Mortgage Securitization and Information Frictions in General Equilibrium

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Views presented are of the author and do not necessarily represent those of the Bank of Spain and the Eurosystem.

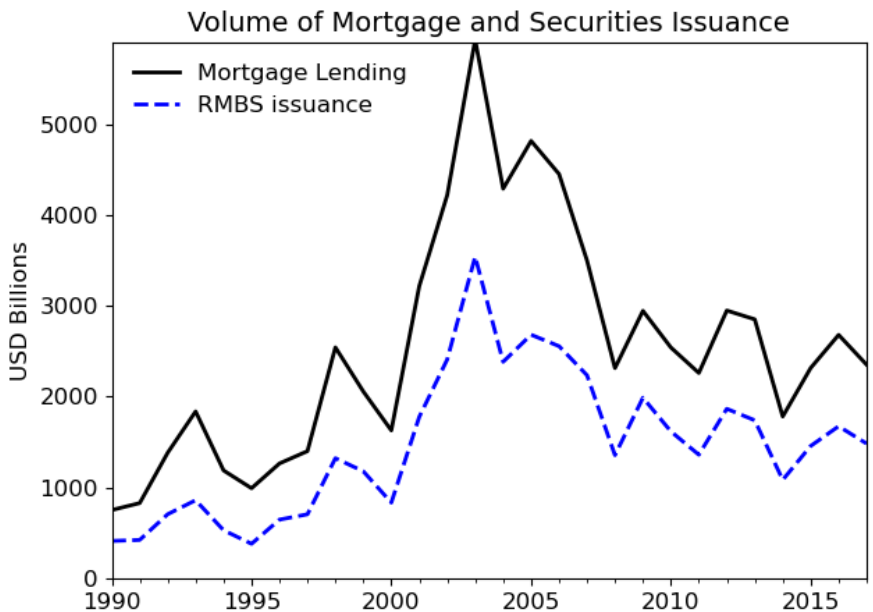
May 25, 2023

Motivation

The Mortgage Market in the United States

1. Dynamics of **mortgage lending** closely tied to **securitization**.

   US credit cycle of 2000's partly fueled by securitization.



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   Large fraction of mortgage originators are liquidity constrained.

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2. **Securitization**: large **source of liquidity** to mortgage originators.

   Large fraction of mortgage originators are liquidity constrained.

3. Evidence of **information frictions** along mortgage origination and securitization.

   Adelino et al (JFE 2019), Piskorski et al (JF 2015), Keys et al(QJE 2010), Downing et al (RFS 2008).

   Private securitization market **collapsed** in 2008.

Motivation

Yet, there is little understanding about...

i. **Equilibrium connection** between the securitization and the mortgage credit markets.

ii. **Role of information frictions** in accounting for aggregate credit dynamics.

    Do info frictions **amplify** mortgage credit responses to households' shocks? What's the mechanism? By how much?

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This paper

Develops a new theory for (i).

Tests the theory during the Great Financial Crisis bust-episode.

Quantifies role of information frictions, and answers (ii).

Evaluates government policies.

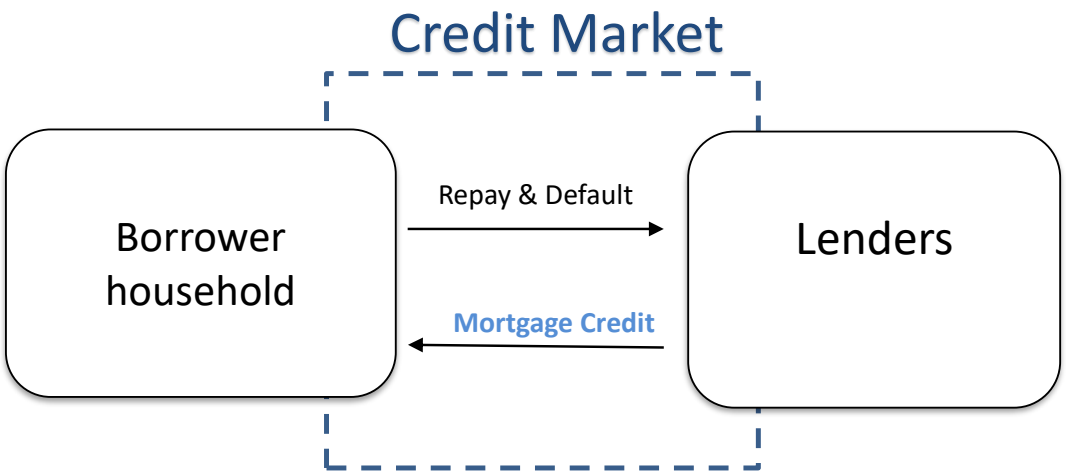
What I do - The Theory

Macro model of Credit Intermediation with Housing.

Standard setup:

Impatient borrowers face income risk + housing risk .

Lenders originate long-term loans to borrowers.



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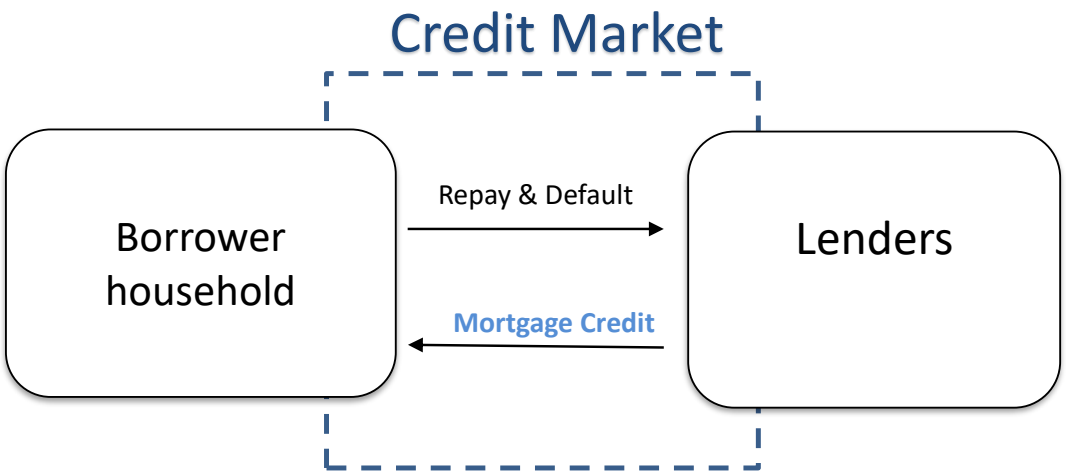

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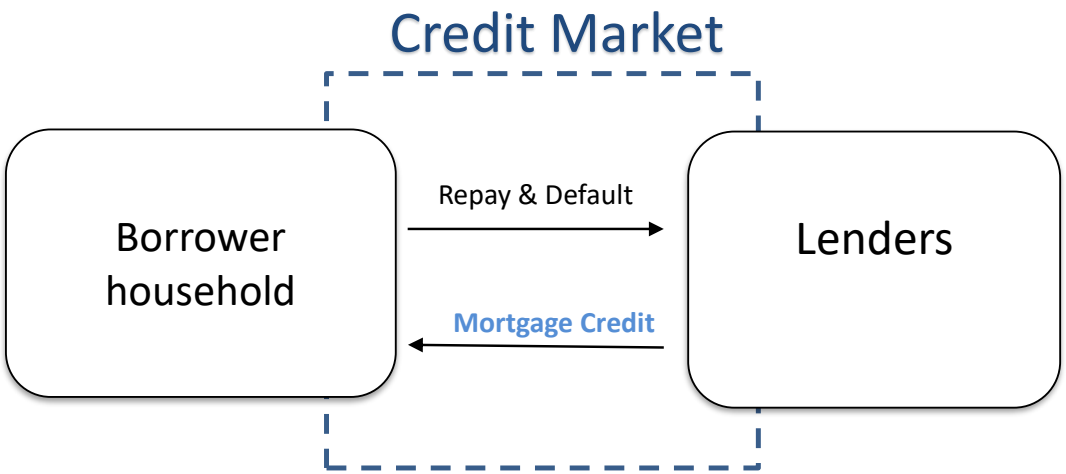

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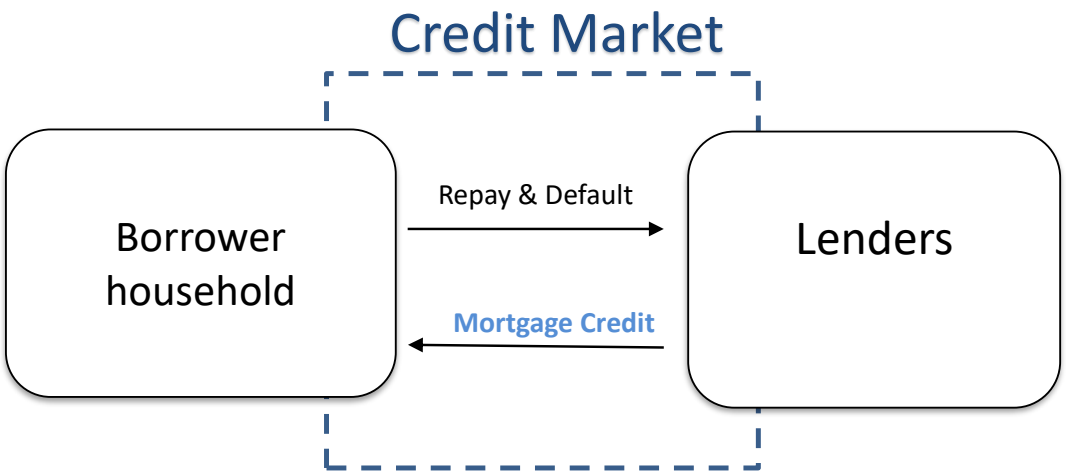

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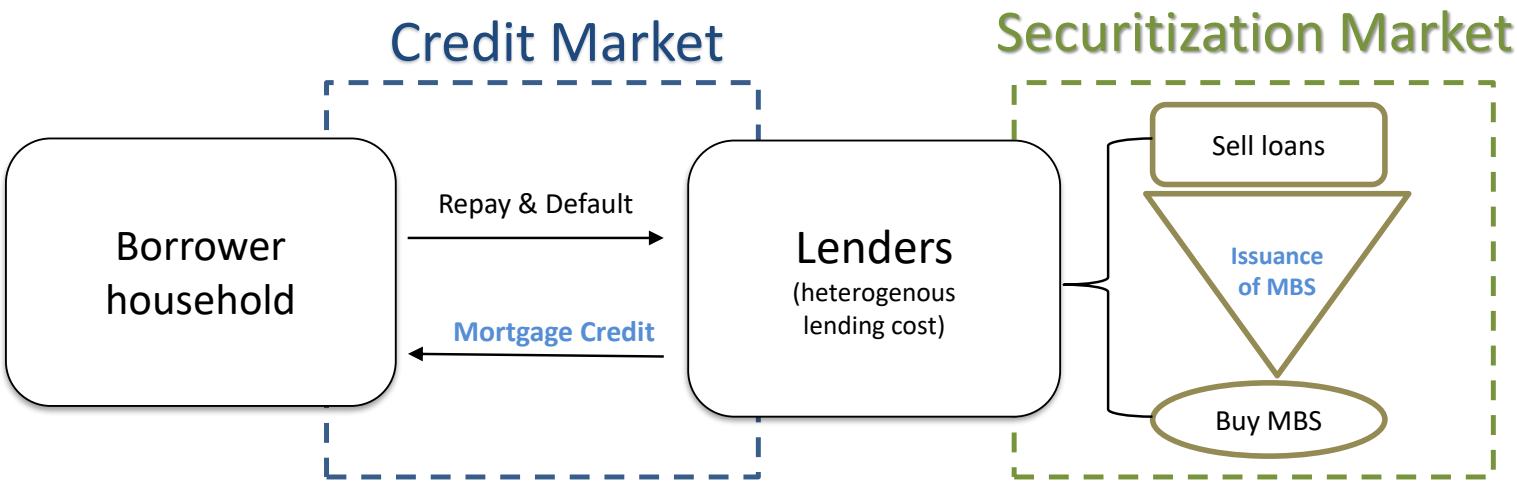

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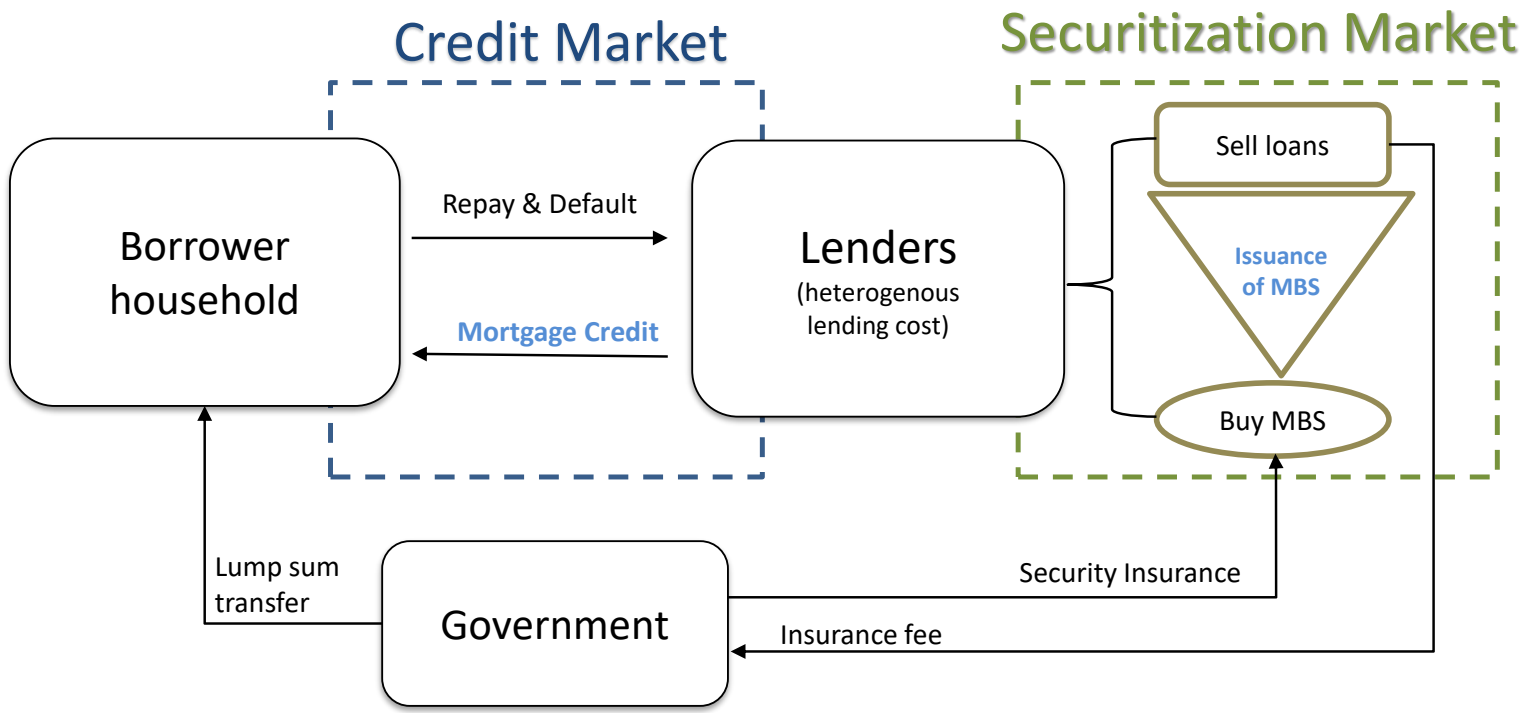

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   Data informs Theory about amplification.

   A role for policy: full credit guarantee policy provides stabilization.

Results - Quantitative

Data: during the Great Financial Crisis (2008-2013) figure-motivation

Mortgage credit contracted by 40%.

MBS issuance contracted by 30%.

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   Model replicates 2/3 of the contraction in mortgage credit and MBS issuance.

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3. **Quantification**

   Information frictions amplify credit contraction by 1.7.

   Post-GFC: more stable securitization but still mispriced credit guarantees.

Related Literature

Macro models of Financial Intermediation with Housing

Elenev, Landvoigt, Van Nieuwerburgh (2016), Favilukis, Ludvigson, Van Nieuwerburgh(2017), Justiniano, Primiceri, Tambalotti (2019), Kaplan, Mitman, Violante (2020).

Contribution: Introduce securitization and quantify the role of information frictions.

Information Frictions in Asset Markets

Eisfeldt (2004), Kurlat (2013), Guerrieri, Shimer (2013), Chari, Shourideh, Zetlin-Jones (2014), Bigio (2015), Caramp (WP, 2017), Asriyan, Vanasco (WP, 2019), Asriyan (2021).

Contribution: extend theory of adverse selection to connect credit and sectzn markets.

Policy in the Securitization Market

Jeske, Krueger, Mitman (2013), Gette, Zechetto (2015), Elenev, Landvoigt, Van Nieuwerburgh (2016), Finkelstein, Strzodka, Vickery (2018), Fuster, Lucca, Vickery (2021).

Contribution: study GSEs policy in macro model with adverse selection.

Outline

Model: lenders

Continuum of lenders with log-preferences over dividends, c_t^j

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Owns a portfolio of long-term loans, b_t^j

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- Priced competitively at q_t.

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Faces **idiosyncratic risk:**

- heterogeneity: lender draws lending cost z_t^j i.i.d $F(z)$,
- gross cost of lending $n_t^j z_t^j$.

Faces **aggregate risk**:

- endogenous borrower's default $_t$ a ects all lenders equally,
- every lender holds a diversi ed portfolio of hhs debt.

Model: lenders (cont)

Lenders face two key frictions...

Information frictions:

- lender can predict and privately identi es low-quality loans $_t b_t^j$.
- defaulting loans have per-unit recovery value < 1.

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Liquidity frictions: limited access to debt markets.

- cash ows: loan payments $(1 \quad _t)mb_t^j + \quad _t b_t^j$
- iliquid wealth: non-maturing loans $(1 \quad _t)(1 \quad)b_t^j$.

Model: securitization market

Asset trading a la Kurlat(2013)
Key assumptions: trade is non-exclusive and anonymous.

TBA (to-be-announced) forward market: Largest MBS market in the U.S.

Model: lenders **sell outstanding loans** $fs^j_{Gt}; s^j_{Bt}g$ and/or **buy securities** $fd^j_t g$.

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(mostly) credit-guaranteed by Government Sponsored Enterprises.

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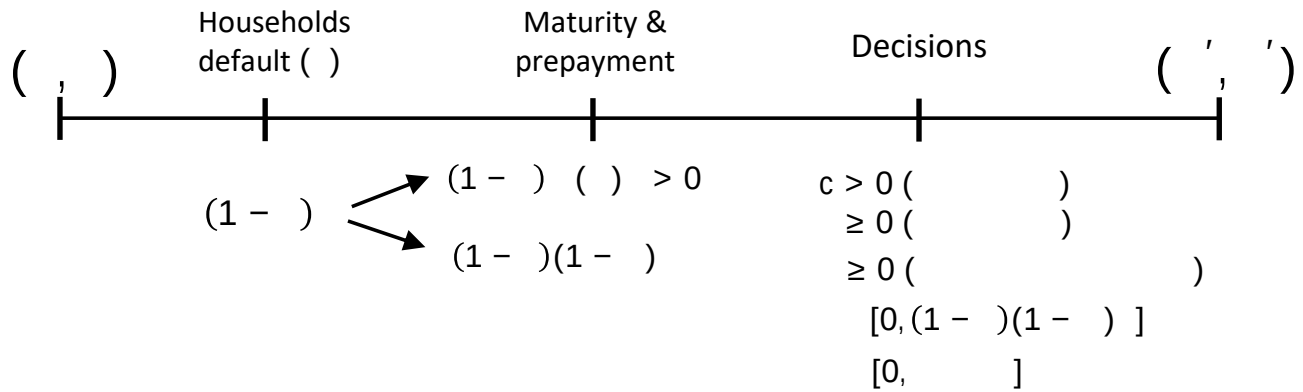
gov. policy: subsidize security purchases ($_t$) and charge guarantee fee ($_t$).

Lender's timeline



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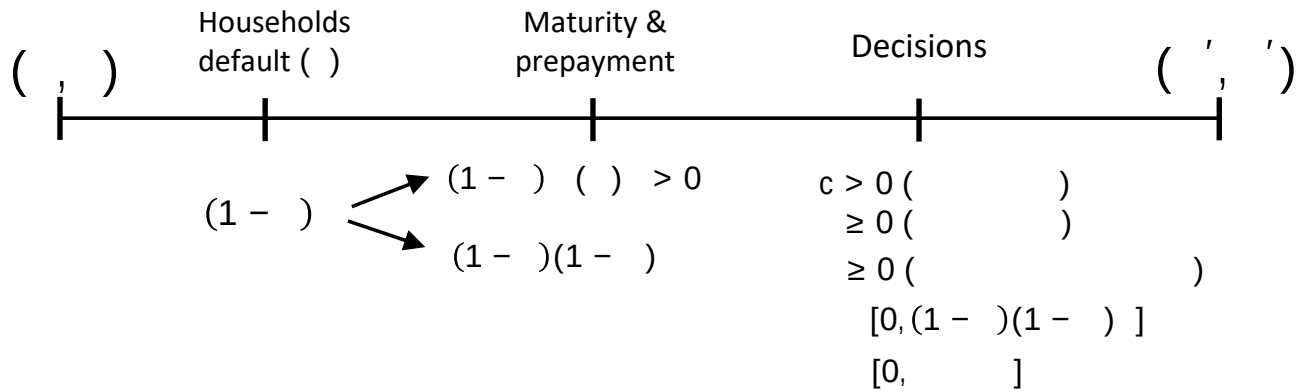

Lender's budget constraint:

$$\underbrace{(1 \quad)mb^j + p(s_G^j + s_B^j) + (\ b^j \quad s_B)}_{\text{in ows}} \qquad c^j + n^j(z^j q + \quad) + pd^j(1 \quad)$$

Cash in ows: borrower's payments + loan sales + recovery from NPLs.

Portfolio law of motion:

$$b^{j0} \quad = \quad (1 \quad)(1 \quad)b^j \quad s_G^j + n^j + (1 \quad)d^j$$

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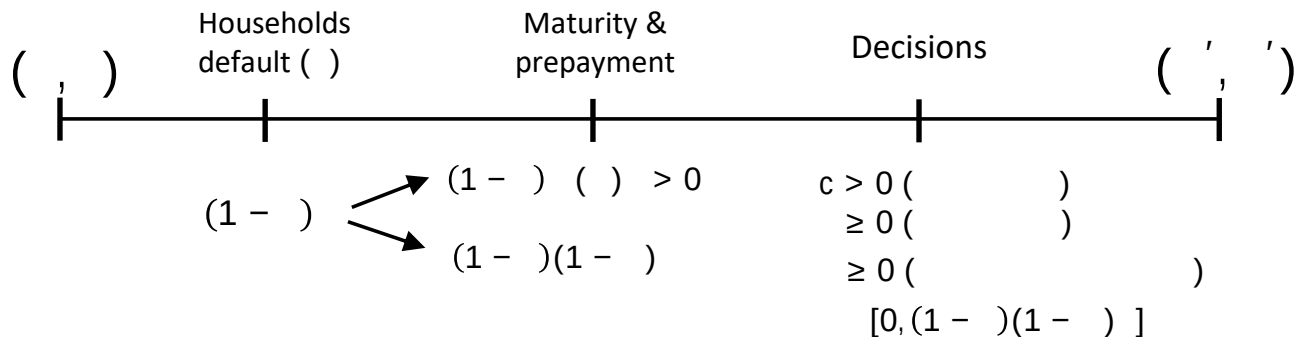

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cash out ows: dividend payments + new lending + security purchases.

Portfolio law of motion:

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Lender's Recursive Problem

$$V^L(z^j; b^j; X) = \max_{\{c; b'; n; d; s_B; s_G\}} \log c^j + {}^L\mathrm{E}_{z'; X' | jX} V^L(z^{j'}; b^{j'}; X')$$

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Portfolio constraints:

$$s_G^j \quad 2 \quad [0;\ (1 \quad)(1 \quad) b^j]$$
$$s_B^j \quad 2 \quad [0;\ \ b^j]$$
$$d^j \quad 0;\quad n^j \quad 0:$$

Theoretical Results

The Role of the Securitization Market

Complete Information: low-quality loans identi ed by everyone.

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Securitization allows for:

i. E cient asset reallocation: lenders become sellers and buyers.

ii. Source of liquidity: higher liquidity to most-e cient (lowest cost) lenders.

Proposition 1. Lower mortgage rate whenever securitization mkt is active:

$$r(q)^{\text{SM}} \quad r(q)^{\text{without SM}}$$

Securitization Market + Private Information

Private Information : low-quality loans identi ed only by owner

i. Private info + anonymity + pooling market ! adverse selection.

p > : All lenders sell low-quality loans s_B,

... only low-z cost lenders sell high-quality loanss_G.

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iii. Equilibrium: prices $f p_t ; q_t ; \ _t g$ + gov. policy $f \ ; \ g$! thresholds $f z^S ; z^B g$.

Trading decisions

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private information disrupts e cient asset allocation ! higher intermediation costs.

Securitization Market + Private Information

Private Information : low-quality loans identi ed only by owner

iv. Severity of private info. maps into information frictions wedge

$$z^B \quad z^S = \frac{p}{q} \quad \frac{1}{1} \quad 1 \quad ;$$

wedge: " increasing in and # decreasing in .

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Private (non-agency) securitization faces credit risk (<) and prepayment risk.

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Dynamics - Main mechanism

i. Main channel: Borrowers credit risk a ect equilibrium in securitization through default ( ) and recovery from foreclosure ( ).

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ii. Securitization market shutdown is possible

all lenders operate with their technology $n^j z^j$.

same as model without securitization.

Taking Stock

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- gov. policy plays a role in reducing severity of info frictions.

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Next: Quantitative e ects depend ondata moments.

Outline

Calibration

i. Estimation of lender's technology $F(z)$.
ii. Borrowers' description
iii. Calibration and estimation of exogenous processes

Calibration. Lenders

Period: 1990-2018.F(z) as Beta(; ; lc)

Param	Value	Target: X-section lending dist(HMDA)	Data	Model
	16.75	market share Q4, top 25% originators	95.7	95.9
	2.25	market share Q3	2.9	2.6
lc	0.67	mortg. spread 30y-FRM wrt 10y-Tb, %	1.66	1.61

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Model: small mass of (low cost) lenders originate most loans.

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" Gains from securitization:lowers intermediation costs .

Large originators depend on sec liquidity:higher fragility .

Loutskina and Strahan (2011), Calem et al (2013).

Calibration (cont.)

Benchmark calibration: 1990-2018

Standard borrower problem with housing and long-term debt.

Endogenous: (i) demand of credit, (ii) default rate (!), (iii) housing recovery rate (!).

Calibration (cont.)

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Exogenous Processesf Y ; ! ; g

Variable		mean (std)	Estimated Markov processes
Y	Income endowment	1.0 (0.0102)	Cyclical component of GDP.
Low !	Low housing volat. (pp)	2.5 (0.76)	Cross-sectional volatility of HP growth rate U.S. state,...
High !	High housing volat. (pp)	5.0 (1.23)	... high volatility regime (78-92, 04-10), FHFA 1975-2020
	Prepayment (pp)	12.0 (2.9)	Prepayment rate for conv. 30y FRM, SIFMA.

Calibration (cont.)

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Government policy

Param		Value	Target
	Guarantee fee	20 bps	Avg. GSEs guarantee fee, 90-06.
G	Securities subsidy = G .	0.56	Avg. fraction of securitized (70%). HMDA 90-18.

Borrowers Description Borrowers Calibration

Targeted Moments

Benchmark calibration: 1990-2018

Variable	Model	Data	Description
Borrowers			
Consumption to income	0.80	0.80	Consumption expenditure to disposable income, NIPA 90-010.
Mortg. lending to housing stock	0.14	0.15	Mortgage lending to residential real estate. FoF 90-18.
Mortgage spread (pp)	1.61	1.66	Spread w.r.t 10y Tbill, 90-18.
Default rate - uncond. (pp)	2.17	2.01	Mortgage deliquency rate (90 days + foreclosure). NMDB, 91-18.
Default rate - crisis (pp)	3.95	4.05	Mortg. deliquency rate (90 days + foreclosure). NMDB, 07-12.
Lenders			
Fraction of loans securitized	0.72	0.70	Mortgages securitized withint a year of origination, HMDA 90-18.
Severity rate - uncond. (pp)	26.8	32.2	Mean severity, mortgages with LTV 60-80. GSEs 99-17.
Severity rate - crisis (pp)	44.6	43.9	Mean severity, mortgages with LTV 60-80. GSEs originated 05-08.
Market share Q4	0.973	0.961	Cross-sectional distribution of mortgage lending (Q4). HMDA, 90-18
Market shares Q3	0.026	0.029	Cross-section mortgage lenders HMDA , 90-18.

Non-Targeted Moments

Benchmark calibration: 1990-2018

Variable	Model	Data	Description
Default rate - normal times (pp)	1.38	1.43	Mortg. deliquency (90 days + foreclosure). NMDB, excluding 07-12.
Mortg. e ective duration	7.25	7.50	E ective duration of 30y xed-rate mortgages. [Walentin, 2014]
Market shares Q1	0.000	0.002	Cross-section mortgage lenders HMDA , 90-06.
Market shares Q2	0.001	0.008	Cross-section mortgage lenders HMDA , 90-06.
Corr(security issn, lending issn)	0.94	0.98	TS correlation for RMBS issuance and mortgage lending (HDMA).
Corr(hhs default, lending growth)	-0.32	-0.35	TS correlation households delinquency and mortgage lending growth.
Corr(hhs default, mortg spread)	0.90	0.53	TS correlation households delinquency and mortgage spread.

Testing the theory

Exercise 1. Testing the theory

Simulate the model w inputs:

Income shock,Y : cyclical component of GDP.

Housing valuation shock, $_{!}$: matches model's default rates to the data.

Exercise 1. Testing the theory

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From 2008 to 2013 the model replicates:

2/3 of the contraction in mortgage lending. (left)

complete contraction in MBS issuance. (right)

! cross-sectional data informs equilibrium prices and allocations.

dynamics of household's aggregates. default rates & consumption

Exercise 2. Ampli cation of Credit Cycles

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Table 1: Average contraction (pp), 2008-13

Aggregates	Private Info	Complete Info	Data
Volume of Mortgages	-28.9	-16.9	-40.6
Volume of Securities	-33.8	-15.3	-29.8

Private information ! ampli cation factor: 1:7 for mortgage credit.

Micro: Calem et al (JMCB, 2013) GFC liquidity shock ampli ed credit contraction on less capitlized banks by 2 to 6 times.

E3. Quantifying forces: shock decomposition

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Table 2: Decomposing the average contraction (pp), 2008-13

Aggregates	Info-frictions	Housing !	Income Y	Data
Volume of Mortgages	-11.8	-8.0	-15.1	-40.6
Volume of Securities	-18.2	-8.9	-11.8	-29.8

E4. Evaluating the post-GFC economy

Two key changes in the securitization market:

1. Structural: private segmented collapsed and agency segment mkt share increased.

   ! model: = 0 :95 .

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Two key changes in the securitization market:

1. Structural: private segmented collapsed and agency segment mkt share increased.
   - ! model: = 0 :95 .
2. Policy: GSEs (Freddie Mac and Fannie Mae) increased the g-fee from 20 to 60 bps.
   - ! model: + to 60 bps.

E4. Evaluating the post-GFC economy

Description	Benchmark	Post-GFC
Lender, Welfare	-	0.08
Borrower, Welfare	-	0.21
B. Consumption, C	-	-1.33
B. Mortgage debt, B	-	5.95
Credit Market		
Default rate - uncond.	2.17	2.30
Default rate - crisis	3.96	4.61
Mortgage spread, mean	1.61	1.58
Mortgage spread, std	1.13	1.07

Small welfare gains for borrowers and lenders.

Less volatile mortgage rates.

! Borrowers consume more housing and take on larger mortgages,

... but default more often.

E4. Evaluating the post-GFC economy

Description	Benchmark	Post-GFC
Securitization Market		
Fraction securitized	72.4	96.1
Price of security, std	7.47	6.44
Prob. of market collapse	8.83	0.81
Per-unit subsidy,	2.95	4.49
De cit/GDP	0.70	0.64

More stable and less volatile securitization market.

! Prob. of mkt collapse falls (higher allocative e ciency)

Credit guarantee still mispriced ! de cit > 0.

G-fee break-even price = 75 bps

Main Takeaways

1. Theory of boom-bust credit cycles connecting credit and securitization markets

   Endogenous securitization akin to TBA market for MBS.

   Ampli cation channel: info frictions & liquidity from securitization.

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2. Quantitative model applied to the Great Financial Crisis:

   Replicates 2/3 of mortgage credit contraction.

   Information frictions: 1.7 times ampli cation in credit contraction.

   Post-GFC: more stable securitization but still mispriced credit guarantees.

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1. Theory of boom-bust credit cycles connecting credit and securitization markets

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   Replicates 2/3 of mortgage credit contraction.

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   Post-GFC: more stable securitization but still mispriced credit guarantees.

3. Trade-o for policy

   Full credit guarantee restores allocative e ciency ! lower intermediation costs

   Downside: $^{+}$ Concentration of credit risk on a single party (GSEs).

Thank you !!

Motivation

Dynamics of mortgage lending are closely tied to the securitization market.

Securitization : large source of liquidity to mortgage originators.

70% of all mortgage loans are securitized within a year of origination.

Back-motivation Back-results

Motivation

Dynamics of mortgage lending are closely tied to the securitization market.

Large presence of government.

GSEs issued 69% of all RMBS before the Great Financial Crisis.

Back-motivation Back-results

Motivation

Dynamics of mortgage lending are closely tied to the securitization market.

Extensive empirical research information frictions along mortgage origination and securitization chain.

Adelino et al (2019), Keys et al (2010), Elul(2011), Downing et al (2008).

Back-motivation Back-results

Model. Formal results.

Environment

- Borrower Recursive Problem
- Lender Recursive Problem
- Aggregate states
- Recursive Competitive Equilibrium

Properties

- Characterization
- Mechanism

back-to-outline

Main mechanism: securitization market

Consider an increase in λ_j to λ_j^+ ($\lambda_j^+ > \lambda_j$), then:

Model allows for shutdown of securitization market:

- All lenders operate with their technology $n^j z^j$.
- Same as model without securitization.

back-to-mechanism

Securitization: model + data $F(z)$

Data: Highly skewed distribution of mortgage lending.

Model: small mass of (low cost) lenders originate most loans.

Calibration-lenders

Credit Market: model + data F(z)

Data: High concentration in mortgage lending.

Model: small mass of (low cost) lenders originate most loans.

Calibration-lenders

Credit Market: model + data F(z)

" Gains from securitization: lowers intermediation costs .

Large originators depend on sec liquidity: higher fragility .

Calibration-lenders

Lender's Recursive Problem

$$V^L(z^j; b^j; X) = \max_{\{c; b'; n; d; s_B; s_G\}} \log c^j + {}^L E_{z'; X' | X} V^L(z^{j\prime}; b^{j\prime}; X')$$

$$(1 \quad (!)) \; b^j + p(s_G^j + s_B^j) \quad c^j + n^j z^j (q + \;) + p d^j (1 \quad)$$

$$b^{j\prime} = (1 \quad (!))(1 \quad) b^j \quad s_G^j + n^j + (1 \quad) d^j$$

$$s_G^j \quad 2 \quad [0; \; (1 \quad)(1 \quad) b^j]$$

$$s_B^j \quad 2 \quad [0; \; (1 \quad) \; b^j]$$

$$d^j \quad 0; \quad n^j \quad 0:$$

back

Aggregate states

Aggregate states

$$X = f B; H; ; Y; \ ! ; \ g$$

Endogenous states

- B, aggregate stock of debt
- H, aggregate housing stock
- $(z; b)$, joint distribution across lenders

Exogenous states

- Y, borrowers income endowment
- $!$, volatility of housing valuation shock
- , borrowers prepayment rate.

back

Exercise 1. Testing the theory

Inputs:

Income shock,Y : cyclical component of GDP.

Housing valuation shock, $^{2}_{!}$: matches model's default rates to the data.

Model: borrowers

Standard borrower household problem

Impatient, preferences: consumption, and housing.

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Long-term mortgages.

subject to default, and prepayment $_t$,

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Family of borrowers, each^i faces housing valuation shock^i $G_!$.

as in Elenev et al (2016), Faria-eCastro(2022)

- endogenous aggregate default rate $_t(!)$,
- endogenous aggregate foreclosure recovery rate $_t(!)$,
- threshold ! function of: hhs leverage, price of credit, volatility of housing.

Borrowers Recursive Problem | Lenders Recursive Problem | Calibration summary

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- endogenous aggregate default rate $_t(!)$,
- endogenous aggregate foreclosure recovery rate $_t(!)$,
- threshold $!$ function of: hhs leverage, price of credit, volatility of housing.

Face aggregate shocks$_t$: income Y_t, housing $_{! t}$, prepayment $_t$g.

Calibration: borrowers

Benchmark calibration: 1990-2018

Param	Description	Value	Target
B	Borrowers discount factor	0.97	Consumption to disposable income. NIPA 90-18.
	Housing expenditure share	0.22	Mortgage credit to residential RE. FoF 90-18
	Loan to value ratio	0.80	Loan to value at origination. NMDB and FHFA.
	Housing adjustment costs	3.50	Moving transaction costs. Piazzesi & Schneidder(2016)
!	Mean housing valuation	0.97	Residential capital depreciation (BEA).
	Mortgages		
	Mortgage contract maturity	0.03	Standard for 30y FRM
	Mortgage contract coupon	0.05	Standard for 30y FRM
	Prepayment rate, mean	0.12	Mean prepayment, conv 30yr FRM. SIFMA.
	Prepayment rate, std	0:03	Std prepayment, conv 30yr FRM. SIFMA.
	Foreclosure recovery	f 0:55; 0:70g	Mortgage severities. Freddie Mac, Fannie Mae, U. Inst.

Calibration summary

Exercise 1. Testing the theory

back

Recursive Competitive Equilibrium

A RCE given gov policy $f\ ;\ ;\ T^B g$ consists of prices $f q; p g$; adverse selection discount $f\ ;\ \ g$; a law of motion $^0(X)$; and transition density $(\ X^0 j X)$; and policy functions $f C; N; B^0; H^0 g^B$ and $f c^j; n^j; d^j; s^j_G; s^j_B g^L_{j2\ J}$ s.t.:

1. Borrowers and lenders optimize.
2. $q(X)$ clears the primary mortgage market

$$N(q; X) = \int n(q; p; X) d\ :$$

3. Whenever $p(X) >$ the securitization market clears

$$D(p; q; X) \quad = \quad S(p; q; X);$$

4. Government balances budget every period

$$N(X) + T^B = \quad pD(X):$$

5. Resource constraint holds

$$C^B + C^L + H^0 \quad _! (1 \quad (!))H = Y + q \int (z \quad 1)n\ d\ :$$

! lenders problem

Characterization: lenders' trading decisions $\{s_B; s_G; d; n\}$

Lemma 2. Trading decisions.

For any $p >$ all lenders sell their low-quality loans

$$s_B = (\ ! \ )b$$

Lenders self-classify into three groups

Sellers: $z < z^S$ $\quad \{s_G > 0;\ d = 0;\ n > 0\}$

Buyers: $z > z^B$ $\quad \{s_G = 0;\ d > 0;\ n = 0\}$

Holders: $z \in [z^S;\ z^B]$ $\quad \{s_G = 0;\ d = 0;\ n > 0\}$

Equilibrium cut-offs: $z^S = \frac{p}{q}\ \ \overline{q};\quad z^B = \frac{p(1\quad)}{q(1\quad)}\ \ \overline{q}.$

back

Borrower's Recursive Problem

$$V^B(B;H;X) = \max_{\{C;N;H^0\}} u(C;H) + {}^B\mathrm{E}_{X^0|X} V(B^0;H^0;X^0)$$

$$\begin{aligned} C + p_h(H^0 + \Xi(H^0)) + m(1 \quad (\pi))B &= Y + qN + (1 \quad (\pi))\mathrm{E}\,\ell_{\ell > \pi} p_h H + T^B \\ B^0 &= (1 \quad)(1 \quad (\pi))B + N \\ B^0 & \quad p_h H^0 \end{aligned}$$

where $(\pi) = G_\ell(\pi_t; \quad)$ default rate at the optimal cutoff π_t.

$$\pi = \frac{B}{p_h H}(m + (1 \quad)q)$$

Assume $G_\ell(\ _1; \ _2)$ is a Gamma Distribution.

Borrower summary | Borrower Individual Problem

Borrower's problem

$$V^{B;j}(b;h;X) = \max_{\{c;n;h';\ (\ !\ j)\}} u(c;h) + {}^{B}\mathrm{E}_{X'jX} V^{B}(b';h';X')$$

Borrower's problem

$$V^{B;j}(b;h;X) = \max_{fc;n;h^0;\ (!^j)g} u(c;h) + {}^{B}\mathrm{E}_{X^0jX} V^{B}(b^0;h^0;X^0)$$

$$c + p_h \quad (h^0) \quad !^j p_h h \quad (!^j) \qquad y + qn \quad mb \quad (!^j) \quad T^B$$

$$b^0 = (1 \quad)b \quad (!^j) + n$$

$$b^0 \qquad p_h h^0$$

given $b_0; h_0$:

income: stochastic endowment y and new debt n.

housing adjustment costs: $(h^0) = h^0 + \frac{}{2}(h^0 \quad h)^2$.

back

Borrower's problem

$$V^{B;j}(b;h;X) = \max_{\{c;n;h^0;\ (\omega^j)\}} u(c;h) + {}^{B}\mathrm{E}_{X^0|X} V^{B}(b^0;h^0;X^0)$$

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$$b^0 \qquad p_h h^0$$

given $b_0; h_0$:

$\omega^j \quad G_\omega$: idiosyncratic housing valuation shock

as in Elenev, Landvoigt, Van Nieuwerburgh (JME, 2016).

default: each borrower decides whether to repay b

$$(\omega^j) = \begin{cases} 0 & \omega^j < \omega \\ 1 & \omega^j \quad \omega \end{cases}$$

after default decision, family of borrower jointly chooses $\{c; n; h^0\}$.

back

Borrower's problem

$$V^{B;j}(b;h;X) = \max_{\{c;n;h^0;\ (\omega^j)g} u(c;h) + {}^{B}\mathrm{E}_{X^0|X} V^{B}(b^0;h^0;X^0)$$

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