Securitization, Non-Recourse Loans and House Prices

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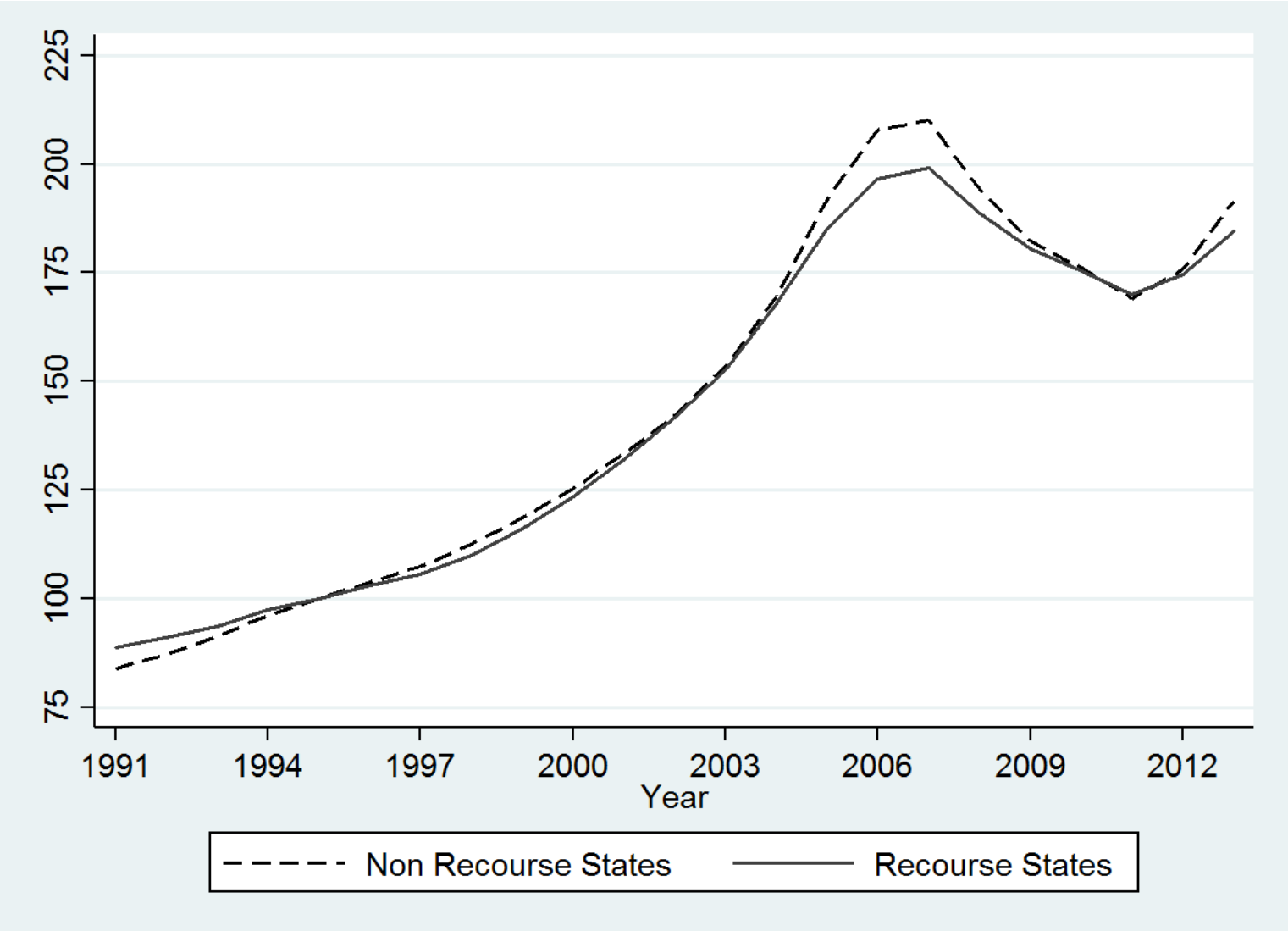
Overview

- Growing evidence that recourse laws in the US mattered in the recent house boom/bust.
  - Non-recourse loans are of *limited liability*; creates a put-option for borrowers.
- Private securitization happened at an unprecedented level.
- I build a model linking house prices to securitization and recourse laws.
- And use heterogeneity in recourse laws between US states to test this for the 2000s.

▸ Recourse Evidence ▸ Bankruptcy ▸ Non-Recourse States ▸ Securitization

House prices, Recourse vs Non-Recourse



▸ Extended

Overview, Theory

- How did recourse laws and securitization affect house prices in the 2000s?
- Model: securitization makes loan originators stop screening borrowers and 'speculators' start receiving loans.
  - Lack of self-selection by borrowers
  - Lack of credible signalling from originators to securitizers.
- With non-recourse mortgages, speculators have an option value that *pushes prices upwards during a boom*.
- Main prediction: the combination of securitization and non-recourse leads to higher prices.
- Secondary predictions for bust: combination leads to greater falls and more defaults.

Overview, Empirics

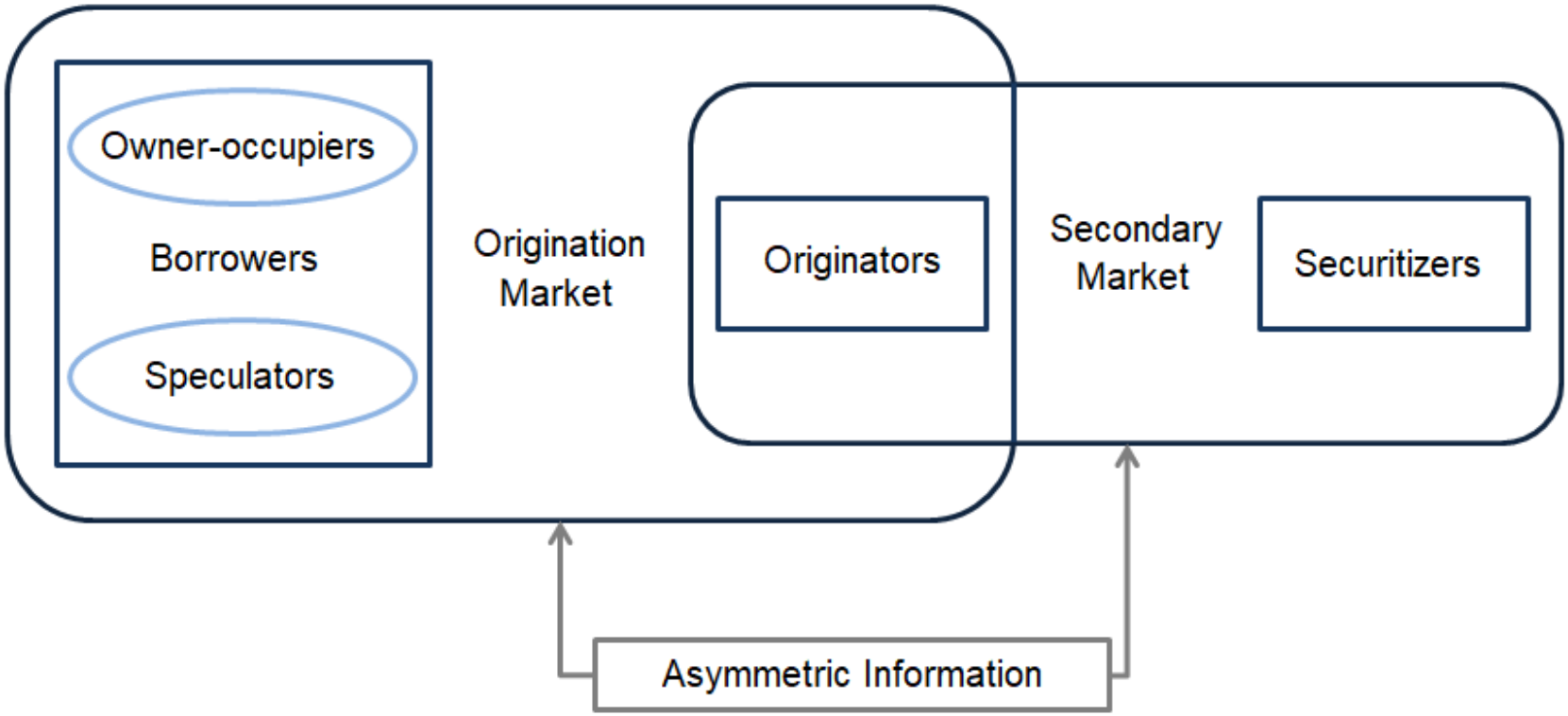
- Regress house prices on the interaction effect of recourse status and percentage of securitized new mortgages.
  - For US states/cities, 2004-2006.
- Securitization is associated with a positive effect on house prices; **non-recourse laws roughly double this effect**.
- Non-recourse states had growth in house prices 4.5 p.p. higher than recourse in a 3 year period; **my mechanism can explain around 75% of that difference.**
- Secondary predictions for bust: weak evidence.

Price Mechanism

- Risk neutral agent owns a house with 2 loan instalments of \$5; is thinking of selling now or waiting.
  - Probability $\frac{1}{2}$ house prices are \$30, $\frac{1}{2}$ they are \$0 next period.
- With recourse loans, expected value of paying and waiting is $-\$5 + \frac{1}{2}(\$30 - \$5) + \frac{1}{2}(\$0 - \$5) = \$5$.
- With non-recourse loans, expected value of waiting is $-\$5 + \frac{1}{2}(\$30 - \$5) + \frac{1}{2}(\$0 - \$0) = \$7.5$.
  - Non-recourse means agents can default with no further obligations.

▸ Bankruptcy

Overview of agents



Overview

- Based on Barlevy and Fisher (2010).
- Model lasts N periods.
- Demand boom from new borrowers with a fixed housing stock.
- Two types of borrowers: people who want to live in houses and those who buy to re-sell.
  - Likely that many home owners have both motives when buying.
- Borrowers need (2 period) loans to purchase houses.

Borrowers

- Arriving cohorts of borrowers, uncertain for how long.
- Borrowers are risk neutral with *stock* utility of owning a house κ_ζ, at the end of time (N).
  - κ for *owner-occupiers.*
  - 0 for *speculators*.
- Borrowers' key actions: choose originator; buy a house on arrival; default; sell a house.
- Housing stock is owned by old low-types (zero utility).

▸ Old Low Types

▸ Borrowers Risk Neutrality

Borrowers

- Utility for borrower of type ζ arriving at ρ is
$$U_{\zeta}^{\rho} = \sum_{t=\rho+1}^{N} c_t + \kappa_{\zeta} B_{\rho} ND_{\rho+1} ND_{\rho+2} \prod_{t=\rho+1}^{N} (1 - S_t)$$
- where the aggregate expenditure is:
$$\sum_{t=\rho}^{N} c_t + B_{\rho} ND_{\rho+1} (A_{\rho} \frac{1+r_{\rho,j}}{2} + ND_{\rho+2} A_{\rho} \frac{1+r_{\rho,j}}{2})$$
- and aggregate income is:
$$\sum_{t=\rho}^{N} y + B_{i,\rho} ND_{i,\rho+1} ND_{i,\rho+2} (\prod_{t=\rho+1}^{N} S_{i,t} A_{i,t})$$
- c_t is consumption, y income, A_t house prices and $r_{t,j}$ interest rate from a loan by originator j.
- B_t, ND_t and S_t indicator functions for buying a house, not defaulting and selling a house.

Loans and borrowers optimal actions

- Owner-occupiers always buy on arrival, never default or sell.
  - In equilibrium, $A_t \leq \kappa$ for all t.
  - No risk so originators always lend.
- Speculators always want to buy, to sell to future cohorts.
  - Cost of defaulting is zero due to put-option, risky.
- Determinacy by period 3 (for chosen housing stock and cohort sizes):
  - Either permanently more owner-occupiers than houses (high prices, marginal sellers) or not (low prices, marginal buyers).

▸ Bankruptcy

Originators

- Originators have deep pockets and are risk averse with utility:

$$U_j^O = \sum_{t=1}^{N} E(W_{j,t}^O) - aV(W_{j,t}^O) - n_{j,t} * C$$

- where W is their wealth/proifts in period t, a is the coefficient of risk aversion, $n_{j,t}$ total borrowers screened and C is (real) cost of screening per borrower.
- Originators key actions: screen/select borrowers and **set interest rates** on mortgages.
  - Interest rates are used by borrowers to choose originators and as a *loan quality signal* to securitizers.

▸ Signalling ▸ Securitization ▸ LTV

Originators

- Originator's wealth/profit is:

$$\begin{aligned} W^{O}_{j,t}(I(j,t)) = & SC_{j,t}(1 - BO_{j,t})Y(Q^0, 1, 0, I(j,t), t) \\ & + SC_{j,t}BO_{j,t}Y(Q^0, 1, 1, I(j,t), t) \\ & + (1 - SC_{j,t)}Y(Q^0, 0, \emptyset, I(j,t), t) \end{aligned}$$

- where $SC_{j,t}$, $BO_{j,t}$ are indicator functions for screening and type lending; $Y(Q^0, SC, BO, I(j,t), t)$ is expected profit earned conditional loans originated $(I(j,t))$ and on loans sold (Q^0) at every period t.
- I.e., $Y(.)$ is essentially profits earned from selling to securitizers or holding on to loans.

▸ Originator Profits

Originators and Securitizers

- Reduced form securitization market: securitizers buy to hold.
- Securitizers are risk neutral, proxy for diversification of risk of securitization.
- Utility: $U^S = \sum_{t=1}^{N} E(W^S_{s,t}(Q_j))$, where

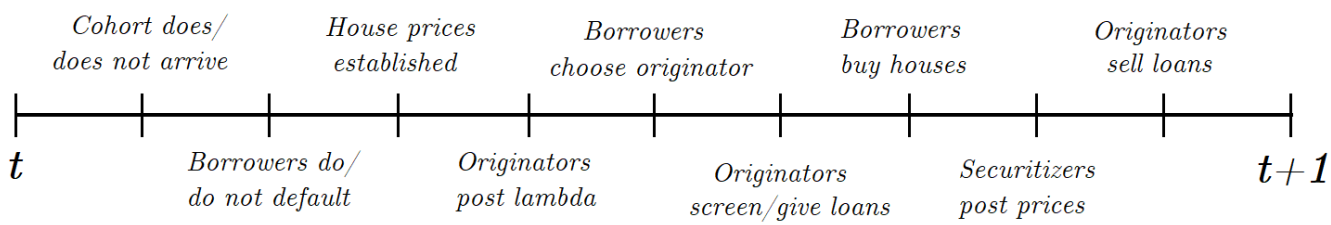
$$W^S_{s,t}(Q_j) = \sum_{j \in J} \{ [\sum_{i \in I(j,H)} q^O_{i,j} (X_H(r_i) - P^*(r_i))] + [\sum_{i \in I(j,L)} q^O_{i,j} (E(X_L(r_i)) - P^*(r_i))] \}$$

- Securitizers cannot screen loans; bid for loans of given interest rates, conditional on beliefs.
- Originators are the 'financial intermediates' in model.

▸ Securitization

Timeline

- A new cohort arrives (or not).
- Default decision by borrowers.
- New borrowers approach originators for loans.
- Borrowers buy houses.
- Securitizers post prices, originators choose to sell loans.



Screening Equilibrium

Under no belief switching. Solved analytically via PBE

- Focus on equilibrium under parameter restrictions: Screening is not too costly and risk aversion is high enough.
- Loans believed to consist of a speculator borrower are too cheap; unprofitable for originators.
- Screening equilibrium where loans are sold cannot exist, due to asymmetry of information.
  - Originators can 'mask' speculators as owner-occupiers.
- Unique result with screening: originators lend only to owner-occupiers, don't sell to securitizers.

▸ Signalling ▸ Restrictions and Prices ▸ Belief Switching

No-Screening Equilibrium

- Additional parameter restrictions: costs are sufficiently high and speculators are a minority.
- New equilibrium: Originators don't screen and sell all loans to securitizers.
  - Price of unscreened loans is higher than cost of loan.
- Potential deviation is to 'skim the cream'.
  - Cost restriction make this unprofitable.

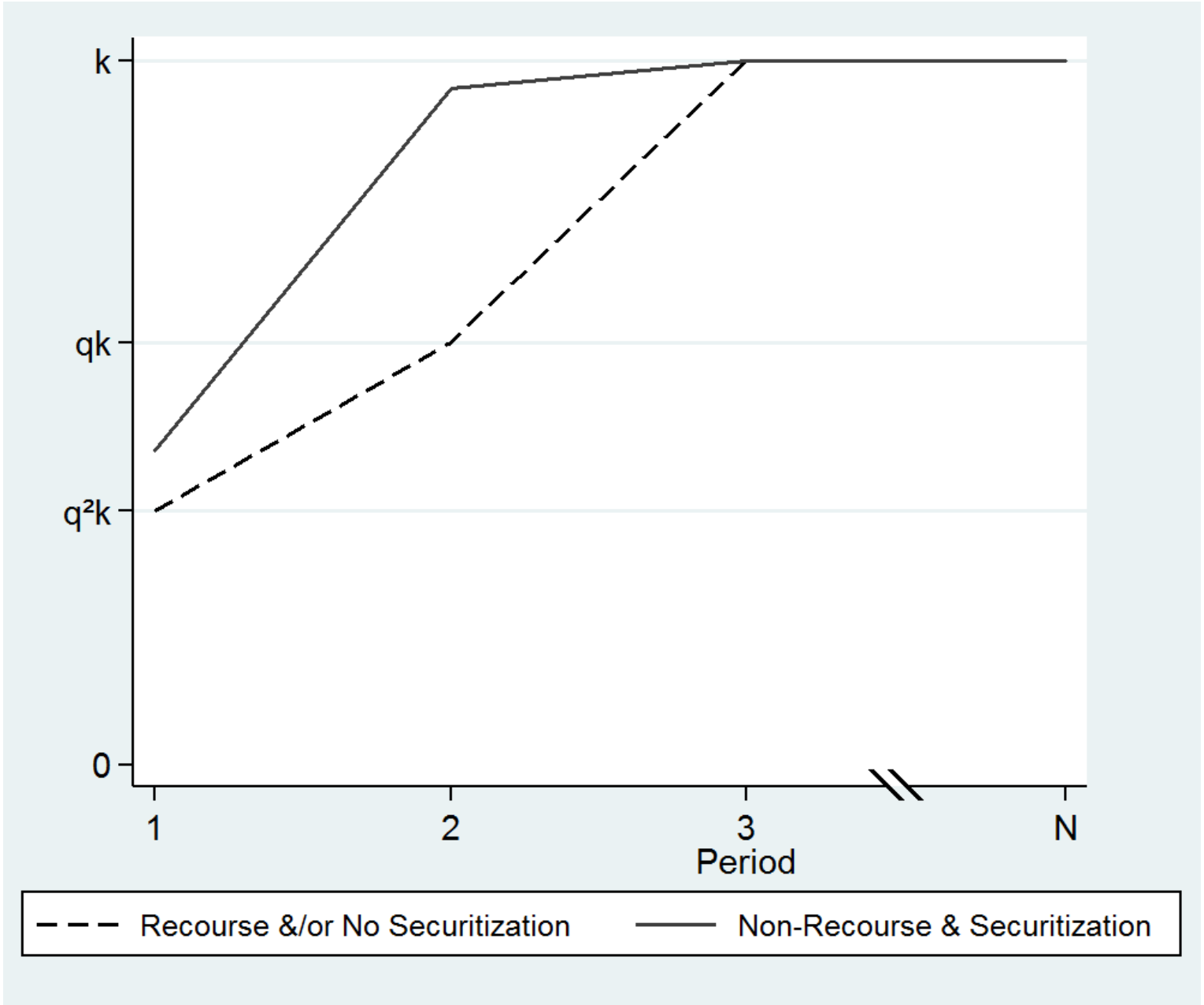
▸ Restrictions ▸ LTV

No-Screening Equilibrium - House prices

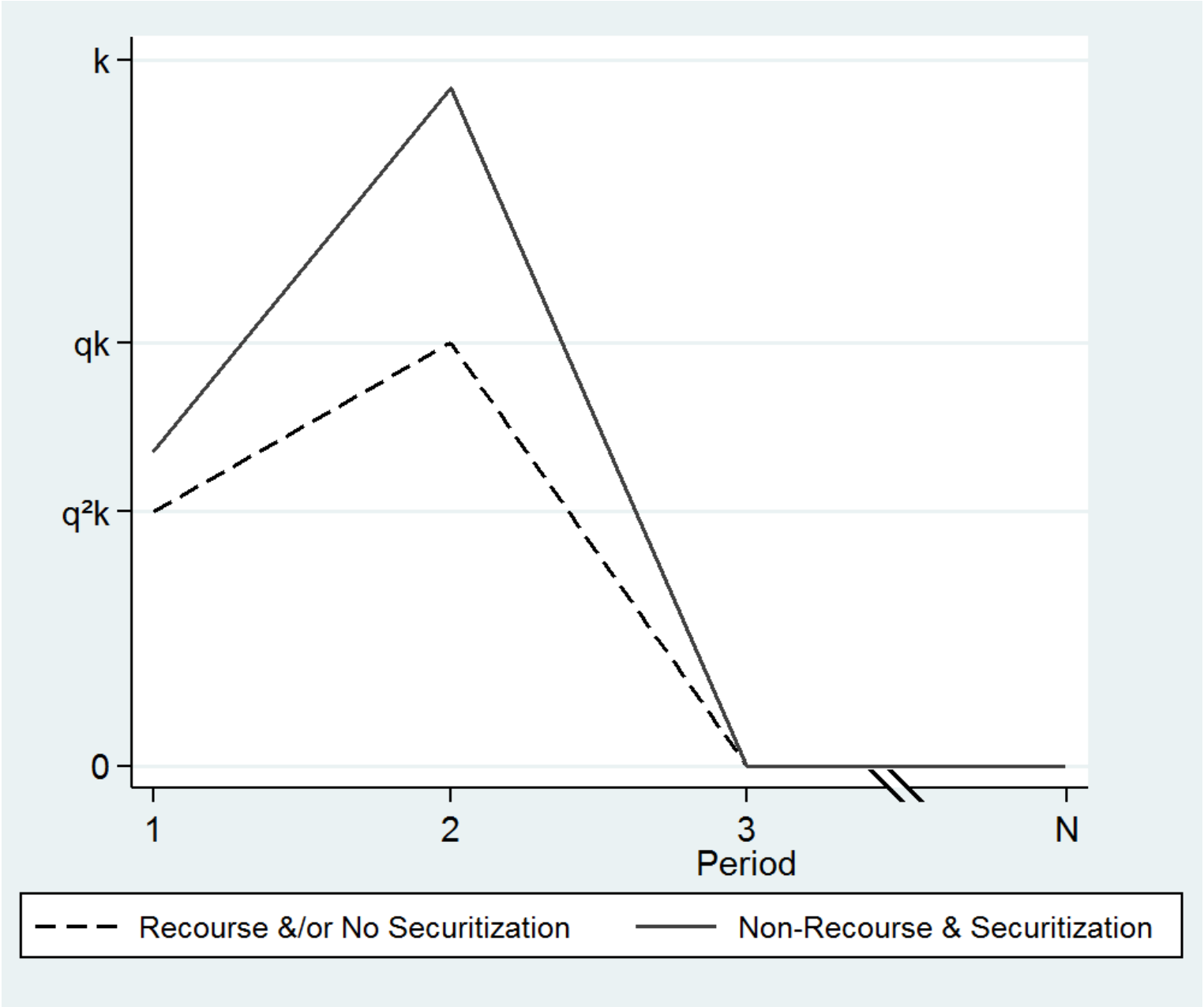
- Both Borrower types receive loans.
- In period 2, arriving borrowers must buy from *speculators* who bought in 1.
- Non-recourse loans increases value of selling speculators.
  - Pushes up prices in 2 and 1, due to RE.
- Absence of securitization and/or non-recourse leads to prices equal to screening equilibrium.

▸ Prices ▸ Interest Rates

House prices boom, no bust



House prices boom and bust



Model predictions

- Only in no-screening equilibrium are loans securitized: our model prediction.
- **Interaction between non-recourse status and securitization** should lead to higher house prices during booms; more securitization means greater chances of speculators loans.
- Equivalent interaction for *accumulated boom securitization* means bigger falls in prices and more defaults during bust.
- Robust to addition of risk-averse borrowers and LTV rations.
- Ex-ante welfare is higher in securitization equilibrium; potentially misleading price.

▸ Welfare ▸ Misleading Prices

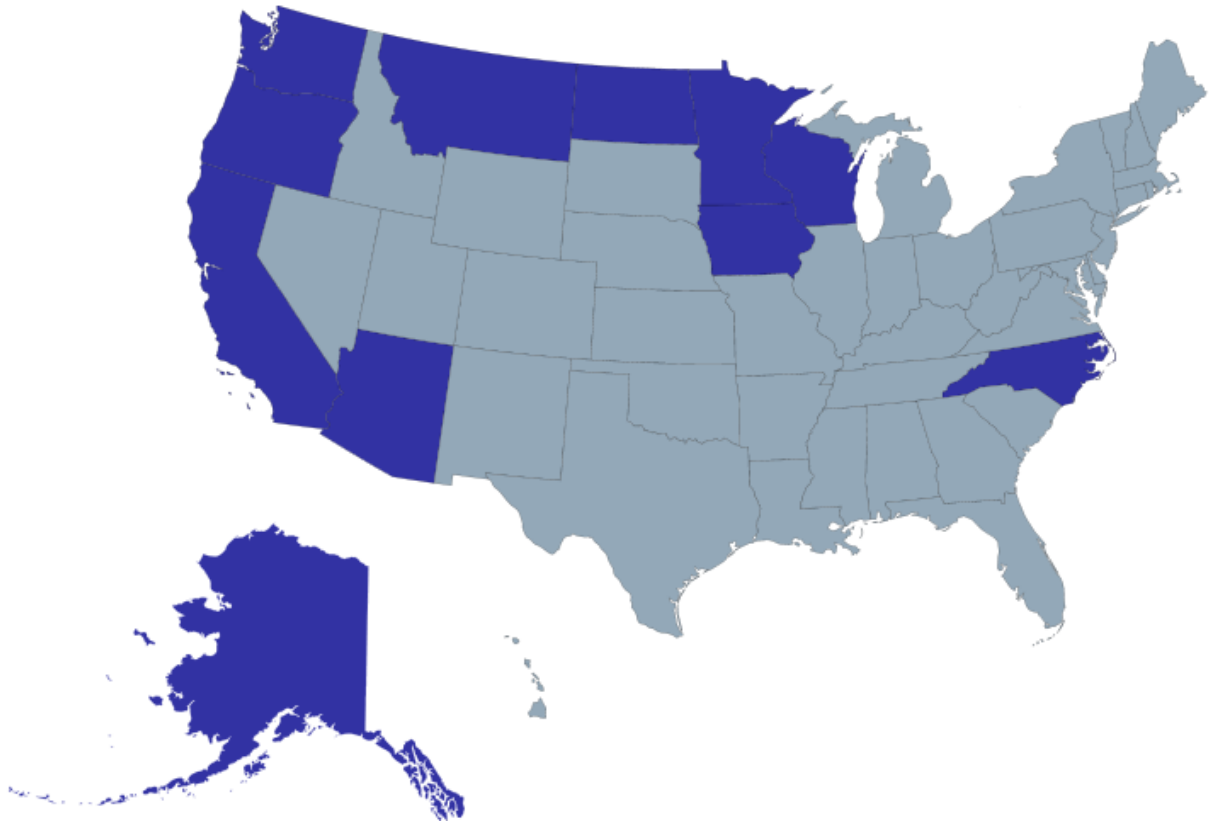
Securitization Data

- Model securitization vs in practice.
  - Control for levels of securitization or a dummy for high levels (above 50%).
- My measure: percentage of loans privately securitized of total purchasing loans originated each year, per state or MSA
- Private securitization data from the HMDA LAR datasets.
  - Originators beliefs for loans sold within calendar years.
  - Likely underestimating measure of securitization; should capture relative differences.
- Focus on State results: better and more data.

▸ Securitization vs Recourse ▸ Data

Non-Recourse States

- Non-recourse stems mainly from the Great Depression.
- Eleven states are non-recourse (Ghent and Kudlyack, 2011): Alaska, Arizona, California, Iowa, Minnesota, Montana, North Carolina, North Dakota, Oregon, Washington and Wisconsin.



Descriptive Statistics

Average 2004-2006	Non-Recourse States	Recourse States
Securitization (%)	3.66 (2.47)	3.94 (2.47)
Income	34523 (3360)	35481 (6451)
Income Growth (%)	4.91 (1.65)	5.29 (1.88)
Population	6922 (9464)	5485 (5296)
Unemployment (%)	4.98 (1.09)	4.83 (1.05)
Mortgage Defaults (%)	0.85 (0.32)	1.21 (0.52)
Subprime (%)	19.23 (7.97)	21.84 (7.13)

Average 2004-2012	Non-Recourse States	Recourse States
Securitization (%)	1.86 (2.07)	1.75 (2.19)
Income	38350 (4957)	39021 (7882)
Income Growth (%)	3.77 (3.48)	3.47 (3.19)
Population	7147 (9704)	5627 (5469)
Unemployment (%)	6.37 (2.28)	6.34 (2.25)
Mortgage Defaults (%)	2.93 (2.60)	3.47 (3.00)
Subprime (%)	10.42 (8.37)	12.54 (8.86)

Standard deviation in parenthesis.

▸ State Defaults

Empirical strategy

$$HPrice_{i,t} = \beta_1 Sec_{i,t} + \beta_2 NonRec_i + \beta_3 Sec * NonRec_{i,t} + \gamma_{i,t} + \varepsilon_{i,t}$$

- where $HPrice_{i,t}$ are house prices in state/MSA i at time t, $Sec_{i,t}$ is the percentage of securitization of new mortgages, $NonRec_i$ is a dummy for non-recourse status, $\gamma_{i,t}$ are controls.

$$HPrice_{i,t} = \beta_1 TopSec_{i,t} + \beta_2 NonRec_i + \beta_3 TopSec * NonRec_{i,t} + \gamma_{i,t} + \varepsilon_{i,t}$$

- where $TopSec_{i,t}$ is a dummy for MSAs with the above median value of securitized new mortgages (top 50%).
- Using state/MSA fixed effects (RE for $TopSec$) and year dummies, from 2004 to 2006, clustered, robust standard errors.

Main Results

VARIABLES	(1) HPrice	(2) HPrice	(3) HPrice
Securitization	1.177**	0.774***	
	(0.484)	(0.228)	
Securitization*NonRecourse	1.262**	0.513**	
	(0.542)	(0.251)	
TopSecuritization			1.679***
			(0.552)
TopSecuritization*NonRecourse			2.663**
			(1.148)
Observations	153	1,055	1,053
R-squared	0.880	0.826	
Number of State/MSA	51	352	351
Dataset	State	MSA	MSA
Method	FE	FE	RE

Robust, clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
Regressions include controls and year dummies. Annual data from 2004 to 2006.

▸ Controls

Empirical Results, Boom period, Robustness checks and alternate specifications

- GSE
- YEAR
- CASE-SHILLER
- ALT RECOURSE
- INTEREST RATES
- NO CALIFORNIA
- WESTERN STATES
- COASTAL STATES
- EXTENDED YEAR
- FURTHER TOP 50%
- SUBPRIME
- LOAN-TO-INCOME
- HAUSMAN-TAYLOR
- ALL

Boom period discussion

- Every 1 p.p. more securitization in a state, house prices increased by 1% in the period.
- Interaction between non-recourse status and securitization roughly doubles the coefficient of securitization.
- Non-recourse states experienced an average 21% increase in house prices vs an increase of 16.5% in recourse states in those 2 years.
- The interaction effect / our mechanism covers around 75% (3.5 p.p.) of the difference.
- Results largely robust and/or compatible to alternative specifications.
- There are potential endogeneity issues.

▸ COVARIATE SHARES

Bust period Strategy

$$HPrice_{i,t}, MDefaults_{i,t} = \beta_1 Dyr \times PastSec_i + \beta_2 Dyr \times NonRec_i + \beta_3 Dyr \times PastSec * NonRec_i + \gamma_{i,t} + \varepsilon_{i,t}$$

- $MDefaults_{i,t}$ is the percentage of mortgage defaults (90+ days delinquent[1]), *PastSec* is the average securitization from 2004 to 2006 and $PastSec * NonRec$ the interaction effect between *PastSec* and *NonRec* and *Dyr* are yearly dummies.
- Using fixed effects and year dummies, from 2007 to 2009/2010, state-level regressions with clustered standard errors.
- Some regressions also include *PastSubprime*, analogous to *PastSec* for subprime mortgages.

[1] FRBNY

Empirical Results, Bust period, House prices

VARIABLES	(1) HPrice	(2) HPrice	(3) HPrice	(4) HPrice
D2008*PastSecuritization	-0.731	-0.630	-0.617	-0.483
	(0.597)	(0.576)	(0.532)	(0.509)
D2009*PastSecuritization	-1.785**	-1.652**	-1.654**	-1.502**
	(0.850)	(0.786)	(0.771)	(0.708)
D2010*PastSecuritization		-2.158**		-2.021**
		(0.808)		(0.774)
D2008*PastSecuritization*NonRecourse	-1.922*	-1.882*	-1.286	-1.261
	(1.116)	(1.121)	(0.977)	(1.018)
D2009*PastSecuritization*NonRecourse	-2.179**	-2.100**	-1.379	-1.362
	(1.008)	(0.989)	(0.991)	(1.004)
D2010*PastSecuritization*NonRecourse		-1.317		-0.658
		(0.949)		(1.072)
Observations	153	204	153	204
R-squared	0.801	0.831	0.824	0.844
Number of State	51	51	51	51
End	2009	2010	2009	2010
Extra Variable	None	None	PastSubprime	PastSubprime

Robust, clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Regressions include controls and year dummies. Annual data from 2007 to 2009/2010.

Empirical Results, Bust period, Defaults

VARIABLES	(1) Defaults	(2) Defaults	(3) Defaults	(4) Defaults
D2008*PastSecuritization	0.204*	0.228*	0.207*	0.211**
	(0.117)	(0.116)	(0.106)	(0.104)
D2009*PastSecuritization	0.692***	0.712***	0.666***	0.660***
	(0.206)	(0.208)	(0.191)	(0.189)
D2010*PastSecuritization		0.593***		0.588***
		(0.205)		(0.199)
D2008*PastSecuritization*NonRecourse	0.0685	0.0913	-0.0142	-0.00267
	(0.176)	(0.159)	(0.179)	(0.171)
D2009*PastSecuritization*NonRecourse	0.0771	0.128	-0.101	-0.0575
	(0.266)	(0.261)	(0.276)	(0.277)
D2010*PastSecuritization*NonRecourse		-0.143		-0.223
		(0.268)		(0.294)
Observations	153	204	153	204
R-squared	0.852	0.847	0.864	0.857
Number of State	51	51	51	51
End	2009	2010	2009	2010
Extra Variable	None	None	PastSubprime	PastSubprime

Robust, clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Regressions include controls and year dummies. Annual data from 2007 to 2009/2010.

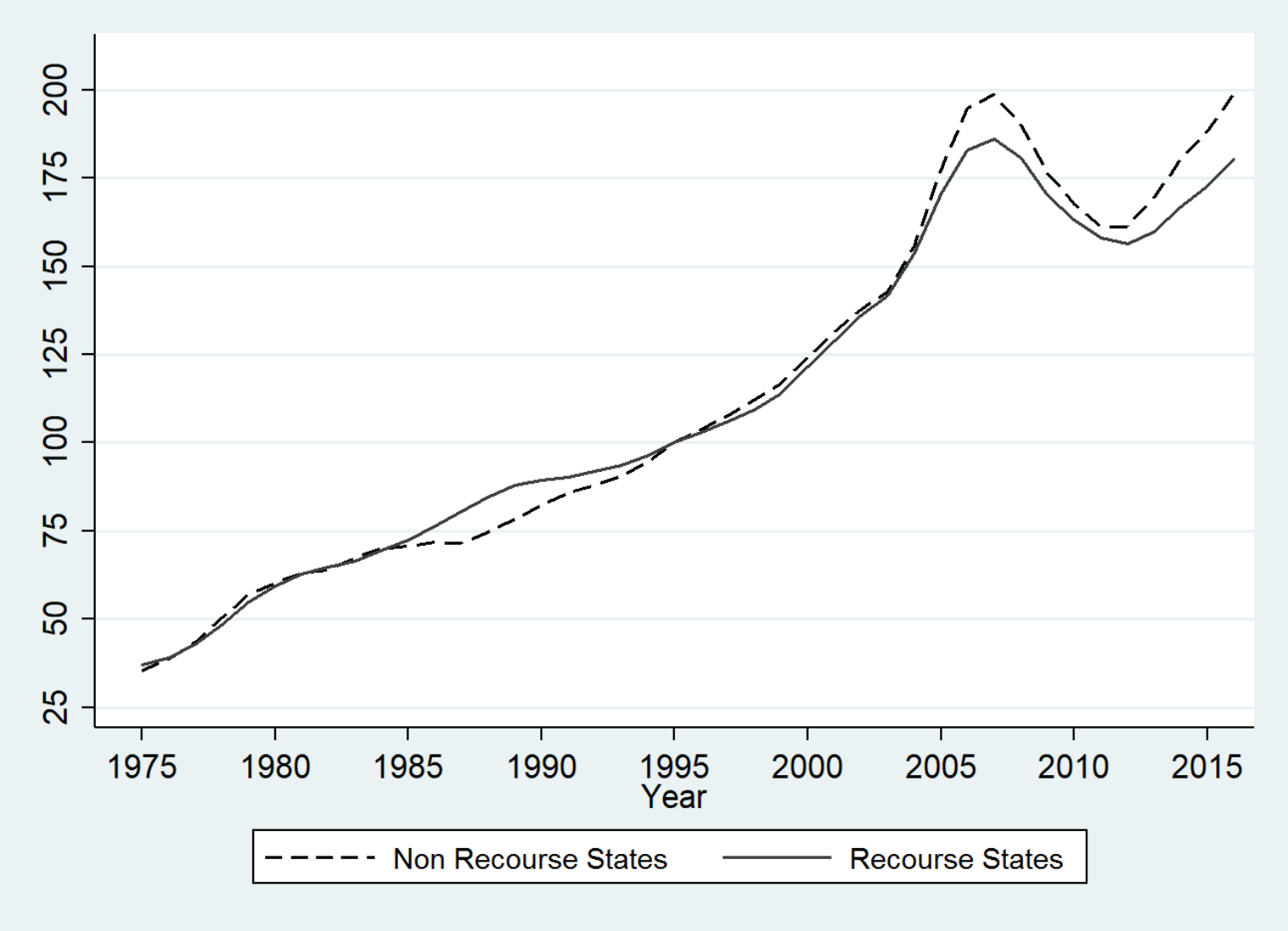
Conclusion

- My model predicts that the interaction between securitization and non-recourse should increase growth in prices during a boom.
- Concurring evidence: House price growth associated with securitization doubled in non-recourse states
- Can explain 75% of the gap between the average recourse and non-recourse state.

Policy implications

- My model and, to some extent, empirical results are independent of subprime loans.
  - Mechanism *may* result in misleading prices; non-RE should relax conditions for model results.
- Suggests that non-recourse markets regulators should pay attention to the secondary market for mortgages.
  - Particularly worrying when financing is loose.
- Recent changes to Dodd-Frank laws are troubling as non-recourse remains.
- Also applicable to in Brazil, with 'alienacao fiduciaria' loans.

House prices, Recourse vs Non-Recourse, Extended



Back

Literature on Recourse

- Evidence (in the 2000s) that recourse affected:
- Defaults: Ghent and Kudlyack(2011), Dobbie and Goldsmith-Pinkham (2014) and Westrupp (2015).
- Recourse affecting debt choices after mortgage default: Chan, Haughwout, Hayashi, and Klaauw (2016).
- House prices and actions for borrowers and loan originators: Ghent and Kudlyack (2011), Nam and Oh (2014).
- Amount recovered in case of defaults: Pennington-Cross (2003).

▸ Overview

Securitization

- Securitization is the process by which loans are sold by originators to intermediates, who aggregate and 'tranche' these loans, and are subsequently re-sold to investors.
- Aggregation to diversify risk; presupposes housing markets are independent of each other.
- Tranching slices default / early pre-payment risk.
- Typically involves many steps and different intermediates.
- 'An overarching friction which plagues every step in the process is asymmetric information...', Ashcraft and Schuermann (2008).
- Elul (2011) suggests that private information by originators explains why securitized loans had higher default rates; no screening.

▸ Overview ▸ Securitizers ▸ GSEs

GSEs, Government Sponsored Enterprises

- I exclude securitization done via Fannie Mae and Freddie Mac.
- Ghent and Kudlyak (2011) find that loans held by GSEs are unaffected by recourse status.
  - FHFA in 2012 found recovery rates of less than 1%.
- Default rates on GSE loans in 2008 and 2009, although high by historical standards, were less than half than for non-Prime loans (Angelides and Thomas, 2011)
- Results robust to regressing with GSEs.

▸ Securitization ▸ Data

Bankruptcy

- Borrowers in the US can declare bankruptcy, via chapter 7 or chapter 13.
- According to Ghent and Kudlyack (2011):
  - Chapter 7 fillings can eliminate the possibility of a deficiency judgment, required to have recourse on a defaulted loan.
  - Chapter 13 does not eliminate it and may be the only avenue in many cases.
- BAPCPA of 2005 greatly reduced the scope for declaring chapter 7.
- Chapter 7 affects all assets / debts, should be more costly and time consuming than defaulting on a single loan.
- In our model, income is high enough and defaults voluntary, so that chapter 7 might not be possible (BAPCPA restricts filings).

Old low types

- Old low types have zero utility for transaction purposes.
  - Need only that utility from housing is lower than that of owner-occupiers.
- Can also be thought of as previous owner-occupiers wishing to move or construction companies, with some stock of houses.
  - For the latter, we need only that there is a lag in construction and demand grows faster than supply.

Back

Borrowers Risk Neutrality

- Borrowers can be made risk averse like originators.
- Does not affect owner-occupiers, no uncertainty.
- For speculators, risk aversion cannot be too high, $\frac{1}{(1-q)(A_2-A_1(1+r))} \geq a$.
- Can show numerically, this holds for $q > 0.25$
- Otherwise, sufficiently risk averse speculators never gamble.

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Signalling

- 'Notably, only the hard information about the borrower (FICO score) and the contractual terms (e.g., LTV ratio, interest rate) are used by investors when buying these loans as part of a securitized pool.' Keys, et al. (2010)
- This is due to the number of intermediates and steps involved in securitization; the possibility of sending 'soft' information is greatly restricted.
  - Whether a borrower is a owner-occupier or speculator comes down to borrower's intent, which is 'soft' information.
- Median state interest rate went from 5.78 to 6.59 from 2004 to 2006 (std of around 0.13).
- Introducing LTV may or may not stop speculators from receiving loans; depends on whether originators are large enough/can affect the house price equilibrium.

▸ Originators ▸ Equilibrium ▸ LTV

Loan-to-value ratios

- Introducing LTV creates three possibilities:
- Without restricted incomes, trivial equilibrium with 100% loans.
- With restricted incomes:
  - If originators are small/take house prices as given, we can sustain the same speculator equilibrium and no down-payments.
  - If originators are large/can affect house prices, down-payments compensate higher r for owner-occupiers and self-selection is possible.
- Median LTV ratios went from 90% to 100%/95% from 2004 to 2006 for securitized Non-Prime loans (Mayer, Pence, and Sherlund, 2009); suggests that speculators were receiving loans.

▸ Originators ▸ Equilibrium ▸ Signalling

Originator profit per period

- Screen and only lend to owner-occupiers:

$$Y(Q_j^O, 1, 0, I(j)) = \sum_{i \in I(j)} q_{i,j}^O (P^*(r_i) - 1) + (1 - q_{i,j}^O) X_H(r_i)$$

- Screen and lend to both types:

$$\begin{aligned} Y(Q_j^O, 1, 1, I(j)) = &\{ \sum_{i \in I(j,H)} q_{i,j}^O (P^*(r_i) - 1) + (1 - q_{i,j}^O) X_H(r_i) \} \\ &+ \{ \sum_{i \in I(j,L)} q_{i,j}^O (P^*(r_i) - 1) + (1 - q_{i,j}^O) E(X_L(r_i)) \} \end{aligned}$$

- Don't screen:

$$\begin{aligned} Y(Q_j^O, 0, \emptyset, I(j)) = &\{ \sum_{i \in I(j,H)} q_{i,j}^O (P^*(r_i) - 1) + (1 - q_{i,j}^O) X_H(r_i) \} \\ &+ \{ \sum_{i \in I(j,L)} q_{i,j}^O (P^*(r_i) - 1) + (1 - q_{i,j}^O) E(X_L(r_i)) \} \end{aligned}$$

▸ Originators

Interest rates

- Without securitization, interest rates are: $\tilde{r} = \frac{1}{1-\gamma(1-q)} - 1$
- With securitization, screening equilibrium interest rates are: $r_{H,.} = \frac{C}{(1-\gamma)q\kappa}$
- With securitization, no-screening equilibrium interest rates are: $\tilde{r}_{P,.} = \frac{1}{1-\gamma(1-q)} - 1$
- Thus our model predicts that no-screening rates are lower than screening ones, through no 'cream skimming' cost restriction.

Interest rates

- Slightly lower interest rates for non-recourse states during boom.
- On a year to year basis, reject equal interest rates at 10%, 5% and 10% for 2004, 2005 and 2006, as per the model.
- Cannot reject the hypothesis that they were equal when testing those years combined.

▸ Prices ▸ Equilibrium

Welfare analysis

- Moving from screening to no-screening increases welfare.
- Aside from costs, all changes in utility involve zero-sum exchanges between risk neutral agents or risk adverse agents without uncertainty.
- Absence of costs means higher welfare in no-screening equilibrium.
- Limitations:
- Risk neutrality as a proxy for securitization limits applicability of welfare analysis; uncertainty, tranching and fraud matter.
- (Speculative) Higher prices may lead to oversupply.

▸ Back ▸ Oversupply

Oversupply

- Prices do not reflect cohort arrival probability when speculators with default options buy houses; increased price may be misleading signal.
- If supply was not fixed, prices above social optimal may lead to overbuilding:
- Prices can be a signal for construction of new homes.
- Houses are built with a lag.
  - Chatterjee and Eyigungor's (2015) calibration finds that overbuilding may explain up to 40% of foreclosures in the bust.
- Furthermore, higher prices with adaptive expectations may lead further speculative behaviour by borrowers (Gao, Sockin and Xiong, 2017).

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Screening Equilibrium

- Screening is not too costly, $C < q\kappa(1-q)(1-\gamma)$.
- Otherwise, no lending.
- Risk aversion is high enough, $a \geq \frac{\sqrt{\gamma^2 + \frac{(1-\gamma(1-q))^2}{q(1-q)}} - \gamma}{2q^2\kappa}$.
- Assumption for analytical convenience; equilibrium is unclear otherwise.

Screening Equilibrium

- Speculators default if $1 + \tilde{r}_{L,2} \geq \frac{1}{q}$, so $P_{L,2} \leq \tilde{A}_2$.
- Old low types only value houses from possible sell value, which corresponds to the fundamental value F_t.
- Prices/fundamental value, will be the expected value of waiting to see owner-occupiers will exceed the housing supply.
  - $F_1 = q^2\kappa + (1-q) \times 0$.
  - $F_2 = q\kappa + (1-q) \times 0$.
  - $F_3 = \kappa$

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Belief Switching

- No Belief Switching: securitizers do not change beliefs about loan composition between periods; trims equilibria into two.
- Relaxing means two more equilibria: in both, no price deviation.
  - Speculators cannot sell in time to affect house prices; we revert to no-loans to speculators.
- With more time periods/different housing stock vs cohort size, deviations are possible.
  - Key: 'Sufficient' amounts of securitization to take place for there to be deviations from fundamental price.

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No Screening Equilibrium Restrictions

- Sufficiently high costs, $\frac{\tilde{A}_2(1-\gamma)\gamma(1-q)}{1-\gamma(1-q)} < C$.
- Otherwise, there will be 'skimming the cream', so only no-securitization equilibrium is sustainable.
- Speculators are a minority, $\gamma < \frac{1}{2}$.
- Otherwise, for some edge cases, no loans are granted.

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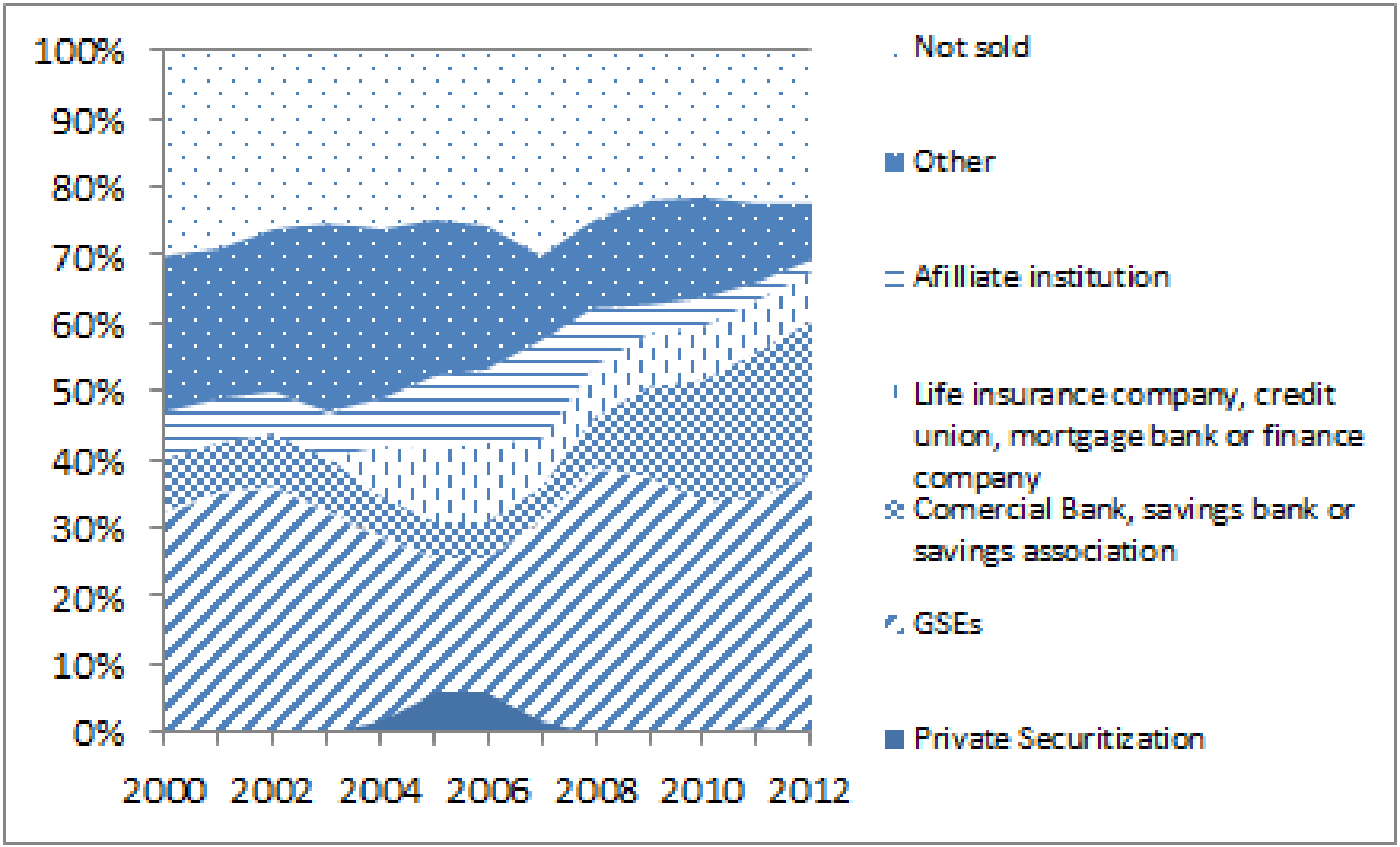
No-Screening Equilibrium

- Equilibrium house prices, $\widetilde{A}$, will be higher than the fundamental price for as long as cohorts arrive and the housing stock is not exhausted:
- $\tilde{A}_1 = q^2\kappa \frac{2(1-\gamma(1-q))}{2(1-\gamma(1-q))-q(1-q)} > q^2\kappa = F_1.$
- $\tilde{A}_2 = q\kappa + q^2\kappa \frac{(1-q)}{2(1-\gamma(1-q))-q(1-q)} > q\kappa = F_2.$

▸ Interest Rates

▸ Equilibrium

Securitization vs other categories in HMDA data



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Securitization and Recourse

VARIABLES	(1) Securitization	(2) Securitization
NonRecourse	-0.286	
	(0.573)	
D2005*NonRecourse		-0.467
		(0.477)
D2006*NonRecourse		-0.033
		(0.497)
Observations	153	153
R-squared		0.814
Number of State/MSA	51	51
Dataset	State	State
Method	RE	FE

Robust clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, Regressions include controls and year dummies. Annual data from 2004 to 2006.

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Data Sources, Securitization

- Securitization data from the HMDA LAR datasets:
- Aggregated on annual basis, covers around 80% of loan originated in any given year[2].
- LAR asks originators to report if loan is sold and to whom, categories of which include 'Private Securitization'
  - If an originator believes the sold loan will be used in securitization, reports as such.
- I use percentage of loans privately securitized of total purchasing loans originated each year, per state or MSA.

▸ GSEs

[2] Fishbein and Essene (2010).

Data Sources, Securitization

- 'Private Securitization' as an option only started from 2004.
- Originators' beliefs may not correspond to what happens.
  - But may be what our model would want anyway.
- Does not cover securitization done by other institutions to whom originators sell loans (intermediate steps in securitization).
- So very likely underestimating the percentage of securitized loans in each State. ▸ Securitization Percent
  - But should be capturing relative differences between states and MSA's levels of securitization.
- House prices from the FHFA (HPI).

▸ HPI and other data

▸ Back

Data Sources, Others

- State and MSA level house prices from FHFA (Fannie Mae and Freddie Mac data), HPI normalized.
  - State uses weighted-repeat sales.
  - MSA use all-transactions methodology.
- Also, population, income and new subprime mortgages [3] for both state and MSA, income growth, unemployment[4] and interest rates[5], for states, all but subprime normalized.

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[3] HMDA.
[4] FRED.
[5] FHFA, effective interest rates for conventional, single family houses.

State Defaults

- Defaults: percentage of 90+ days delinquent mortgages, FRBNY.
- Average recourse states systematically experience more defaults in the period, on a year-by-year basis.
- Including key years of 2007/2008/2009.
- Not statistically significantly different.

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Controls, Boom Period

VARIABLES	(1) HPrice	(2) HPrice	(3)
Income	1.025***	0.881***	1.005***
	(0.311)	(0.0684)	(0.0660)
IncomeGrowth	-0.00694		
	(0.00848)		
Unemployment	-0.169***		
	(0.0619)		
Population	1.821***	0.524**	0.492**
	(0.504)	(0.227)	(0.196)
NonRecourse			0.318
			(0.654)
Constant	-169.4**	-41.90**	-51.12***
	(64.48)	(21.08)	(18.80)
Observations	153	1,076	1,074
R-squared	0.880	0.821	
Number of State/MSA	51	359	358
Dataset	State	MSA	MSA
Method	FE	FE	RE

Robust, clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Regressions include controls and year dummies. Annual data from 2004 to 2006.

Robustness, Boom period, GSE

VARIABLES	(1) HPrice	(2) HPrice
Securitization NonRecourse	1.300***	1.194**
	(0.460)	(0.469)
Securitization*NonRecourse	1.421**	1.841***
	(0.550)	(0.570)
GSE	-0.348**	-0.466**
	(0.160)	(0.180)
GSE*NonRecourse		0.858***
		(0.282)
Observations	153	153
R-squared	0.886	0.892
Number of State	51	51
Dataset	State	State
Method	FE	FE
Change	GSE	GSE w/ Interaction

Robust, clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Regressions include controls and year dummies. Annual data from 2004 to 2006.

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Robustness, Boom period, YEAR

VARIABLES	(1) HPrice	(2) HPrice
Securitization	0.708	0.957***
	(0.752)	(0.264)
Securitization*NonRecourse	3.714*	0.596
	(2.052)	(0.411)
Observations	102	204
R-squared	0.858	0.866
Number of State/MSA	51	51
Dataset	State	State
Method	FE	FE
Change	Start 2005	End 2007

Robust, clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Regressions include controls and year dummies. Annual data from 2004 to 2006.

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Robustness, Boom period, CASE-SHILLER

VARIABLES	(1) HPrice
Securitization	0.842
	(0.495)
Securitization*NonRecourse	0.749
	(1.000)
Observations	54
R-squared	0.787
Number of State/MSA	18
Dataset	MSA
Method	FE
Change	Case-Shiller

Robust, clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Regressions include controls and year dummies. Annual data from 2004 to 2006.

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Robustness, Boom period, ALT REC CLASSIFICATION

VARIABLES	(1) HPrice
Securitization	1.176**
	(0.479)
Securitization*NonRecourse(KM)	1.118*
	(0.569)
Observations	153
R-squared	0.877
Number of State/MSA	51
Dataset	State
Method	FE
Change	Alt Recourse

Robust clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, Regressions include controls and year dummies. Annual data from 2004 to 2006. NonRecourse(KM) classifies Alaska, North Carolina and Wisconsin as recourse, compared to NonRecourse.

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Robustness, Boom period, INTEREST RATES

VARIABLES	(1) HPrice	(2) HPrice
Securitization	1.159**	0.430
	(0.491)	(0.610)
Securitization*NonRecourse	1.258**	0.971*
	(0.545)	(0.518)
Observations	153	153
R-squared	0.880	0.888
Number of State/MSA	51	51
Dataset	State	State
Method	FE	FE
Change	Interest Rates	Int and Subprime

Robust, clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Regressions include controls and year dummies. Annual data from 2004 to 2006.

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Robustness, Boom period, SUBPRIME

VARIABLES	(1) HPrice	(2) HPrice	(3) HPrice
Securitization	0.409	0.113	0.430
	(0.600)	(0.244)	(0.610)
Securitization*NonRecourse	0.969*	0.343	0.971*
	(0.518)	(0.240)	(0.518)
Observations	153	1,055	153
R-squared	0.888	0.840	0.888
Number of State/MSA	51	352	51
Dataset	State	MSA	State
Method	FE	FE	FE
Change	Subprime	Subprime	Int and Subprime

Robust, clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Regressions include controls and year dummies. Annual data from 2004 to 2006.

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Robustness, Boom period, NO CALIFORNIA

VARIABLES	(1) HPrice	(2) HPrice
Securitization	0.456	0.840***
	(0.598)	(0.226)
Securitization*NonRecourse	1.264*	0.952***
	(0.667)	(0.352)
Observations	150	977
R-squared	0.886	0.810
Number of State/MSA	50	326
Dataset	State	MSA
Method	FE	FE
Change	No California	No California

Robust, clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Regressions include controls and year dummies. Annual data from 2004 to 2006.

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Robustness, Boom period, WESTERN STATES

VARIABLES	(1) HPrice	(2) HPrice
Securitization	1.251	1.189
	(0.890)	(0.726)
Securitization*NonRecourse	2.428***	-0.862**
	(0.786)	(0.403)
Observations	111	114
R-squared	0.737	0.844
Number of State/MSA	13	38
Dataset	State	State
Method	FE	FE
Change	Western	Non-Western

Robust, clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Regressions include controls and year dummies. Annual data from 2004 to 2006.

Robustness, Boom period, WESTERN STATES

- Average securitization level of MSAs in non-Western, non-recourse states is 2.2%, compared to 5.9% in Western states.
- In non-Western, non-recourse states 19% of MSAs (7 in total) are among the top 50%, in Western, non-recourse states, 85% of MSAs are.
- Highest percentage of securitization experienced by any MSA in the non-Western, non-recourse states was 5.9%, just over 15.7% in Western, non-recourse states.
- Not enough securitization in non-recourse, non-Western states for our model mechanisms to take place in a state level.
- We run using the top securitization dummy instead; positive, but smaller and insignificant coefficient.

Robustness, Boom period, WESTERN STATES

VARIABLES	(1) HPrice	(2) HPrice
TopSecuritization	2.341***	
	(0.569)	
TopSecuritization×NonRecourse	0.870	
	(3.123)	
D2005×TopSecuritization		3.045***
		(0.713)
D2006×TopSecuritization		4.753***
		(1.192)
D2005×TopSecuritization×NonRecourse		0.694
		(3.560)
D2006×TopSecuritization×NonRecourse		0.791
		(5.707)
Observations	837	837
R-squared		0.784
Number of MSA	279	279
Dataset	MSA	MSA
Method	RE	FE

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Regressions include controls and year dummies. Annual data from 2004-2006

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Robustness, Boom period, COASTAL STATES

VARIABLES	(1) HPrice	(2) HPrice
Securitization	1.426***	0.160
	(0.205)	(0.335)
Securitization*NonRecourse	0.803	1.487
	(0.505)	(0.954)
Observations	72	81
R-squared	0.911	0.887
Number of State/MSA	24	27
Dataset	State	State
Method	FE	FE
Change	Coastal	Non-Coastal

Robust, clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Regressions include controls and year dummies. Annual data from 2004 to 2006.

Back

Robustness, Boom period, 1991-2006

VARIABLES	(1) HPrice
Securitization	3.333***
	(0.425)
Securitization*NonRecourse	1.525***
	(0.570)
Observations	816
R-squared	0.949
Number of State/MSA	51
Dataset	State
Method	FE
Change	1991-2006

Robust clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, Regressions include controls and year dummies. Annual data from 1991 to 2006. Regression assumes securitization is zero prior to 2004.

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Robustness, Boom period, FURTHER TOP 50%

VARIABLES	(1) HPrice	(2) HPrice
Securitization	0.394	
	(0.320)	
Securitization*NonRecourse	0.536*	
	(0.285)	
D2005*TopSecuritization		2.537***
		(0.681)
D2006*TopSecuritization		3.879***
		(1.143)
D2005*TopSecuritization*NonRecourse		4.824***
		(1.338)
D2006*TopSecuritization*NonRecourse		4.413*
		(2.373)
Observations	528	1,053
R-squared	0.848	0.833
Number of State/MSA	176	351
Dataset	MSA	MSA
Method	RE	FE
Change	Top 50%	Top 50% w/ year dummies

Robust, clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
Regressions include controls and year dummies. Annual data from 2004 to 2006.

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Robustness, Boom period, Loan-to-Income

VARIABLES	(1) HPrice
Securitization	1.852***
	(0.445)
Securitization*NonRecourse	1.509***
	(0.506)
Observations	153
Number of State	51
R-squared	0.904
Dataset	State
Method	FE
Change	LTI

Robust, clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Regressions include controls and year dummies. Annual data from 2004 to 2006.

Back

Robustness, Boom period, Hausman-Taylor

VARIABLES	(1) HPrice	(2) HPrice
Securitization	2.988***	0.787***
	(0.717)	(0.229)
Securitization*NonRecourse	1.532	0.528**
	(0.964)	(0.235)
Observations	459	1,076
R-squared		
Number of State/MSA	51	359
Dataset	State	MSA
Method	HT	HT

Robust, clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Regressions include controls and year dummies. Annual data from 2004 to 2006.

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Robustness, Boom period, All additional controls

VARIABLES	(1) HPrice
Securitization*NonRecourse	0.552
	(0.405)
Securitization*NonRecourse	1.386***
	(0.321)
Observations	153
Number of State	51
R-squared	0.938
Dataset	State
Method	FE
Change	All

Robust, clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Regressions include controls and year dummies. Annual data from 2004 to 2006. Controls include GSE, GSE*NonRecourse, Subprime, Interest rates and LTI.

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Share of covariates in explaining average house price growth

Variable	Non-Recourse	Recourse
Sec	15%	18%
SecNonRec	16%	N/A
Inc	41%	55%
Pop	18%	16%
IncG	-1%	-1%
Unemp	11%	11%

At average values, shares each covariate explains fitted, average house price growth in recourse and non-recourse states from 2004-2006.

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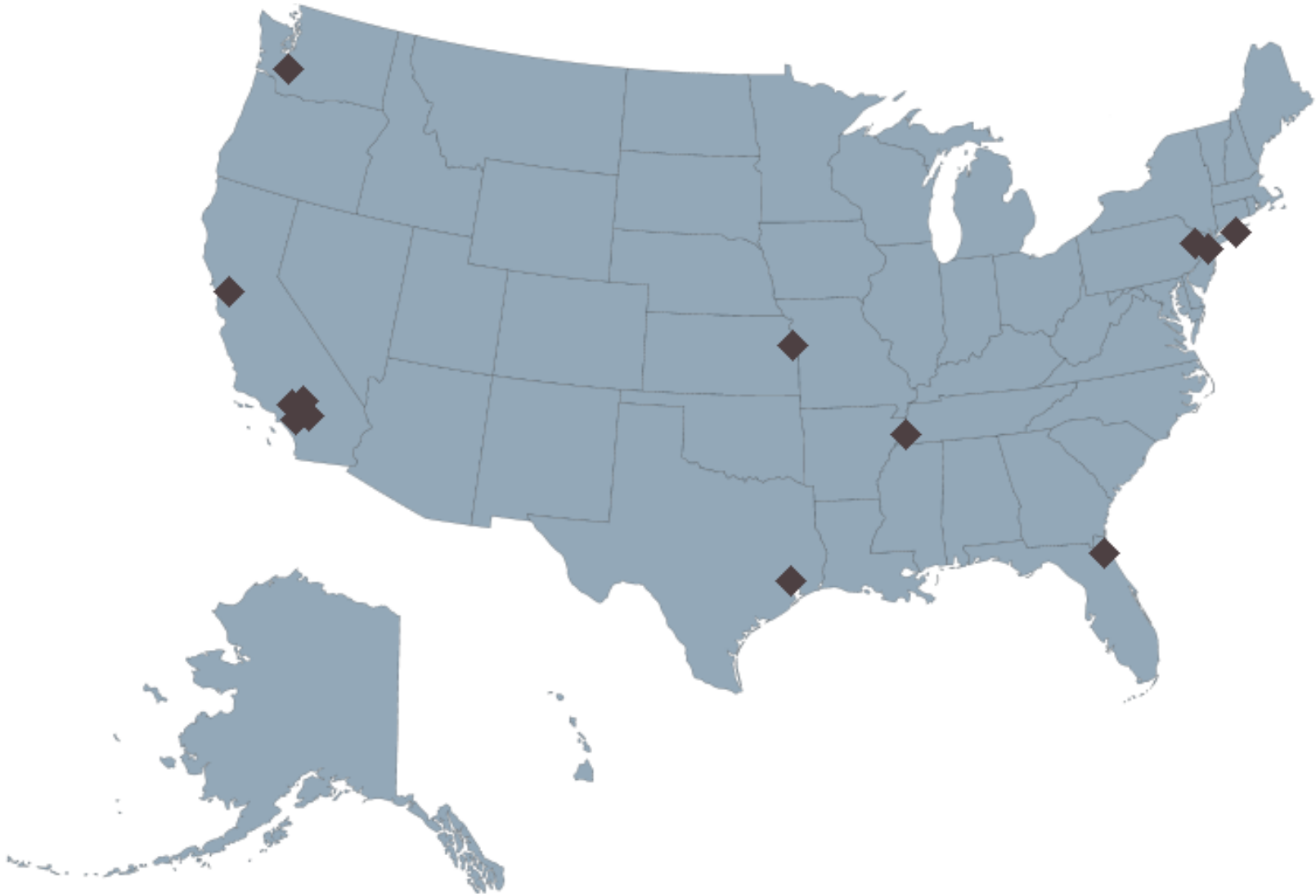
Headquarters

Originator	Foundation Date	Headquarter City
NOVASTAR MORTGAGE	1996	Kansas City, MO
FIRST HORIZON HOME LOAN	1995	Memphis, TN
FIRST RESIDENTIAL MORTGAGE	1995	Louisville, KY
LOAN CENTER OF CALIFORNIA	1995	Suisun City, CA
GATEWAY FUNDING DIVERSIFIED	1994	Horsham, PA
AEGIS MORTGAGE	1993	Houston, TX
INDYMAC BANCORP	1985	Pasadena, CA
EAGLE HOME MORTGAGE	1984	Bellevue, WA
CHAPEL MORTGAGE	1984	Rancocas, NJ
DELTA FUNDING	1982	Woodbury, NY
MERRILL LYNCH CREDIT	1981	Jacksonville, FL
LONG BEACH MORTGAGE	1980	Orange, CA
COUNTRYWIDE HOME LOANS	1969	Calabasas/Pasadena, CA
FREMONT INVESTMENT & LOAN	1937	Brea, CA

- "... Chapel Mortgage Corporation (...) initial goal was to establish a regional mortgage banking platform to meet the needs of the small to mid-sized broker."

Headquarters



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