LOAN ORIGINATIONS AND DEFAULTS IN THE MORTGAGE CRISIS: THE ROLE OF THE MIDDLE CLASS

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Motivation

- A common view of the ‘07 mortgage crisis is that innovations and perverted incentives in credit supply led to distortions in the allocation of credit, especially to poorer households
  - Financial sector provided mortgages at unsustainable debt-to-income levels, in particular to low income borrowers.
  - As a results, significant emphasis on understanding the role of the low-income and subprime borrowers for the crisis.

- Evidence for the credit supply view relies on negative correlation between mortgage growth and per capita income growth at the zip code level
  - “Decoupling” of mortgage growth and income growth in the pre-crisis period, Mian and Sufi (2009), especially for poor neighborhoods

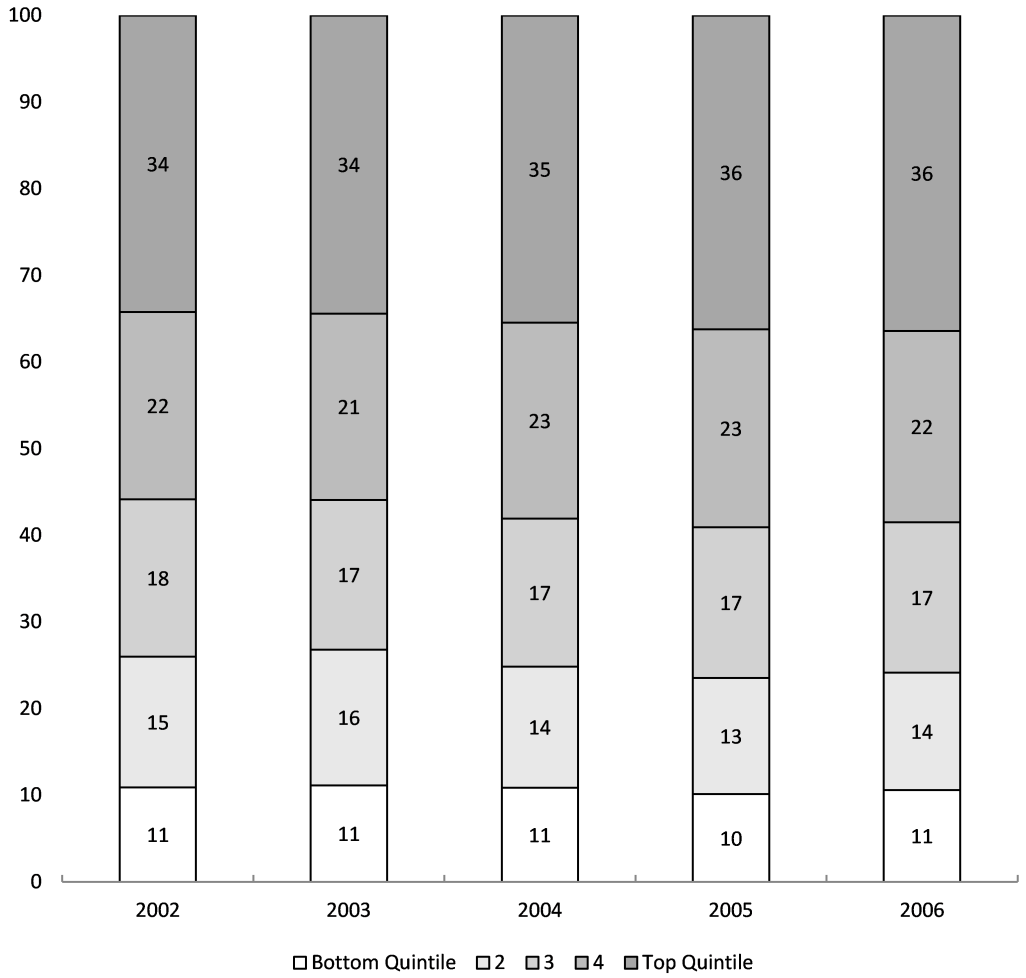
This Paper

- Credit expanded across the income distribution, not just the poor
  - Middle/high income households had a much larger contribution to overall mortgage debt before the crisis than the poor
  - Mortgage debt-to-income levels (DTI) in-line with prior years, no decoupling at origination
- Sharp increase in delinquencies for middle class and prime borrowers after 2007
  - Middle class and higher FICO score borrowers make up much larger share of defaults, especially in areas with high house price growth
- Results point to the importance of house prices for home buying and lending decisions
  - Increase in debt due to faster turnover and cash- out refinancing in the mortgage market (larger % of households had recent transactions)
  - Credit demand and house price expectation important drivers of credit
  - Potential build-up of systemic risk prior to the crisis

Data

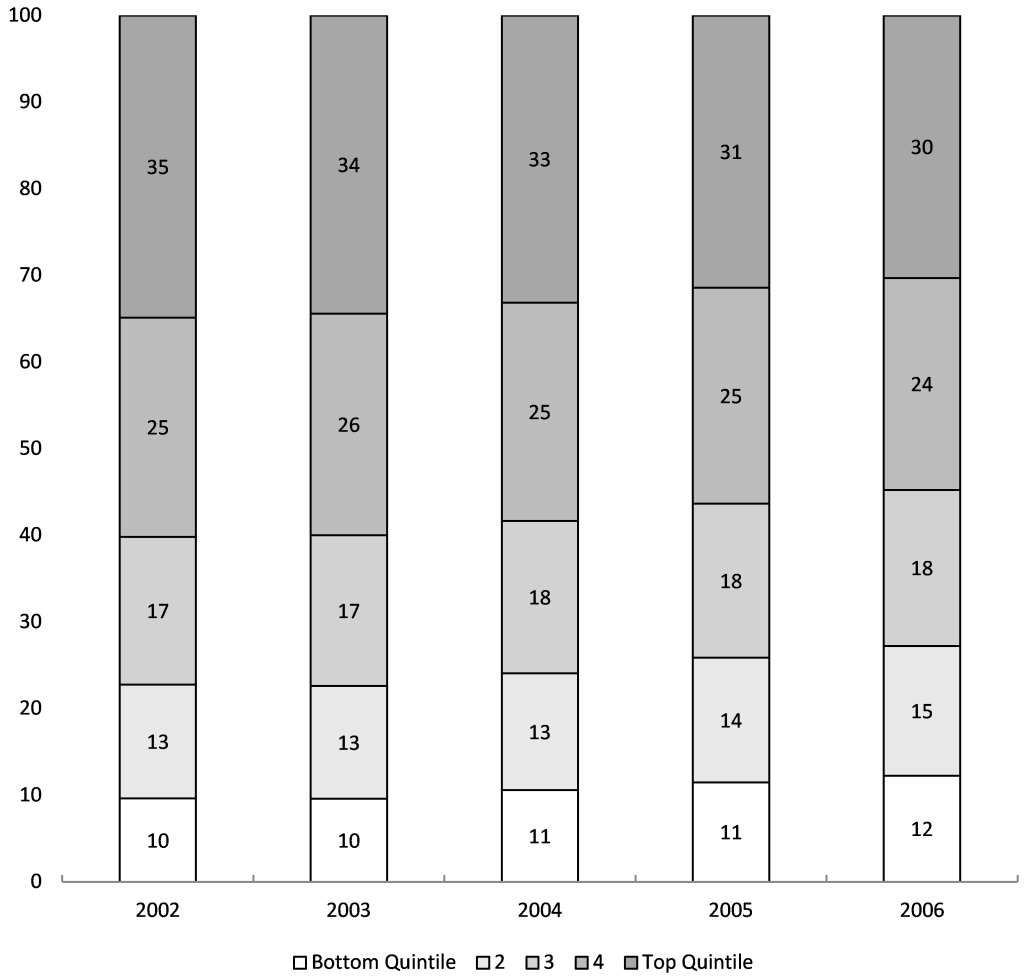
- Home Mortgage Disclosure Act data
  - Balance of individual mortgages originated in the US (2002-2006)
  - Mortgage type (purchase vs refinance)
  - Borrower income from mortgage application
- IRS income at the zip code level.
- House prices and house turn-over from Zillow.
- Mortgage size and performance from LPS: 5% random sample, Freddie Mac, Black Box Logic
- Household Debt (stock): Federal Reserve Board Survey of Consumer Finances

Aggregate Mortgage Origination by Buyer Income (HMDA) Stayed Stable



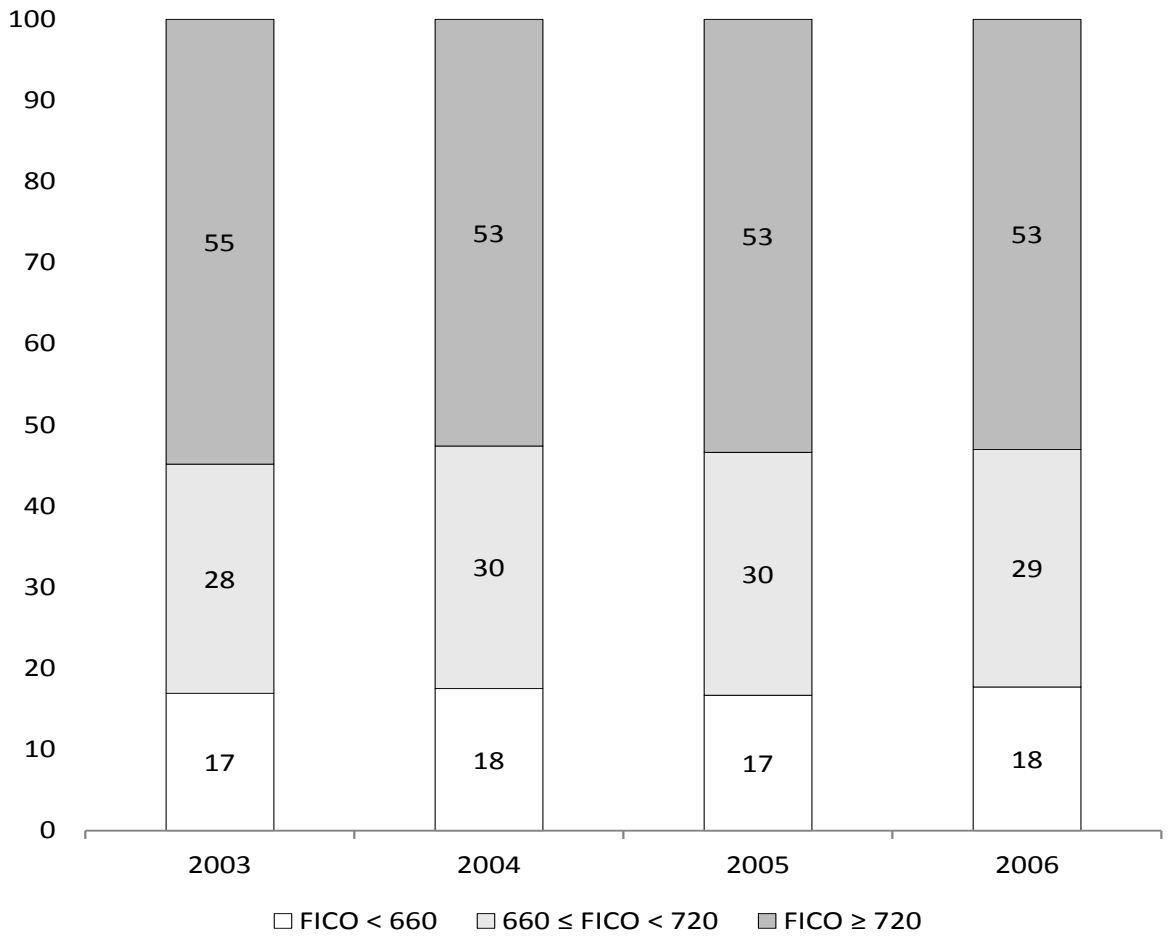
Fraction of mortgage dollars originated per year by income quintile

Aggregate Mortgage Origination by IRS Household Income. Stayed Stable

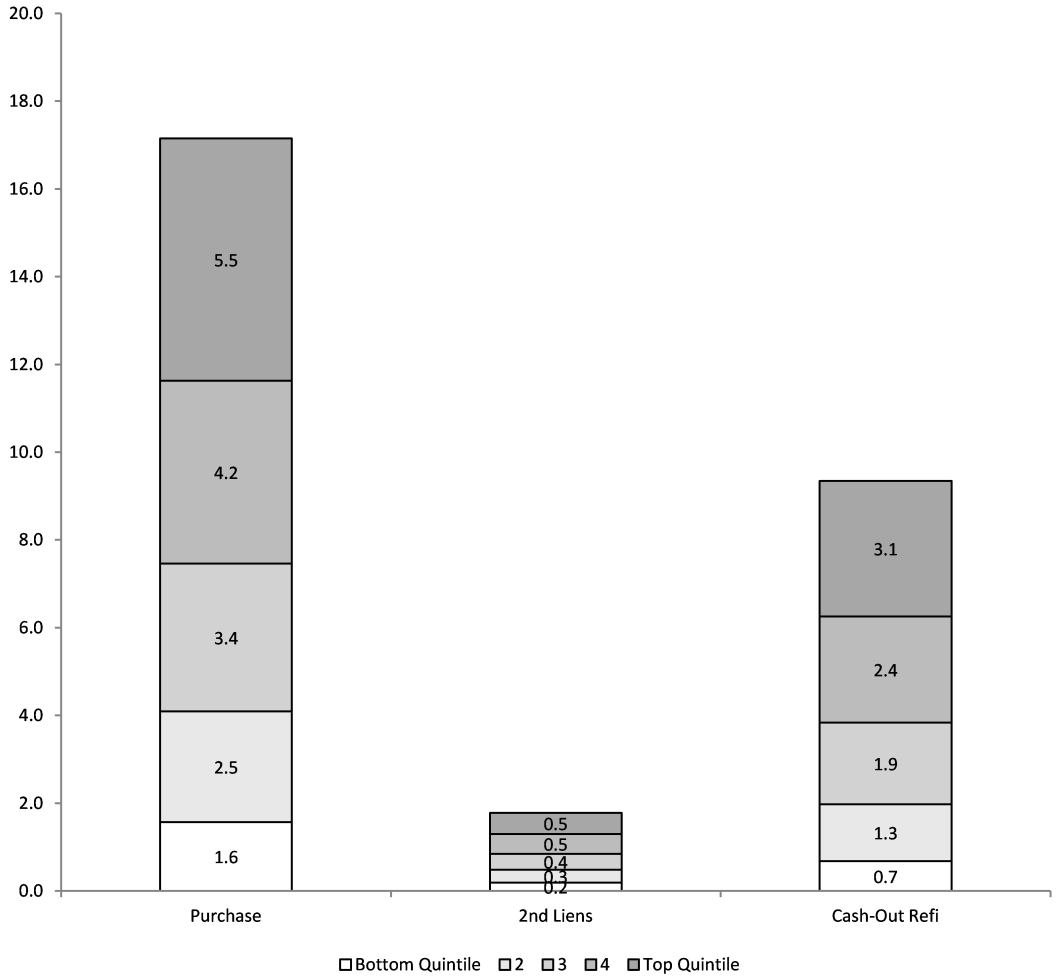


Fraction of mortgage dollars originated per year by income quintile

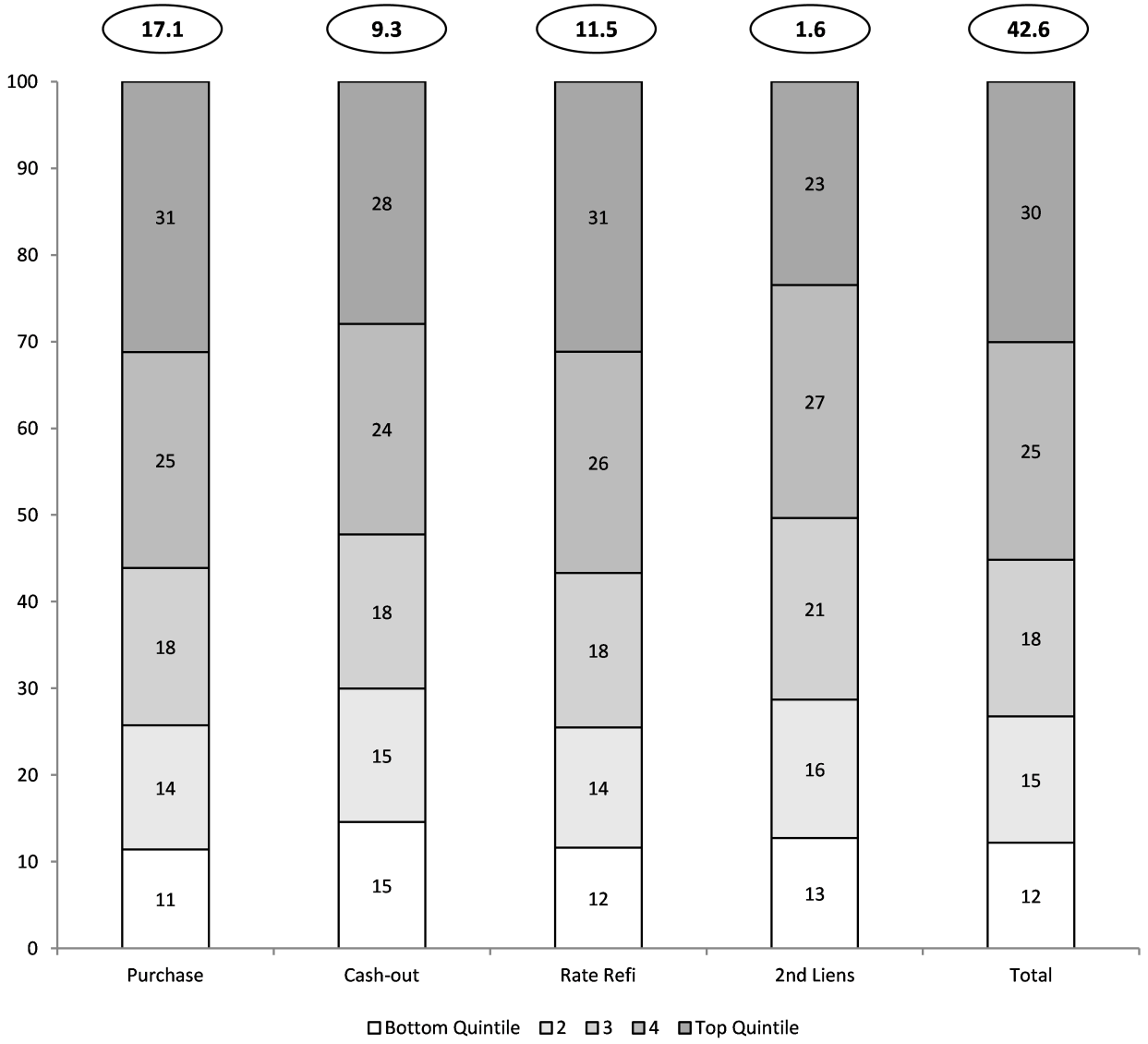
Origination by FICO scores



How Did Household Leverage Build Up? Cash-out Refi and 2nd liens in 2006 (LPS)



In %.. -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Purchase
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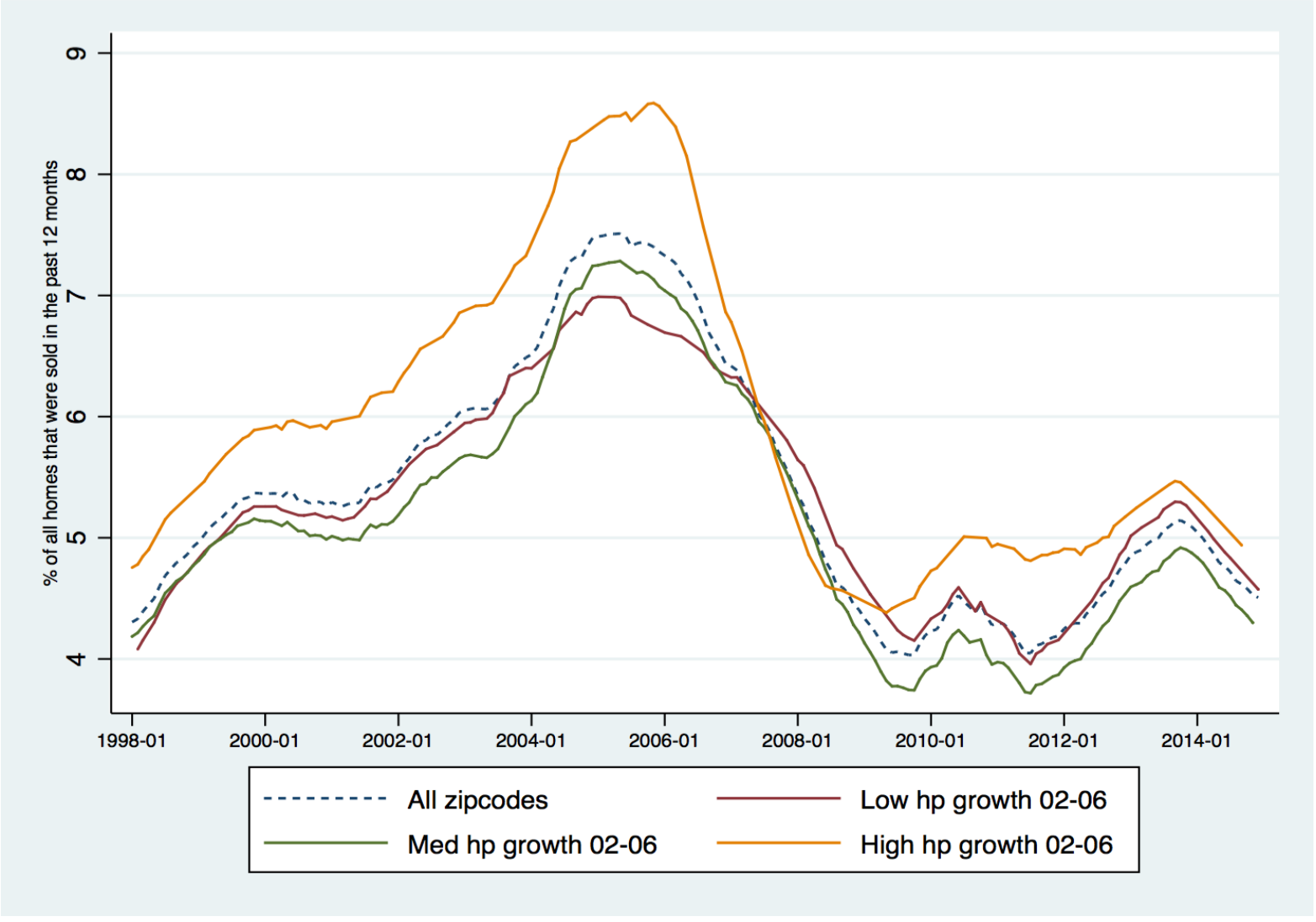
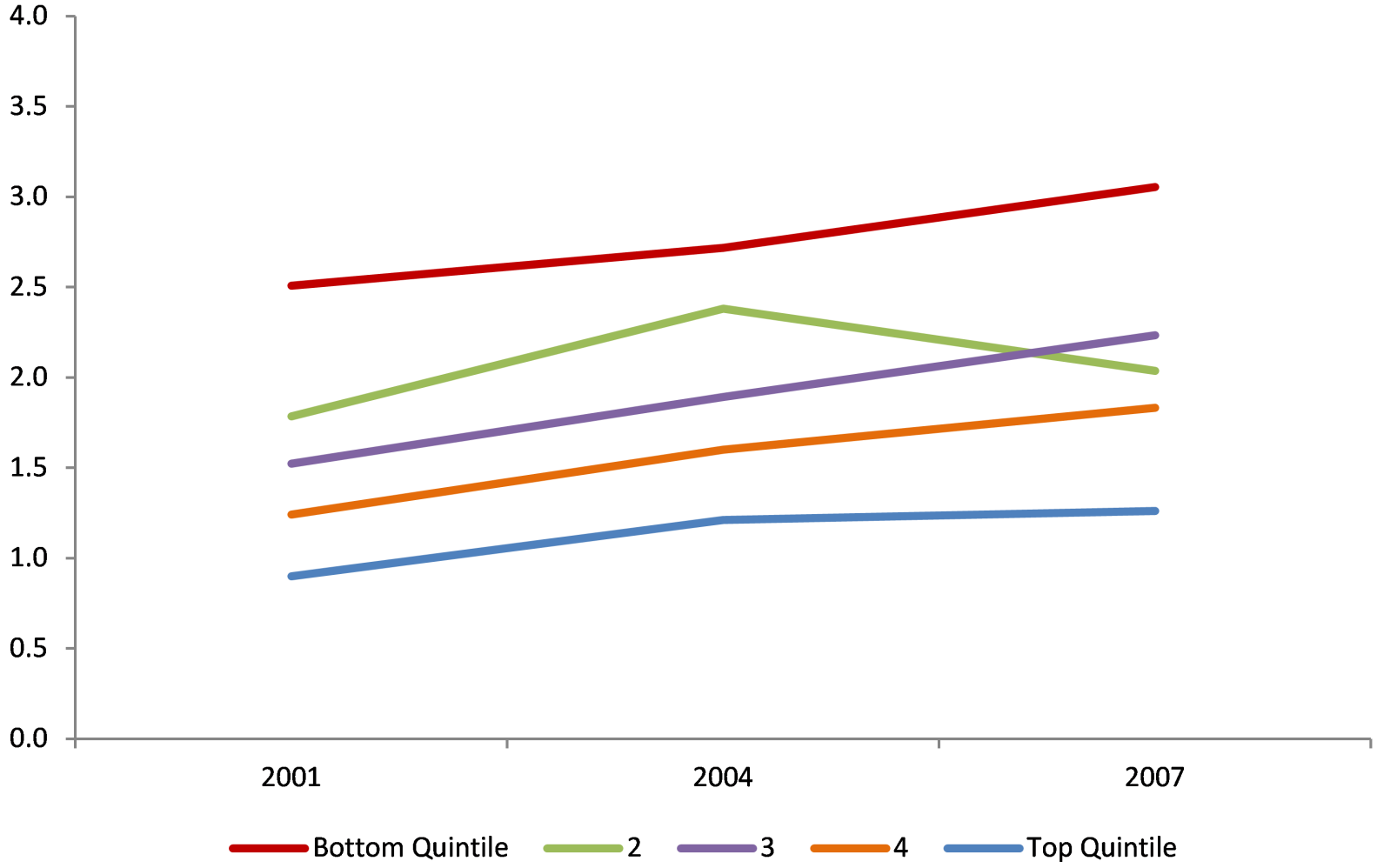
Top Quintile

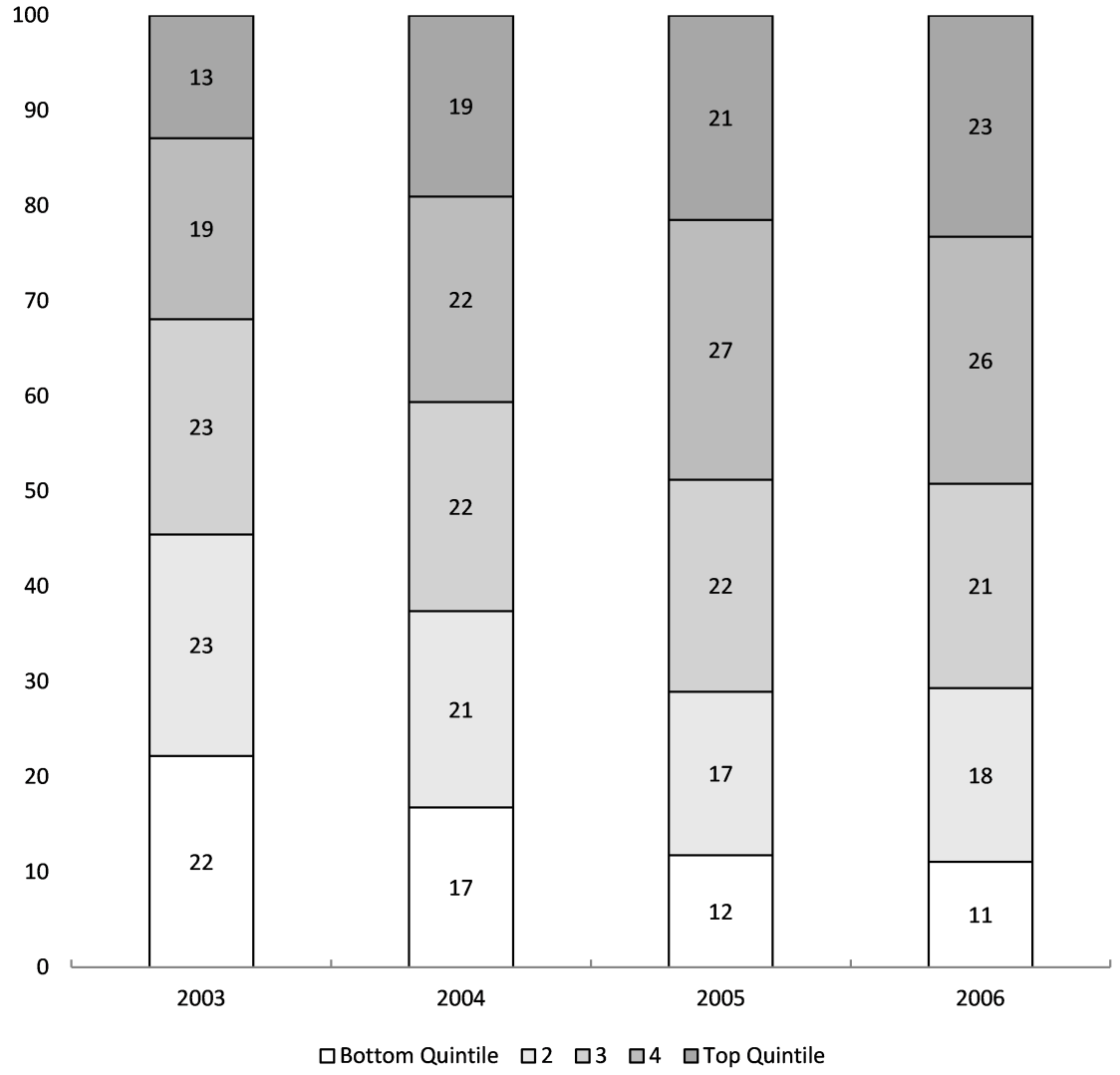
How Did Household Leverage Build Up? Increased Speed of Home Sales



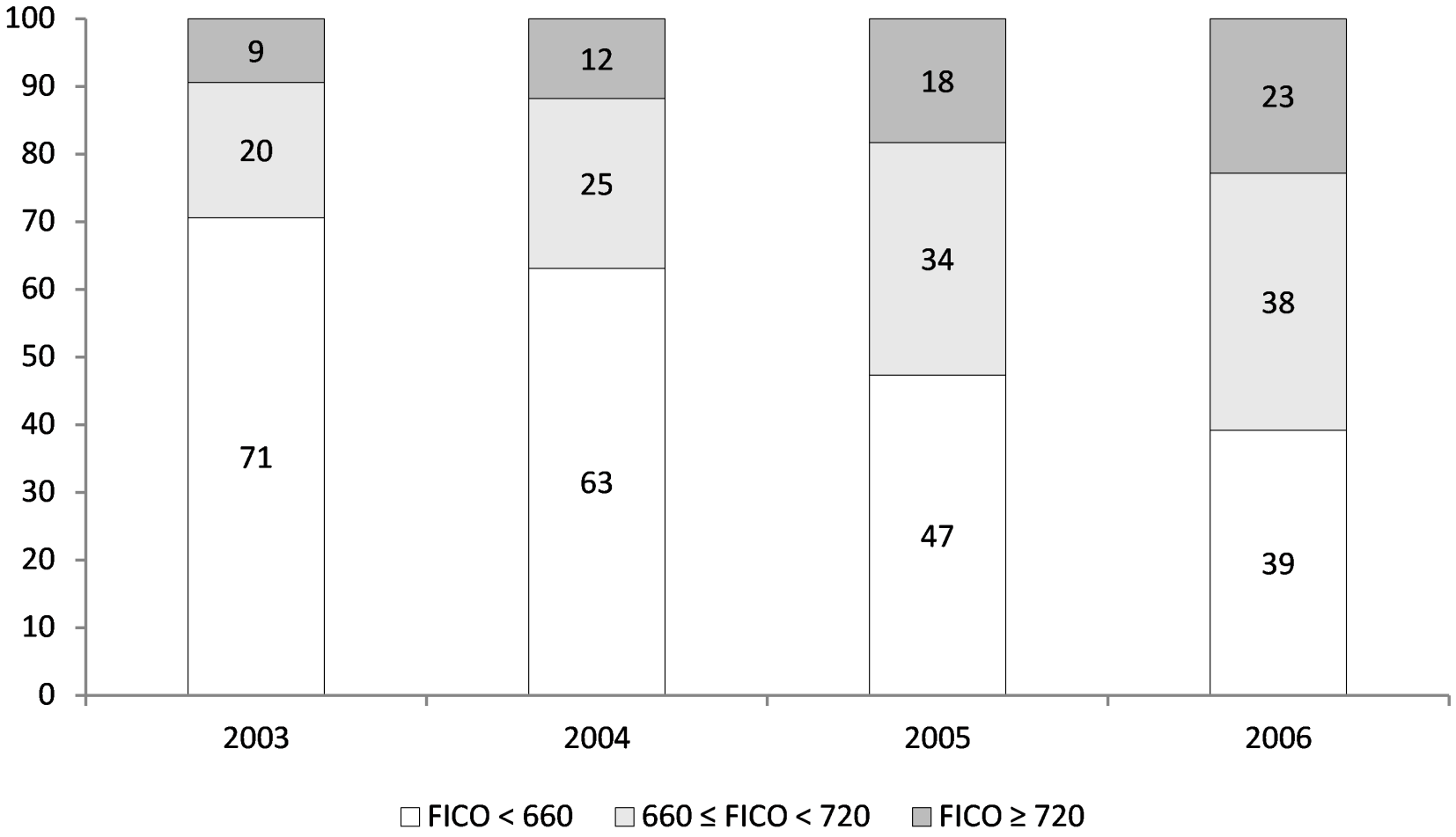
Effect on the Stock of Household Mortgage Debt (SCF)



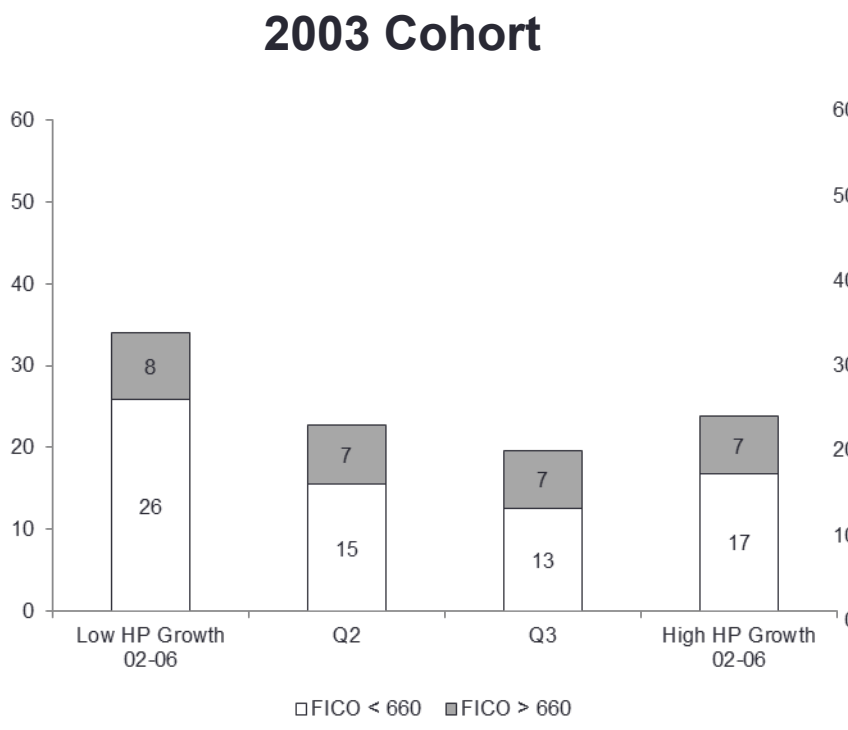
Share of Delinquent Mortgage Debt 3 Years Out by Buyer Income (LPS) – Value Weighted

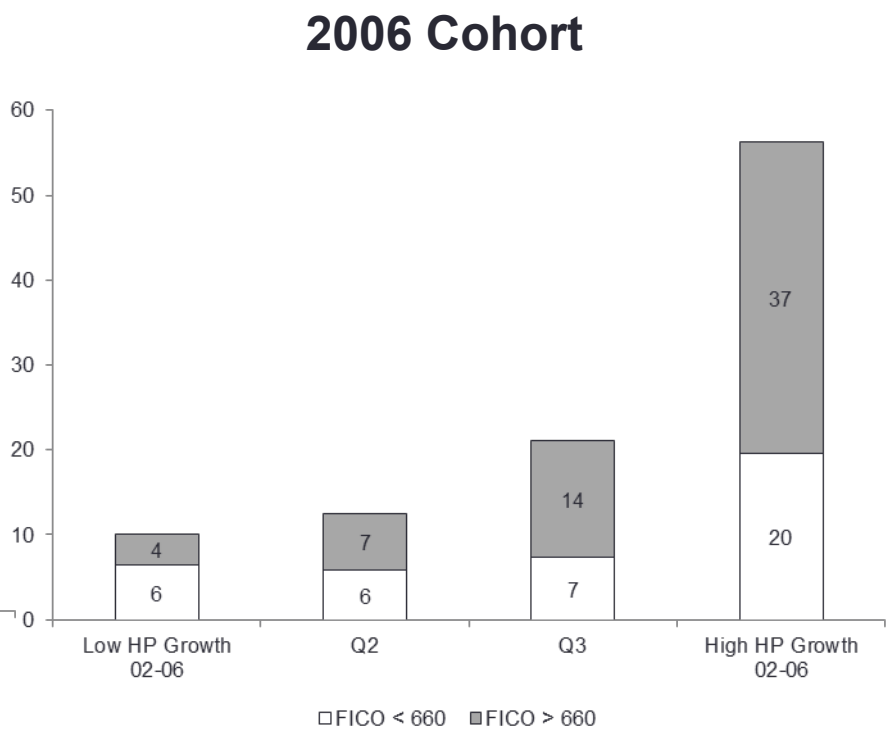


Share of Delinquent Mortgages 3 Yrs Out by FICO and Cohort (LPS) –Value Weighted



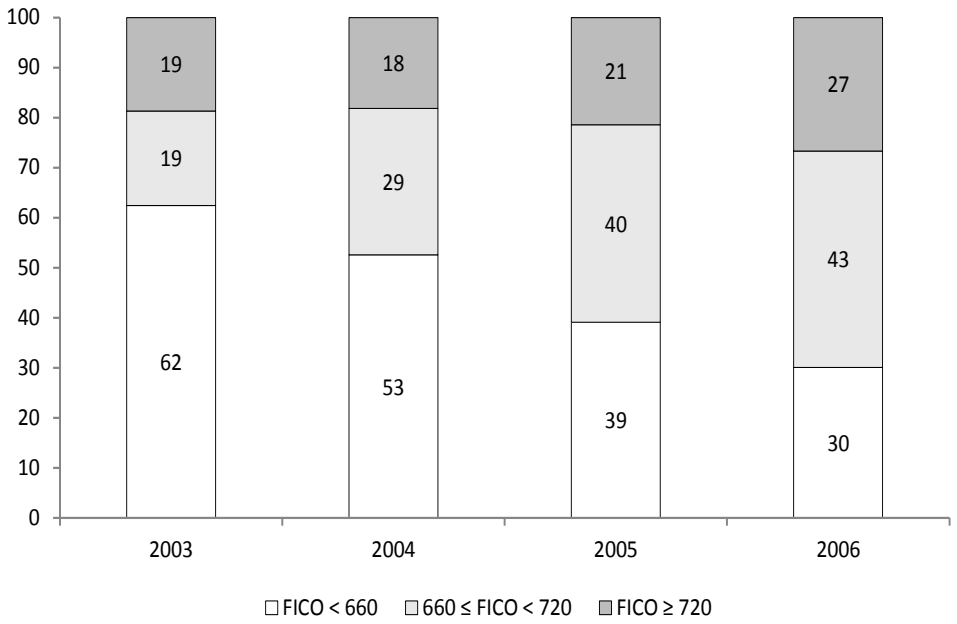
Share of Delinquency 3 Years Out by HP Growth and FICO – Value Weighted



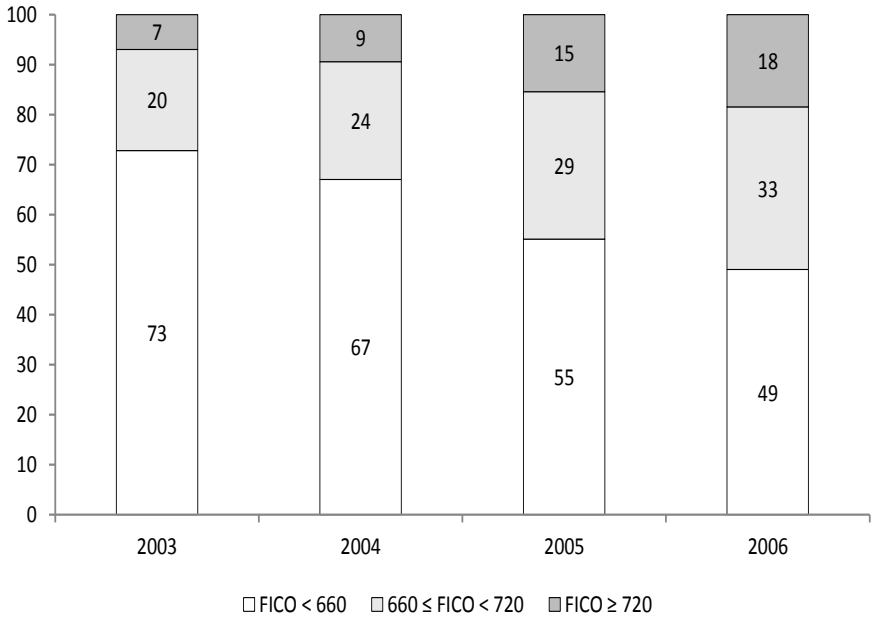


Recourse vs. Non-Recourse States

Non-Recourse States



Recourse States



Results Robust Across Different Data Sets

- Main dataset: LPS 5 % random sample of US mortgages

- **Same patterns with alternative datasets:**
- Freddie Mac, loan performance 50,000 loans per year single family homes
- Blackbox Logic, 90% of privately securitized loans
- Survey of Consumer Finance, household debt and income data from
- Federal Reserve Board Survey
- Paul Willen and Chris Foote have rerun our results using Equifax data

Differences to prior results

Prior results rely on ***zip code level*** analysis (Mian and Sufi, 2009) :

$$\Delta Mortgage_{i,2006-02} = \beta_1 \Delta IRSIncome_{i,2002-06} + c_{county} + \varepsilon_i$$

- Decompose total mortgage origination into
  - growth in individual mortgage size
  - growth in number of mortgages in a zip code
- County fixed effects only pick up *relative* changes within county
  - This is equivalent of assuming house prices change at the county level
- Per capita income growth with IRS data combines residents and home buyer income
  - If composition of buyers changes, IRS data worse reflection of buyers
  - Account for potential misreporting during this period.

Decomposition of Total Mortgage Growth

	Growth in		
	Total Mortgage Origination	Average Mortgage Size	Number of Mortgage
IRS income growth	-0.182**	0.239***	-0.402***
	(0.090)	(0.026)	(0.075)
County FE	Y	Y	Y
Number of observations	8,619	8,619	8,619
R2	0.33	0.68	0.31

Across Different Time Periods

	Growth in Average Mortgage Amount Size			
	1996-1998	1998-2002	2002-2006	2007-2011
IRS income growth		0.131***	0.208***	
		(0.021)	(0.023)	
Buyer income growth	0.261***	0.176***	0.276***	0.307***
	(0.015)	(0.015)	(0.015)	(0.015)
County FE	Y	Y	Y	Y
Number of observatior	8,597	8,605	8,619	8,550
R2	0.46	0.58	0.73	0.64

Mortgage Regressions at Transaction Level

$$Ln(Mortgage_{i,t}) = \beta_{inc} Ln(Income)_{i,t} + FE_{year} + FE_{county} + \varepsilon_{it}$$

	Ln(Mortgage Amount)			
Ln(Buyer income)	0.403***	0.366***	0.340***	0.313***
	(0.008)	(0.008)	(0.006)	(0.007)
Ln(Buyer income)		0.015***		0.012***
x Linear trend		(0.002)		(0.002)
Ln(Census tract IRS income)	0.382***	0.409***	0.313***	0.302***
	(0.012)	(0.015)	(0.024)	(0.030)
Ln(Census tract IRS income)		-0.011***		-0.004
x Linear trend		(0.004)		(0.004)
Year FE and county FE	Y	Y	N	N
Year FE and census tract FE	N	N	Y	Y
Number of observations	17,220,064	17,220,064	17,220,064	17,220,064
R2	0.30	0.30	0.33	0.33

Takeaway: Decomposing Total Mortgage Growth

- Negative correlation within counties entirely driven by the extensive margin (differential growth in number of loans)
  - Average household leverage rose in line with income
  - Quick churning of houses in poorer neighborhoods
- Top quartile of zip codes saw very fast income growth, and slow growth in number of mortgages
  - Top quartile exhibits negative relationship between income growth and population. Suggest the relative “emptying” of richer zip codes.
- Highlights the importance of understanding changes in composition of buyers across zip codes.

How to put this together?

- Novel explanation of credit expansion due to economy wide increase of leverage, not just poor or marginal borrowers
  - Homebuyers (and lenders) at all levels of the income distribution bought into the increasing house prices
  - DTI levels did not “decouple” across the income distribution
  - Homebuyers re-levered via quicker churn and more refinancing

- Consistent with a view that systemic build-up in risk led to defaults once the economy slowed down
  - Dollars in default increased most in the middle/high income groups and for high FICO scores
  - Defaults increase in areas with sharpest home price movements
  - Cannot rule our credit demand or house price expectation as important drivers of credit expansion and crisis

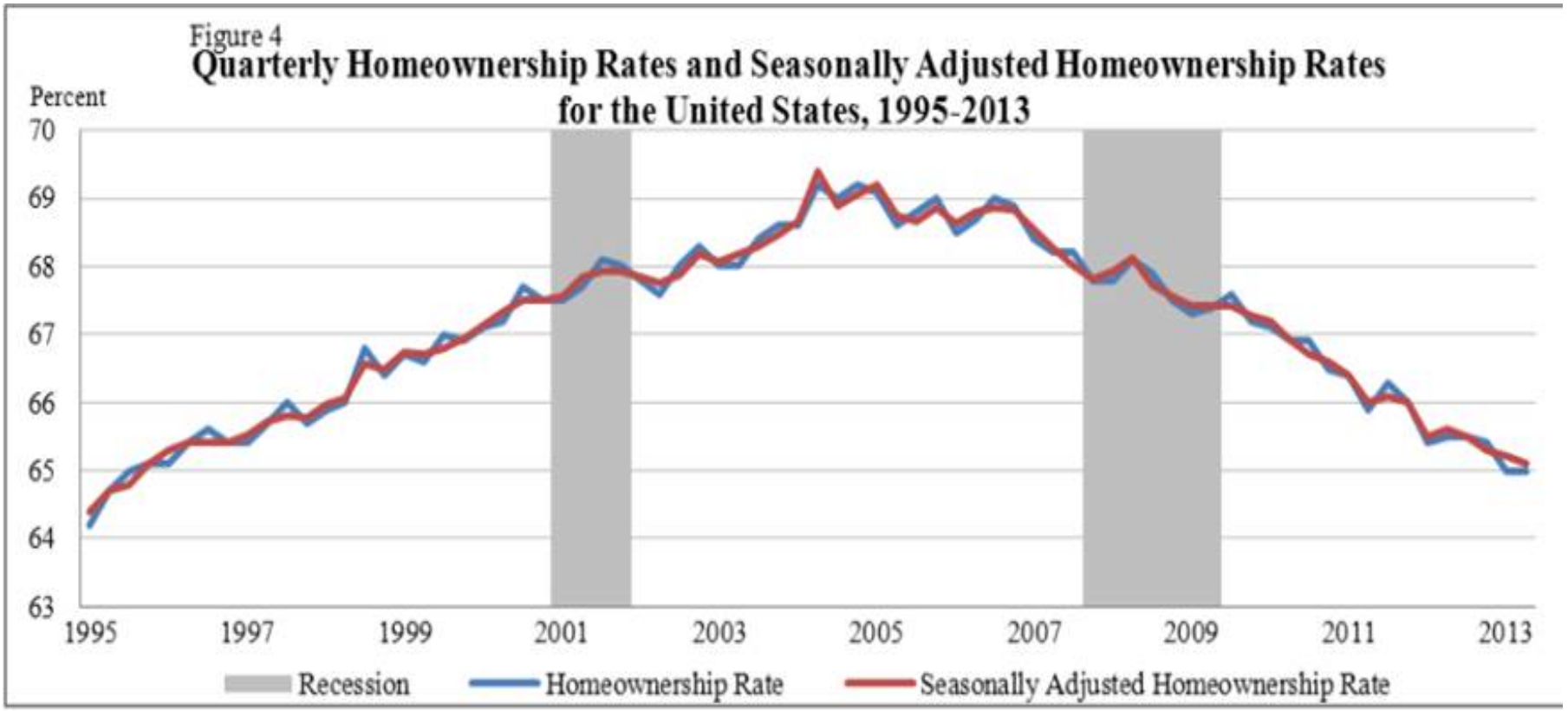
Important Policy Implications

- More focus on macro-prudential implications
  - A lot of regulation after the crisis focuses on micro-prudential regulation, for example screening of marginal borrowers
  - Systemic build up of risk can lead to losses across the financial system, e.g. strategic responses to house price drops
- Protect functioning of financial system when crisis occurs
  - How to build provisions against losses across financial institutions?
  - How to absorb or distribute losses once a crisis occurs?

Thank you

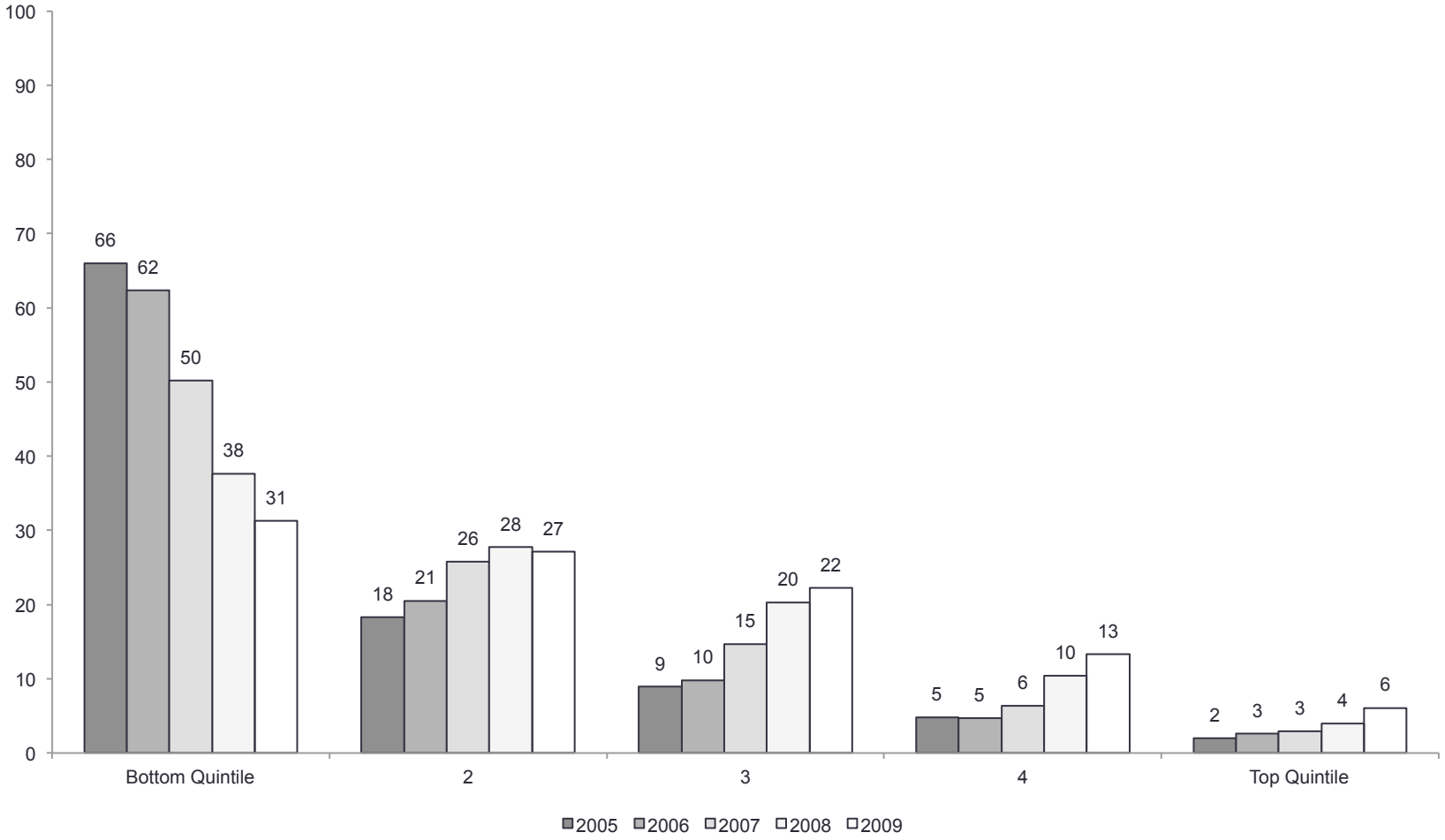
No expansion of ownership for marginal borrowers

Homeownership Rate Goes up 1% from 2002-06

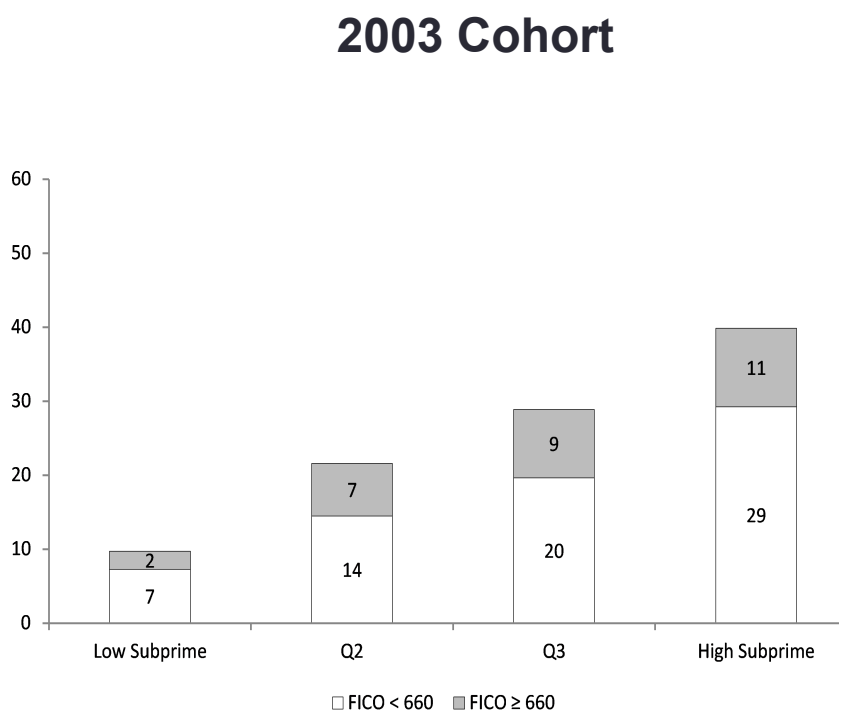


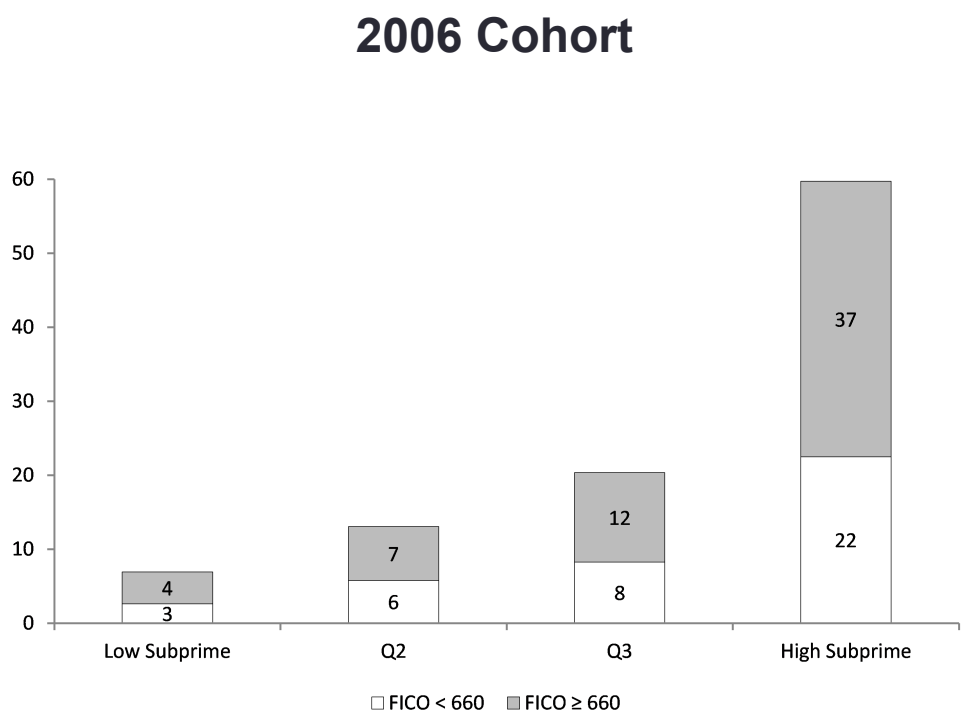
Current Population Survey/ Housing Vacancy Survey, 2014

Delinquencies by FICO quintiles



Share of Delinquency 3 Years Out by Subprime Fraction and FICO – Value Weighted





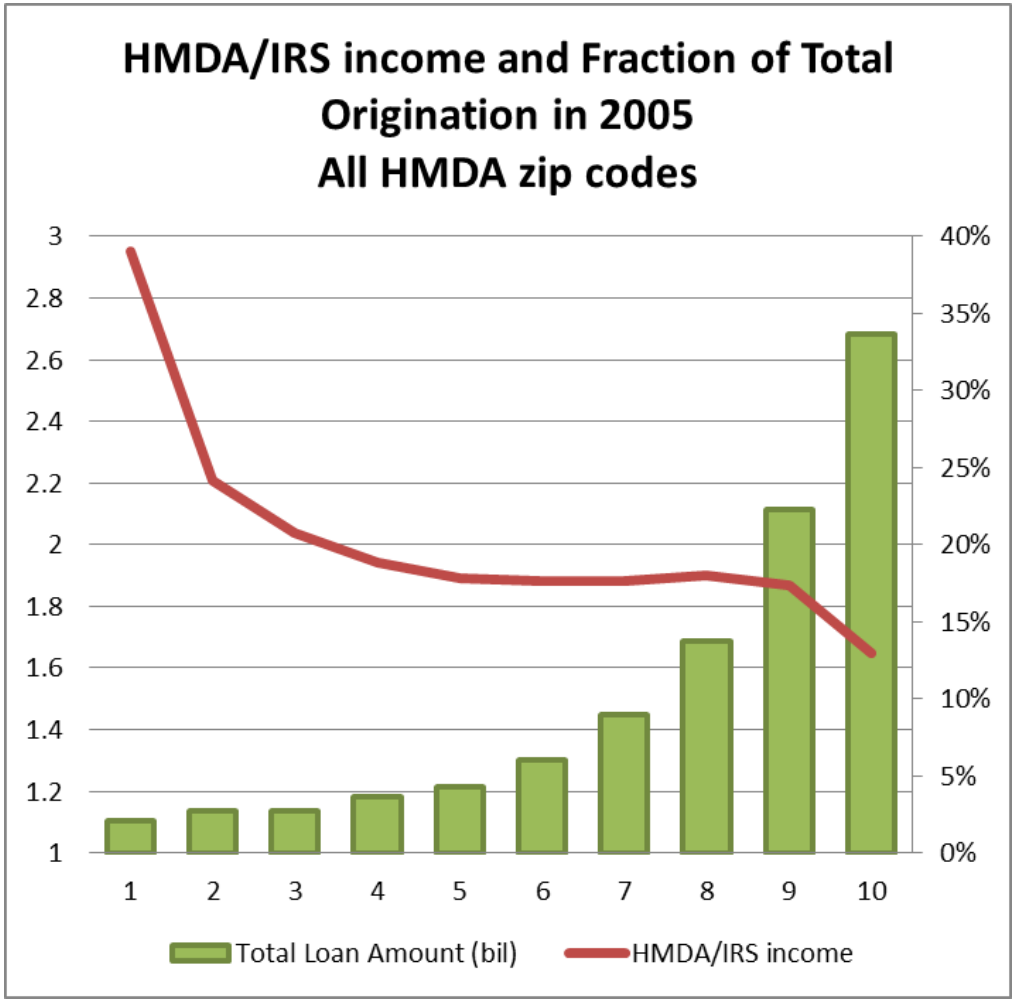
Appendix I: Is Misreporting in HMDA Driving Results?

- Results hold when using IRS data
  - Central insight is that intensive and extensive margin behaved differently across the boom period
  - Results on share of originations and defaults is also independent of which income data we use

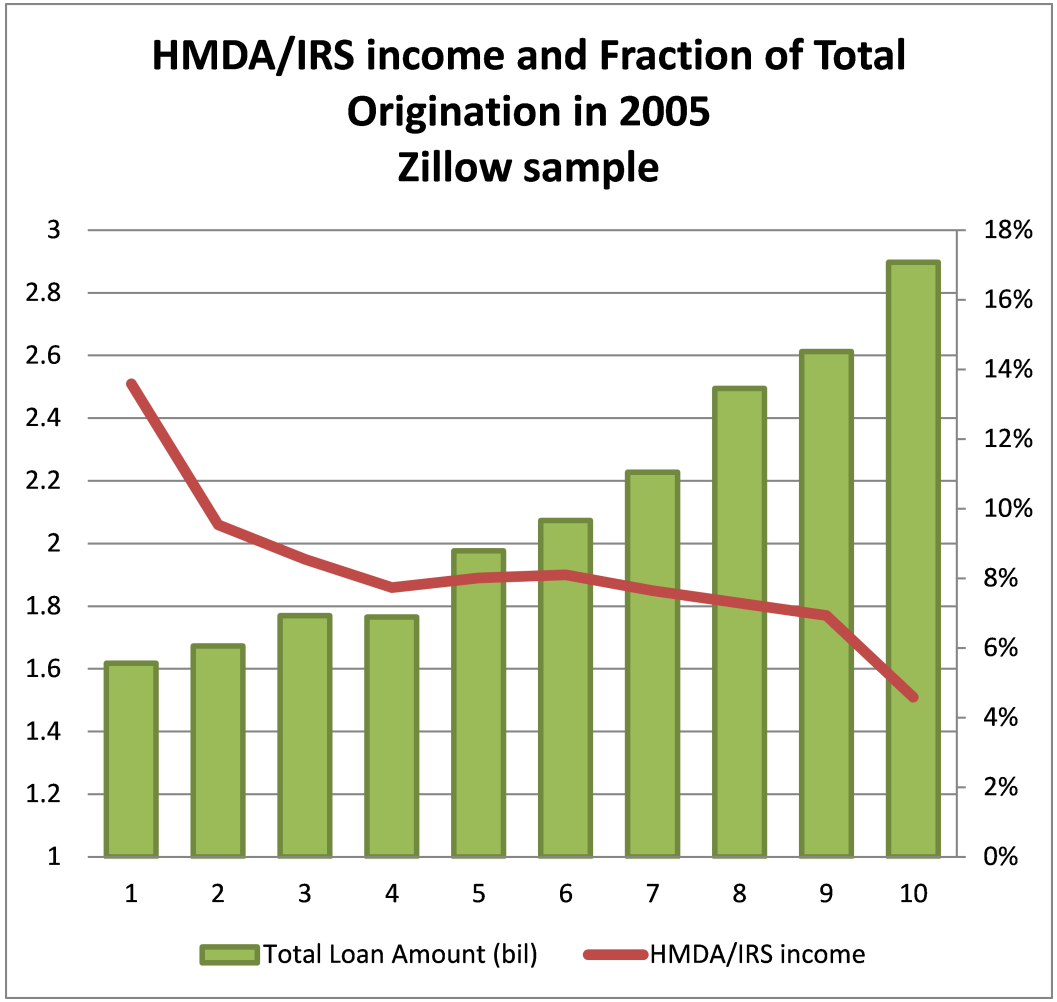
- Magnitudes are too large to explain composition changes
  - Best estimates range from 15% to 25%. See Jiang et al (2014)
  - Buyer income is twice the level of residents

- Sensitivity of mortgage levels to income levels is very similar across
  - Prime/sub-prime lenders or GSE/non-GSE loans
  - zip codes where MS2015 proclaim greatest “income overstatement”

Loan Origination and MS 2015 Measure of Overstatement (All HMDA)



Loan Origination and MS 2015 Measure of Overstatement (Zillow)



Adding Buyer Income (HMDA)

	Growth in					
	Total Mortgage Origination		Average Mortgage Size		Number of Mortgage	
Buyer income growth	0.369***	0.376***	0.282***	0.276***	0.117***	0.130***
	(0.047)	(0.047)	(0.015)	(0.015)	(0.040)	(0.040)
IRS income growth		-0.224**		0.208***		-0.417***
		(0.088)		(0.023)		(0.075)
County FE	Y	Y	Y	Y	Y	Y
Number of observations	8,619	8,619	8,619	8,619	8,619	8,619
R2	0.35	0.35	0.72	0.73	0.31	0.32

Test in Subsamples (Total Mortgage)

	Growth in Total Mortgage Origination					
	High GSE Fraction	Med GSE Fraction	Low GSE Fraction	High Subp Fraction	Med Subp Fraction	Low Subp Fraction
IRS income growth	-0.072	-0.046	-0.495***	-0.190	-0.109	-0.098
	(0.160)	(0.112)	(0.170)	(0.179)	(0.138)	(0.123)
Buyer income growth	0.338***	0.389***	0.363***	0.477***	0.316***	0.379***
	(0.089)	(0.060)	(0.104)	(0.098)	(0.065)	(0.092)
County FE	Y	Y	Y	Y	Y	Y
Number of observations	2,203	4,355	2,061	2,119	4,326	2,174
R2	0.01	0.02	0.03	0.03	0.02	0.02

Test in Subsample (Average Mortgage Size)

	Growth in Average Mortgage Size					
	High GSE Fraction	Med GSE Fraction	Low GSE Fraction	High Subp Fraction	Med Subp Fraction	Low Subp Fraction
IRS income growth	0.150***	0.217***	0.231***	0.179***	0.202***	0.161***
	(0.047)	(0.029)	(0.045)	(0.051)	(0.032)	(0.030)
Buyer income growth	0.330***	0.279***	0.237***	0.169***	0.283***	0.383***
	(0.025)	(0.021)	(0.026)	(0.027)	(0.019)	(0.027)
County FE	Y	Y	Y	Y	Y	Y
Number of observations	2,203	4,355	2,061	2,119	4,326	2,174
R2	0.23	0.20	0.18	0.09	0.21	0.30

Dropping Zip Codes Based on MS (2015) Measure of Overstatement (Total Mortgage)

	Growth in total mortgage origination				
	All	< 90th buyer/irs	< 80th buyer/irs	< 70th buyer/irs	< 60th buyer/irs
IRS income growth	-0.224**	-0.150*	-0.111	-0.113	-0.138
	(0.088)	(0.083)	(0.086)	(0.087)	(0.098)
Buyer income growth	0.376***	0.348***	0.325***	0.311***	0.315***
	(0.047)	(0.051)	(0.054)	(0.058)	(0.066)
County FE	Y	Y	Y	Y	Y
N of observations	8,619	7,755	6,893	6,032	5,170
R2	0.02	0.02	0.01	0.01	0.01

Dropping Zip Codes Based on MS(2015) Measure of Overstatement (Average Mortgage)

	Growth in average mortgage size				
	All	< 90th buyer/irs	< 80th buyer/irs	< 70th buyer/irs	< 60th buyer/irs
IRS income growth	0.208***	0.221***	0.223***	0.220***	0.215***
	(0.023)	(0.024)	(0.026)	(0.028)	(0.030)
Buyer income growth	0.276***	0.261***	0.259***	0.261***	0.256***
	(0.015)	(0.016)	(0.017)	(0.018)	(0.019)
County FE	Y	Y	Y	Y	Y
N of observations	8,619	7,755	6,893	6,032	5,170
R2	0.20	0.19	0.19	0.19	0.19