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**Mortgage Loan Securitization and  
Relative Loan Performance**

John Krainer

Federal Reserve Bank of San Francisco

Elizabeth Laderman

Federal Reserve Bank of San Francisco

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# Mortgage Loan Securitization and Relative Loan Performance \*

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## Abstract

We compare the ex ante observable risk characteristics and the default rates of securitized mortgage loans and mortgage loans retained by the original lender. We find that privately securitized loans tend to be riskier and to default at a faster rate than loans securitized with the GSEs and lender-retained loans. However, the differences in default rates across investor types are of secondary importance for explaining mortgage defaults compared to more conventional predictors, such as original loan-to-value ratios and the path for house prices. Privately securitized home mortgages have conditionally higher expected returns than retained loans, suggesting the presence of risk factors that are unobservable but nonetheless at least partially acknowledged by the market.

JEL Codes: G21, L11, D82. Key Words: Mortgage Lending, Securitization, Loan Quality, Asymmetric Information.

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# 1 Introduction

Mortgage markets have undergone a steady process of innovation since the financial industry deregulation in the 1980s. One of the more important developments has been the process of disintermediation that has occurred through the growth of loan securitization, whereby lenders specialize in the production of mortgage loans, but do not maintain a lasting exposure to the loans after passing them on to investors. In this paper, we compare the ex ante risk characteristics, the default performance, and the pricing of loans that are securitized, either privately or through the government-sponsored enterprises (GSEs), versus loans that are retained in a lender's portfolio. To preview the results, we find that, on balance, lenders chose to securitize loans through private-label transactions that appear to be observably riskier than the loans they retained in their own portfolios. In terms of default experience, there does appear some evidence that default rates were higher for privately-securitized mortgages. While we do not seek to downplay this result, other observable risk factors appear to be more robust for explaining the patterns of mortgage default in our data.

The literature has identified numerous reasons for loan securitizations and for mortgage loan securitizations, in particular. These reasons, with their varying theoretical implications for the relative riskiness of securitized versus retained loans, motivate our empirical investigation of the ex ante risk characteristics and ex post performance of these loan categories. In addition, they guide our selection of control variables for our securitization regressions and provide an informal framework within which to discuss the empirical correlates of securitization. Perhaps the simplest motive for lenders to securitize is the desire to generate fee income and maintain the funding flexibility needed to increase lending or manage the lender's leverage position. In the so-called "originate-to-distribute" model, lenders effectively fund a portion of their operations through the capital markets, selling their mortgages to investors shortly after origination (see Pavel and Phillis (1987) and Karaoglu (2005)). To the extent that mortgage credit risk depends closely on house prices, loan securitization also may help lenders offload or diversify away geographically-based risks. This motivation for securitization likely would be more important for smaller lenders than for larger lenders (see, again, Pavel and Phillis (1987)). Note that neither of these aforementioned securitization motives have an obvious implication for loan performance, although reputational concerns may

motivate lenders who want to reliably generate fee income or diversify away geographically-based risks to securitize their less risky loans.

Another possibility is that lenders may want to securitize mortgage loans in order to reduce their regulatory capital ratios. This motive will be particularly relevant for regulated commercial banks. Throughout most of the time period that we will investigate (2000-2007), regulatory capital rules have stipulated a one-size-fits-all capital charge for mortgage loans on a bank's books. If those capital charges are perceived by lenders to be too high, then, all else held constant, banks would have an incentive to securitize their lower-risk mortgages while retaining the higher-risk loans for which the regulatory capital charge is closer to optimal. (See, for example, Jones (2004), Dionne and Harchaoui (2003), Minton, Sanders, and Strahan (2004), Nolan (2005), and Ambrose, LaCour-Little, and Sanders (2003).)

An alternative reason for loan securitization relies on the significant informational asymmetries that characterize lending decisions and the entire securitization process. Mortgage originators possess more information than investors about the default probability of a mortgage. Lenders may take advantage of this informational edge and pass on "lemons" to investors, while retaining the safer loans in their own portfolio. (See, for example, Carey (1998), with a focus on corporate bonds.) In a recent paper Elul (2009) finds some evidence of differential loan performance consistent with this story in certain mortgage product types. More precisely and less maliciously, securitization may undermine a lender's incentives to screen borrowers, as these activities are costly, and lenders may not directly benefit from heightened screening of loans that likely will be securitized. These possibilities have been investigated in a recent paper by Keys, Mukherjee, Seru, and Vig (2010), wherein the authors point to an industry rule-of-thumb that loans to borrowers with FICO credit scores just below 620 are more difficult to securitize than loans with scores just above this threshold. Given this discrete jump in the probability that the loan can be sold, the authors reason that lenders have a stronger incentive to produce "soft" information in order to better discriminate between good and bad credit risks for loans to borrowers with FICO scores below 620 than above 620. In turn, the authors find that, despite the normally negative correlation between FICO scores and credit risk, delinquency rates are lower for borrowers just below the 620 FICO cutoff for a large sample of

securitized mortgages. The authors contend that this reflects lenders' stronger incentive to produce information for the apparently less highly securitized group. However, in a response to the Keys et. al. paper, Bubb and Kaufman (2009) show that in a sample of securitized *and* retained mortgages, the securitization rate for conforming and for low documentation loans does not jump at 620. These authors contend that this indicates the absence of a securitization cutoff rule at 620 and therefore the inability of that point to be used to distinguish between the screening behavior of lenders when they intend to securitize and when they don't.

In this paper we examine three basic issues related to securitization. First, we use a large loan-level data set to explore the factors that are correlated with securitization. Throughout this part of the analysis we will focus on the choice lenders face to either hold the loan in portfolio or securitize through a nonagency or private-label securitization.<sup>1</sup> The rationale for this exclusion is the presumption that lenders found it efficient to securitize virtually all of the conforming mortgage debt through the GSEs. In effect, the interesting margin for analysis is the securitization decision for nonconforming mortgages. In addition, the underwriting standards for the mortgages going into nonagency securitizations changed much more over the course of the 2000s than was the case for mortgages securitized with the GSEs (see also Demyanyk and van Hemert(2008)). Second, we compare the default performance of securitized versus retained mortgage loans, both unconditionally and conditioned on the same factors that we explore in connection with the securitization decision. In this section we include loans retained in the lenders' portfolios as well as loans securitized both with the GSEs and in with private investors. Third, we compare the conditional pricing of securitized mortgages and mortgages retained in the portfolio.

To answer these questions we use a very rich data set of California mortgages that allows us to gain insight into mortgage terms, borrower characteristics, and measures of the amount of lender competition in the market. California is an excellent laboratory for investigating these questions. It is a large and highly diverse state economically, possessing equally diverse local real estate markets. California has some of the best and worst-performing markets (in terms of mortgage delinquency rates) in the country. In addition, the level of house prices in California is quite a bit higher than

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<sup>1</sup>Typically, the sponsors of private-label securitizations are commercial banks or securities firms.

for the overall country. As such, the conforming loan limits set by the GSEs tend to be binding for a larger segment of the California market than for other states. Thus, innovations that made mortgage lending through the securitization process more attractive had a relatively large impact on the origination of mortgage debt in California.

The rest of the paper is organized as follows. In Section 2 we offer a brief overview of the nonagency securitization process. In Section 3, we describe the data used in the empirical analysis. Section 4 presents the results from our securitization regressions. Section 5 contains the analysis of the comparative default experience of securitized and nonsecuritized mortgages. Section 6 contains price regressions. In the remaining section before the conclusion, we compare our results to those seen in Keys, Mukherjee, Seru, and Vig (2010). Specifically, we investigate the relationship between securitization propensity, loan performance and the FICO score. Section 8 concludes.

## **2 The nonagency securitization process**

Securitization is the process by which originated loans are combined and repackaged for sale to capital market investors. There are two different channels by which residential mortgages are securitized in the United States. Agency securitizations are issued through the government sponsored enterprises (GSEs) such as Ginnie Mae, Fannie Mae, and Freddie Mac. Nonagency securitizations, or private-label securitizations, are issued by entities other than the GSEs, usually large banks or Wall Street firms. The nonagency securitization process results in the transformation of whole mortgage loans into publicly-traded securities which are registered through the Securities and Exchange Commission.

In terms of economics, the main difference between agency and nonagency securitizations is in the credit quality of the underlying mortgages. The GSEs fully guarantee the timely repayment of principle and interest of their securitizations. Because the GSEs have traditionally been viewed as, implicitly or explicitly, enjoying the backing of the U.S. government, strict criteria have been put in place in the attempt to limit the amount of credit risk taken on by the GSEs. These criteria include caps on the size of the individual mortgages sold to the GSEs (the conforming loan limits), as well as other restrictions on the amount of borrower leverage in place and the ratio of borrowers'

scheduled monthly debt repayment to income. In essence, the nonagency market grew up to absorb the demand for mortgages that were “nonconforming”, either in terms of their size or because of some violation of one or several underwriting criteria. According to Bruskin, Sanders, and Sykes (1999), the first nonagency mortgage security was issued by Bank of America in 1977. But the real growth in the nonagency market took place in the 2000s. According to the Federal Reserve’s Flow of Funds data, nonagency securitizations accounted for about 14% of all residential mortgage securitizations in 2000:Q1. By 2006, the nonagency share had risen to 36%.

At a conceptual level, the process of privately securitizing residential mortgages is relatively simple; lenders extend mortgage credit to borrowers, and then sell the loans so that they may be repackaged and sold on to investors. In practice, however, specialization has led a large number of economic agents that are party to the securitization process. Figure 1 contains a general schematic of the various parties involved in a mortgage transaction that eventually ends up in a nonagency securitization. In brief, originators extend financing to borrowers, or mortgagors. If the originator is a depository institution such as a commercial bank, then it is possible initially to finance the loan through deposits. Alternatively, the originator may finance its lending through short-term loans from a warehouse lender. After origination, an arranger, or sponsor, buys the mortgage loans from the originator and proceeds to sell the mortgages to a bankruptcy-remote trust. The arranger then packages the mortgages into securities, obtains a rating for the securities by one of the major credit rating agencies, and then sells the securities to outside investors. As borrowers make interest and principal payments, or pay off the loans in their entirety, a servicer passes the cash flows on to investors in accordance with the terms laid out in the securities prospectus.<sup>2</sup>

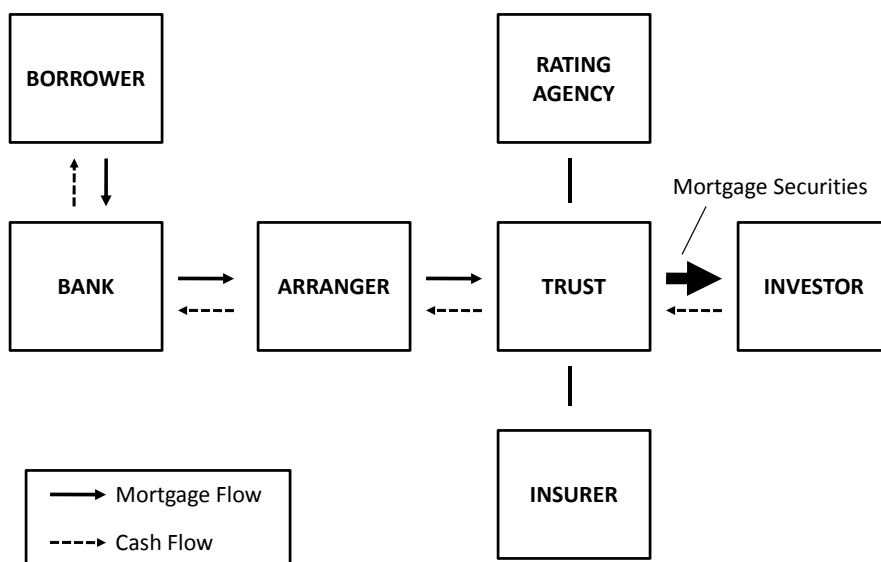
Ashcraft and Schuermann (2008) point out that the parties in each of the interactions listed above have potentially different information about the quality of the underlying mortgages.<sup>3</sup>

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<sup>2</sup>For example, a “plain-vanilla” security might stipulate that an investor is entitled to a pro-rata share of the cash flows generated by the pool of mortgages owned by the trust. Alternatively, the claims on the assets may be structured, in which case investors in different securities have different priority to the cash flows on the underlying mortgages.

<sup>3</sup>Losses due to borrower default may not necessarily be borne by investors in the private-label securitizations. The arrangers may have “over-collateralized” the structure by setting the par value of the securities below the face value of the underlying mortgages, thus building in some buffer for losses. Alternatively, the arrangers may have purchased some limited insurance to cover losses. Either way, the focus here is on the different information produced by the originator relative to the other parties.

Figure 1: The nonagency securitization process



Originators perform the original underwriting on the loans and (presumably) verify the borrower’s income, employment history, credit score, and other information, to the extent that that verification is required by the arrangers. Arrangers issue underwriting guidelines to the originators stating parameters needed to be satisfied for any loan purchase. Arrangers do not typically “reunderwrite” the loans in the pool. Instead, arrangers are protected through representations and warranties made by the originator that the mortgages were not originated in violation of any consumer protection laws, that the mortgages were not fraudulently misrepresented, or that the mortgagors were not already in default. Originators are under obligation to buy back loans found to be in breach of the representations and warranties. Of course, the representations and warranties provide a solution to this potential agency problem only insofar as the originator is in good enough financial condition to repurchase the loans.

The potential information asymmetries between originators and the arrangers and the eventual investors help motivate empirical investigation in the following sections of default rates for securitized versus retained loans. In particular, we will investigate the degree to which ex ante observable risk factors can or cannot account for the higher default rates of securitized loans and therefore the

degree to which asymmetric information may play a role.

### 3 Data

Our data set consists of information on the characteristics, terms, and eventual performance of nearly 2.4 million first-lien conventional mortgage loans originated in California between January 1, 2000 and December 31, 2007. The data come from LPS Applied Analytics, which collects data from the major mortgage servicers.<sup>4</sup> Importantly, LPS reports the “investor type” for each loan in its database as the loan moves through time. Thus, we are able to discern between loans that were sold to the GSEs (Fannie Mae and Freddie Mac), sold to private investors through a nonagency securitization, and loans which remained on the originating institution’s balance sheet. In practice, the identity of the investor can change over time. In the first few months of a loan’s life, for example, the investor is typically identified as the originator, which retains ownership of the loan throughout the “warehousing” period. The investor identity would then change as these loans leave the balance sheet of the originator and proceed through the securitization process. Investor type can change even after the initial warehousing period. For example, if Freddie Mac were to purchase a nonagency MBS and hold it in its portfolio, Freddie Mac would then be recorded as the investor. The convention used in this paper is to make a once-and-for-all assignment of the investor type, which is based on the last investor to hold the loan.

On balance, about 83% of the sample contains loans that were securitized in some way—either privately, or through the GSEs (see Table 1). The share of nonagency securitizations increased over the course of the sample period, from about 26% to nearly 40% of all California mortgages in 2006, before falling back as the housing market began to weaken in 2007. As is well known, house price appreciation was strong in California during the early part of the 2000s, and generally outpaced the rate of increase in the GSE’s conforming loan limits. Thus, we see the share of jumbo (i.e., loan sizes above the conforming loan limit) increasing from about 20% in 2002 to 35% in 2006. This pressure on home affordability also apparently led to a change in borrower preferences

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<sup>4</sup>In LPS’s marketing literature, they claim that their participating servicers account for about 60% of the entire mortgage market.

for ARMs versus fixed-rate mortgages. Indeed, option ARMs, or ARMs where borrowers are able to negatively amortize their mortgages for a set period of time also gained in popularity as the housing boom progressed.

We also see some evidence of the much-discussed decline in underwriting standards. For example, LTVs moved up modestly, over the sample period. The subprime share of total originations climbed from about 1% to a peak of 10% in 2006. The incidence of less-than-full documentation of borrower income and assets rose steadily over the period as well. Other sample statistics are presented in Table 1.

Note that the loan-level data in our sample allow us to identify the location of the property backing the mortgage. This allows us to include measures of lending competition for the market in which the house is located, such as lender concentration measures based on the distribution of bank deposits in the local market. In the specifications used below we use a simple concentration measure, the Herfindahl-Hirschman Index (HHI), based on bank deposit data for the metropolitan area in which the property resides. We also include the last two years of house price appreciation in the zipcode of the property in several of our specifications. The zipcode-level data are from the Home Value Indices constructed by Zillow. Given the strong persistence of house prices in the data, we include this variable to account for possible lender optimism about house price appreciation at a very local level.

In table 2 we recast the sample summary statistics in order to show how the key variables in the data vary across investor type. Obviously, there are large differences between the mortgages sold to the GSEs on the one hand, and on the other hand mortgages either retained by lenders or securitized through the nonagency channel. It is perhaps surprising to see that the GSEs hold any jumbo mortgages, or mortgages with nonconforming features such as option ARMs or mortgages labeled as subprime. We can conjecture that these mortgages were not part of GSE-securitizations, but rather were originally nonagency securitizations that the GSEs proceeded to purchase and then hold in their portfolios.

The other interesting feature of table 2 is the similarity of the mortgage characteristics across retained and privately securitized mortgages. In terms of the major risk factors thought to contribute

Table 1: Summary Statistics

	Full Sample		2002 Originations		2006 Originations	
	mean	std. dev.	mean	std. dev.	mean	std. dev.
Securitized	.83		.90		.77	
Nonagency securitized	.30		.26		.38	
Refinance	.74		.78		.69	
Jumbo	.26		.20		.35	
ARM	.35		.22		.58	
Option ARM	.17		.05		.38	
Loan amount	\$314,663	\$253,498	\$253,711	\$183,309	\$428,068	\$334,454
Loan-to-value	.63		.63		.69	
Subprime	.03		.01		.10	
FICO	721	57	727	56	715	59
Low/no documentation	.24		.09		.48	
Local HHI (deposits)	1080	274	1089	263	1026	297
2-yr House price apprec.	.34	.20	.27	.13	.34	.20
Delinquent 60+ days	.04		.01		.14	
Observations	2,360,200		269,871		204,296	

Table 2: Risk and Default Characteristics of Securitized Vs. Retained Loans

	GSE securitized		Private securitized		Retained	
	mean	std. dev.	mean	std. dev.	mean	st. dev
Jumbo	.01		.53		.57	
ARM	.13		.51		.77	
Option ARM	.05		.26		.38	
Loan amount	\$212,071	\$84,893	\$403,839	\$264,724	\$477,460	\$399,959
Loan-to-value	.6	.19	.66	.16	.69	.16
Subprime	0.0		.08		.05	
FICO	725	55	718	59	715	59
Low/no documentation	.17		.29		.37	
Local HHI (deposits)	1075	276	1086	271	1087	269
2-yr House price apprec.	.34	.19	.27	.13	.34	.20
Delinquent 60+ days	.02		.08		.06	
Observations	1,249,151		716,141		394,908	

to default—LTV, FICO score, documentation status—it is not obvious that lenders systematically withheld safe mortgages from the market for retention in their portfolios.

## 4 Determinants of securitization

In this section we investigate the propensity of lenders to securitize loans. In aggregate, the securitization propensity was generally flat over the sample period (see Figure 2). However, this relatively constant use of securitization by lenders masks large shifts that took place in the means that the securitization was achieved. In 2000, about 20% of the California mortgages were securitized privately. By 2006, the total had increased to about 60%. This time period in which the nonagency securitizations increased market share coincided with rapid house price appreciation in the state of California. The multivariate analysis will allow us to control for additional variables in order to provide a richer and clearer picture of the correlates of the securitization decision. All regressions are estimated as probits. To handle outliers, we winsorize all of the continuous variables in the regressions. We also include a complete set of time-MSA interaction dummies in each specification.

Figure 2: Securitization by Year



The results in Table 3 are based on probit models of the securitization outcome. In these regressions we chose to drop all mortgages that were securitized through the GSEs. In effect, we are acknowledging the fact that for virtually all mortgages that met the conforming loan requirements, it was advantageous for lenders to sell the loans to the GSEs. We include both purchase loans and refinance loans.<sup>5</sup>The specifications are organized by roughly grouping the explanatory variables by loan characteristics (jumbo, arm, option ARM, LTV), borrower characteristics (subprime status, credit score, documentation status), and market characteristics (banking market concentration, past house price appreciation). All specifications include a complete set of year-MSA interactions. We report robust standard errors after clustering on MSA.

In panel 1, we see the measured effect of mortgage characteristics on the securitization decision. On balance, we see that for the loans that lenders chose not to securitize with the GSEs, they were more likely to sell jumbo-sized loans to the capital market investors in nonagency securitizations. Lenders also tended to securitize the higher LTV loans. This makes sense, given that LTV is one of the primary drivers of default risk. All else held constant, securitization would tend to offer a means for lenders to offload credit risk tied to regional house price fluctuations, and pass it on to the capital markets where the risk can be diversified. The ARMs originated over this period turned out to perform much worse than fixed-rate mortgages (FRMs). But we do not interpret the lenders' ex ante tendency to retain ARMs compared to FRMs as a sign of an appetite for risk. Rather, it is more likely that ARMs were attractive to lenders for their short durations, which benefit the lenders' trying to balance the durations of their assets and liabilities. The coefficient on the option ARM variable is never statistically significant at conventional levels.

We see a somewhat more ambiguous picture when looking at borrower characteristics (panel 2). Loans rated as subprime by the lenders were more likely to be sold. However, after conditioning on the subprime designation, privately securitized mortgages tended to have higher borrower credit scores than the retained mortgages. This turns out to be a consequence of the mix of FICO scores in the privately securitized loan pools. In effect, private market investors were willing to hold two kinds of mortgages that were being produced in ample quantity over this time period: low FICO

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<sup>5</sup>We estimated the models separately for purchases and refinances and the results were very similar

Table 3: Probit models of securitization

	(i)	(ii)	(iii)	(iv)	(v)
Jumbo	.066 (.017)***			.075 (.017)***	.081 (.015)***
ARM	-.282 (.012)***			-.286 (.011)***	-.286 (.011)***
Option ARM	.008 (.028)			.009 (.031)	.008 (.031)
Loan-to-value	-.022 (.020)			-.033 (.021)**	-.040 (.019)**
Subprime		.135 (.015)***		.168 (.011)***	.166 (.010)***
FICO		.001 (.0001)		.0003 (.00007)***	.0003 (7.27e-5)***
Low/no documentation		-.073 (.011)***		-.0002 (.013)	-.001 (.013)
Local deposit concentration			-.001 (2.07e-6)***		-.001 (4.54e-5)***
Past 2yr House price apprec.			.036 (.036)		.088 (.031)***
Pseudo $R^2$	.08	.04	.03	.09	.09
Observations	2,360,200	2,360,200		2,360,200	2,360,200

All specifications include year-MSA interactions.  
 Coefficient estimates are marginal effects.  
 Standard errors clustered by MSA.  
 Significant at: .01(\*\*\*), .05(\*\*), .1(\*).

score subprime loans and higher FICO score alt-A loans where borrower attributes were better (safer) but some other risk factor rendered the loan nonconforming.<sup>6</sup> A somewhat unexpected result is the negative association between private-label securitization and the documentation status of income and assets of the mortgage borrower. Given the costly nature of the documentation process that needs to be incurred by the lender, we would naturally expect that lenders would be less likely—not more likely—to do the documentation when they expect to sell the loan. However, this coefficient is not significant when additional risk factors are included in the regressions.

In panel 3, we examine market-based measures. Markets with high securitization rates tend to have low deposit concentration measures. This result is consistent with the notion that lenders in unconcentrated markets with lower HHIs are thought to have little market power and, thus, little ability to charge borrowers rates and fees in excess of the broader market rates. In competitive markets marked by low concentration measures, lenders apparently have more incentive to act as pure intermediaries, originating loans, and then immediately selling them off.

In summary, what emerges from the models of the securitization choice is a general picture of lenders retaining ARMs (though, not necessarily option ARMs), and selling off loans that appear to be marginally riskier than the loans that are retained. This differential risk in the loans will be important when evaluating the eventual loan performance of the mortgages.

## 5 Determinants of Mortgage Delinquencies

While the results of the previous section provide insights into the relationships between mortgage securitization and loan, borrower, market, and lender characteristics, they have unclear implications for the performance of securitized relative to retained loans. Privately securitized mortgages appear to be riskier in observable ways: the borrowers associated with the securitized mortgages are more likely to be subprime borrowers and tend to have higher LTVs. The strategy employed in the analysis of mortgage default below is twofold. First, we would like to identify the key determinants of mortgage default in our sample. Second, we would like to control for observable risk factors as best

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<sup>6</sup>In California at this time, many alt-A loans were labeled thus because the loan amounts exceeded the conforming loan limits, or some the borrower debt-to-income or LTV ratios were considered too high.

we can so as to focus on the relative performance of the securitized and retained mortgages. On this front, the biggest challenge is to properly control for changes in the value of the underlying collateral. Theory and empirics all suggest a primary role for house price changes as key determinants behind the default decision. However, we observe the value of the house only at the time of the loan origination. Thereafter, we can only estimate the value of homeowners’s equity in the house by applying a local house price index to the original equity position. If a local housing market is fairly homogeneous, then our index-based estimates of home values will be reliable. To attempt to control for market-specific heterogeneity, we include MSA fixed effects in all of our empirical specifications.

Unconditionally, securitized mortgages do appear to have higher delinquency rates than retained mortgages. As seen in Table 2, the delinquency rate on privately securitized loans in our sample, at about 8%, is notably higher than the 6% default rate for retained loans. To investigate the performance of the loans in our sample more carefully we follow the literature and model the default event with a proportional hazard model. In this setting, the termination event is the date on which a borrower becomes more than 60 days past due on his or her mortgage payment. Terminations due to early prepayment are treated as censored observations.<sup>7</sup> The hazard rate,  $\lambda(t)$  is the probability that the borrower terminates the mortgage at time  $t$ , conditional on not terminating the mortgage prior to that time. In the proportional hazard framework, the hazard takes the form,

$$\lambda(t) = \lambda_0 \exp(\beta X(t)),$$

where  $\lambda_0$  is the “baseline hazard” and  $X(t)$  is a vector of covariates that shift the baseline hazard. That is, the covariates shift the relative risk of failure but they do not affect the underlying shape of the hazard function. The model allows for time-varying covariates. In all of the specifications explored here, we construct a time-varying current LTV by applying the zipcode-level house value index from Zillow to the reported LTV at time of origination. We also employ a set of static covariates, including those used in the securitization regressions in the previous section, and additional controls for the documentation status of the mortgage, and indicators for whether the ARM is an

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<sup>7</sup>We do not distinguish between the event of a borrower paying off the mortgage in accordance with the amortization schedule and the event of the borrower paying the mortgage off with an early prepayment (i.e., a refinance).

option ARM. We also include indicator variables for whether the initial LTV was low (less than 75%), high (greater than 85%), and exactly equal to 80%. This latter LTV bucket is particularly important given the large number of loans in our sample with exactly 80% LTV. Given the rapid rise in house prices in California and the rise in the jumbo share, it is certainly possible that some of these loans with 80% LTV actually understate true borrower leverage because of the existence of a second-lien mortgage that we do not observe. By slotting LTV at origination into the low, 80%, and high groupings, we allow for potentially complex relationships between LTV and default. Finally, we include the local house price appreciation over the past two years leading up to the loan origination as a way to control for markets which may have experienced a housing market bubble that proceeded to burst.

Since the estimation of time-varying hazard models is resource-intensive, the results below reflect estimation on a 10 percent random sample of our data set.

The results generally conform with the unconditional results as well as our expectations about the role of risk factors. In terms of observable risk factors, the current LTV is a strong predictor of default. This, of course, is exactly what we would expect from a theoretical model of default. Absent any information about mortgage terms and borrower characteristics, we would predict borrowers to be more inclined to default on their mortgages when their home equity values go down. This could be due to ruthless default, or could simply reflect the fact that homeowners who have suffered some sort of life event, like illness or divorce, will have a more difficult time avoiding default if they cannot sell their houses for enough to repay their mortgages.

Other risk factors shift the hazard rate in the expected manner. Subprime borrowers have much higher hazard rates than non-subprime borrowers, possibly because subprime borrowers are more vulnerable to income and employment shocks. Borrowers with less-than-complete documentation on their loans also default at a faster rate. Again, this is not surprising, given the potential for these borrowers to misrepresent their incomes. Finally, it is interesting to note that markets (in both space and time) characterized by relatively high appreciation rates leading up to the loan origination date had higher default experience relative to the baseline. This could be an indication of borrowers, in relative terms, being forced to pay more for their houses and then encountering

Table 4: Hazard Models

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Priv. investor	1.41 (.051)***	1.52 (.085)***	1.20 (.052)***	1.27 (.060)***	1.28 (.067)***	1.28 (.066)***
GSE investor	.47 (.019)***	.81 (.036)***	.77 (.032)***	.50 (.045)	1.05 (.051)	1.03 (.045)
Current LTV	2.55 (.048)***	1.86 (.179)***	1.66 (.178)***	1.85 (.204)***	1.71 (.186)***	1.61 (.174)***
Low LTV at orig.		.55 (.019)***	.57 (.031)***	.51 (.020)***	.60 (.020)***	.61 (.020)***
High LTV at orig.		1.48 (.193)***	1.07 (.086)***	1.43 (.184)**	1.16 (.089)*	1.05 (.088)
80% LTV at orig.		1.41 (.073)***	1.40 (.068)***	1.45 (.059)***	1.36 (.067)***	1.31 (.053)***
ARM		1.84 (.126)***			1.41 (.079)***	1.46 (.086)***
Option ARM		1.98 (.200)***			1.28 (.060)***	1.24 (.063)***
Jumbo		.81 (.033)***			1.09 (.035)***	1.08 (.041)*
Low doc.			2.10 (.093)***		1.80 (.078)***	1.70 (.100)***
Subprime			2.45 (.179)***		2.24 (.175)***	2.22 (.122)***
FICO Score			.99 (3.72e-4)****		.99 (3.72e-4)***	.99 (3.09e-4)***
Deposit market concentration			.99	(.002)***	.99	(.002)**
Past 2yr House price apprec.				2.77 (.801)***		1.04 (.201)
MSA dummies	No	Yes	Yes	Yes	Yes	Yes
Standard errors clustered by MSA.						
Number subjects	118,025	118,025	118,025	118,025	118,025	118,025

Significance: .01(\*\*\*), .05(\*\*), .1(\*).

financial difficulties more quickly. Alternatively, we know that markets with rapid house price appreciation in the early part of the decade experienced relatively larger declines after the housing market peaked. Since we are already controlling for changes in LTV, this could indicate that realized appreciation was much worse than expected by homeowners and they consequently defaulted more quickly on their mortgages.

The main variables of interest in the hazard model analysis, however, are investor-type variables. In every specification the effect of private investor is to raise the hazard rate. For example, in specification (vi) above with the full list of control variables, the private investor designation shifts the hazard rate higher by 26%. GSE-owned or guaranteed mortgages, by contrast, had much better loan performance, but not on a risk-adjusted basis. Looking again at specification (vi) above with the full complement of controls, the measured effect of the GSEs as investors indistinguishable from the baseline hazard rate. Thus, controlling for risk, mortgages bought or securitized by the GSEs appear to have roughly the same performance characteristics as the mortgages retained by lenders. Note that the hazard ratios reported in the table above invariably point to variables other than the investor identity as the most economically important contributors to default risk. Simply put, the hazard ratios on these other variables are larger in magnitude. However, given our belief that we have available the relevant predictors of default for our hazard modeling, it seems to be true that nonagency securitized mortgages performed worse than other mortgages originated in California.

We can further examine this finding by looking at interactions of the investor type with the year of origination. In table 5 we re-estimate the proportional hazard model with current LTV and a complete set of year-investor interactions (see also ? for a similar type of analysis). Relative to the baseline of a mortgage originated in 2000 and not securitized through a nonagency securitization, we see that there are strong vintage effects in the data. The hazard rate for a mortgage originated in 2006 was 92% higher than the baseline. In this specification, the indicator on the private-label investor is associated with a high hazard ratio (nearly 75% above baseline). However, the coefficient is not statistically significant. The year-private investor interaction terms display what might be considered the expected pattern: the measured impact of the private-investor on the hazard rate grows as the California housing market boomed between 2003 and 2006. This was, consequently,

also the period that the overall nonagency securitization also grew. However, only in 2006 is the interaction term statistically significant.

Table 5: Hazard Models with Interactions

	Hazard ratio	standard error
Current LTV	2.104	(.040)***
Priv. investor	1.726	(.594)
2001	.231	(.056)***
2002	.379	(.083)***
2003	.388	(.081)***
2004	.680	(.143)*
2005	1.538	(.321)**
2006	1.918	(.402)***
2007	1.760	(.367)***
2001*investor	1.182	(.479)
2002*investor	.699	(.263)
2003*investor	.461	(.166)**
2004*investor	.741	(.262)
2005*investor	1.345	(.469)
2006*investor	1.874	(.654)*
2007*investor	.931	(.329)

Standard errors clustered by MSA.

Significance: .01(\*\*\*), .05(\*\*), .1(\*).

House price changes seem to be of paramount importance for explaining mortgage default in this data set. However, there are legitimate concerns that we do not measure house prices very accurately at the property level. Moreover, default more generally could depend on other developments in the local economy that, for whatever reason, may not be fully captured in our imperfect measure of house price appreciation in the hazard models. As robustness check, we also estimate probit models of the default event, using the same set of static covariates as conditioning variables that were used in the securitization regressions and the hazard models. One of the benefits of the probits is that they offer greater flexibility in capturing the effects of local economic conditions. In particular, it is easier to estimate probit models on large data sets with a large number of interaction terms than it is to estimate hazard models. Thus, we estimate the probits below with a full set of MSA-year fixed effects, while understanding that the MSA-year fixed effects

may be capturing more than just changes in the housing market.

The results from the probit regressions are in the table below. We report the marginal effects on the explanatory variables. The estimates for the MSA-year interaction terms are suppressed.

Table 6: Probit models of loan delinquency

	(i)	(ii)	(iii)	(iv)	(v)
Priv. securitized	.020 (.001)***	.004 (.0003)***	.018 (.001)	.006 (.0003)***	.005 (.0004)***
GSE	-.006 (.001)***	-.010 (.001)***	-.030 (.002)***	-.001 (.010)	.001 (.001)*
Jumbo	-.013 (.001)***			-.001 (.001)	.0002 (.001)
ARM	.019 (.002)***			.007 (.001)***	.007 (.001)***
Option ARM	.012 (.04)			.004 (.001)***	.004 (.001)***
LTV	.149 (.002)***			.064 (.002)***	.063 (.002)***
Subprime		.068 (.006)***		.047 (.005)***	.045 (.005)***
FICO		-.0003 (5.35e-6)***		-.0002 (6.18e-6)***	-.0002 (5.96e-6)***
Low/no documentation		.012 (.001)***		.008 (.0004)***	.007 (.0005)***
Local HHI (deposits)			3.61e-5 (4.16e-6)***		1.53e-5 (2.13e-7)***
Past 2yr House price apprec.			.086 (.016)***		.021 (.003)***
Pseudo $R^2$	.21	.24	.16	.26	.27
Observations	2,360,200	2,360,200	2,360,200	2,360,200	2,360,200

All specifications include year-MSA interactions.

Coefficient estimates are marginal effects.

Standard errors clustered by MSA.

Significant at: .01(\*\*\*), .05(\*\*), .1(\*).

In summary, the probits paint much the same picture of securitization and mortgage loan performance as the hazard model analysis. Privately securitized mortgages tended to perform somewhat worse than mortgages funded through alternative sources, all else held constant. On balance, the signs of the coefficient estimates on the non investor-type variables and the incidence of statistical significance conform with results from the hazard models.

## 6 Price Regressions

While the results from the default rate analysis shows some indication that privately securitized loans have performed worse than loans with similar observable risk characteristics that were retained on lender portfolios, one explanation for this might be that the privately securitized loans are characterized by risk factors that are unobservable to the econometrician. If these unobservables are perceived by lenders and investors, however, then it is possible that we can detect the presence of these risk factors in loan pricing. To do this, we regress loan spreads, or the difference between the rate on the mortgage loan and a benchmark interest rate, on the same set of risk controls used in the delinquency regressions. For the case of FRMs, the benchmark security is a riskless Treasury rate of comparable maturity in the one-month period prior to origination. For the case of ARMs, we use the stated margin rate on the loan, which is literally the spread described above at the time of reset. Thus, we have eliminated the effect of any so-called “teaser rates” from the regressions. As before, all regression specifications include a complete set of year and MSA fixed effects, and their interactions.

If our set of risk measures is comprehensive, then we should be able to extract the pricing function employed by lenders from the data. In the absence of any differential treatment for loans that are securitized, the coefficient on the nonagency securitization dummy should be insignificant. The results are in table 7.

The results shown in Table 7 indicate that the coefficient on securitization is, more often than not, statistically significant and positive. The loan price spreads in the analysis are recorded as percentage points. Thus, in the full specification regressions in panels (iv) and (v) of table 7, nonagency mortgage loans commanded spreads that were about .08%, or 8 basis points higher than non-securitized loans, all else held equal.

The positive correlation of securitization with the loan spread, even in the presence of our risk factors and control variables, suggests that there may indeed have been some unobservable risk factors associated with securitization that were priced. We emphasize, however, that these results do not necessarily explain why the default rates on mortgages in nonagency securitizations are higher than other mortgages. To do so convincingly would require an asset pricing model.

Table 7: Loan price regressions (OLS)

	(i)	(ii)	(iii)	(iv)	(v)
Priv. securitized	.195 (.026)***	-.139 (.019)***	-.048 (.033)	.076 (.015)***	.077 (.015)***
GSE	-.162 (.020)***	-.482 (.019)***	-.667 (.023)***	-.015 (.010)***	-.016 (.009)***
Jumbo	-.246 (.039)***			-.012 (.014)	-.023 (.014)*
ARM	.998 (.054)***			.789 (.033)***	.790 (.034)***
Option ARM	.092 (.062)			.237 (.037)***	.251 (.035)***
LTV	.757 (.044)***			.455 (.036)***	.468 (.034)***
Subprime		2.260 (.049)***		2.036 (.026)***	2.041 (.025)***
FICO		-.002 (.266)***		-.002 (6.66e-6)***	-.002 (.0001)***
Low/no documentation		.298 (.005)***		.039 (.007)***	.040 (.008)***
Local HHI (deposits)			-.0001 (4.16e-6)***		6.68e-5 (3.86e-6)***
Past 2yr House price apprec.			.541 (.076)***		-.183 (.025)***
All specifications include year-MSA interactions. Standard errors clustered by MSA.					
$R^2$	.37	.41	.18	.56	.56
Observations	2,360,200	2,360,200	2,360,200	2,360,200	2,360,200

Significant at: .01(\*\*\*), .05(\*\*), .1(\*).

Indeed, we cannot know whether an extra 8 basis points on average for a mortgage destined for a nonagency securitization is adequate compensation for the unobservables that may be captured in these regressions. Alternatively, it is possible that the underlying risk factors that account for higher spreads on securitized loans may be unobservable to both the econometrician and to market participants. If private investors feared some sort of “lemons” problem in the mortgages purchased from lenders in a nonagency securitization, then one rational response would be to charge a premium for these loans.

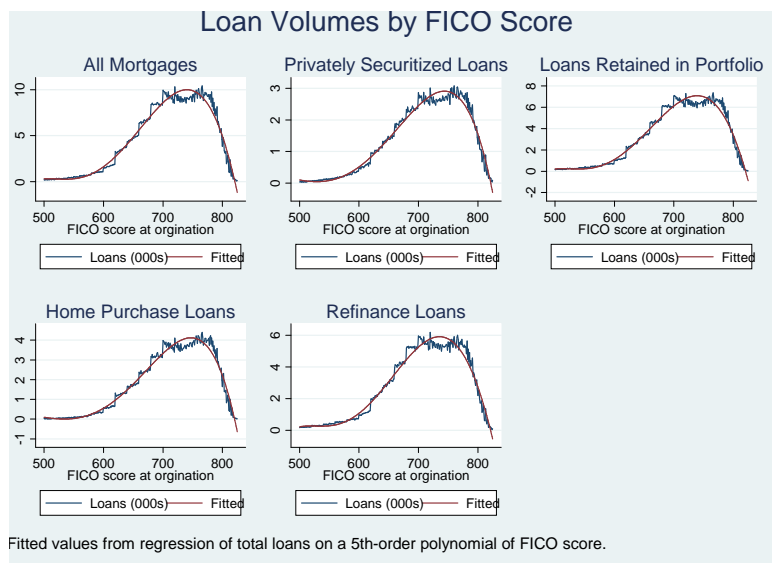
## 7 Securitization, loan performance, and the FICO Score

The analysis thus far has considered securitization and default outcomes across the entire spectrum of risk characteristics. This approach, though broad, may not be refined enough to identify the margin where lenders face a real choice between securitizing a mortgage and holding it their portfolio. One paper that has sought to precisely identify this margin is the influential paper by Keys, Mukherjee, Seru, and Vig (2010). In that work, the authors exploited a rule of thumb that mortgages with borrower FICO scores just below a cutoff point—FICO score equal to 620—have lower probabilities of being securitized than mortgages with borrower FICO scores above that cutoff. The authors argue that if FICO scores are good summary measures of risk and if the true distribution of FICO scores is continuous at this point, then the default probability as a function of FICO score should also be continuous at this point. In fact, they find evidence that defaults are also discontinuous near the 620 FICO cutoff. Mortgages with FICO scores just below 620 have lower default rates than mortgages just above 620. The analysis suggests that lenders exert relatively more effort screening borrowers below the cutoff, possibly because of the risk that the lender will not be able to sell the loan.

One potential issue with the Keys et. al. data is that the loans observed with FICO scores just under the cutoff actually were securitized. In our data, we are able to observe both loans that were securitized and loans which were retained in lender portfolios. By looking at actual securitization outcomes we can better assess questions of whether the originate-to-distribute model has led to lower (relative) loan performance.

Figure 3 plots the distribution of loans in the sample after collapsing the data on FICO. The smooth line in the figure represents the fitted values from a regression of the number of loans in each FICO score bucket on a 5th order polynomial of FICO.

Figure 3:



One immediate observation is the several pronounced discontinuities below 700. These discontinuities tend to occur at points for which anecdotal evidence suggests industry "rule-of-thumb" cut-offs for either loan qualification or, once the underwriting decision has been made, qualification for the loan to be securitized.<sup>8</sup> This latter point is the focus of Keys et. al. paper, where the authors argue that loans just below 620 are less likely to be securitized, and therefore face different underwriting standards than do loans just above 620. Interestingly, Figure 3 shows that the discontinuities in the distribution of FICO scores are not just artifacts of securitization criteria, but

<sup>8</sup>The most prominent discontinuities in these data occur at 600, 620, 650, and 700.

actually are features of the entire population of retained and securitized loans. Regardless of where the mortgage loans are placed—in an MBS pool or in the originator’s portfolio—and regardless of the loan purpose—a home purchase or a refinancing—these discontinuities persist in the data. It is not obvious why a scoring model would generate such a distribution. One possibility, mentioned above, is that not only do securitization probabilities vary discontinuously across FICO, but so too do mortgage approval probabilities. Another, not necessarily mutually exclusive, possibility is that borrowers know their own credit scores and know about these cut-off points used for origination and/or securitization, and thus take steps to improve their scores before applying for a mortgage.

## 7.1 Securitization propensity

To see the way securitization varies with the FICO score, we plot the securitization rate across 1-point intervals of the FICO score distribution (see Figure 4). The smooth lines in the figures represent the fitted values from a regression discontinuity model,

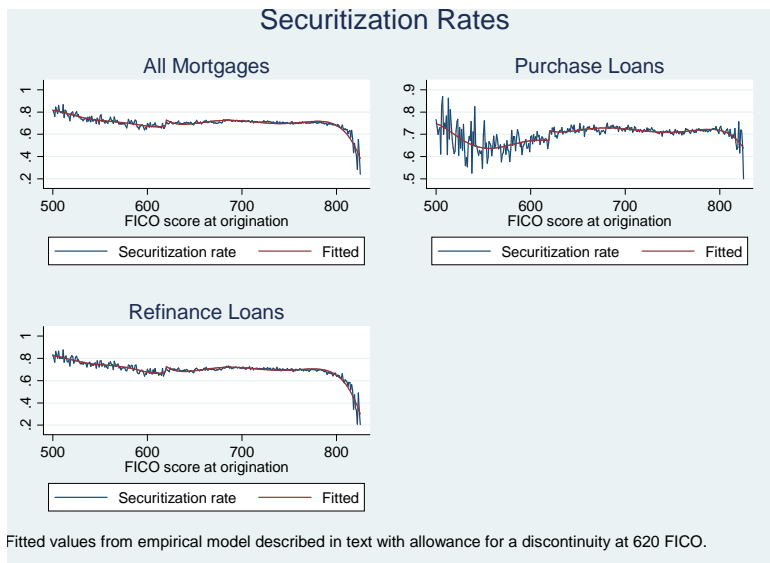
$$s_j = \alpha + \beta_j T_j + \theta f(FICO_j) + \gamma T_j f(FICO_j) + \epsilon_j.$$

Here,  $s_j$  is the securitization rate, or the percent number of loans securitized in FICO bucket  $j$ . The variable  $T_j$  is a dummy variable taking a value of one if FICO score  $j$  is greater than or equal to the cut-off point. The function  $f(FICO_j)$  is a 5th order polynomial in the FICO score. The error term  $\epsilon_j$  is mean zero.

This model is the workhorse specification of Keys et. al.’s investigation into the relationship between securitization and loan performance. The main coefficient of interest is  $\beta$ , which measures the magnitude of the change in the securitization rate at the cut-off point defined by  $T_j$ . The function  $f(FICO_j)$  is meant to fit the data as closely as possible on either side of the cut-off point. When the FICO score data are “recentered” so that the score at the cut-off point is zero, the estimated  $\beta$  coefficient provides a local approximation to the discrete change in the securitization rate at the cut-off point.

Figure 4 illustrates how securitization rates are fairly constant at about 70% over the 650-780

Figure 4:



FICO score interval, which is the range containing most of our observations. In the range below FICO 620, however, securitization rates are declining in the score. Evidently, the lowest FICO score mortgages are the most likely mortgages to be securitized during this time period. To the degree that FICO measures risk, this suggests a tendency to securitize riskier loans. It is also apparent that securitization rates for home purchase mortgages are very noisy functions of FICO score in the range below 620. This segment of the FICO score distribution represents approximately 5% of our observations.

The fitted lines in Figure 4 demonstrate that there is an increase in the securitization rate at FICO 620. In Table 8, we quantify the size of this discontinuity for all the points of discontinuity observed in Figure 3. At FICO score 600 and also 620, the securitization rate jumps discretely by about 5 percentage points. These estimates are statistically significant at the conventional levels. There is also a statistically significant increase in the securitization rate at 650, though the effect (2.7%) is much smaller. For loans for home purchases, the only significant jump in the securitization rate is at 620 FICO, where the securitization rate jumps by 4.5%. For the case of refinancings, there are significant discontinuities in the securitization rate at 600, 620, and 650.

## 7.2 Loan performance and default

In this section, we build on the work of Keys et. al. and search for discontinuities in the delinquency rate that may occur on either side of a critical value of a FICO score. The regression discontinuity framework is the same as the one employed to evaluate changes in the securitization rate at the different critical values for the FICO score, only replacing the securitization rate with the 60-day delinquency rate. So the specification is:

$$d_j = \alpha + \beta_j T_j + \theta f(FICO_j) + \gamma T_j f(FICO_j) + \epsilon_j,$$

where  $d_j$  is the 60-day delinquency rate.<sup>9</sup>

In Figure 5 we plot the delinquency rates by FICO score bin. The fitted lines in the chart

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<sup>9</sup>We performed this analysis using other definitions of the delinquency rate, such as the 90-day past due rate or the foreclosure rate, and the basic results were unaffected.

Table 8: **Threshold Tests for Discontinuity in the Securitization Rate**

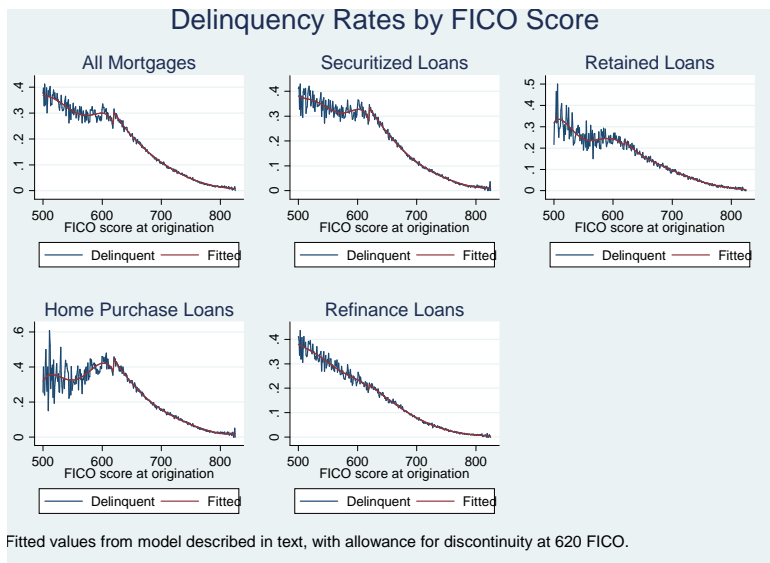
The tables report estimates of  $\beta$  from the regression specified in equation (1) in the text. The securitization rate is the percent number of loans per FICO score bin that are securitized through a private label securitization.

All Mortgages				
boundary	$\beta$	p-value	observations	$R^2$ adj.
FICO $\geq$ 600	.051	.007	326	.831
FICO $\geq$ 620	.048	.005	326	.845
FICO $\geq$ 650	.027	.089	326	.853
FICO $\geq$ 680	.049	.001	326	.861
FICO $\geq$ 700	.013	.390	326	.862

Purchase Loans				
boundary	$\beta$	p-value	observations	$R^2$ adj.
FICO $\geq$ 600	.037	.717	326	.409
FICO $\geq$ 620	.045	.078	326	.412
FICO $\geq$ 650	-.003	.891	326	.408
FICO $\geq$ 680	.033	.159	326	.411
FICO $\geq$ 700	-.001	.996	326	.408

Refinance Loans				
boundary	$\beta$	p-value	observations	$R^2$ adj.
FICO $\geq$ 600	.052	.009	326	.882
FICO $\geq$ 620	.043	.014	326	.893
FICO $\geq$ 650	.032	.051	326	.896
FICO $\geq$ 680	.045	.005	326	.898
FICO $\geq$ 700	.010	.529	326	.898

Figure 5:



correspond to the model with  $T_j = 1$  if  $FICO \geq 620$ , and zero otherwise. The delinquency rate is declining in the FICO score, which is to be expected given that the FICO score is thought to be a summary measure of borrower risk. For most of the panels in Figure 5, what is most obvious is that the slope of the delinquency rate curve differs above and below approximately FICO 620. This is most evident for the case of loans for home purchase, where the delinquency rate peaks at about 620 and is actually lower on either side of this peak. This can be interpreted in several ways. It is possible that for low FICO score borrowers with loans for purchase of a house, information asymmetries are substantial enough to render the credit scores ineffective at discriminating between default probabilities. The figure depicting the delinquency rate curve for loan refinancings lends support to this interpretation; the delinquency-FICO score relationship is smooth and nearly linear. Thus, it appears that there is substantial information production associated with a borrower's buying of a house and paying the mortgage. A related interpretation is that, in this region, other sources of risk such as borrower LTV and local economic conditions, play heightened roles in explaining mortgage delinquency.

Globally, the delinquency rate declines as FICO scores increase. However, Figure 5 also shows evidence of a discrete jump in the delinquency rate in the neighborhood of FICO 620. This result corroborates the results found in Keys, et. al., using different data. The magnitudes of this jump at 620 and at other critical values of the FICO score distribution are reported in Table 9. Turning directly to the panel with the privately securitized mortgages, delinquency rates are significantly higher by 4.5%-5% in the neighborhood of 600 and 620. To put these magnitudes in perspective, the 60-day past due rate in our sample is approximately 28% in the FICO 610-630 region. We observe smaller increases in the delinquency rate at the same cutpoints for loans retained in the lender's portfolio. However, in this specification, these increases are not statistically significant at the conventional levels. This particular result, however, is not robust. Different assumptions for the order of the polynomial  $f(FICO)$  influence the regression standard errors, with the result that in some specifications, we estimate statistically significant increases in the delinquency rate for retained mortgages at 600 and 620. Regardless of specification, the estimated change in the delinquency rate at 600 and 620 is larger in economic terms for securitized loans compared to

Table 9: **Threshold Tests for Discontinuity in the Delinquency Rate**

The tables report estimates of  $\beta$  from the regression specified in equation (2) in the text. The delinquency rate is the percent number of loans per FICO score bin that are 60-days or more past due or in foreclosure.

All Mortgages				
boundary	$\beta$	p-value	observations	$R^2$ adj.
FICO $\geq$ 600	.045	0.0	326	.987
FICO $\geq$ 620	.050	0.0	326	.988
FICO $\geq$ 650	.011	.252	326	.987
FICO $\geq$ 680	-.008	.425	326	.987
FICO $\geq$ 700	-.014	.146	326	.986

Privately Securitized Loans				
boundary	$\beta$	p-value	observations	$R^2$ adj.
FICO $\geq$ 600	.047	.000	326	.983
FICO $\geq$ 620	.058	.000	326	.983
FICO $\geq$ 650	.015	.233	326	.982
FICO $\geq$ 680	-.011	.353	326	.982
FICO $\geq$ 700	.017	.171	326	.981

Retained Loans				
boundary	$\beta$	p-value	observations	$R^2$ adj.
FICO $\geq$ 600	.029	.143	326	.942
FICO $\geq$ 620	.019	.293	326	.942
FICO $\geq$ 650	-.003	.846	326	.941
FICO $\geq$ 680	-.007	.646	326	.940
FICO $\geq$ 700	-.013	.469	326	.938

retained loans.

We advise caution in interpreting these results. We cannot disentangle two competing explanations from these data. Namely, it is not clear whether the discontinuity in the delinquency rate is due to some action that borrowers took to increase their score in advance of their loan application. If this were the case, then we would consider the delinquency rate to be higher than expected just to the right of the FICO score cut-off point. It is also possible to view the delinquency rate to be lower than expected just to the left of the FICO score cut-off point, as would be the case if lenders took some action to enhance the screening for these borrowers.

## 8 Conclusion

We use a large loan-level data set to explore the factors that help explain which loans get securitized through a nonagency securitization and which loans get retained in a lender's portfolio. While we find some support for several conventional hypotheses of securitization motives, the main overall conclusion in this section is that, during the sample period under consideration, lenders appear to have securitized loans that were in many ways observably riskier than the loans they retained in their portfolios. Thus, the results appear to be consistent with a story that lenders securitize loans in part to diversify away risks they hesitate to hold on their balance sheets.

Given the disastrous loan performance of California mortgages towards the end of the 2000s, one obvious question is whether the growth of private-label securitization somehow eroded underwriting standards, perhaps by exacerbating the many potential agency problems endemic to mortgage lending. It is certainly possible that the high nonagency mortgage default rates of 2007-2008 reflect poor or incomplete underwriting and the possible mispricing of risk. Our empirical results lend some support to this conclusion with the finding that the conditional default rate on privately-securitized loans is higher than for retained loans. However, the main results in this paper suggest that the most important indicators of mortgage default remain the set of classic risk factors such as LTV at origination, adverse changes in house prices, and the collection of attributes that result in borrowers being given the subprime classification. There does appear to have been a shift over time in private-label loan performance: loans originated in California and then sold to investors

defaulted at increasing rates in the years leading up to the housing market peak. However, these effects are not easily separated out from vintage effects present in all mortgages.

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