

**“Housing Markets and the Macroeconomy
During the 2000s”**

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Macro Effects of Housing Markets on US Economy During 2000s

- **Masked structural declines in labor market**
 - Charles, Hurst, and Notowidigdo 2016a, 2016b.

- **Long lasting impact #1**
 - Housing boom during 2000s discouraged schooling.
 - Left those treated with the housing boom with persistently lower levels of schooling.
 - Charles, Hurst, and Notowidigdo 2016c.

- **Long lasting impact #2**
 - Work in progress with Amit Seru
 - Housing/Finance boom on STEM jobs in early 2000s
 - Missing patents of young inventors (?)
 - Could affect productivity after housing/finance booms.

Mortgage Markets and Macro Stabilization

- **Lack of spatial interest rate variation in GSE mortgage markets**
 - Default risk varies spatially
 - Mortgage markets transfer resources across U.S. regions in state contingent ways.
 - Hurst, Keys, Seru and Vavra (2016)

- **Collateral values affect stimulative effects of monetary policy**
 - **“Regional Heterogeneity and Monetary Policy”**
 - Focus of my talk today.
 - New paper with Martin Beraja, Andreas Fuster and Joe Vavra
 - Part of a growing literature exploring effects of monetary policy through the mortgage/housing market.

Motivation

- **Great Recession/Eurozone Crisis:**
 - Unprecedented monetary policy actions to reduce long rates.
 - Large variation in real activity and house price growth across member regions (Nevada v. Texas ; Spain v. Germany).

- **Usually studied w/ representative agent DSGE NK models**

- **This paper, distribution of collateral matters for:**
 - Aggregate spending response to monetary policy
 - Inequality across regions in response to monetary policy

- **Aggregate and distributional effects of monetary policy (through housing market) vary across time.**
 - During Great Recession – aggregate stimulus effect was small and regional inequality effects were large.

Monetary Policy-Region Interactions

- **For the most part, monetary policy tools (rates, reserve requirements, etc.) constant across regions in a monetary union.**
- **However, strength of monetary policy transmission to real activity can differ across regions.**
- **Collateralized lending channel of monetary policy**
 - Ability to borrow depends on collateral values → regional collateral values affect monetary transmission.
 - Regions with low collateral values may see less increase in borrowing in response to monetary expansion.
 - Non-linearities can lead to aggregate consequences

Specific Collateral Application

- **Our focus: mortgage refinancing**
- **In US most mortgages are long-term fixed rate mortgages**
- **When rates decline:**
 - Households can refinance to cut payments and reduce default risk
 - Households can extract housing equity (“cash out”) at refinancing (potentially important channel of monetary policy)
- **Refinancing, however, requires equity in home**
 - Can’t refinance if LTV is too high
 - But only need to meet LTV if refinancing (or Debt-Income Ratio) – creates a non-linearity between LTV and refinancing response to policy.
- **Creates interaction between regional house price growth, refinancing activity and spending (with both aggregate and regional consequences)**

Overview of Paper

- **Empirical (focus of talk today)**

- Do local conditions affect refi, cash-out and spending responses to QE1?
- QE1 had stronger effects on areas with relatively high equity and low unemployment (likely amplified regional dispersion)
- Explore patterns in 2001-2003 cycle. Draw a distinction between the two.

- **Theoretical (touch on briefly today)**

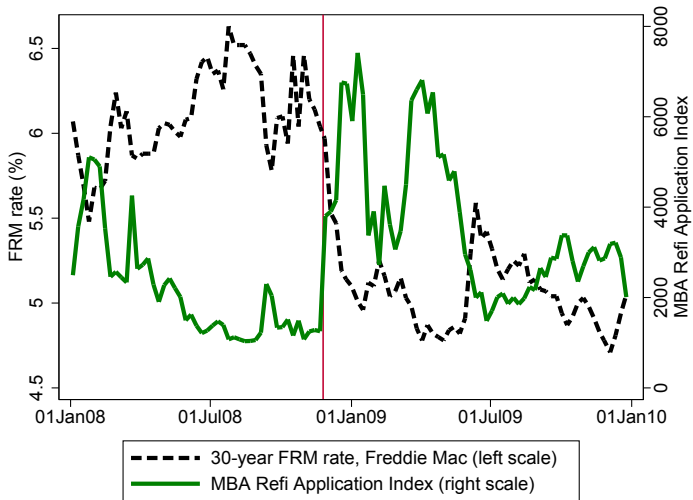
- Incomplete markets hh model w/collateralized borrowing, costly refi, income and HP shocks disciplined by cross region evidence.
- Use model to assess aggregate response of monetary policy during Great Recession in GE (who owns debt)
- Counterfactuals: What features of the collateral distribution influence aggregate stimulus and regional inequality response to rate declines?
- Conclusion:
 - 2008 – Modest aggregate effect of Fed policy (large regional dispersion)
 - 2001 – Large aggregate effects of Fed policy (small regional dispersion)

Empirical Evidence: Response to Fed's large-scale asset purchases (“QE”)

Study refinancing response to a specific episode of expansionary monetary policy: “QE1”

- Announcement on Nov 25, 2008: purchase \$500 bn in MBS and \$100 bn in agency bonds
 - Extended in March 2009
 - Subsequent rounds: Aug/Nov 2010, Sep 2012
- Stated goal: increase availability & reduce cost of mortgage credit; support housing markets and financial markets more generally
- Largely unanticipated before announcement
 - Use “event study” approach
 - Large effect on rates and quantities

Announcement effect on mortgage rates & applications



(little immediate effect on purchase mortgage applications)

Main data sources

- Want to measure at MSA level:
 - Monthly “refinance propensities” and cashout volumes
 - Borrower equity at onset of QE1

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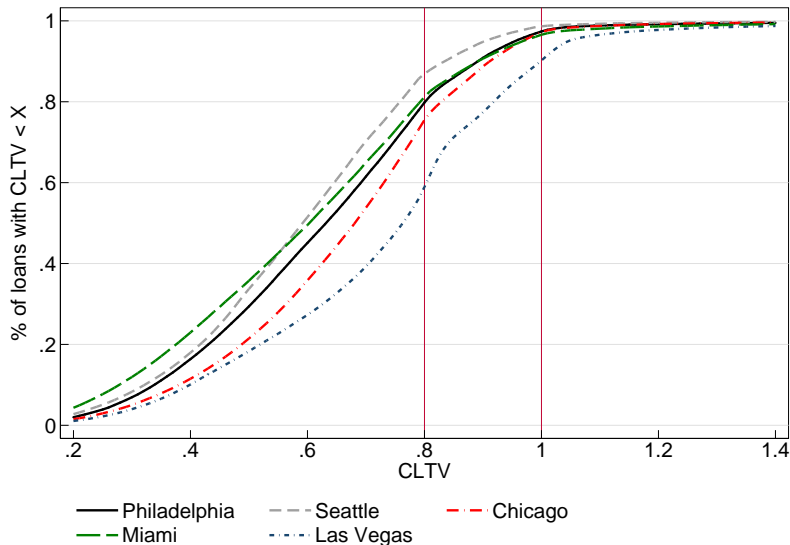
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- HMDA data. ~90% of market covered. Fed-internal version tracks exact application and origination dates.
 - Only has originations, but can use ACS to measure stock
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 - Only has originations, but can use ACS to measure stock
 - Can't measure cashouts (tracks loans not households)
- Equifax CRISM data. Mortgage servicing records matched to credit records. ~65% coverage (starting mid-2005).
 - Can link borrowers over time (tracks households across multiple mortgages)
 - Measure refi propensity more precisely; also cashout conditional on refi
 - Can measure borrowers' combined Loan-to-value ratio (including all liens)

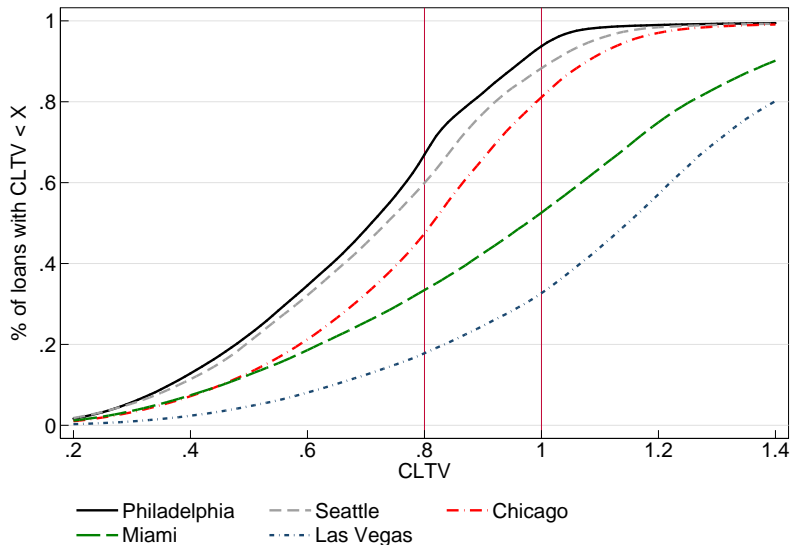
CLTV distribution across MSAs

January 2007 (beginning of HP drop)

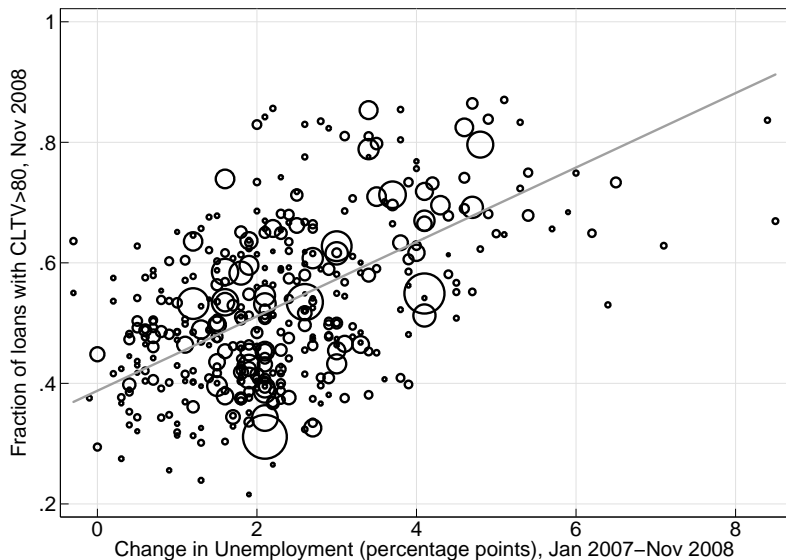


CLTV distribution across MSAs

November 2008 (when QE announced)

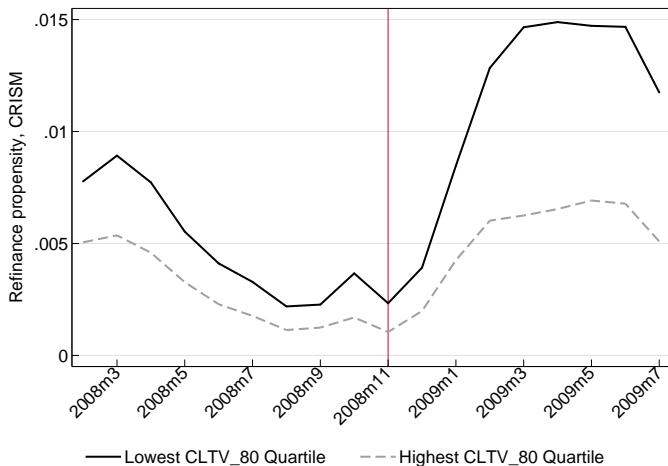


Unemployment increase vs. CLTV > 80% ($N=381$ MSAs)



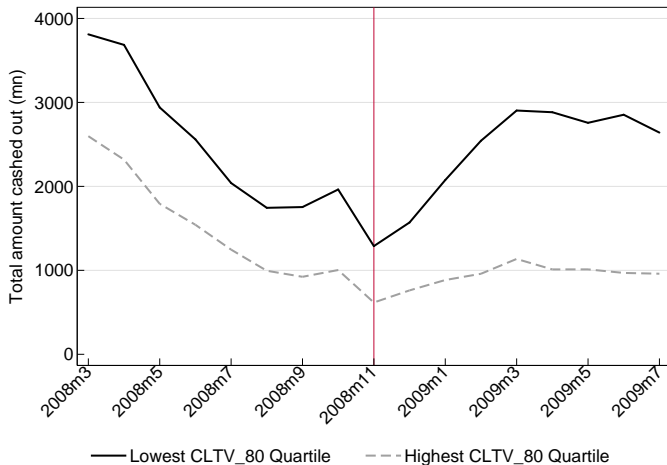
Results: Refi propensities around QE1 (CRISM data)

Top vs. bottom quartile of MSAs in terms of % borrowers with CLTV > 80.



Much more refinancing in high equity locations

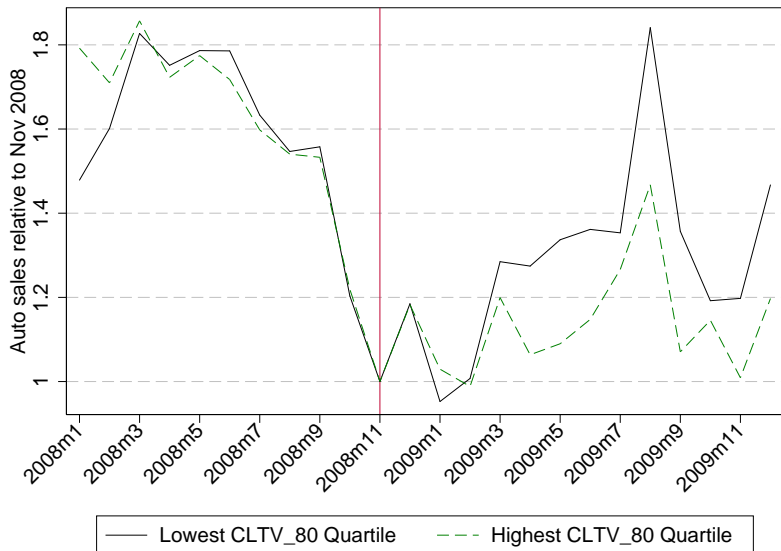
Cash-out refinancing around QE1 (CRISM data in \$)



\$10bn more refinancing in high equity locations

Effects on durables spending: auto sales

Data source: R.L. Polk (as in Mian, Rao, and Sufi, 2013)



Regression analysis and summary of results around QE1

- Run regressions to formally assess significance + control for various confounding effects
 - Control for MSA: education, age, race, nationality, % homeowners, % w/ mortgage if homeowner
- Summary:
 - In MSAs where borrowers had less equity (and which had higher ΔU):

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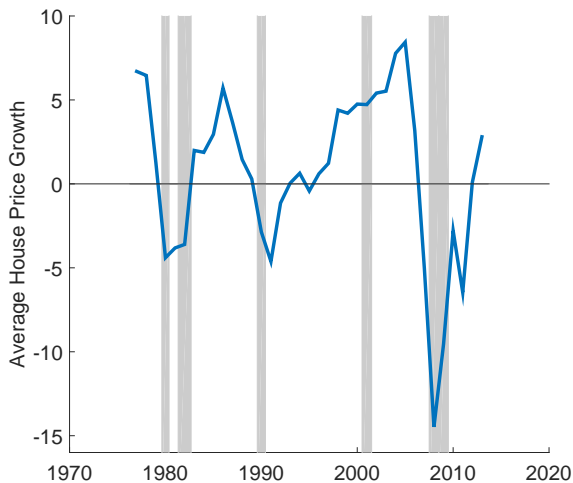
⇒ Monetary policy action, at least through mortgage channel, may have increased inequality across regions

Do the 2008 patterns hold in all recessions?

- Can't measure CLTV before 2005, but can measure state-level HP growth (highly correlated with CLTV) and unemployment back to 1976

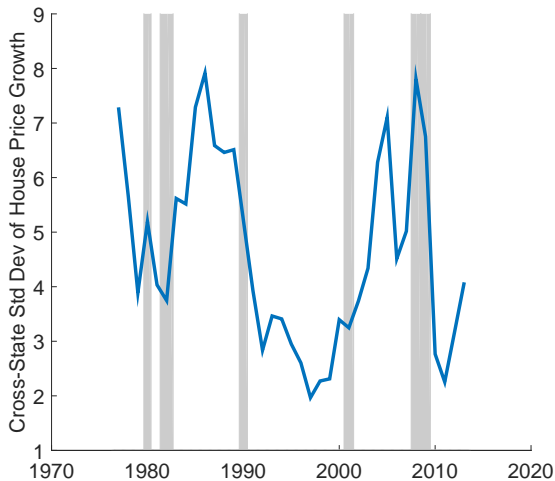
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Average House Price Growth:



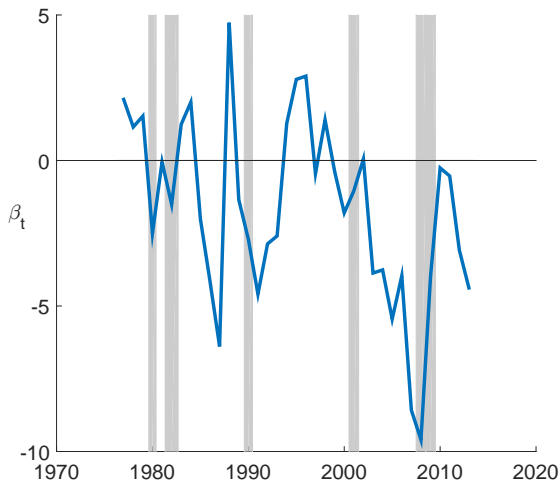
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Cross-State SD of House Price Growth:



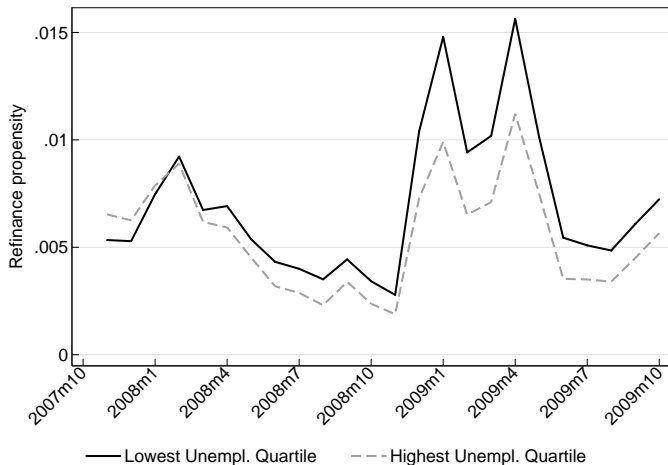
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Response of House Price Growth to Urate



Changing HP-Urate relationship matters for refi patterns

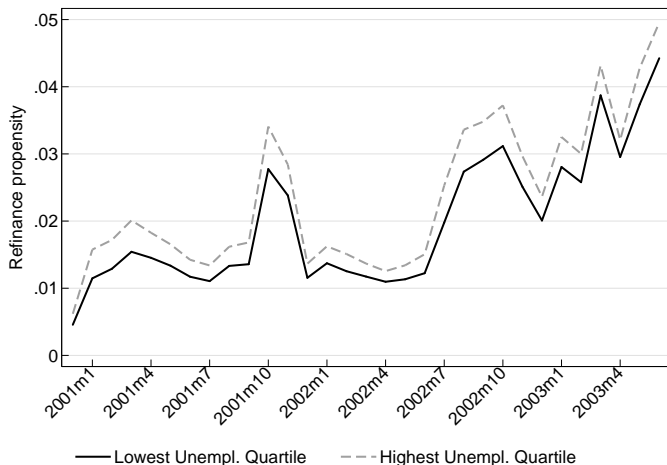
Compare 2007-2009 to 2001-2003:



- 2007-9: refi propensities by top/bottom unemployment quartiles – similar to earlier results

Changing HP-Urate relationship matters for refi patterns

Compare 2007-2009 to 2001-2003:



- 2001-3: opposite pattern – higher U MSAs have higher refis
- Overall refi levels substantially higher \Rightarrow transmission channel stronger

Part 2

Quantitative Model

Quantitative model

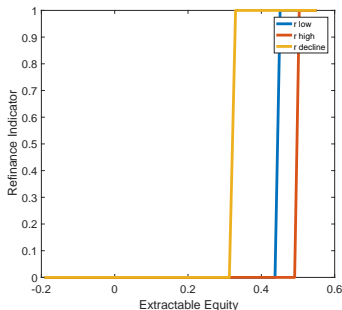
- Goal: Broader insights about interplay between monetary policy and regional heterogeneity
- Match cross-region evidence from QE1 and then explore aggregate implications
- Counterfactuals:
 - Vary cross-region distribution of collateral values and income as in earlier recessions
- To study how this matters for
 - 1 Aggregate transmission of monetary policy
 - 2 Effect of monetary policy on regional inequality
- What features of distribution matter and why?

Model setup (Sketch)

- Borrowers solve saving problem w/ borrowing constraints + mortgages
- Stochastic exogenous income
- Endowed with house w/ stochastic regional price shocks + trend growth
 - Cannot buy or sell, but can borrow against value using interest only mortgage at current rate r^m
 - Can be refinanced at any time by paying fixed cost
 - Baseline: full cash-out mortgages, so when refinancing:
 - $M' = \gamma P$ where γ is max LTV and P is current price
 - New payment is $r^m M'$
 - Cash-out amount is $\gamma(P - P_0)$
- Can save in risk-free asset $a \geq 0$ with interest rate r
- PIH representative lender to account for equilibrium effect of reduced mortgage payments on lender consumption

Model Parameterization

- Income and house prices random walks with common drift
 - Eliminates P as state-variable, equity x becomes relevant state
 - House price drift means x grows on average
 - Refi policy follows an (income, asset, interest rate dependent) threshold rule:
 - When equity low, not worth fixed cost to refi
 - When equity high enough, pay fixed cost, extract equity and refi



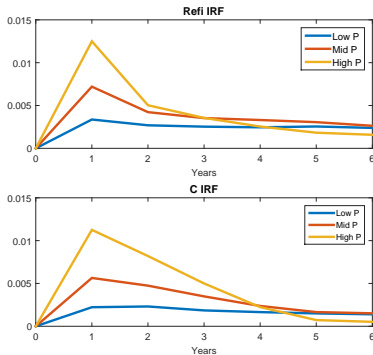
- Annual model, most parameters calibrated at standard values

Defining regions, baseline calibration and experiment

- Baseline impulse response:
 - Assume r^m constant forever
 - 1-time unanticipated permanent decline from 6% to 5%
- Assume shocks to house prices and income across regions uncorrelated on average (i.e. when solving hh problem)
- But explore impulse responses after different realizations of shocks
 - i.e. interpret different recessions as lucky or unlucky realizations of HP shocks, not permanent changes in process
- Calibrate baseline distribution of economic activity to match observables just prior to QE1:
 - Aggregate house price decline of 12.5%
 - Large variance of house prices
 - House price and income shocks highly correlated

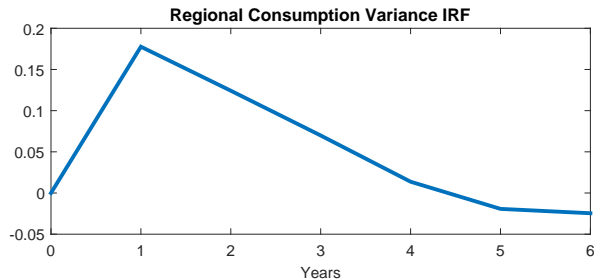
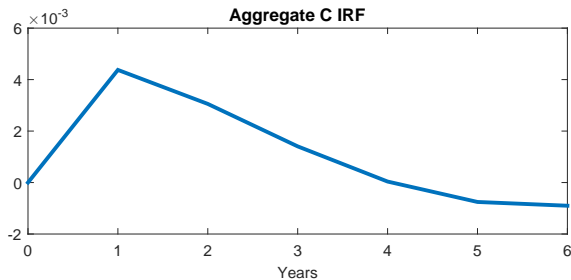
Using our empirical evidence

- Calibrate fixed costs to match empirical refinancing activity across regions before and after QE1



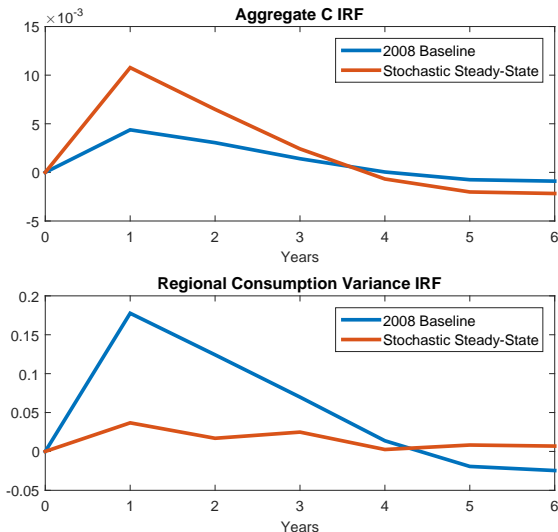
- Then look at implications for aggregates and inequality which can't be measured directly in data

Baseline Results: Stimulus vs Inequality



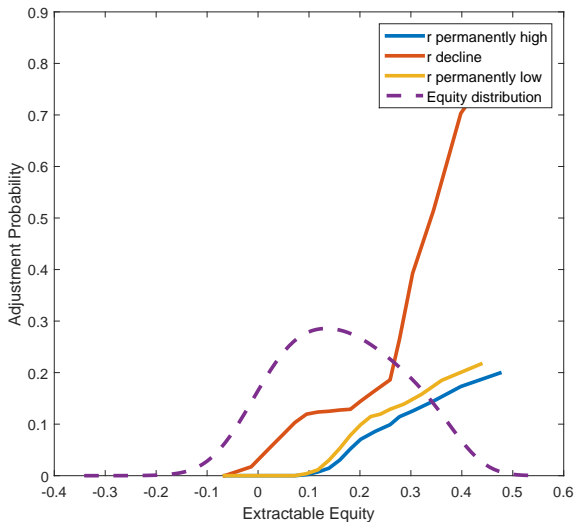
Effects of 2008 Distribution

- Compare IRF in 2008 to IRF in stochastic-steady state



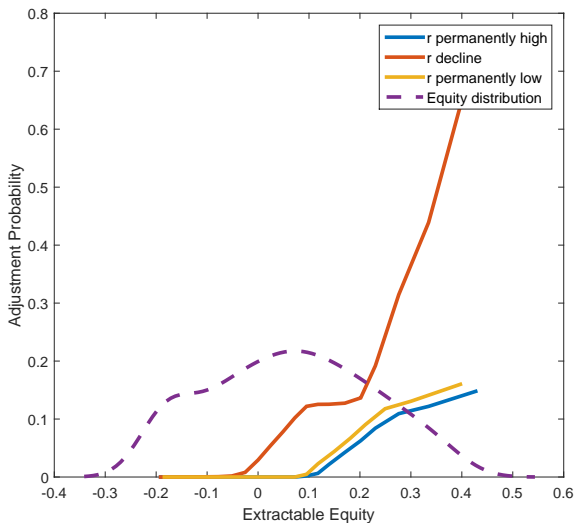
Understanding Role of Distribution

Stochastic Steady-State



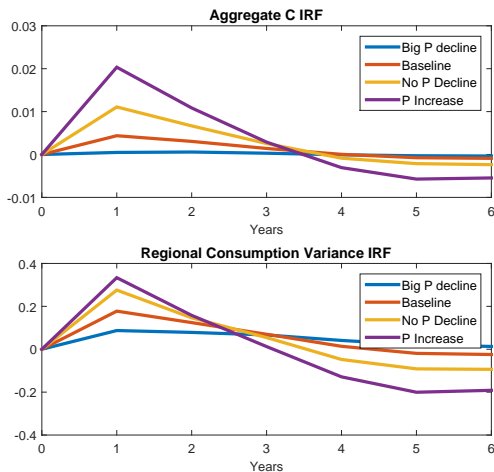
Understanding Role of Distribution

2008



How Do Different Moments of Distribution Matter?

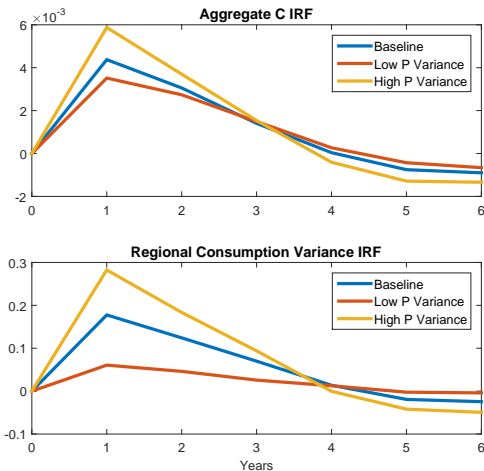
Changing Average Collateral



- Little refinancing or cash-out when equity low

How Do Different Moments of Distribution Matter?

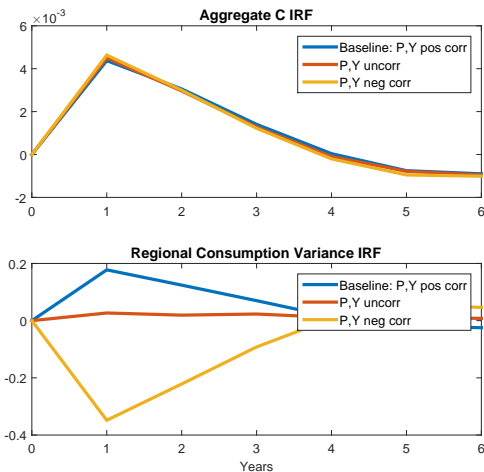
Changing Regional Variance of Collateral



- Non-linearity: high equity hh respond more, underwater hh respond 0

How Do Different Moments of Distribution Matter?

Changing Correlation of Collateral and Income



- If high equity have lowest income, inequality reduced

Robustness Summary

- Empirically ARM share larger in low equity regions during QE1
 - Results robust to including ARMs, matching empirical shares
- Robust to stochastic r^m with AR process
- Robust to endogenizing cash-out decision
- Robust to various assumptions on lender/GE side

Model takeaways

- To understand consequences of monetary policy for aggregate spending and inequality need to know (time-varying) collateral distribution
 - 2008 distribution \implies drag on aggregate monetary policy and amplification of inequality
 - But not true in general, e.g. different patterns in 2001
- Joins growing literature showing even if just care about aggregate stimulus, need to look at micro data

Conclusion

- Important to understand interaction between collateral distribution and monetary policy
- Our data is US mortgages, but importance of collateral channel is broader
 - Same forces should apply to other collateralized lending
 - Europe has seen similar regional patterns
- Due to regional heterogeneity, QE exacerbated inequality, had more limited aggregate effects
- Does that mean should do less monetary accommodation? Arguably no, because aggregate transmission weaker
 - But tradeoffs with inequality worse
- Interplay with fiscal policy – in this example government refi program (HARP; introduced in 2009 but not very effective until 2012)