Credit Supply and Housing Speculation

Atif Mian
Princeton

Amir Sufi
Chicago Booth

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Motivation

- "Asset price bubbles depend on the growth in credit" - Charles Kindleberger

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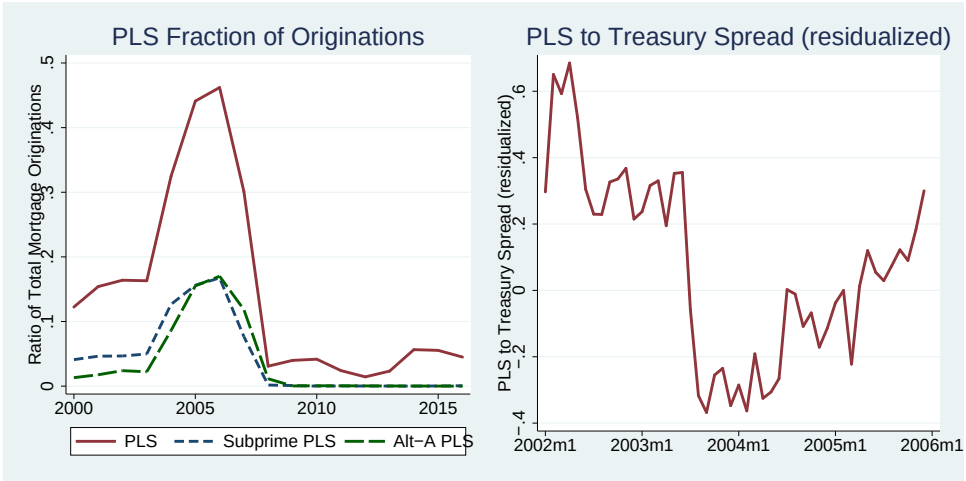
- "Asset price bubbles depend on the growth in credit" - Charles Kindleberger
- How can we test Kindleberger's claim?
  - Isolate a plausibly exogenous expansion in the *supply* of credit
  - Data that allows for measurement of *marginal buyers*
- Measurement of marginal buyers is critical; in theory, "easy credit" ...
  - allows speculators to **shift risk**: Allen and Gale (1993, 2000)
  - fuels speculators trying to **ride the bubble** looking for a "greater fool": Miller (1977), Harrison and Kreps (1978), Scheinkman and Xiong (2003), Abreu and Brunnermeier (2003)
  - increases ability of **optimists** to affect prices when beliefs are hetergeneous: Geanakoplos (2010), Simsek (2013), Burnside, et al (2016), Bordalo et al (2017)

What we do

- **Setting:** Natural experiment - global rise of shadow banking and PLS in 2003, local variation in exposure
- **Data:** HMDA (mortgage-level, originator, monthly as well), TransUnion (at borrower-account level, 10% random sample of universe, construct origination data), Call reports (bank level), Michigan Survey of Consumers (county-level, housing market beliefs), CoreLogic (house prices, transaction volume)
- **Strategy:** Estimate the effect of credit expansion on house prices, volume, and speculative trading activity in the cross-section

Acceleration of private label securitization of mortgages



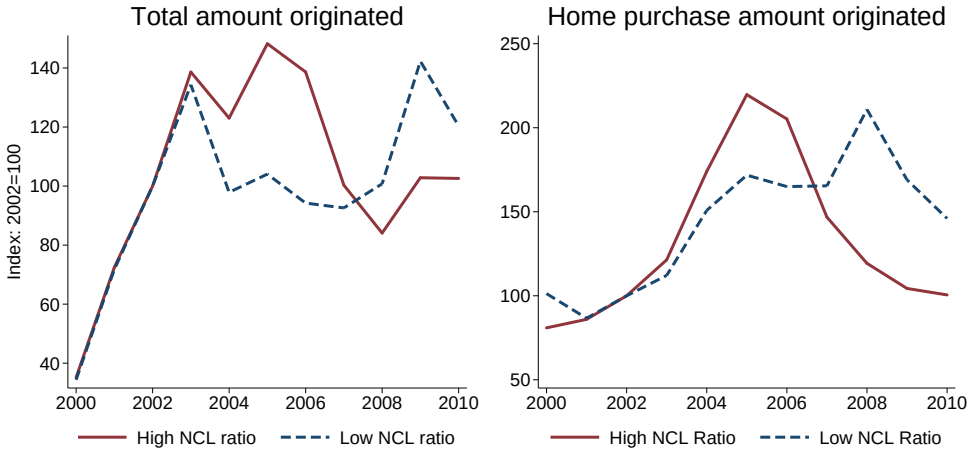
First Stage and Exclusion Restriction

Empirical strategy: Lender level

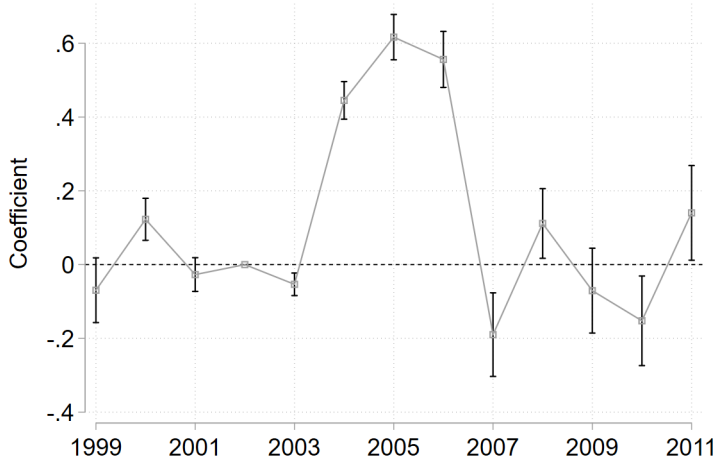
- Aggregate shock: PLS market accelerates in late summer 2003
- Lenders that rely more on non-core deposit liability financing see relative reduction in cost of financing
- Key lender-level variable: $NCLRatio_{l,2002} = (1 - \frac{coredeposits_{l,2002}}{totalliabilities_{l,2002}})$
- A lender's *NCLRatio* is sticky over time (could use 1998 with same results)
- High NCL lenders are comprised of:

  1. Deposit-taking banks that have a low core deposit to liability ratio
  2. Mortgage lenders that don't take deposits

High NCL lenders boost mortgage lending suddenly in 2003

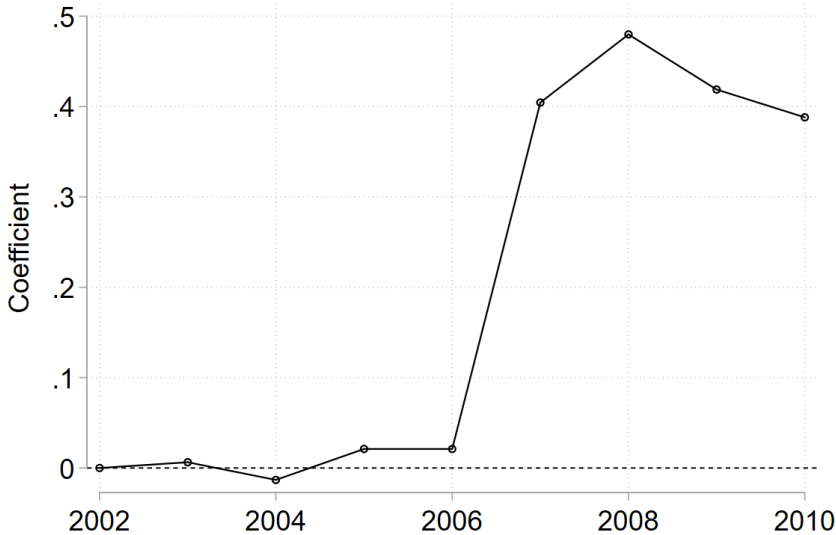


Saturating zip code level credit demand shocks



$$\Delta y_{b,z,(t-'02)} = \alpha_z + \beta NCL_{b,2002} + \varepsilon_{b,z,(t-'02)}$$

Saturating zip code level credit demand shocks



Empirical strategy: Zip code level

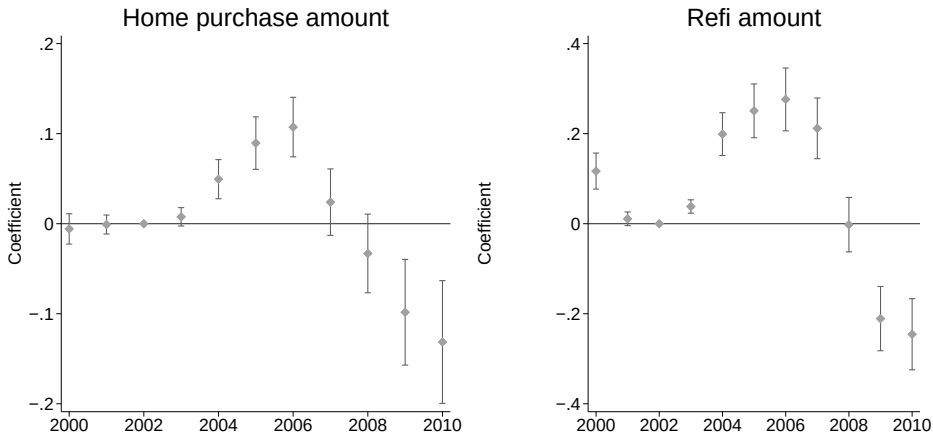
- Construct zip-code level exposure as the weighted average of NCL of lenders originating mortgages in zip code as of 2002:

$$NCLShare_{z,2002} = \sum_{l} \omega_{z,l,2002} * NCLRatio_{l,2002}$$

$$\omega_{z,l,2002} = \frac{Originations_{z,l,2002}}{\sum_{l} Originations_{z,l,2002}}$$

- NCL share of zip code is sticky over time – fixed attribute

Credit supply shock pass-through to local areas

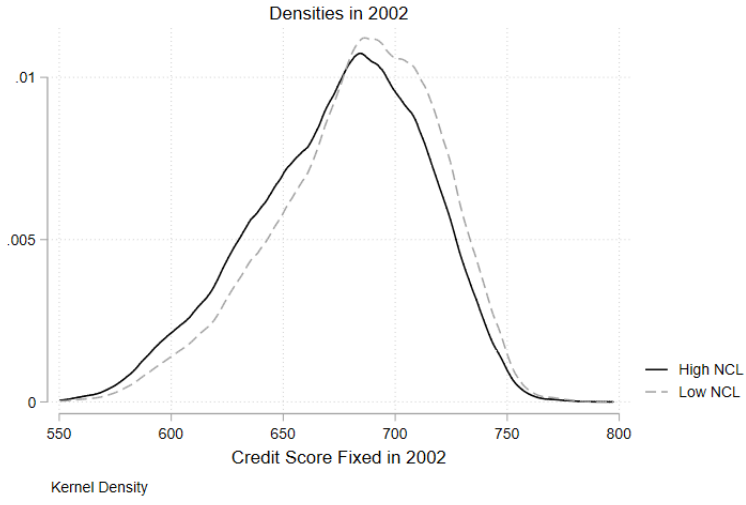


$$ln(y_{z,t}) = \alpha_z + \gamma_t + \sum_{k \neq 2002} \mathbb{1}_{t=k} \beta_k NCL_{z,2002} + \varepsilon_{z,t}$$

Exclusion restriction

- Zip codes more exposed to high NCL lenders have lower deposit to funding need ratios, lower credit scores, larger share of hispanics and blacks
- Four tests to address exclusion restriction concerns
  1. Lender-zip code level regressions with zip code fixed effects for originations; MSA fixed effects for other outcomes (Khwaja and Mian (2008))
  2. Lack of pre-trend in any of the outcome variables
  3. No relative change in housing market optimism prior to boom
  4. Timing of relative expansion corresponds exactly with expansion in PLS market

High / Low NCL Credit Score distributions



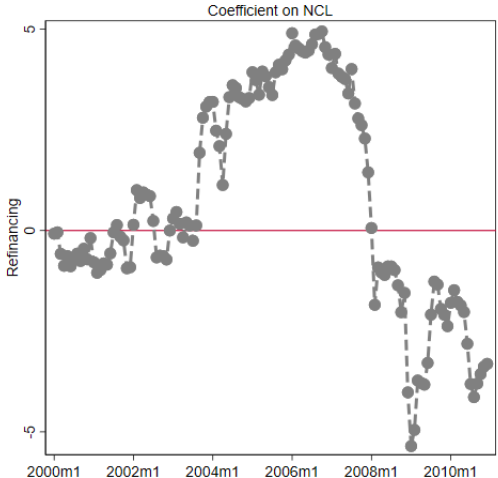
Relative shift in lending scores

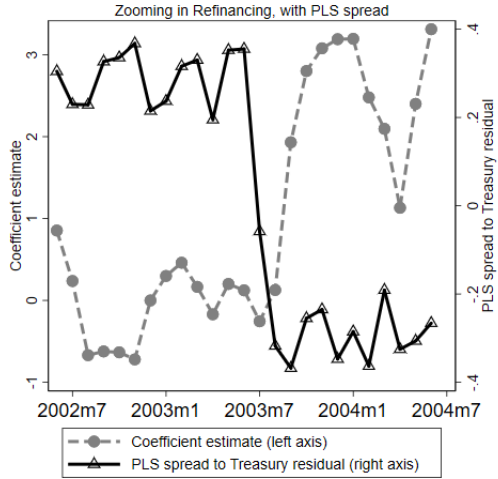
Table: NCL Ratio and Bank Level Credit Score Percentiles

	(1) 10th Percentile	(2) 25th Percentile	(3) 50th Percentile	(4) 75th Percentile	(5) 90th Percentile
2002 NCL Ratio	-26.630***	-26.899***	-21.158***	-16.556***	-12.431***
	(4.450)	(4.269)	(3.461)	(2.981)	(2.430)
I_{2006}	-18.640***	-19.115***	-13.576**	-11.154**	-9.083**
	(5.488)	(5.105)	(4.252)	(3.543)	(2.963)
I_{2006} X 2002 NCL Ratio	11.927	11.560	6.801	5.703	5.427
	(6.722)	(6.312)	(5.286)	(4.320)	(3.468)
N	8641	8641	8641	8641	8641
R-sq	0.239	0.270	0.229	0.195	0.141

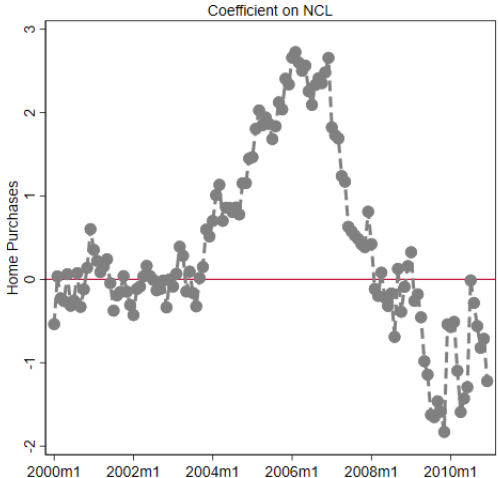
Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

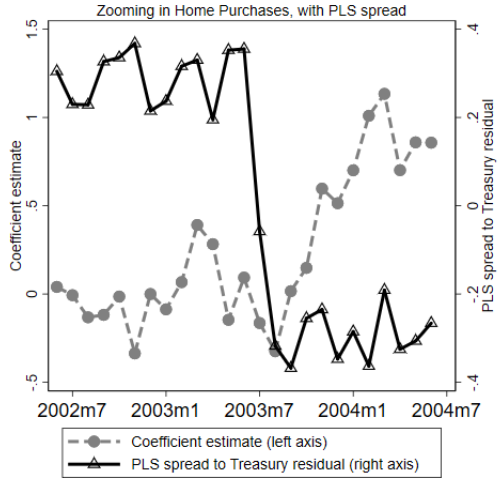
Timing coincides sharply at monthly frequency





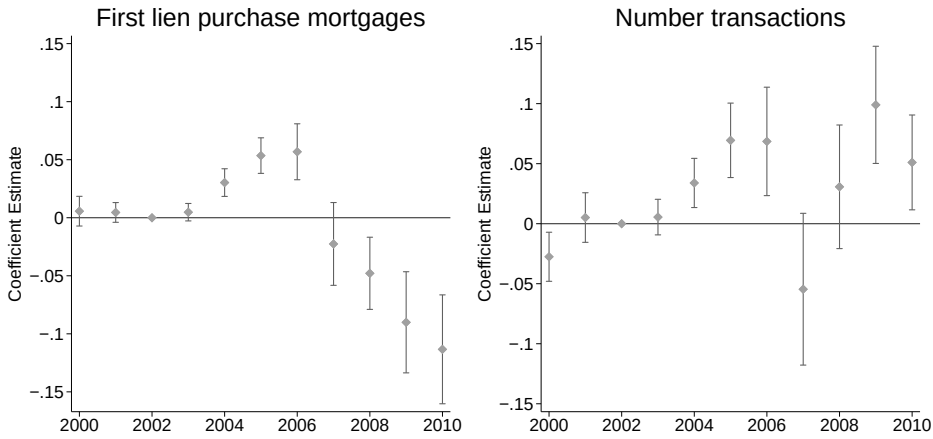
Timing coincides sharply at monthly frequency





Marginal Buyers and Speculation

Zip-code transaction volume by NCL Share: Panel regressions

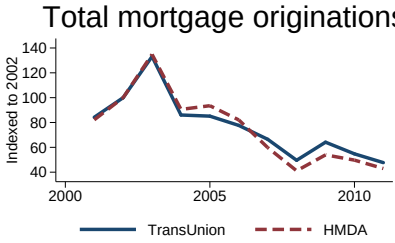


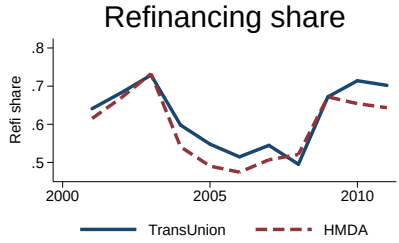
$$ln(y_{z,t}) = \alpha_z + \gamma_t + \sum_{k \neq 2002} \mathbb{1}_{t=k} \beta_k NCL_{z,2002} + \varepsilon_{z,t}$$

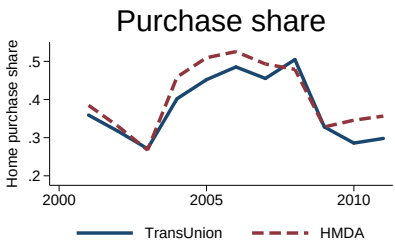
TransUnion origination dataset

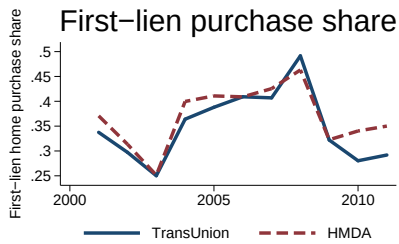
- Credit bureau data used to construct an equivalent of HMDA, but with individual characteristics
- Allows us to measure the marginal buyers brought in by the rise of PLS
- Flippers:
  - individuals who open and close a first-lien mortgage in less than 12 months (with no associated refinancing)
  - individuals who take out two first-lien mortgages in a two year period
- Risk:
  - Ex ante credit score
  - Ex post default

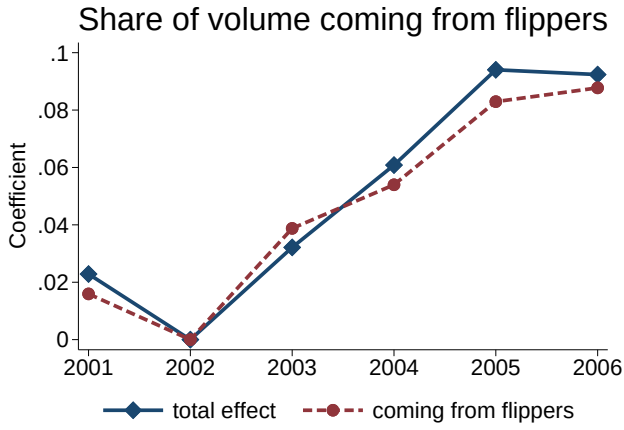
HMDA and TransUnion comparison





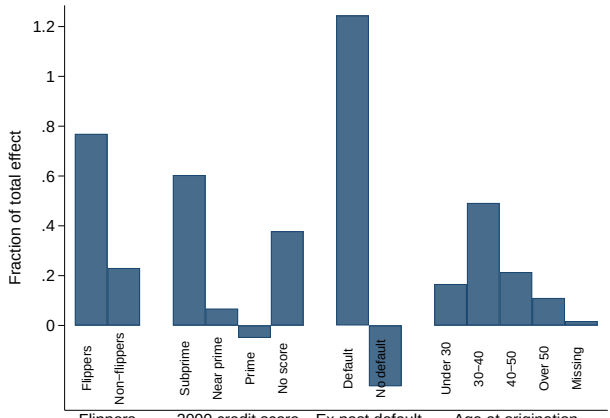






$$yindex^{i}_{z,t} = \alpha_z + \gamma_t + \sum_{k \neq 2002} \mathbb{1}_{t=k} \beta_k NCL_{z,2002} + \varepsilon_{z,t}, \text{ where } yindex^{i}_{z,t} = \frac{firstlienmortgages^{i}_{z,t} - firstlienmortgages^{i}_{z,2002}}{firstlienmortgages_{z,2002}}$$

Decomposing growth in first-lien mortgages in high NCL share zip codes

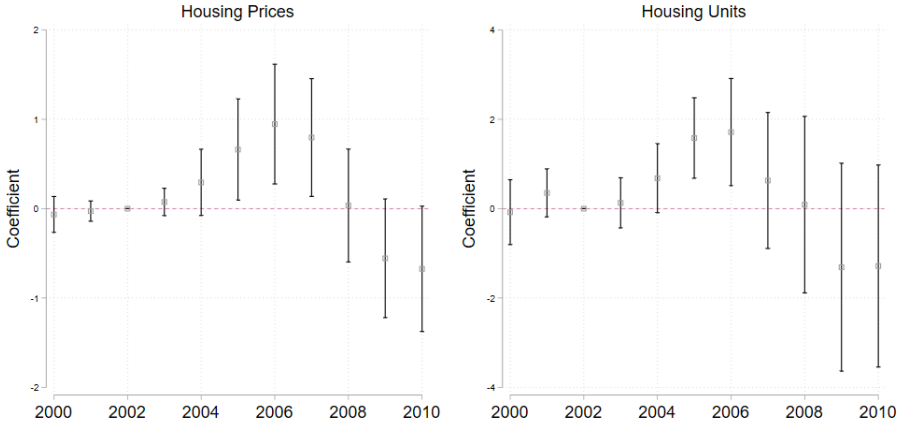


Credit and asset prices: the speculation mechanism

- Zip codes more exposed to PLS market see a large relative increase in **volume** of transactions.
- Almost the entire credit-driven increase in volume is explained by flippers
- Marginal borrowers are also riskier (ex-ante and ex-post)
- Overall a very small percentage, 0.92%, of people

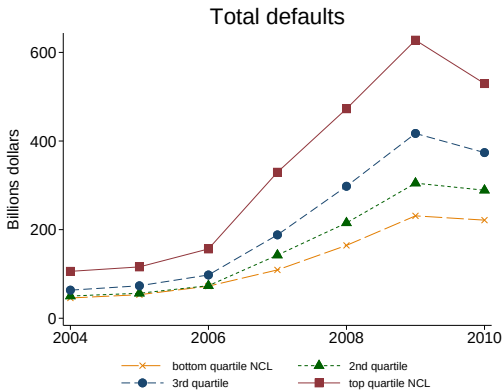
House Prices

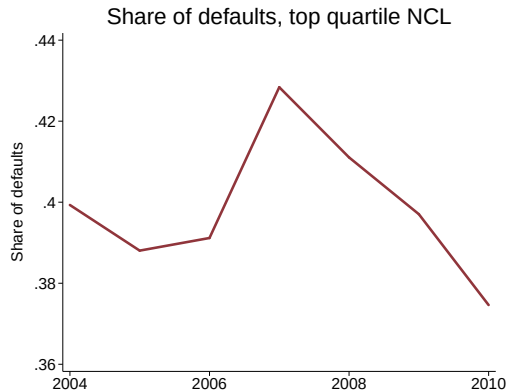
Credit supply expansion predicts the boom-bust "bubble"



Regression: $ln(y_{z,t}) = \alpha_z + \gamma_t + \sum_{k \neq 2002} \mathbb{1}_{t=k} \beta_k NCL_{z,2002} + \varepsilon_{z,t}$

Mortgage defaults by NCL share





Beliefs

Measures of optimism on housing market from the Michigan Survey

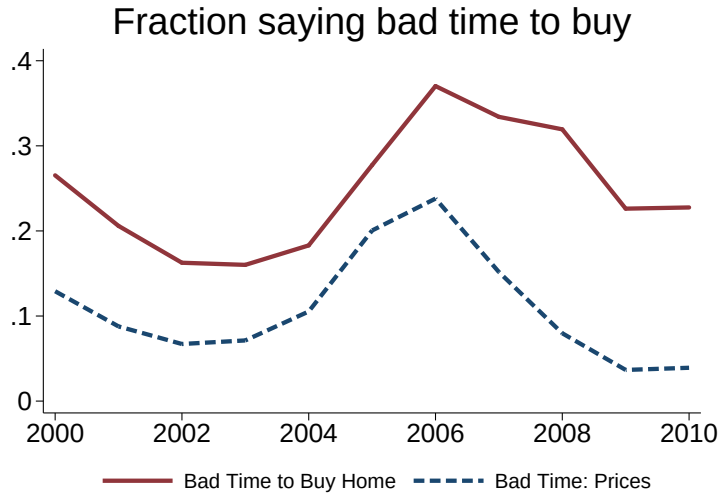


Table: NCL Share and Housing Market Optimism: CBSA-Level

	(1) Δ_{boom} Bad time to buy	(2) Δ_{boom} Bad time to buy	(3) Δ_{boom} Bad time to buy bc of prices	(4) Δ_{boom} Bad time to buy bc of prices
HP growth, 02 to 06	0.271***	0.299	0.299***	0.222*
	(0.047)	(0.157)	(0.042)	(0.110)
Type	OLS	IV	OLS	IV
N	253	253	253	253
R-sq	0.190	0.188	0.355	0.331

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

$$y_m = \alpha + \beta HPgrowth_{m,0206} + \varepsilon_m$$

Table: NCL Share and Housing Market Optimism: CBSA-Level

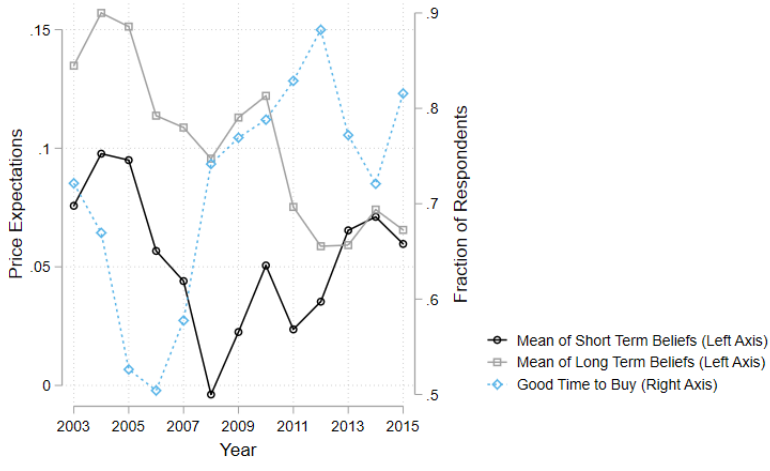
	Δ_{BOOM} Bad: Prices too high		Δ_{BOOM} Bad: Prices will fall	
	(1)	(2)	(3)	(4)
HP growth, 02 to 06	0.261***	0.232*	0.039***	-0.010
	(0.038)	(0.097)	(0.010)	(0.035)
Type	OLS	IV	OLS	IV
N	253	253	253	253
R-sq	0.308	0.305	0.088	.

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

$y_m = \alpha + \beta HPgrowth_{m,0206} + \varepsilon_m$

Divergence between average beliefs and home-buyer beliefs

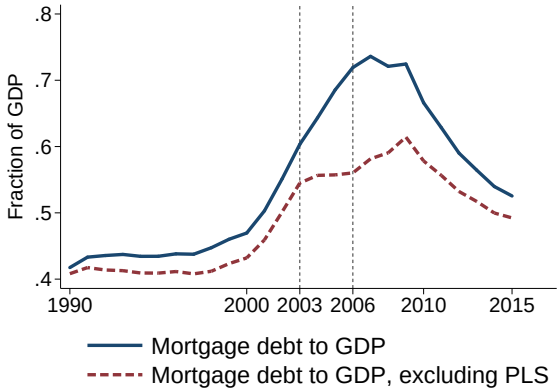


Conclusion

- Expansion of the PLS market generated a boom and bust cycle from 2002 to 2010
- Consistent with models of speculation, PLS-driven credit expansion allowed a small fraction of speculators to have large effects on house prices and volume; defaults in this market triggered the mortgage default crisis
- Evidence is inconsistent with a general rise in optimism being a main driver of house prices during the boom; heterogeneity in beliefs and credit supply important

Extra

Was PLS important for aggregate mortgage debt?



Almost entire rise in mortgage debt to GDP from 2003 to 2006 was PLS!

Table: Summary Statistics

	Obs	Mean	SD	Median	P10	P90
Lender level						
2002 NCL ratio	5026	0.74	0.20	0.68	0.49	1.00
2002 Non-bank	5040	0.25	0.43	0.00	0.00	1.00
$\Delta_{02,05}$ PLS share	3950	0.15	0.26	0.08	-0.09	0.53
$\Delta_{02,05}$ ln (Amount originated)	3950	-0.02	0.73	-0.09	-0.46	0.62
Zip level						
2002 NCL Share	12427	0.77	0.05	0.77	0.71	0.82
Δ_{BOOM} (Home purchase amount originated)	12419	0.57	0.36	0.54	0.18	1.01
Δ_{BOOM} (Refinancing amount originated)	12400	0.32	0.53	0.23	-0.25	1.05
Δ_{BOOM} (First-lien mortgages, HMDA)	12418	0.14	0.28	0.12	-0.15	0.47
Δ_{BOOM} (Volume of housing transactions)	3727	0.16	0.29	0.12	-0.13	0.49
$\Delta_{02,06}$ (House Prices)	6619	0.37	0.22	0.36	0.10	0.67
Zip level: TransUnion data						
Δ_{BOOM} (First-lien mortgages, TransUnion)	9023	0.09	0.67	0.05	-0.69	0.92
Δ_{BOOM} (First-lien mortgages, HMDA)	9019	0.12	0.29	0.09	-0.21	0.47

Table: High NCL Ratio Predicts Growth in Mortgage Originations

	Δ Fraction PLS, 02 to 05	Amount growth, 02 to 05			Amount growth, Pre-Boom	
	(1)	(2)	(3)	(4)	(5) 1998-2000	(6) 2000-2002
2002 NCL ratio	0.151**	0.183***		0.203*	-0.006	-0.083
	(0.049)	(0.047)		(0.082)	(0.046)	(0.105)
Non-bank 2002			0.284*	-0.067		
			(0.114)	(0.189)		
Sample	Banks	Full	Full	Full	Full	Full
N	3287	3947	3950	3947	3447	3433
R-sq	0.210	0.061	0.027	0.062	0.000	0.007

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table: NCL Share and Change in Volume during Boom

	Δ_boom Volume per housing unit		Δ_boom First-lien per housing unit	
	(1)	(2)	(3)	(4)
2002 NCL Share	0.016***	0.016***	0.017***	0.018***
	(0.004)	(0.003)	(0.004)	(0.003)
MSA FE	N	Y	N	Y
N	3704	3704	3702	3702
R-sq	0.016	0.117	0.014	0.099

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Saturating credit-demand shocks at the zip code level

- as in Khwaja and Mian (2008)

$$\Delta y_{b,z,0205} = \alpha_z + \beta NCL_{b,2002} + \varepsilon_{b,z,0205}$$

Table: High NCL Ratio Predicts Growth in Mortgage Originations: With Geography Fixed Effects

	Bank-MSA amount originated, 02 to 05		Bank-Zip-Code amount originated, 02 to 05	
	(1)	(2)	(3)	(4)
2002 NCL Ratio	0.169***	0.140***	0.154***	0.125***
	(0.007)	(0.006)	(0.006)	(0.006)
Geography FE	N	Y	N	Y
N	65446	65446	888272	888272
R-sq	0.041	0.162	0.031	0.204

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Saturating credit-demand shocks at the zip code level

- as in Khwaja and Mian (2008)

$$\Delta y_{b,z,0205} = \alpha_z + \beta NCL_{b,2002} + \varepsilon_{b,z,0205}$$

Table: NCL Ratio and Mortgage Originations, Interactions

	Bank-Zip Code amount originated, 02 to					
	(1)	(2)	(3)	(4)	(5)	(6
2002 NCL Ratio	0.834***	0.692***	0.760***	0.615***	-1.980***	0.893
	(0.037)	(0.029)	(0.032)	(0.031)	(0.264)	(0.05
2002 NCL Ratio X Credit Score 2002					0.388***	
					(0.040)	
2002 NCL Ratio X Denial Rate 2002						-1.343
						(0.19
2002 NCL Ratio X House Prices Change $\%_{98,00}$						
2002 NCL Ratio X House Prices Change $\%_{00,02}$						

Table: NCL Share and Mortgage Origination Growth

	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta_{00,02}$ Good time to buy	$\Delta_{00,02}$ Good time to buy bc of prices	Δ_{boom} Purch amount	Δ_{boom} Purch amount	Δ_{boom} Refi amount	Δ_{boom} Refi amount
2002 NCL Share	0.006	0.002	0.086***	0.117***	0.224***	0.287***
	(0.011)	(0.007)	(0.016)	(0.017)	(0.030)	(0.030)
Level	MSA	MSA				
MSA FE			N	Y	N	Y
N	337	337	12419	12419	12400	12400
R-sq	0.001	0.000	0.056	0.410	0.180	0.670

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

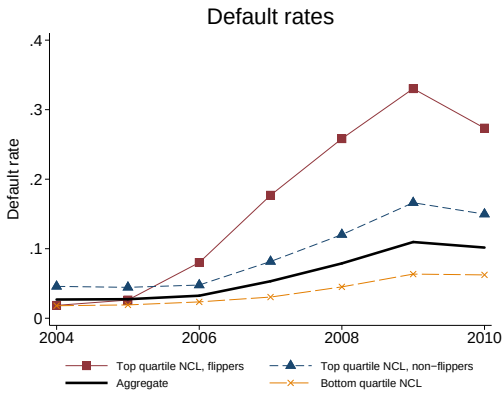
Findings

- Expansion of credit due to PLS boosted house prices, volume, speculative trading activity, and ex-post defaults
- PLS-driven credit expansion allowed a small fraction of population ("speculators," "flippers") to have large effects on the housing market
- Evidence contradicts the notion of a general rise in housing market optimism, supportive of models in which belief heterogeneity matters
- PLS market was crucial in instigating the mortgage default crisis

Table: 2002 NCL Share Correlations with Observable Variables

Covariates	Across MSA	Within MSA
2000 Deposits/Purchase amount originated	-1.11***	
	(.246)	
Saiz elasticity	-.262***	
	(.071)	
1998 NCL share	.849***	.842***
	(.024)	(.006)
2000 Fraction age 65+	-.006**	-.010***
	(.001)	(.000)
2000 Fraction hispanic or black	.069***	.110***
	(.011)	(.002)
2000 Fraction renters	.008	.030***
	(.005)	(.001)
2000 Log median home value	.033	-.110***
	(.020)	(.005)
2000 Log median household income	-.009	-.081***
	(.017)	(.003)
2000 Subprime share	.029***	.070***
	(.003)	(.001)

The Crash


Default rates
Default rate
.4
.3
.2
.1
0
2004
2006
2008
2010
Top quartile NCL, flippers
Top quartile NCL, non−flippers
Aggregate
Bottom quartile NCL

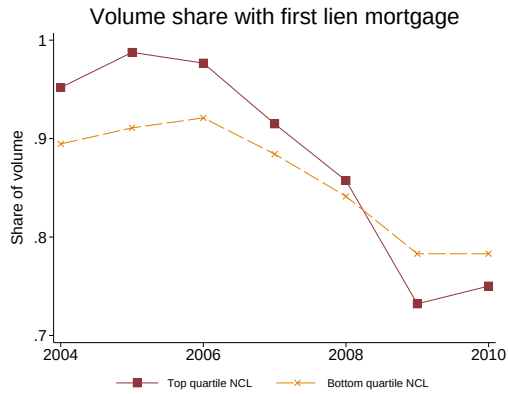
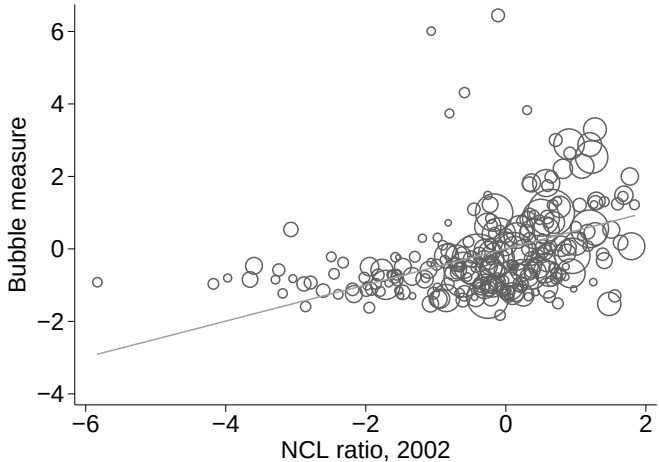

Volume share with first lien mortgage
Share of volume
1
.9
.8
.7
2004
2006
2008
2010
Top quartile NCL
Bottom quartile NCL

Table: NCL Share and House Price Growth

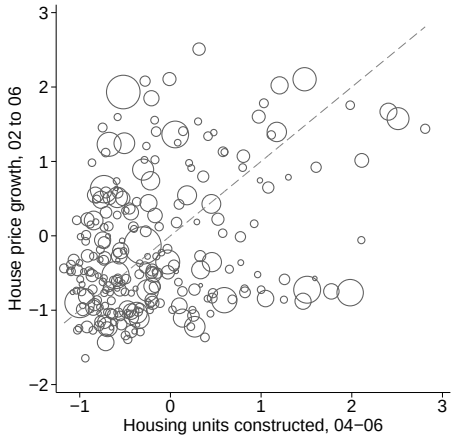
	House Price Growth, 02 to 06					HP Growth, 06 to 10	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2002 NCL Share	0.059***	0.043**	0.151***	0.018*	0.063***	-0.084***	-0.049***
	(0.018)	(0.015)	(0.027)	(0.008)	(0.017)	(0.016)	(0.008)
Supply elasticity		-0.122***	0.791***				
		(0.017)	(0.151)				
2002 NCL Share X Supply elasticity			-0.055***		-0.027***		
			(0.010)		(0.007)		
MSA FE	N	N	N	Y	Y	N	Y
N	5540	5540	5540	5540	5540	5540	5540
R-sq	0.060	0.345	0.413	0.929	0.933	0.114	0.866

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

NCL share and bubble cities



Credit supply expansion explains "bubble MSAs"



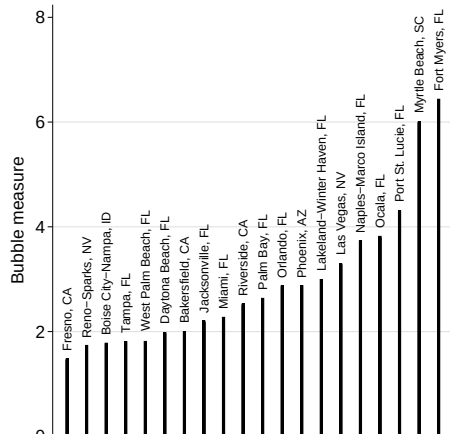


Table: NCL Share and Bubble MSAs

	(1) Bubble measure	(2) Bubble measure	(3) HP growth 02 to 10	(4) HP growth 02 to 10	(5) Δ units 09-11 minus 00-02	(6) Δ units 09-11 minus 00-02
2002 NCL share	0.439***	0.216**	-0.031*	-0.063***	-0.006***	-0.004***
	(0.078)	(0.069)	(0.012)	(0.013)	(0.001)	(0.001)
Housing supply elasticity	-0.283***	-0.198***	-0.017	-0.004	-0.000	0.001
	(0.057)	(0.044)	(0.011)	(0.010)	(0.001)	(0.001)
Census Division FE	N	Y	N	Y	N	Y
N	253	253	253	253	259	259
R-sq	0.290	0.513	0.042	0.445	0.130	0.416

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$