Securitization in the Mortgage Market under General Equilibrium

Salomón García
Bank of Spain

XXVI Meeting of the Central Bank Research Network
CEMLA

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

November 9, 2021

Motivation

1. Dynamics of **mortgage lending** closely tied to securitization.
    - US credit cycle of 2000's partly fueled by **securitization**.
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 chain.
    - Private Segment of securitization market **collapsed** in 2008.

Yet, there is not much **quantification** of

- **equilibrium connection** between securitization and mortgage credit.
- aggregate **effects** of information frictions in this market.

$\rightarrow$ **This paper**

What I do

What I do

Develop a quantitative GE model of financial intermediation.

- Endogenous securitization market.
- Main friction: private information (adverse selection).
- Exogenous shocks: borrower's income and housing depreciation.

What I do

Develop a quantitative GE model of financial intermediation.

- Endogenous securitization market.
- Main friction: private information (adverse selection).
- Exogenous shocks: borrower's income and housing depreciation.

Quantify the role of information frictions during the Great Recession (GR).

What I do

Develop a quantitative GE model of financial intermediation.

- Endogenous securitization market.
- Main friction: private information (adverse selection).
- Exogenous shocks: borrower's income and housing depreciation.

Quantify the role of information frictions during the Great Recession (GR).

Evaluate policy changes introduced after GR.

- Expansion of insurance on securities

Results

1. Model **replicates** 2/3 the **dynamics** of mortgage lending and securities issuance during the GR.

2. **Information frictions** account for 27% of contraction in mortgage lending
   - Elements: (i) **Info frictions**, (ii) **high exposure** to securitization, (iii) **high concentration** among mortgage originators.

Results

1. Model **replicates** 2/3 the **dynamics** of mortgage lending and securities issuance during the GR.

2. **Information frictions** account for 27% of contraction in mortgage lending
   - Elements: (i) **Info frictions**, (ii) **high exposure** to securitization, (iii) **high concentration** among mortgage originators.
   - **Insight**: X-section mortgage data informative about equilibrium in lending-securitization market.

3. **Expanding insurance** on securities can be welfare improving.

Results

1. Model **replicates** 2/3 the **dynamics** of mortgage lending and securities issuance during the GR.

2. **Information frictions** account for 27% of contraction in mortgage lending
   - Elements: (i) **Info frictions**, (ii) **high exposure** to securitization, (iii) **high concentration** among mortgage originators.
   - **Insight**: X-section mortgage data informative about equilibrium in lending-securitization market.

3. **Expanding insurance** on securities can be welfare improving.
   - Δ^- **volatility** of mortgage lending and mortgage rate.
   - Δ^+ **borrower's default** rate.
   - Δ^+ cost of financing the policy by about 2 times.
   - **Small welfare gains** to borrowers, larger welfare gains for lenders.

Related Literature

- Macro Models of Aggregate Fluctuations with Housing

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

  Contribution: quantify the role information frictions in aggregate dynamics.

- 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: link dynamics of securitization market to primary credit market.

- Policy in the Securitization Market

  Passmore (2006), Lucas (2011), Jeske, Krueger, Mitman (2013), Gette, Zechetto (2015), Elenev, Landvoigt, Van Nieuwerburgh (2016), Passmore, Sherlund (2016), Lucas (2018).

  Contribution: study the role of GSEs policys in macro model with adverse selection.

Outline

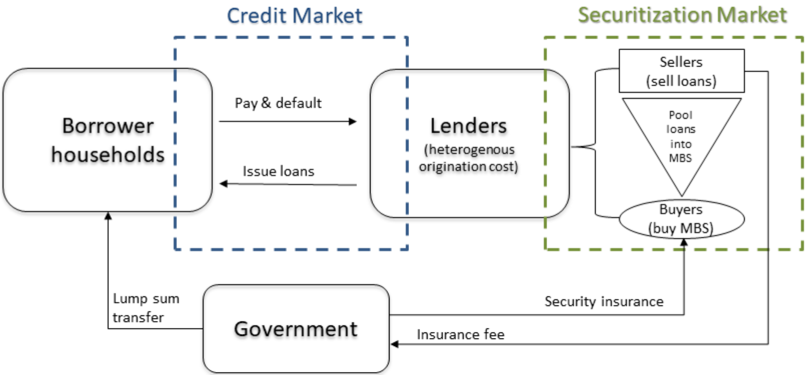
I. Model
  - Environment
  - Main mechanism

II. Quantification
  - Calibration
  - Simulating the Great Recession
  - Decomposition exercise

III. Policy Evaluation

Part I. The Model

Model Overview



Model: borrowers

- Log-preferences over ND consumption C_t, and housing H_t.
- **Long-term mortgages** B_t (geometrically declining payments ϕ), **defaultable**, **competitive price** q_t.
- Borrowing constraint: $B_{t+1} \leq \pi H_{t+1}$

Model: borrowers

- Log-preferences over ND consumption C_t, and housing H_t.
- **Long-term mortgages** B_t (geometrically declining payments ϕ), **defaultable**, **competitive price** q_t.
- Borrowing constraint: $B_{t+1} \leq \pi H_{t+1}$
- **Default** on mortgages:
  - aggregate across borrowers: continuous **default rate** $\lambda(\bar{\omega}_t)$
  - family member s.t. individual **housing valuation shocks** ω_t^i.
  - default if $\omega_t^i < \bar{\omega}_t = f(B_t, H_t, q_t, \phi)$ **endogenous threshold**.

Model: borrowers

- Log-preferences over ND consumption C_t, and housing H_t.
- **Long-term mortgages** B_t (geometrically declining payments ϕ), **defaultable**, **competitive price** q_t.
- Borrowing constraint: $B_{t+1} \leq \pi H_{t+1}$
- **Default** on mortgages:
  - aggregate across borrowers: continuous **default rate** $\lambda(\bar{\omega}_t)$
  - family member s.t. individual **housing valuation shocks** ω_t^i.
  - default if $\omega_t^i < \bar{\omega}_t = f(B_t, H_t, q_t, \phi)$ **endogenous threshold**.
- Exogenous aggregate shocks:
  - **Income endowment**: $Y_t \sim$ Markov process.
  - Housing valuation **volatility**: $\sigma_{\omega,t} \in \{\sigma^H_{\omega,t}, \sigma^L_{\omega,t}\} \sim$ Markov process.

Borrowers Recursive Problem

Model: lenders

- Log-preferences over ND consumption (dividends).
- Only income: **borrowers payments** ϕb_t^j.
- Only equity: portfolio of **outstanding loans** $(1-\phi)b_t^j$.

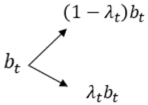
Model: lenders

- Log-preferences over ND consumption (dividends).
- Only income: **borrowers payments** ϕb_t^j.
- Only equity: portfolio of **outstanding loans** $(1-\phi)b_t^j$.
- Lending technology:
  - every period draws **lending cost** $z_t^j \sim$ i.i.d (idiosyncratic risk).
  - lender issues **new loans** n_t^j at gross cost $n_t^j z_t^j$. (heterogeneity).

Model: lenders

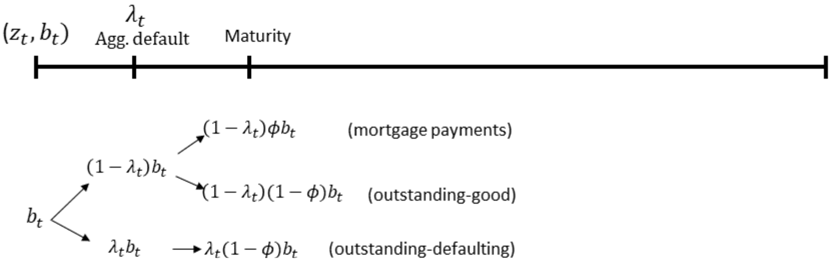
- Log-preferences over ND consumption (dividends).
- Only income: **borrowers payments** ϕb_t^j.
- Only equity: portfolio of **outstanding loans** $(1-\phi)b_t^j$.
- Lending technology:
  - every period draws **lending cost** $z_t^j \sim$ i.i.d (idiosyncratic risk).
  - lender issues **new loans** n_t^j at gross cost $n_t^j z_t^j$. (heterogeneity).
- Securitization market à la Kurlat(2013):
  - Lender can **sell outstanding loans** and/or **buy securities**.
  - Assumption 1: trade is anonymous.
  - Assumption 2: trade is non-exclusive, competitive (pooling) price p_t.

Lender's timeline



- **Aggregate default rate** $\lambda_t(\bar{\omega})$ affects all lenders equally.
  - **private information**: lender privately identifies defaulting loans $\lambda_t(\bar{\omega})b_t^j$.
  - defaulting loans do not accumulate to the next period.

Lender's timeline



- **Aggregate default rate** $\lambda_t(\bar{\omega})$ affects all lenders equally.
  - **private information**: lender privately identifies defaulting loans $\lambda_t(\bar{\omega})b_t^j$.
  - defaulting loans do not accumulate to the next period.

Lender's Budget Constraint

Model Properties

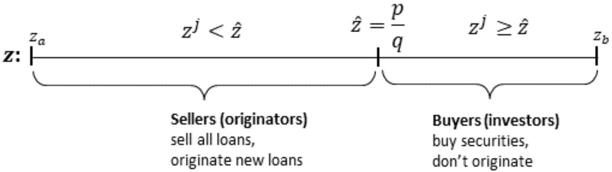
The Role of the Securitization Market

Complete Information: defaulting loans are identified by everyone.

Securitization allows for:

i. **Financial specialization**: lenders become originators and security investors.

ii. **Lower intermediation costs,** mortgage rate under securitization is lower than without it: $r(q)^{\text{SM}} \leq r(q)^{\text{without SM}}$.



Securitization Market + Private Information

Private Information: defaulting loans are identified only by owner.

i. Private info + anonymity + pooling market leads to an **adverse selection problem**.
    - All lenders sell their defaulting loans s_B.
    - Only high-z cost lenders sell their non-defaulting (good) loans s_G.

Securitization Market + Private Information

Private Information: defaulting loans are identified only by owner.

i. Private info + anonymity + pooling market leads to an **adverse selection problem**.
   - All lenders sell their defaulting loans s_B.
   - Only high-z cost lenders sell their non-defaulting (good) loans s_G.

ii. Buying securities becomes less profitable: buyers face an **adverse selection discount** μ.

$$\mu = \frac{S_B}{S_B + S_G}$$

μ: fraction of defaulting loans traded.

Securitization Market + Private Information

Private Information: defaulting loans are identified only by owner.

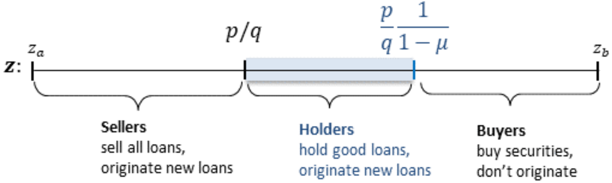
i. Private info + anonymity + pooling market leads to an **adverse selection problem**.
   - All lenders sell their defaulting loans s_B.
   - Only high-z cost lenders sell their non-defaulting (good) loans s_G.

ii. Buying securities becomes less profitable: buyers face an **adverse selection discount** μ.

$$\mu = \frac{S_B}{S_B + S_G}$$

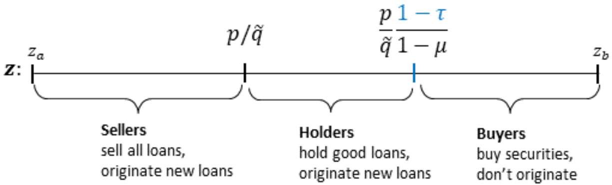
μ: fraction of defaulting loans traded.

iii. **Holders**: some lenders remain with their iliquid portfolio of good loans.



Government Policy

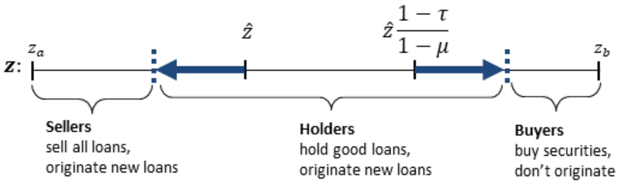
- **Subsidy** τ (insurance) **to buyers** of securities: $p(1-\tau)$.
- **Tax loan originators** ($\tilde{q} = q + \gamma$) and **borrowers** to finance the subsidy.



Main Mechanism

Main mechanism: securitization market

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

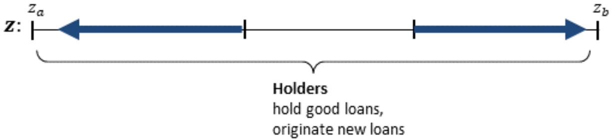


In the **securitization market**

- $\Delta^+ \mu$ fraction of defaulting loans traded.
- $\Delta^- D$ lower demand of securities.
- $\Delta^- p$ lower price of securities.

Main mechanism: securitization market

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



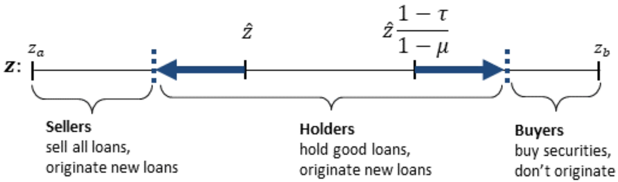
Model allows for **crash of securitization market:**

- There is no positive price that clears the market, $p \not> 0$
- **All lenders operate** with their technology $n^j z^j$.
- Same as **model without securitization**.

Main mechanism: primary market

In the **credit market**, consider an increase in $\sigma_\omega \rightarrow \Delta^+\lambda(\bar{\omega})$, can lead to:

- Δ^- liquid resources for lending.
- $\Delta^- N$ aggregate lending.
- $\Delta^+ r(q)$: higher lending rate.



- Distribution $F(z)$ determines the magnitude of the effect on prices.

Outline

I. Model
- Environment
- Main mechanism

II. Quantification
- Calibration
- Simulating the Great Recession
- Decomposition exercise

III. Policy Evaluation

Part II. Quantitative Analysis

Calibration

Benchmark calibration: 1990-2006

Lenders

Param	**Value**	**Target moment**	**Data**	**Model**
β^L	0.985	interest rate 1Y T-bill (risk free, pp)	1.6	1.7
ϕ	0.21	maturity of mortgage bond index	4.0	4.0
$F(z)$	**Beta**(α, β)	lending distribution $\Theta(n)$ in HMDA data		
$\boldsymbol{\alpha}$	4.20	market share top 25% originators	95.7	95.9
$\boldsymbol{\beta}$	2.25	loan issuance volume top-10/bot-90	9.3	9.2
lc	0.63	mortgage rate 30Y FRM real, %	5.0	5.1

Government

Param	**Value**	**Target moment**	**Data**	**Model**
$\boldsymbol{\gamma}$	0.007	Guarantee fee GSEs (bps)	20.0	20.0
$\boldsymbol{\tau}$	0.69μ	GSEs market share of RMBS issuance	69.0	69.0

Borrowers Exogenous processes

Non-targeted Moments

Benchmark calibration: 1990-2006

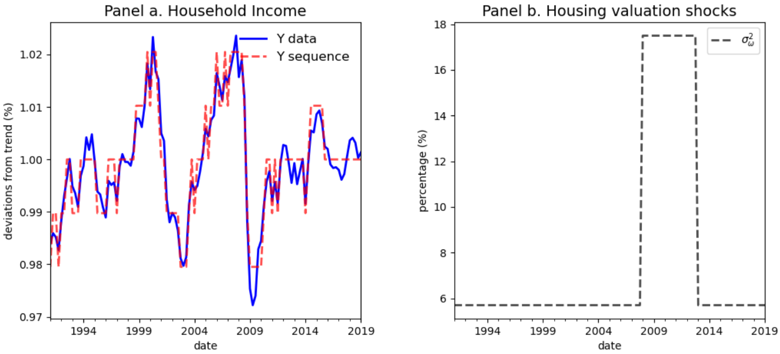
Moment	**Data**	**Model**
average sales of loans, fraction of portfolio. (pp)	61.8	73.9
average mortgage spread (bps)	178	329
Correlations		
volume lending & sec-issuance	0.86	0.90
log-lending & default	-0.71	-0.81
log-security issuance & default	-0.68	-0.85
borrower's income & default	-0.37	-0.41

Distribution of lending $\Theta(n)$

	Q1	Q2	Q3	Q4
Data	0.002	0.008	0.030	0.959
Model	0.006	0.007	0.030	0.957

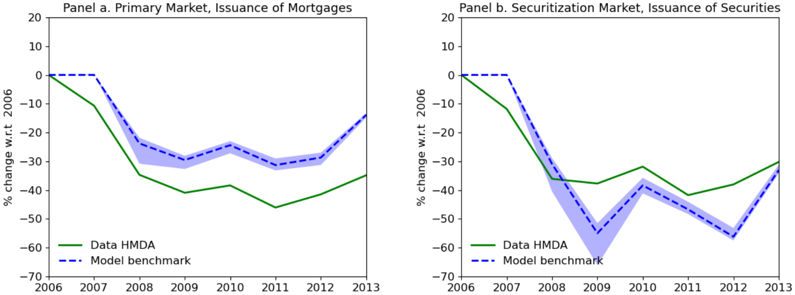
Simulating the Great Recession

The Great Recession. Exogenous Processes



- Income shock, Y: cyclical component of GDP.
- Housing valuation shock, σ_ω^2: matches model's default rates to the data.

The Great Recession. Primary and Securitization Market



From 2008 to 2013 the model replicates:

- 2/3 of the contraction in mortgage lending.
- total contraction in MBS issuance.
- X-section mortgage data informative about equilibrium in lending-securitization market.

mechanism

Quantifying Information Frictions

Quantifying Information Frictions: shock decomposition

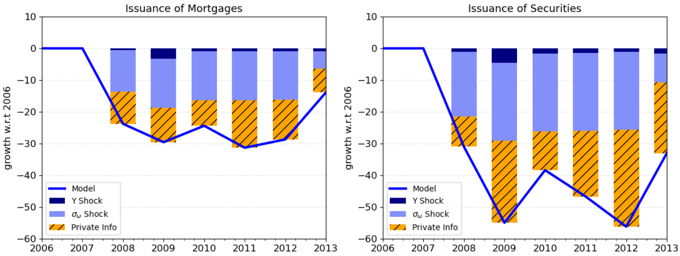


Table 1: Average contribution (pp), 08-13

Volume of issuance	priv. info	σ_ω^2	Y
Credit Market	43	52	5
Securitization Market	46	50	4

- **Information frictions account for about 45% of predicted contraction.**

Quantifying Information Frictions: shock decomposition

Table 2: Average contribution (pp), 08-13

Volume of issuance	priv. info	σ_ω^2	Y
Credit Market	43	52	5
Securitization Market	46	50	4

Mortgage lending contraction during Great Recession

- This paper:
  - Information frictions (45%), housing dynamics (50%), income (5%).
- Kaplan, Mitman, Violante (QJE, 2020).
  - Decomposition: house price (50%), households' beliefs (50%).

Part III. Evaluating Policy Changes

Policy: expanding insurance on securities

GSEs effectively took on the entire MBS market after 2012.

Description	Benchmark	$\Delta^{+}(\tau, \gamma)$	Δ Model	Δ Data
Primary Market				
Mortgage spread, avg (*bps*)	330	290	Δ^{-}	Δ^{-}
Mortgage spread, std (pp)	6.2	4.7	Δ^{-}	Δ^{-}
Hhs default (*pp*)	2.7	3.0	Δ^{+}	Δ^{+}
Securitization Market				
Fraction of loans traded %	74.0	100	Δ^{+}	Δ^{+}
Prob. market collapse (pp)	5.9	0.0	Δ^{-}	
Gov. Policy				
Costs of policy (pp), τ	6.5	11.3	Δ^{+}	
Gov deficit/Y	0.8	2.7	Δ^{+}	Δ^{+}

1. higher insurance stabilizes price of securities and mortgage spread.
2. default rates increase due to higher indebtedness of households.
   housing wealth accumulation increases by 6%.
3. Cost of policy doubles $\rightarrow$ higher taxes

Welfare Evaluation

Table 3: Welfare effects: policy changes after Great Recession

Description	$\Delta^{+}(\tau, \gamma)$	Decomposition	
		$\Delta^{+}\tau$	$\Delta^{+}\gamma$
Δ% Borrower welfare	0.06	-0.16	0.18
Δ% Non-durable cons.	-0.15	-0.69	0.47
Δ% Housing good cons.	0.55	2.63	-1.89
Δ% Lenders' welfare	1.3	3.01	-1.53

Main Takeaways

- **Information frictions** can account for **large fluctuations** in mortgage lending

  For the Great Recession:

  - 45% of contraction in MBS issuance.
  - 27% of contraction in mortgage lending.

- **Expanding insurance** on securities can be **welfare improving**

  - Provides **stabilization** at a **high cost**.
    lower mortgage rates,
    higher default,
    higher taxes to households.

Thanks!!

Model. Formal results.

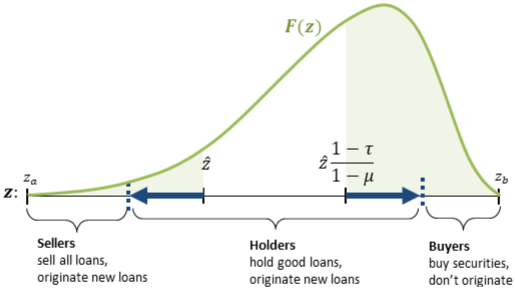
Environment

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

Properties

- Characterization
- Mechanism

Main mechanism: model + data

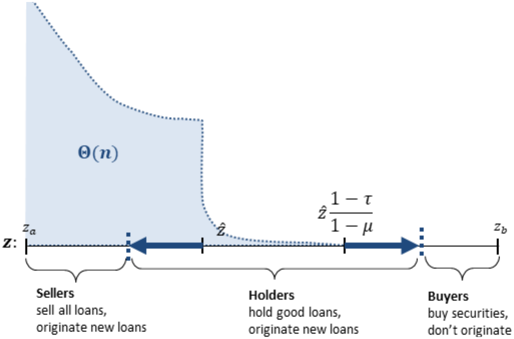


- High concentration (data): **small mass** of (low cost) lenders originate most loans.

  → benefit: **low cost intermediation**.

back

Main mechanism: model + data



- High concentration (data): **small mass** of (low cost) lenders originate most loans.

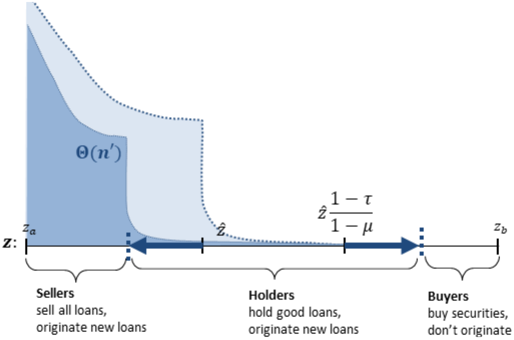
  → benefit: **low cost intermediation**.

- **Large liquidity benefits** of accessing securitization market.

  → cons: **higher fragility**.

back

Main mechanism: model + data



- High concentration (data): **small mass** of (low cost) lenders originate most loans.

  → benefit: **low cost intermediation**.

- **Large liquidity benefits** of accessing securitization market.

  → cons: **higher fragility**.

back

Borrower's problem

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

Borrower's problem

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

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

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

Borrower's problem

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

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

- $\omega^j \sim G_\omega$: idiosyncratic housing valuation shock
  as in Elenev, Landvoigt, Van Nieuwerburgh (JME, 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 $\{c, n, h'\}$.

Borrower's problem

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

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

- $\omega^j \sim G_\omega$: idiosyncratic housing valuation shock.
- 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 chooses $\{c, n, h'\}$.

back

Borrower's Problem

- Recursive problem of the family

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

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

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

$$\bar{\omega}_t = \frac{B_t}{p_{h,t}H_t}(\phi + (1-\phi)q_t)$$

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

Borrower summary | Borrower Individual Problem | back

Lender's Recursive Problem

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

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

back

Aggregate states

- Aggregate states

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

- Endogenous states
  - B, aggregate stock of debt
  - H, aggregate housing stock
  - $\Gamma(z, b)$, joint distribution across lenders
- Exogenous states
  - y, borrower's income endowment
  - σ_ω, volatility of housing valuation shock
  - $\{\sigma_\omega, y\} \sim$ joint stochastic process, first order Markov

back

Calibration: borrowers

Benchmark calibration: 1990-2006

Param	Value	Target moment	Data	Model
β^B	0.97	cons. ndur & serv to DPI, C/Y	0.80	0.80
θ	0.13	cons. ndur & serv to real estate, C/H	0.40	0.40
π	0.43	mortgage debt to real estate, B/H	0.43	0.43
ν	2.0	residential real estate investment, I/H	0.04	0.04
μ_ω	0.975	residential housing depreciation.	0.03	0.03
σ_ω^L	0.057	RM default 30 dd+ (pp), normal times	2.18	2.74
σ_ω^H	0.175	RM default 30 dd+ (pp), crisis times	8.64	8.14

- Exogenous processes $\{y, \sigma_\omega^2\}$ joint Markov

	Mean	Std	ρ	Description
Y_{cy}	1.00	0.01	0.69	cyclical component of household's DPI
σ_ω^2	0.074	0.04	0.66	2-state Markov chain, ELV(2016).
				$\sigma_\omega^2 \in (\sigma_\omega^L, \sigma_\omega^H) = (0.057,\ 0.175)$
corr(Y_{cy},σ_ω^2)	-0.35			

back

Recursive Competitive Equilibrium

A RCE given gov policy $\{\tau, \gamma, T^B\}$ consists of prices $\{q(X), p(X)\}$; adverse selection discount $\{\mu(X)\}$; a law of motion $\Gamma'(X)$; and transition density $\Pi(X'|X)$; and policy functions $\{C, N, B', H'\}^B$ and $\{c^j, n^j, d^j, s_G^j, s_B^j\}_{j \in J}^L$ s.t.:

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

$$N(q; X) = \int n(q, p; X) d\Gamma.$$

3. Whenever $p(X) > 0$ the **securitization market** clears

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

4. Government balances budget every period

$$\gamma N(X) + T^B = \tau p D(X).$$

5. Resource constraint holds

$$C^B + C^L + H' - \mu_\omega (1 - \lambda(\bar{\omega}))H = Y + q \int (z - 1) n \; d\Gamma.$$

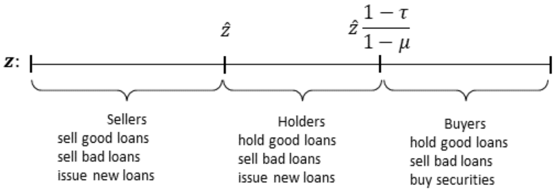
back

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

- For any $p > 0$ all lenders sell their defaulting loans

$$s_B = \lambda(\bar{\omega})(1-\phi)b$$

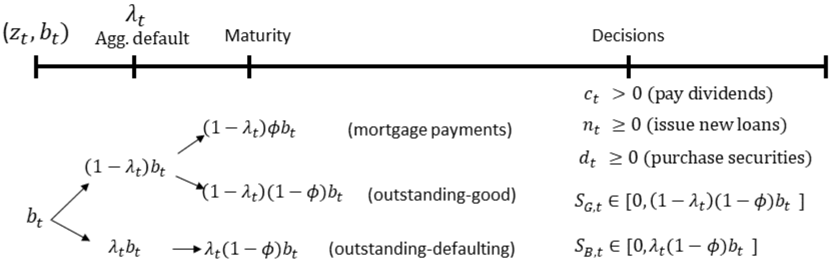
- Lenders self-classify into three groups
  - Sellers: $z < \hat{z}$ $\{s_G > 0,\ d = 0,\ n > 0\}$
  - Buyers: $z > \hat{z}\frac{1-\tau}{1-\mu}$ $\{s_G = 0,\ d > 0,\ n = 0\}$
  - Holders: $z \in [\hat{z},\ \hat{z}\frac{1-\tau}{1-\mu}]$ $\{s_G = 0,\ d = 0,\ n > 0\}$



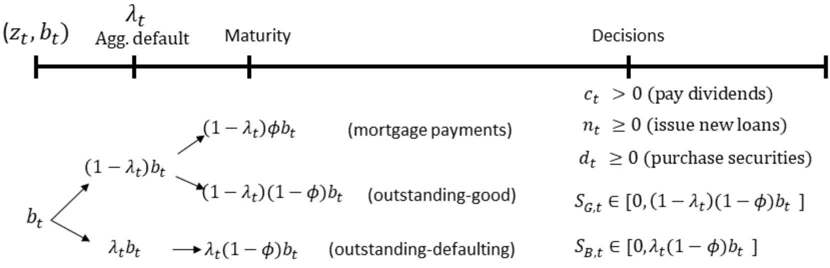
- holders have limited access to liquidity from securitization.

back

Lender's timeline



Lender's timeline

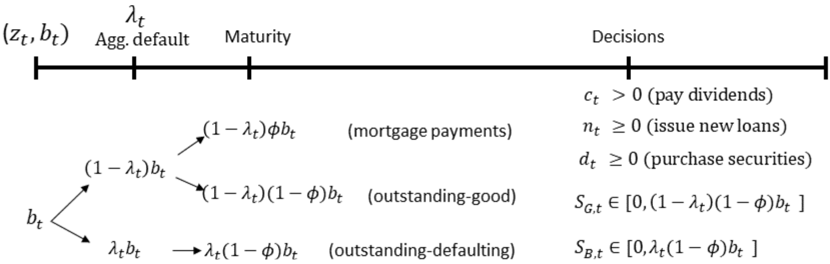


- **Lender's budget constraint**:

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

Cash inflows: borrower's payments + loan sales.

Lender's timeline



- **Lender's budget constraint**:

$$(1-\lambda(\bar{\omega}))\phi b^j + p(s^j_G + s^j_B) \quad \geq \quad \underbrace{c^j + n^j z^j (q+\gamma) + pd^j(1-\tau)}_{\text{outflows}}$$

Cash outflows: dividend payments + new lending + security purchases.

Lender's Recursive Problem

back