Credit Growth and the Financial Crisis: A New Narrative

Stefania Albanesi, OSU
Giacomo DeGiorgi, FRBNY
Jaromir Nosal, Boston College

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Introduction

- Prevailing narrative about the financial crisis
  - credit growth during boom concentrated in subprime segment
  - defaults during financial crisis also concentrated in this segment

$\Rightarrow$ expansion of subprime credit viewed as a leading cause for the crisis

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- Mechanism: Defaults&foreclosures $\rightarrow$ Drop in house prices
  $\rightarrow$ Contraction in credit&consumption
  $\rightarrow$ Recession

  (Justiniano & al. 2016, Berger & al. 2015, Lorenzoni & Guerreri 2015, Kehoe, Midrigan & Pastorino 2014, Mian & Sufi 2014, Midrigan & Philippon 2016, Kaplan, Mittman &Violante 2016, Hedlund & Garriga 2016, etc.)

Our Contribution

- Study behavior of household credit and delinquency, 1999-2013
- Using large administrative panel: FRBNY CCP/Equifax data

  debt positions, delinquencies, credit scores

  Findings:

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1. Credit growth during boom and defaults during the crisis concentrated at mid/top of credit score distribution for all debt categories
   - challenges prevailing narrative (consistent with Adelino, Shoar & Severino 2015 and Foote, Loewenstein & Willen 2016 findings for home debt)
   - raises questions on drivers of default risk & policy responses

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   - raises questions on drivers of default risk & policy responses
2. Also true within zip codes, including those with large subprime population
   - Empirical approach based on geographical variation distorts evidence on distribution of debt and defaults, overstates role of subprime debt

Data

- Federal Reserve Bank of New York Consumer Credit Panel/Equifax Data
  - quarterly, 1999:Q1-2013:Q4
  - all individuals with an Equifax credit report (anonymous)
- Use 1% sample – about 2.5 million individuals each quarter
- Over 600 variables
  - all aspects of financial liabilities:
    by type of account, balances, numbers
  - delinquent behavior: by severity, type of debt
  - public record items: court judgements, collections, etc.
  - credit score, age, ZIP code
- For 2009, matched to payroll data

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  proprietary measure, ranks individuals by probability of 90 day+ delinquency in subsequent 8 quarters

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- Our approach: Rank *individuals* by credit score at time of borrowing

  recent score, though not contemporaneous with delinquencies
- Our findings:
  - Credit growth during boom concentrated in prime segment
  - Defaults concentrated in middle of credit score distribution

    share of new defaults to subprime drops during crisis

Comparison to Previous Work

- Individuals or geographical areas ranked by initial credit scores
  1996 (Mian & Sufi 2009, for zip codes)
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  Role of subprime segment magnified by ranking with initial credit scores

  Apparent growth in subprime borrowing based on initial credit scores mostly explained by life cycle demand

  Geographical aggregation further distorts role of initial credit score

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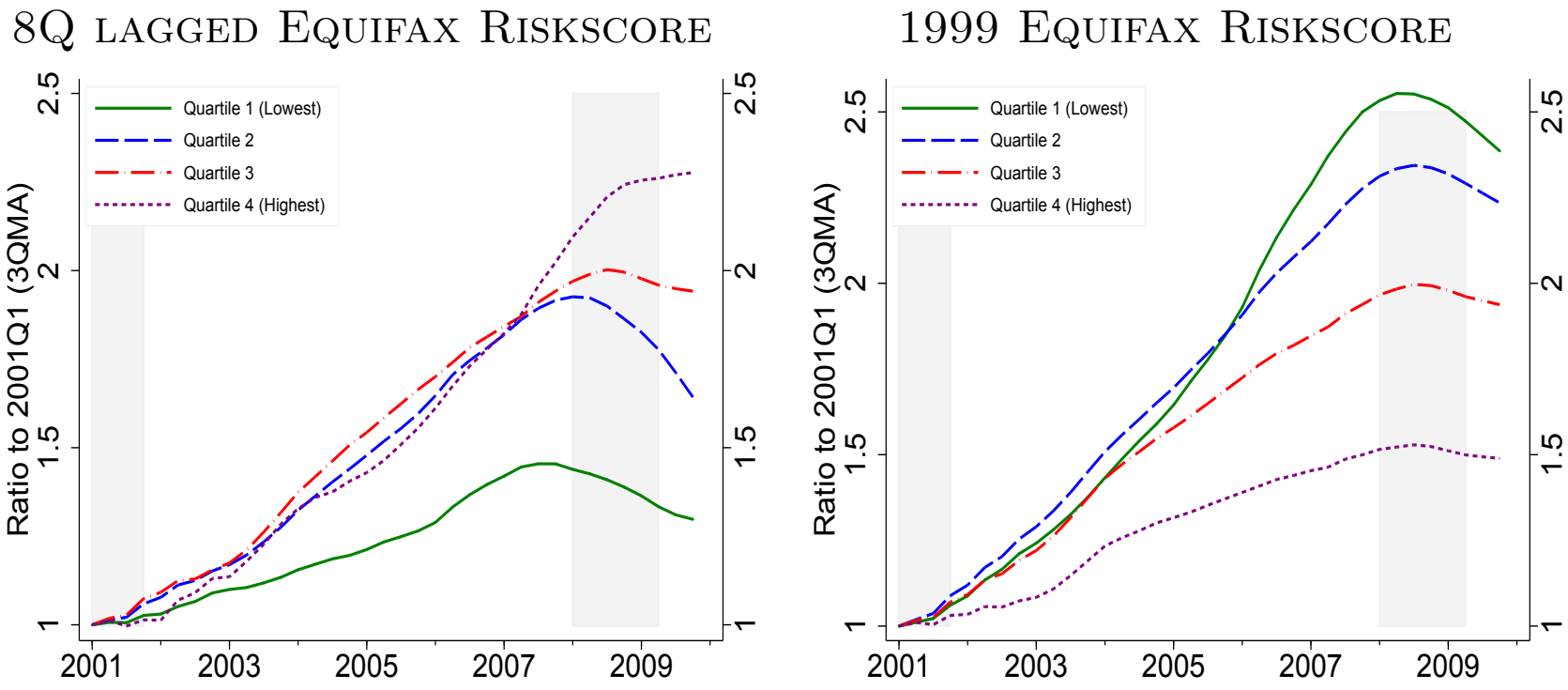
- Similar findings restricted to mortgage borrowing:

  Adelino et al. (2015): Middle income households account for most credit growth during boom (individual data)

  Foote et al. (2016): Distribution of mortgage borrowing by income unchanged during the boom; distribution of subsequent foreclosures mirrors debt distribution (zip code level data)

Comparison: Total Debt Balances

- Initial ranking overstates growth for quartile 1 relative to recent ranking



Total debt balances by Equifax Riskscore quartile. Ratio to 2001Q1. Quartile cutoffs: 615, 720, 791, 840. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Comparison: Mortgage Balances

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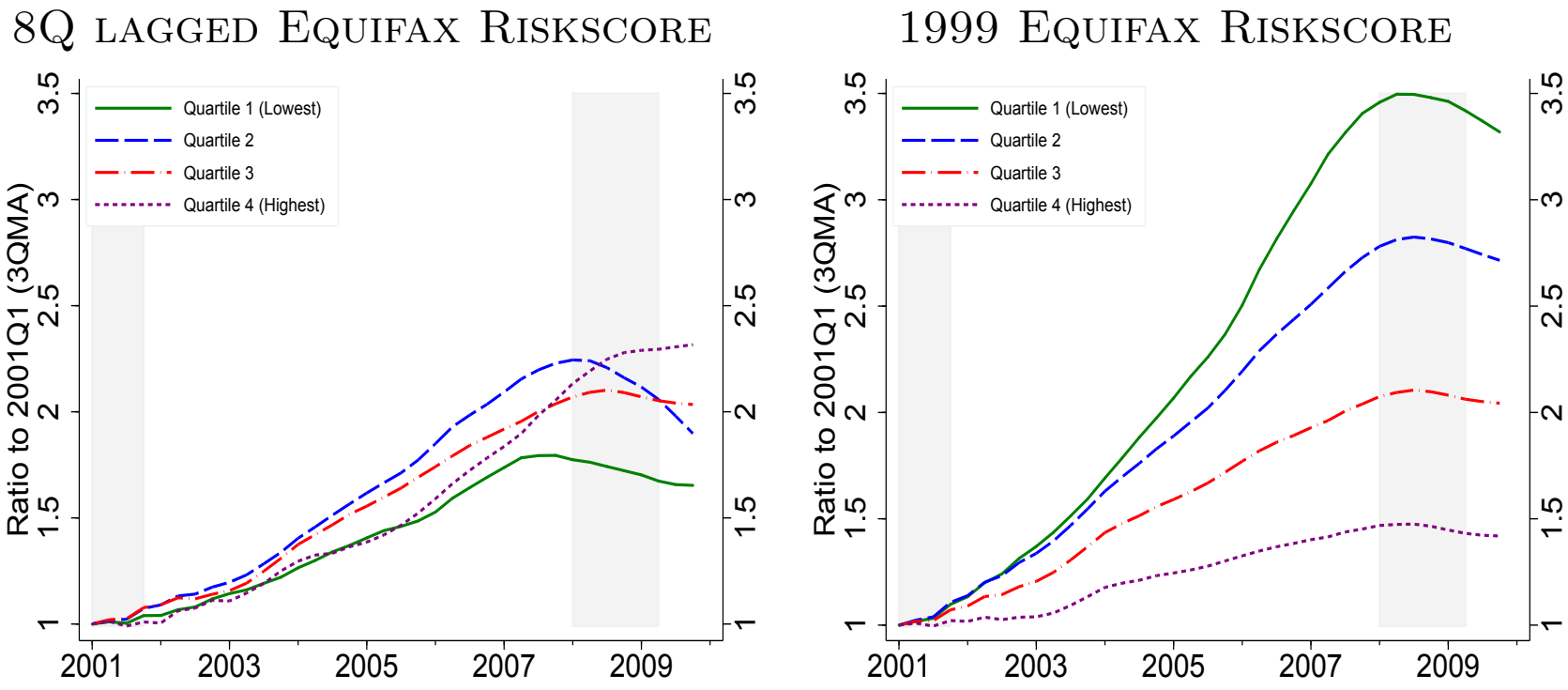

Mortgage balances. Ratio to 2001Q1. Quartile cutoffs: 615, 720, 791, 840.
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Comparison: Mortgage Originations

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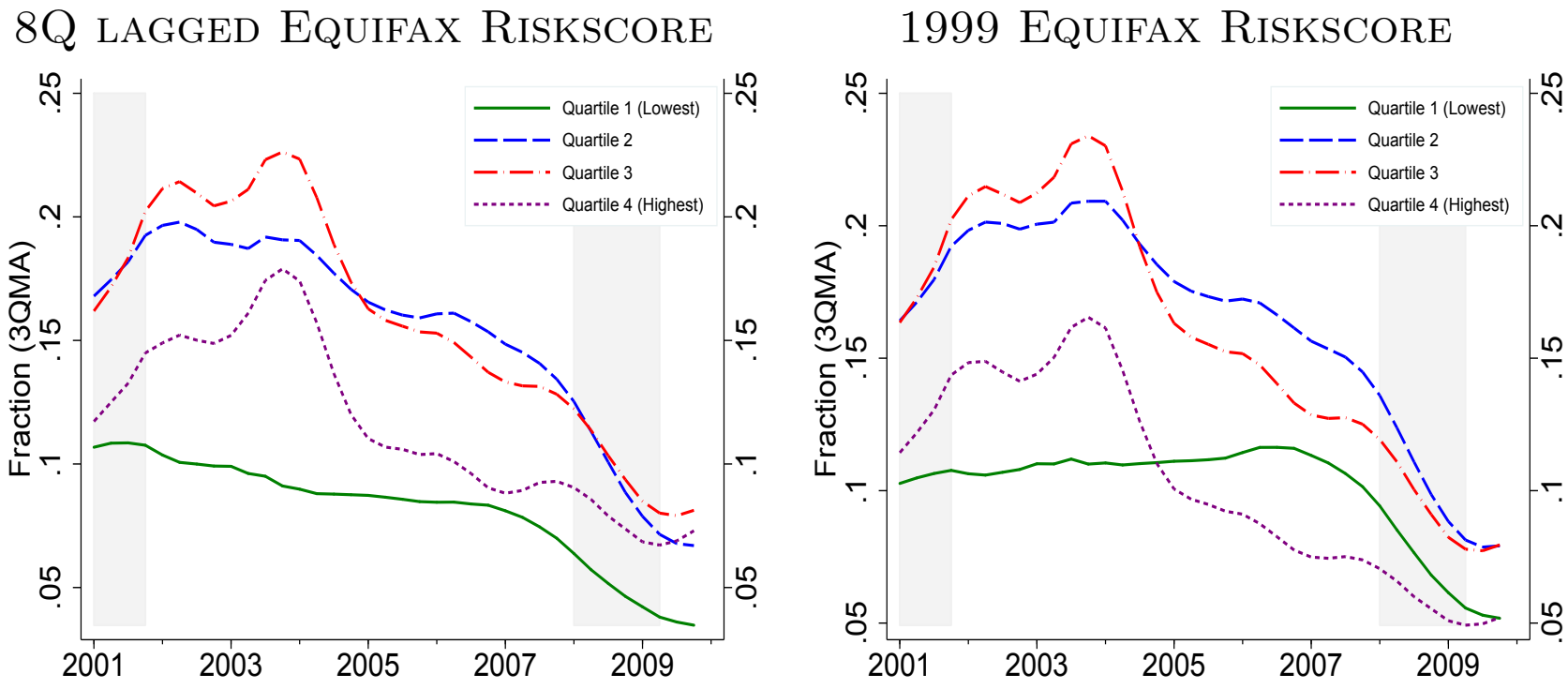
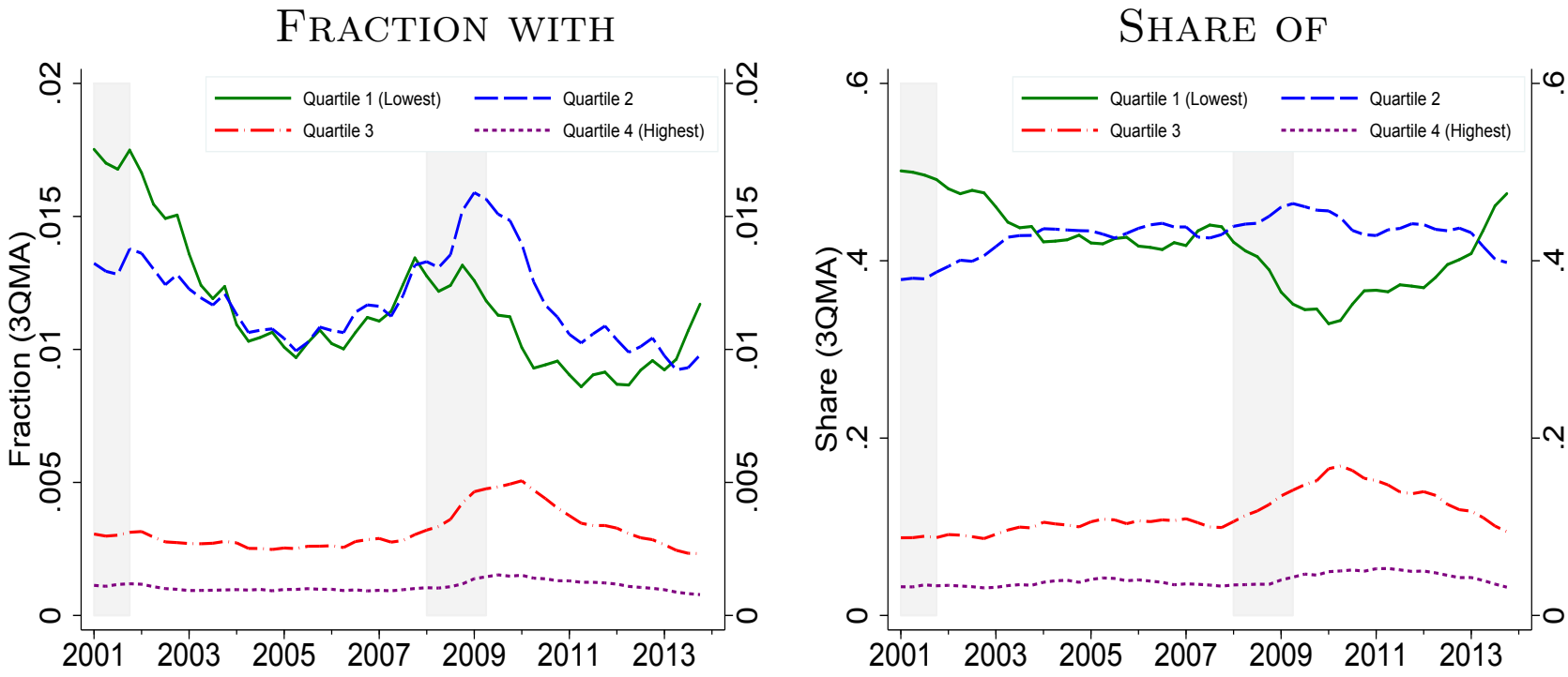


Fraction with new mortgage origination. Quartile cutoffs: 615, 720, 791, 840.
Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Defaults: Delinquencies

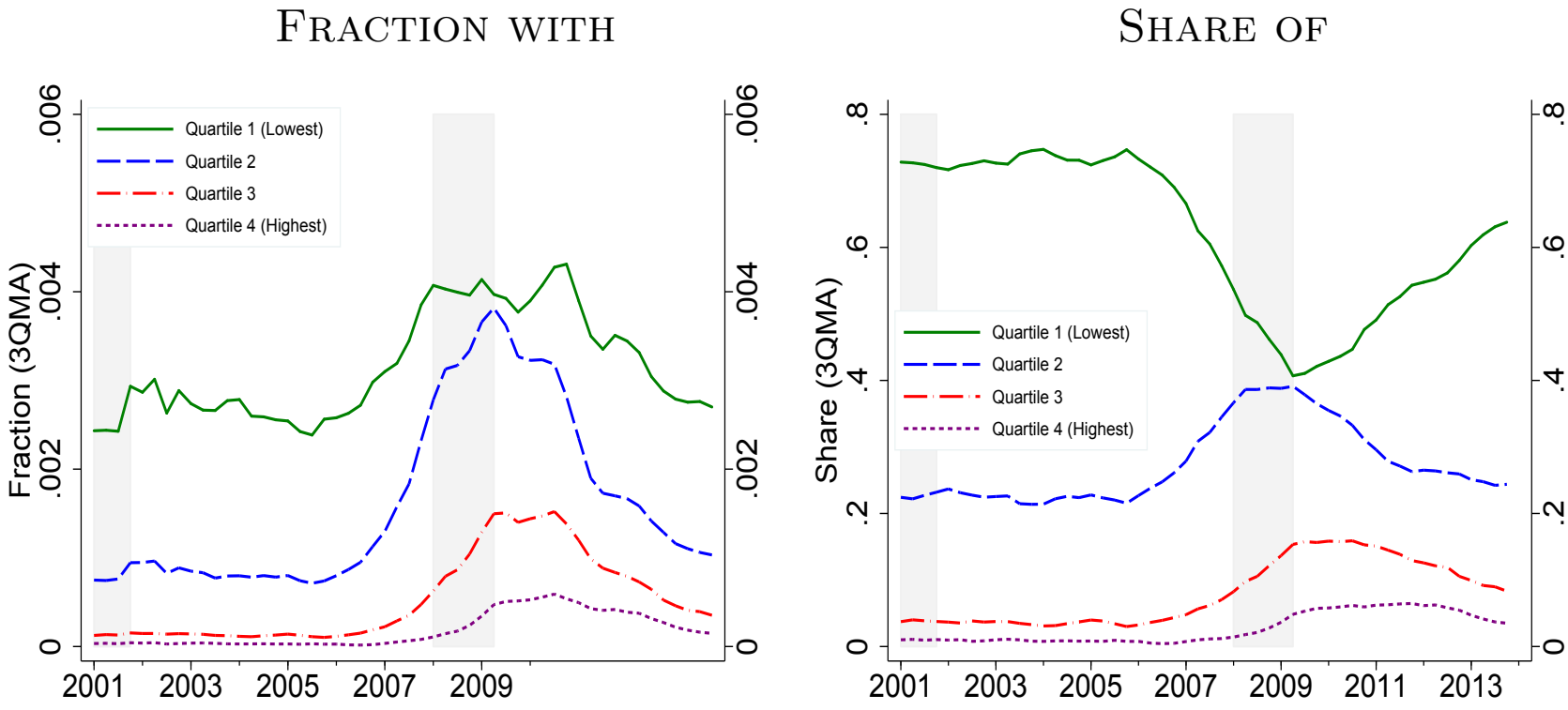
- Quartile 1 share of new delinquencies drops during crisis; quartile 3 share rises



New 90 days+ delinquencies by credit score quartile, 8Q lagged Equifax Riskscore. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Defaults: New Foreclosures

- Quartile 1 share of new foreclosures drops during crisis; quartile 3 share rises



New foreclosures by credit score quartile, 8Q lagged Equifax Riskscore. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Summary

- Initial credit score ranking overstates credit growth for low credit scores
  applies to all debt categories [Credit Cards] [Auto Loans]
- Using recent credit score ranking
  - credit growth during boom concentrated in prime quartiles
  - rise in defaults concentrated in middle of credit score distribution
    share of new delinquencies/foreclosures to subprime drops during crisis

  $\rightarrow$ rise in foreclosures 50% lower with no rise for prime borrowers

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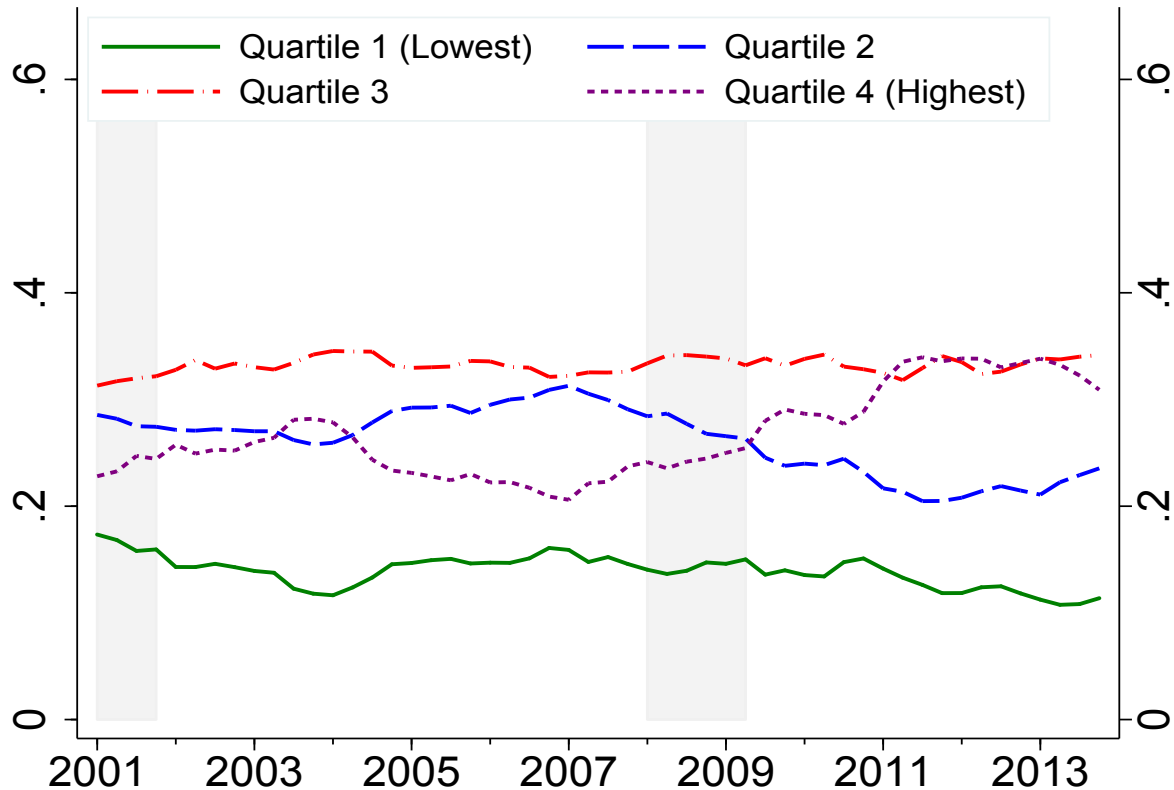
- Recent credit score
  - better assessment of default risk at time of borrowing
  - closely related to income at time of borrowing
  - 4-12Q lag avoids joint endogeneity
  - consistent with credit scores at origination

Credit Scores at Origination

- Consistent with distribution of credit scores at origination for mortgages

  No growth in share of originations for quartile 1 **during boom**



Individuals with a new mortgage origination. Fraction in each quartile of the current Equifax Riskscore distribution. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Role of Life Cycle

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- Credit growth for subprime individuals in 1999 driven by life cycle demand

Credit Score and Age

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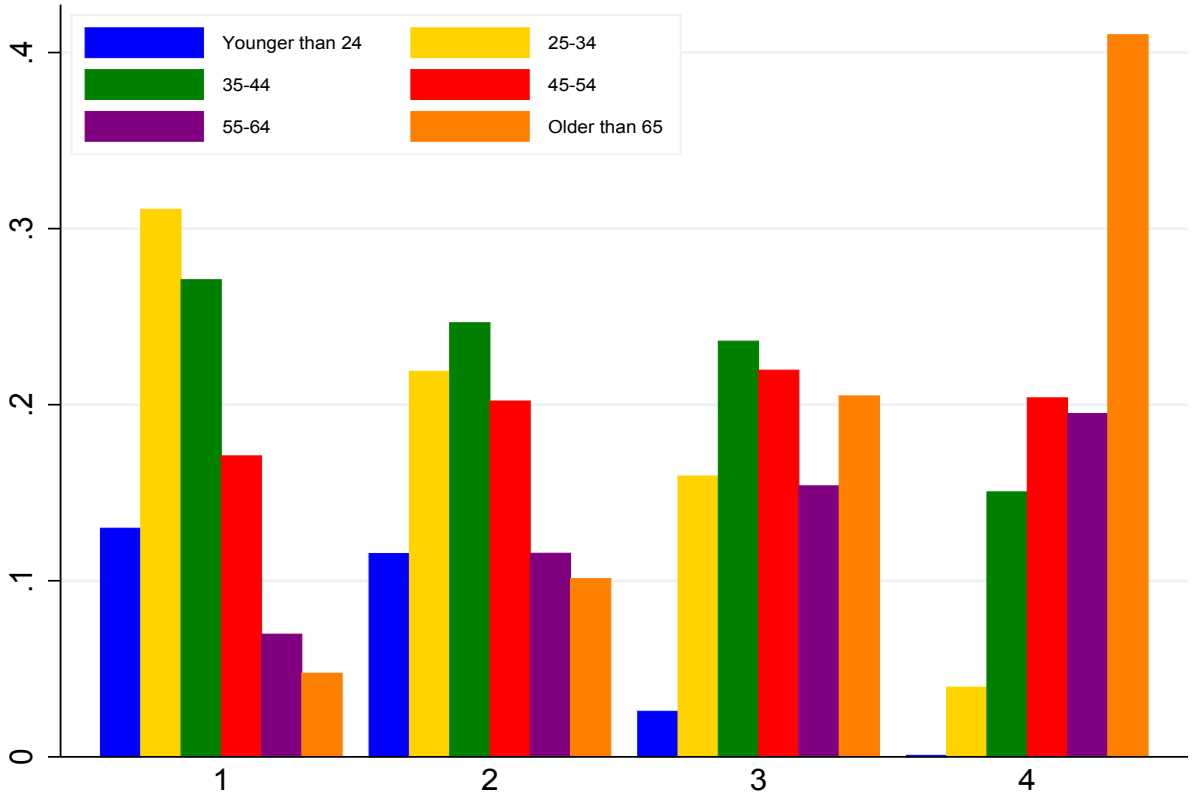
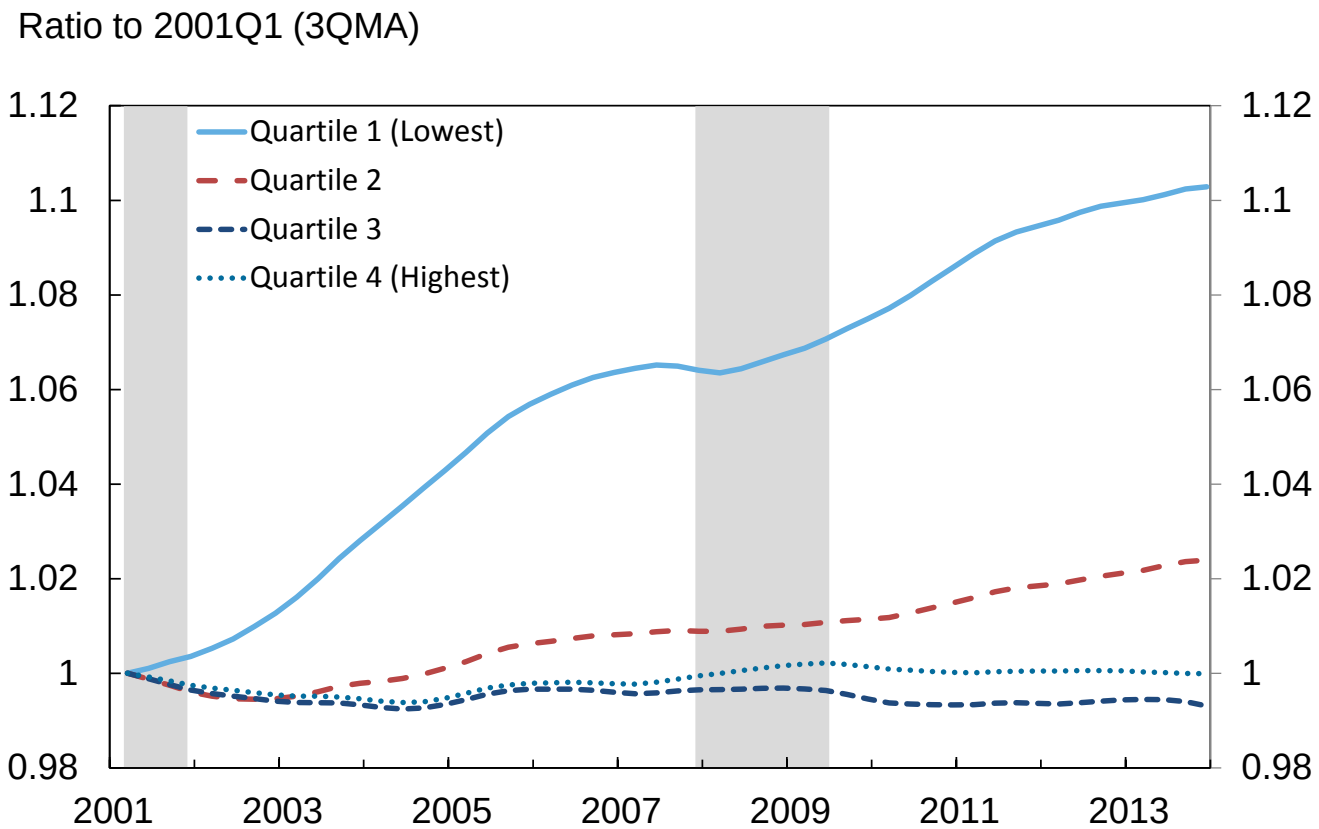


Fraction in each age bin in 1999 by Equifax Riskscore quartile in 1999.
Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Credit Score and Age

- Low credit score individuals in 1999 exhibit credit score growth over time

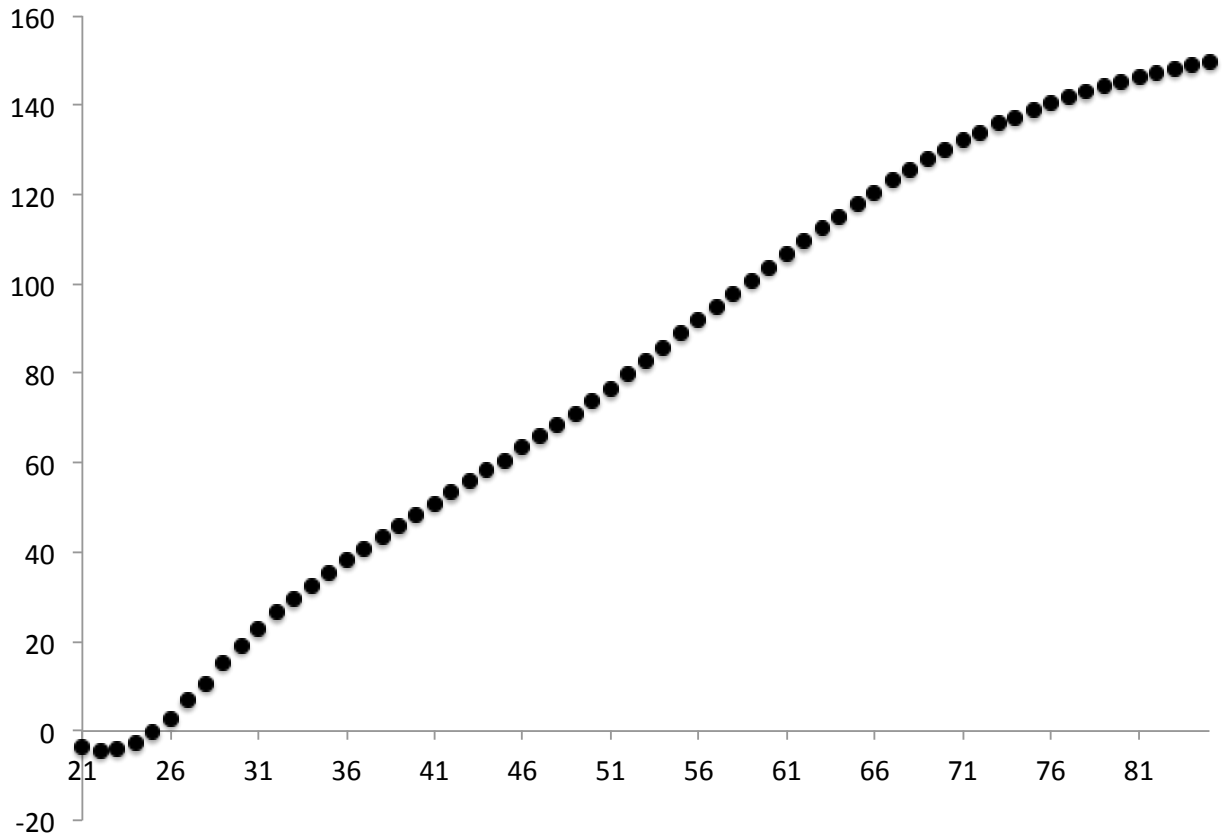


Current credit score as ratio to 1999, by Equifax Riskscore quartile in 1999.
Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Credit Score and Age

$$\text{credit score at t} = \text{age FE} + \text{time FE} + \text{state FE}$$

- Estimated age effects



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Debt Balances and Age

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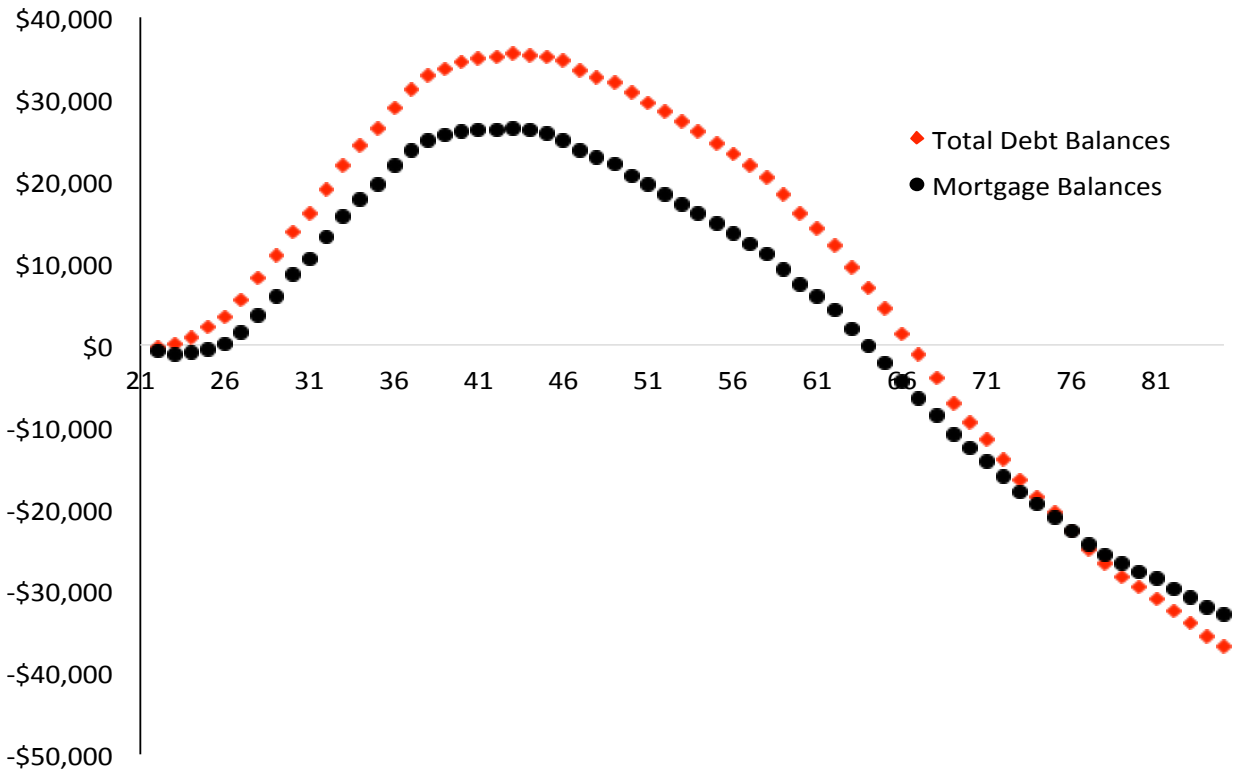

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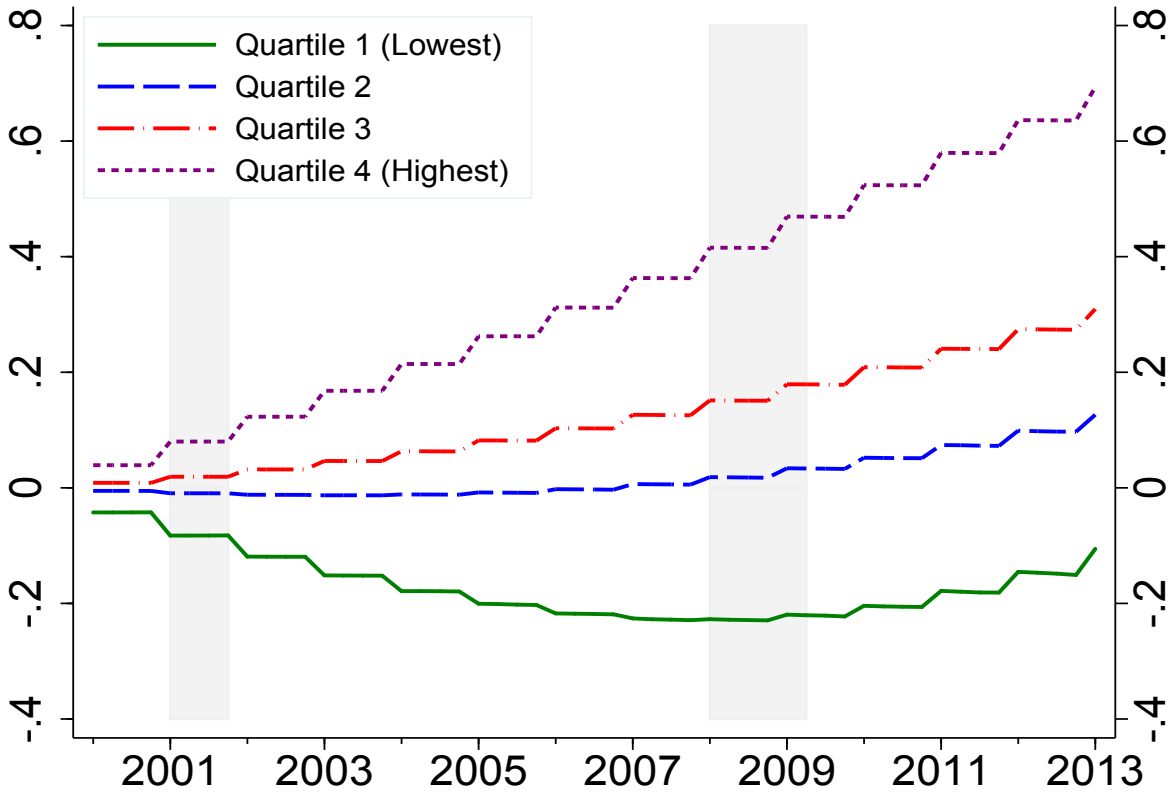
Debt Balances and Age

- Change in credit growth from removing age effects by 1999 CS quartile

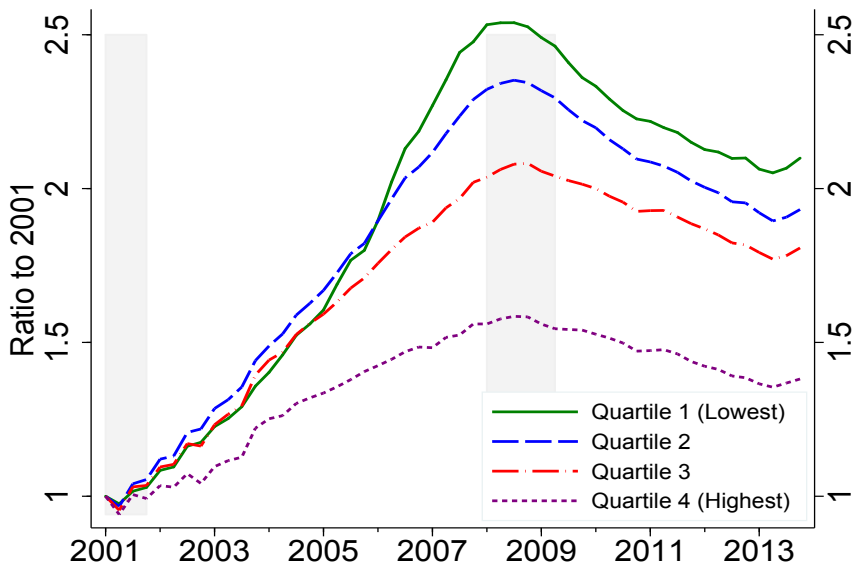


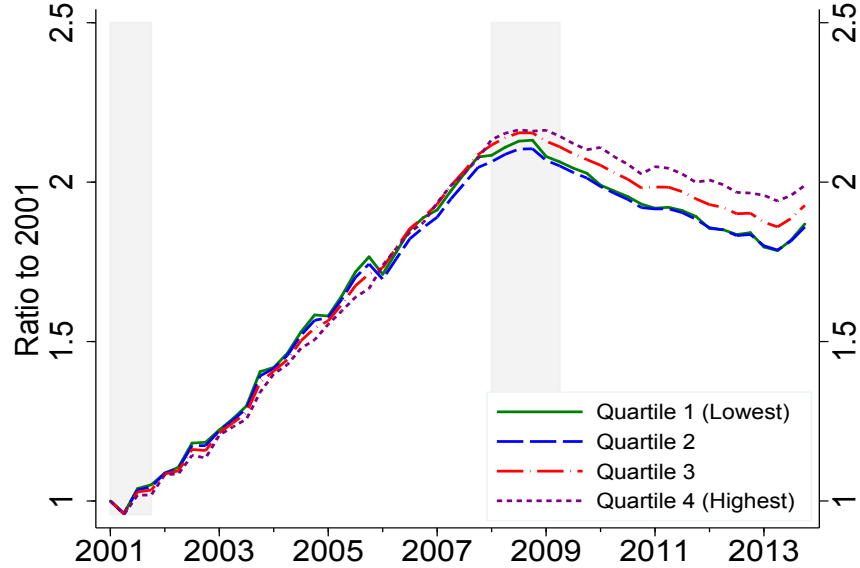
Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Life Cycle and Credit Demand

- Counterfactual total balances removing life cycle effects

  Absent lifecycle effects, credit growth by initial credit score similar across quartiles during boom





Total debt balances by 1999 Equifax Riskscore quartile, actual and counterfactual. Ratio to 2001Q1. Counterfactual assigns to each 1999 age bin, in each quarter, debt balances of those who currently are in that age bin. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Credit Scores, Debt Balances and Income

- Why are recent credit scores better indicators of default risk?

  variation in recent credit scores mostly accounted for by variation in income, conditional on age

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- Use supplementary payroll data for 2009, merged with Equifax CCP
  - 11k observations, comparable with CPS, ACS

Percentile	10%	25%	50%	75%	90%	Mean	St. Dev.
Riskscore	519	602	700	775	808	680	112
Income	16,640	22,880	39,520	64,100	99,840	49,728	35,057

Distribution of 8Q lagged Equifax Riskscore and 2009 Worknumber total annual labor income. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

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- Use supplementary payroll data for 2009, merged with Equifax CCP
  - 11k observations, comparable with CPS, ACS
  - change from 25th to 75th income percentile increases 8Q lagged credit score by 120 points after controlling for age

    69% of change from 25th to 75th percentile [Specification]

Debt and Income Over the Life Cycle

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  highest growth for young in 1999 with high income in 2009

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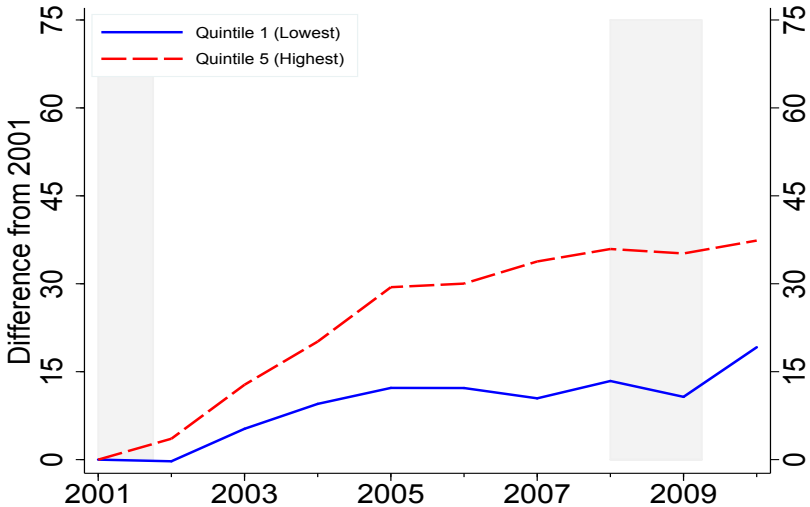
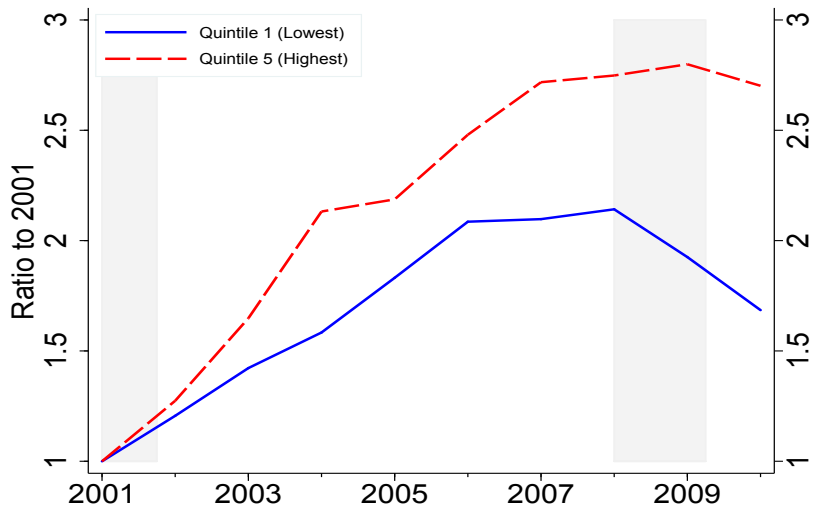
  25-34 yo in 1999 by their income quintile in 2009 [35-44 in 1999] [45-54 in 1999]

Credit score



Total debt balances



Equifax Riskscore and total debt balances for 25-34 yo in 1999 by their 2009 Worknumber total annual labor income quantile. Difference with 2001 (credit score) and ratio to 2001 (balances). Source: Authors' calculations based on FRBNY CCP/Equifax Data.

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  Highest growth in both income and borrowing for switchers

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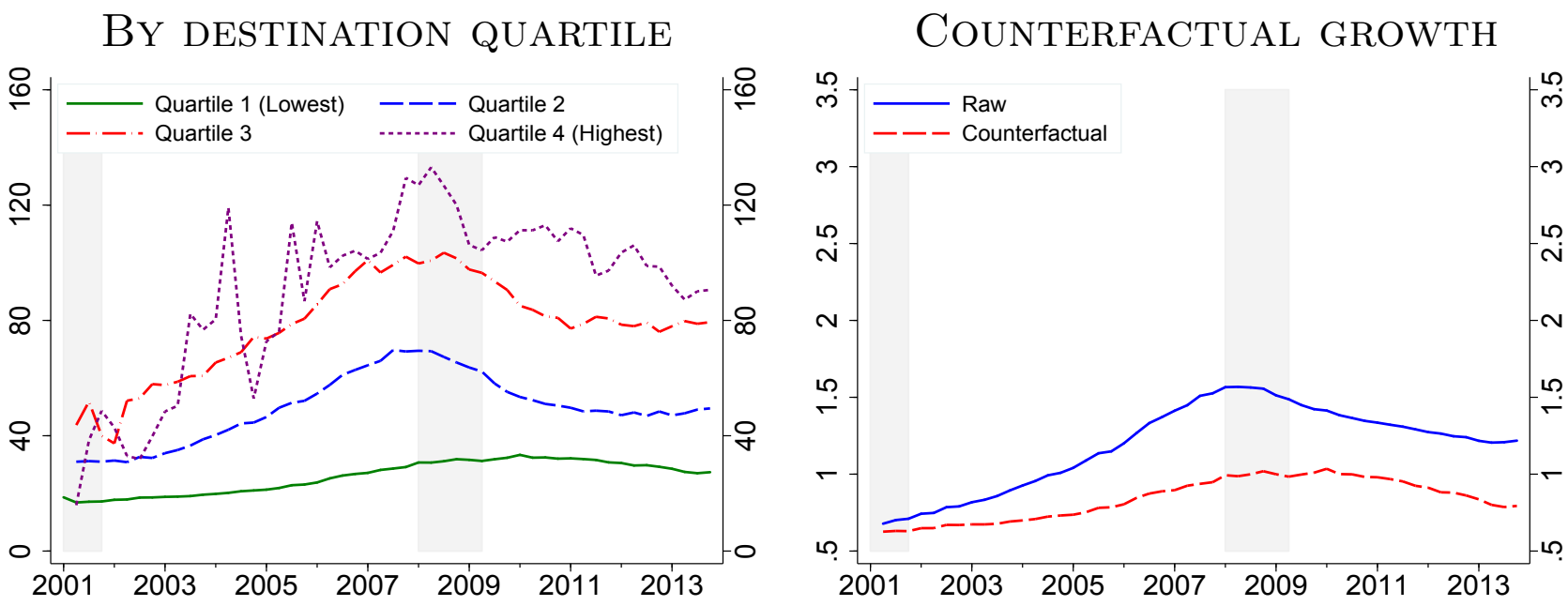
- Credit score growth associated with income and balance growth for quartile 1 based on 1999 ranking

2009 credit score	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Debt balances	\$38k	\$74k	\$126k	\$213k
Income	\$39k	\$47k	\$57k	\$62k

Mean income and total debt balances by 2009 Equifax Riskscore quartile for individuals in the first quartile of the 1999 Equifax Riskscore distribution. Worknumber total annual labor income for restricted Worknumber sample. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Credit Score Growth and Balance Growth

- Most balance growth for quartile 1 of initial ranking accounted by switchers; credit score at borrowing higher than in 1999



Total debt balances per capita by current quartile (left panel, per capita thousands of USD) and actual and counterfactual debt balances (right panel, billions of USD) for individuals in quartile 1 of the 1999 Equifax Riskscore ranking. Counterfactual includes only balances for non-switchers. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

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- Role of lifecycle in credit score and debt growth for young/subprime individuals in 1999 during the credit boom related to their subsequent **income growth**

  Consistent with PSID analysis on relation between income and borrowing

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- Role of lifecycle in credit score and debt growth for young/subprime individuals in 1999 during the credit boom related to their subsequent **income growth**

  Consistent with PSID analysis on relation between income and borrowing
- For complete sample, growth in credit during the boom for quartile 1 of initial ranking mostly accounted for by those who switch to higher quartiles

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- Specification:

$$\Delta B^i_{t,t+h} = \sum_{j=1,2,3,4} \alpha(j_{-1}) + \gamma(t) + \Delta CS^i_{t-1,t-1-k} + \varepsilon^i_t$$

$\Delta B^i_{t,t+h}$ = change in balances between t and $t+h$
i = individual, t = quarter, $h \in \{4, 8, 12\}$ horizon
$\alpha(j_{-1})$ = effect for 1Q lagged quartile of credit score distribution
$\gamma(t)$ = time effects
$\Delta CS^i_{t-1,t-1-k}$ = change in credit score between $t-1$ and $t-1-k$
$k \in \{4, 6, 8\}$ length of history
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  $k \in \{4, 6, 8\}$ length of history
  also age effects & interactions
- Findings: Highest growth for prime borrowers (quartiles 2-4) **during boom**

Credit Growth by Credit Score: Total Debt

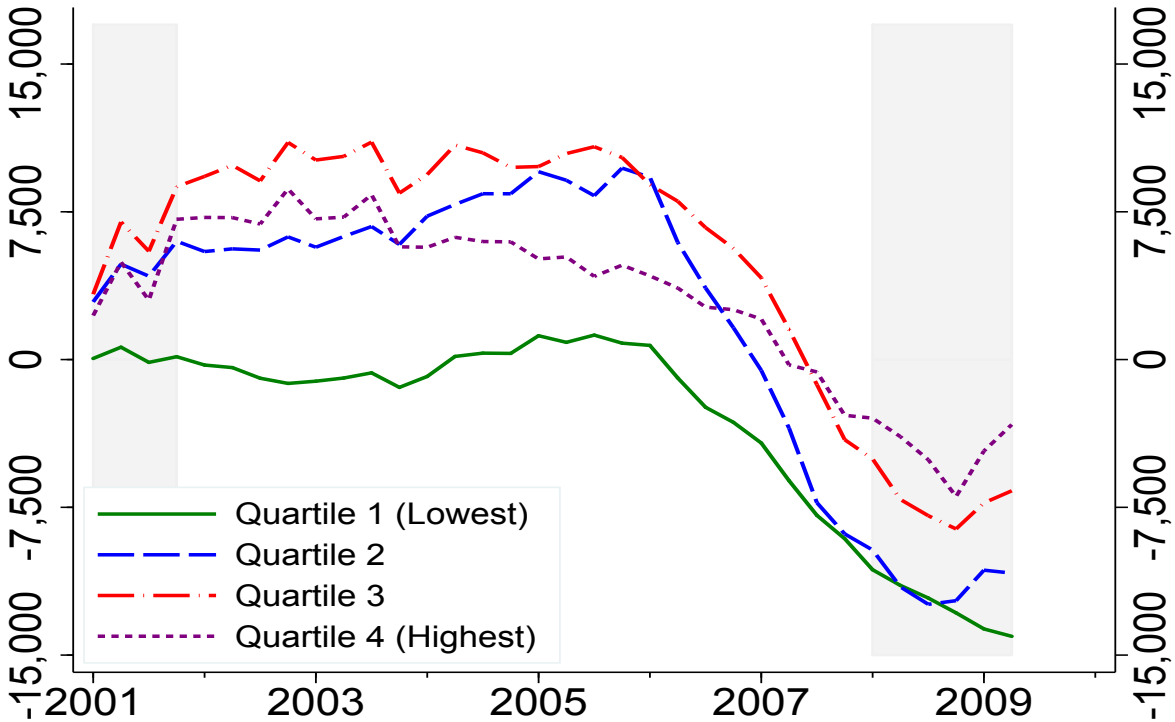
- 8Q ahead change in total debt increased with 1Q lagged credit score
- Negligible contribution of past credit score change to future borrowing
- Similar findings at 4Q and 12Q horizon and for mortgage balances

Dependent Variable: 8Q Ahead Total Debt Balance Change (USD)						
1Q lagged CS Quartile Effects				ΔCS_{-1}		
1	2	3	4	4Q	6Q	8Q
9,080	14,597	13,937	12,529			
10,788	16,723	16,509	13,962	73		
12,973	20,127	19,427	15,430		84	
14,573	24,192	25,002	19,982			85

Estimated 1Q lagged Equifax Riskscore quartile effects and coefficients for 4Q, 6Q, 8Q past change from 1Q lagged score in balance change regressions. Age, age-squared terms included. All estimates significant at 1% level. Sample period 1999Q2-2012Q4. Number of obs. 7,777,264. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Credit Growth by Credit Score: Total Debt

- Estimated time effects suggest no growth for quartile 1 during boom; growth in balances delayed for quartiles 2,3 relative to quartile 4

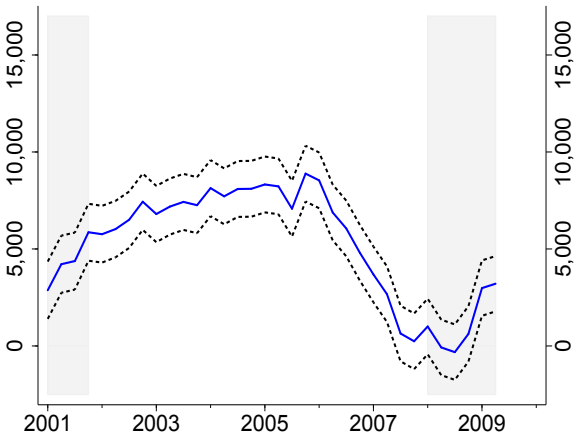


Estimated time effects by 1Q lagged Equifax Riskscore quartile from balance change regressions. Age, age-squared terms included. Dependent variable is the 8Q ahead change in per capita total debt balances in USD. Sample period 1999Q2-2012Q4. Number of obs. 7,777,264. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

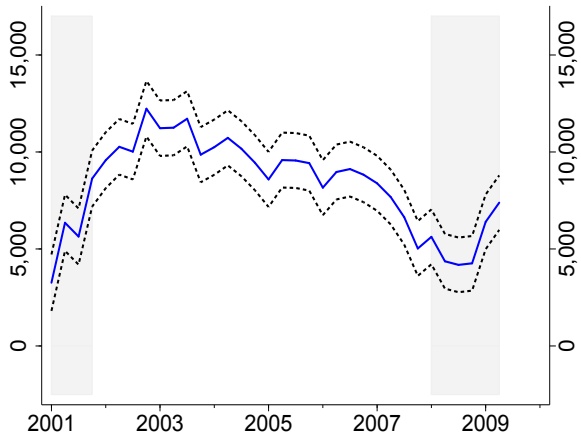
Credit Growth by Credit Score: Total Debt

- Sizable and highly significant difference in time effects for quartiles 2-4 and quartile 1
  Similar for 4Q ahead and 12Q ahead and for mortgage balances

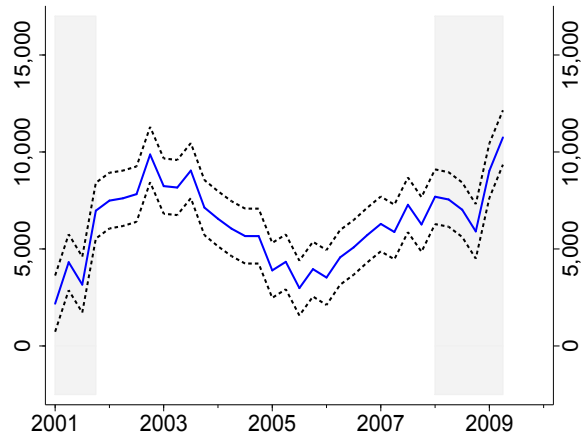
Quart2-Quart1



Quart3-Quart1



Quart4-Quart1



Estimated time effects by 1Q lagged Equifax Riskscore quartile from balance change regressions. Age fixed effects included. Dependent variable is the 8Q ahead change in per capita total debt balances in USD. Sample period 1999Q2-2012Q4. Number of obs. 7,777,264. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Defaults by Credit Score: Delinquent Balances

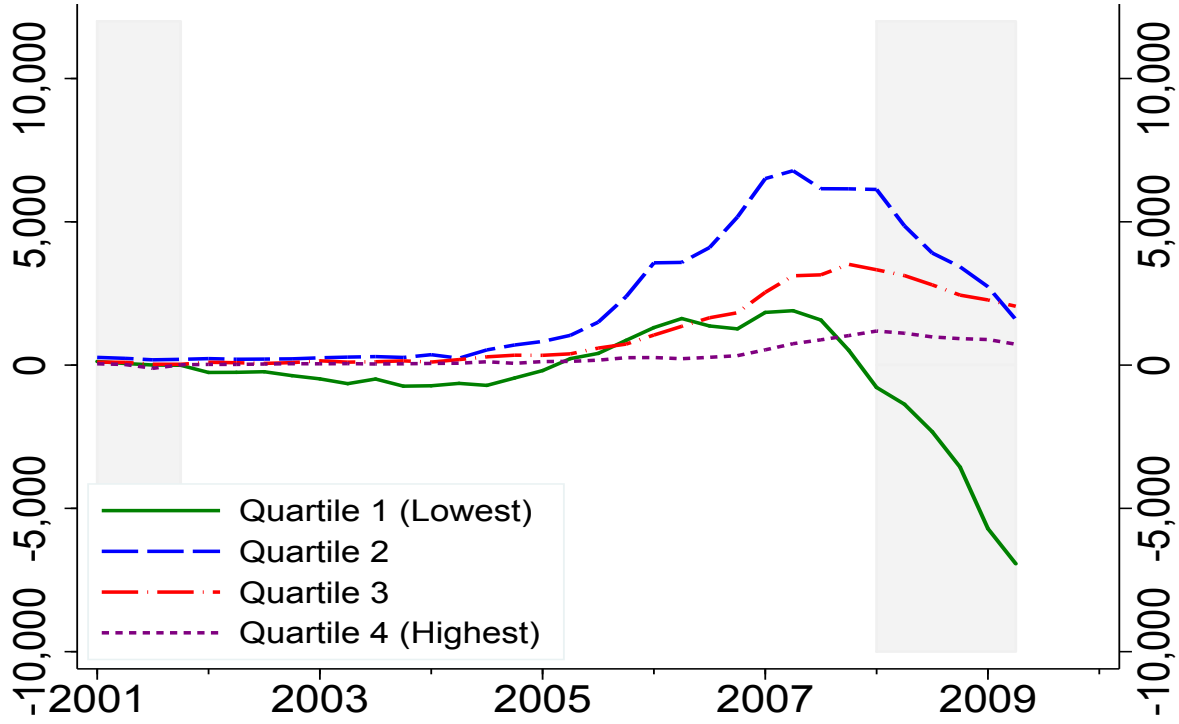
- Change in delinquent balances falls with 1Q lagged credit score on average
- Negligible contribution of past credit score change to delinquencies
- Similar findings at 4Q and 12Q horizon and for mortgage balances

Dependent Variable: 8Q Ahead 90+ Days Delinquent Debt Balance Change (USD)						
1Q lagged CS Quartile Effects				ΔCS_{-1}		
1	2	3	4	4Q	6Q	8Q
263	941	718	853			
803	854	410	412	29		
1,072	823	528	418		32	
1,196	833	412	286			33

Estimated 1Q lagged Equifax Riskscore quartile effects and coefficients for 4Q, 6Q, 8Q past change from 1Q lagged Riskscore in balance change regressions. Age, age-squared terms included. All estimates significant at 1% level. Sample period 1999Q2-2012Q4. Number of obs. 7,777,264. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Defaults by Credit Score: Delinquent Balances

- Estimated time effects suggest large rise for quartiles 2-3 during crisis



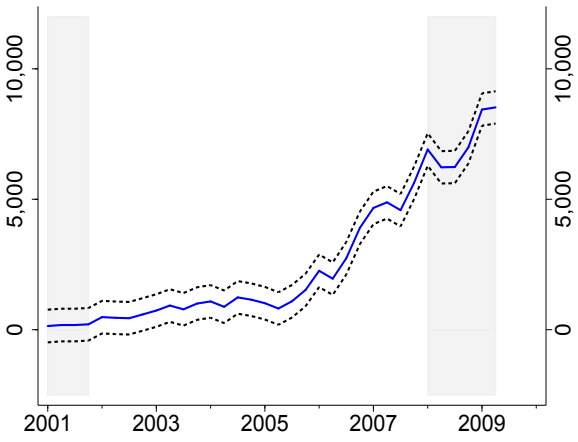
Estimated time effects by 1Q lagged Equifax Riskscore quartile from balance change regressions. Age fixed effects included. Dependent variable is the 8Q ahead change in per capita 90+ days delinquent debt balances in USD. Sample period 1999Q2-2012Q4. Number of obs. 7,777,264. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Defaults by Credit Score: Delinquent Balances

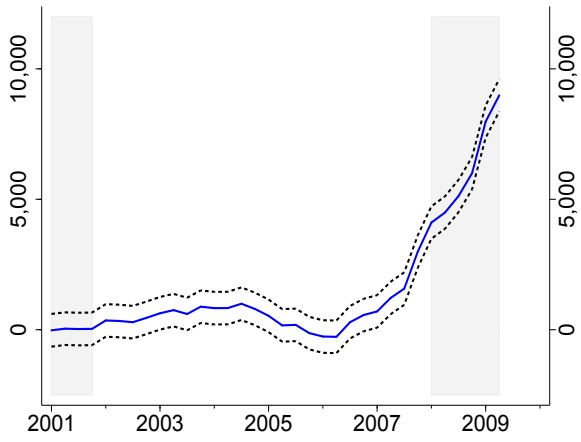
- Difference in estimated time effects for quartiles 2-4 and quartile 1 are sizable and highly significant

  Similar for 4Q ahead and 12Q ahead and for mortgage balances

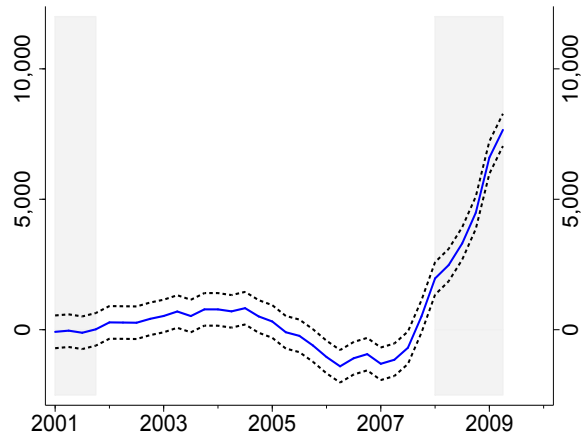
Quart2-Quart1



Quart3-Quart1



Quart4-Quart1



Estimated time effects by 1Q lagged Equifax Riskscore quartile from balance change regressions. Age fixed effects included. Dependent variable is the 8Q ahead change in per capita total debt balances in USD. Sample period 1999Q2-2012Q4. Number of obs. 7,777,264. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

New Evidence: Summary

- Higher credit scores associated with higher future credit growth **during boom** and defaults **during crisis**

  no growth in credit & defaults for first quartile (subprime)

  little role of past credit score change (credit score manipulation)

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  Ranking by recent credit score equivalent to lender's approach

- Why did individuals with 'good credit' experience defaults during crisis?

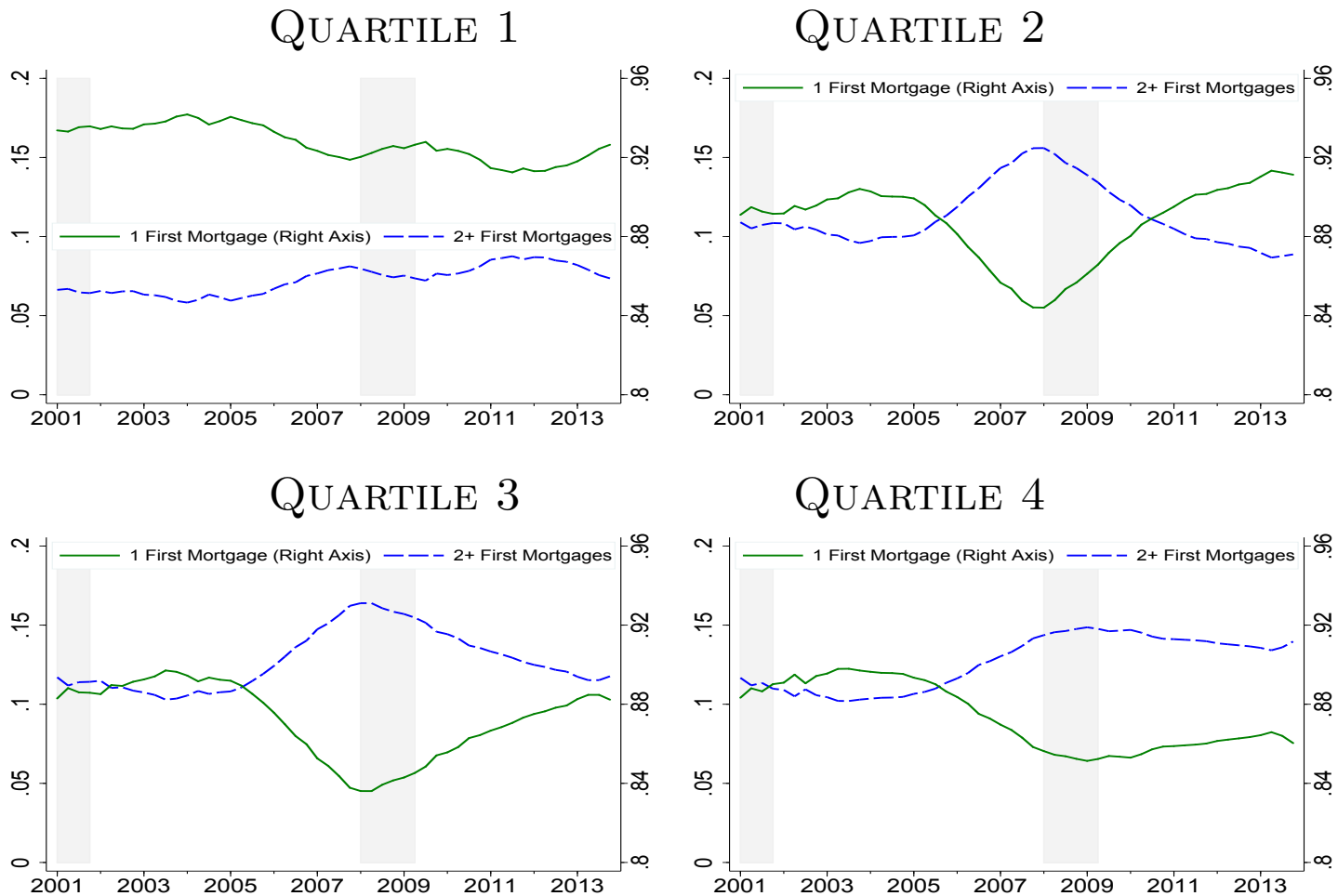
  Rise in investors (multiple first mortgages)

  Risky loans (non-conforming loans, ARM etc)

  Large aggregate shock (decline in house prices, rise in unemployment)

Role of Investors

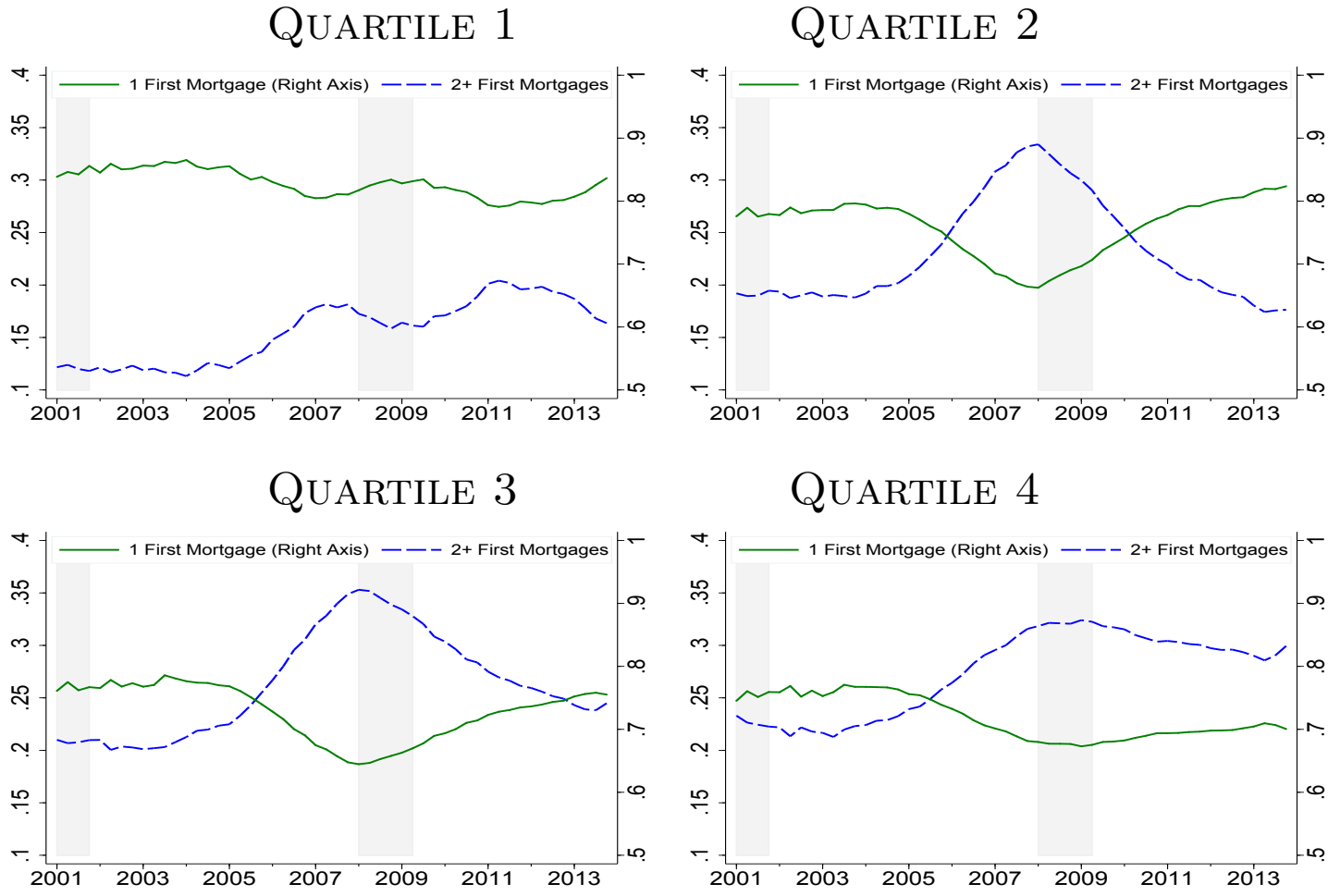
- Investors (2+ first mortgages) rise during boom, especially for mid quartiles



Fraction with 1 and 2+ first mortgages by 8Q lag Equifax Riskscore quartile.
Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Role of Investors: Mortgage Balances

- Share held by investors grows during boom, especially in mid quartiles

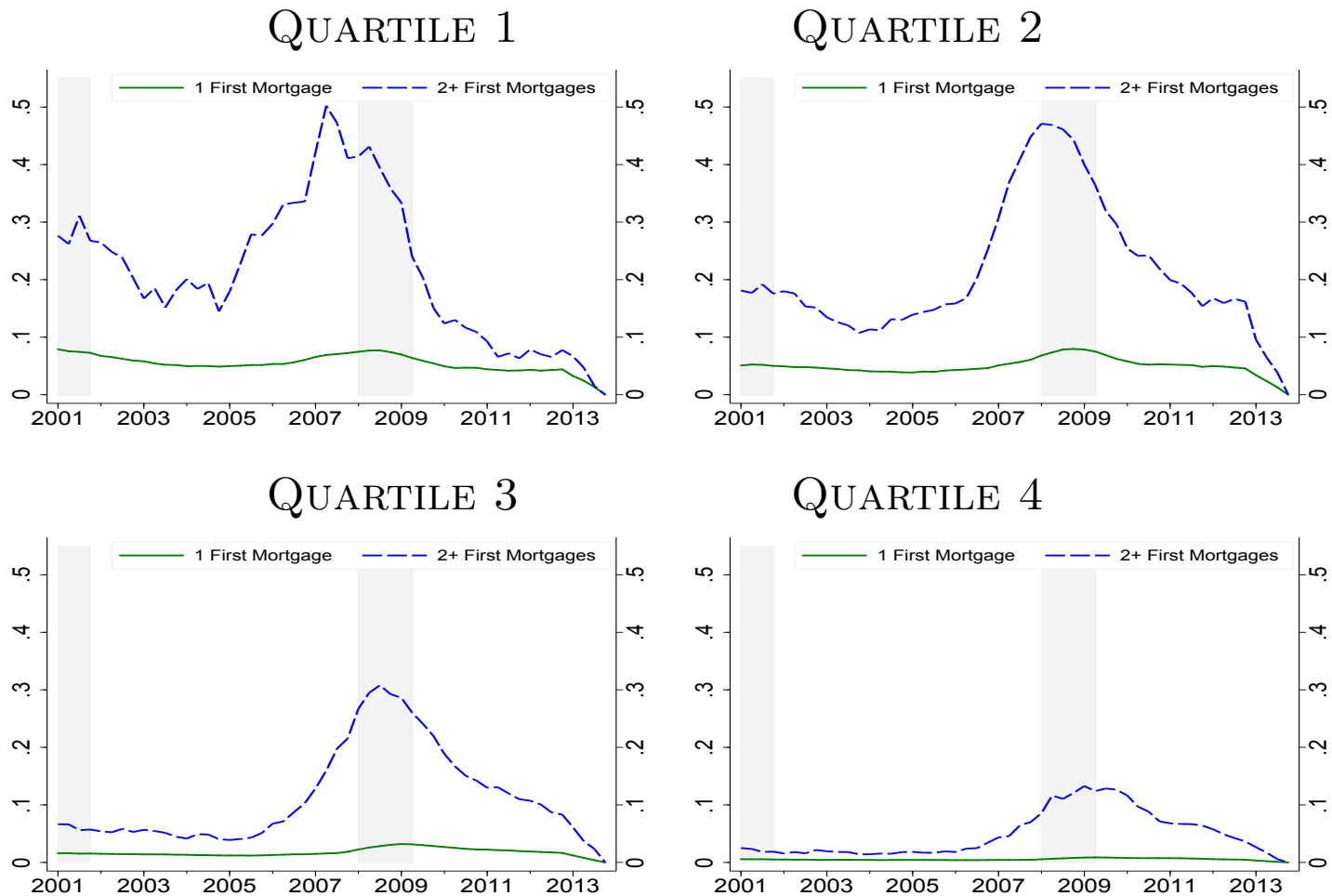


Share of mortgage balances by number of first mortgages (1 and 2+) by 8Q lag Equifax Riskscore quartile.

Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Role of Investors: Mortgage Delinquencies

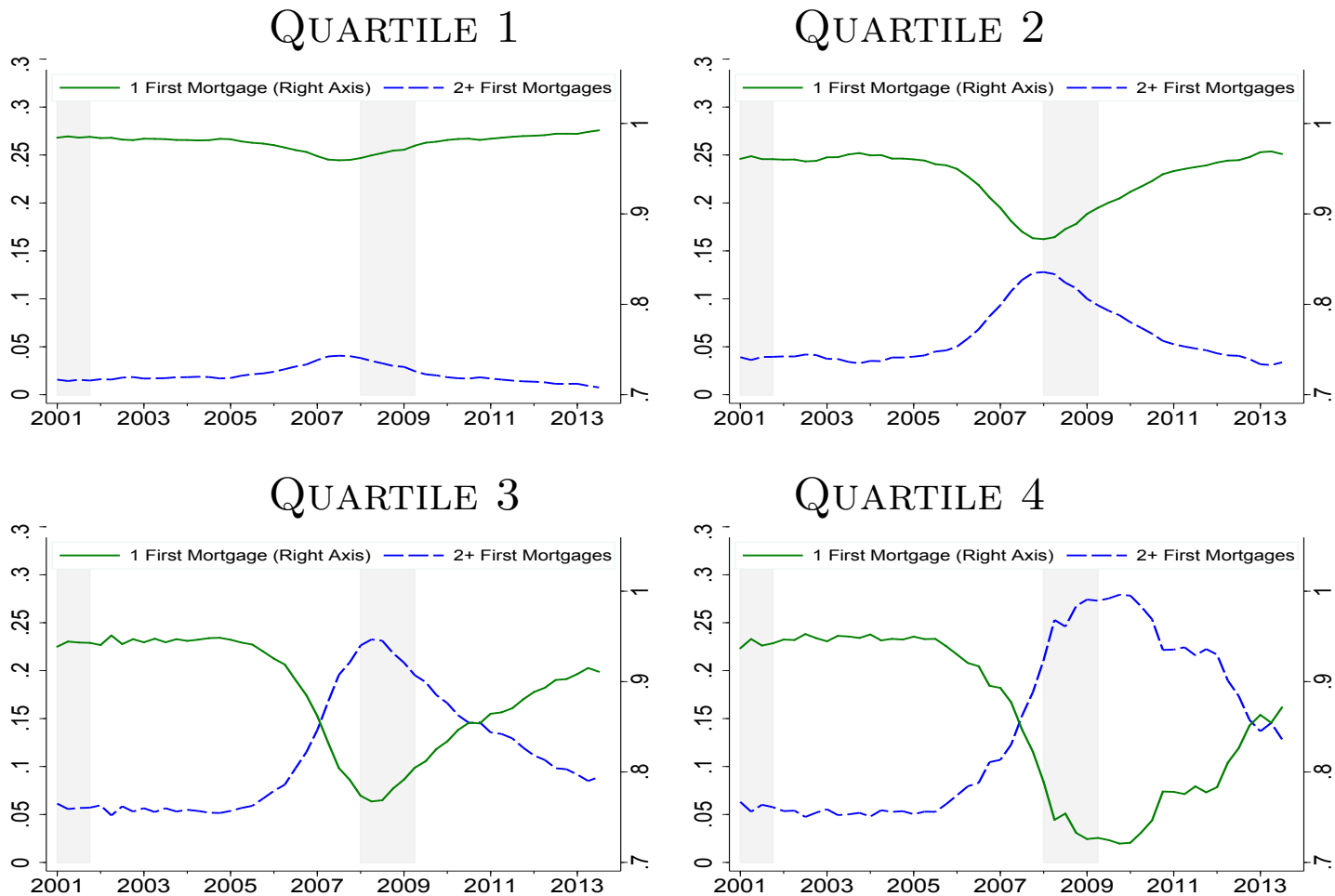
- Greater rise in fraction with 90+ days delinquent mortgage balances for investors during crisis



Fraction with 90+ days delinquent mortgage balances by 8Q lag Equifax Riskscore quartile.
Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Role of Investors: Mortgage Delinquencies

- Share of 90+ days delinquent mortgage balances rises for investors in prime segments during crisis



Share of mortgage holders with 90+ days delinquent mortgage balances by number of first mortgages, by 8Q lag Equifax Riskscore quartile.
Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Risky Mortgages: Non-Conforming Loans

- Rise in fraction with non-conforming loans during the boom, for prime segment only

quartile	1	2	3	4
2001Q1	0.1%	0.4%	0.7%	1.1%
2003Q1	0.1%	0.5%	1.1%	1.4%
2005Q1	0.1%	0.7%	1.5%	1.7%
2007Q1	0.2%	0.7%	1.5%	1.9%
2009Q1	0.1%	0.3%	0.3%	0.7%

Fraction with non-conforming mortgages by 8Q lagged Equifax Riskscore ranking.
Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Broader Implications

- Aggregate consequences of growth in subprime lending:

  Defaults&foreclosures $\rightarrow$ Drop in house prices

  $\rightarrow$ Contraction in credit&consumption

  $\rightarrow$ Recession

- Causal link based on geographical variation (zip code, MSA, county, state)

  (Mian & Sufi 2014, Mian, Rao & Sufi 2013, Kehoe, Midrigan & Pastorino 2014, Mian, Sufi & Trebbi 2014, Midrigan & Philippon 2016, Justiniano, Primiceri & Tambalotti 2016, etc)

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- New findings challenge validity of evidence based on geographical variation

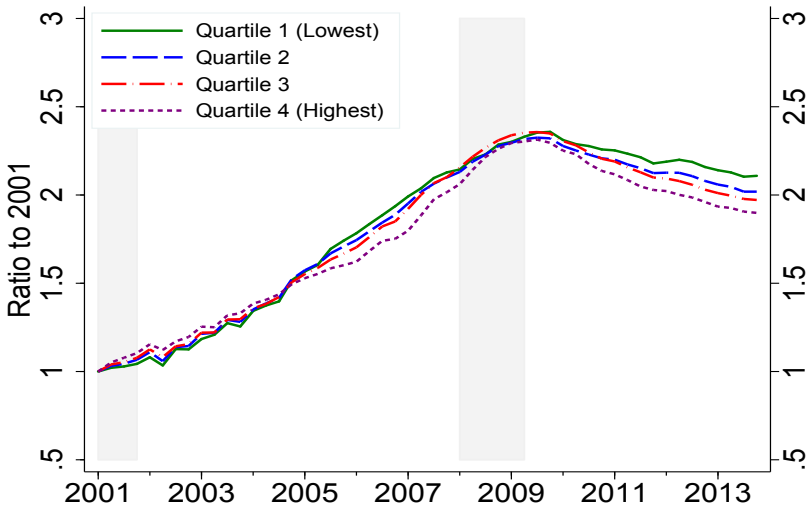
Geographical Variation: Zip Codes

- Credit growth by zip code, ranked by share of subprime individuals in 1999: credit score below 660 considered subprime (Mian & Sufi 2009)

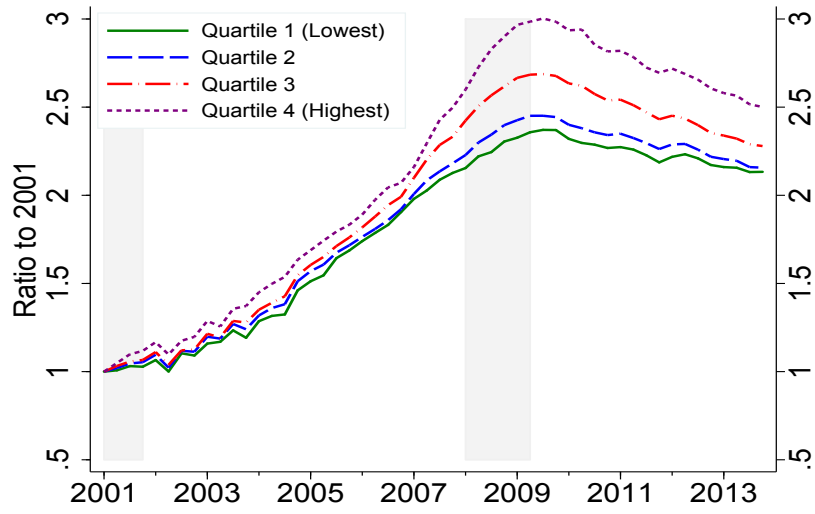
Geographical Variation: Zip Codes

- Credit growth by zip code, ranked by share of subprime individuals in 1999: credit score below 660 considered subprime (Mian & Sufi 2009)
- Mortgage credit grows more for zip codes with high share of subprime; no difference for total balances

Total Debt Balances



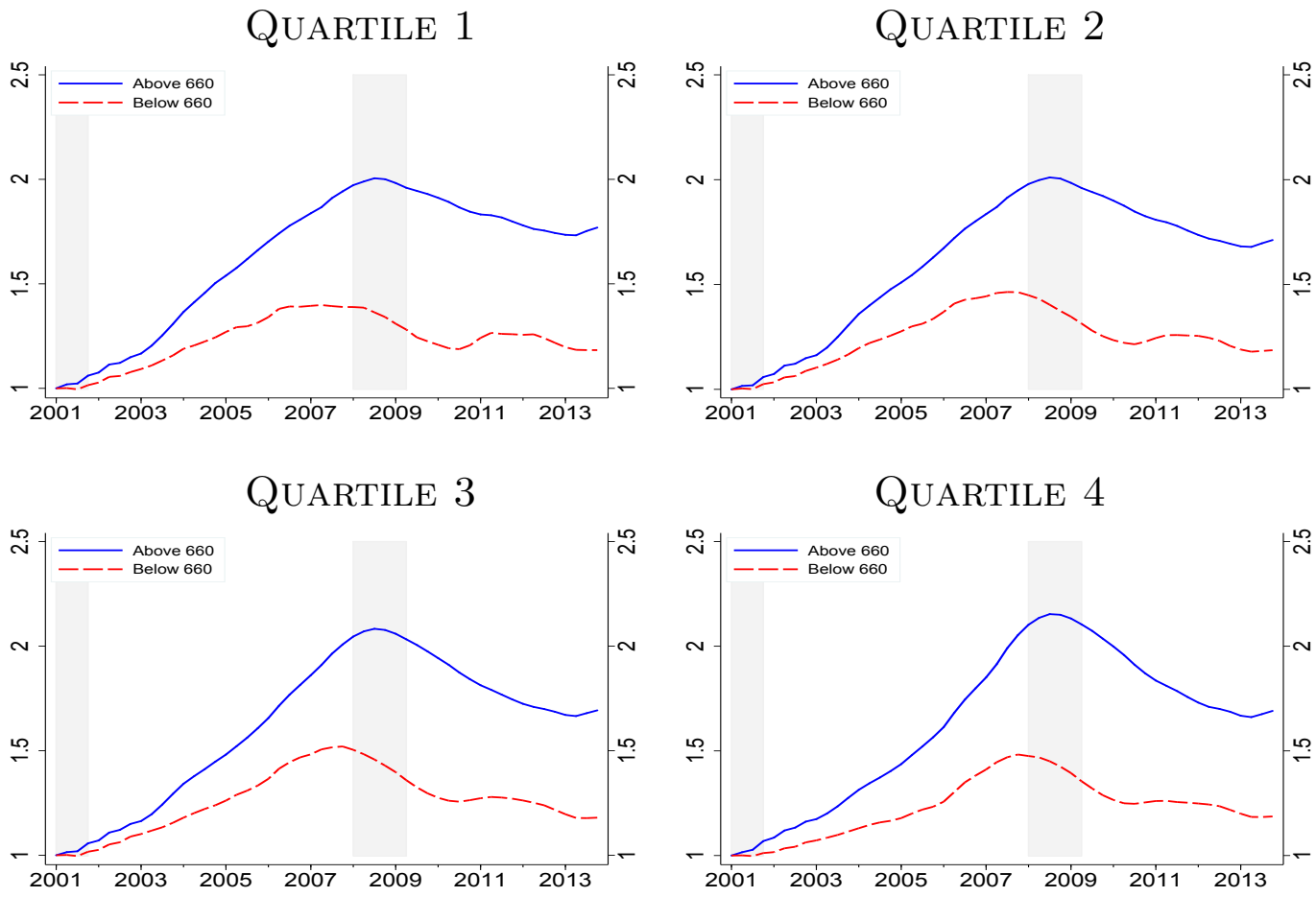
Mortgage Balances



Growth in total and mortgage balances by share of individuals with Equifax Riskscore below 660 in 1999. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Geographical Variation: Zip Codes

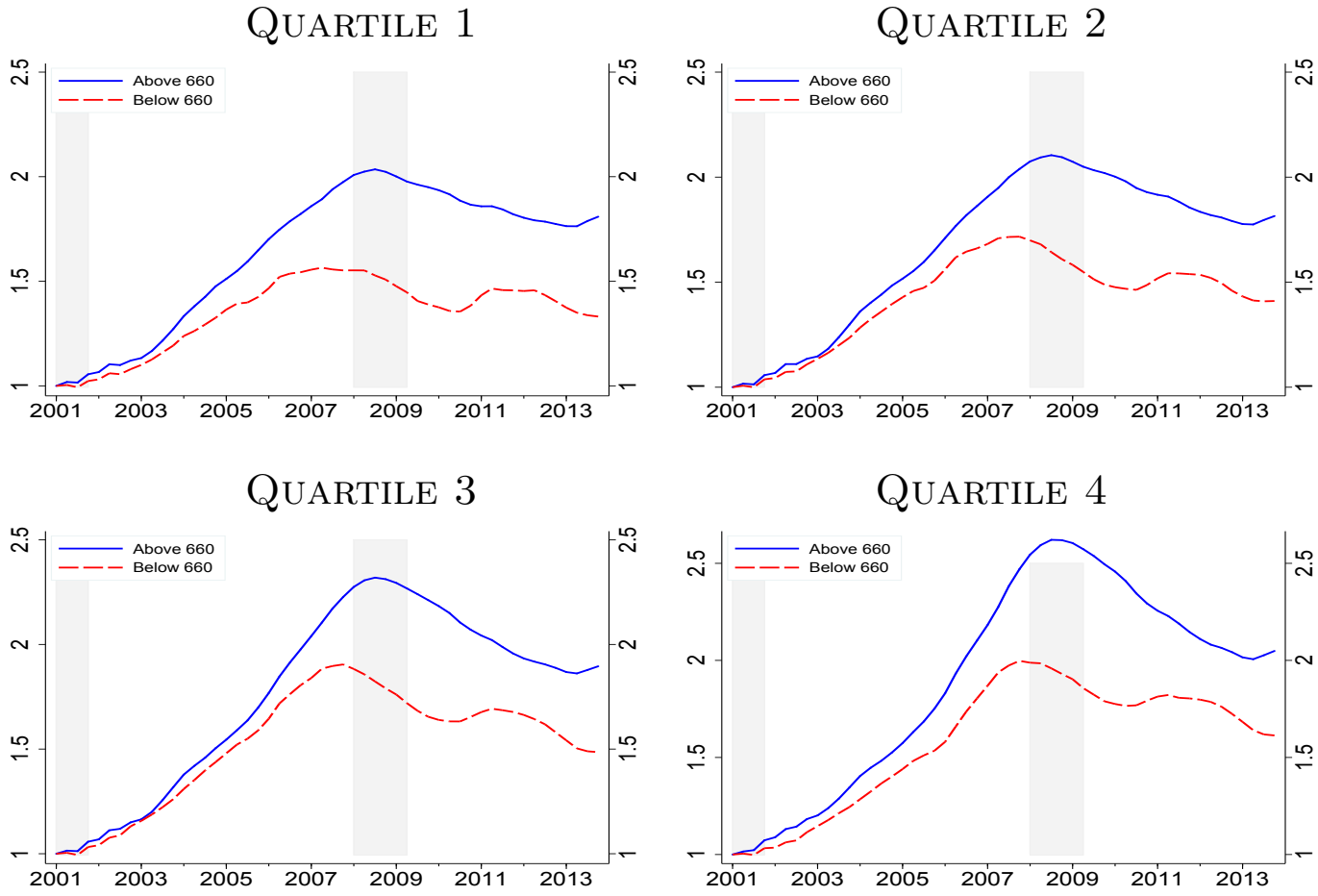
- Higher credit growth in **all** zip codes for prime individuals; total balances



Total debt growth for prime&subprime individuals by quartile of share of subprime in 1999. Based on 8Q lagged individual credit scores. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Geographical Variation: Zip Codes

- Higher credit growth in **all** zip codes for prime individuals; mortgage balances

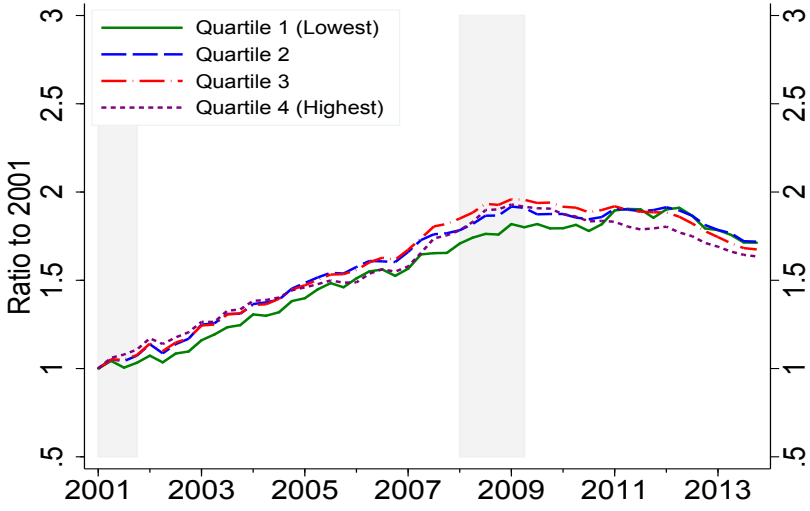


Mortgage debt growth for prime&subprime individuals by quartile of share of subprime in 1999. Based on 8Q lagged individual credit scores. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

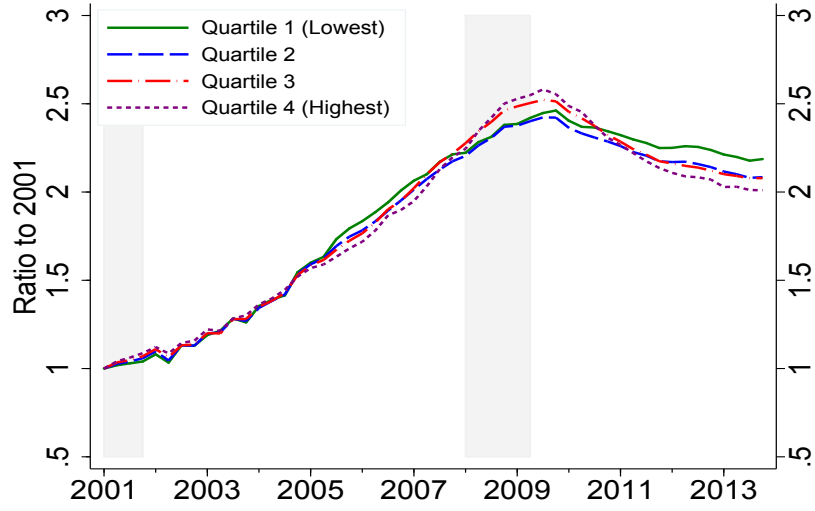
Geographical Variation: Zip Codes

- Counterfactual growth in total balances by share of subprime in 1999: for all individuals, growth set equal to subprime or prime
- Differences in credit growth across prime and subprime individuals, not across zip codes

All Subprime



All Prime

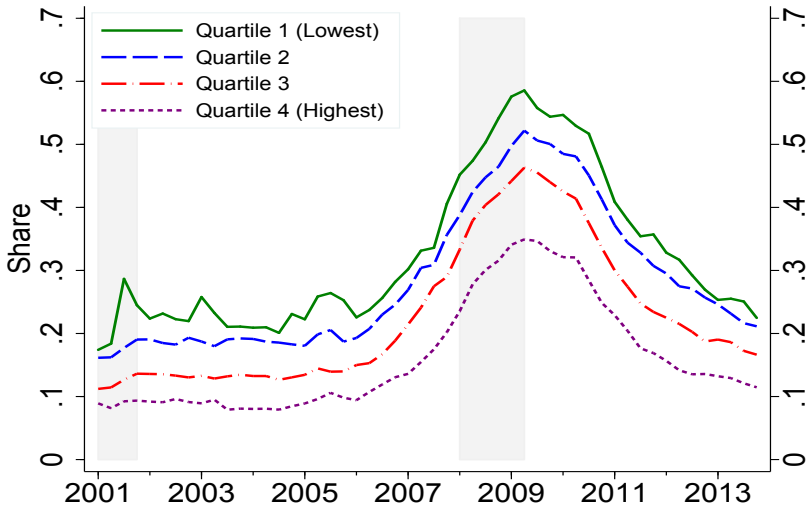


Counterfactual growth in total balances by quartile of subprime share in 1999. For all individuals, growth equated to that of subprime or prime individuals in each quartile. Source: Authors' calculations based on FRBNY CCP/Equifax Data.

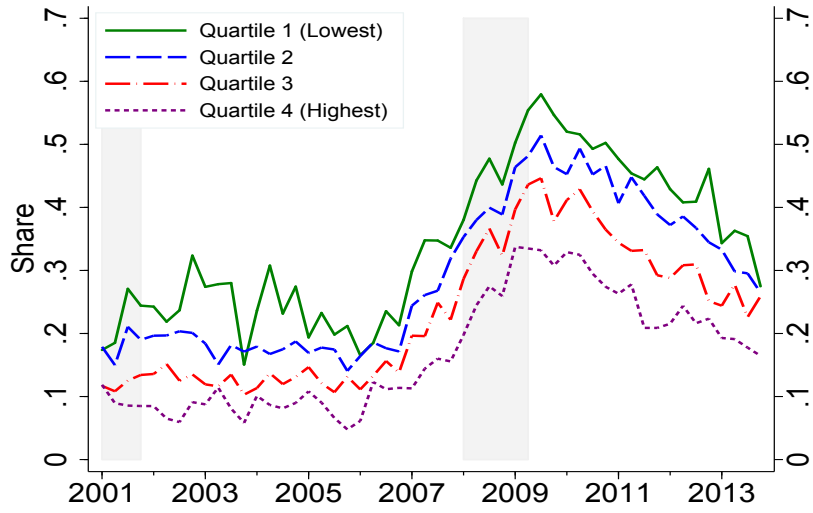
Geographical Variation: Zip Codes

- Prime individuals contribute more to growth in delinquent balances and foreclosures during crisis in **all** zip codes

Delinquent Balances



Foreclosures



Share of 90+ days delinquent balances and new foreclosures for prime individuals, based on 8Q lagged individual credit score. Quartiles of subprime share in 1999.
Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Geographical Variation: Zip Codes

- Why did zip codes with high share of subprime experience more severe 2007-09 recession?

  Young, low income, low education, high inequality, urban areas, more sensitive to business cycles

	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Median age	50	49	48	46
$\frac{\text{Associate degree or more}}{\text{Some college or less}}$ (2012)	0.55	0.52	0.37	0.26
Average UR 2001-2007	5.02%	5.15%	5.47%	5.93%
Average PDI 2001-2007	$38,627	$27,800	$20,069	$14,809
$\frac{\text{Mean Income} \geq \$200K}{\text{Mean Income}}$ (2000)	5.5	7	8.6	10.7
Pop per sq mile	2099	3614	3322	4868
PDI Growth 2001-2007	27%	27%	21%	16%
HPI Growth 2001-2007	53%	63%	75%	74%
In sand states	10%	20%	25%	17%

Quartiles of subprime share in 1999. Source: Authors' calculations based on FRBNY CCP/Equifax Data, IPUMS, IRS, BLS, ACS data.

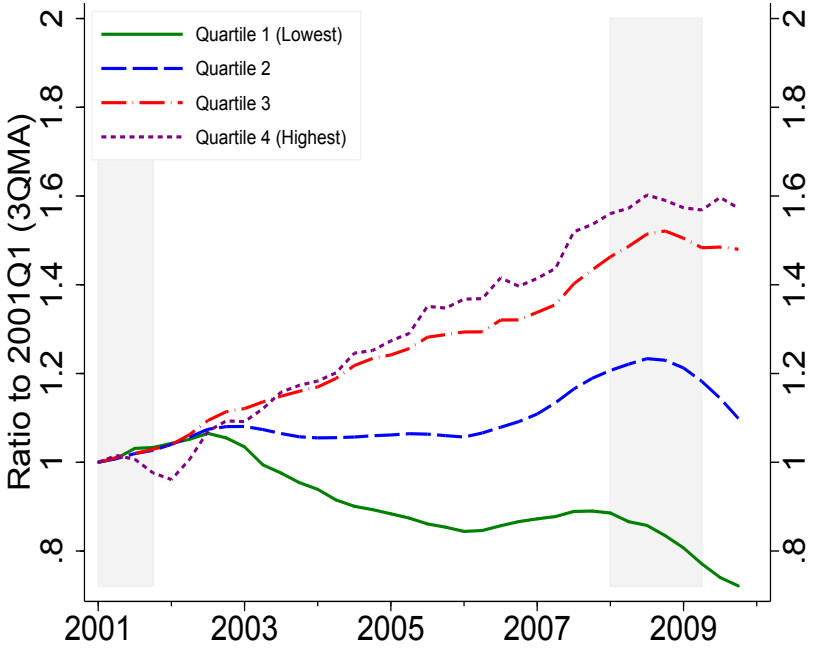
Discussion and Ongoing Work

- Reassessment of role of subprime credit in the crisis
  - need to rethink driving factors
  - crucial for policy responses and prevention
- Why rise in defaults for individuals with good credit?
  - investors, high leverage & risky mortgages
  - large income shocks, unrealistic house price expectations?
  - alternative default risk indicators?
- Ongoing work:
  - further analysis of geographical variation
  - reassessment of collateral channel

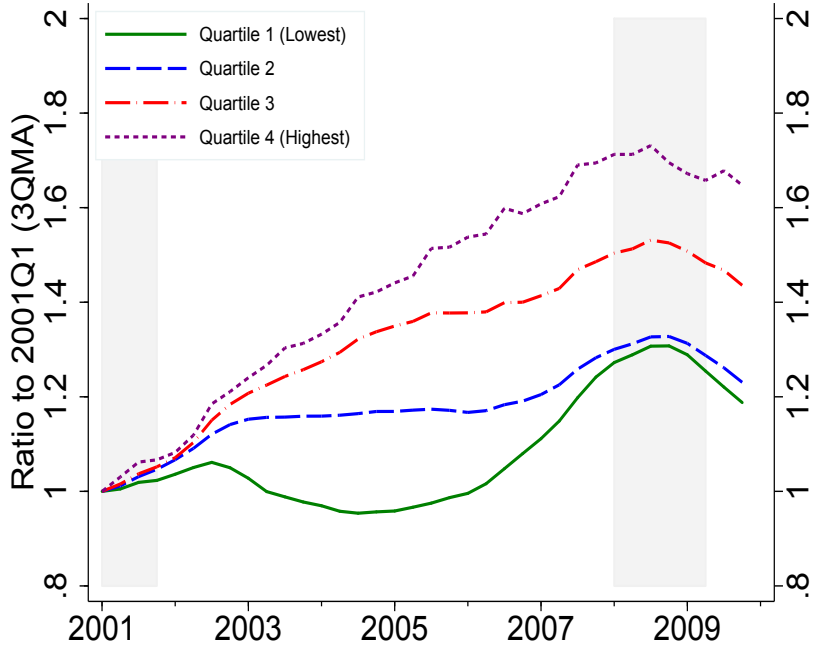
Comparison: Credit Card Balances

- Initial ranking overstates growth for quartile 1 relative to recent ranking

8Q lagged Equifax Riskscore



1999 Equifax Riskscore

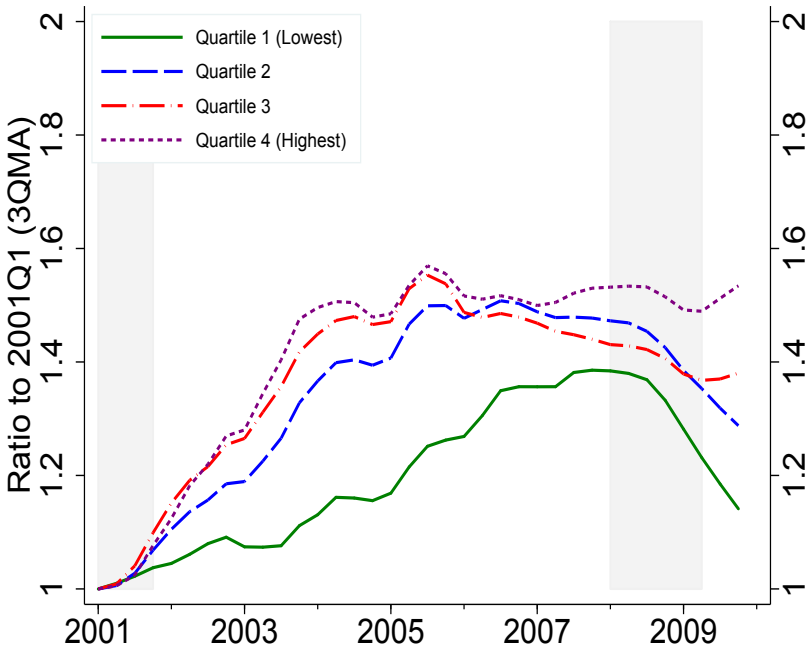


Average credit card balances. Ratio to 2001Q1.
Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Comparison: Auto Loans

- Initial ranking overstates growth for quartile 1 relative to recent ranking

8Q lagged Equifax Riskscore



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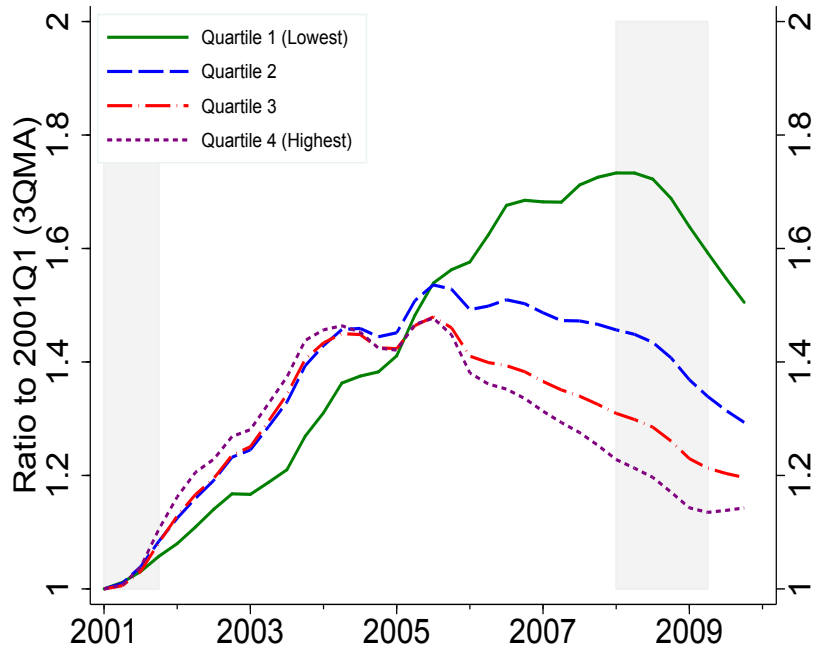


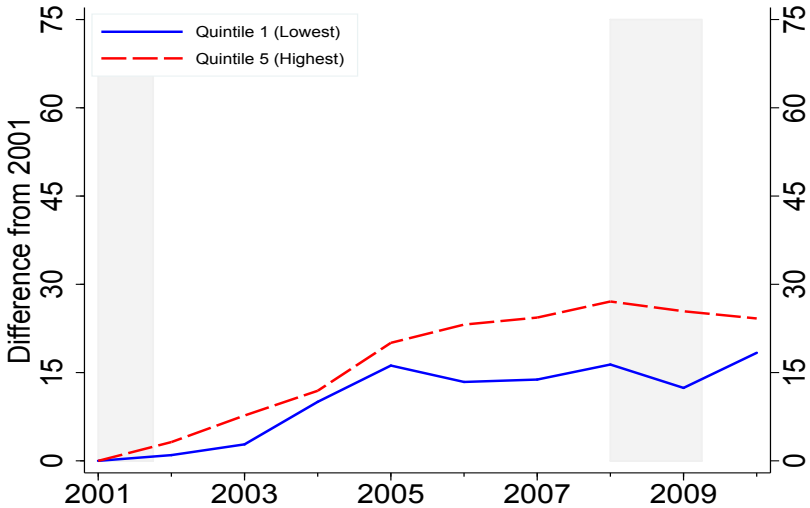
Average balance on auto loans. Ratio 2001Q1.
Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Debt and Income Over the Life Cycle

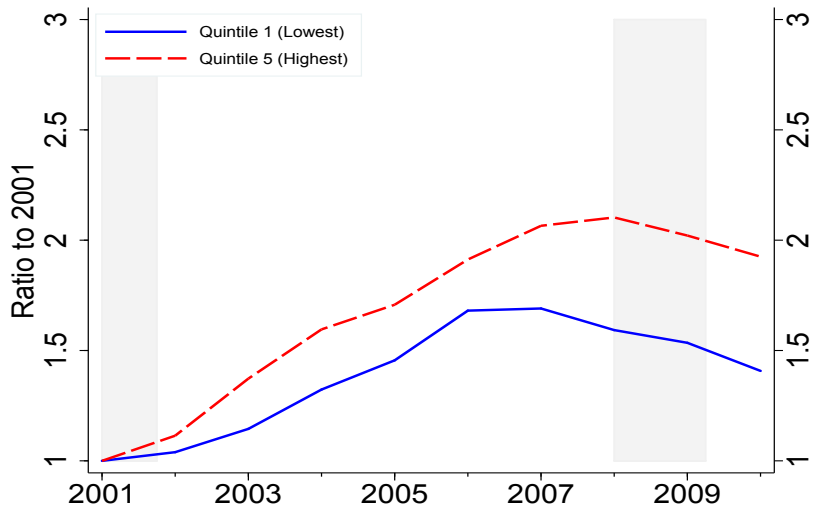
- How do credit scores and borrowing by age in 1999 vary with income in 2009?

  35-44 yo in 1999 by their income quintile in 2009 [25-34 in 1999]

Credit score



Total debt balances



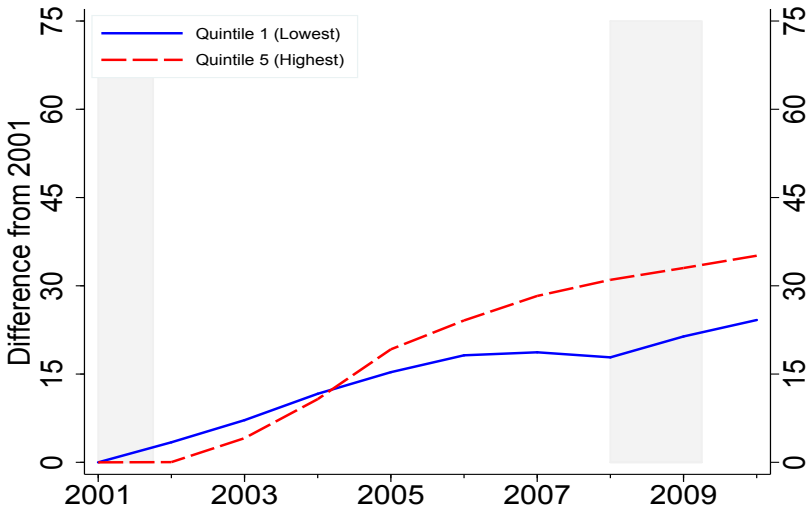
Equifax Riskscore and total debt balances for 35-44 yo in 1999 by their 2009 Worknumber total annual labor income quantile. Difference with 2001 (credit score) and ratio to 2001 (balances). Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Debt and Income Over the Life Cycle

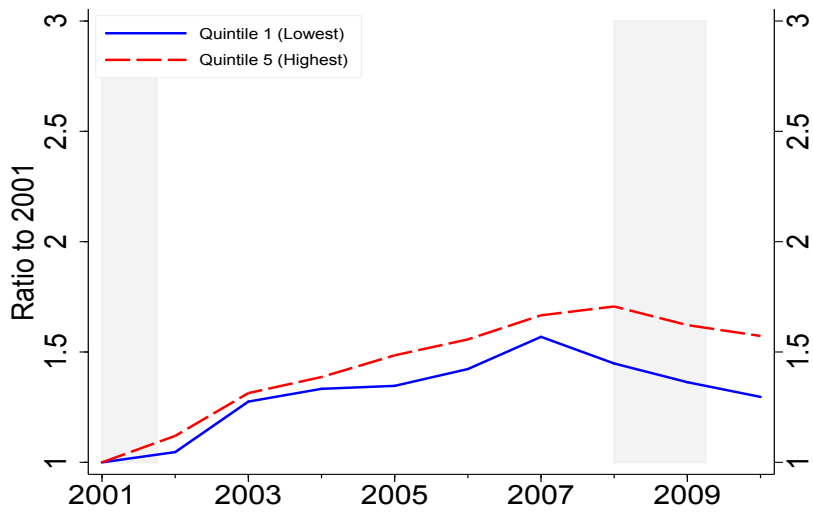
- How do credit scores and borrowing by age in 1999 vary with income in 2009?

  45-54 yo in 1999 by their income quintile in 2009 [25-34 in 1999]

Credit score



Total debt balances



Equifax Riskscore and total debt balances for 45-54 yo in 1999 by their 2009 Worknumber total annual labor income quantile. Difference with 2001 (credit score) and ratio to 2001 (balances). Source: Authors' calculations based on FRBNY CCP/Equifax Data.

Econometric Specifications

- Cross-sectional relation between income and credit score [Results]

$$CS^i_{2009-h} = \alpha + \beta y^i_{2009} + \text{age effects} + \varepsilon^i_{2009}$$

CS^i_{2009-h} = credit score at $2009 - h$
$h \in \{0, 4Q, 8Q\}$
α = constant
y^i_{2009} = total labor income in 2009