

# Interest Rate Risk, Prepayment Risk and Banks' Securitization of Mortgages

Zhanbing Xiao



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# Motivation

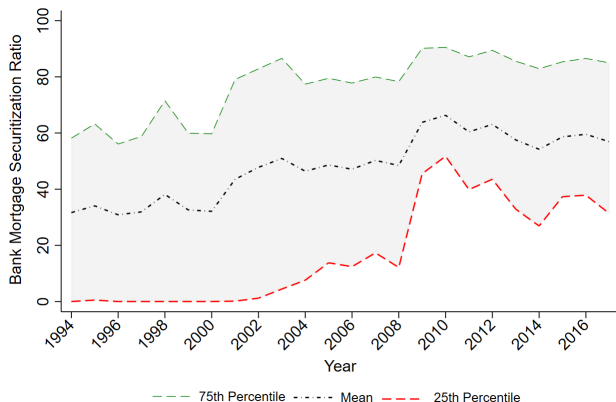


Figure: Securitization in the U.S. Mortgage Market

## Research Question

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What causes the large dispersion in cross-bank mortgage securitization in a given year?

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- Interest rate risk and prepayment risk in mortgages.

## Overview of Key Results

- In the conforming mortgage market, banks with longer-maturity liabilities securitize fewer mortgages.
- In the jumbo mortgage market, banks with shorter-maturity liabilities have a much lower approval rate.
- Banks deal with the prepayment risk induced by household refinancing in two ways:
  - *Ex ante*, more securitization;
  - *Ex post*, less likely to help households refinance their existing mortgages.

## Interest Rate Risk in Mortgages

- Interest rate risk in mortgages - a change in market interest rates leads to an opposite change in the value of a mortgage.

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- 30-year fixed-rate mortgages (FRMs) dominate the U.S. mortgage market.
  - FRMs make up 91% of U.S. first-lien mortgages originated between 2009—2013, and 83% of the stock of loans as of December 2013 (Fuster and Vickery 2015).
- U.S. interest rates vary widely over time.

# Markets for Mortgage Securitization

## Agency v.s Non-agency Market (PLS)

- Agency Market: GSEs (Fannie Mae and Freddie Mac);
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### Conforming v.s Jumbo Mortgages

- The conforming loan limit (CLL), e.g., \$ 510,400 in 2020.
- Conforming Mortgages - can be securitized through the agency market;
- Jumbo Mortgages - can **not** be securitized through the agency market;

## Hypotheses - Interest Rate Risk, Conforming Mortgages

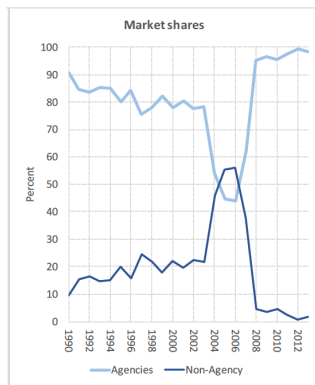
- Conforming mortgages can be securitized easily.
- Retaining or securitizing a mortgage crucially depends on a bank's ability to take interest rate risk in the mortgage.
- This ability is determined by the maturity of a bank's liability.

## Hypotheses - Interest Rate Risk, Conforming Mortgages

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- Retaining or securitizing a mortgage crucially depends on a bank's ability to take interest rate risk in the mortgage.
- This ability is determined by the maturity of a bank's liability.
- Hypothesis 1: Banks with longer-maturity liabilities are more capable of taking the interest rate risk in mortgages and thus securitize fewer mortgages.
- Maturity Matching.

## Hypotheses - Interest Rate Risk, Jumbo Mortgages

- Jumbo mortgages can **not** be securitized through the agency market.
- The agency market is much larger than the non-agency market.
- Jumbo mortgages are much more difficult to be securitized.



Source: Justiniano et al. 2017 Figure 1.2

## Hypotheses - Interest Rate Risk, Jumbo Mortgages

- Jumbo mortgages are difficult to be securitized.
- Banks with short-maturity liabilities do not want to hold mortgages on balance sheets.
- Hypothesis 2: Banks with shorter-maturity liabilities originate fewer jumbo mortgages.

## Data and Sample

- Bank Call Reports
- Summary of Deposits
- HMDA
- Fed Funds rates (FFR) from the website of the Federal Reserve Bank of St Louis, data on monetary shocks from Nakamura and Steinsson 2018, and distance data from NBER county-to-county database.

Over 7,000 banks in about 3,000 counties from 1994 to 2017.

## Measuring the Maturity of a Bank's Liability

- **Interest Expense Beta** - the sensitivity of a bank's interest expenses to changes in Fed funds rate (Drechsler, Savov, and Schnabl 2020).
- The smaller the beta is, the longer maturity a bank's liability has.
  - Managing a large network of deposit franchise gives banks deposit market power, which allows them to pay deposit rates that are low and insensitive to market interest rates.
  - Maintaining this power requires banks to pay large and interest-insensitive operating costs.
  - Total costs of deposits of low-beta banks are similar to fixed-rate and long-term debt.
  - Banks match the interest-rate sensitivities of their expenses and income one-for-one.

## Estimating Interest Expense Beta

$$\Delta \text{Int Exp}_{i,t} = \alpha_{i,t} + \sum_{\tau=0}^3 \beta_{i,t,\tau}^{\text{Exp}} \Delta \text{Fed Funds Rate}_{t-\tau} + \varepsilon_{i,t} \quad (1)$$

- $i$  represents bank and  $t$  represents quarter.

$\Delta \text{Int Exp}_{i,t}$  is the change in bank  $i$ 's interest expenses to total assets from  $t$  to  $t+1$ .

$\Delta \text{Fed Funds Rate}_t$  is the change in Fed funds rate from  $t$  to  $t+1$ .

- A rolling window of 40 quarters (10 years) and a minimum of 24-quarter (6-year) data is required.



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- A rolling window of 40 quarters (10 years) and a minimum of 24-quarter (6-year) data is required.
- $\beta_{i,t} = \sum_{\tau=0}^3 \beta_{i,t,\tau}^{\text{Exp}}$ .
- Aggregate it at the year level by calculating a simple average.

## Securitization - Conforming Mortgages

- **HMDA** - bank-county level.

$$\text{Securitization}_{i,j,t} = \frac{\text{Number of mortgages Sold}_{i,j,t}}{\text{Number of mortgages Originated}_{i,j,t}} \quad (2)$$

$i$ : bank,  $j$ : county,  $t$ : year.

## Conforming Mortgages

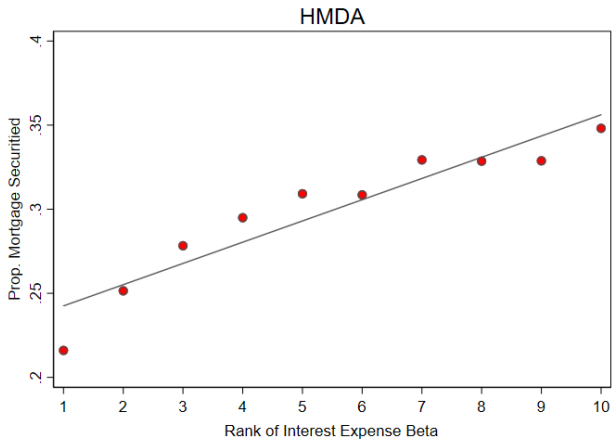


Figure: Cross-sectional Patterns

## Interest Expense Beta and Mortgage Securitization

	(1)	(2)	(3)	(4)	(5)	(6)
	Mortgage Securitization					
Interest Expense Beta	0.061*** (0.010)	0.316*** (0.009)	0.312*** (0.006)	0.335*** (0.006)	0.325*** (0.006)	0.267*** (0.010)
Observations	988,436	987,989	923,925	923,906	918,420	918,409
Bank Controls	No	Yes	Yes	Yes	Yes	Yes
Bank-County Controls	No	No	Yes	Yes	Yes	Yes
Mortgage Controls	No	No	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	No	No
Borrower Home County FE	No	No	No	Yes	No	No
Borrower Home County*Year FE	No	No	No	No	Yes	Yes
Bank Headquarter State*Year FE	No	No	No	No	No	Yes
Adjusted R-squared	0.001	0.114	0.256	0.312	0.312	0.430

- Banks with interest expense beta one standard deviation above the average securitize **10.18%** more mortgages than those with interest beta one standard deviation below the average.

## Identification

- The interest expense beta is endogenously determined.
- Exogenous monetary shocks - surprises in changes in interest rates that are beyond the market's expectation.
- Larger interest rate risk in mortgages in periods with larger monetary shocks.
- Banks with short-maturity liabilities securitize even more mortgages - a larger securitization gap.

## Monetary Shocks and Mortgage Securitization

	(1)	(2)	(3)	(4)
	Mortgage Securitization			
	Fed Funds Rate Shock		Policy News Shock	
Interest Expense Beta	0.295*** (0.008)	0.230*** (0.011)	0.202*** (0.009)	0.221*** (0.012)
Interest Expense Beta*Monetary Shock	0.057*** (0.009)	0.113*** (0.011)	0.205*** (0.008)	0.112*** (0.011)
Monetary Shock	-0.053*** (0.004)		-0.111*** (0.004)	
Observations	794,747	790,390	794,747	790,390
Bank Controls	Yes	Yes	Yes	Yes
Bank-County Controls	Yes	Yes	Yes	Yes
Mortgage Controls	Yes	Yes	Yes	Yes
Borrower Home County*Year FE	No	Yes	No	Yes
Bank Headquarter State*Year FE	No	Yes	No	Yes
Adjusted R-squared	0.273	0.436	0.274	0.436

## Non-mortgage Long-term Assets

	(1)	(2)	(3)	(4)
	Mortgage Securitization			
Interest Expense Beta	0.261*** (0.007)	0.287*** (0.006)	0.278*** (0.006)	0.190*** (0.010)
Interest Expense Beta * High Security Holding	0.241*** (0.010)	0.244*** (0.009)	0.247*** (0.009)	0.338*** (0.010)
High Security Holding	-0.105*** (0.005)	-0.099*** (0.004)	-0.101*** (0.004)	-0.113*** (0.005)
Observations	982,150	982,118	976,751	976,749
Bank Controls	Yes	Yes	Yes	Yes
Bank-County Controls	Yes	Yes	Yes	Yes
Mortgage Controls	Yes	Yes	Yes	Yes
Mortgage Controls	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	No
Borrower Home County FE	No	Yes	No	No
Borrower Home County*Year FE	No	No	Yes	Yes
Bank Headquarter State*Year FE	No	No	No	Yes
Adjusted R-squared	0.267	0.321	0.321	0.431

# Jumbo Mortgages

- Hypothesis 2: Banks with shorter-maturity liabilities originate fewer jumbo mortgages.
- Jumbo mortgages can not be securitized through the agency market - the dominant market for mortgage securitization.



# Jumbo Mortgage Approval Rate

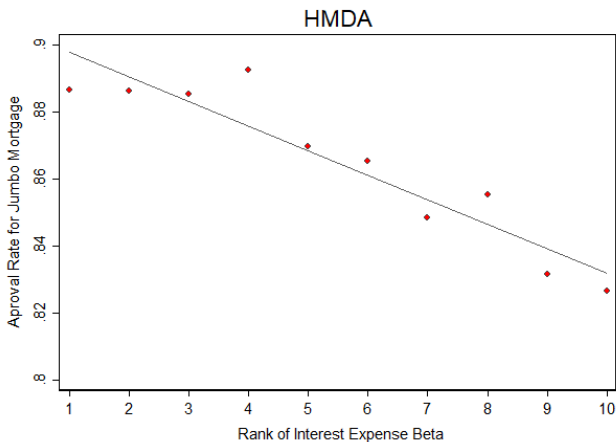


Figure: Jumbo Mortgage Approval Rate

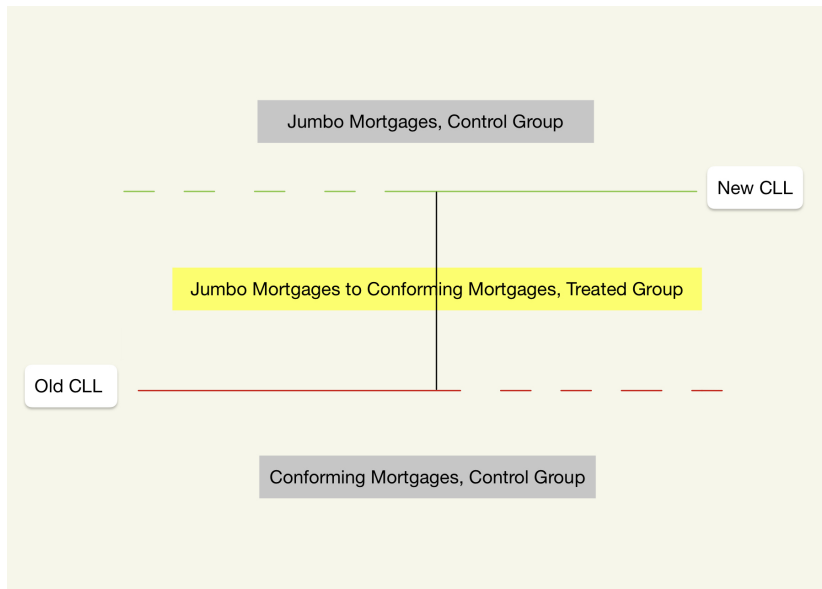
## Increases in Conforming Loan Limit (CLL)

- The CLL increases every year - \$ 203,150 in 1994 & \$ 424,100 in 2017.
- Up to 2007, CLL was uniform across counties except some high-cost areas ( 50% higher in Alaska, Hawaii, Guam, and the U.S. Virgin Islands).

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- Up to 2007, CLL was uniform across counties except some high-cost areas ( 50% higher in Alaska, Hawaii, Guam, and the U.S. Virgin Islands).
- Determined by changes in the national average of single-family housing prices.
- Exogenous shocks to a local mortgage market.
- Starting from 2008, local housing prices are incorporated in determining CLL.

# A Difference-in-Differences Test



## A Difference-in-Differences Test

	(1)	(2)	(3)	(4)	(5)	(6)
	Change in Mortgage Approval Rate					
	Full Sample			HSEC	LSEC	
Treat	-0.025*** (0.004)	-0.023*** (0.004)	-0.023*** (0.004)	-0.009** (0.004)	-0.000 (0.004)	-0.011 (0.007)
High Interest Expense Beta * Treat	0.033*** (0.004)	0.032*** (0.004)	0.027*** (0.004)	0.016*** (0.004)	0.008 (0.005)	0.019*** (0.007)
High Interest Expense Beta	-0.027*** (0.001)	-0.029*** (0.001)	-0.028*** (0.001)	-0.029*** (0.001)	-0.009*** (0.002)	-0.073*** (0.003)
Observations	386,398	386,365	383,128	383,122	101,961	274,252
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank-County Controls	Yes	Yes	Yes	Yes	Yes	Yes
Mortgage Controls	Yes	Yes	Yes	Yes	Yes	Yes
Borrower Home County FE	No	Yes	No	No	No	No
Year FE	No	Yes	No	No	No	No
Borrower Home County*Year FE	No	No	Yes	Yes	Yes	Yes
Bank Headquarter State*Year FE	No	No	No	Yes	Yes	Yes
Adjusted R-squared	0.012	0.021	0.032	0.160	0.287	0.190

- Banks with short-maturity liabilities increase their approval rate by about 70 bps.

## Mortgage Refinancing and Prepayment Risk

- Household mortgage refinancing generates prepayment risk.
- Prepayment risk - the outstanding amount of a mortgage is prematurely paid back.

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  - Losses in interest income;
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- Prepayment risk - the outstanding amount of a mortgage is prematurely paid back.
- Two main impacts on banks:
  - Losses in interest income;
  - Disruption in maturity matching;
- No prepayment penalties in the U.S. mortgage market.



## Mortgage Refinancing and Prepayment Risk

- Matters more for banks with longer-maturity liabilities - more mortgages on balance sheets.

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- Matters more for banks with longer-maturity liabilities - more mortgages on balance sheets.
- Two ways to avoid the prepayment risk:
  - *Ex ante*, more securitization;
  - *Ex post*, rejecting household refinancing requests.

## Hypotheses - Prepayment Risk

- Hypothesis 3: *Ex ante*, anticipating the prepayment risk, banks with longer-maturity liabilities securitize more mortgages, resulting in a smaller securitization gap between banks with long- and short-maturity liabilities.
- Hypothesis 4: *Ex post*, banks with longer-maturity liabilities are less likely to help households refinance their existing mortgages, i.e., fewer supplies of refinancing mortgages.

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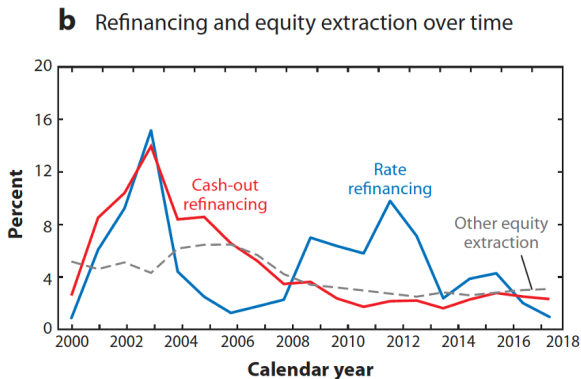
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- Hypothesis 4: *Ex post*, banks with longer-maturity liabilities are less likely to help households refinance their existing mortgages, i.e., fewer supplies of refinancing mortgages.
- Measuring prepayment risk - the average growth rate of refinancing mortgages in a county over the past five years (e.g., Maturana and Nickerson [2019](#), McCartney and Shah [2019](#), Miller and Soo [2020](#)).

## Prepayment Risk and Mortgage Securitization

	(1)	(2)	(3)	(4)
	Mortgage Securitization			
	Full		HIR	LIR
Interest Expense Beta	0.372*** (0.013)	0.261*** (0.014)	0.389*** (0.017)	0.165*** (0.018)
Interest Expense Beta*Prepayment Risk	-0.089*** (0.013)	-0.020** (0.010)	-0.061*** (0.013)	0.018 (0.014)
Prepayment Risk	0.038*** (0.006)			
Bank Controls	Yes	Yes	Yes	Yes
Bank-County Controls	Yes	Yes	Yes	Yes
Mortgage Controls	Yes	Yes	Yes	Yes
Borrower Home County*Year FE	No	Yes	Yes	Yes
Bank Headquarter State*Year FE	No	Yes	Yes	Yes

## Mortgage Refinancing Over Time

- Cash-out refinancing - consume accumulated home equities;
- Rate refinancing - reduce monthly interest payments;



Source: Amromin, Bhutta, and Keys 2020 Figure 4b

## Supplies of Refinancing Mortgages

	(1)	(2)	(3)	(4)	(5)	(6)
	Supply of Refinancing Mortgages					
	Full Sample			HIR	LIR	
Interest Expense Beta	0.870*** (0.023)	0.328*** (0.032)	0.462*** (0.028)	0.157*** (0.030)	0.336*** (0.035)	0.283*** (0.042)
Interest Expense Beta*HMKT			0.256*** (0.023)	1.103*** (0.017)		
HMKT			0.658*** (0.040)	0.091*** (0.030)		
Observations	594,472	586,021	594,472	586,021	258,498	327,523
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank-County Controls	Yes	Yes	Yes	Yes	Yes	Yes
Mortgage Controls	Yes	Yes	Yes	Yes	Yes	Yes
Borrower Home County*Year FE	No	Yes	Yes	Yes	Yes	Yes
Bank Headquarter State*Year FE	No	Yes	Yes	Yes	Yes	Yes

- On average, one standard deviation increase in interest expense beta is associated with a 4.1% increase in banks' supplies of refinancing mortgages.

## Conclusions

- Risks in FRMs: default risk, **interest rate risk and prepayment risk**.
- Banks with short-maturity liabilities securitize more conforming mortgages and originate fewer jumbo mortgages.
- Banks with long-maturity liabilities avoid the prepayment risk in two ways: 1) *ex ante* more securitization; 2) *ex post* fewer supplies of refinancing mortgages.