loans in the county loan *i* is located.

HHI: A Herfindahl–Hirschman index of lenders' market shares in the county where loan *i*. Market share is the ratio of the total value of mortgage loans originated in county *c* by lender *l* relative to the total value of mortgage loans originated by all institutions in county *c*.

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NONBANK: A dummy variable equal to 1 if loan *i* is originated by a non-depository institution.

BANK_SIZE: Total assets of lender *l*.

ZSCORE: Calculated using the formula $Z_l = (\text{ROA}_l + \text{ETA}_l)/\text{ROASD}_l$ where ROA_l, ETA_l, and ROASD_l are return on assets, the ratio of equity to total assets, and the standard deviation of returns on assets over the 4 quarters of 2018 for bank *l*, respectively.

CAPITAL_RATIO: The ratio of equity capital to total assets for lender *l*.

NII_RATIO: The ratio of net interest income to total assets for lender *l*.

COST_OF_DEPOSITS: The ratio of deposit interest expenses to deposit liabilities for lender *l*.

OUT_OF_STATE: A dummy variable equal to 1 if loan *i* is located in a state outside lender *l*'s headquarter state.

UNEMPLOYMENT_RATE: The unemployment rate in the county loan *i* is located.

PER_CAPITA_INCOME: The level of income per capita in the county loan *i* is located.

URBAN: A dummy variable equal to 1 if loan *i* is located in urban areas.

POVERTY_RATE: The share of the population living below the poverty line in the county loan *i* is located.

BLACK_POPULATION: The share of the population who are black in the county loan *i* is located.

HISPANIC_POPULATION: The share of the population who are Hispanic in the county loan *i* is located.

VIOLENT_CRIME_RATE: The number of violent crimes per 1,000 population in the county loan *i* is located.

DEGREE: The share of the number of people with at least a College degree education in the county loan *i* is located.

NET_MIGRATION: Net migration (immigration minus emigration) per 1,000 population into county *c* between 2013 and 2017.

Supplementary Material

To view supplementary material for this article, please visit http://doi.org/10.1017/S0022109022000552.

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