Changes in Buyer Composition and the Expansion of Credit During the Boom

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Motivation

A common view of the mortgage crisis is that innovations in credit supply led to distortions in the allocation of credit, **especially to poorer households**

- Credit supply distortions in turn caused house prices to become inflated and crash once credit was not easily available

Evidence for credit supply-income distortion 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)

Preview of the Results

1. Credit expanded **throughout the income distribution, not just for the poor.**

- Middle/high income households had a much larger contribution to overall mortgage debt before the crisis.
- No evidence that debt increased disproportionately for poorer households

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2. The majority of credit in default (when focus on dollar values of defaults) during the crisis coming from:

  - **middle income households** (and zip codes)
  - **high FICO** score borrowers (even within subprime areas)

Consistent with a view were recent participation in the mortgage market implies a larger fraction of households close to their maximum capacity when prices dropped

Previous of the Results II

3. Focus on **households (not zip codes)** as unit of analysis when looking at relationship between mortgage and income growth

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mortgage debt at zip code: number of loans * individual mortgage size

- individual mortgage size: (+) correlated with growth in income per capita (no matter which income measure we use)
- number of loans: (-) correlated with growth in income per capita.

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- individual mortgage size: (+) correlated with growth in income per capita (no matter which income measure we use)
- number of loans: (-) correlated with growth in income per capita.

No evidence of distortion in the allocation of credit with respect to income

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

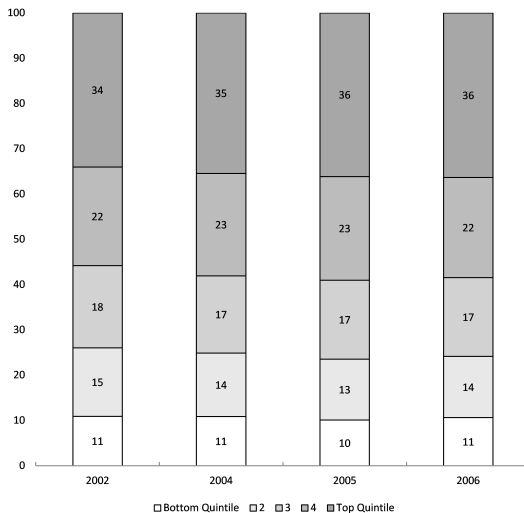IRS income at the zip code level.

House prices from Zillow.

Demographic characteristics from Census.

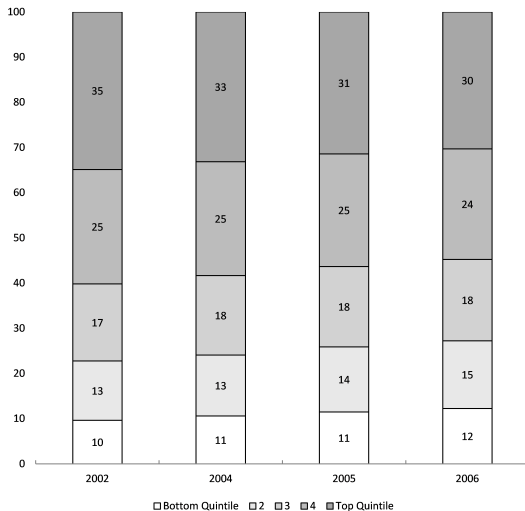Mortgage size and performance from LPS: 5% random sample

Aggregate mortgage origination by borrower income (HMDA) stayed stable

Bottom Quintile 2 3 4 Top Quintile

Aggregate mortgage origination by per capita income (IRS) stayed stable

Other Housing Debt: Distribution of credit in 2006 (LPS)
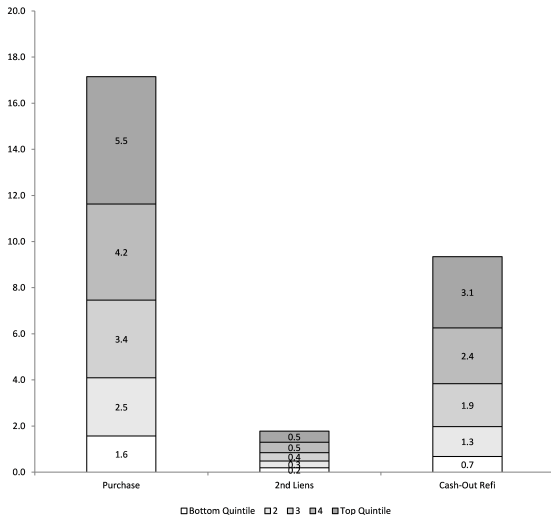
Dollar value of delinquent mortgage debt by borrower income (LPS)

Bottom Quintile 2 3 4 Top Quintile
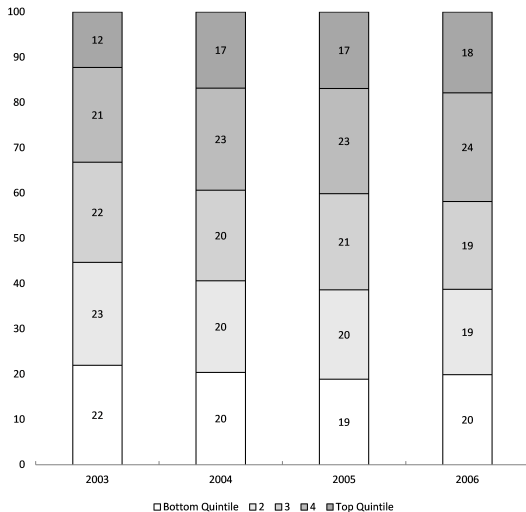
Delinquent mortgages by FICO and origination year
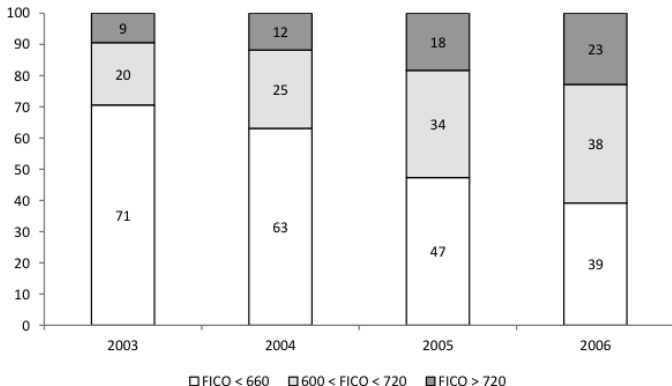
Fractions based on value of delinquent mortgage dollars three years after origination

Delinquent mortgages by FICO... within subprime-prime areas (LPS)
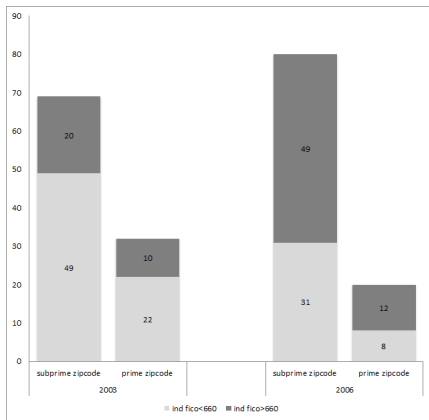
Fractions based on value of delinquent mortgage dollars three years after origination

Credit and income

Previous results rely on zip code level analysis:

$$g_{2006-2002}(Mortgage_i) = \beta_{inc} g_{2006-2002}(Income_i) + FE_{county} + \varepsilon_i$$

Decompose total mortgage origination into

- growth in individual mortgage size
- number of mortgages in a zip code

Per capita income growth with IRS data combines residents and home buyer income

- when composition of buyer is changing, IRS data is 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

How to put all this together?

Novel explanation of observed credit expansion due to system wide increase of leverage, **not just the poor.**

- Credit allocation did not "decouple" across income distribution
- Homebuyers (and lenders) at all levels of the income distribution bought into the house price bubble
- Number of mortgages grew more in poorer zip codes, mortgage sizes grew more where house prices increased most rapidly

How to put all this together?

Consistent with a view that systemic build up in leverage led to defaults once the economy slowed down, defaults increased most in:

- Middle/high income groups
- High FICO borrowers (even within subprime areas)

Recent mortgage market participation implies a large fraction of households were close to maximum capacity when prices dropped.

Important macro-prudential implications to avoid excesive leverage in the economy

Thank you!

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 observation	8,597	8,605	8,619	8,550
R2	0.46	0.58	0.73	0.64

Subprime and House Prices Summary Statistics

Distribution of zip codes

	Low HP growth	2	3	High HP growth
Low subprime	533	651	646	340
2	638	612	522	396
3	583	602	483	484
High subprime	435	351	539	800

Growth in total lending

	Low HP growth	2	3	High HP growth
Low subprime	7.1%	11.3%	10.1%	15.0%
2	7.5%	11.0%	12.1%	15.2%
3	7.2%	12.1%	13.2%	17.9%
High subprime	8.1%	13.6%	15.9%	18.2%

Subprime and House Prices Summary Statistics

Growth in applicant income

	Low HP growth	2	3	High HP growth
Low subprime	3.7%	5.0%	7.2%	9.9%
2	3.2%	5.1%	7.4%	9.7%
3	3.0%	4.8%	6.9%	10.5%
High subprime	2.8%	5.1%	8.2%	11.9%

Fraction of loans by subprime originators

	Low HP growth	2	3	High HP growth
Low subprime	3.8%	3.8%	3.8%	4.3%
2	8.0%	8.1%	8.1%	8.0%
3	12.6%	12.4%	12.6%	12.7%
High subprime	22.8%	22.1%	23.3%	26.1%

Mortgage Origination Volume
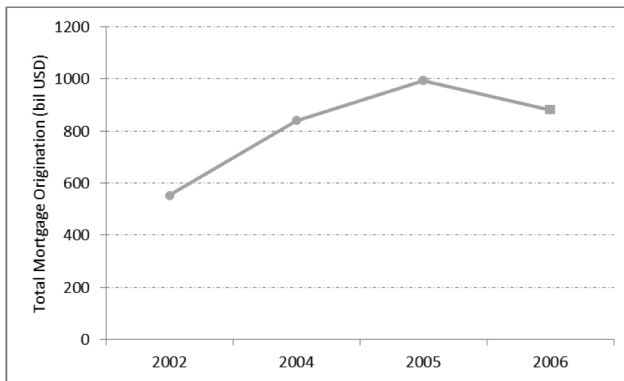
Debt to Income per Income Decile

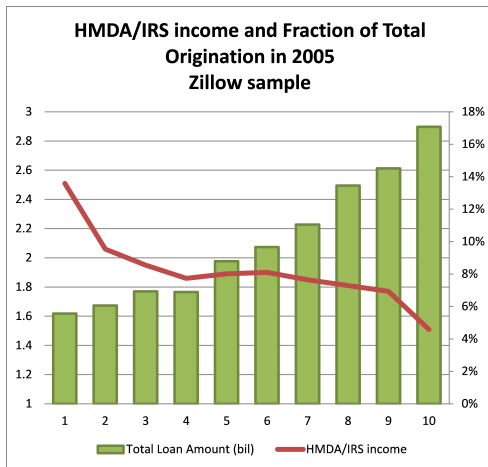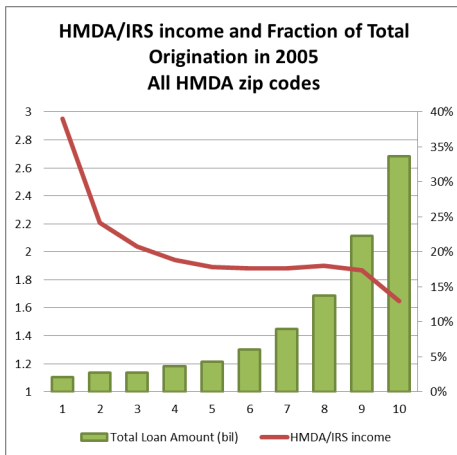| Year	Applicant Income Decile									
	1	2	3	4	5	6	7	8	9	10
2002	3.06	2.42	2.23	2.09	1.97	1.87	1.80	1.71	1.63	1.38
	6.17	1.16	1.09	1.03	0.98	0.93	0.90	0.88	0.87	0.87
2004	3.32	2.76	2.60	2.47	2.36	2.26	2.15	2.05	1.92	1.58
	5.17	1.37	1.32	1.28	1.25	1.21	1.17	1.14	1.10	1.06
2005	3.34	2.87	2.71	2.59	2.48	2.40	2.31	2.21	2.07	1.72
	6.59	1.45	1.42	1.39	1.37	1.34	1.31	1.27	1.22	1.15
2006	3.60	2.71	2.54	2.41	2.31	2.23	2.15	2.05	1.93	1.58
	13.47	1.47	1.44	1.40	1.38	1.36	1.34	1.30	1.23	1.12

Mortgage regression at transaction level

$$ln(mortgage_{kt}) =$$
$$\beta_{inc}\,ln(income_{kt}) + \beta_{zipinc}\,ln(zipinc_{it}) + FE_{year} + FE_{county} + \varepsilon_{kt}$$

	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

Loan Origination and MS 2015 Measure of Overstatement (Zillow Sample)

HMDA/IRS income and Fraction of Total Origination in 2005 Zillow sample

Legend: Total Loan Amount (bil) — HMDA/IRS income

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

Heterogeneity: House Price Growth

	Growth in total mortgage origination			Growth in average mortgage size			Growth in number of mortgages originated		
	High	Med	Low	High	Med	Low	High	Med	Low
IRS income growth	-0.370*	-0.339***	0.213	0.221***	0.198***	0.232***	-0.564***	-0.512***	-0.037
	(0.193)	(0.106)	(0.161)	(0.035)	(0.030)	(0.048)	(0.165)	(0.097)	(0.143)
Buyer income growth	0.449***	0.422***	0.185**	0.249***	0.331***	0.210***	0.210***	0.127**	0.024
	(0.089)	(0.069)	(0.088)	(0.031)	(0.018)	(0.027)	(0.076)	(0.063)	(0.069)
County FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Number of observations	2,020	4,407	2,192	2,020	4,407	2,192	2,020	4,407	2,192
R2	0.03	0.03	0.01	0.20	0.24	0.13	0.02	0.02	0.00

Heterogeneity: Per capita income in 2002

	Growth in total mortgage origination			Growth in average mortgage size			Growth in number of mortgages originated		
	High	Med	Low	High	Med	Low	High	Med	Low
IRS income growth	-0.239*	0.160	0.163	0.173***	0.206***	0.229***	-0.410***	-0.051	-0.114
	(0.125)	(0.120)	(0.223)	(0.028)	(0.030)	(0.059)	(0.109)	(0.108)	(0.193)
Buyer income growth	0.309***	0.282***	0.575***	0.344***	0.253***	0.234***	0.024	0.068	0.324***
	(0.086)	(0.072)	(0.084)	(0.031)	(0.018)	(0.028)	(0.081)	(0.061)	(0.066)
County FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Number of observations	2,088	4,346	2,185	2,088	4,346	2,185	2,088	4,346	2,185
R2	0.02	0.01	0.05	0.30	0.19	0.12	0.01	0.00	0.02

No County Fixed Effect

	Growth in		
	Total Mortgage Origination	Average Mortgage Size	Number of Mortgage
IRS income growth	0.368***	0.587***	-0.218**
	(0.109)	(0.038)	(0.091)
County FE	N	N	N
Number of observations	8,619	8,619	8,619
R2	0.00	0.09	0.00

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

Robustness

- Sensitivity is similar across different time periods
- Mortgage size grew more in places where house prices increases most rapidly.
- Composition effect stronger in high income areas, suggest income grew more than need for mortgage in those areas.

Is Misreporting on HMDA data driving the results? MS 2015 Critique

1. Results hold when using IRS data

   - Central insight is that intensive and extensive margin behaved differently across the boom period

2. Sensitivity of mortgage growth to buyer income robust to:

   - drop "overstated" zip codes''
   - comparison between prime/subprime lenders or GSE/non-GSE loans

Drop Zip codes based on "Overstatement" (Av. Mortgage)

	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

Drop Zip codes based on "Overstatement" (Total Mortgage)

	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

Test of Subsamples

|	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

How to reconcile it with previous results? (income and FICO)

Income is not the same than FICO scores.

Origination by income quintile and FICO score in 2006 (LPS)
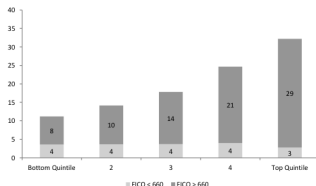
Mortgage origination by FICO and origination year
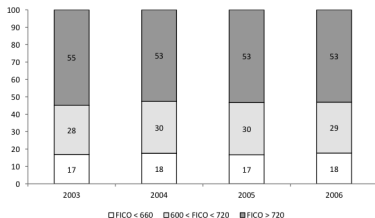
Fractions base on value of mortgage dollars three years after origination