Regional Heterogeneity and the Refinancing Channel of Monetary Policy

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The views expressed are those of the authors and do not necessarily represent the views of the Federal Reserve Bank of New York or the Federal Reserve System.

This paper

1. Most US hh borrowing in fixed-rate mortgages with refinancing option
   - If monetary policy reduces mortgage rates $\Rightarrow$ **Refinancing channel**
2. Refinancing requires equity and housing markets have fundamental local component that affects equity
   - Vegas vs. Boston in 2008

$\Longrightarrow$

- This paper: regional distribution of home equity matters for
  - **Aggregate spending** response to monetary policy
  - **Cross-region** responses to monetary policy
- Consequences of monetary policy are **time-varying**
- Note: Not arguing Fed should stabilize region shocks, but show Fed actions have heterogeneous local effects which then matter for aggregates

Overview

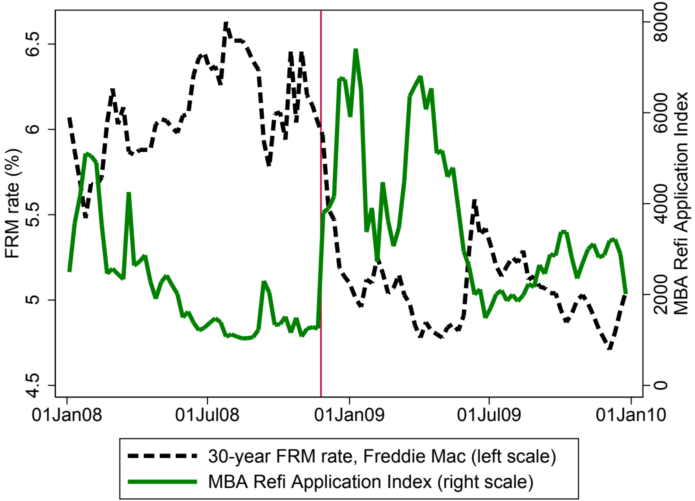
- **Empirical**: (a) Event study around QE1 v. (b) '01-'03 easing cycle
    a. Refi, cash-out and spending responded more in areas where, before QE, equity was higher and unemployment lower
    b. In '01-'03, much smaller aggregate decline and regional variation in house price growth. Larger refinancing response in regions with higher unemployment.
- **Theoretical**: Heterogenous agents, incomplete markets model with costly refinancing. Disciplined by cross-region evidence around QE1
    - What does cross-region evidence imply for aggregate response in equilibrium?
    - What features of equity distribution influence stimulus and inequality in response to rate declines?
    - How do other policies (e.g., HARP) interact with monetary policy?

Part 1

Empirical Evidence

Response to Fed's large-scale asset purchases ("QE")

- Event study of specific episode of expansionary monetary policy:
  - "QE1" announcement on Nov 25, 2008

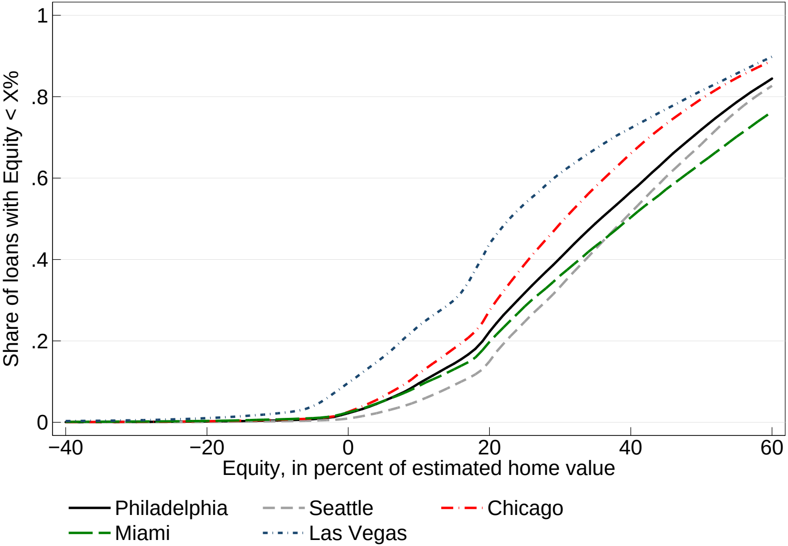


Micro data

- Focus on regions: primary shocks to hh equity + interact w/ local labor markets + practical advantages for policy
- Measure at MSA level:
  - Monthly "refinancing propensities" and cash-out volumes
  - Borrower equity at onset of QE1
- Primary data source: Equifax CRISM data. Mortgage servicing records (McDash) matched to credit records.
  - $\sim$65% market coverage (starting mid-2005)
  - Tracks households across multiple mortgages
  - Measure refi propensity precisely; also cash-out conditional on refi
  - Can measure borrowers' combined loan-to-value (LTV) ratio (including all liens). Updated based on local HPI. Equity = 1−CLTV
- Also use Home Mortgage Disclosure Act (HMDA) data
  - Robustness: 2008/9 refi propensities almost identical
  - Can use for pre-2005 periods + sharper event study (application date)

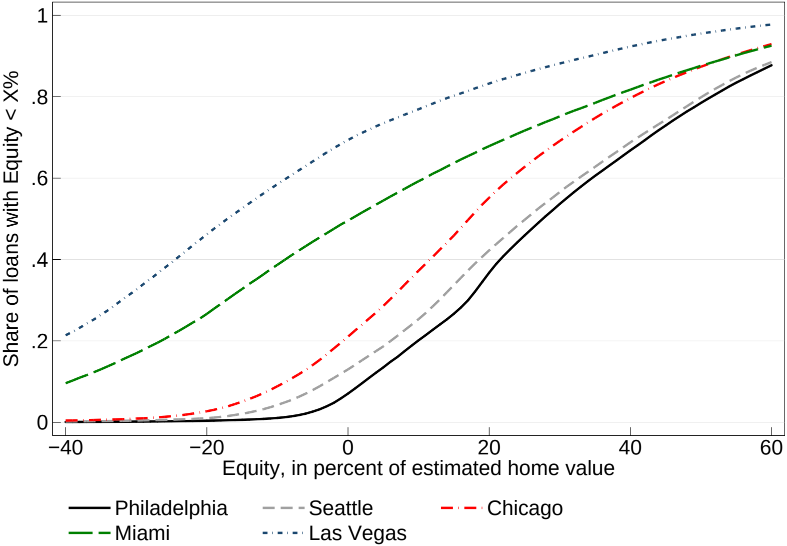
Equity distribution across MSAs

January 2007 (beginning of HP drop)

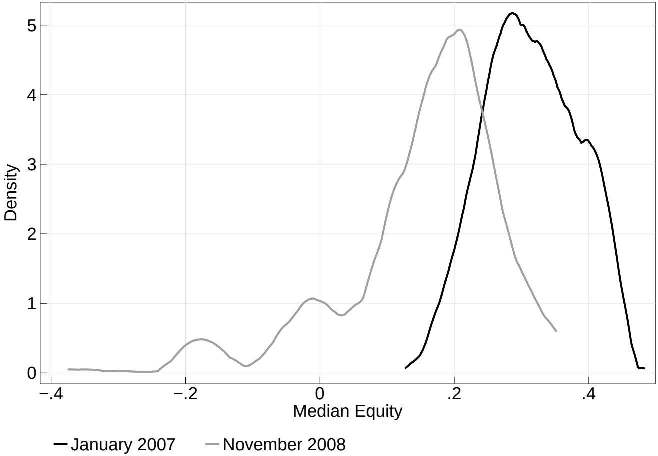


Equity distribution across MSAs

November 2008 (when QE announced)



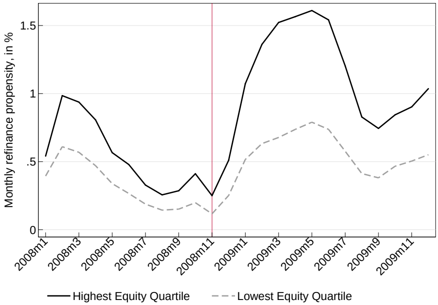
Equity: MSA medians (N =381 MSAs)



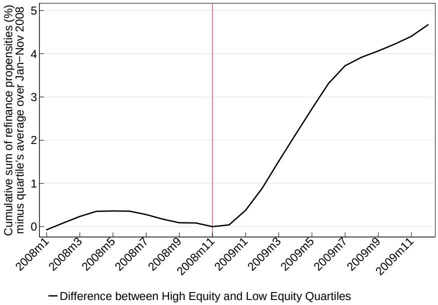
- Use median equity as of Nov 2008 as our "sorting variable"
- Note: strong negative correlation w/ unemployment

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

Results: Refi propensities around QE1



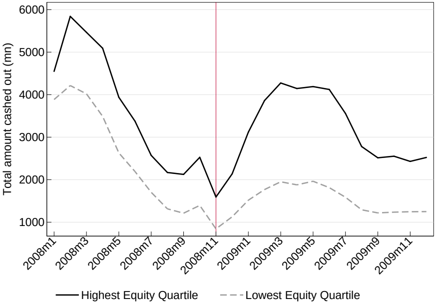
(a) Refinance Propensities



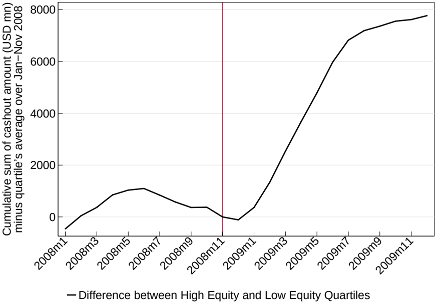
(b) Cumulative Difference

- In paper, do all results with formal regressions w/ various controls
- Differences highly significant

Cash-out refinancing around QE1



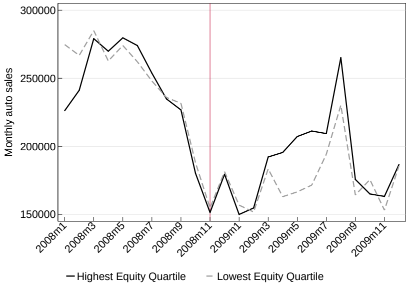
(a) Cash-out Volumes, in million $



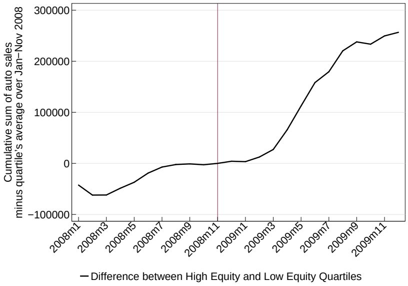
(b) Cumulative Difference

- Magnitude:
  - \$8 billion $\approx$ 10% of difference across MSAs in Δ spending in recession
  - \$280 per household extra cash in highest quartile MSAs

Effects on durables spending: auto sales



(a) Monthly Auto Sales

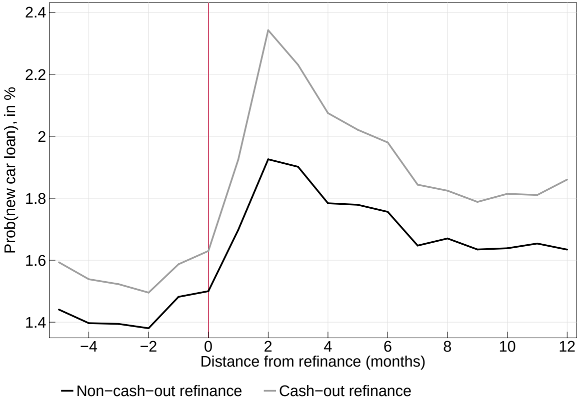


(b) Cumulative Difference

- Much of equity withdrawn spent on consumption and home improvements [Brady et al. (2000), Canner et al. (2002), Hurst and Stafford (2004), Bhutta and Keys (2016)]

Is Spending-LTV pattern driven by Refi-LTV relationship?

- LTV might affect $\frac{dC}{dr}$ through channels unrelated to refi
  - Bank health, credit supply, etc.
- Does spending difference arise through refi channel:
  - More direct evidence: refi leads to more spending at individual level



- Model provides further insight into causal mechanism

Regression analysis and summary of results around QE1

- Run regressions to formally assess significance + control for various confounding effects
  - MSA + month FE plus pre/post QE interaction with equity as well as ΔUR, FICO, prior mortgage rates, average loan age, jumbo share, ARM share, GSE share, FHA/VA share and Private sec. share.
- Summary:
  - In MSAs where borrowers had less equity (and which had higher ΔU):
    - Refinancing increased by less following the announcement of QE1
    - Borrowers extracted less home equity (both unconditionally and conditional on refinancing)
    - Auto sales increased less

$\Rightarrow$ Monetary policy action, at least through mortgage channel, may have increased inequality across regions

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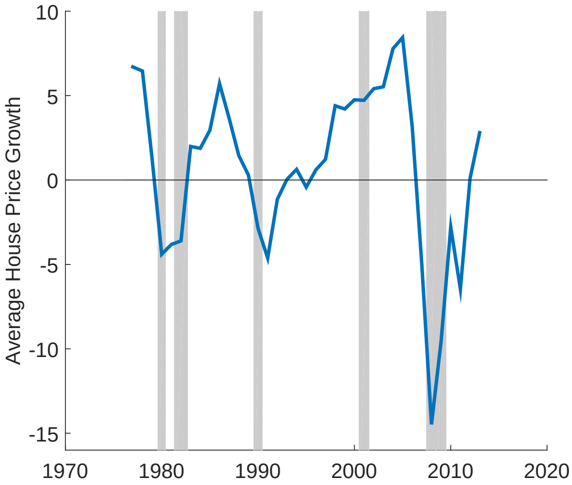
Do the 2008 patterns hold in all recessions?



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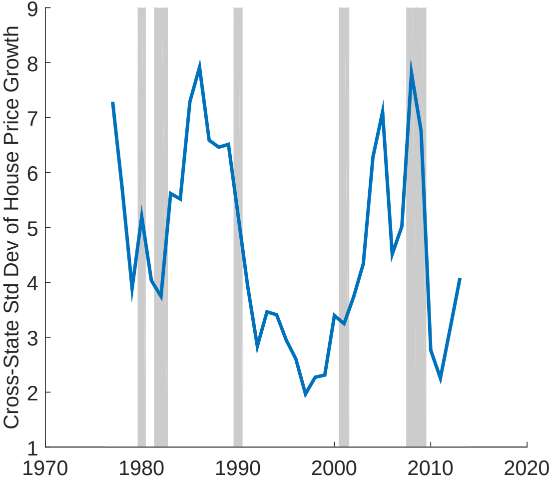
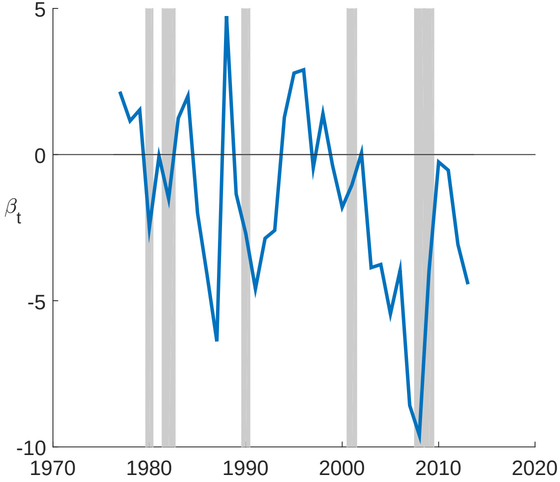


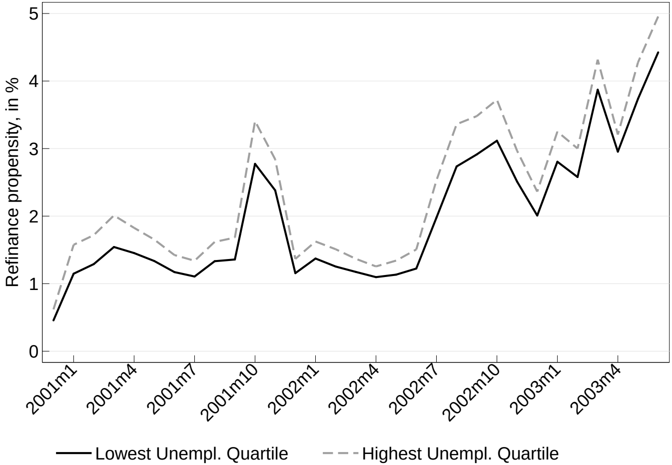
Do the 2008 patterns hold in all recessions?

Strength of HP growth - unempl. relationship:

$$\Delta \log HP_{i,t} = \alpha + \beta_t \Delta UR_{i,t} + \gamma_t + \zeta_i + \epsilon_{i,t}$$



Changing HP-Urate relationship matters for refi patterns



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

Longer Time-Series Evidence

- 2001 and 2008 differ in many ways besides HP patterns
- Any more systematic evidence?
- No earlier data on regional refi, but can look at agg refi relationship with cross-state HP patterns
- Regress aggregate refinancing on mortgage rates (incentives, changes, surprises) interacted with cross-state HP
- Result: rate declines increase refi, but more when house prices growing and when variance large

Part 2

Quantitative Model

Quantitative model

- **Goal**: Understand interplay between monetary policy, regional heterogeneity and refinancing/spending and to explore aggregate implications (accounting for lenders)
- **Counterfactuals**: vary cross-region distribution of equity and income and explore effects on:
  - Aggregate and cross-region effects of monetary policy
- **Additional Policy**:What can help when monetary policy hindered by equity distribution like in 2008:
  - explore modification policies; countercyclical LTV caps

Model setup (Overview)

- Try to capture essential elements of refi-house price-interest rate interactions in "GE"
- 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
- 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 Details

- Infinitely lived households indexed by i live in $j = 1, 2, ..., J$ regions
- Utility over consumption $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$
- Idiosyncratic earnings:

$$log(y^{ij\prime}) = \mu_y^j + log(y^{ij}) + \varepsilon^{ij}$$

- Save in risk-free asset $a \geq 0$ with interest rate r
- Endowed with 1 unit housing w/ stochastic regional price shocks + trend growth

$$log(p^{j\prime}) = \mu_p^j + log(p^j) + \nu^j$$

Refinancing

- To isolate refinancing effects: cannot buy/sell house, but can borrow against value using interest only mortgage at rate r_t^m
- Refinance at any time by paying iid stochastic fixed cost proportional to house value $F_t^i p_t^j$
- Baseline: full cash-out mortgages, so when refinancing:
  - $M' = \gamma p^j$ where γ is max LTV
  - New payment is $r_t^m M'$
  - Cash-out amount is $\gamma(p^j - p_0^j)$ where p_0^j is value when previous mortgage originated

Understanding Refinancing Decisions

- Budget constraint when refinancing:

$$c + a' \leq a(1 + r) + y - \gamma r_t^m p_0^j + \gamma(p^j - p_0^j) - Fp^j$$

- Budget constraint when no refi:

$$c + a' \leq a(1 + r) + y - \gamma r_0^m p_0^j$$

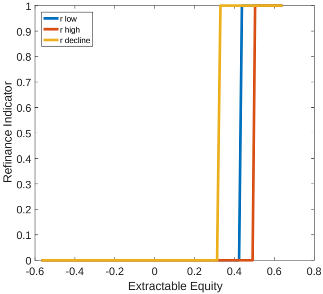
- What encourages refi?

$$r_t^m < r_0^m \text{ and } p^j > p_0^j$$

- But borrowing constraints mean y and a will also affect decision
  - i.e. through mpc: how valuable is cash today vs tomorrow?

Characterizing Solutions: Key State-Variable

- Random walk y and P plus CRRA u eliminate P as state
- Equity $x = \frac{P}{P_0}$ is relevant state, grows on average w/ P drift
- One-sided (S,s) refi threshold, dependent on (y, a, r):
  - When equity low, not worth fixed cost to refi
  - When equity high enough, pay fixed cost, extract equity and refi



  - When interest rates lower, refi sooner
  - When a and y lower, refi sooner

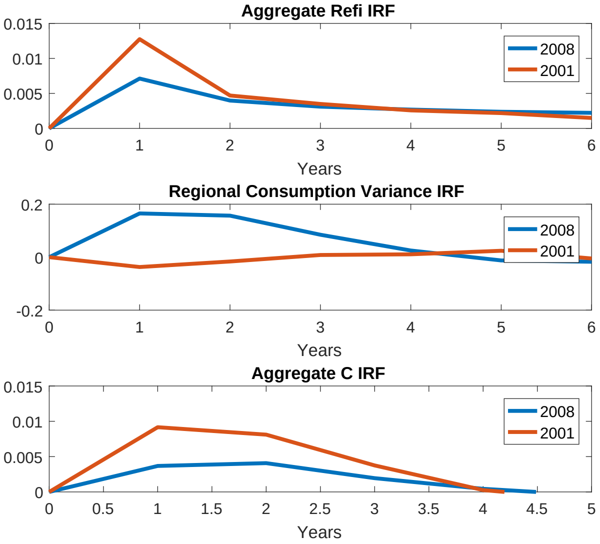
Equilibrium

- All interesting model action is on borrowers described above
- But want to account for effect of borrower refi on lender income/consumption as in Greenwald (2016)
- Interest rate exogenously set by central bank but introduce
  - PIH representative lender receives payments from borrowers:
  - $d_t = \int \left[\gamma r_t^m(i,j)\tilde{M}_t(i) - \left(\gamma(p_t^j - p_{t0}^j) - F_t^i p_t^j \right) \mathbb{I}_t^{refi}(i,j) \right] didj$
  - Smooths consumption
  - Total consumption is the sum of heterogeneous borrowers and representative lender

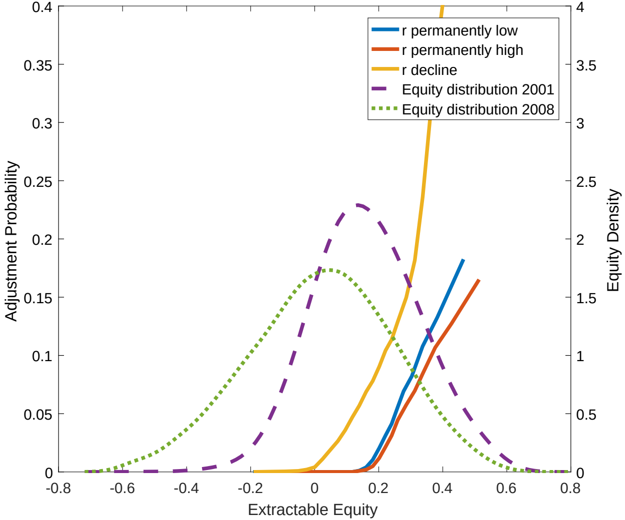
Baseline calibration and experiment

- Annual model; most parameters calibrated at standard values
- Calibrate remaining parameters to 2008 QE cross-region evidence
  - Specification check w/ untargeted moments: household equity distribution in 2008 model and data very similar
- Main counterfactual of interest: would economy have responded differently if regional equity looked like 2001?

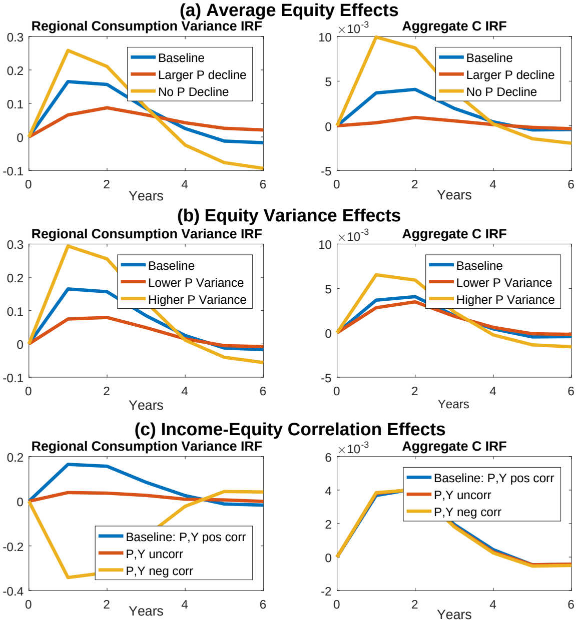
Baseline aggregate results in 2008 vs. 2001 calibration



Understanding role of distribution



How do different moments of distribution matter?

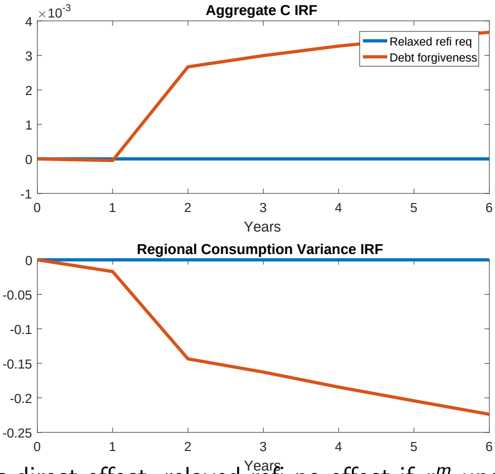


Interaction with other policies

- Model implies monetary policy had little aggregate effect and effects mostly went to locations doing relatively well in 2008
- Can other policies improve efficacy of monetary policy?
- Simulate very stylized version of mortgage modification policies
    - "Relaxed refi standards": can refi when underwater ($\sim$HARP)
    - "Debt forgiveness": forgive underwater debt ($\sim$HAMP)
    - In both cases, refinancing costs set to zero
- Also study effects of tighter or time-varying LTV caps

Mortgage modification results

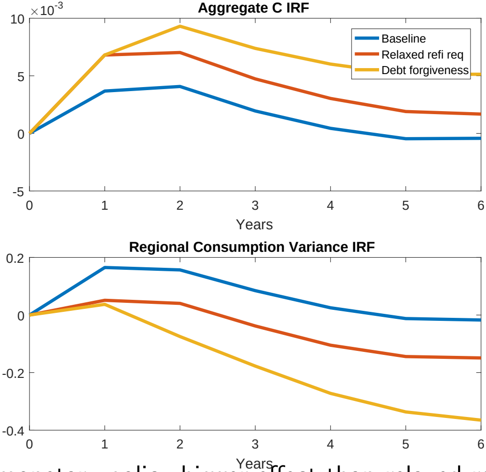
Response to Mortgage Modification w/ constant r^m



- Debt relief has direct effect, relaxed refi no effect if r^m unchanged, since underwater hh only do rate refi

Mortgage modification results

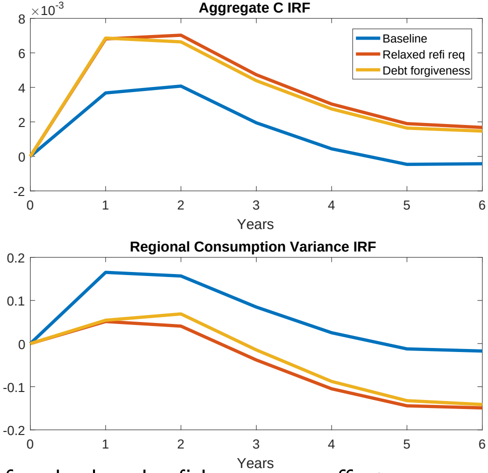
Response to Simultaneous Mortgage Modification + r^m Decline



- Debt relief + monetary policy bigger effect than relaxed refi + monetary policy, since debt relief gets extra direct effect

Mortgage modification results

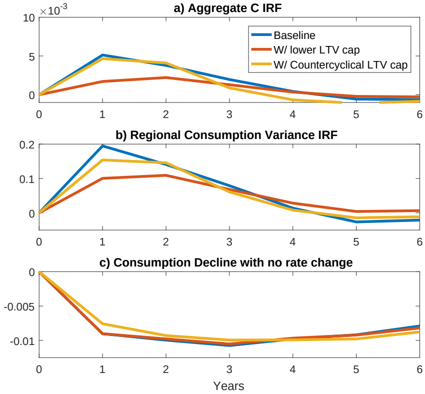
Response to r^m Decline, taking Mortgage Modification Programs as Given



- Both debt-relief and relaxed refi have same effect on consequences of monetary policy after removing direct effect

Macroprudential leverage regulation

- How do simple policies to limit leverage interact with refi?
  - Policy 1) Lower LTV cap from 0.8 to 0.7
  - Policy 2) Lower LTV cap from 0.8 to 0.7 but rises to 0.9 during bad recession



- Policy 1) weakens monetary policy, policy 2) leaves aggregate effects unchanged but reduces inequality trade-off

Model extensions and robustness

- Robustness More
  - Assumptions on rate process, cash outs, income process
  - Endogenizing income, house prices
- Other ex-ante differences across regions More
  - ARM shares
  - Preceding boom

Key takeaways

- Monetary policy makers should track collateral distribution over time
- It affects aggregate spending and whether stimulus flows to places that need it most
  - 2008 distribution: drag on aggregate stimulus and amplified inequality
  - But not true in general, e.g., different patterns in 2001
- Some complementary policies can enhance monetary policy effectiveness when collateral distribution unfavorable

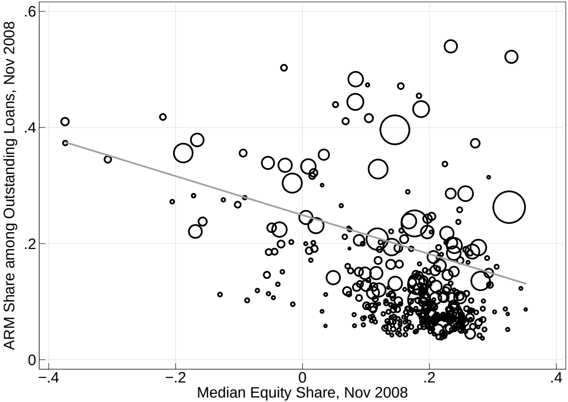
Robustness

- Baseline Model Summary:
  - Time-varying house price distribution matters: Less stimulus, more inequality in 2008
- Does interest rate process matter?
  - Stochastic vs. permanent, spread vs overall rate? No
- Does full-cash out assumption matter? No
- Does "more" GE matter?
  - Endogenize income with sticky prices?
  - Endogenize house prices, housing adjustment, construction?
- Much more complicated model, will be harder to solve & understand
  - Should only amplify our results:
  - Biggest local response of income, HP, etc. in locations with biggest refi response, which are regions doing well in 2008
  - Aggregate income should respond more when aggregate demand response bigger

Back

Ex-ante heterogeneity: ARM shares

- Regions with lower equity have higher ARM shares in 2008:



- Their rates automatically decline without refi (after fixed period), maybe undoes our effects

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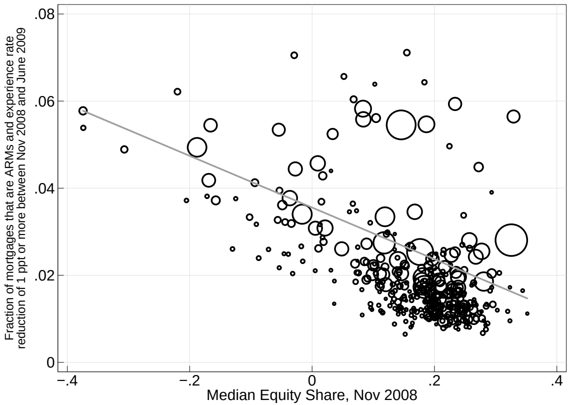

- Their rates automatically decline without refi (after fixed period), maybe undoes our effects
- But only few actually reset in 2009:H1

Ex-ante heterogeneity: ARM shares

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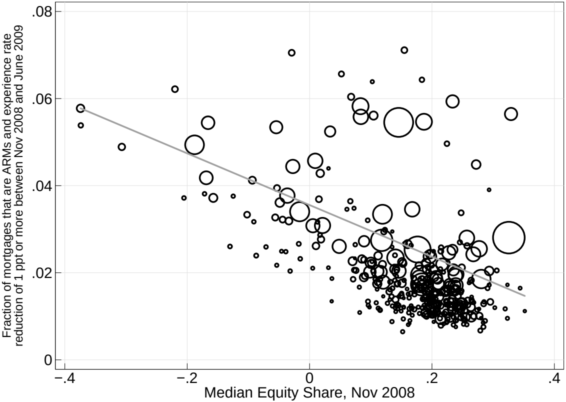
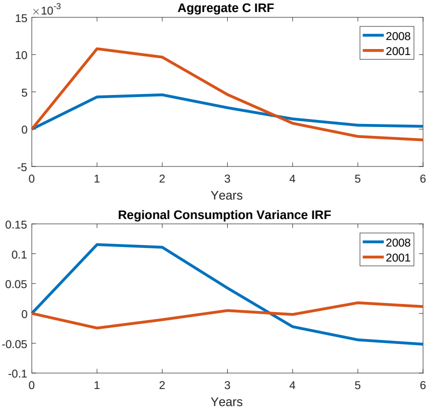


- Their rates automatically decline without refi (after fixed period), maybe undoes our effects
- And still need equity for cash-out

Ex-ante heterogeneity: ARM shares

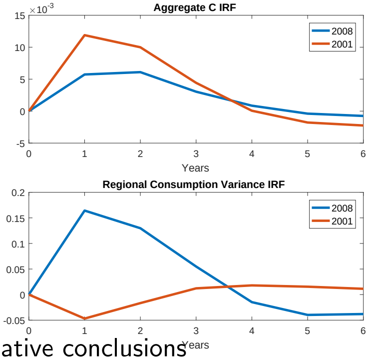
- Solve model with mixture of ARMs and FRMs
- Conservative calibration: match ARM shares, not share with resets



- Doesn't change qualitative conclusions

Ex-ante heterogeneity: Boom-bust episode

- Model results thus far start from steady-state
- In reality, regions with biggest bust previously had biggest boom
  - Maybe monetary policy not increasing inequality if current bust regions still ahead overall
  - Simulate boom-bust episode and repeat experiment



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