# 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

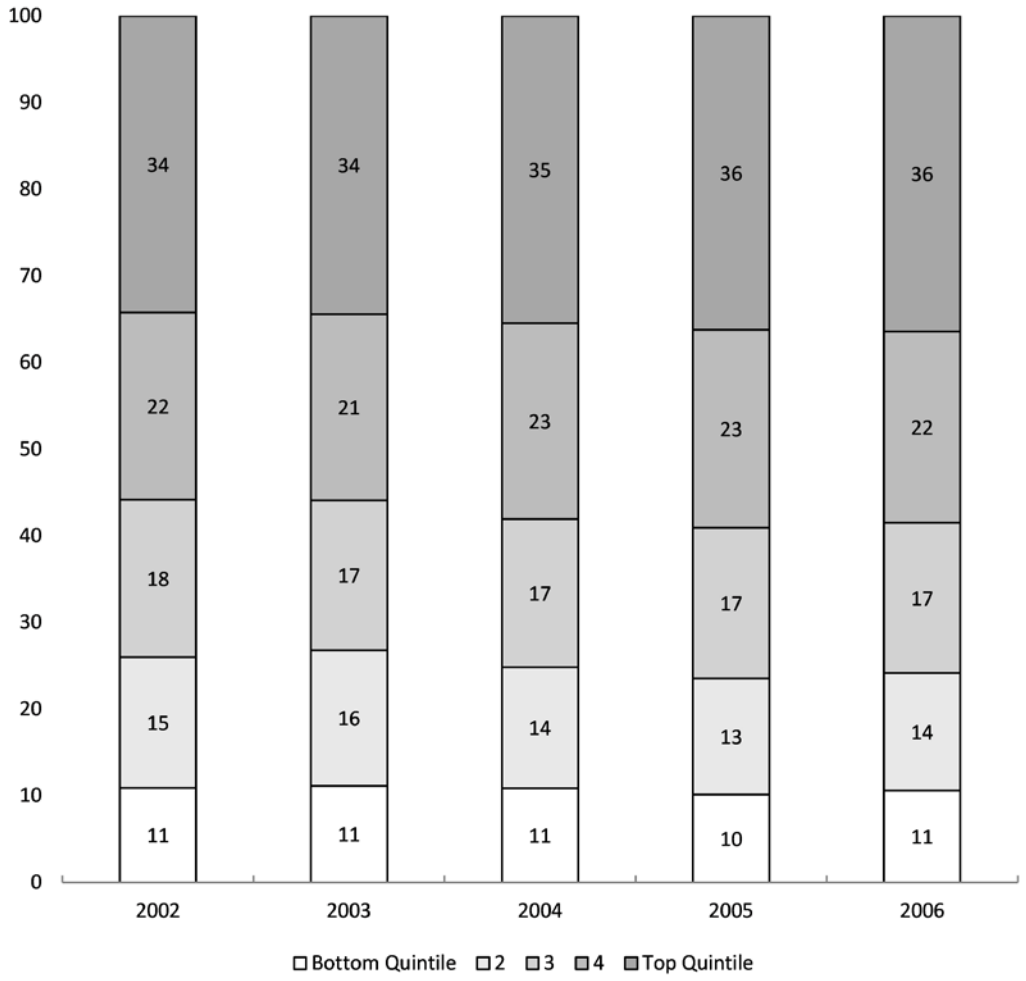
# This Paper

- 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

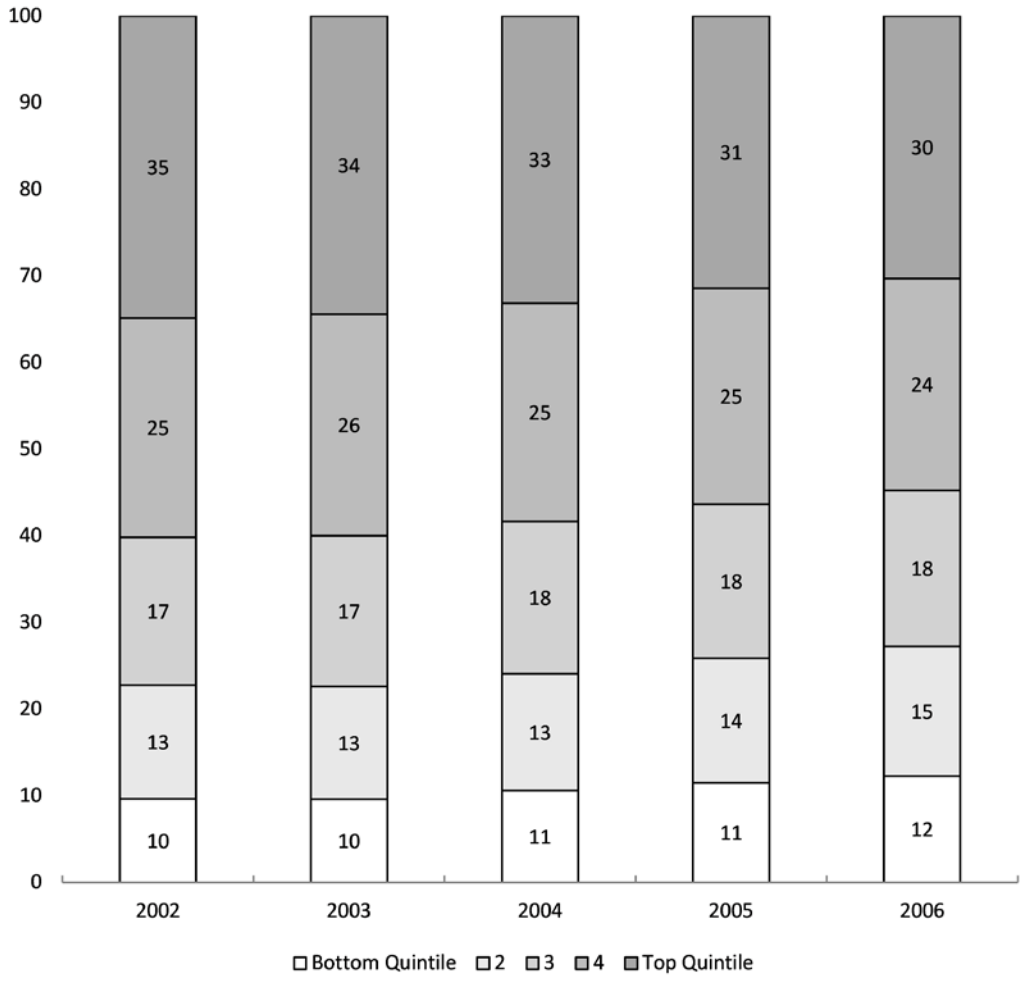
- Home Mortgage Disclosure Act data
  - Balance of individual mortgages originated in the US (2002-2006)
  - Mortgage type (purchase vs refinance)
  - Borrower income from mortgage application
- IRS income at the zip code level.
- House prices and house turn-over from Zillow.
- Mortgage size and performance 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



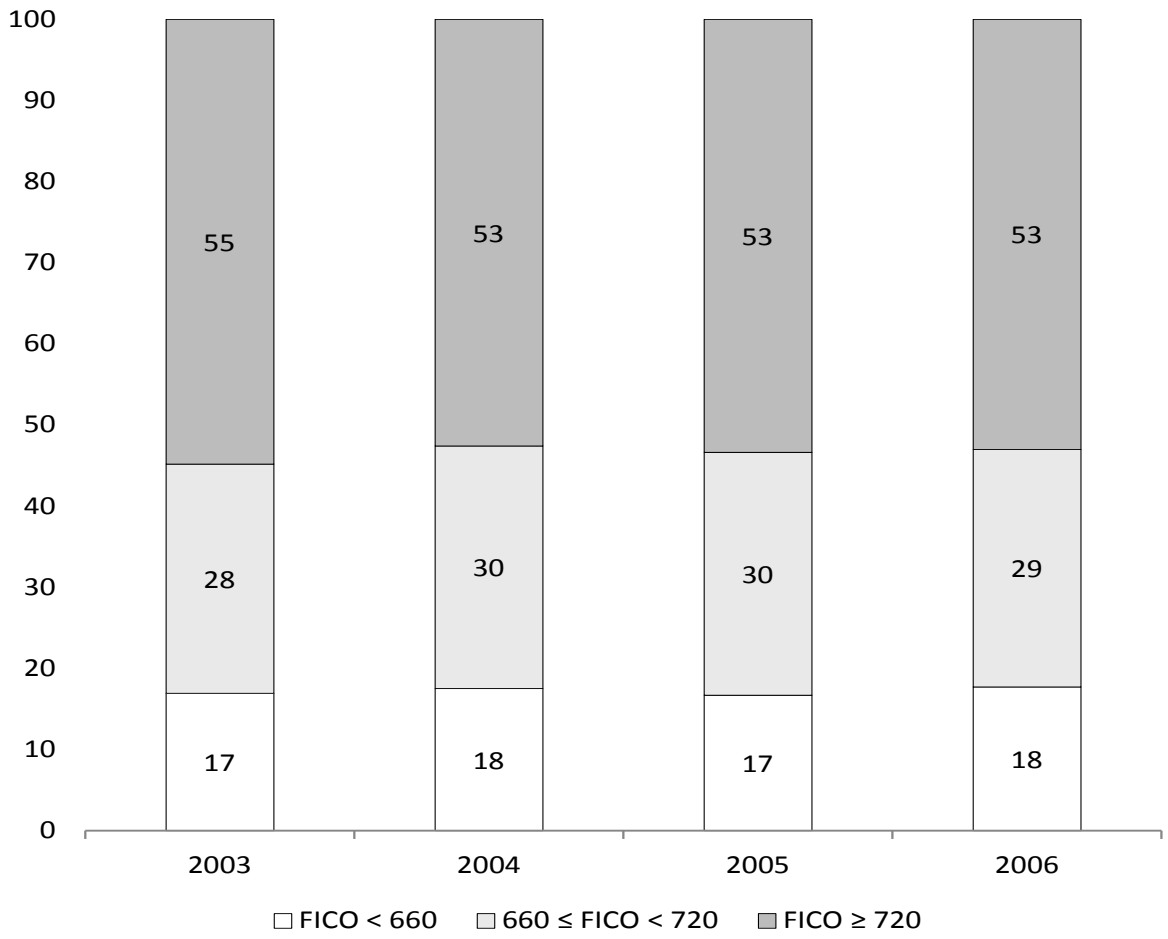

Fraction of mortgage dollars originated per year by income quintile

# Aggregate Mortgage Origination by IRS Household Income. Stayed Stable

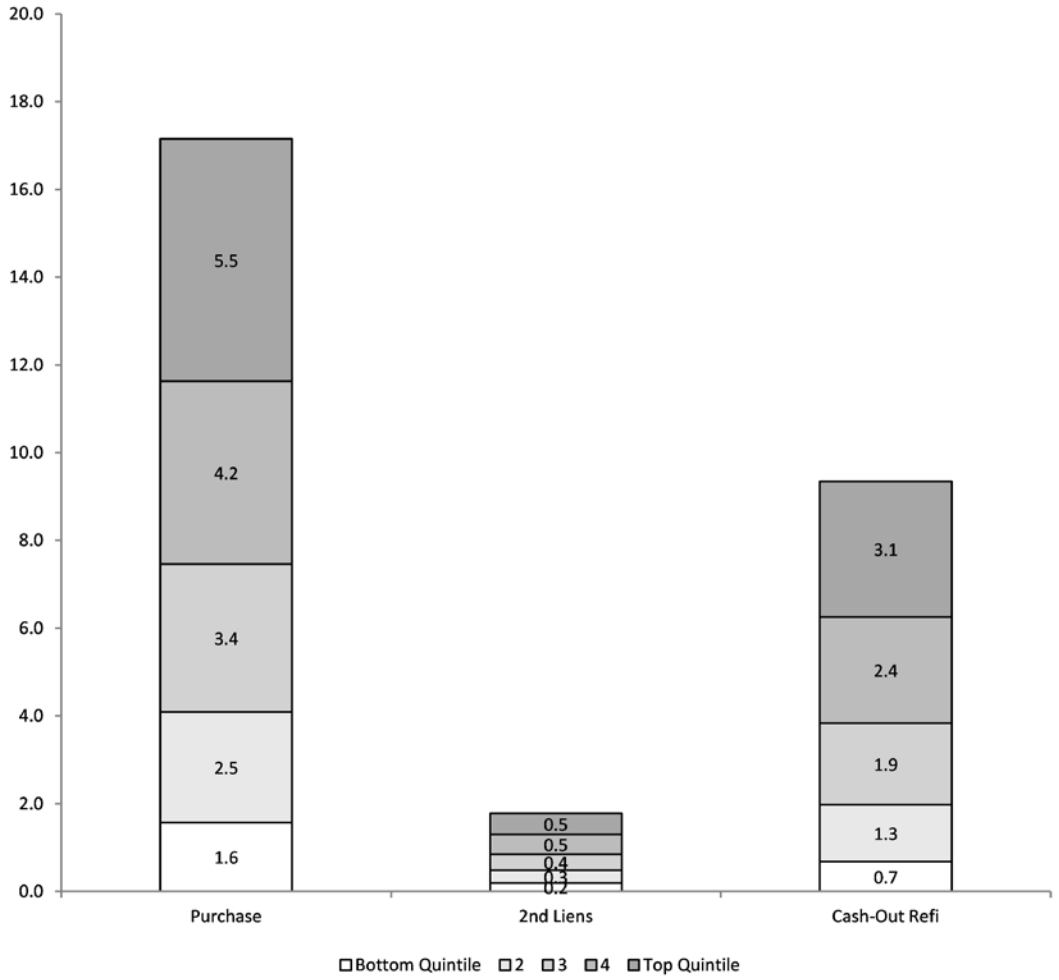



Fraction of mortgage dollars originated per year by income quintile

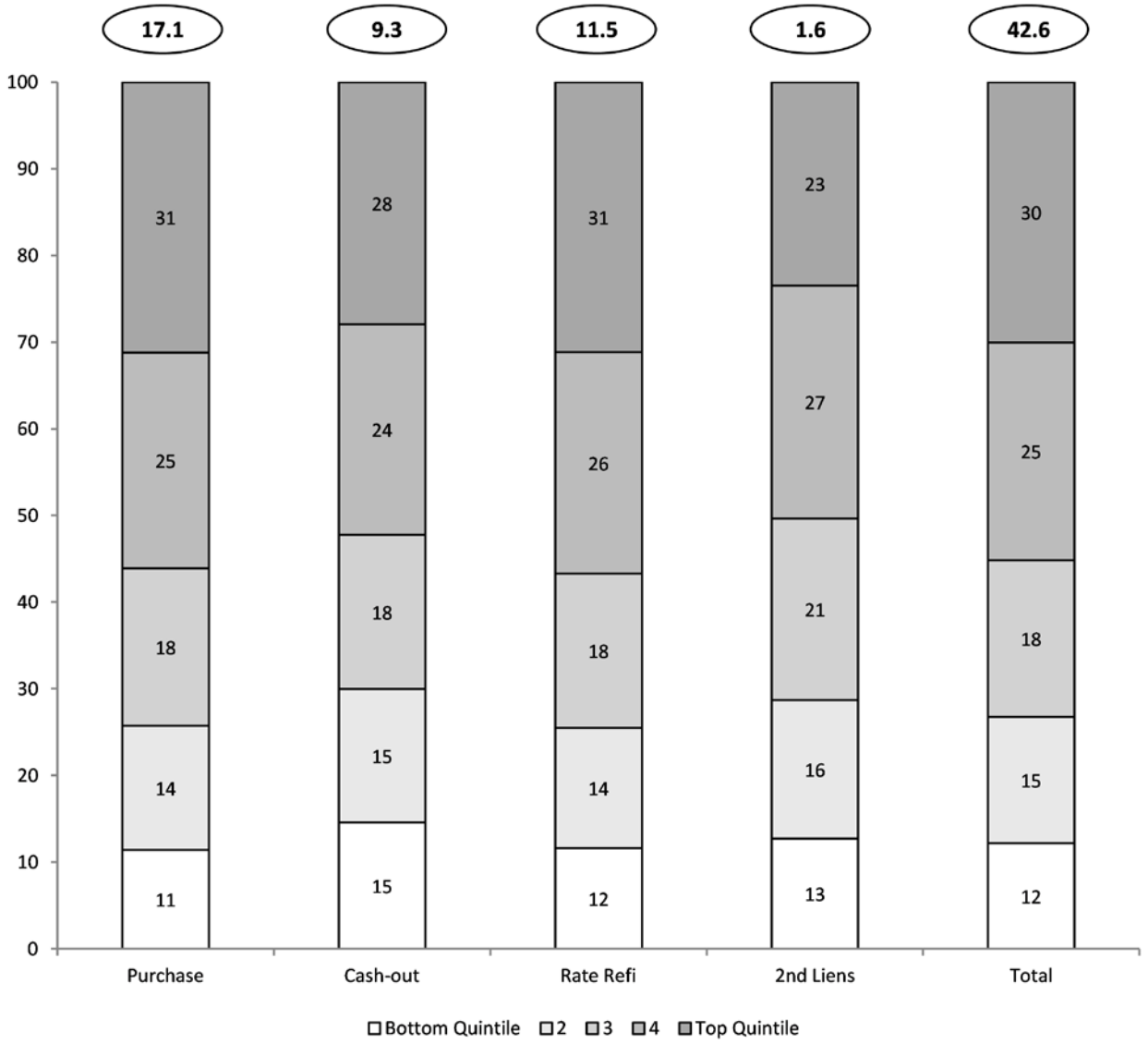
# Origination by FICO scores



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



# In %.. -


17.1
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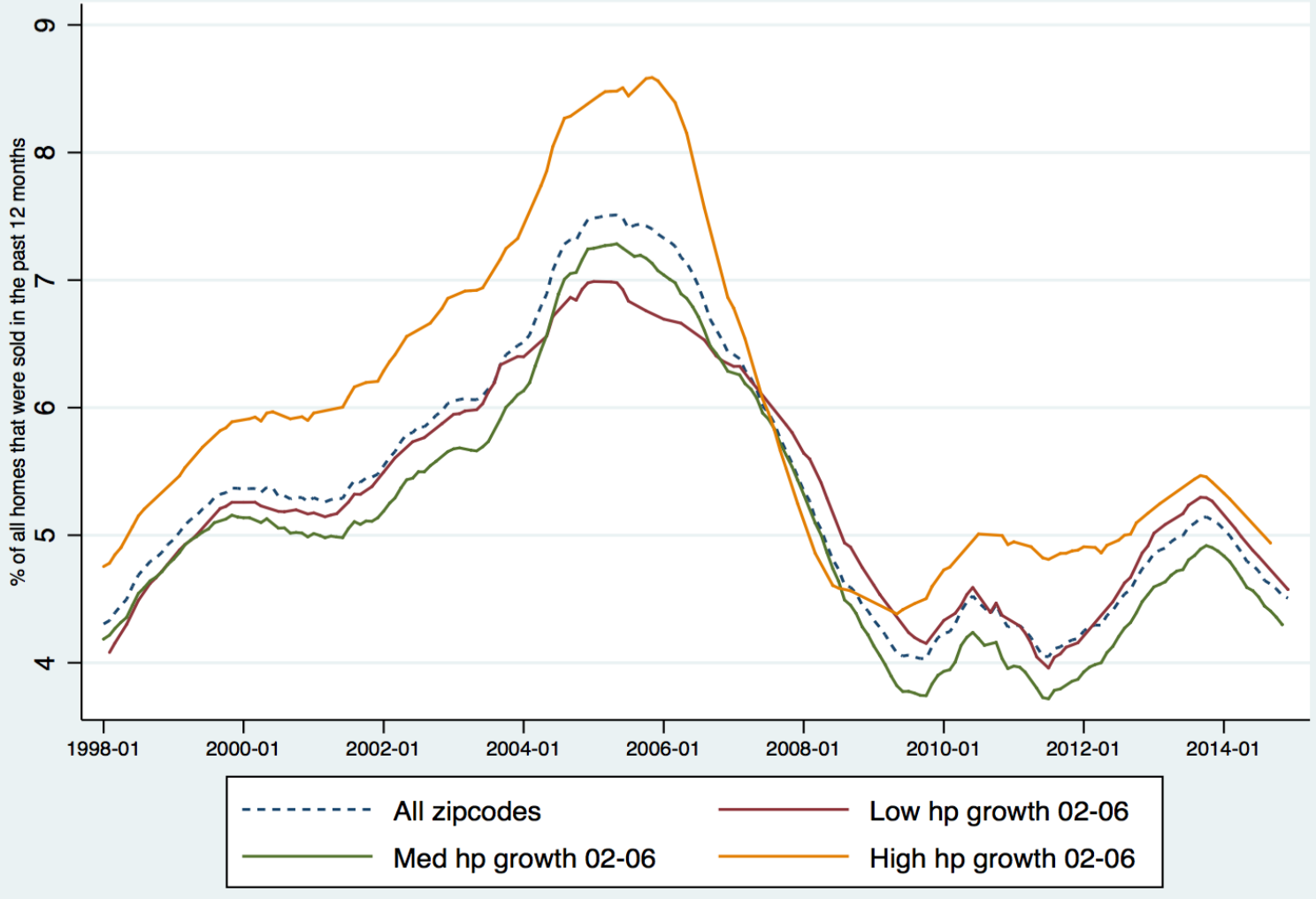
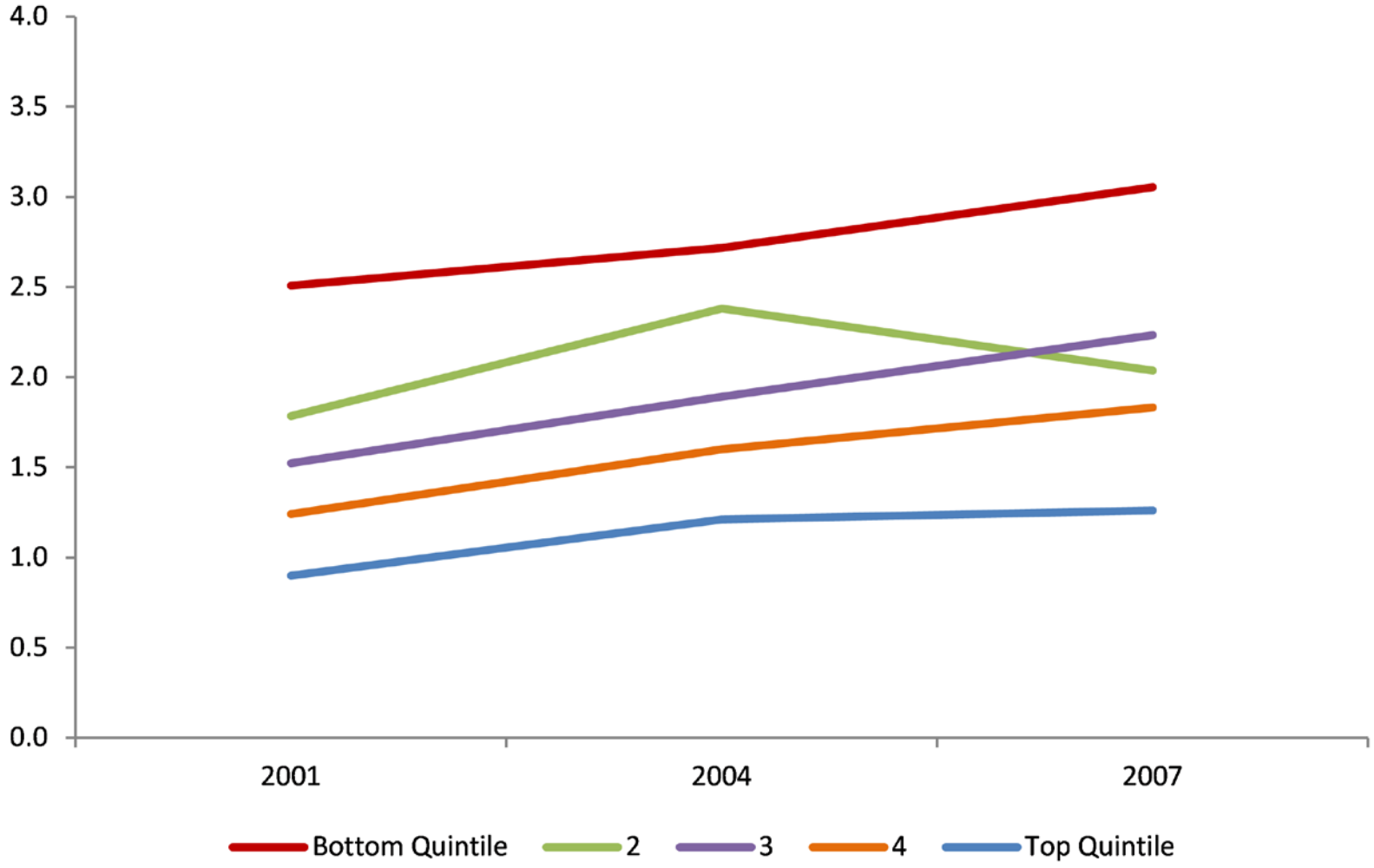
Purchase
Cash-out
Rate Refi
2nd Liens
Total
Bottom Quintile
2
3
4
Top Quintile

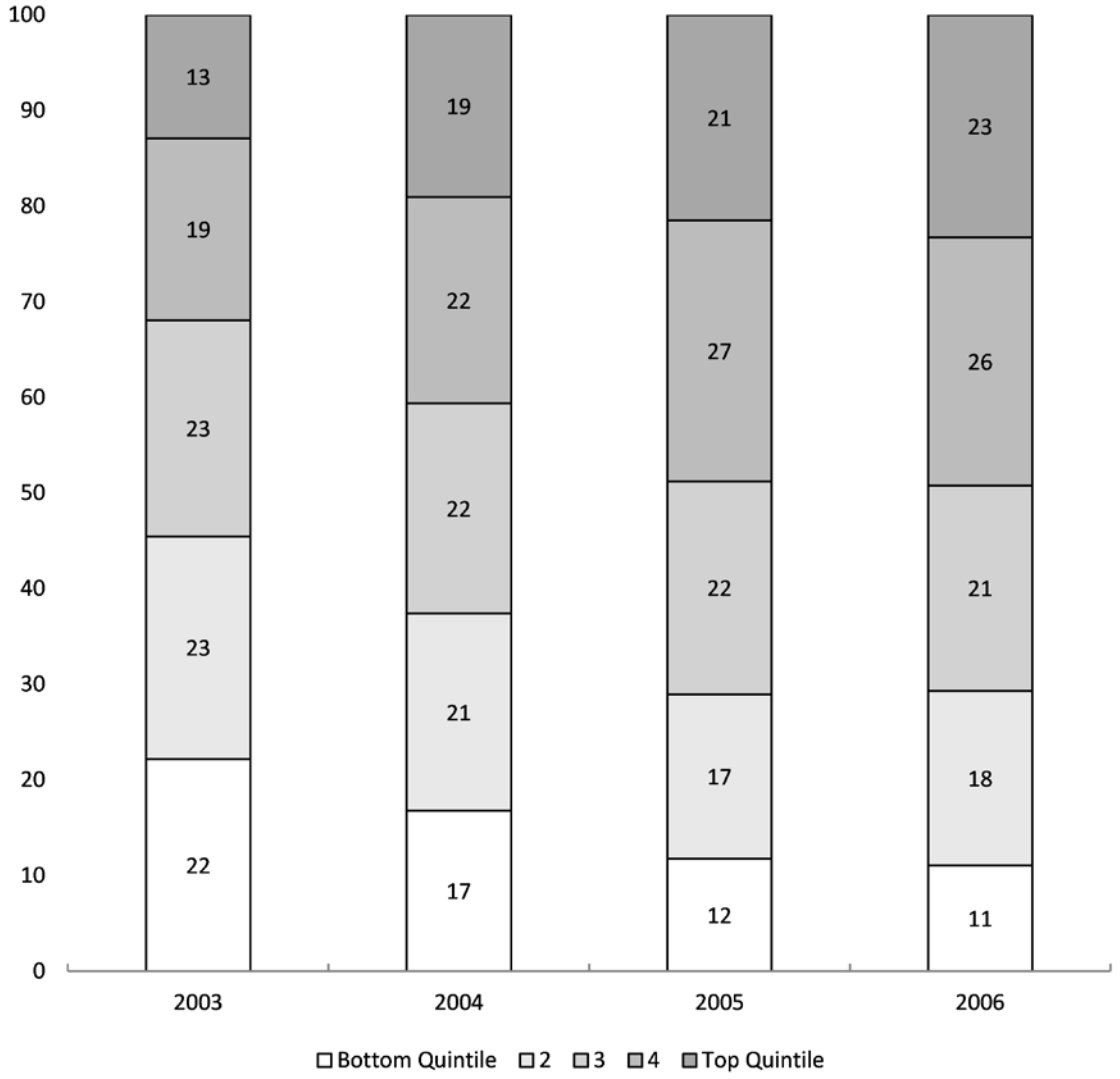
# How Did Household Leverage Build Up? Increased Speed of Home Sales



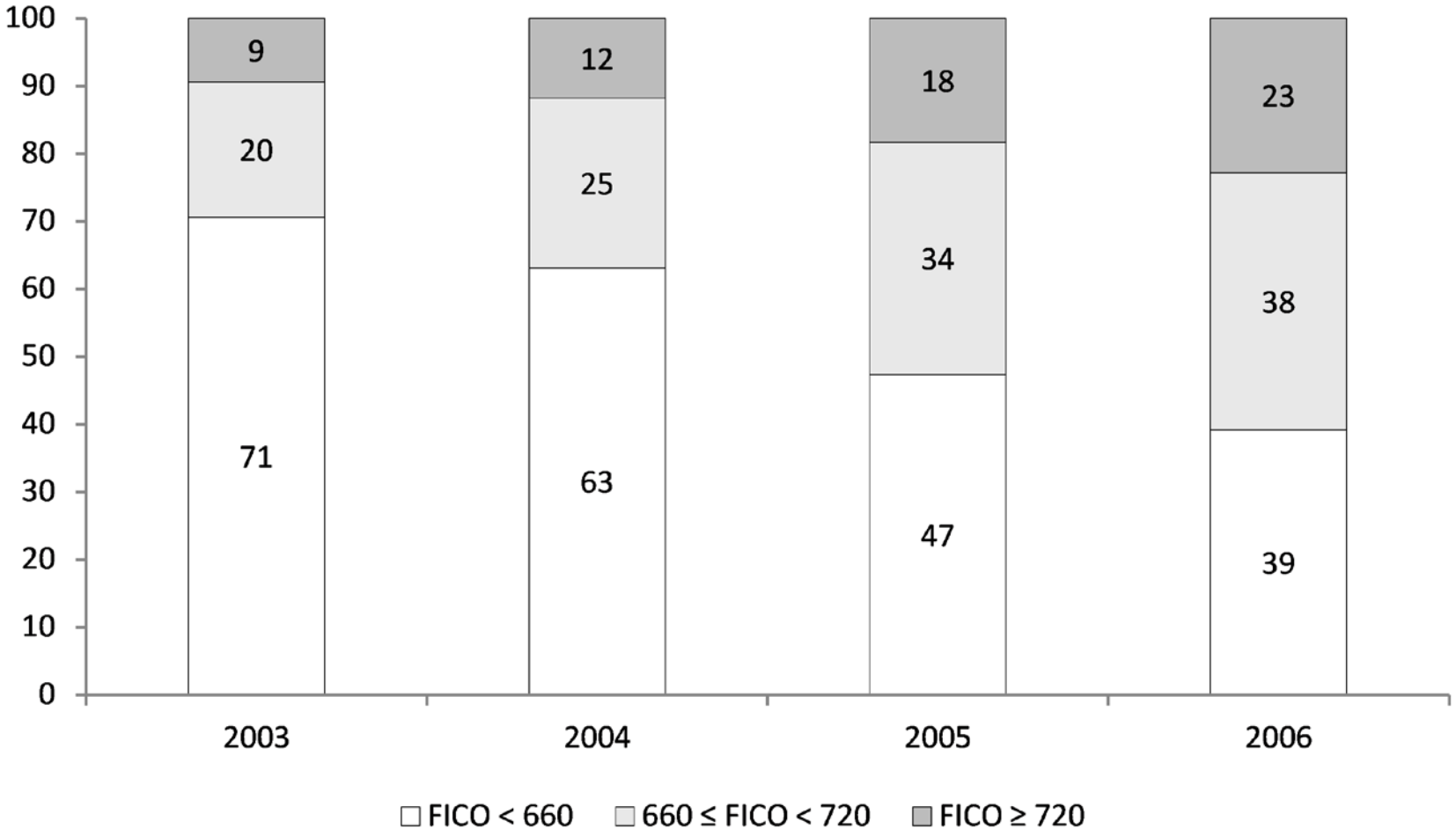
# Effect on the Stock of Household Mortgage Debt (SCF)



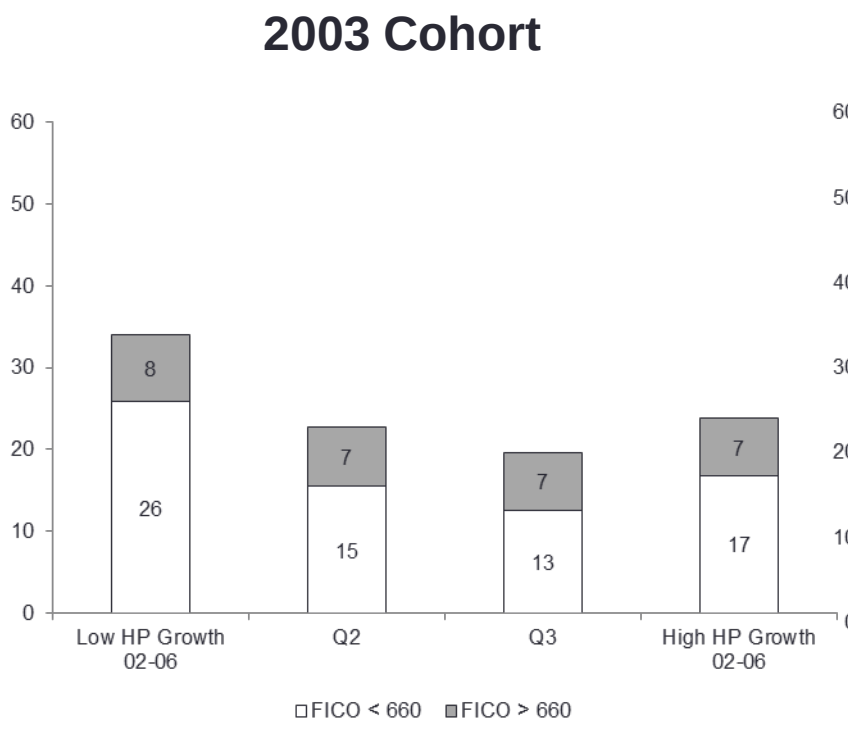
# Share of Delinquent Mortgage Debt 3 Years Out by Buyer Income (LPS) – Value Weighted

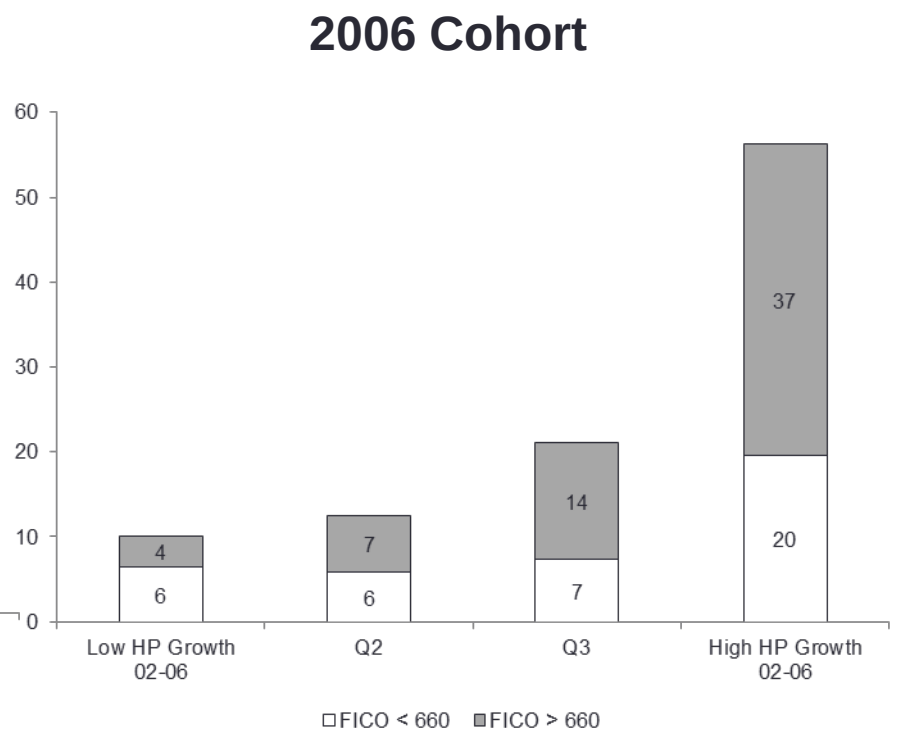


# Share of Delinquent Mortgages 3 Yrs Out by FICO and Cohort (LPS) –Value Weighted



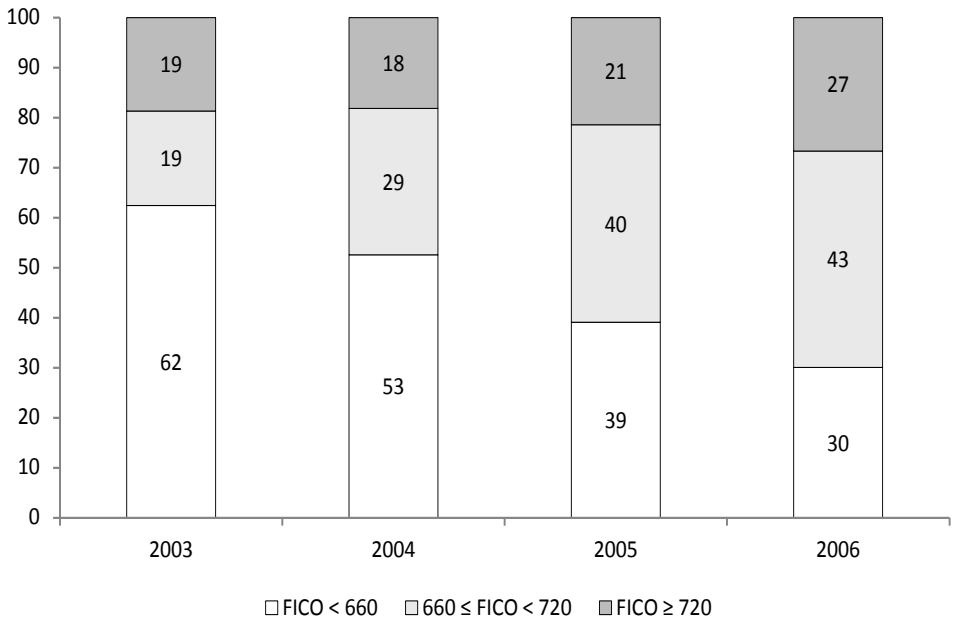
# Share of Delinquency 3 Years Out by HP Growth and FICO – Value Weighted



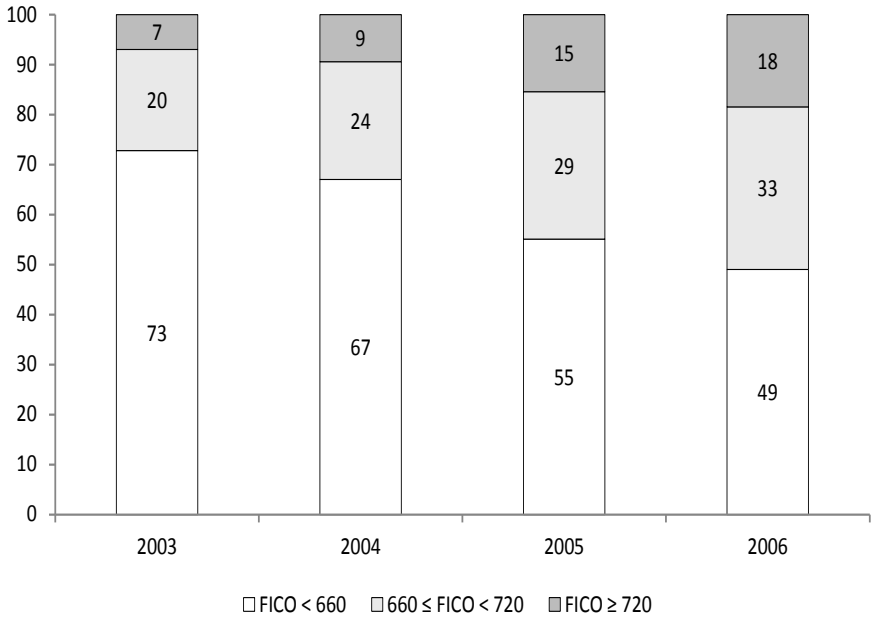



# Recourse vs. Non-Recourse States

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

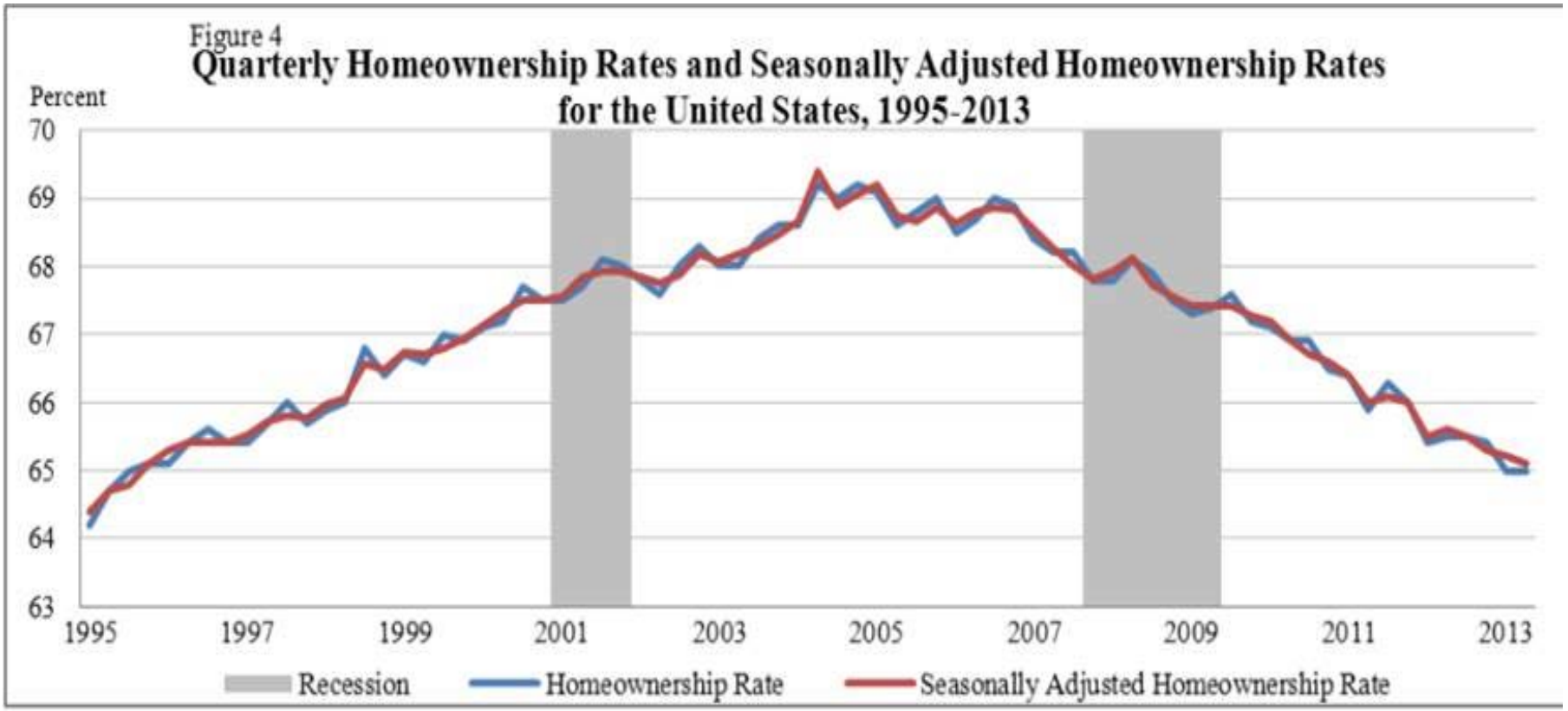
# Important Policy Implications

- 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

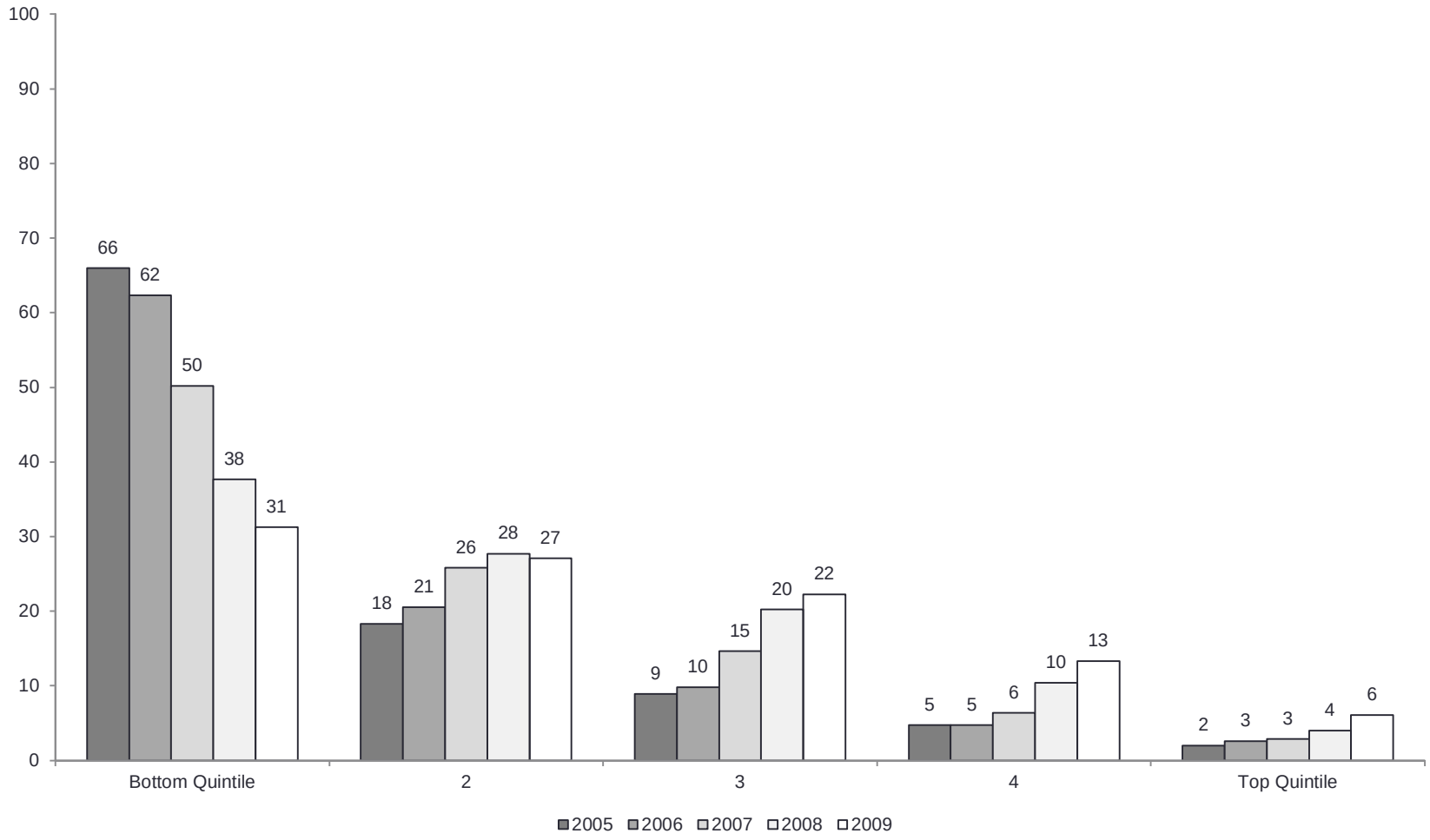
# No expansion of ownership for marginal borrowers

Homeownership Rate Goes up 1% from 2002-06

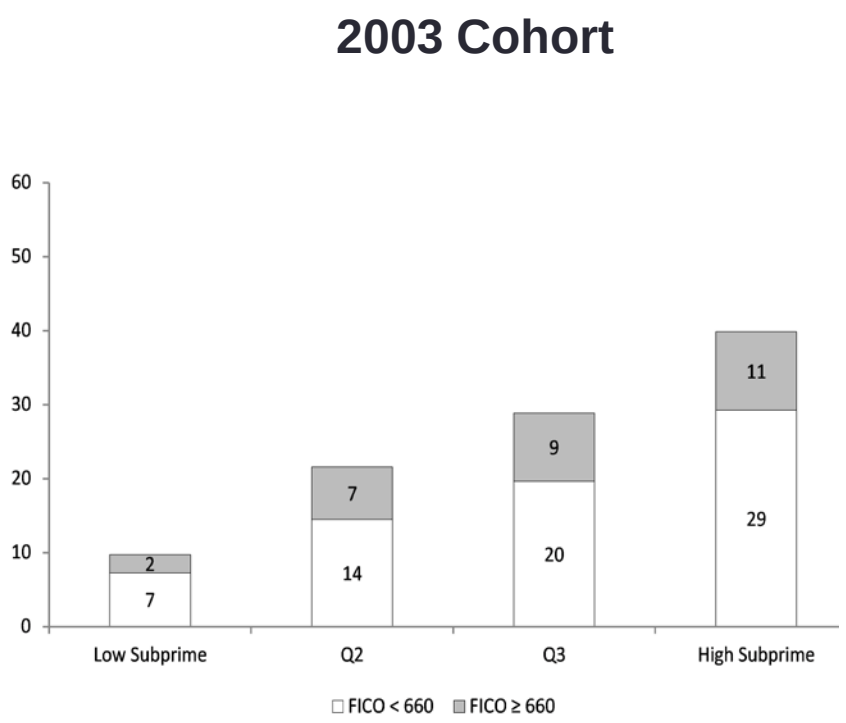


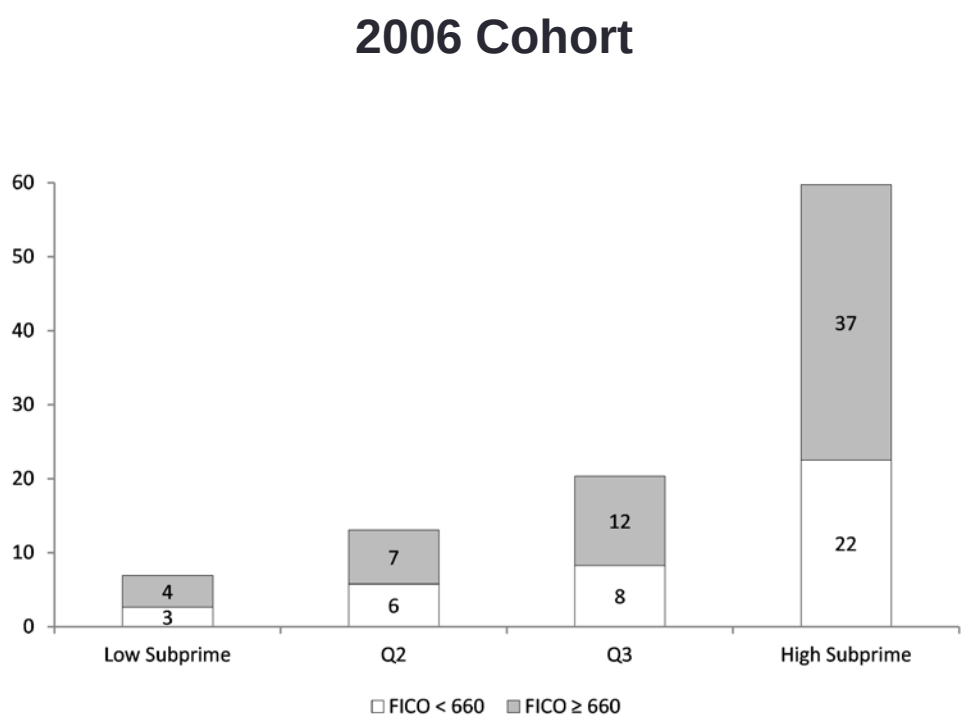

Current Population Survey/ Housing Vacancy Survey, 2014

# Delinquencies by FICO quintiles



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



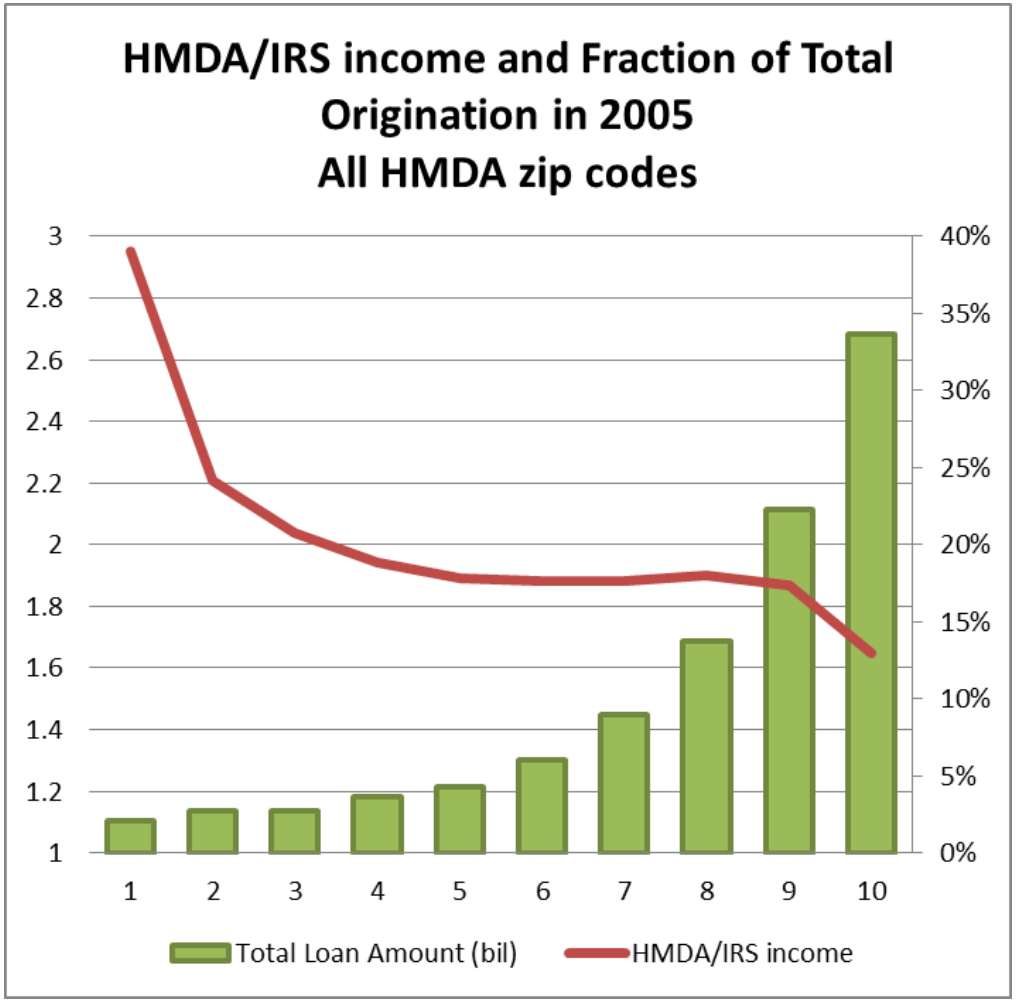
# Appendix I: Is Misreporting in HMDA Driving Results?

- 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

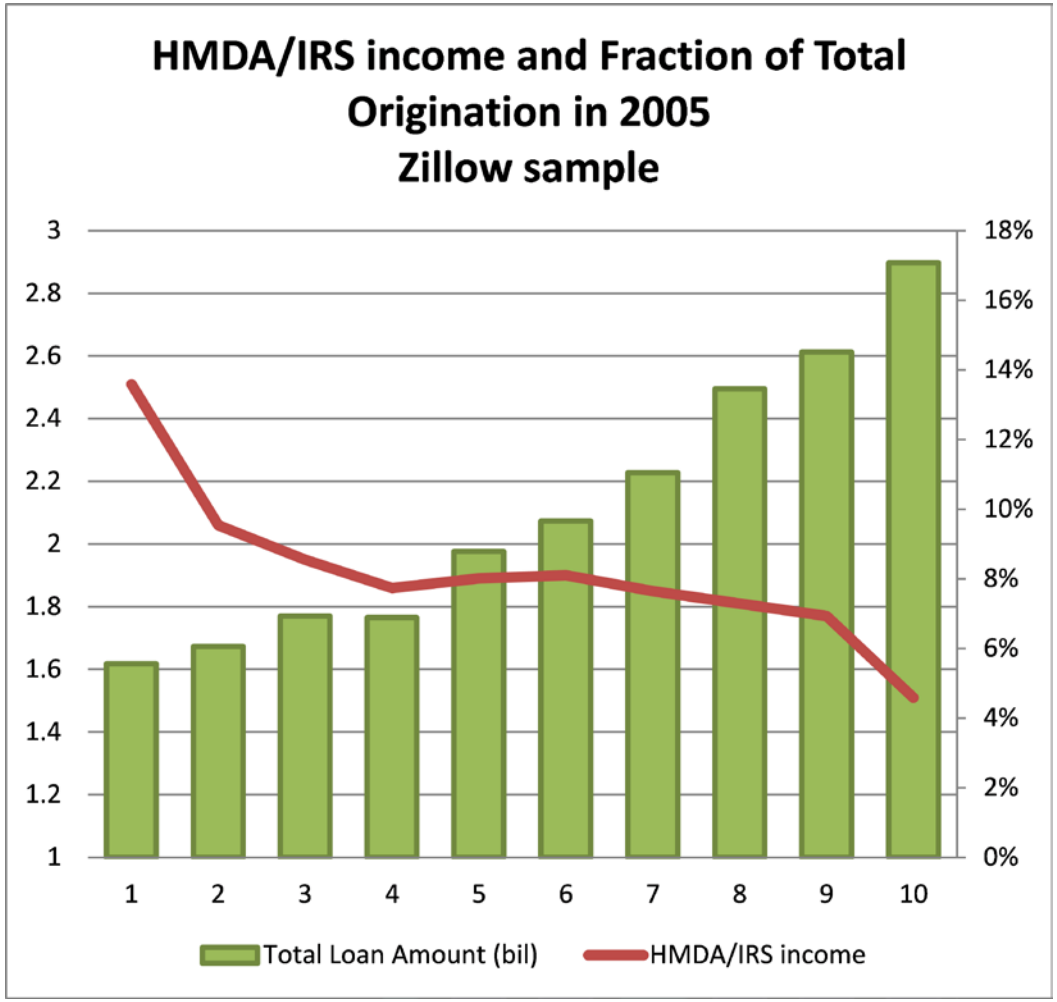
- Magnitudes are too large to explain composition changes
  - Best estimates range from 15% to 25%. See Jiang et al (2014)
  - Buyer income is twice the level of residents

- 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 |