Mortgage Securitization and Information Frictions in General Equilibrium

Salomón García-Villegas

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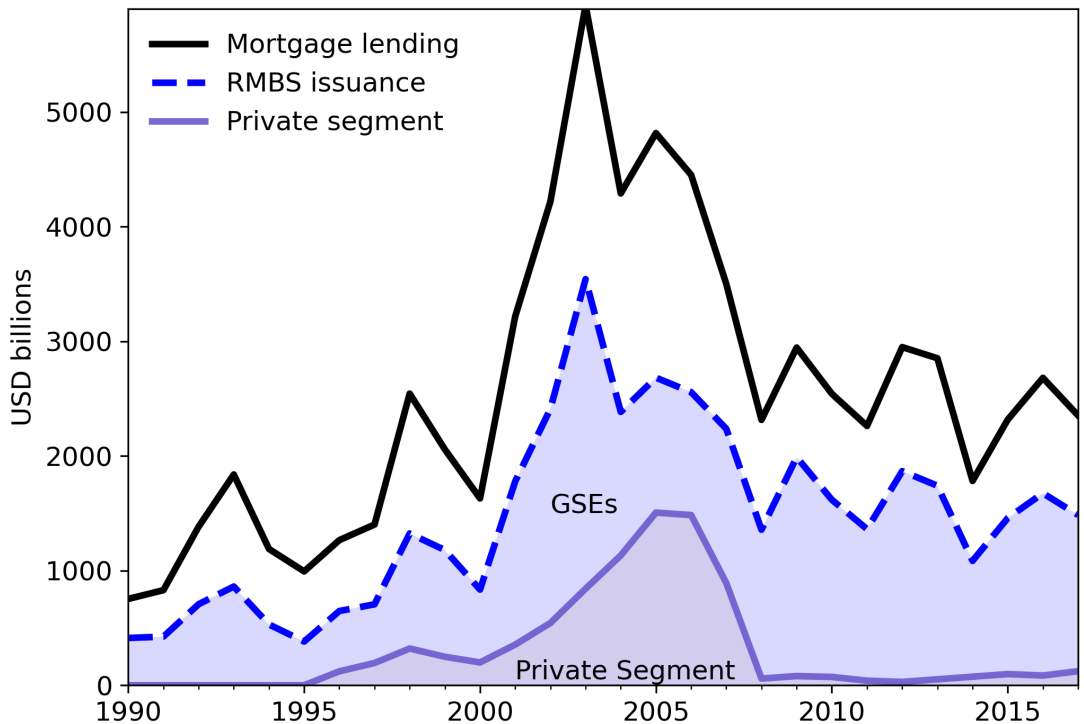
Motivation

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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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 (2019), Piskorski et al (2015), Keys et al(2010), Downing et al (2008).
   - Private securitization market **collapsed** in 2008.

Research Questions

Yet, less 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?

This paper

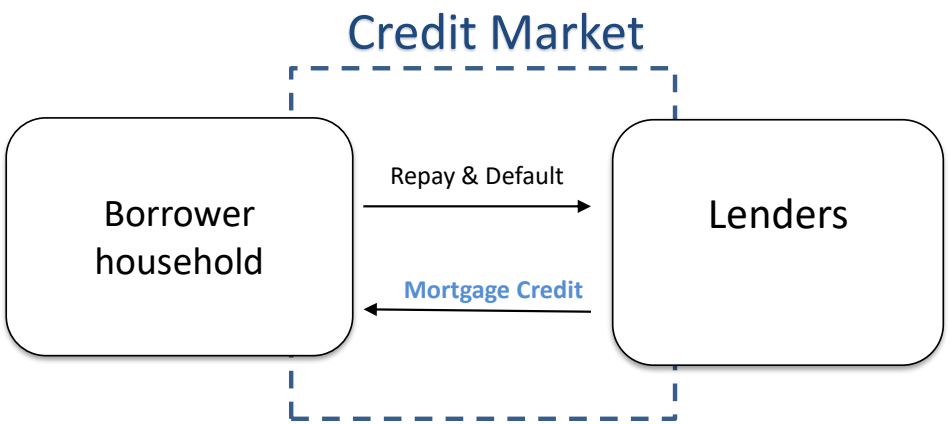
- **Develops** a new theory for (i).
- **Tests** the theory during the Great Financial Crisis bust-episode.
- **Quantifies** role of information frictions, and answers (ii).
- **Evaluates** government policies.

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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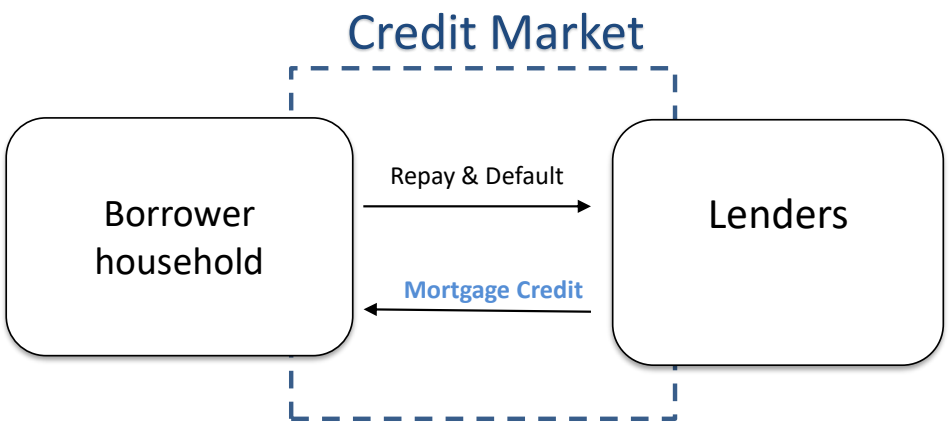

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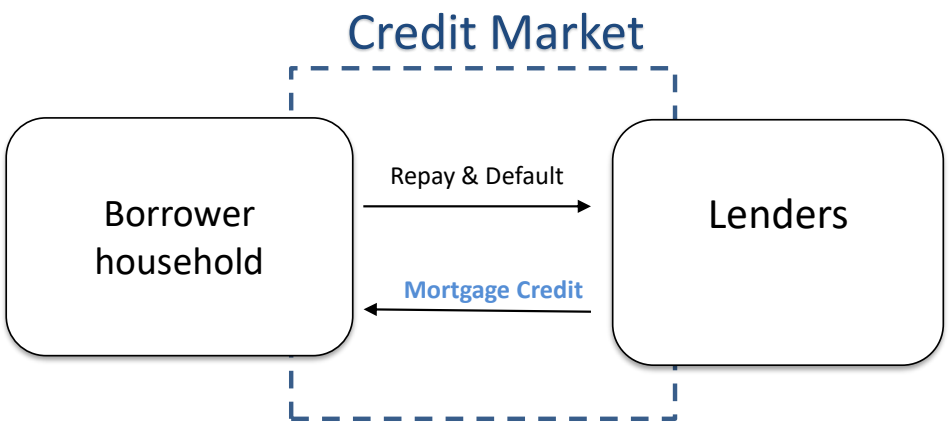

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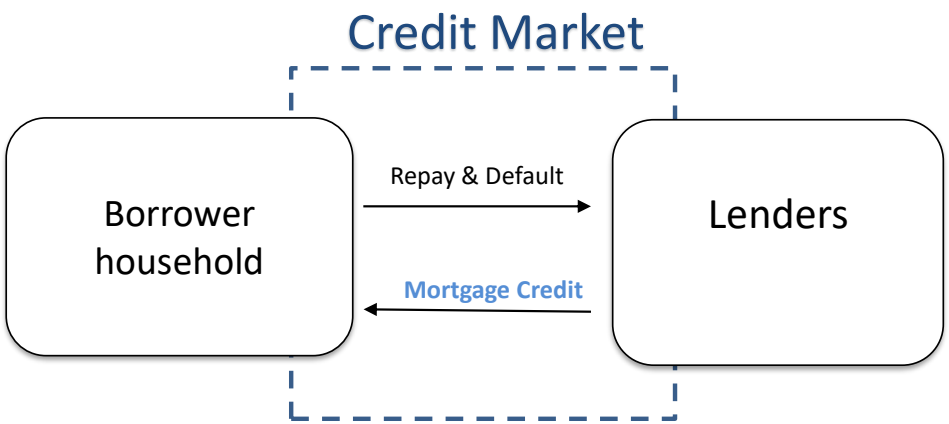

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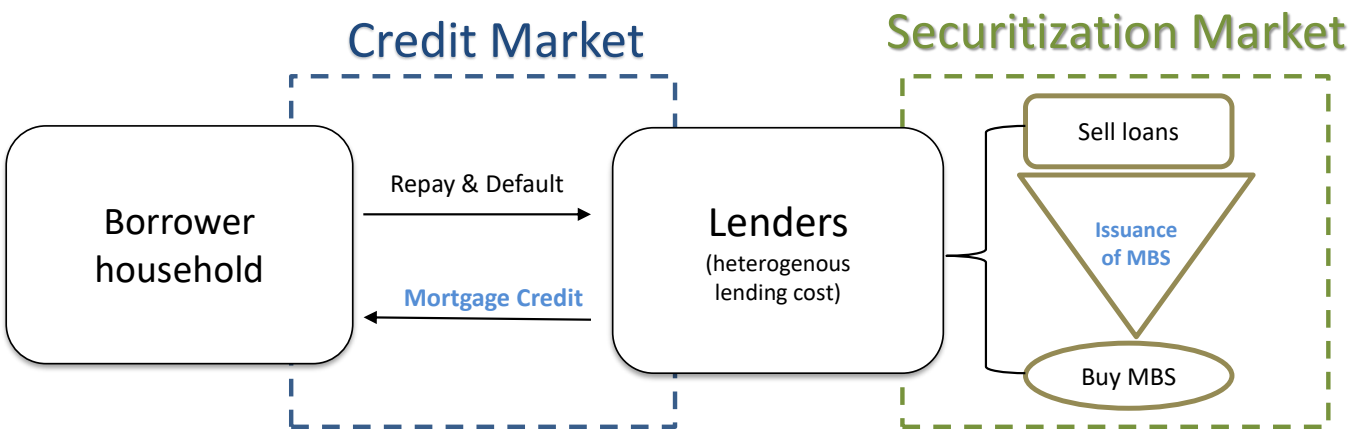

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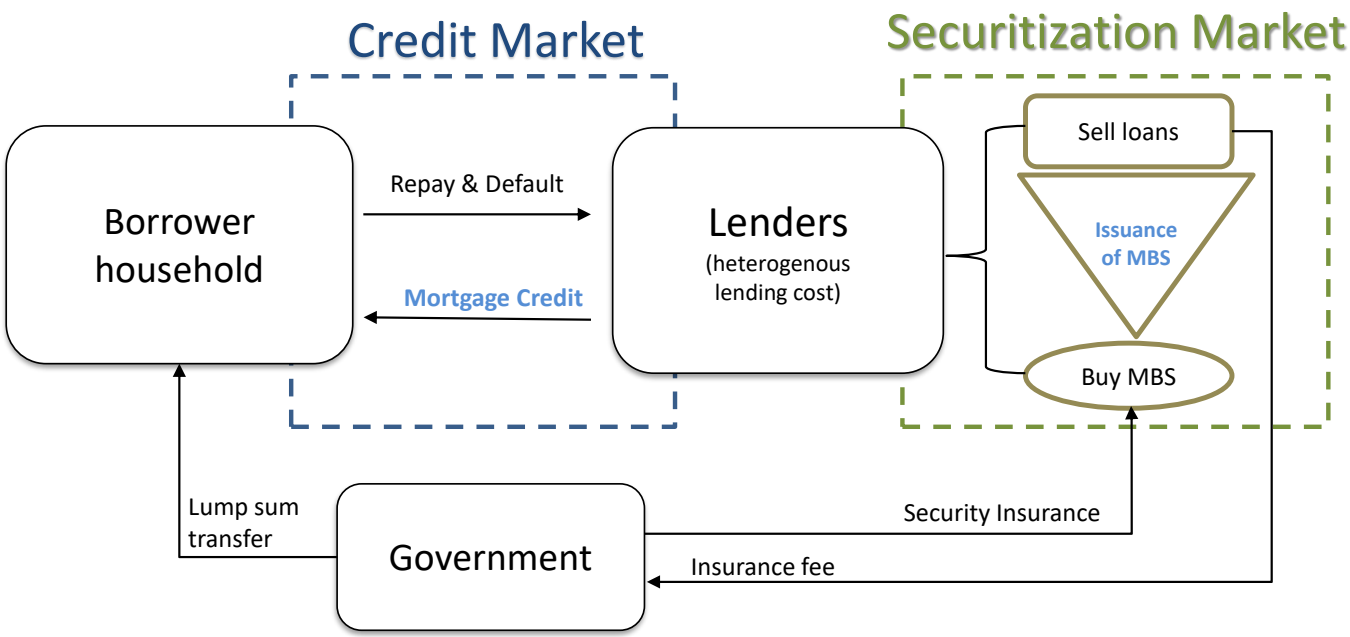

Results

1. **The theory delivers:**
   - Boom-bust credit cycles driven by household's income and housing shocks.
   - Information frictions: (i) amplify credit fluctuations, (ii) securitization shutdown.

     Data informs Theory about amplification.
   - Role for policy: credit guarantee policy provides stabilization.

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2. **Quantitative model:**
   - Validation: Model replicates contraction in mortgage credit and MBS issuance during GFC-bust.
   - Quantification: Information-friction multiplier on credit cycles ≈ 1.2.
   - Policy: 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.

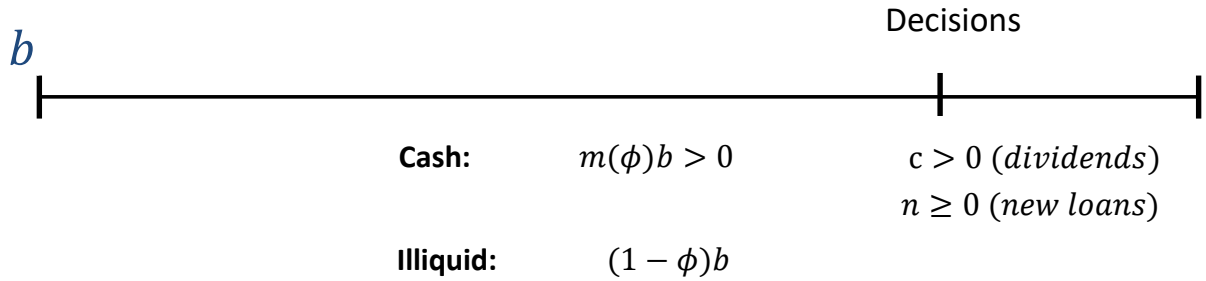
Outline

I. Model
   - Environment
   - Theoretical results
   - Quantitative mechanism

II. Application to the GFC
   - Calibration
   - Model Performance
   - Shock Decomposition

Model: lenders

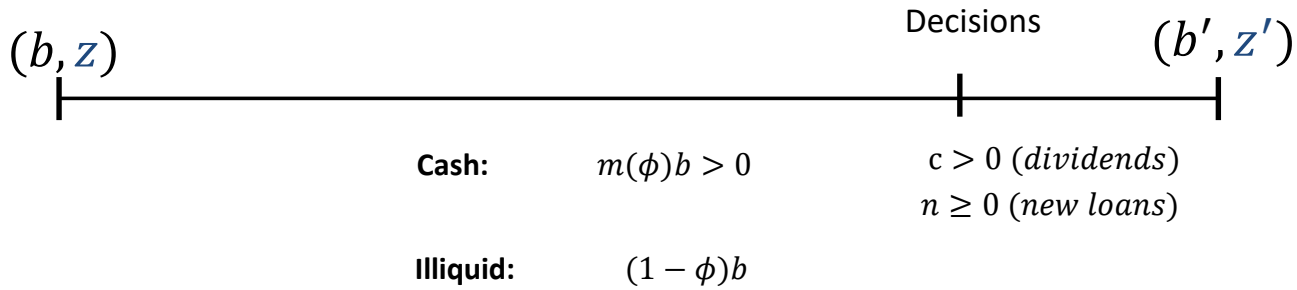
Continuum of lenders



- Owns a portfolio of long-term loans, b_t^j
  - with maturity ϕ, and per-unit cash flows $m(\phi)$.
- Issues new loans n_t^j
  - Priced competitively at q_t.
- log-preferences over dividends, c_t^j

Model: lenders

Lenders face aggregate and idiosyncratic risk



- **Idiosyncratic risk:**
  - heterogeneity: lender draws lending cost $z_t^j \sim$ i.i.d $F(z)$,
  - gross cost of lending $n_t^j z_t^j$.
  - z_t^j remains private.

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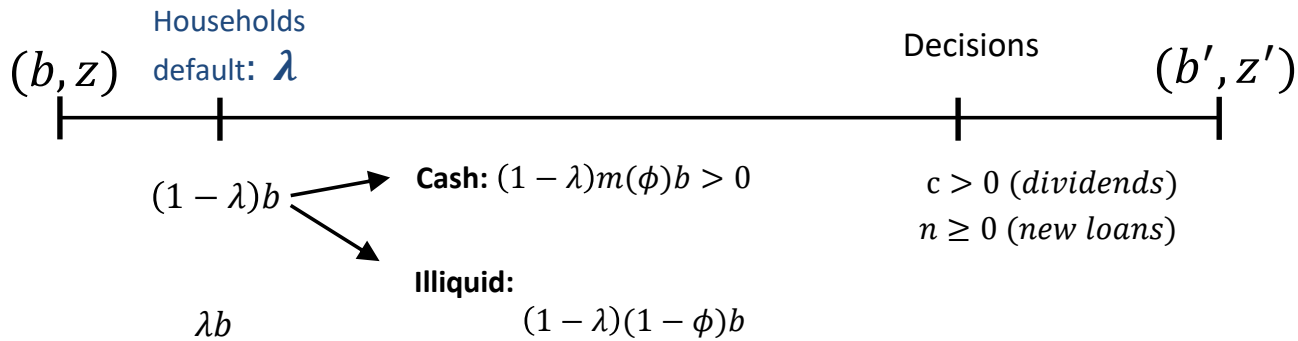

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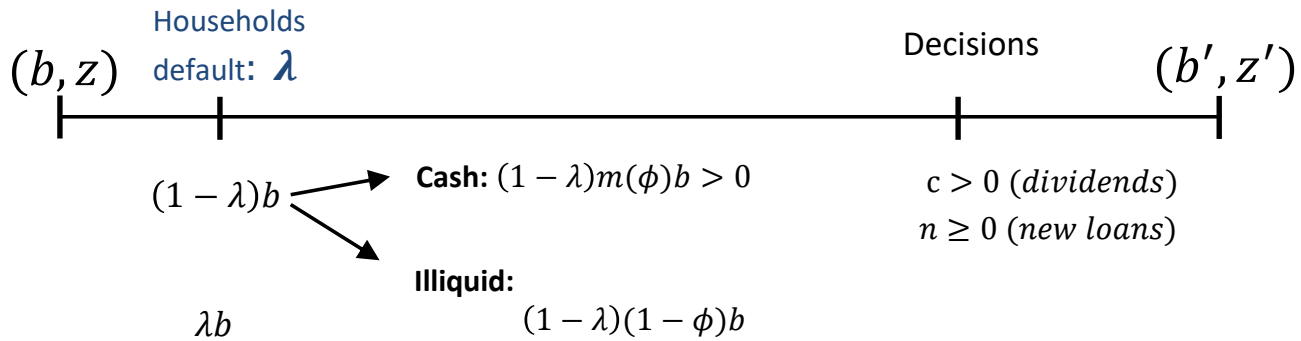
  - z remains private.

- **Aggregate risk**:
  - endogenous borrower's default λ_t affects all lenders equally,
  - every lender holds a diversified portfolio of HHs debt.

Model: lenders

Lenders face two key frictions



- **Information frictions**:
  - lender predicts and privately identifies low-quality loans $\lambda_t b_t^j$.
  - info friction lasts one period.
  - low-quality loans: per-unit recovery value $\Psi < 1$.

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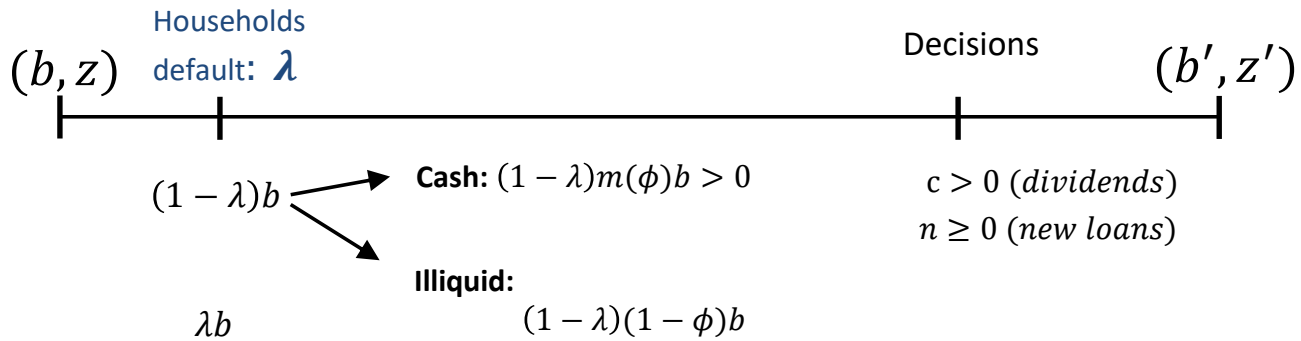

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  - cash flows: mortg. payments $(1-\lambda_t)mb_t^j + \Psi\lambda_t b_t^j$
  - limited access to debt markets.

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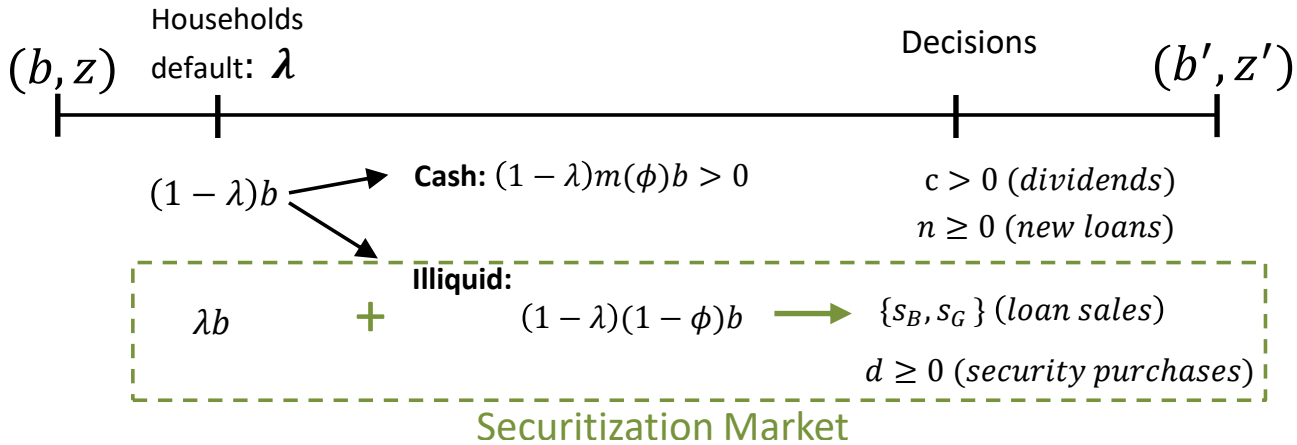

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Model: securitization market

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

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

- pass-through MBS: pool different-quality loans (no tranching).

Model: lenders **sell outstanding loans** $\{s^j_{Gt}, s^j_{Bt}\}$ and/or **buy securities** $\{d^j_t\}$.

- security: pool of high & low quality loan sales.

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

- pass-through MBS: pool different-quality loans (no tranching).
- priced competitively.
- "cheapest-to-deliver" practice.
- (mostly) credit-guaranteed by Government Sponsored Enterprises.

Model: lenders **sell outstanding loans** $\{s^j_{Gt}, s^j_{Bt}\}$ and/or **buy securities** $\{d^j_t\}$.

- security: pool of high & low quality loan sales.
- competitive pooling price: p_t.
- first deliver the low-quality $\rightarrow$ market discount: μ_t.
- **gov. policy:** guarantee for security purchases (τ_t) and charge guarantee fee (γ_t).

Lender's Recursive Problem

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

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- **Lender's budget constraint**:

$$\underbrace{(1-\lambda) m b^j + p(s_G^j + s_B^j) + (\lambda b^j - s_B)\Psi}_{\text{inflows}} \quad \geq \quad c^j + n^j(z^j q + \gamma) + p d^j (1-\tau)$$

  Inflows: borrower's payments + loan sales + recovery from NPLs.

- **Portfolio law of motion**:

$$b^{j\prime} \quad = \quad (1-\lambda)(1-\phi) b^j - s_G^j + n^j + (1-\mu) d^j$$

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  Outflows: dividend payments + new lending + security purchases.

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Model: borrowers

Standard borrower household problem

- Impatient, preferences: consumption, and housing.
- Long-term mortgages.
  - subject to default, and prepayment
- Face loan-to-value borrowing constraint, π^{LTV}.
- Family of borrowers, each i faces housing valuation shock $\omega^i \sim G_\omega$.

  as in Elenev et al (2016), Faria-eCastro(2022)
- Face aggregate shocks: $\{$ income Y_t, housing $\sigma_{\omega t}$, prepayment $\eta_t\}$.

$\rightarrow$ Endogenous: Credit demand, default rate $\lambda(\bar{\omega})$, housing recovery rate $\Psi(\bar{\omega})$.

Borrowers description | Borrowers Recursive Problem | Aggregate states

Theoretical Results

Securitization Market + Private Information

Private Information: low-quality loans identified only by owner.

i. Private info + anonymity + pooling market $\longrightarrow$ adverse selection.

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

  ... only low-z cost lenders sell high-quality loans s_G.

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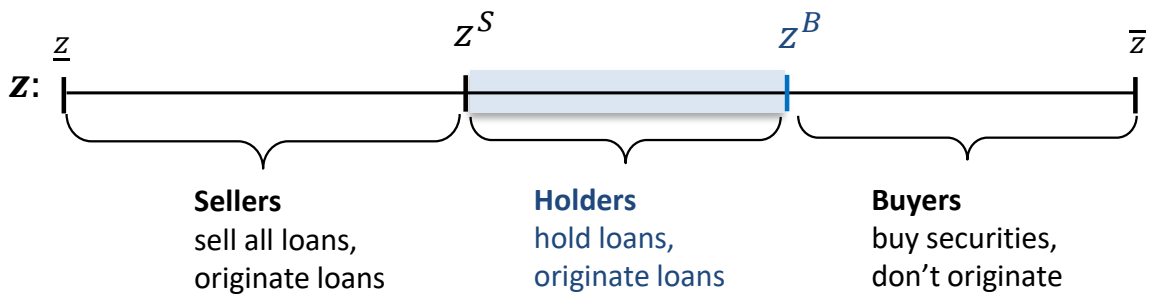
iii. Equilibrium: prices $\{p_t, q_t, \mu_t\}$ + gov. policy $\{\tau, \gamma\} \rightarrow$ thresholds $\{z^S, z^B\}$.



- **holders**-lenders remain with their illiquid portfolio of good loans.
- private information disrupts efficient asset allocation $\rightarrow$ higher intermediation costs.

Trading decisions - private info | Complete info case | Dynamics

Securitization Market + Private Information

Private Information: low-quality loans identified only by owner.

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

$$Z^B - Z^S = \frac{p}{q}\left(\frac{1-\tau}{1-\mu} - 1\right),$$

- wedge: $\uparrow$ increasing in μ and $\downarrow$ decreasing in τ.

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- wedge: $\uparrow$ increasing in μ and $\downarrow$ decreasing in τ.

v. Role of government policy:

- A subsidy $\tau > 0$ reduces the information frictions wedge.
- Proposition 2. Policy $\tau = \mu$ restores allocative efficiency as $Z^B - Z^S \to 0$.

Model: information frictions rationalizes a credit guarantee policy (GSEs).

- GSEs (agency) securitization fully guarantees against credit risk ($\tau = \mu$)
  ... only face prepayment risk.
- Private (non-agency) securitization faces credit risk ($\tau < \mu$) and prepayment risk.

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I. Model
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   - Quantitative Mechanism

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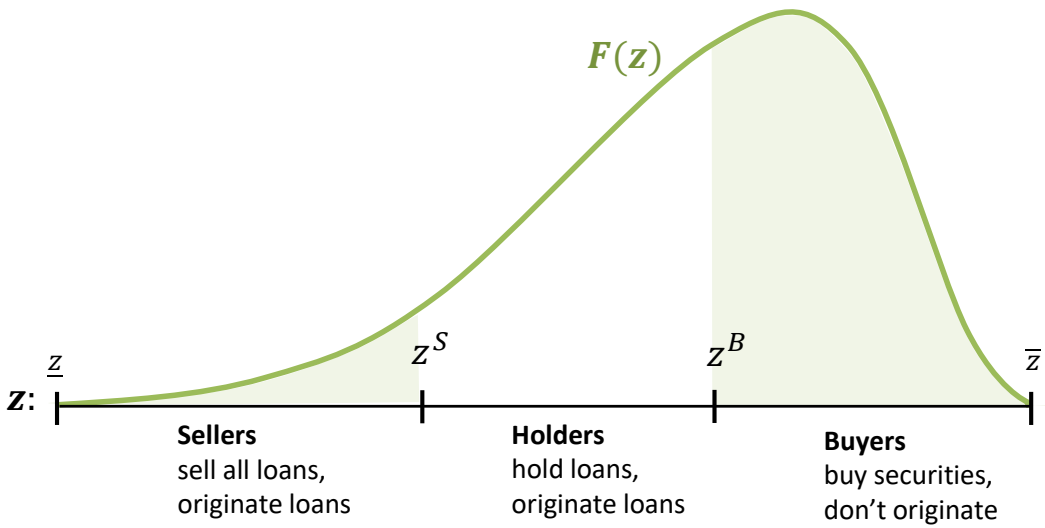
Quantitative Results

Calibration. Lenders

Period: 1990-2018. $F(z)$ as Beta(α, β, lc)

Param	Value	Target: X-section lending dist (HMDA)	Data	Model
s_1	7.55	market share Q4, top 25% originators	0.960	0.947
s_2	5.95	market share Q3	0.029	0.045
lc	0.694	mortg. spread 30y-FRM wrt 10y-Tb, %	1.66	1.80



- Data: Highly skewed distribution of mortgage lending.
- Model: **small mass** of (low cost) lenders originate most loans.

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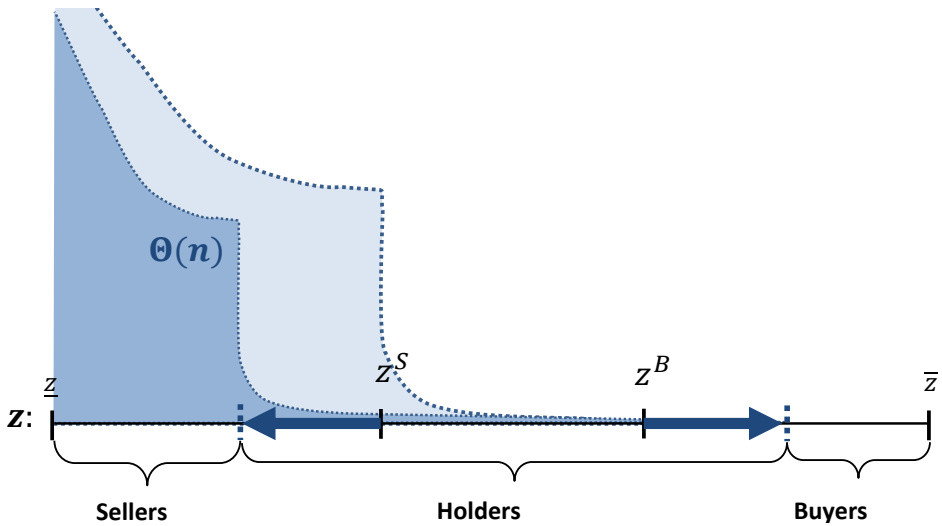


- ↑ Gains from securitization: **lowers intermediation costs**.
- ↓ Large originators depend on sec liquidity: **higher fragility**.
  Loutskina and Strahan (2011), Calem et al (2013).

Calibration (cont.)

Benchmark calibration: 1990-2018

- Exogenous Processes: $\{Y, \sigma_\omega, \eta\}$

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

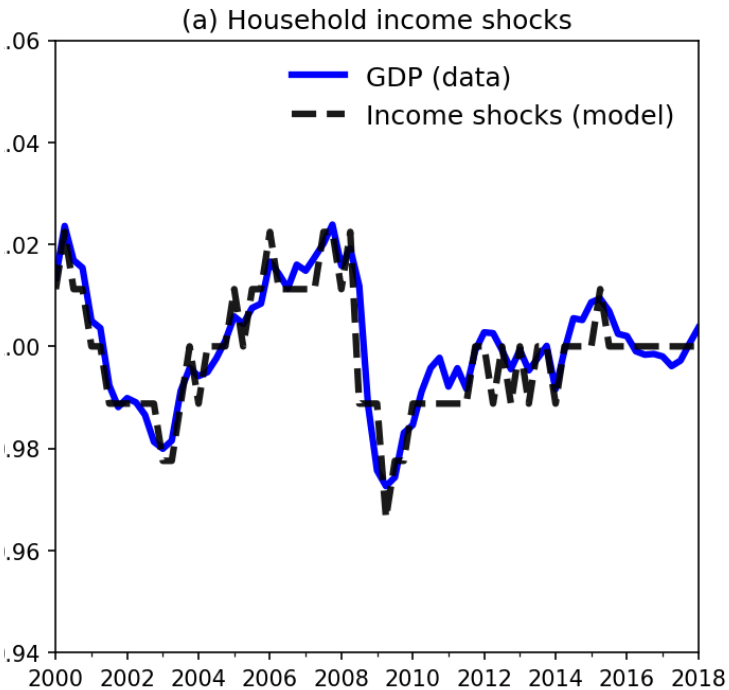
- Government policy

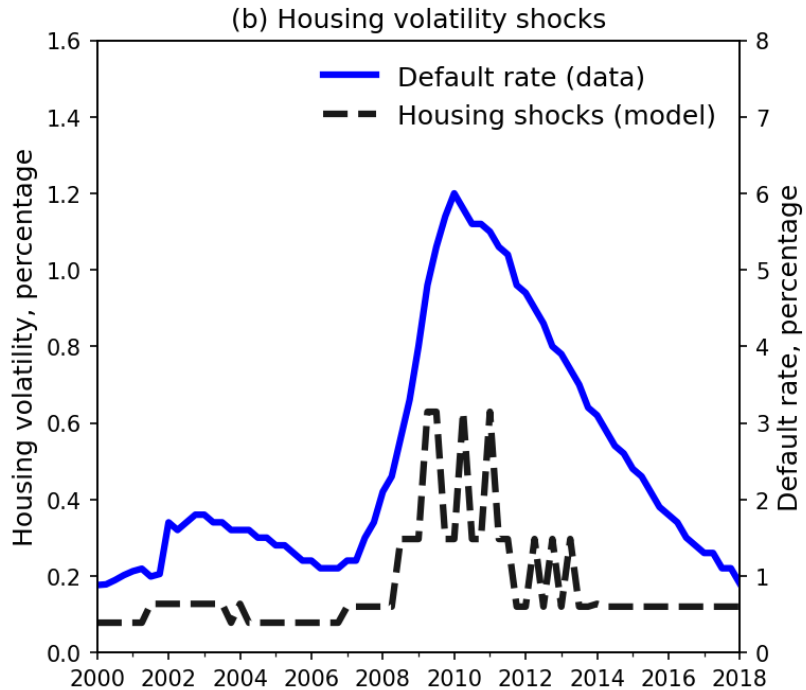
Param		Value	Target
γ	Guarantee fee	20 bps	Avg. GSEs guarantee fee, 90-06.
α_G	Securities subsidy $\tau = \alpha_G \times \mu$.	0.60	Avg. market share of GSE MBS, SIFMA 90-06.

Borrowers Description | Borrowers Calibration | Targeted moments | Non-targeted moments

Testing the theory

Exercise 1. Testing the theory





Simulate the model w inputs:

- Income shock, Y: cyclical component of GDP.
- Housing valuation shock, σ_ω: matches model's default rates to the data.

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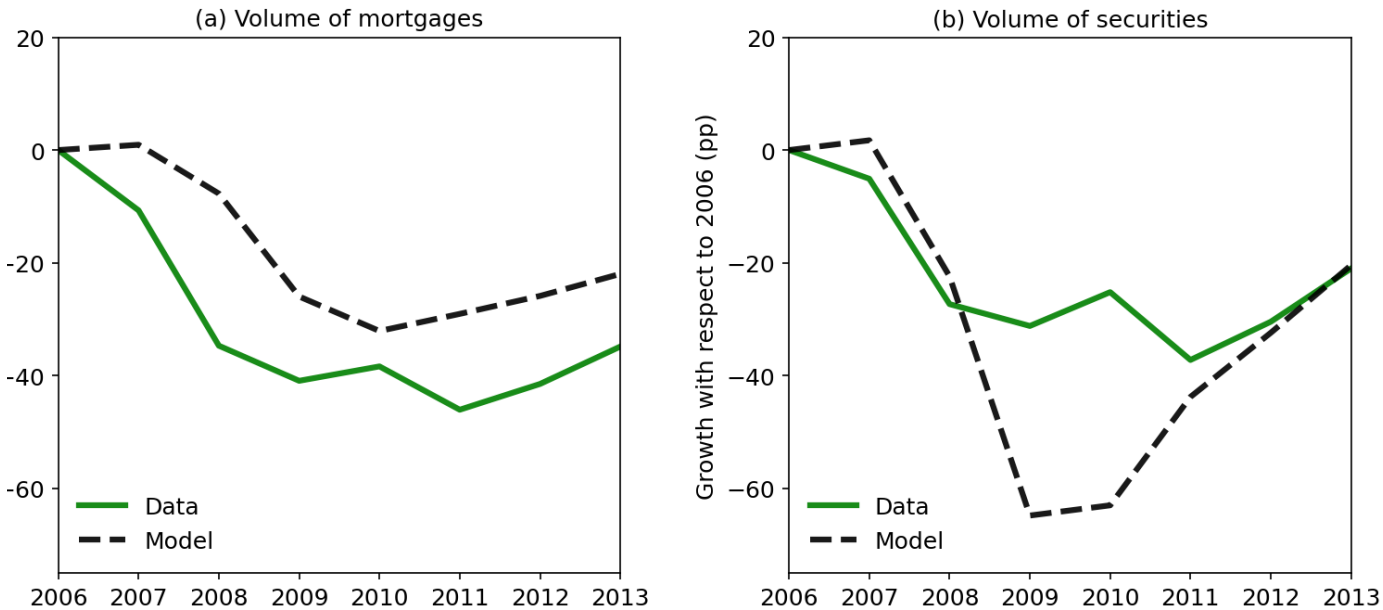


From 2008 to 2013 the model replicates:

- 2/3 of the contraction in mortgage lending. (left)
- complete contraction in MBS issuance. (right)
- dynamics of household's aggregates. default rates & consumption

Exercise 2. Amplification of Credit Cycles

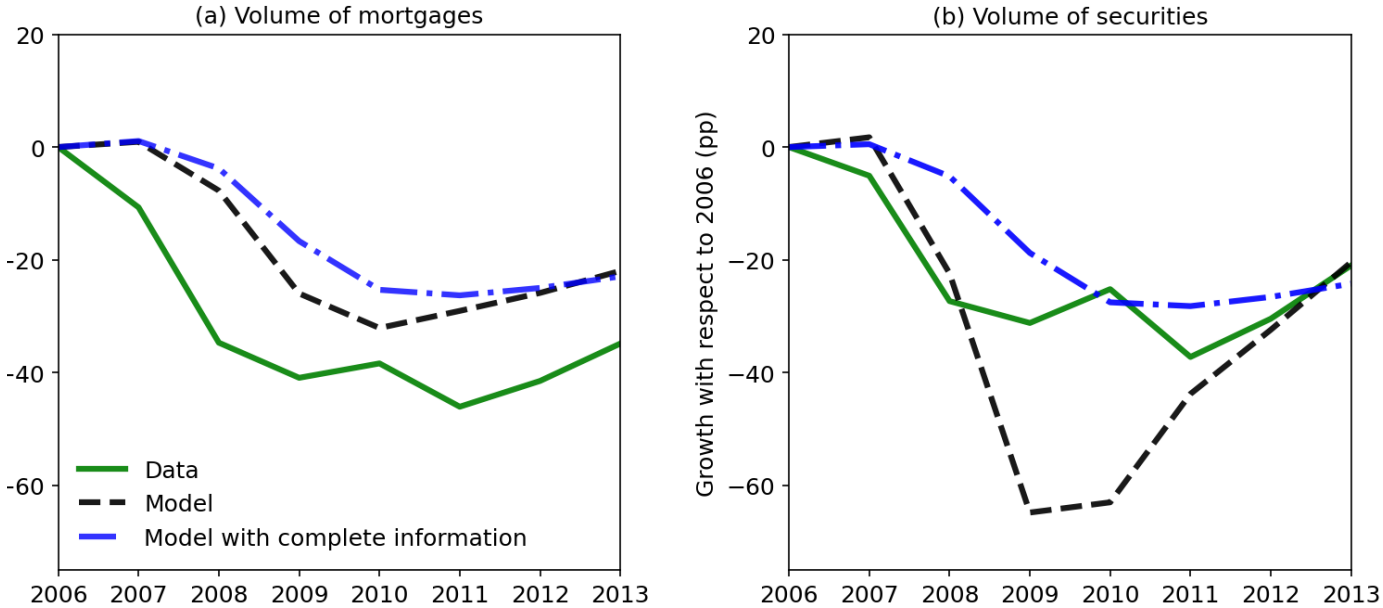
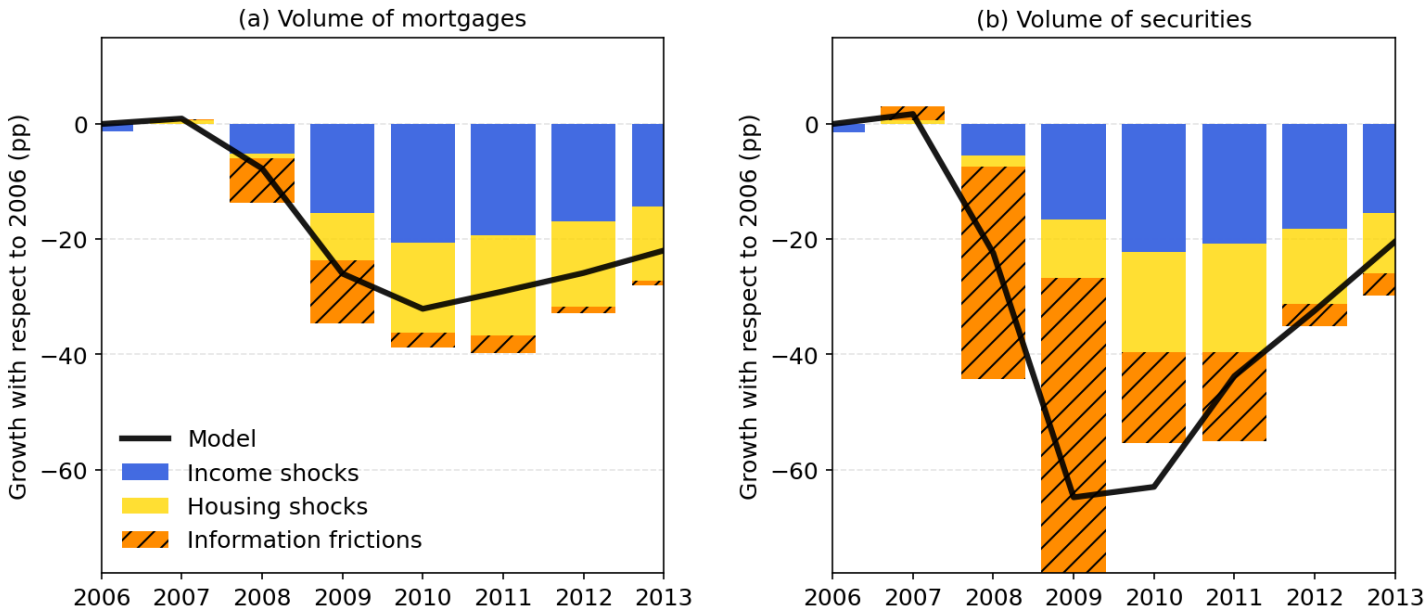


Table 1: Average contraction (pp), 2008-13

Aggregates	Baseline (Private Info)	Complete Info	Data
Volume of Mortgages	-25.7	-22.0	-40.6
Volume of Securities	-43.0	-23.7	-29.8

- Private information $\rightarrow$ amplification factor ≈ 1.2 for mortgage credit.

E3. Quantifying forces: shock decomposition



- Decomposition isolates contributions of income shocks, housing-volatility shocks, and information frictions.
- Information frictions amplify household shocks most strongly during 2008–2010, coinciding with the unexpected surge in mortgage defaults.

E4. Evaluating the post-GFC economy

Two key changes in the securitization market after the GFC:

1. Private segment collapsed $\rightarrow$ fully GSE-dominated market: $\alpha = 1$.
2. GSE guarantee fee tripled to 60 bps $\rightarrow \Delta^{+}\gamma$.

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Description	Post-GFC	Post-GFC + break-even fee
Credit guarantee fee (bps)	60	**155**
Mortgage spread, mean (pp)	1.09	1.38
Mortgage spread, std (pp)	1.02	1.20
Default rate, unconditional (pp)	2.78	1.94
Default rate, crisis times (pp)	6.27	5.59
Security prices volatility	4.05	4.62
Prob. of market collapse (pp)	4.68	1.40
Deficit / GDP (pp)	1.47	0.00

- Post-GFC pricing stabilizes credit but generates a deficit-to-GDP of 1.5%.
- Break-even fee (155 bps) accounts for amplification effects of information frictions.

  $\rightarrow$ eliminates the deficit, lowers defaults, and reduces probability of market collapse.

  $\rightarrow$ welfare gains for both borrowers and lenders. $\Rightarrow$

Main Takeaways

1. Theory of boom-bust credit cycles connecting credit and securitization markets
   - Endogenous securitization akin to TBA market for MBS.
   - Amplification channel: info frictions & liquidity from securitization.

2. Quantitative model applied to the Great Financial Crisis:
   - Replicates 2/3 of mortgage credit contraction and the collapse of MBS issuance.
   - Information frictions amplify the credit contraction by a factor of ≈ 1.2.
   - Post-GFC pricing stabilizes credit but leaves a 1.5% deficit-to-GDP.

3. Policy implication
   - Pricing guarantees to reflect amplification effects of information frictions eliminates the deficit and delivers welfare gains for both borrowers and lenders.

Thank you !!

Welfare evaluation

Welfare changes in consumption equivalent units (%):

	Borrowers	**Lenders**
Pre-GFC vs Post-GFC	2.74	-0.51
Post-GFC vs Break-even fee	-2.46	-0.10

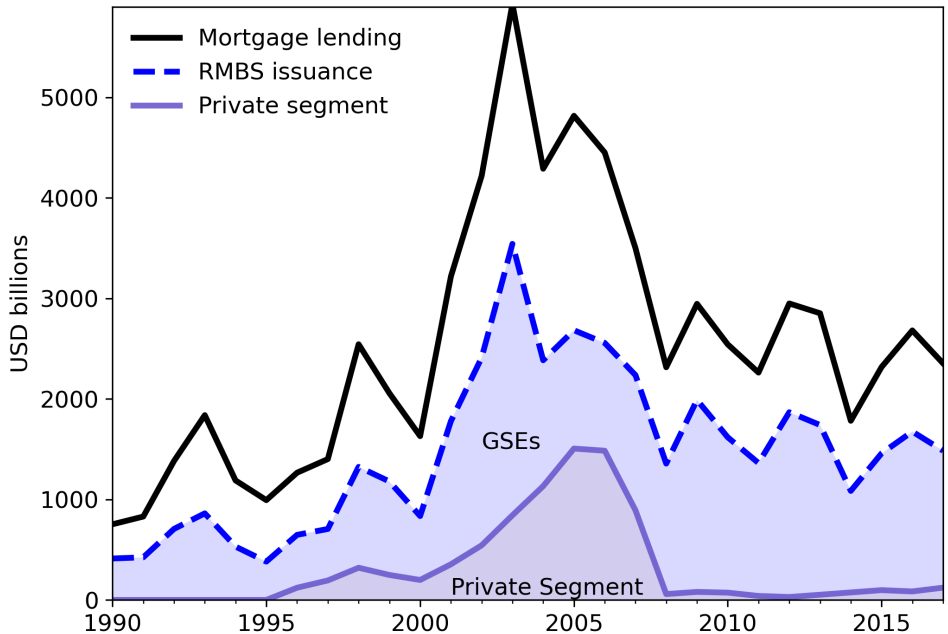
- Positive numbers = welfare losses; negative numbers = welfare gains.
- **Pre-GFC vs Post-GFC**: borrowers worse off (higher taxes); lenders slightly better off (allocative efficiency).
- **Post-GFC vs Break-even fee**: both borrowers and lenders gain.

  → Lower defaults, smaller equity losses, no fiscal burden.

back

Motivation

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

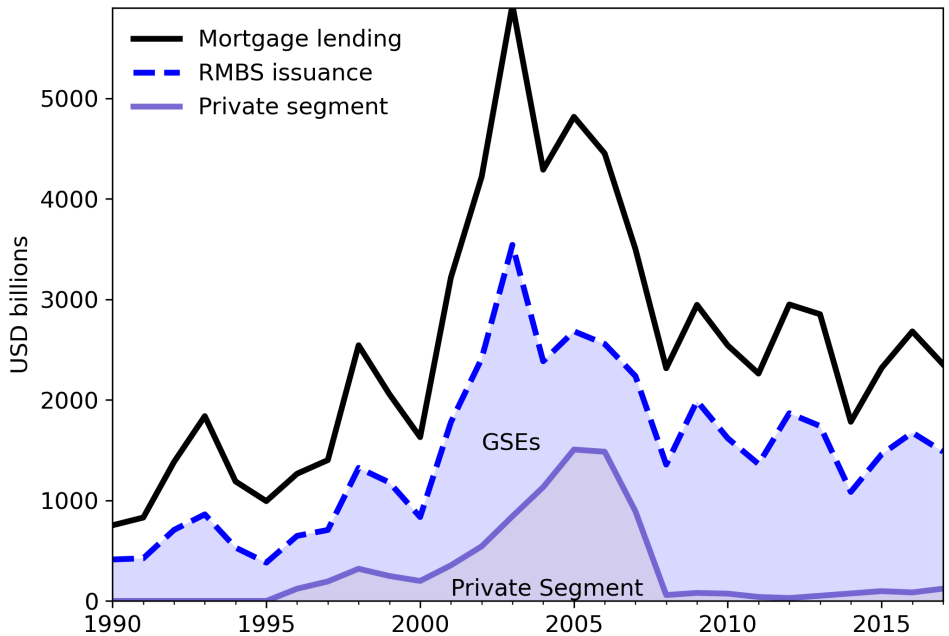


- **Securitization**: large **source of liquidity** to mortgage originators.
  - 70% of all mortgage loans are securitized within a year of origination.

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

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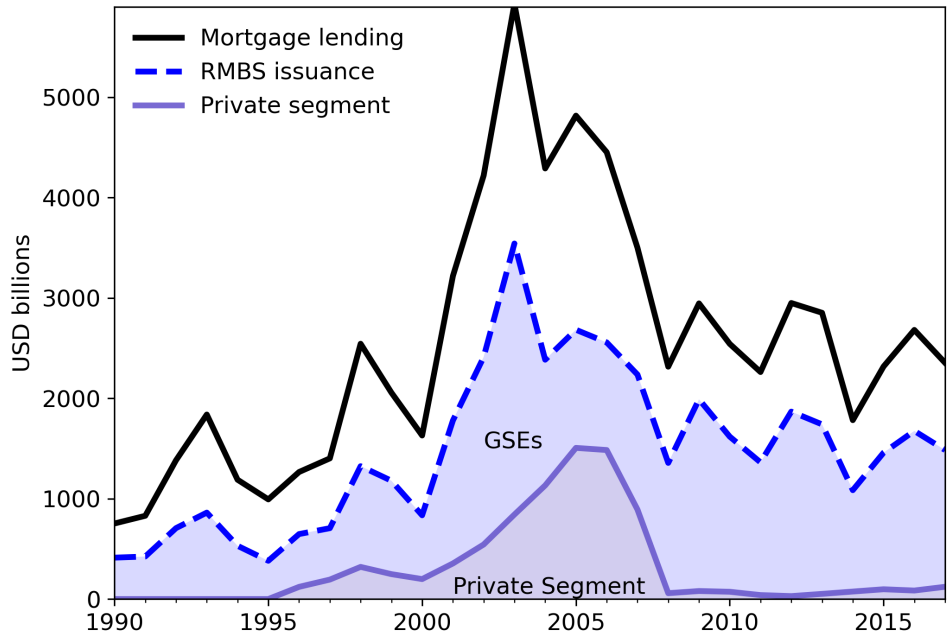
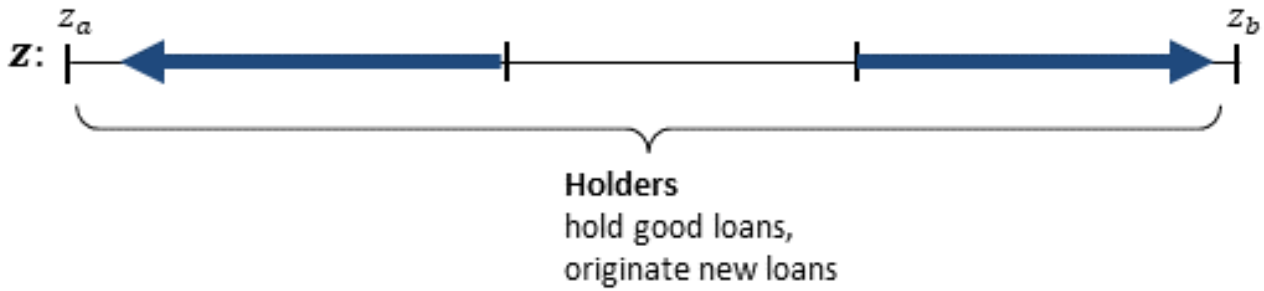


- Extensive empirical research: **information frictions** along mortgage origination and securitization chain.
  - Adelino et al (2019), Keys et al (2010), Elul(2011), Downing et al (2008).

Back-motivation Back-results

Main mechanism: securitization market

Consider an increase in $\sigma_\omega \to \Delta^+\lambda(\bar{\omega})$, then:

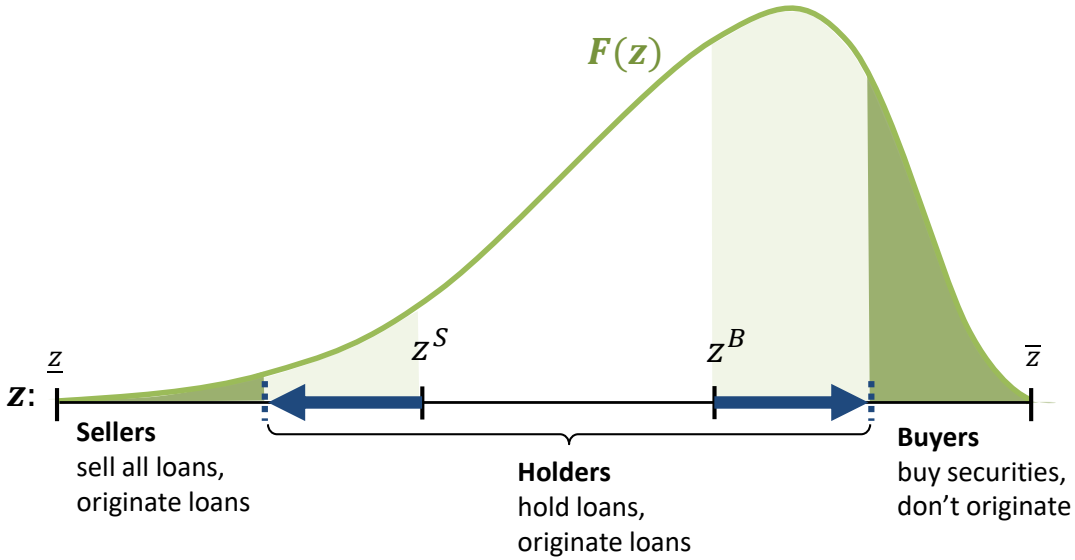


Model allows for shutdown of securitization market:

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

back-to-mechanism

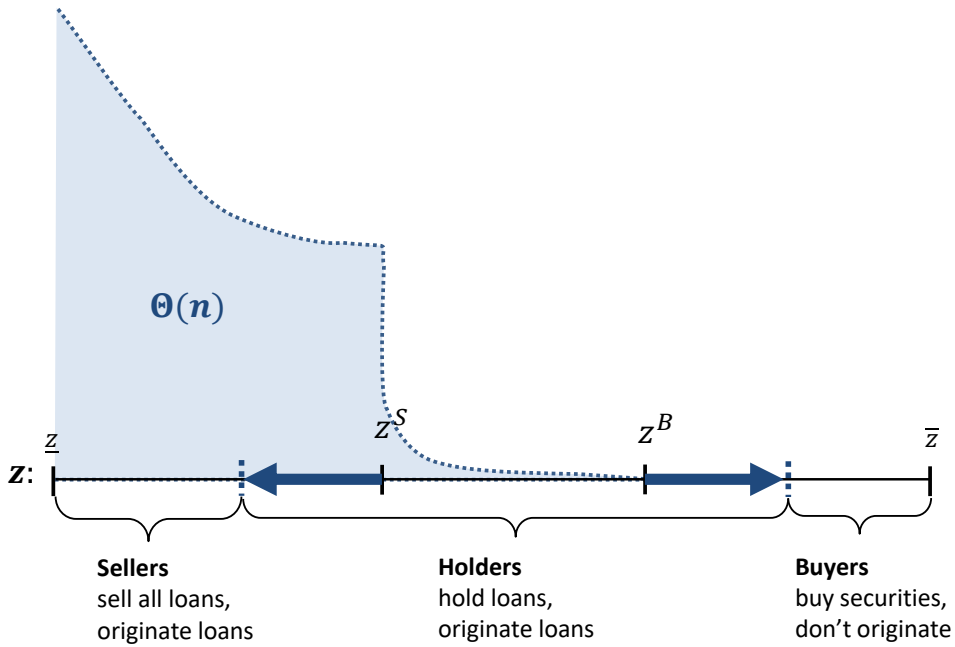
Securitization: model + data $F(z)$



- Data: Highly skewed distribution of mortgage lending.
- Model: **small mass** of (low cost) lenders originate most loans.

Calibration-lenders

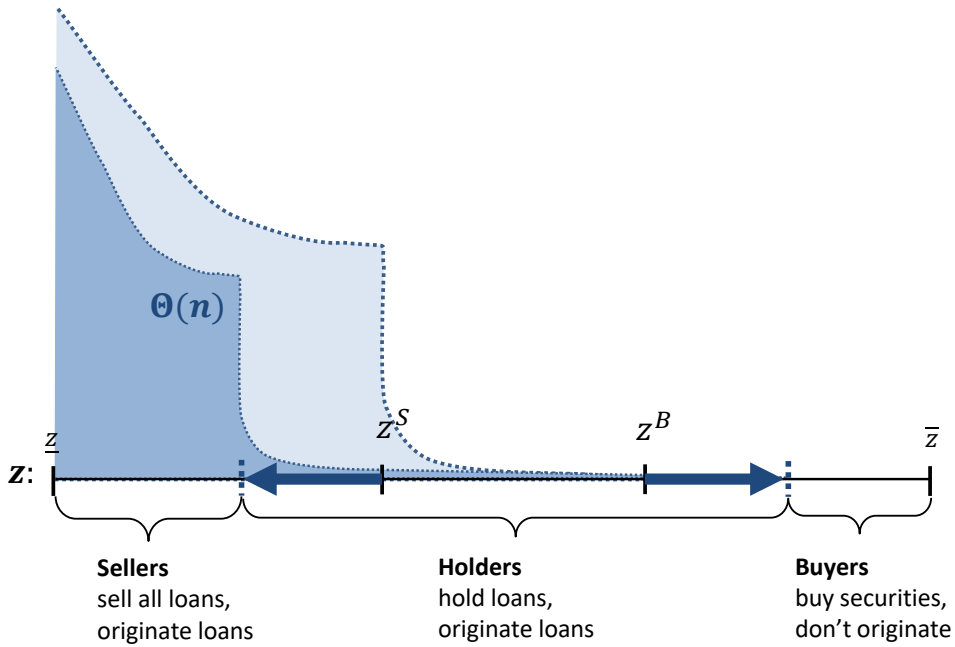
Credit Market: model + data F(z)



- 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

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

$$\begin{aligned}
(1-\lambda(\bar{\omega}))\phi b^j + p(s_G^j + s_B^j) &\leq c^j + n^j z^j (q+\gamma) + p d^j (1-\tau) \\
b^{j\prime} &= (1-\lambda(\bar{\omega}))(1-\phi) b^j - s_G^j + n^j + (1-\mu) d^j \\
s_G^j &\in [0,\ (1-\phi)(1-\lambda) b^j] \\
s_B^j &\in [0,\ (1-\phi)\lambda b^j] \\
& d^j \geq 0, \quad n^j \geq 0.
\end{aligned}$$

back

Aggregate states

- Aggregate states

$$X = \{B, H, \Gamma; Y, \sigma_\omega, \eta\}$$

- Endogenous states
  - B, aggregate stock of debt
  - H, aggregate housing stock
  - $\Gamma(z, b)$, joint distribution across lenders

- Exogenous states
  - Y, borrowers income endowment
  - σ_ω, volatility of housing valuation shock
  - η, borrowers prepayment rate.

back

The Role of the Securitization Market

Complete Information: low-quality loans identified by everyone.

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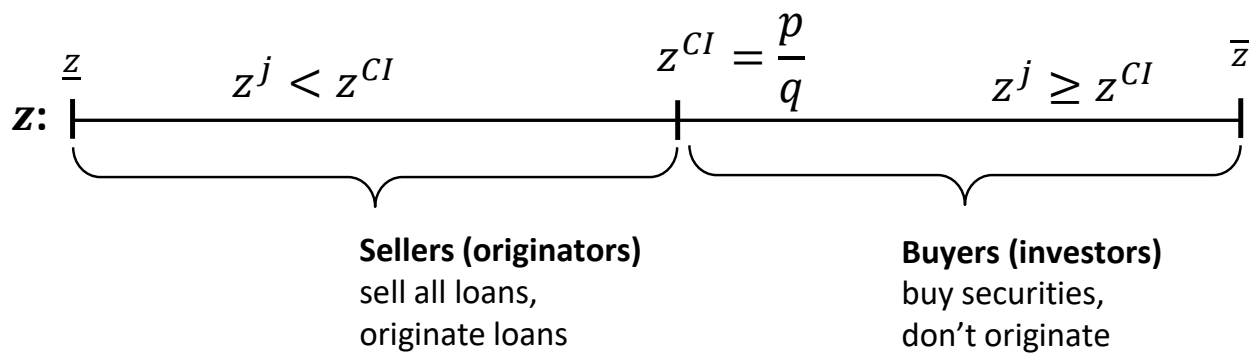
In equilibrium, prices $\{p_t, q_t\}$ define a threshold z^{CI} such that:



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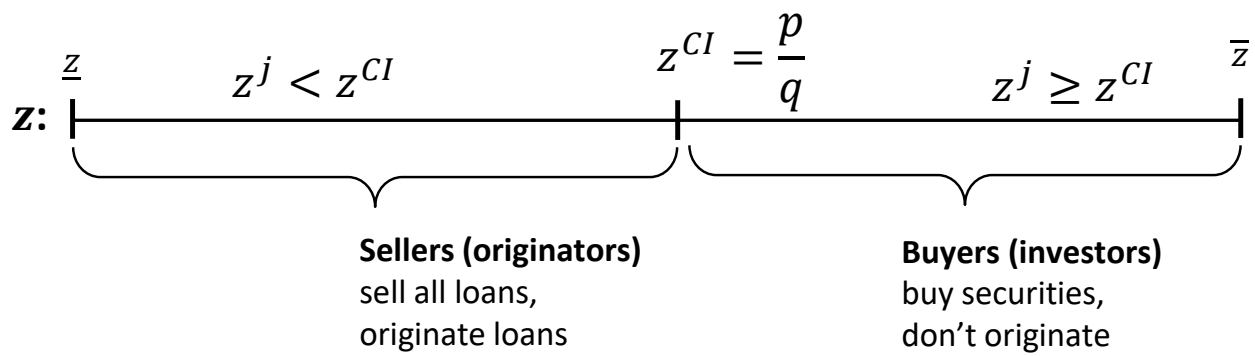

Securitization allows for:

i. Efficient asset reallocation: lenders become sellers and buyers.

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

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

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

Model: borrowers

Standard borrower household problem

- Impatient, preferences: consumption, and housing.

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- Family of borrowers, each i faces housing valuation shock $\omega^i \sim G_\omega$.

  as in Elenev et al (2016), Faria-eCastro(2022)
  - endogenous aggregate default rate $\lambda_t(\bar{\omega})$,
  - endogenous aggregate foreclosure recovery rate $\Psi_t(\bar{\omega})$,
  - threshold $\bar{\omega}$ function of: hhs leverage, price of credit, volatility of housing.

Borrowers Recursive Problem | Lenders Recursive Problem | Calibration summary

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- Face aggregate shocks: $\{$ income Y_t, housing $\sigma_{\omega t}$, prepayment $\eta_t\}$.

Borrowers Recursive Problem | Lenders Recursive Problem | Calibration summary

Calibration: borrowers

Benchmark calibration: 1990-2018

Param	Description	Value	Target
β^B	Borrowers discount factor	0.97	Consumption to disposable income. NIPA 90-18.
θ	Housing expenditure share	0.22	Mortgage credit to residential RE. HMDA 90-18.
ζ^H	Housing services	0.51	Annual housing returns.
π	Loan to value ratio	0.80	Loan to value at origination. NMDB and FHFA.
ν_1	Housing quadratic adj. costs	14.5	Housing moving frequency.
μ_ω	Mean housing valuation	0.97	Residential capital depreciation (BEA).
σ^2_ω	Variance of housing shocks	$\{0.001, 0.006\}$	Mortgage default rate in crisis times.
	Mortgages		
δ	Mortgage contract maturity	0.03	Standard for 30y FRM.
κ	Mortgage contract coupon	0.05	Standard for 30y FRM.
$\bar{\eta}$	Prepayment rate, mean	0.12	Mean prepayment, conv 30yr FRM. SIFMA.
ϵ_η	Prepayment rate, std	0.03	Std prepayment, conv 30yr FRM. SIFMA.
ψ	Foreclosure recovery	$\{0.50, 0.65\}$	Mortgage severities. Freddie Mac, Fannie Mae, U. Inst.

Calibration summary

Targeted Moments

Benchmark calibration: 1990-2018

Variable	Model	Data	Description
Borrowers			
Consumption to income	0.81	0.79	Consumption to disposable income, NIPA 90-18.
Mortg. debt to housing stock	0.13	0.15	Mortgage lending to residential real estate. HMDA 90-18.
Housing returns, mean (pp)	9.20	9.42	Returns to housing, 90-06.
Mortgage spread (pp)	1.80	1.66	Spread w.r.t. 10y Tbill, FRED 90-18.
Default rate - uncond. (pp)	2.01	1.99	Mortgage delinquency (90d + foreclosure). NMDB 91-18.
Default rate - crisis (pp)	4.36	4.05	Mortg. delinquency (90d + foreclosure). NMDB 07-12.
Lenders			
Fraction of loans securitized	0.71	0.70	Mortgages securitized within 1st-year. HMDA 90-18.
Severity rate - uncond. (pp)	40.69	31.99	Mean severity, mortgages with LTV 60-80. GSEs 99-17.
Severity rate - crisis (pp)	50.70	43.85	Mean severity, mortgages with LTV 60-80. GSEs 05-08.
Market share Q4	0.947	0.960	Cross-sectional distribution of mortgage lending (Q4). HMDA 90-18.
Market share Q3	0.045	0.029	Cross-section mortgage lenders. HMDA 90-18.

back

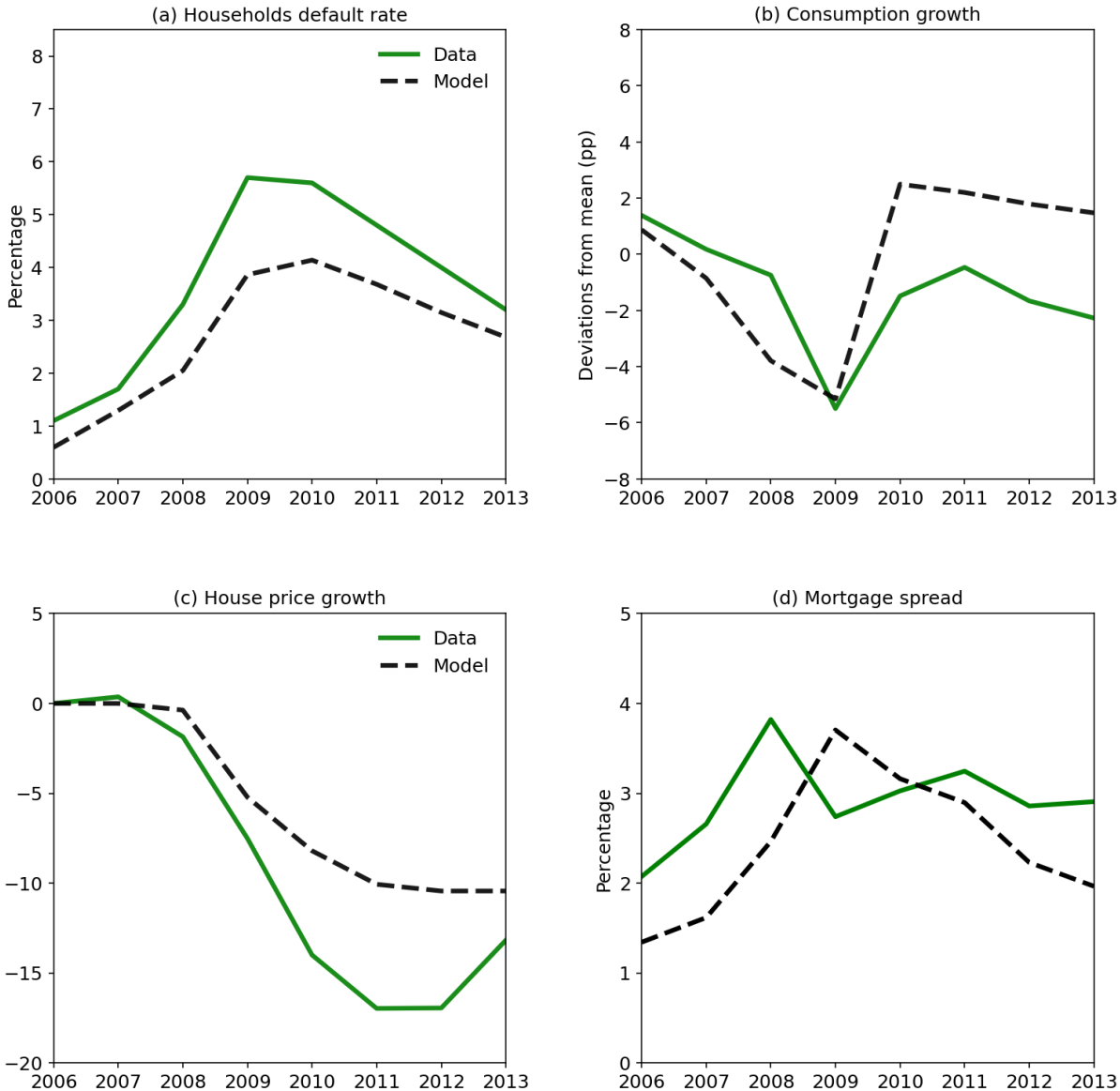
Non-Targeted Moments

Benchmark calibration: 1990-2018

Variable	Model	Data	Description
Default rate - normal times (pp)	1.82	1.20	Mortg. delinquency (90d + foreclosure). NMDB, 91-06.
Mortg. effective duration	7.25	7.50	Effective duration of 30y FRM. [**?**]
Fraction of small lenders	0.83	0.91	Cross-section mortgage lenders. HMDA 90-18.
Lending vol., top 10%/bottom 90%	16.09	9.19	Cross-section mortgage lenders. HMDA 90-18.
Market share Q1	0.003	0.002	Cross-section mortgage lenders. HMDA 90-18.
Correlations			
Corr(security issn, lending issn)	0.83	0.94	TS corr. RMBS issuance and mortgage lending, 90-18.
Corr(hhs default, lending growth)	-0.11	-0.14	TS corr. household delinquency and mortgage lending growth.
Corr(rent growth, housing premium)	0.45	0.29	Rent growth and housing premium, 90-18.
Corr(rent growth, housing returns)	0.37	0.41	Rent growth and housing returns, 90-18.

back

Exercise 1. Testing the theory



back

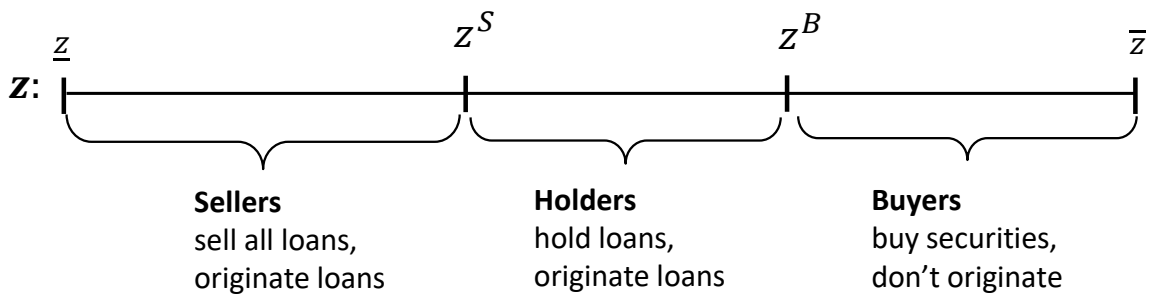
Characterization: lenders' trading decisions $\{s_B, s_G, d, n\}$

Lemma 2. Trading decisions.

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

$$s_B = \lambda(\bar{\omega})b$$

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



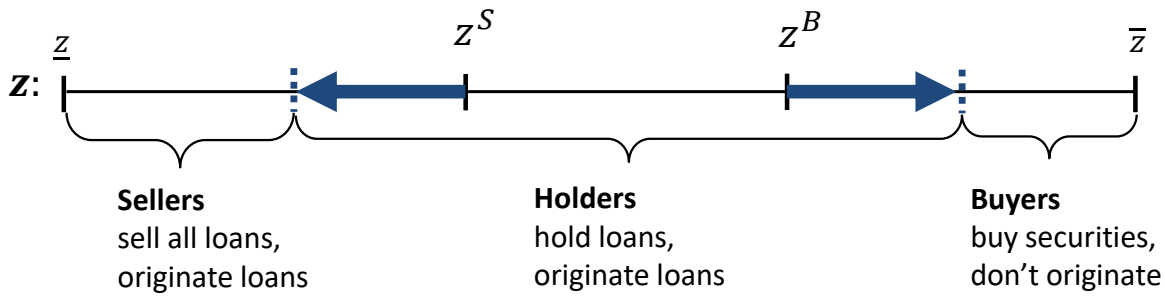
- Equilibrium cut-offs: $z^S = \frac{p}{q} - \frac{\gamma}{q}$, $\quad z^B = \frac{p(1-\tau)}{q(1-\mu)} - \frac{\gamma}{q}$.

back

Securitization Market + Private Information

Dynamics - Main mechanism

i. Proposition 3. Δ^+ borrowers credit risk $\rightarrow$ Δ^+ information frictions wedge.



back

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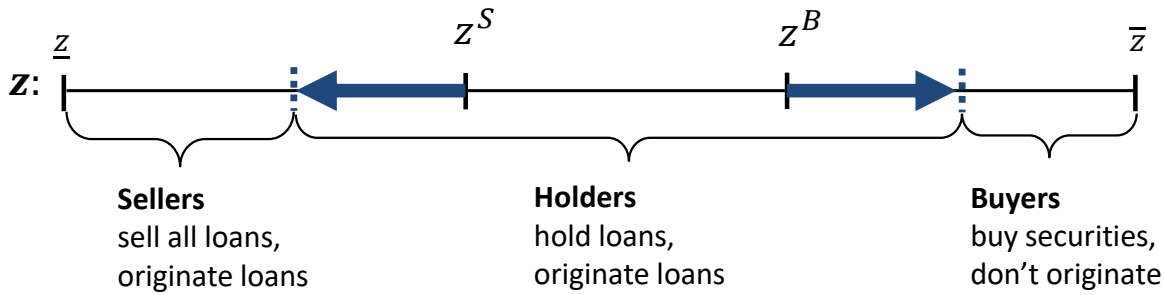
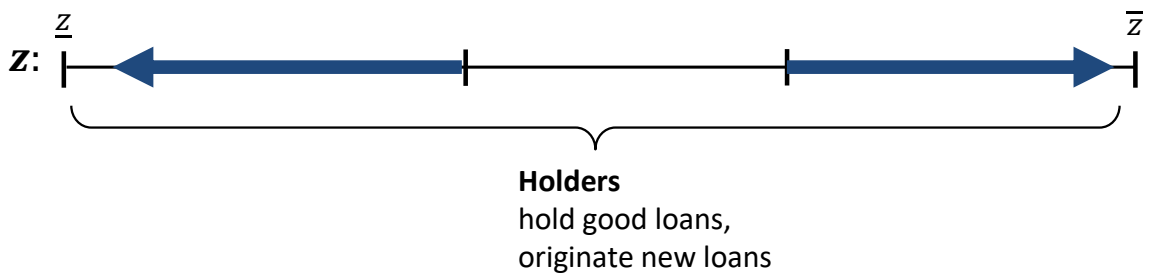


ii. Securitization market shutdown is possible

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



back

Borrower's Recursive Problem

$$V^B(B,H;X) = \max_{\{C,N,H'\}} u(C,H) + \beta^B \mathbb{E}_{X'|X} V(B',H';X')$$

$$\begin{aligned} C + p_h(H' + \Xi(H')) + m(1-\lambda(\bar{\omega}))B &= Y + qN + (1-\lambda(\bar{\omega}))\mathbb{E}\omega_{\omega>\bar{\omega}} p_h H + T^B \\ B' &= (1-\phi)(1-\lambda(\bar{\omega}))B + N \\ B' &\leq \pi p_h H' \end{aligned}$$

where $\lambda(\bar{\omega}) = G_\omega(\bar{\omega}_t;\chi)$ default rate at the optimal cutoff $\bar{\omega}_t$.

$$\bar{\omega} = \frac{B}{p_h H}(m + (1-\phi)q)$$

- Assume $G_\omega(\chi_1,\chi_2)$ is a Gamma Distribution.

Borrower summary | Borrower Individual Problem

Borrower's problem

$$V^{B,j}(b,h;X) \quad = \quad \max_{\{c,n,h',\iota(\omega^j)\}} u(c,h) + \beta^B \mathbb{E}_{X'|X} V^B(b',h';X')$$

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$$\begin{aligned} c + p_h\psi(h') - \omega^j p_h h\ \iota(\omega^j) &\leq y + qn - mb\ \iota(\omega^j) - T^B \\ b' &= (1-\phi)b\ \iota(\omega^j) + n \\ b' &\leq \pi p_h h' \\ &\text{given} \quad b_0, h_0. \end{aligned}$$

- income: stochastic endowment y and new debt n.
- housing adjustment costs: $\psi(h') = h' + \frac{\nu}{2}(h'-h)^2$.

back

Borrower's problem

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- $\omega^j \sim G_\omega$: idiosyncratic housing valuation shock
  as in Elenev, Landvoigt, Van Nieuwerburgh (2016).
- default: each borrower decides whether to repay b

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

- after default decision, family of borrower jointly chooses $\{c, n, h'\}$.

back

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