

Why Did So Many Subprime Borrowers Default During the Crisis: Loose Credit or Plummeting Prices?

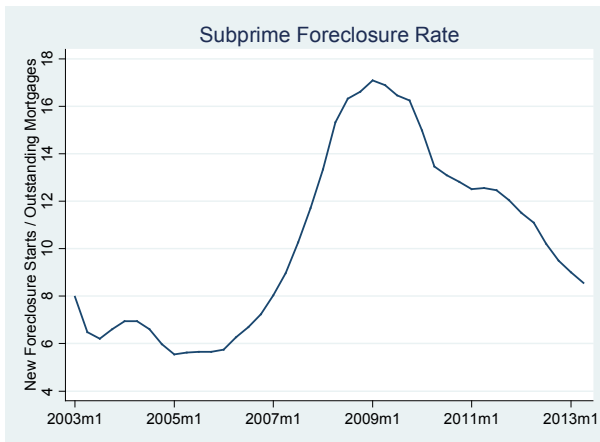
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Subprime Foreclosures: Crisis Ground Zero

- Subprime mortgages were almost 60% of recession foreclosures



Source: Author's calculations using Mortgage Bankers Association National Delinquency Survey

\$1 trillion Question: Why Surge in Subprime Defaults?

- IMF (2008) predicted \$1 trillion in subprime-induced losses
- Lots of factors, two competing stories
 - (1) Composition of subprime borrowers/mortgages
 - something changed about subprime lending
 - (2) Economic conditions:
 - Negative equity, unemployment, etc.
- Both reasonable (and both true), disentangling important for policy

Outline

- ① Motivation: Two competing stories
- ② Data: how were subprime borrowers and mortgage changing?
- ③ Hazard model of mortgage default: what does the data say?
- ④ How to disentangle role of credit and prices
- ⑤ Results, policy implications, conclusion

Two sides to the debate: lending standards or prices?

Underwriting Standards to blame!

1. "...[M]any borrowers are ill-equipped to make judgments about 'exotic' loans, like subprime loans that offer a low initial 'teaser' rate that suddenly jumps after two years, and that include prepayment penalties preventing the borrowers from undoing their mistakes... Maybe the subprime catastrophe will be enough to remind us why financial regulation was introduced in the first place."

—Paul Krugman (*New York Times*, 2007)

Two sides to the debate: lending standards or prices?

Price declines to blame!

2. “Many policy makers and ordinary people blame the rise of foreclosures squarely on subprime mortgage lenders who presumably misled borrowers... What is really behind the mushrooming rate of mortgage foreclosures since 2007? The evidence... suggests that the single *most important factor is whether the homeowner has negative equity in a house*... The difference in policy implications is enormous.”

—Stan Liebowitz (*Wall Street Journal*, 2009)

Why does this matter?

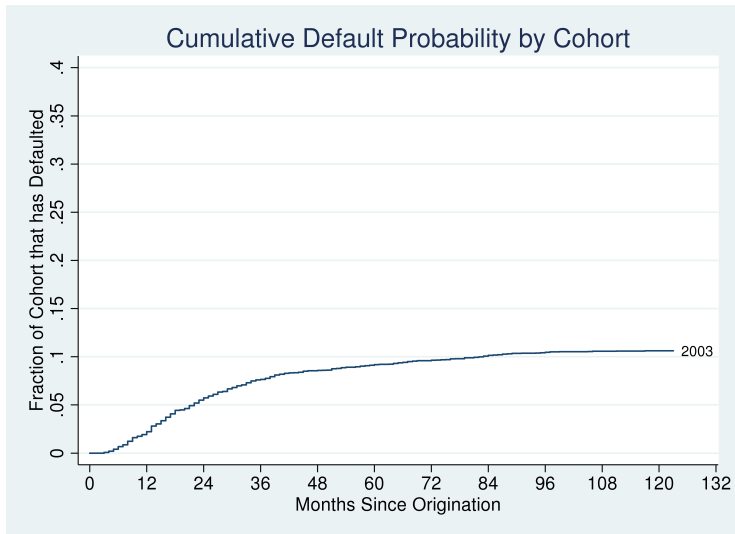
Divergent policy implications!

1. Lending standards fell, leading to a decline in borrower quality
 - e.g. decreased underwriting standards, liar loans, automated underwriting, etc.
 - policy remedy is microprudential: regulate, restrict contract space (e.g. Dodd-Frank Qualified Mortgages)
 2. Decline in property values impeded distressed sales
 - ability to sell/refinance house to get out of mortgage plummets
 - policy remedy is macroprudential: e.g. increase capital charges, prevent bubbles
- Important distinction for regulation, stress testing, risk management, ex-post remediation, etc.

How can we figure this out?

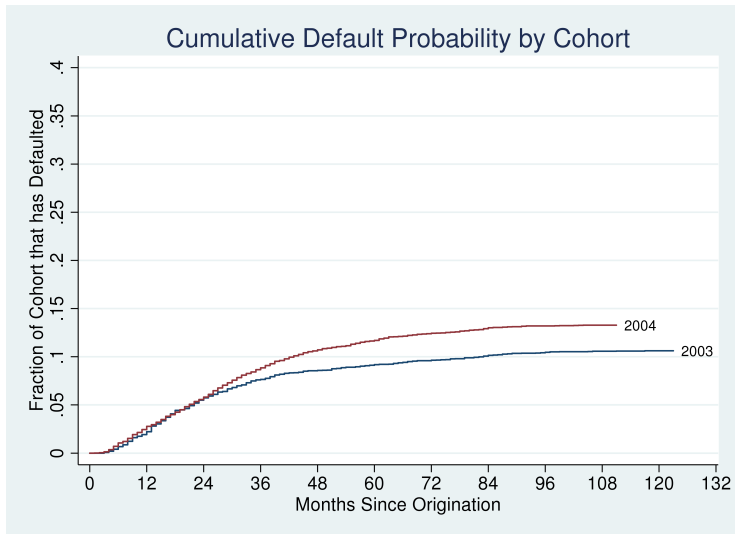
- Popular approach: compare performance of borrower cohorts
 - e.g. JEC (2007), Krugman (2007), Haughwout et al. (2008), Mayer et al. (2009), Demyanyk and Van Hemert (2011), Krainer and Laderman (2011), Bhardwaj and Sengupta (2014)
- Indicative of cause of surge in defaults?

Each cohort had successively higher default rates



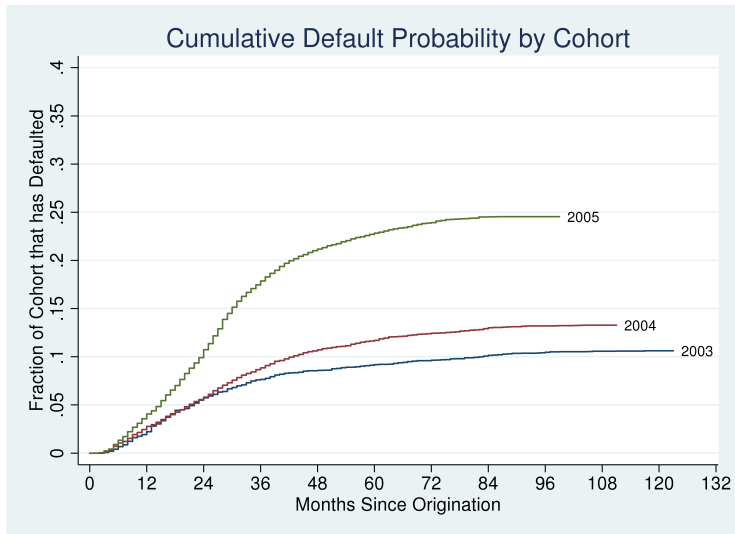
Source: Author's calculations using CoreLogic LoanPerformance data.

Each cohort had successively higher default rates



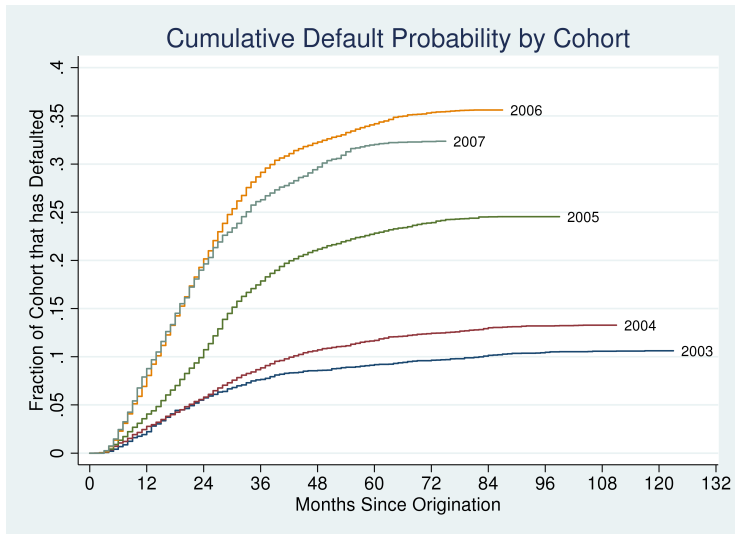
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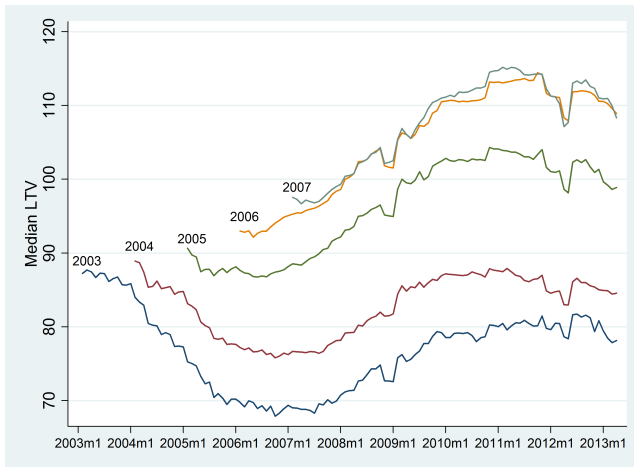


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Where does cohort default pattern come from?

- Pattern could come from a change in borrowers...
- ...or a change in what happened to the borrowers
- Not either-or! How much of each?
- Empirical challenge: how to identify importance of lending standards vs. prices...
 - ...if fall in property values was *itself* caused by loose credit?

Later cohorts more likely underwater



Source: Author's calculations using CoreLogic LoanPerformance data.

LP Data

- CoreLogic LoanPerformance (LP) data from private-label securitized subprime mortgages
- Standard subprime loan-level data source, covers $\approx 75\%$ of subprime mortgage market
- 1% sample of 2003–2007 first-lien mortgages: over 1m observations
- Contains
 - borrower characteristics (DTI, FICO, owner-occupant, etc.)
 - loan characteristics (LTV, interest rate, purchase mortgage, etc.)

Borrowers Observable Characteristics Not Changing Much

	2003	2004	Cohort 2005	2006	2007
FICO Score	617.00 (61.85)	618.15 (61.15)	618.59 (59.68)	616.08 (56.48)	614.33 (54.72)
Debt-to-Income (non-missing)	0.39 (0.10)	0.39 (0.10)	0.40 (0.10)	0.41 (0.10)	0.41 (0.10)
Full Documentation	0.71 (0.45)	0.70 (0.46)	0.68 (0.47)	0.67 (0.47)	0.68 (0.46)
Owner Occupied	0.91 (0.28)	0.91 (0.28)	0.92 (0.28)	0.92 (0.27)	0.91 (0.29)
Observations	4,407	7,251	9,444	8,336	2,734

mean coefficients; sd in parentheses

Product Characteristics Change

	Cohort				
	2003	2004	2005	2006	2007
Combined LTV at Origination	0.83 (0.13)	0.84 (0.13)	0.86 (0.14)	0.86 (0.14)	0.84 (0.15)
Interest Rate	7.23 (1.29)	6.78 (1.21)	6.89 (1.18)	7.89 (1.25)	8.07 (1.39)
Cash-out Refi	0.57 (0.50)	0.57 (0.49)	0.53 (0.50)	0.51 (0.50)	0.58 (0.49)
Adjustable Rate	0.61 (0.49)	0.63 (0.48)	0.57 (0.50)	0.45 (0.50)	0.34 (0.47)
Interest-only	0.03 (0.16)	0.11 (0.31)	0.21 (0.41)	0.13 (0.33)	0.09 (0.29)
Balloon	0.01 (0.10)	0.00 (0.04)	0.02 (0.15)	0.21 (0.41)	0.28 (0.45)
Has 2nd Lien	0.07 (0.25)	0.15 (0.36)	0.24 (0.42)	0.28 (0.45)	0.16 (0.37)
Observations	4407	7251	9444	8336	2734

Empirical Model of Mortgage Default

- Proportional hazard with covariates X_{icgt}
 - loan i , cohort c , CBSA g , month t

$$\lambda_{icg}(t) = \exp(X'_{icgt}\beta) \lambda_0(t)$$

Empirical Model of Mortgage Default

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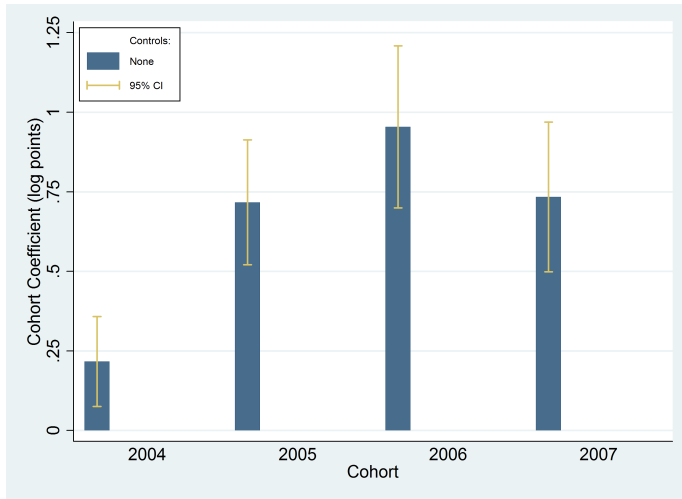
$$\lambda_{icg}(t) = \exp(X'_{icgt}\beta) \lambda_0(t)$$

$$X'_{icgt}\beta = \gamma_c + \theta'_B W_i^{borrower} + \theta'_L W_i^{loan} + \delta \cdot \Delta Prices_{igt} + \alpha_g$$

- Cohort fixed effects γ_c capture the residual performance of cohort c
- Adding controls tests what accounts for differences across cohorts

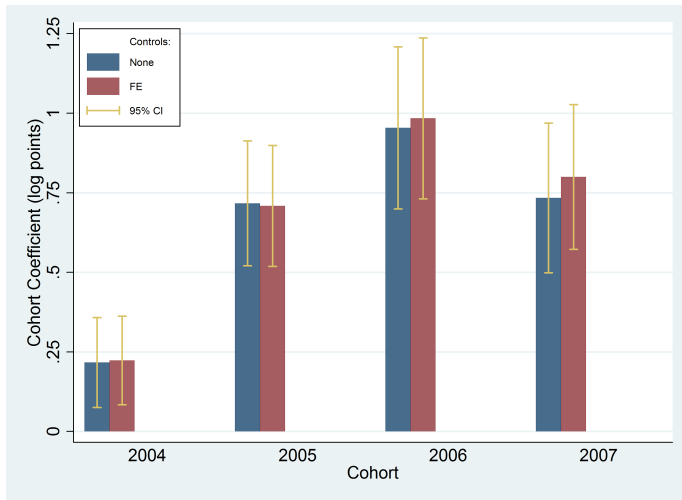
What Explains Cohort Heterogeneity?

$$X'_{icgt}\beta = \gamma_c$$



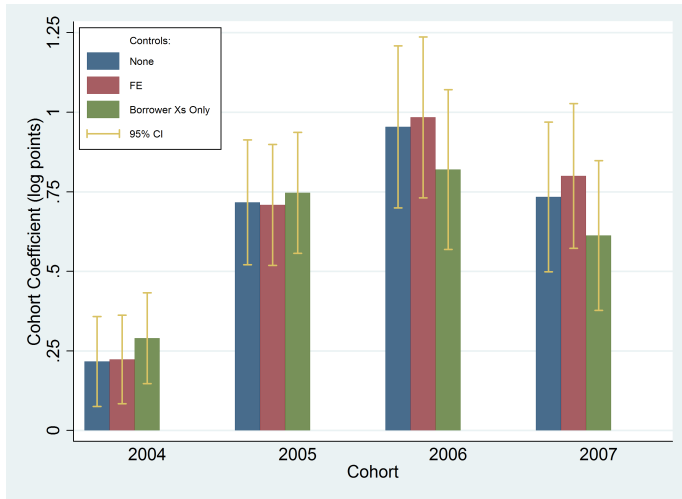
What Explains Cohort Heterogeneity?

$$X'_{icgt}\beta = \gamma_c + \alpha_g$$



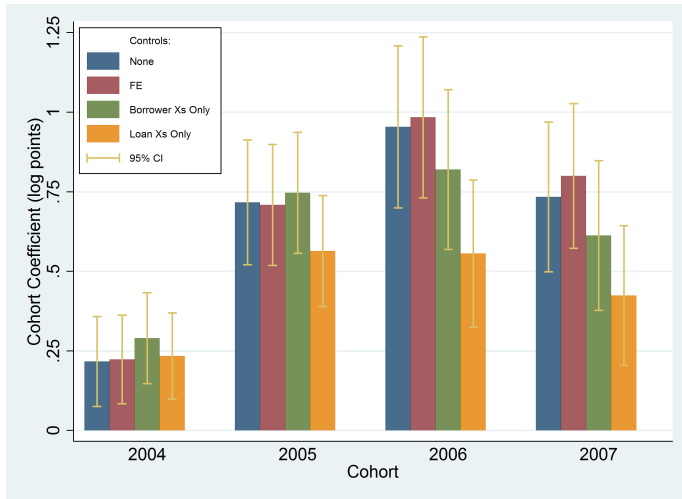
What Explains Cohort Heterogeneity?

$$X'_{icgt}\beta = \gamma_c + \alpha_g + \theta'_B W_i^{borrower}$$



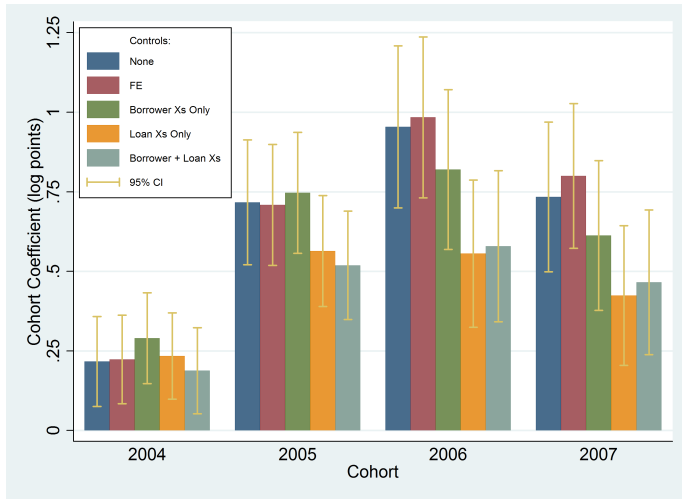
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$$X'_{icgt}\beta = \gamma_c + \alpha_g + \theta'_B W_i^{borrower} + \theta'_L W_i^{loan}$$

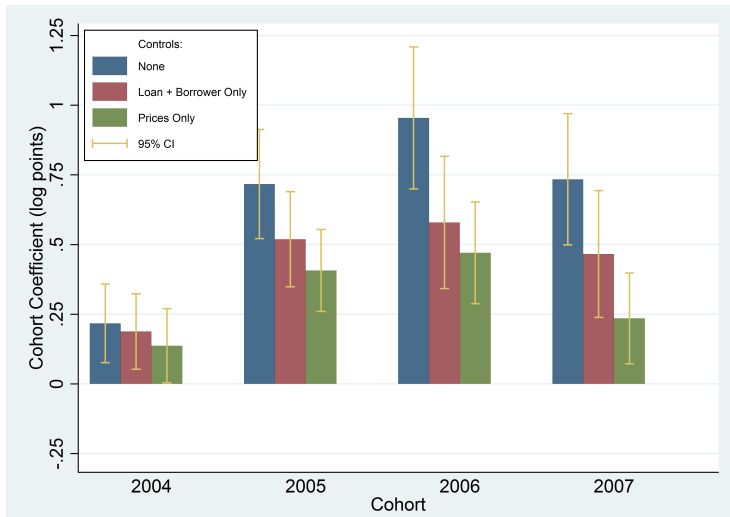


Specifying $\Delta Prices$

- CoreLogic Repeat Sales Home Price Indices (HPI) at CBSA level for 900+ CBSAs
- Available monthly since 1976: allows exploiting historical variation
- Provides measure of change in prices for relevant market
- $\Delta Prices \equiv \log(HPI_{igt}) - \log(HPI_{igt-12})$

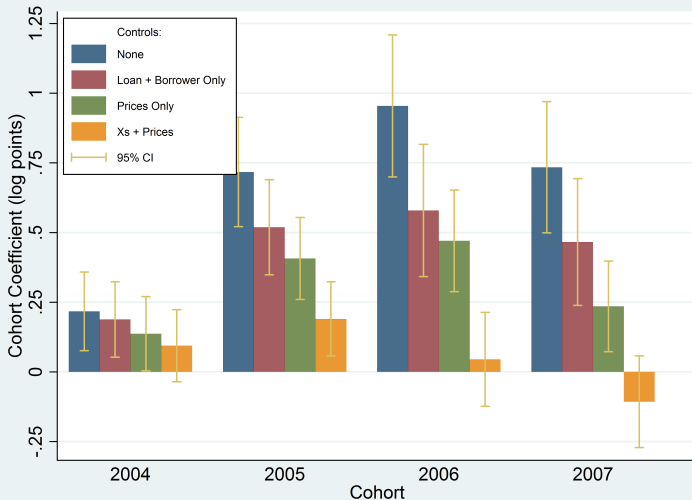
What Explains Cohort Heterogeneity?

$$X'_{icgt}\beta = \gamma_c + \alpha_g + \delta \cdot \Delta Prices_{gt}$$



What Explains Cohort Heterogeneity?

$$X'_{icgt}\beta = \gamma_c + \alpha_g + \theta'_B W_i^{borrower} + \theta'_L W_i^{loan} + \delta \cdot \Delta Prices_{gt}$$



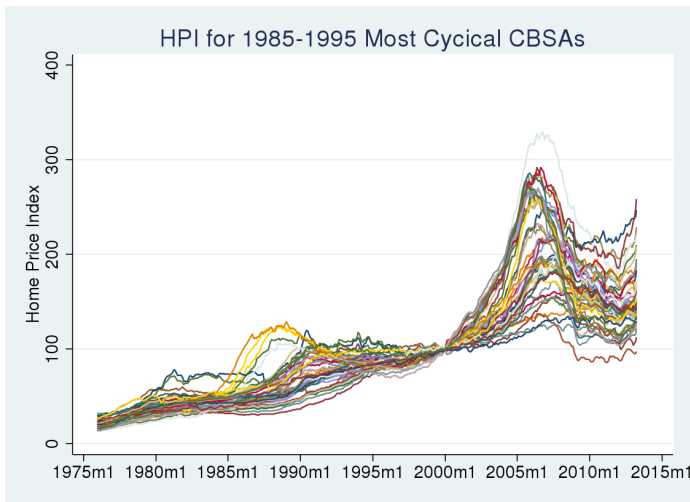
Endogeneity of Price Cycle

- But wait! Weren't prices themselves caused by loose credit?
 - e.g. Mian & Sufi (2009), Di Maggio & Kermani (2015)
- If so, how to conclude anything about relative importance?
- Challenge: need factor that predicts $\Delta Prices$ but not lending standards
- Solution: use 1980s price cycles that are unrelated to 2000s lending

Instrument Specification

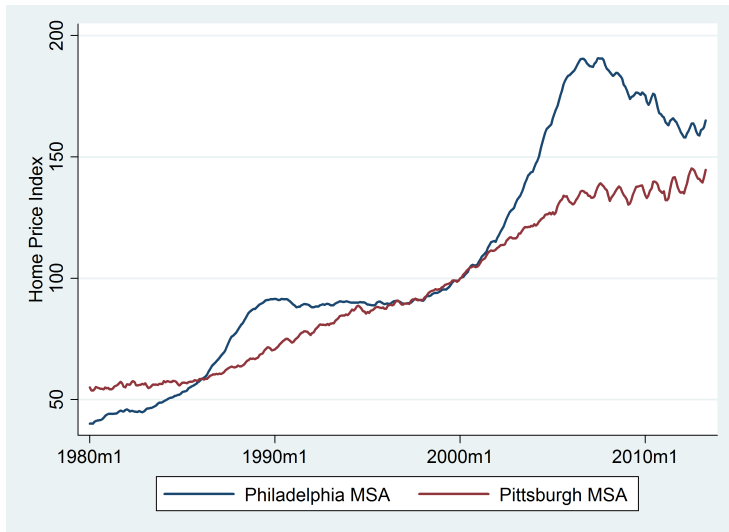
- Sinai (2012): same cities boom-bust in 1980s and 2000s
- Measure long-run cyclicalities of a city, map onto current price cycle
- Instrument σ^P is the standard deviation of annual change in the home price index from 1980-1995

On average, cyclical 1980s \Rightarrow cyclical 2000s



Source: Author's calculations using CoreLogic HPI data.

Complier Examples: Philadelphia and Pittsburgh



Source: FHFA Repeat-Sales House Price Index

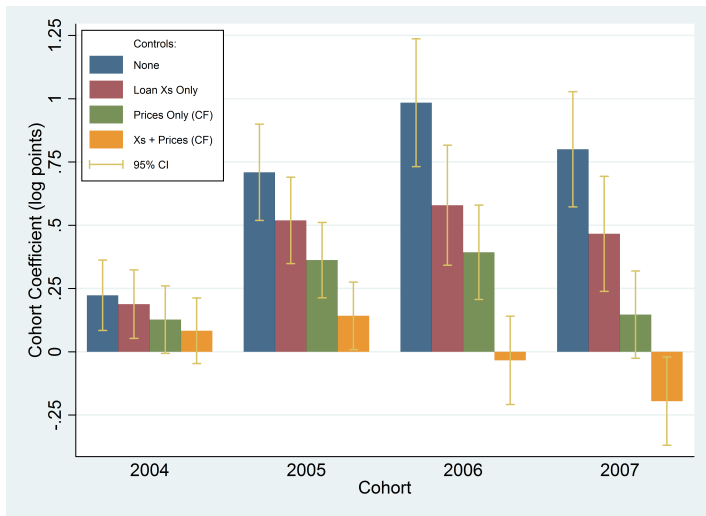
Control Function Estimation

- First stage strong, exclusion restriction plausible (see paper)
- Fitted residuals \hat{v}_{icgt} from first stage for price change variable

$$\hat{v}_{icgt} = \Delta Prices_{icgt} - \widehat{\Delta Prices_{icgt}}$$

$$X'_{icgt}\beta = \gamma_c + \theta'_B W_i^{borrower} + \theta'_L W_i^{loan} + \delta \cdot \Delta Prices_{gt} + \kappa \hat{v}_{icgt} + \alpha_g$$

What Explains Cohort Heterogeneity?



$$X'_{icgt}\beta = \gamma_c + \alpha_g + \theta'_B W_i^{borrower} + \theta'_L W_i^{loan} + \delta \cdot \Delta Prices_{gt} + \kappa \hat{v}_{icgt}$$

Takeaways

- Lending standards explain 30% of rise in defaults
- Prices explain 60% of cohort heterogeneity
- Is this still all just a loose credit story? No. Robust to instrumenting.
- Prices + X s combined explain 95% of cohort heterogeneity

Alternative Price Paths

- 2003 cohort actually defaulted: 4.2%/year
- 2006 cohort actually defaulted: 12%/year
- What would have had to change about 2006 cohort to default less?

Alternative Price Paths

Counterfactual Scenarios

Cohort	Actual	2003 \bar{P}	2006 \bar{P}	$\Delta P = 0$	$\Delta P = 0$ 2003 \bar{X}
2003	4.2%	4.1%	8.5%	6.3%	5.3%
2006	12.0%	5.6%	11.0%	7.9%	4.7%
Overall	8.7%	5.1%	10.2%	7.4%	5.3%

Policy Implications

- ① Lending standards caused 30% of default increase
 - ⇒ Microprudential regulation important
- ② Price declines caused 60% of default increase
 - ⇒ Macroprudential regulation important
- ③ Are price declines only relevant for risky borrowers?
No! Everyone impacted.
 - ⇒ Microprudential w/o macroprudential not enough
 - ⇒ Incidence of microprudential may disproportionately burden risky borrowers with crisis prevention

Conclusion

- Goal: speak to debate about causes of subprime crisis
- New strategy distinguishes effects of lending and prices
- Blame for increase in subprime defaults?
 - 30% lending standards
 - 60% prices
 - < 5% not captured by borrower + loan observables and prices
- Mortgage regulation not enough and could even go too far
 - need for shared sacrifice through complementary macroprudential policy
- Implications for stress testing, risk management, loan modifications