Revisiting Subprime Lending: Cross-Sectional Patterns of Mortgage Debt During the Housing Boom

Christopher Foote, Lara Loewenstein, and Paul Willen

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FEDERAL RESERVE BANK OF BOSTON™

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  - **Distorted beliefs/over-optimism:**

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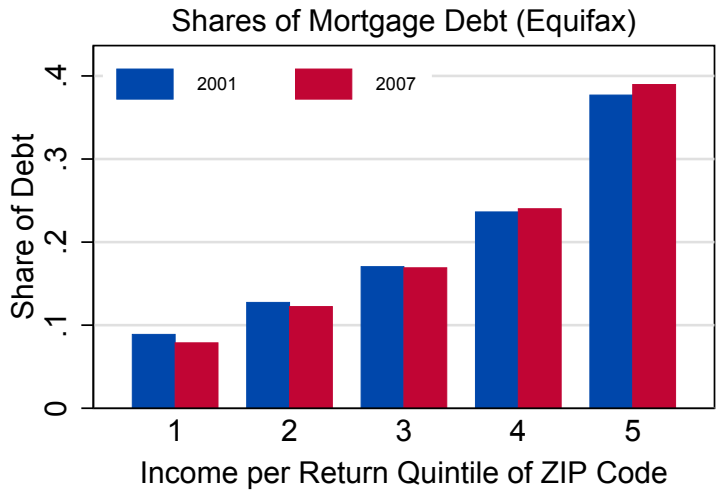
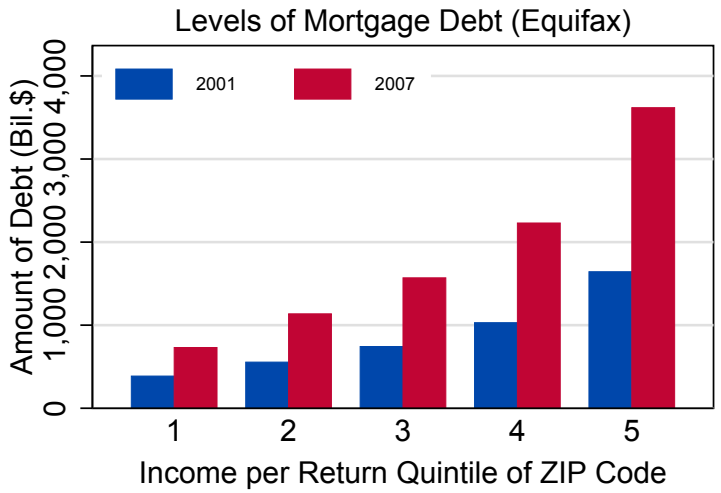
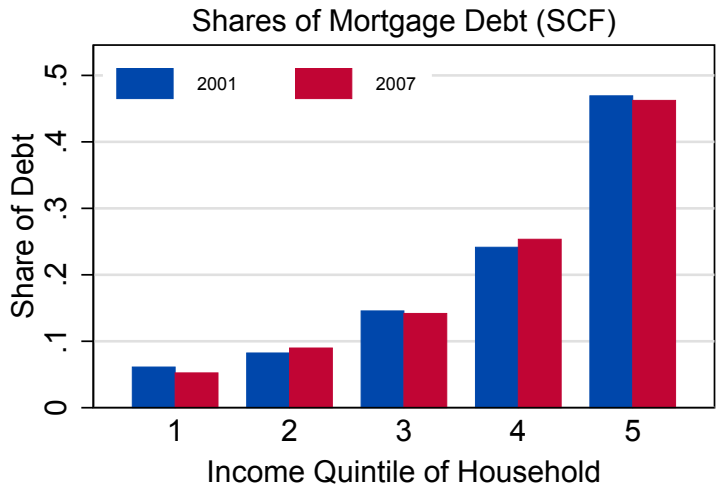
   - Subprime did not cause a reallocation of debt.
   - It prevented one.

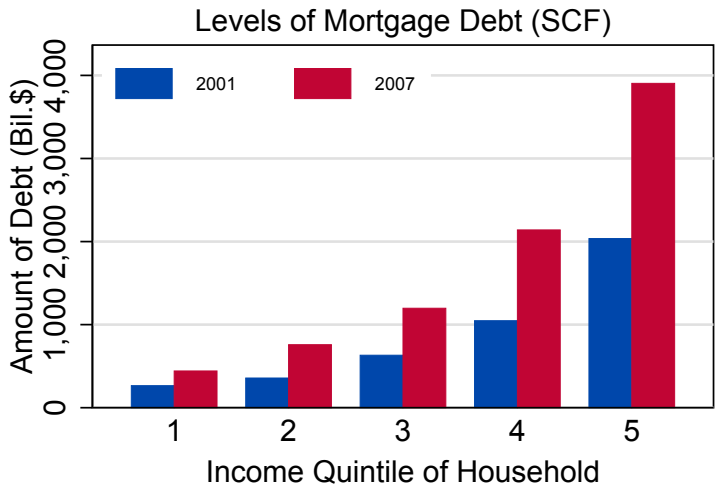
Distribution of Mortgage Debt

Sources: NY Fed Consumer Credit Panel/Equifax, IRS, and SCF.









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   - HMDA data is a good measure of one gross flow (originations)...
   - ... but HMDA measures neither the other gross flow (terminations) nor the stock of debt.
   - Stocks/flows distinction is crucial for understanding the debate between Mian and Sufi (2009) and Adelino, Schoar and Severino (2015).

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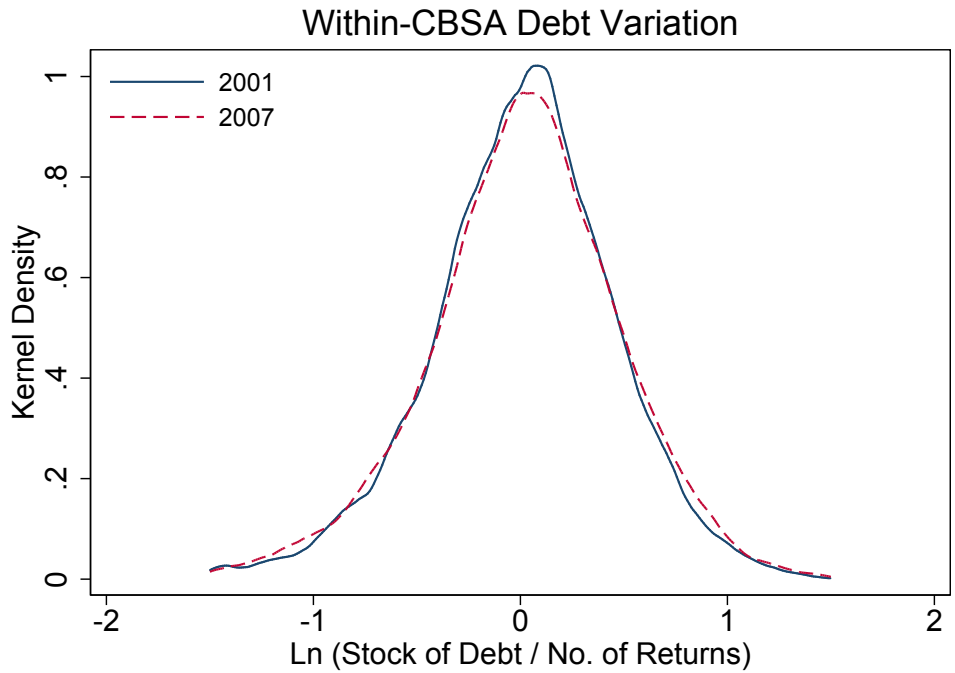
   - Distribution of ZIP-level debt on within-CBSA basis:



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    - The number of returns in 2007 increased sharply, especially in low income areas, due to the availability of a stimulus payment.

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  - Relatively small samples (about 3,000 to 6,500 households per survey).

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   - We need to estimate β_1 in each year to rule out this possibility.

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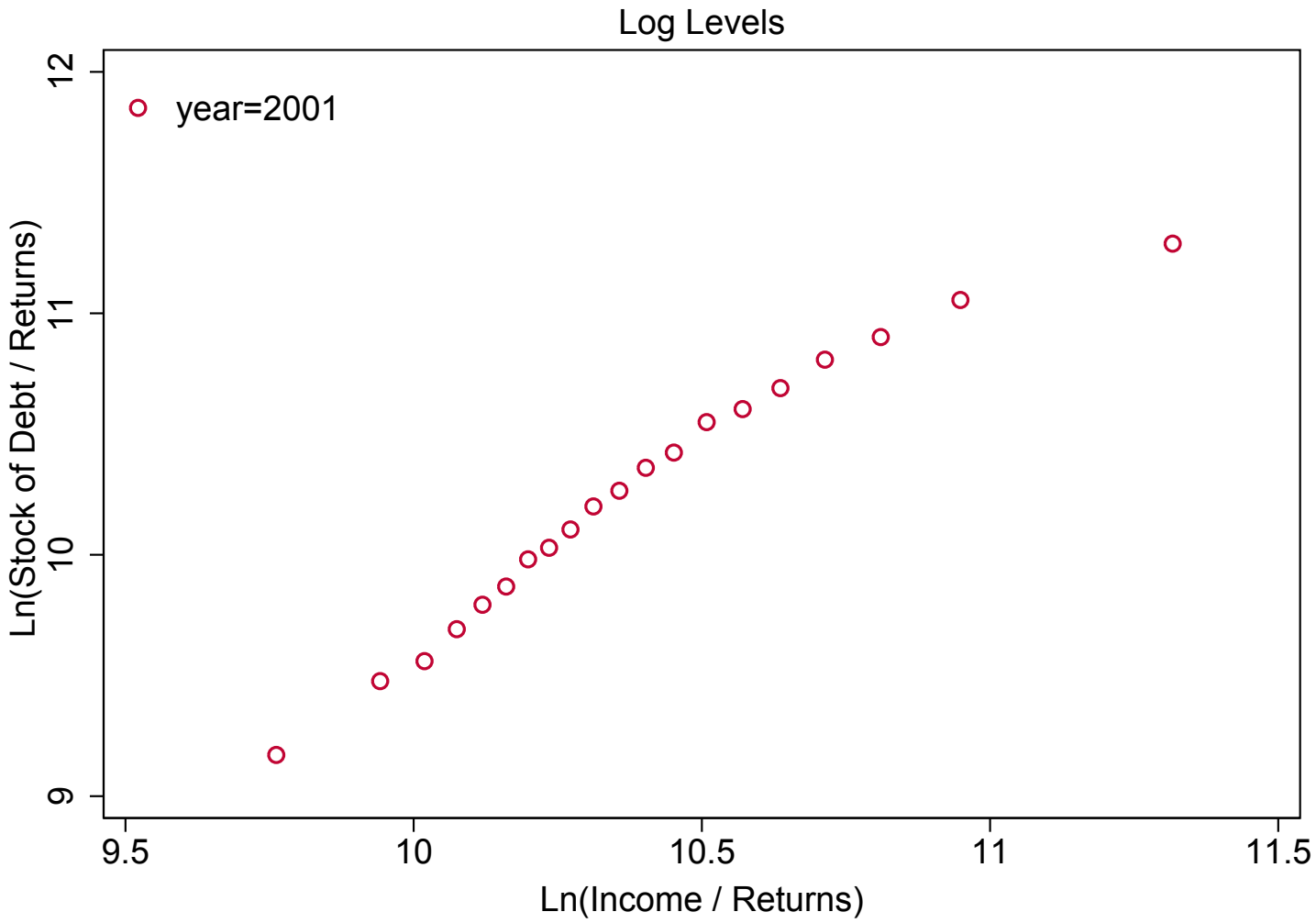

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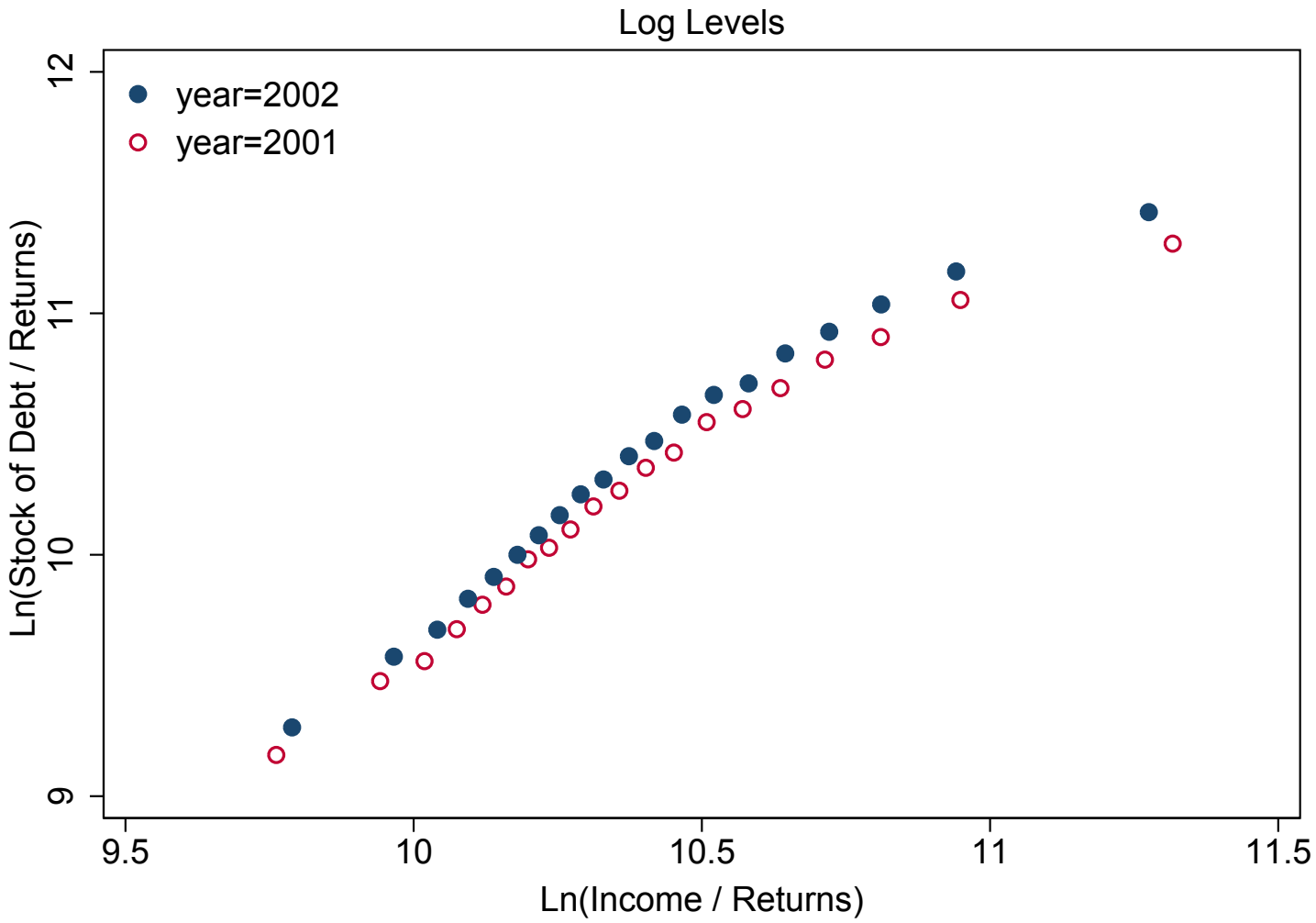

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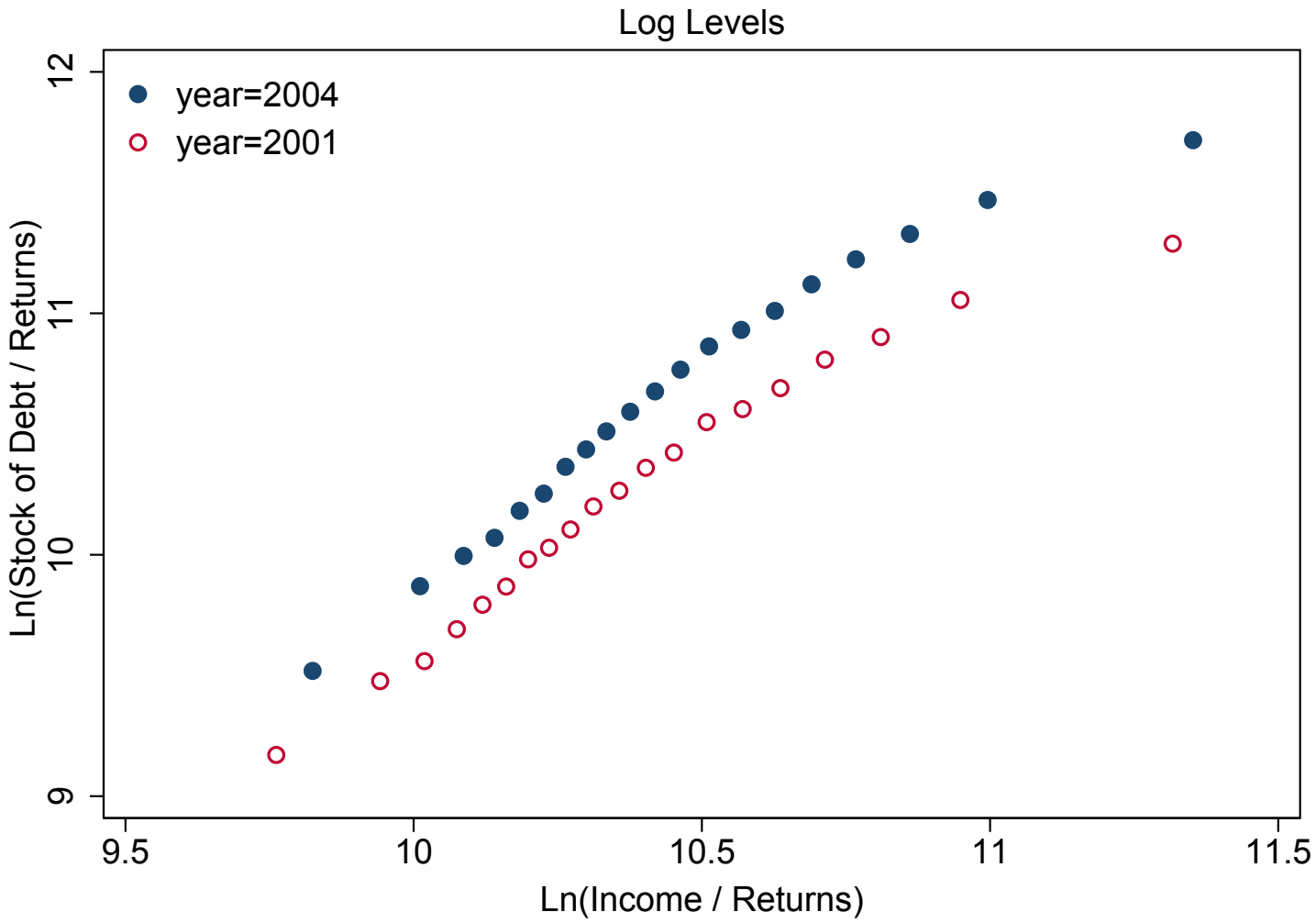

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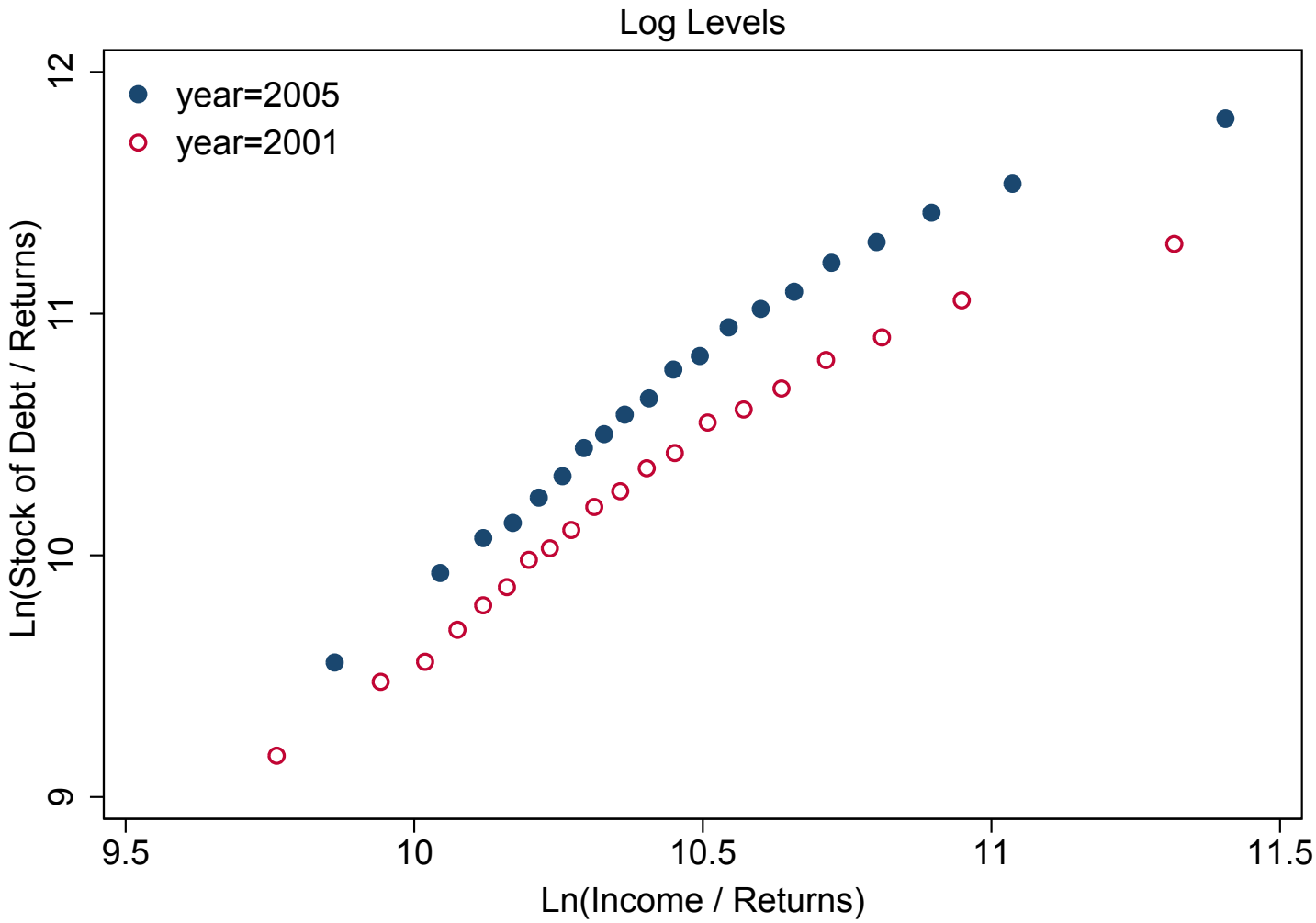

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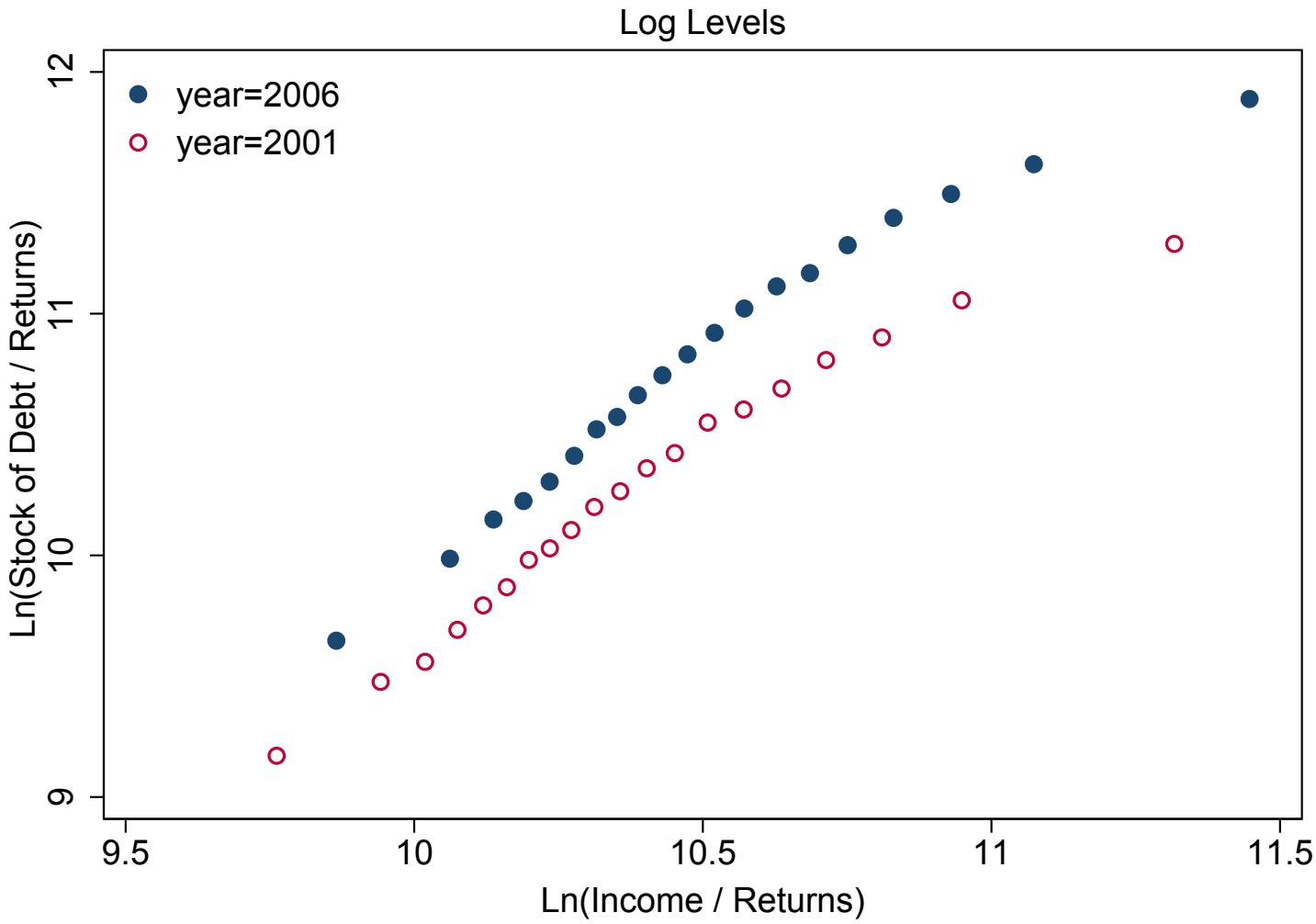

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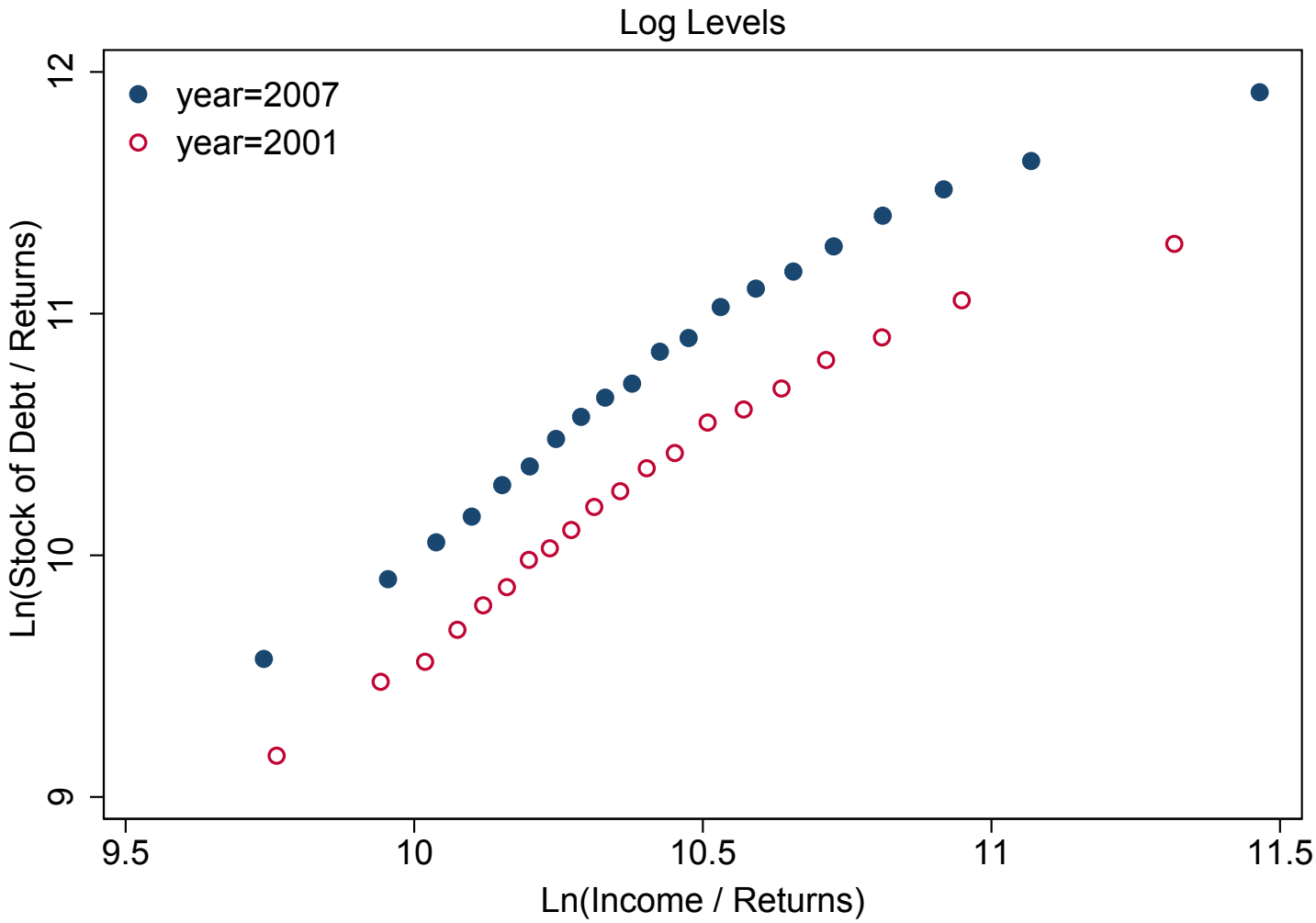

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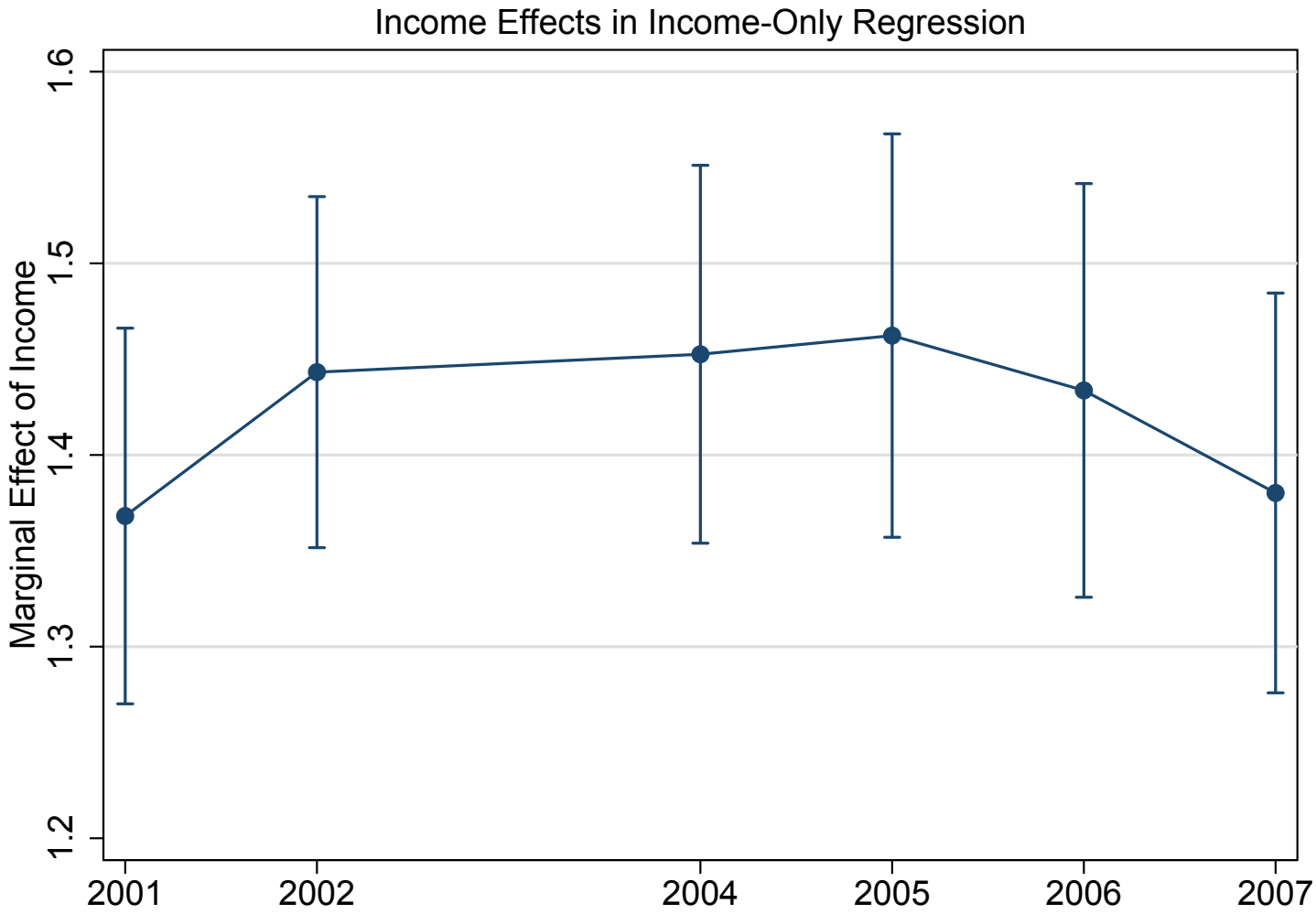

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  - Why did debt rise more in Phoenix than in Wichita?

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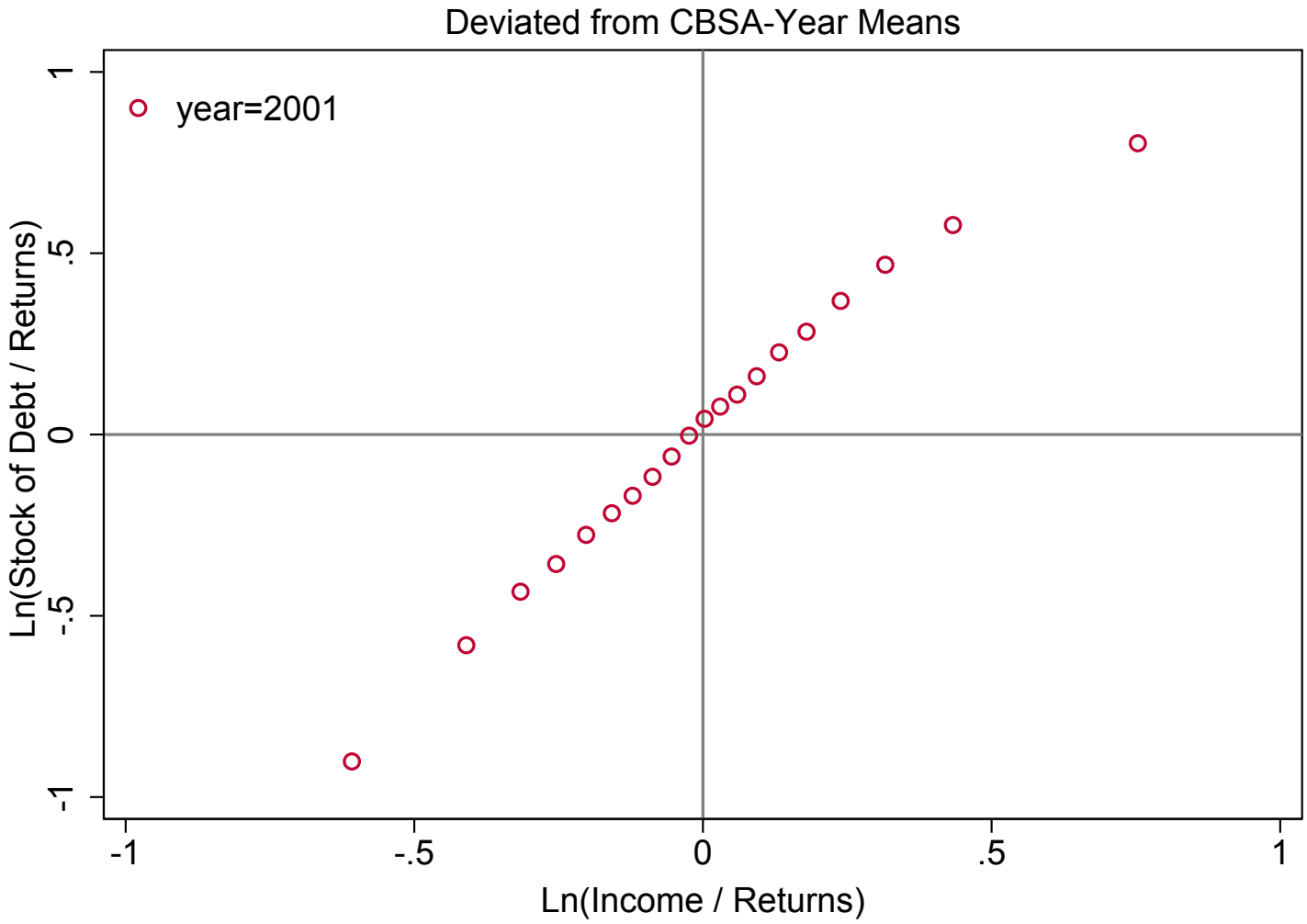

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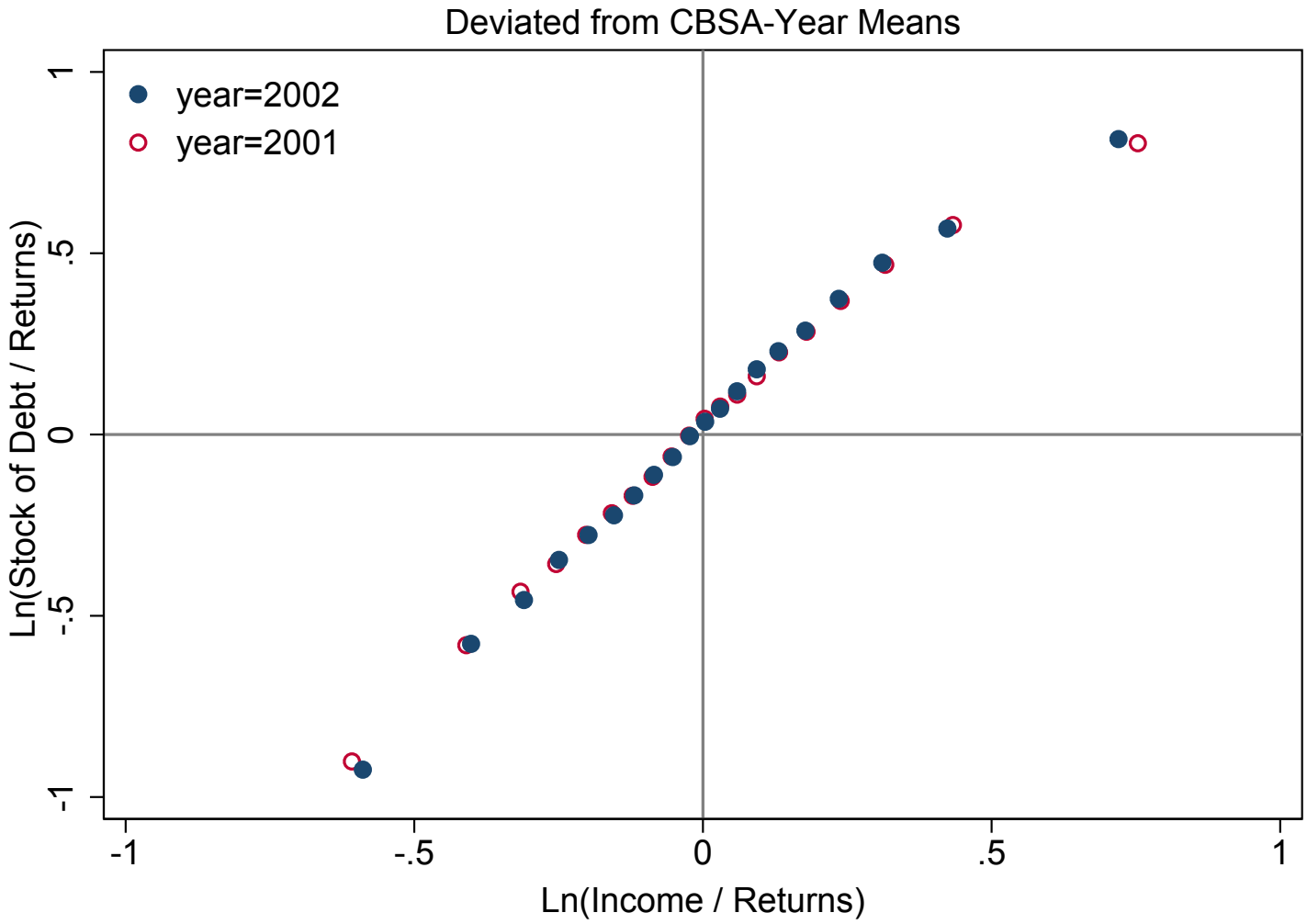

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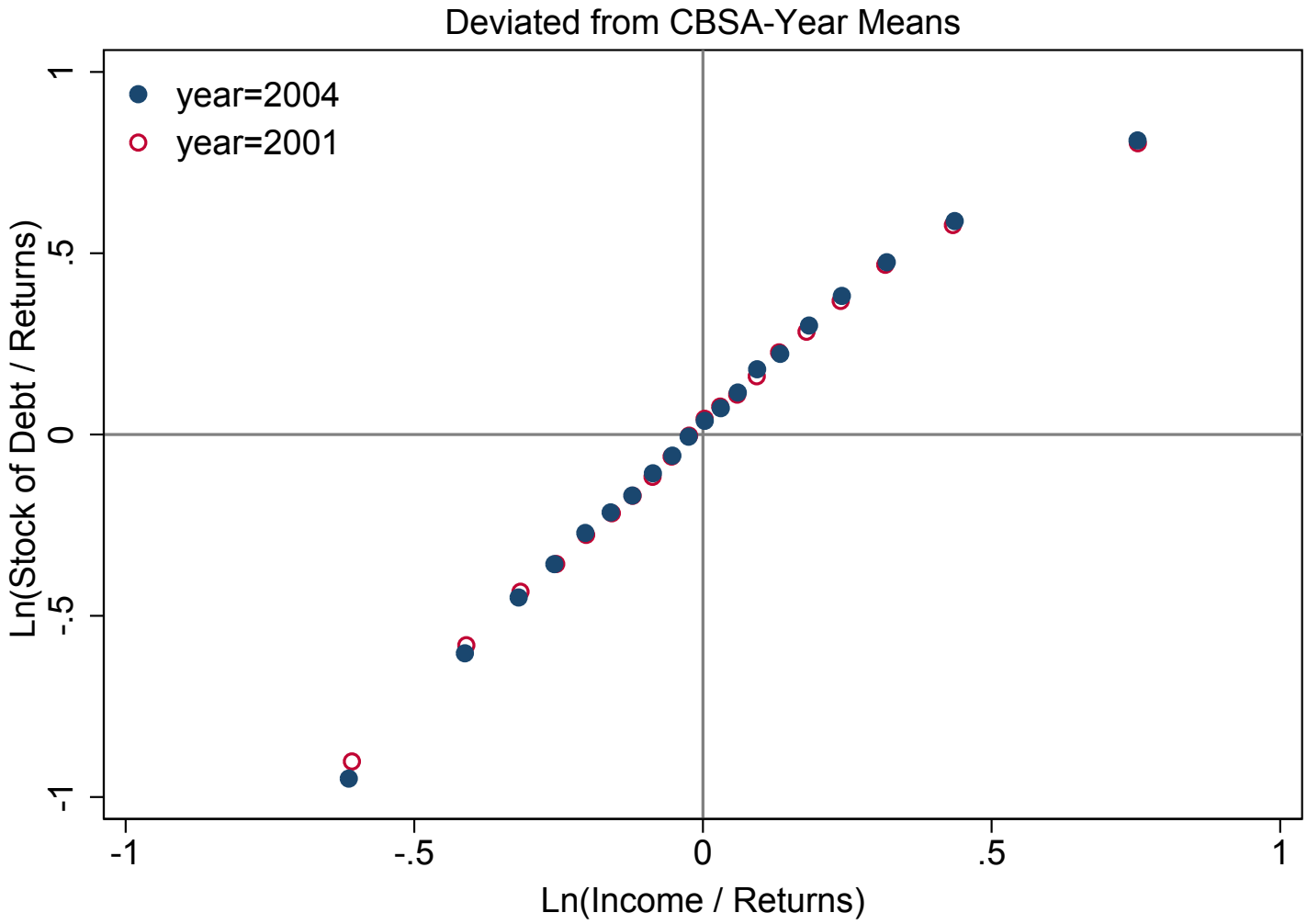

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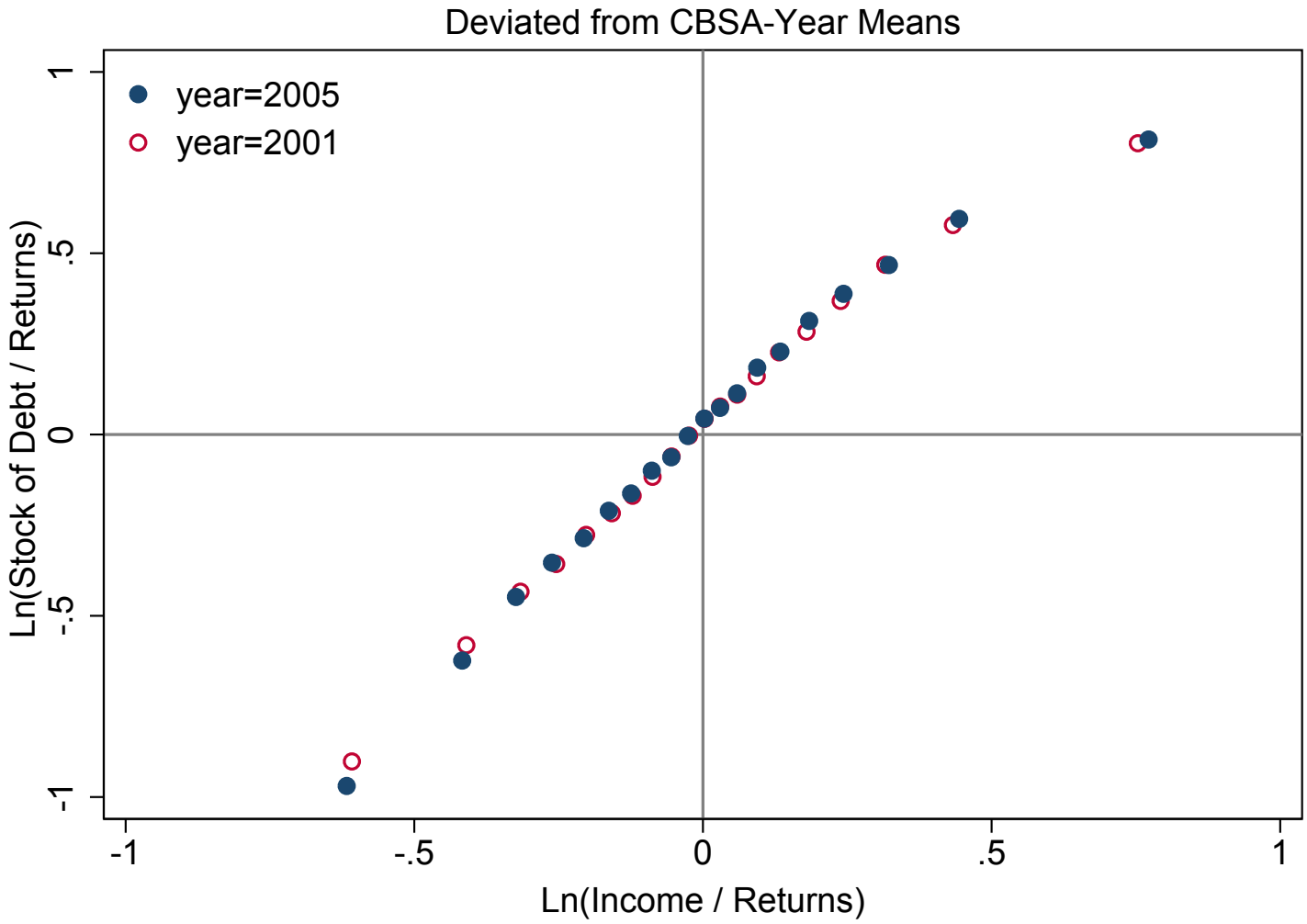

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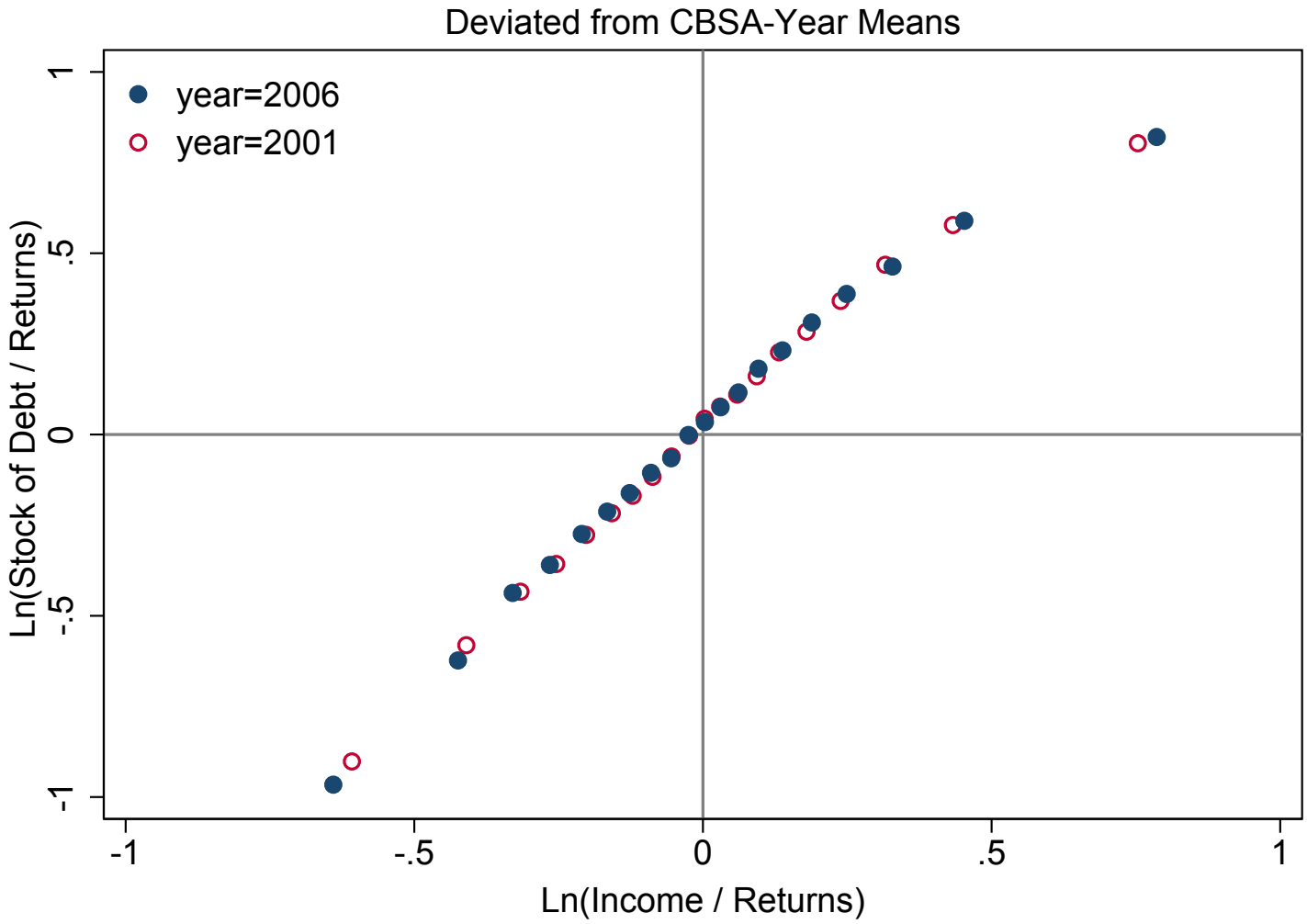

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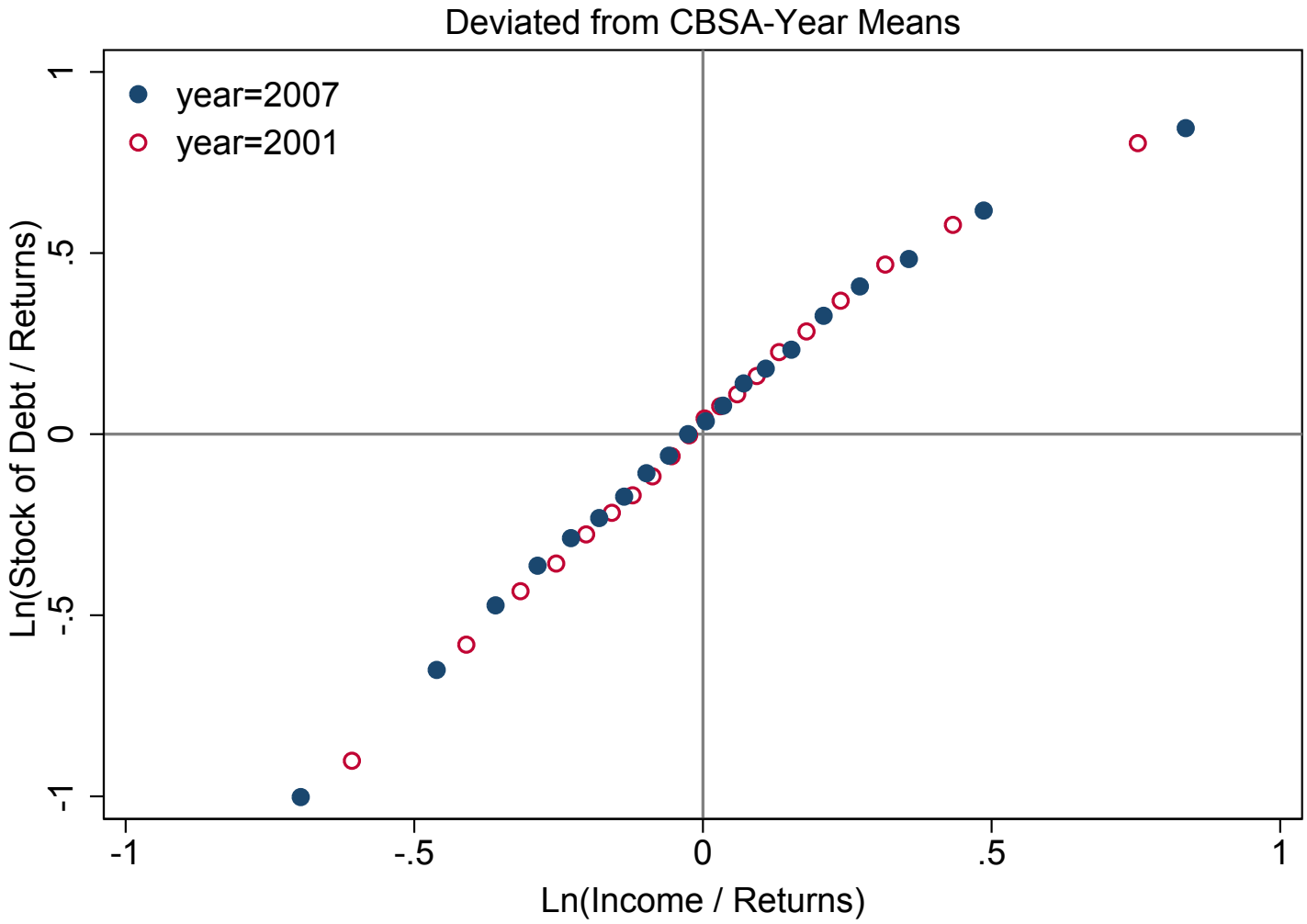

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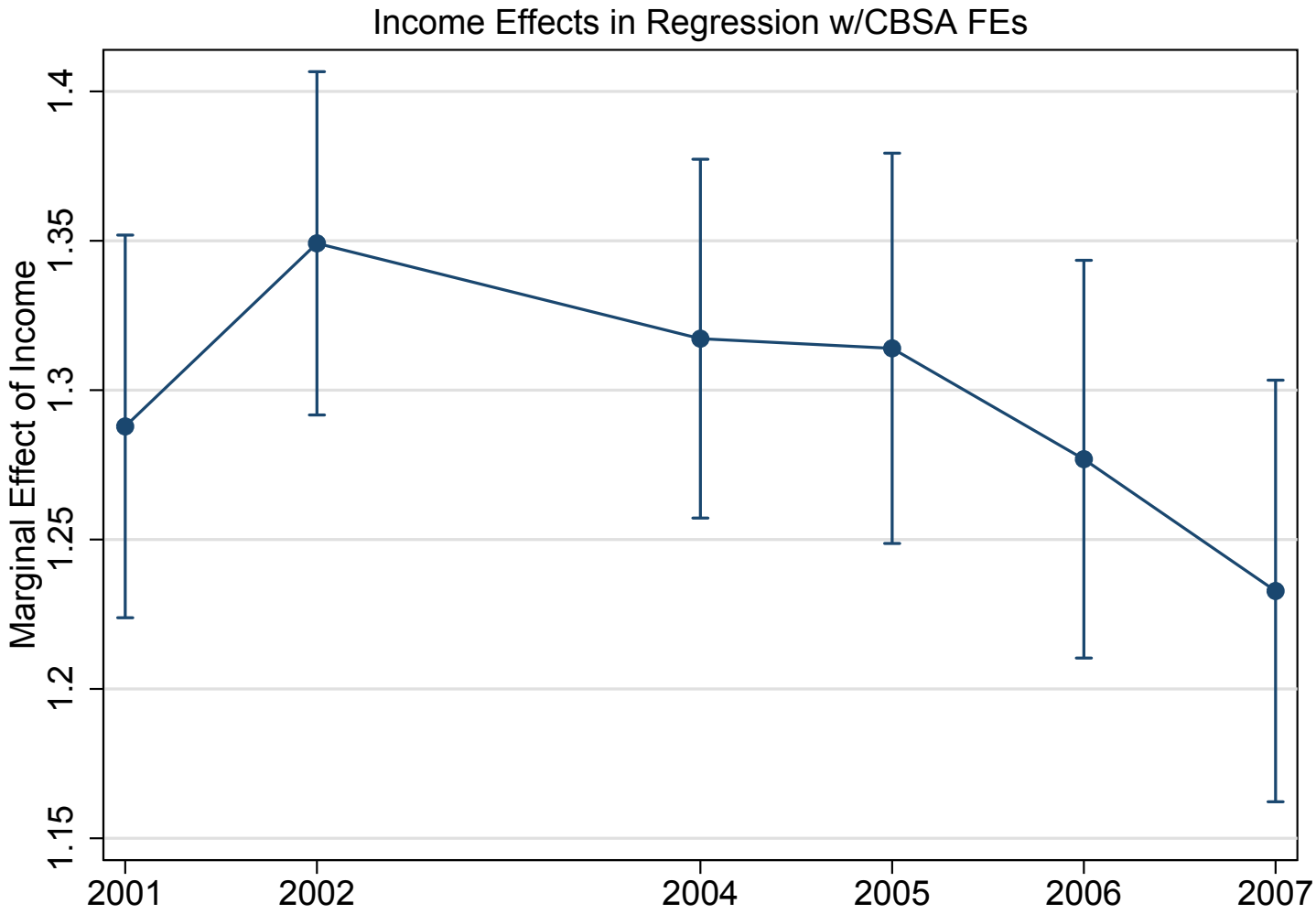

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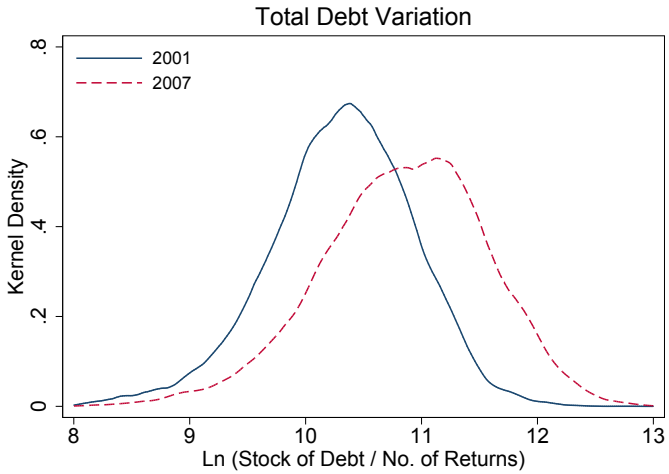
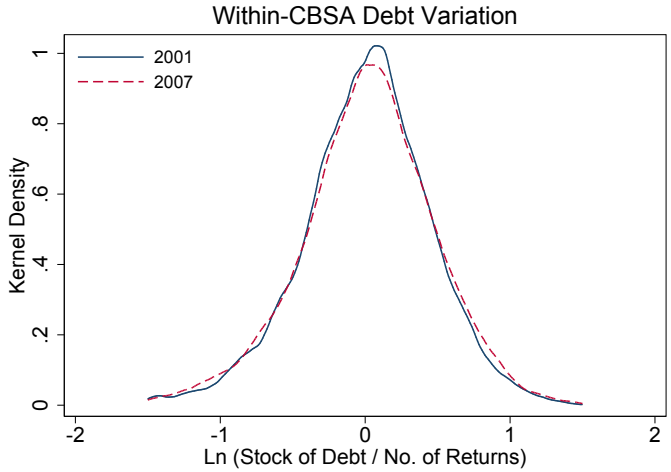
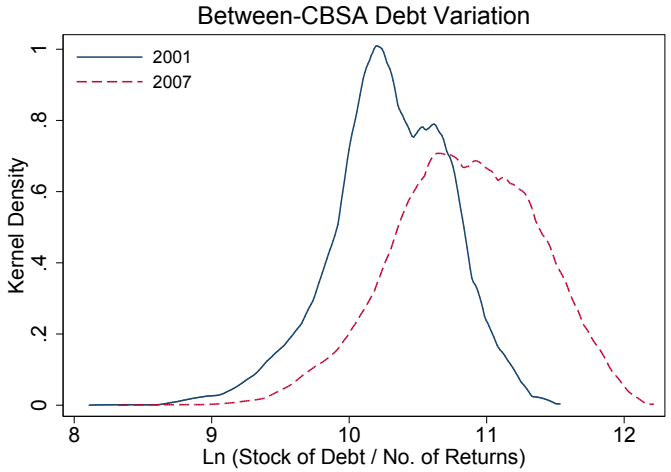
Total, Within- and Between-CBSA Variation

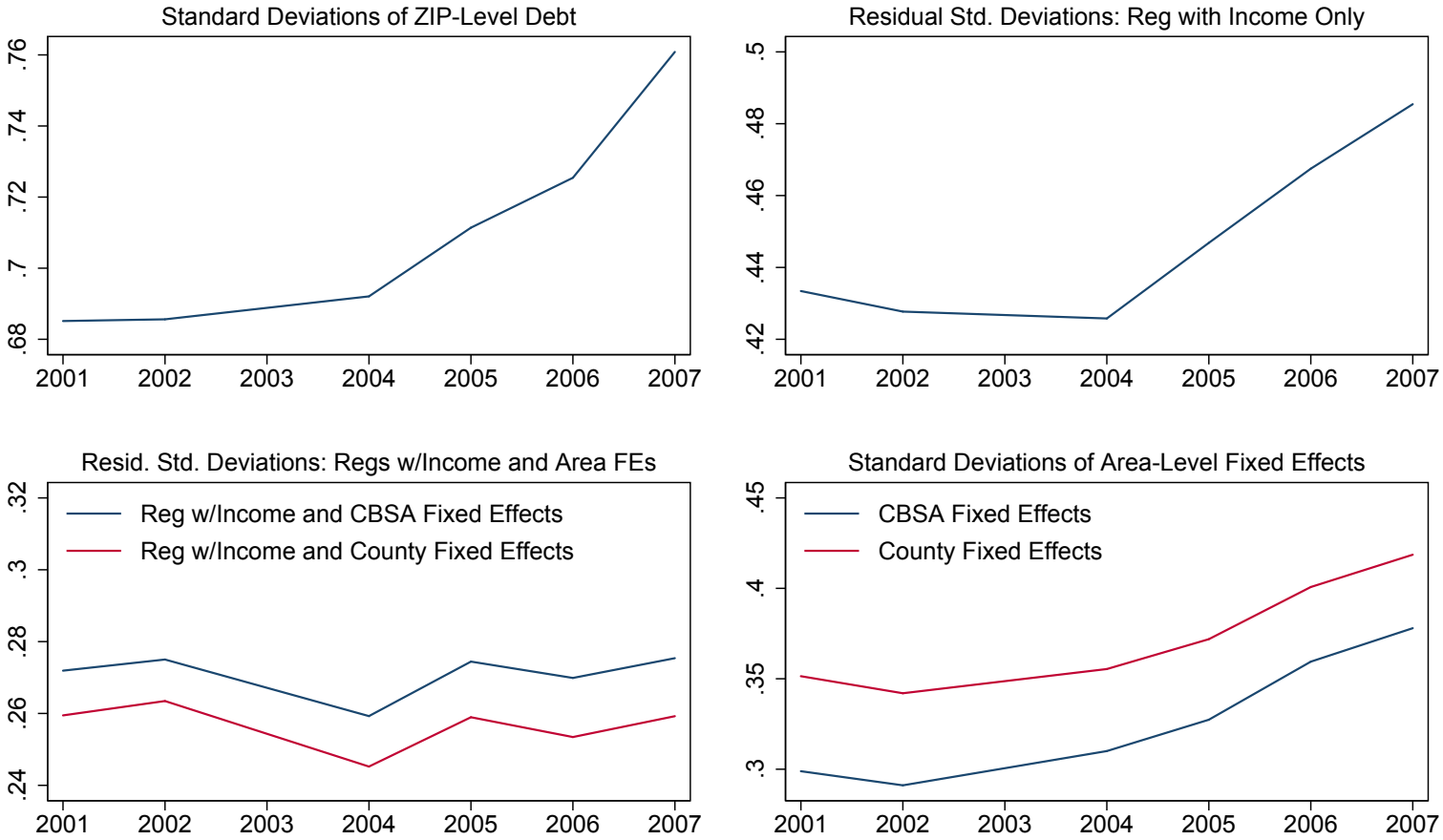






Source: NY Fed Consumer Credit Panel/Equifax and IRS.

Between and Within Variation in Regressions



Source: NY Fed Consumer Credit Panel/Equifax and IRS.

Credit Allocation Function in Long-Difference Form

$$Debt_{ic,2007} = \beta_{c,2007} + \beta_1 Income_{ic,2007} + \epsilon_{ic,2007}$$

$$Debt_{ic,2001} = \beta_{c,2001} + \beta_1 Income_{ic,2001} + \epsilon_{ic,2001}$$

- How does debt for a given ZIP code change over time?

Credit Allocation Function in Long-Difference Form

$$Debt_{ic,2007} = \beta_{c,2007} + \beta_1 Income_{ic,2007} + \epsilon_{ic,2007}$$

$$Debt_{ic,2001} = \beta_{c,2001} + \beta_1 Income_{ic,2001} + \epsilon_{ic,2001}$$

- How does debt for a given ZIP code change over time?
- If β_1s do not change over time, then estimating a long-difference regression is easy:

$$\Delta Debt_{ic} = \Delta\beta_c + \beta_1 \Delta Income_{ic} + \Delta\epsilon_{ic}$$

Credit Allocation Function in Long-Difference Form

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- If β_1s do change, then we need to put an income level in the regression as well.

Long-Difference Specification Issues

$$
\begin{aligned}
y_2 &= \beta_2 x_2 \\
y_1 &= \beta_1 x_1 \\
y_2 - y_1 &= \beta_2 x_2 - \beta_1 x_1 \\
y_2 - y_1 &= \beta_2 (x_2 - x_1) + x_1 (\beta_2 - \beta_1) \\
y_2 - y_1 &= \beta_1 (x_2 - x_1) + x_2 (\beta_2 - \beta_1)
\end{aligned}
$$

- Note that coefficient on level (x_1 or x_2) is always the same: $\beta_2 - \beta_1$.

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- Coefficient on change $(x_2 - x_1)$...
  - ...depends on which level is included...

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- Note that coefficient on level (x_1 or x_2) is always the same: $\beta_2 - \beta_1$.
- Coefficient on change ($x_2 - x_1$)...
  - ...depends on which level is included...
  - ... but always reflects a level effect (β_1 or β_2).

Long-Difference Regression Results

Dependent Variable: 2001-07 ZIP-Level Change in Ln Mortgage Debt per Return

Sample Restriction	(1) None	(2) None	(3) 1% Trim	(4) 5% Trim
Panel A: All ZIP Codes				
2001-07 Change in Ln Income per Return	1.071***	1.050***	1.170***	1.031***
	(0.040)	(0.043)	(0.054)	(0.061)
2001 Ln Income per Return Level		0.019	0.010	0.031
		(0.012)	(0.014)	(0.016)
Constant	0.527***	0.527***	0.528***	0.528***
	(0.008)	(0.008)	(0.008)	(0.008)
R-sq.	0.122	0.122	0.150	0.117
Observations (No. of ZIP Codes)	35,595	35,595	27,337	18,313
Expected Diff. in Debt Growth: 90th 2001 Income Pctile vs. 10th 2001 Income Pctile		0.017	0.009	0.027

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: NY Fed Consumer Credit Panel/Equifax and IRS.

Long-Difference Regression Results

Dependent Variable: 2001-07 ZIP-Level Change in Ln Mortgage Debt per Return

Sample Restriction	(1) None	(2) None	(3) 1% Trim	(4) 5% Trim
Panel B: CBSA ZIP Codes without Fixed Effects				
2001-07 Change in Ln Income per Return	1.088***	1.059***	1.192***	1.028***
	(0.043)	(0.046)	(0.057)	(0.064)
2001 Ln Income per Return Level		0.027*	0.010	0.032
		(0.014)	(0.016)	(0.018)
Constant	0.527***	0.527***	0.528***	0.529***
	(0.009)	(0.009)	(0.009)	(0.008)
R-sq.	0.141	0.142	0.164	0.120
Observations (No. of ZIP Codes)	27,567	27,567	21,634	15,165
Expected Diff. in Debt Growth: 90th 2001 Income Pctile vs. 10th 2001 Income Pctile		0.023	0.009	0.028

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: NY Fed Consumer Credit Panel/Equifax and IRS.

Long-Difference Regression Results

Dependent Variable: 2001-07 ZIP-Level Change in Ln Mortgage Debt per Return

Sample Restriction	(1) None	(2) None	(3) 1% Trim	(4) 5% Trim
Panel C: CBSA ZIP Codes with CBSA Fixed Effects				
2001-07 Change in Ln Income per Return	0.827***	0.858***	0.990***	0.925***
	(0.064)	(0.060)	(0.062)	(0.066)
2001 Ln Income per Return Level		−0.027	−0.057***	−0.052***
		(0.015)	(0.016)	(0.015)
Constant	0.527***	0.527***	0.528***	0.529***
	(0.000)	(0.000)	(0.000)	(0.000)
R-sq.	0.429	0.429	0.553	0.580
Observations (No. of ZIP Codes)	27,567	27,567	21,634	15,165
Expected Diff. in Debt Growth: 90th 2001 Income Pctile vs. 10th 2001 Income Pctile		−0.023	−0.049	−0.045

Standard errors in parentheses

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Source: NY Fed Consumer Credit Panel/Equifax and IRS.

Determinants of CBSA-Level Debt Growth

Dependent Variable: CBSA-Level Fixed Effects from ZIP-Level Long-Diff Regressions

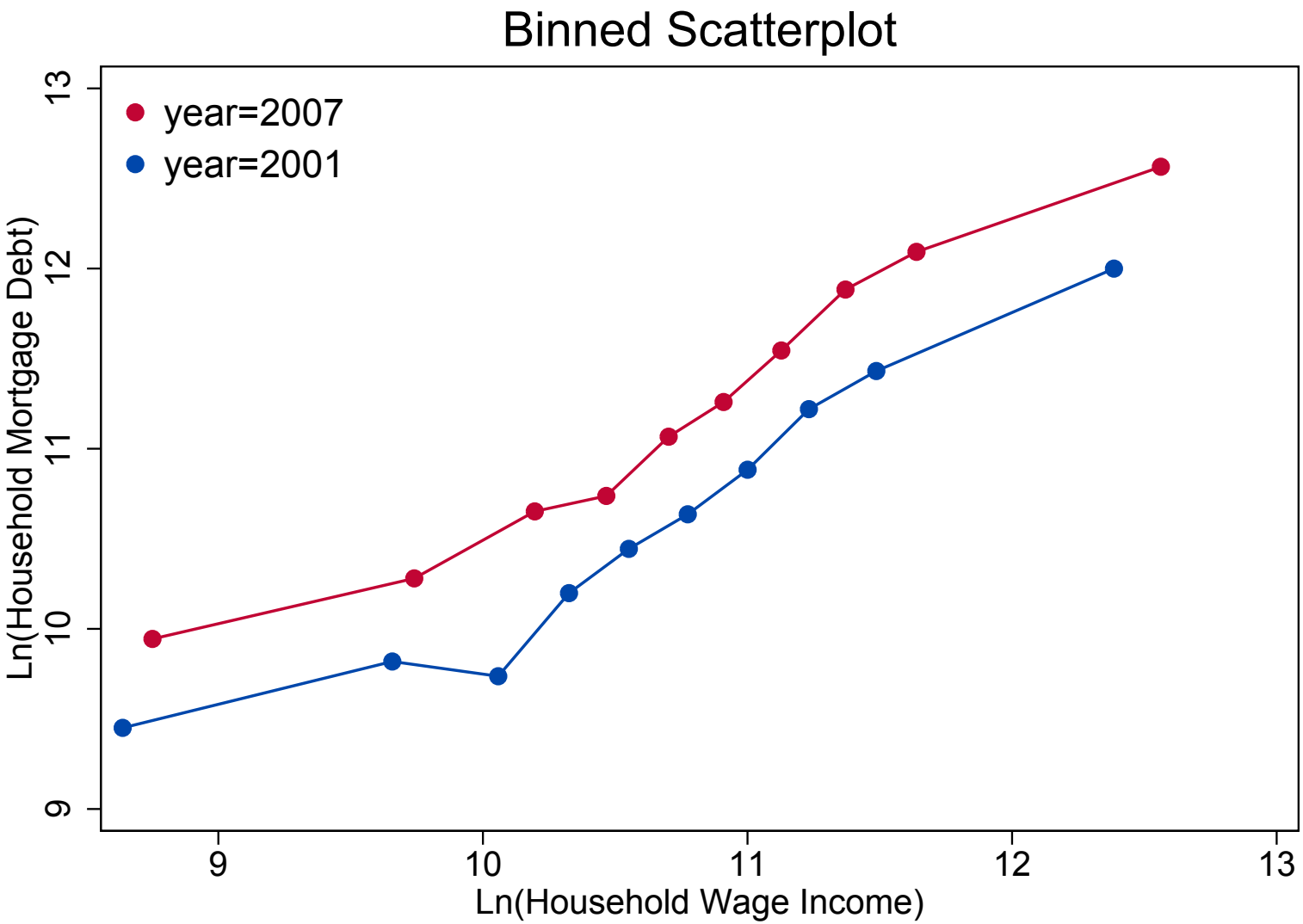
	(1)	(2)	(3)	(4)	(5)	(6)
2001-07 Change in Ln CBSA Income		0.68***	0.55**		−0.28	−0.45*
		(0.16)	(0.17)		(0.17)	(0.18)
2001 Ln CBSA Income Level			0.22***			0.24***
			(0.05)			(0.04)
2001-07 Change in Ln CBSA House Price				0.40***	0.44***	0.45***
				(0.04)	(0.04)	(0.04)
Constant	0.53***	0.53***	0.53***	0.36***	0.35***	0.34***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Observations (No. of CBSAa)	934	934	934	934	934	934
R-sq.	0.00	0.05	0.13	0.31	0.32	0.42

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: NY Fed Consumer Credit Panel/Equifax and IRS.

Household-Level Data from SCF



SCF Regression Model

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  - Indicators for age group of household head (<35,35-44,45-54,55-64), nonwhite, and marital status.

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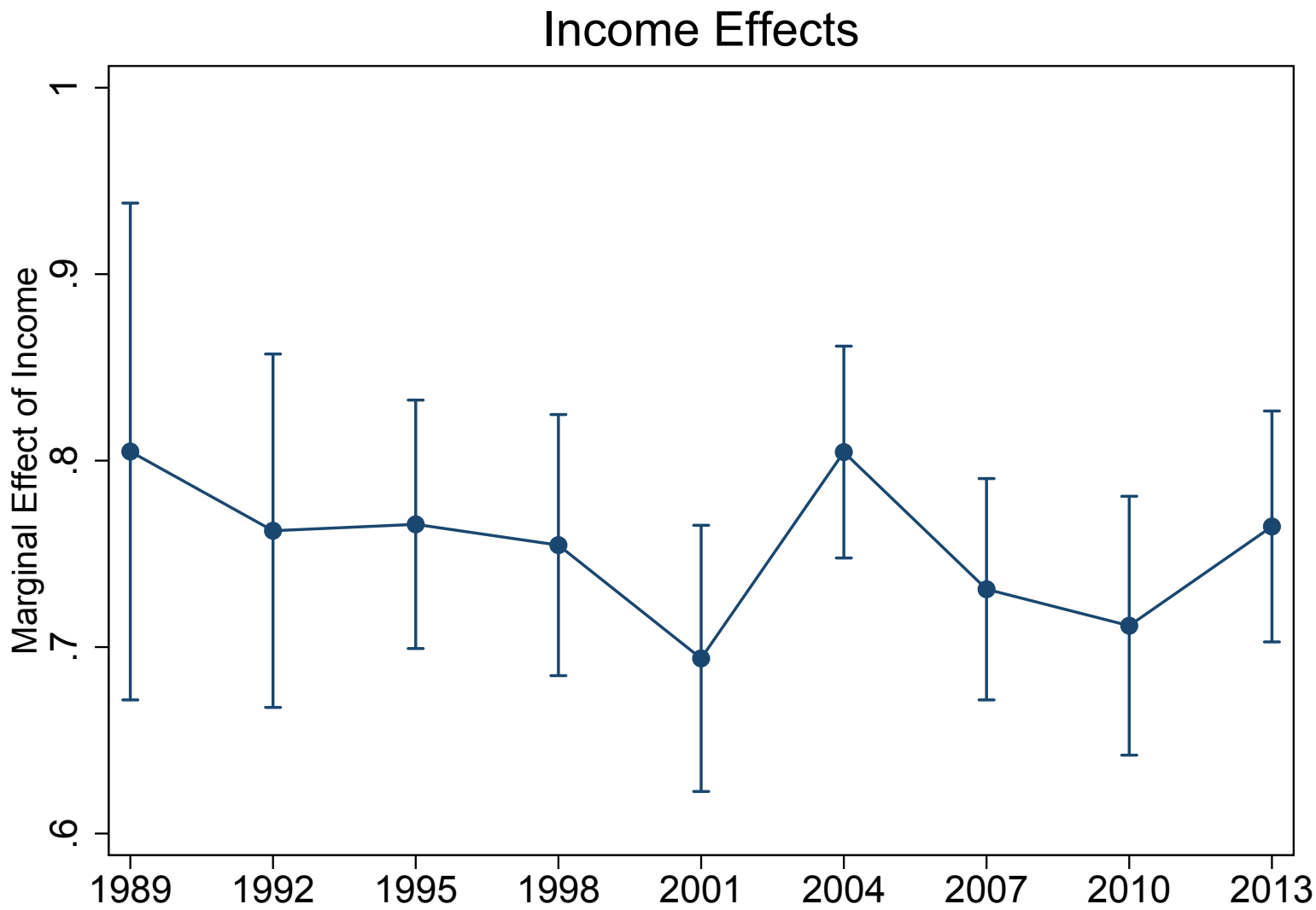
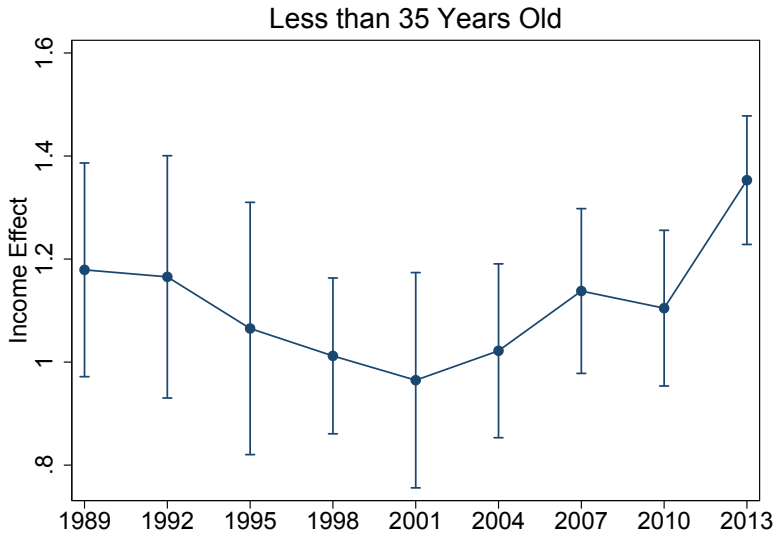
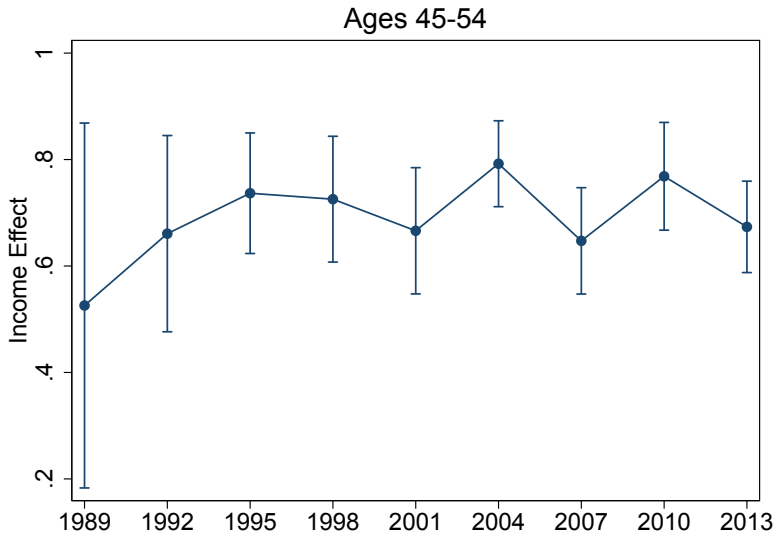
  - Number of children.
- Households headed by persons 65 or older are excluded, as are people with no wage income.

SCF Results


Income Effects
Marginal Effect of Income
.6
.7
.8
.9
1
1989
1992
1995
1998
2001
2004
2007
2010
2013

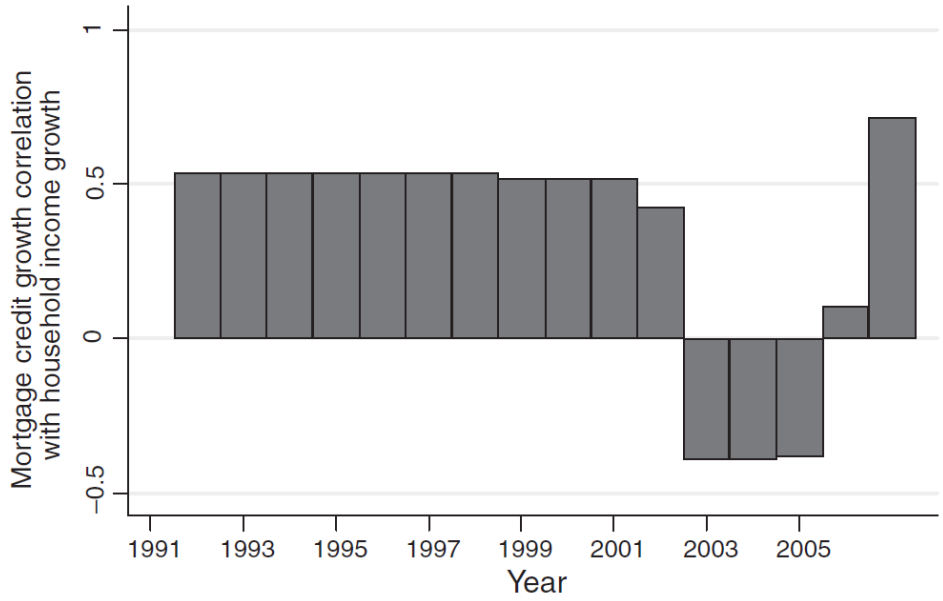
SCF Results: With Age × Income Interactions





The Negative Correlation in Mian and Sufi (2009)

Note: All correlations calculated on a within-county basis.



- Potential specifications for regressions of Δ debt on Δ income:

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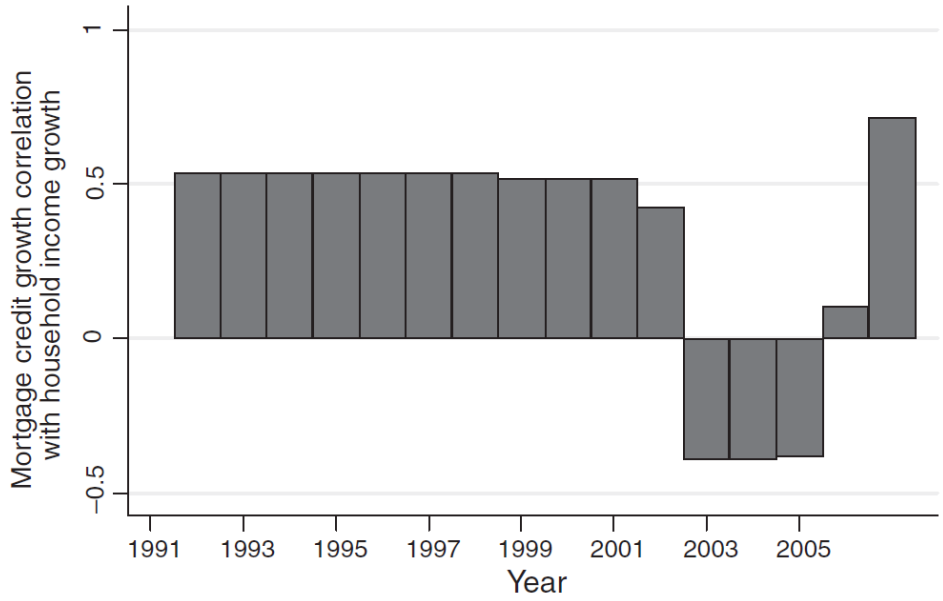

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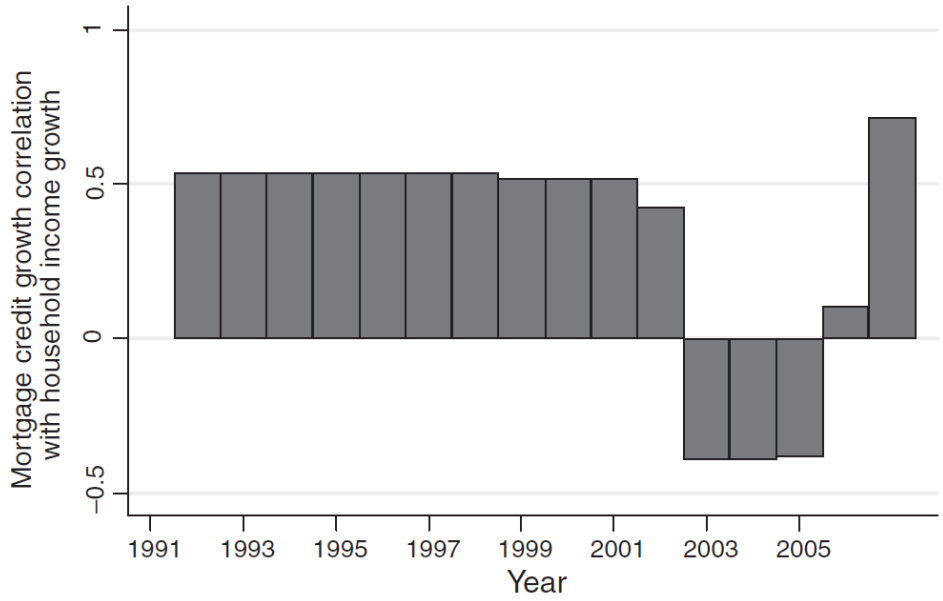

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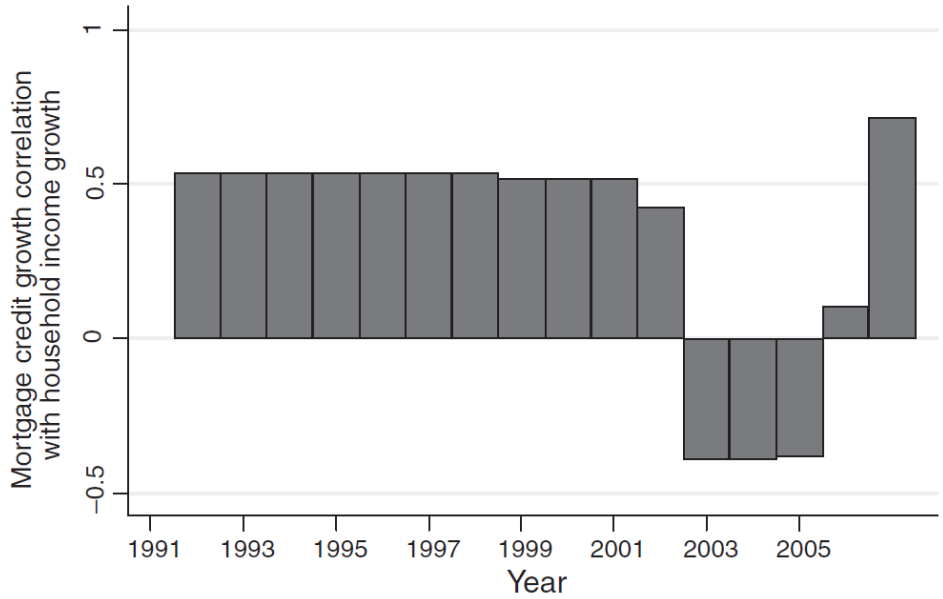

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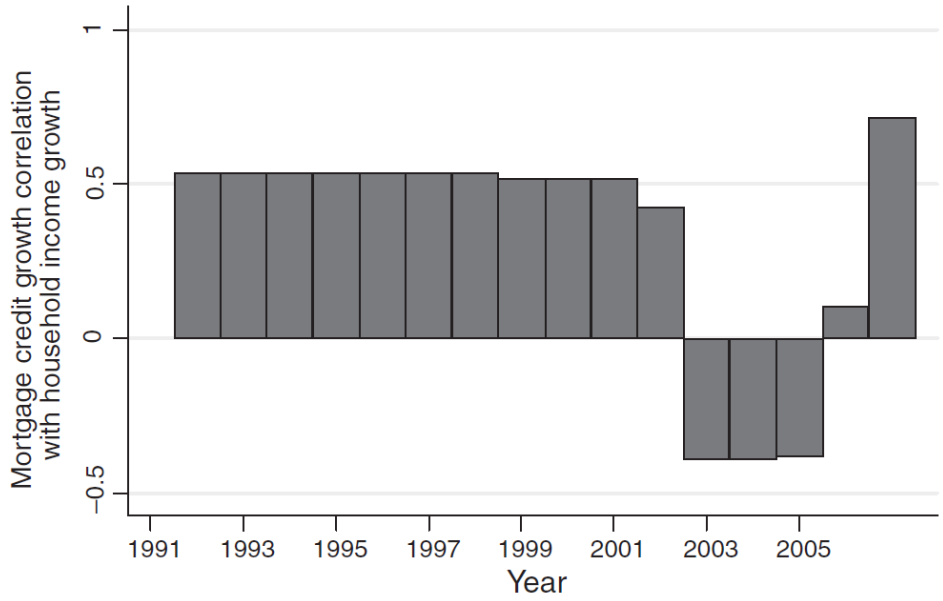

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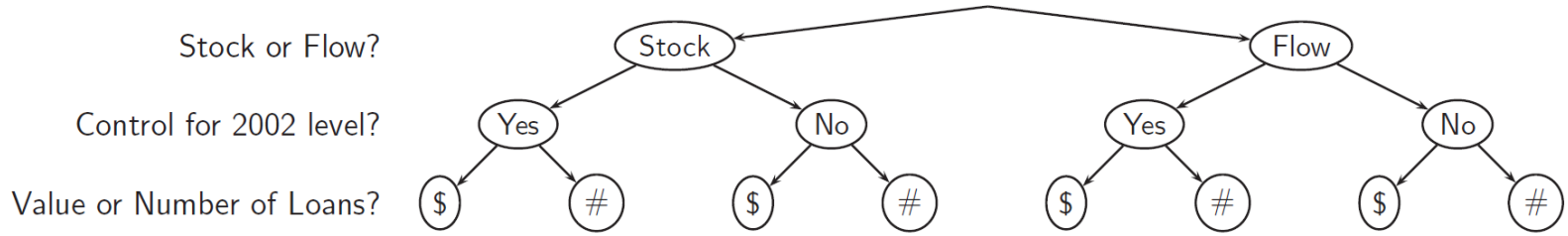
  4. Adelino et al. (2015): Value of loans versus number of loans?

2002-06 Debt-Growth Regressions

All regressions include county FEs and use AGI as income measure



	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ ln(AGI/Returns)	0.42***	0.09**	0.29***	0.14***	0.29***	0.60***	0.17***	-0.34***
	(0.05)	(0.04)	(0.05)	(0.03)	(0.04)	(0.07)	(0.03)	(0.07)
ln(AGI/Returns in 2006)	-0.05***	0.02			-0.04***	-0.34***		
	(0.01)	(0.01)			(0.01)	(0.02)		
Constant	0.55***	0.07	0.37***	0.14***	0.36***	1.52***	0.21***	0.33***
	(0.04)	(0.05)	(0.01)	(0.01)	(0.04)	(0.07)	(0.01)	(0.01)
Observations	35,683	35,864	35,683	35,864	29,008	29,008	29,008	29,008
R-sq.	0.40	0.28	0.39	0.28	0.67	0.63	0.67	0.57
R-sq. w/o County FE	0.04	0.02	0.04	0.02	0.08	0.15	0.07	0.00

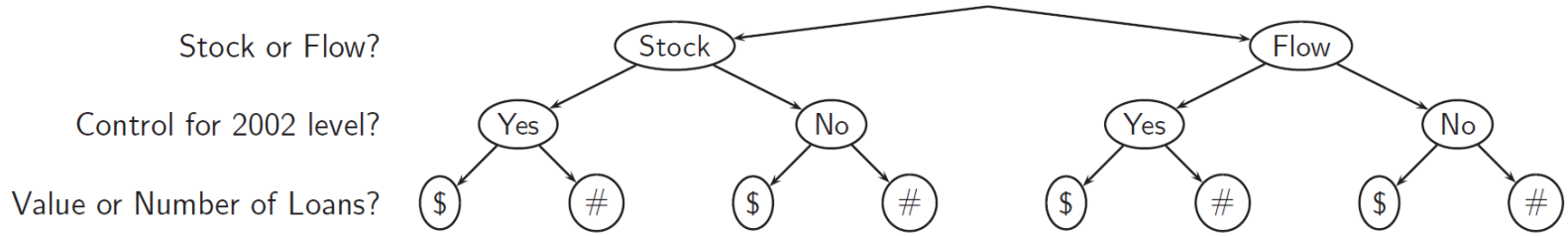
Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: NY Fed Consumer Credit Panel/Equifax and IRS.

2002-06 Debt-Growth Regressions

All regressions include county FEs and use salary and wages as income measure



	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ ln(Salary/Returns)	0.74***	0.38***	0.70***	0.47***	0.29***	0.68***	0.22***	0.02
	(0.05)	(0.06)	(0.05)	(0.07)	(0.06)	(0.08)	(0.05)	(0.09)
ln(Salary/Returns in 2006)	-0.02	0.06***			-0.04***	-0.37***		
	(0.01)	(0.02)			(0.01)	(0.02)		
Constant	0.41***	-0.07	0.34***	0.12***	0.36***	1.52***	0.22***	0.27***
	(0.05)	(0.06)	(0.01)	(0.01)	(0.04)	(0.08)	(0.01)	(0.01)
Observations	35,611	35,788	35,611	35,788	28,967	28,967	28,967	28,967
R-sq.	0.41	0.30	0.41	0.30	0.67	0.62	0.66	0.57
R-sq. w/o County FE	0.07	0.04	0.07	0.03	0.10	0.13	0.09	0.00

Standard errors in parentheses

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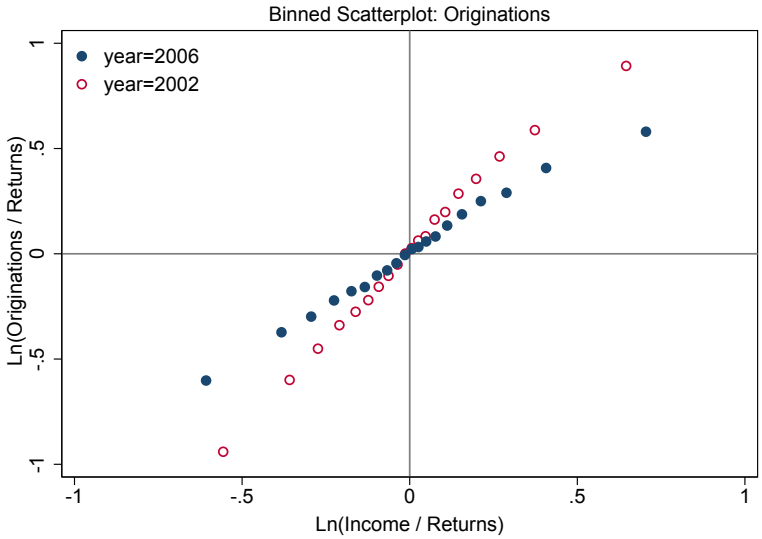
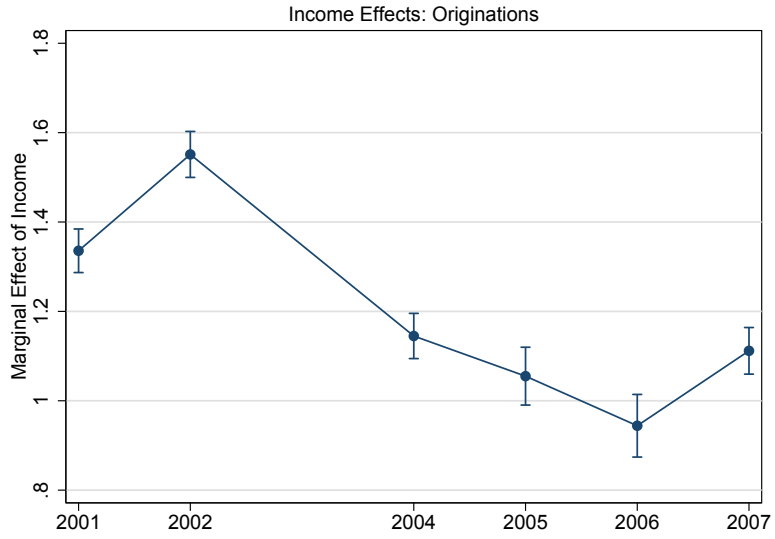
Source: NY Fed Consumer Credit Panel/Equifax and IRS.

Stocks vs. Flows: Total Value of Originations





Source: NY Fed Consumer Credit Panel/Equifax and IRS.

- Using the Equifax data, we also find decline in the positive relationship between income and originations at the ZIP code level.

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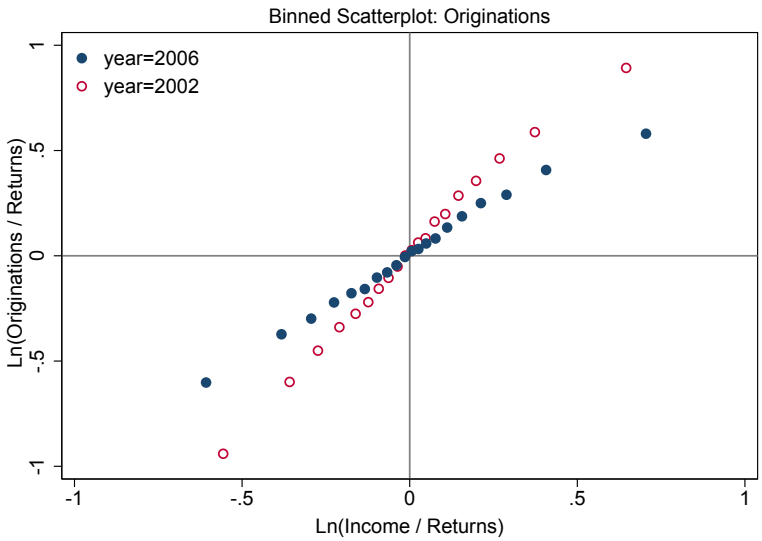
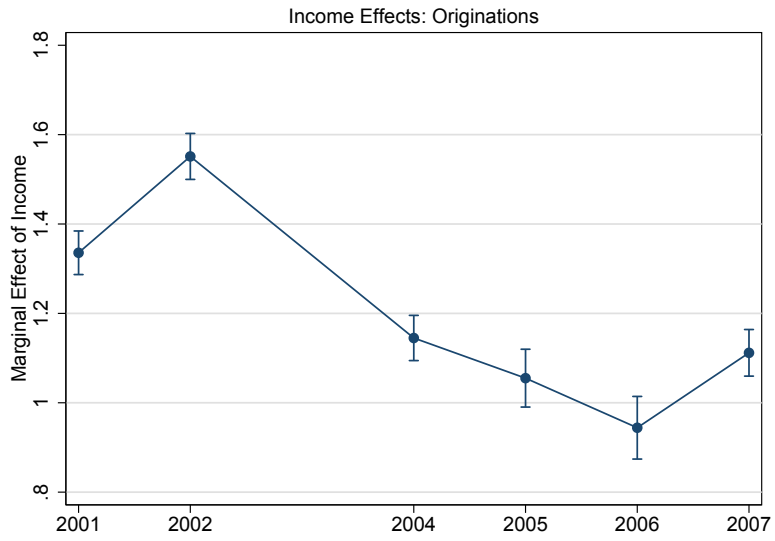
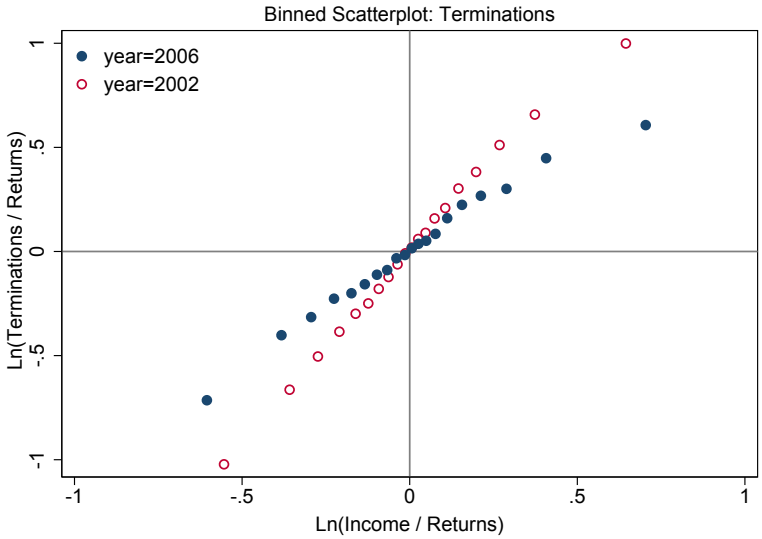


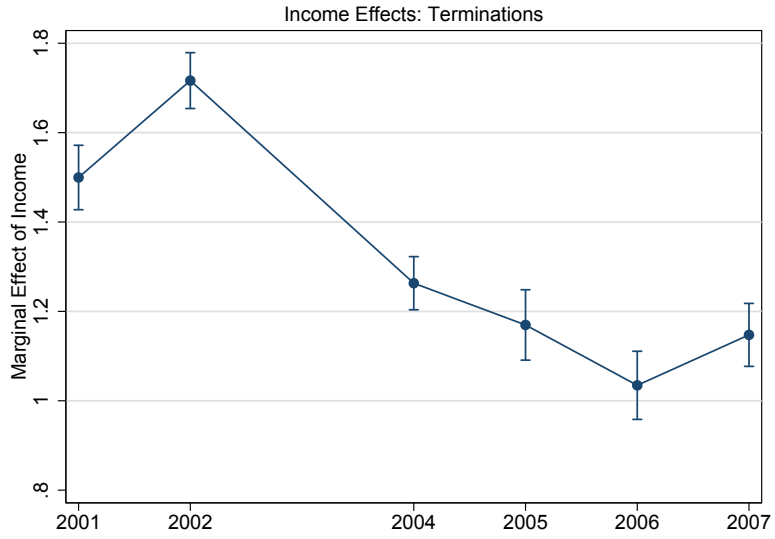


Source: NY Fed Consumer Credit Panel/Equifax and IRS.

- Using the Equifax data, we also find decline in the positive relationship between income and originations at the ZIP code level.
- Over the course of the housing boom, originations rose more in ZIP codes that were relatively poor compared to others in their county.

Stocks vs. Flows: Total Value of Terminations





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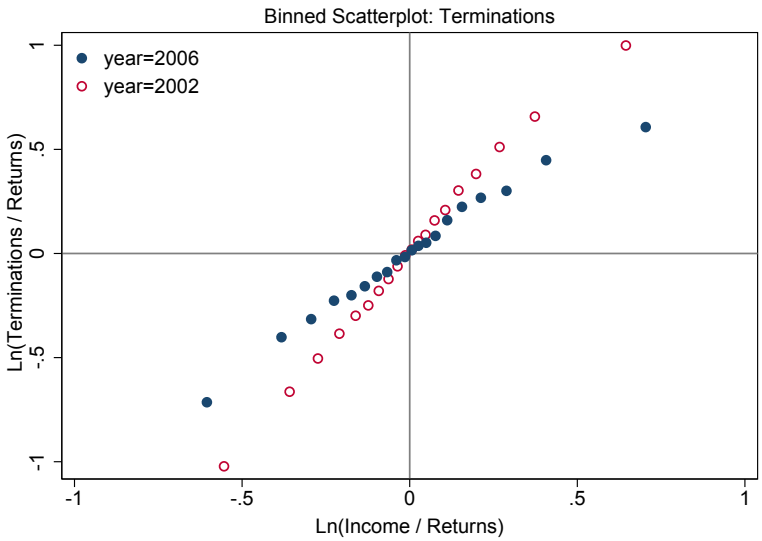

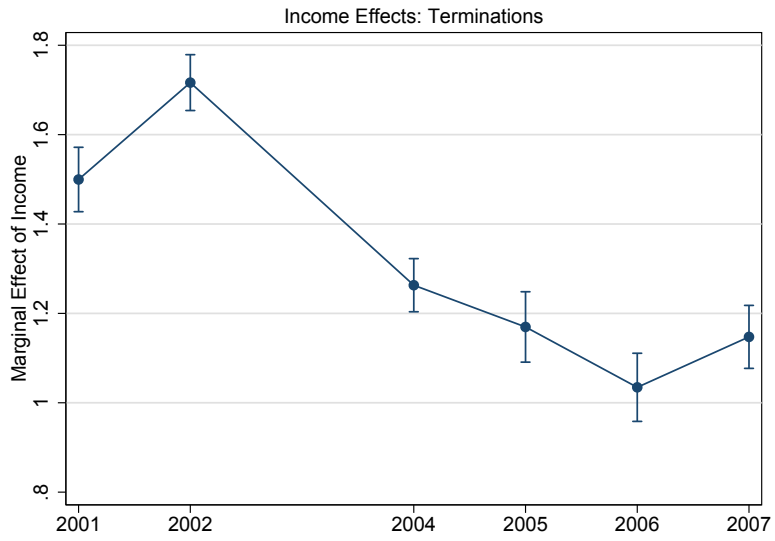

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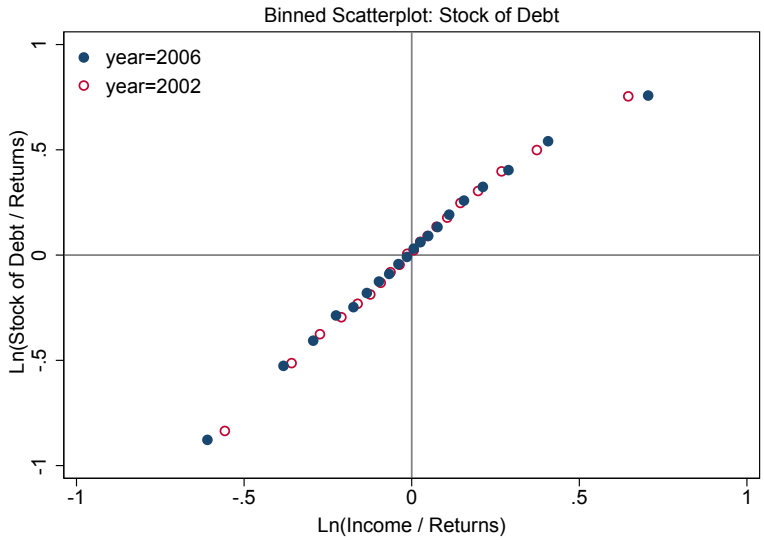
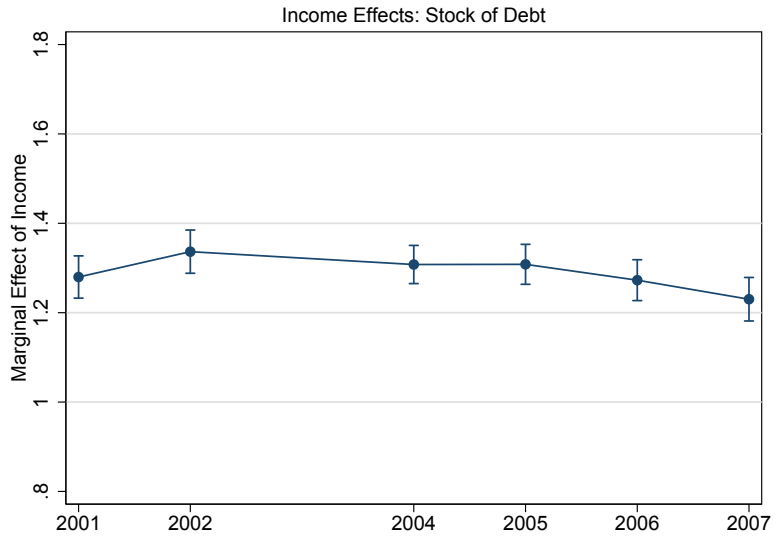
Stocks vs. Flows: Stock of Debt





Source: NY Fed Consumer Credit Panel/Equifax and IRS.

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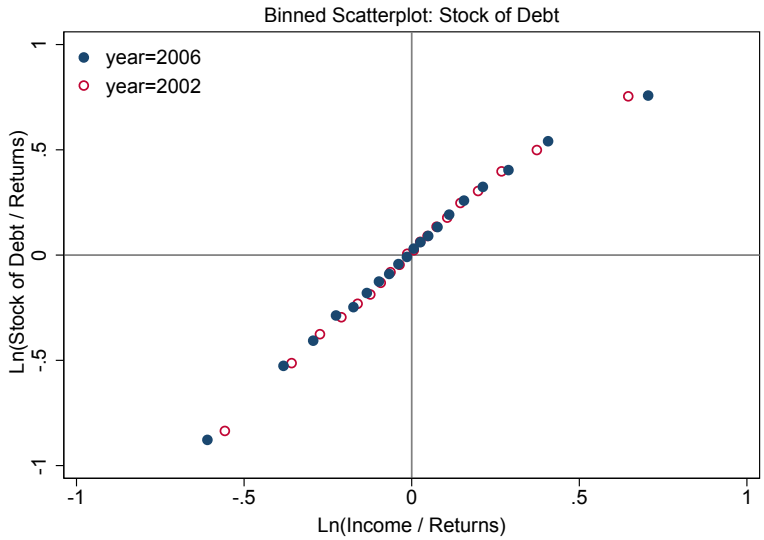
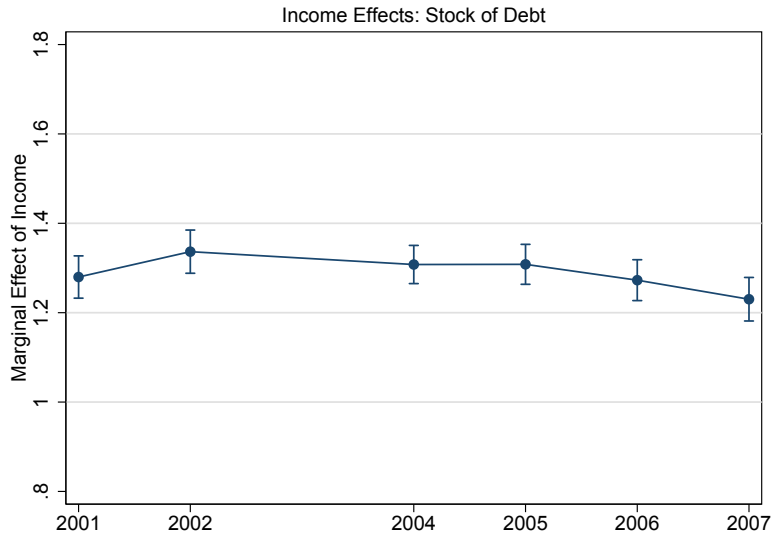
Stocks vs. Flows: Stock of Debt





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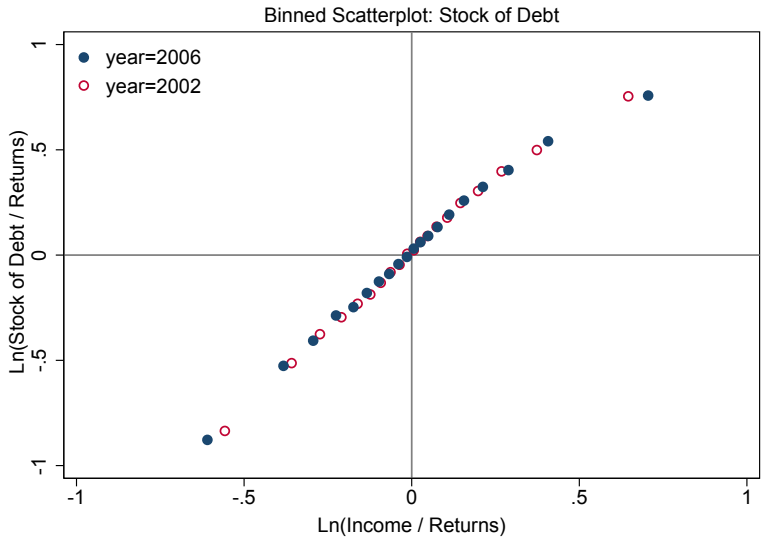

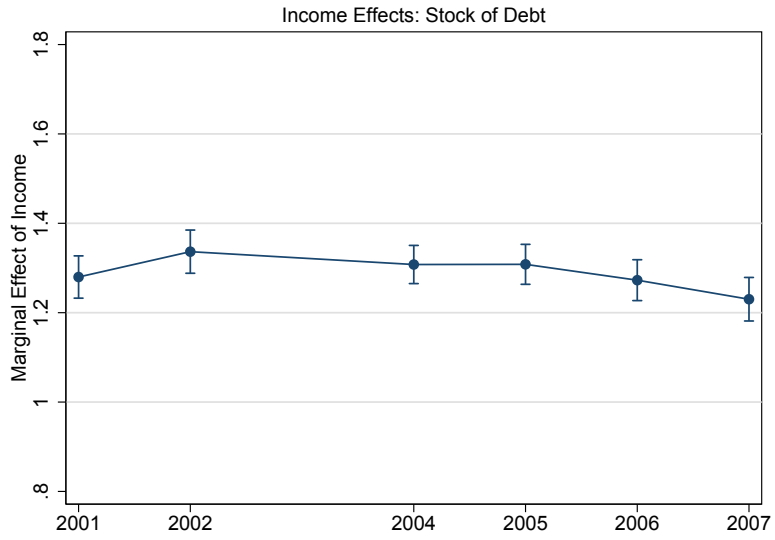

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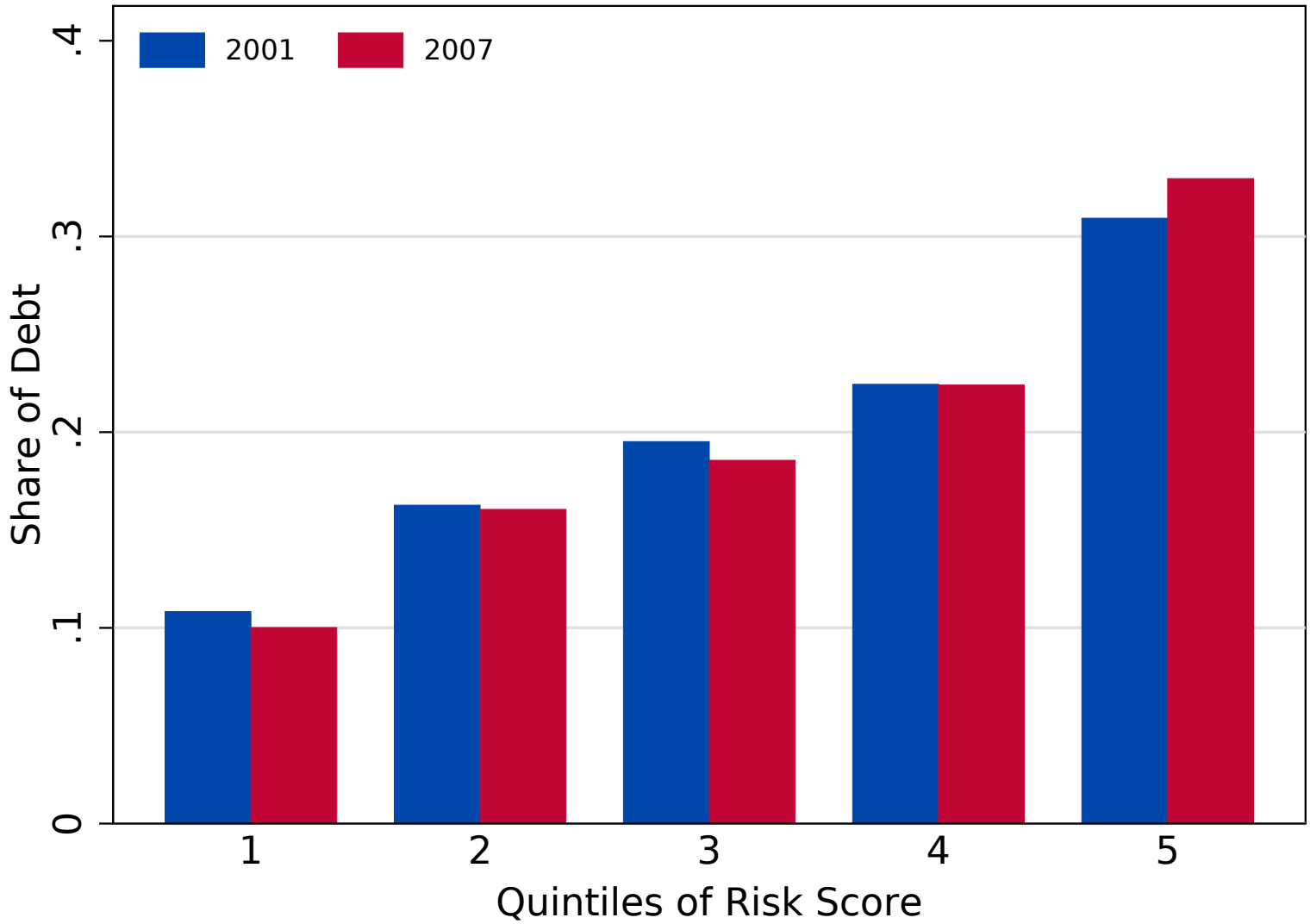
- Only difference was time period (2001-07) and use of CBSA (not county) fixed effects.

What About Credit Scores?



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  - **Distorted beliefs/over-optimism:**

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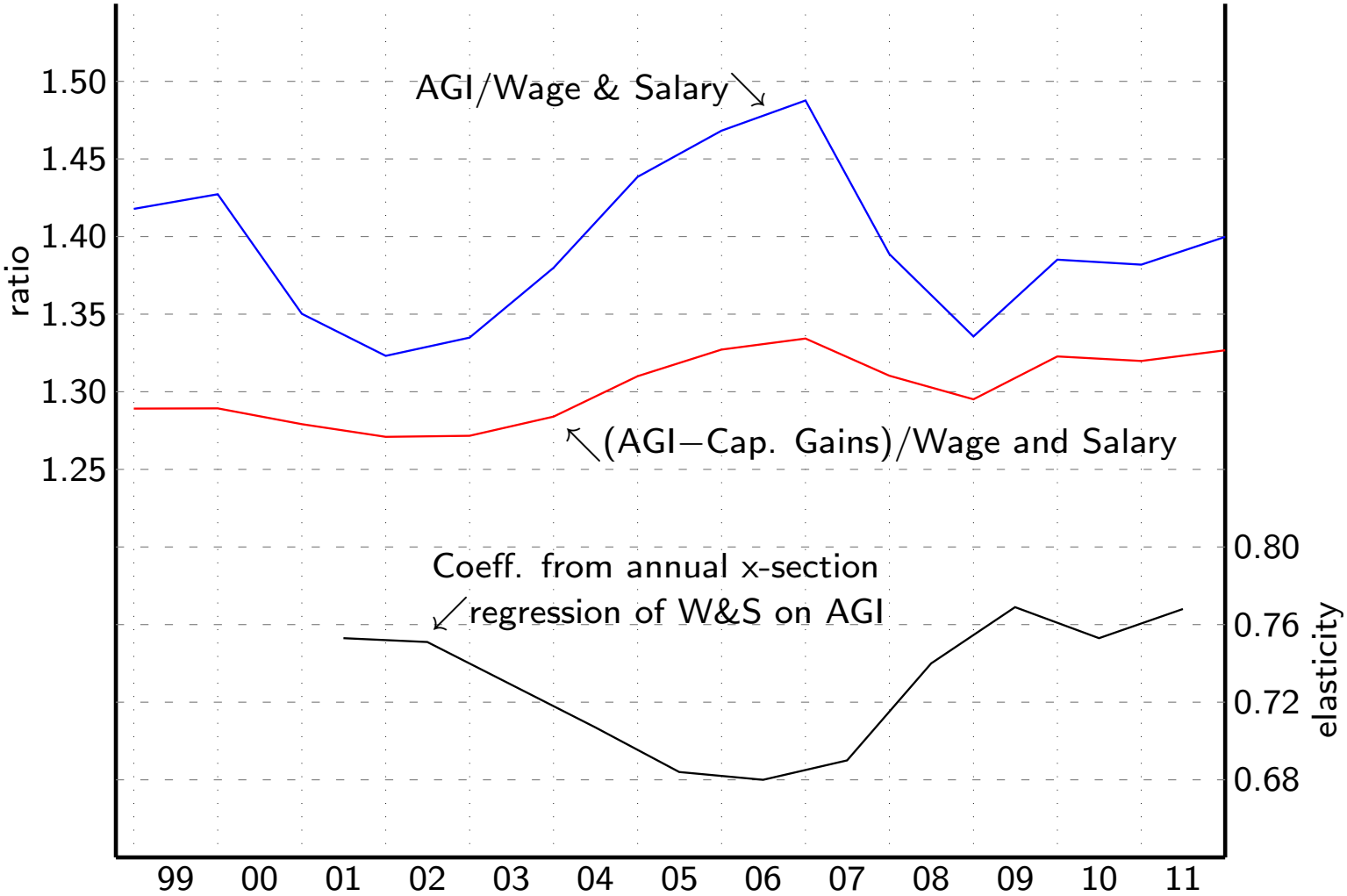
Supplementary Slides

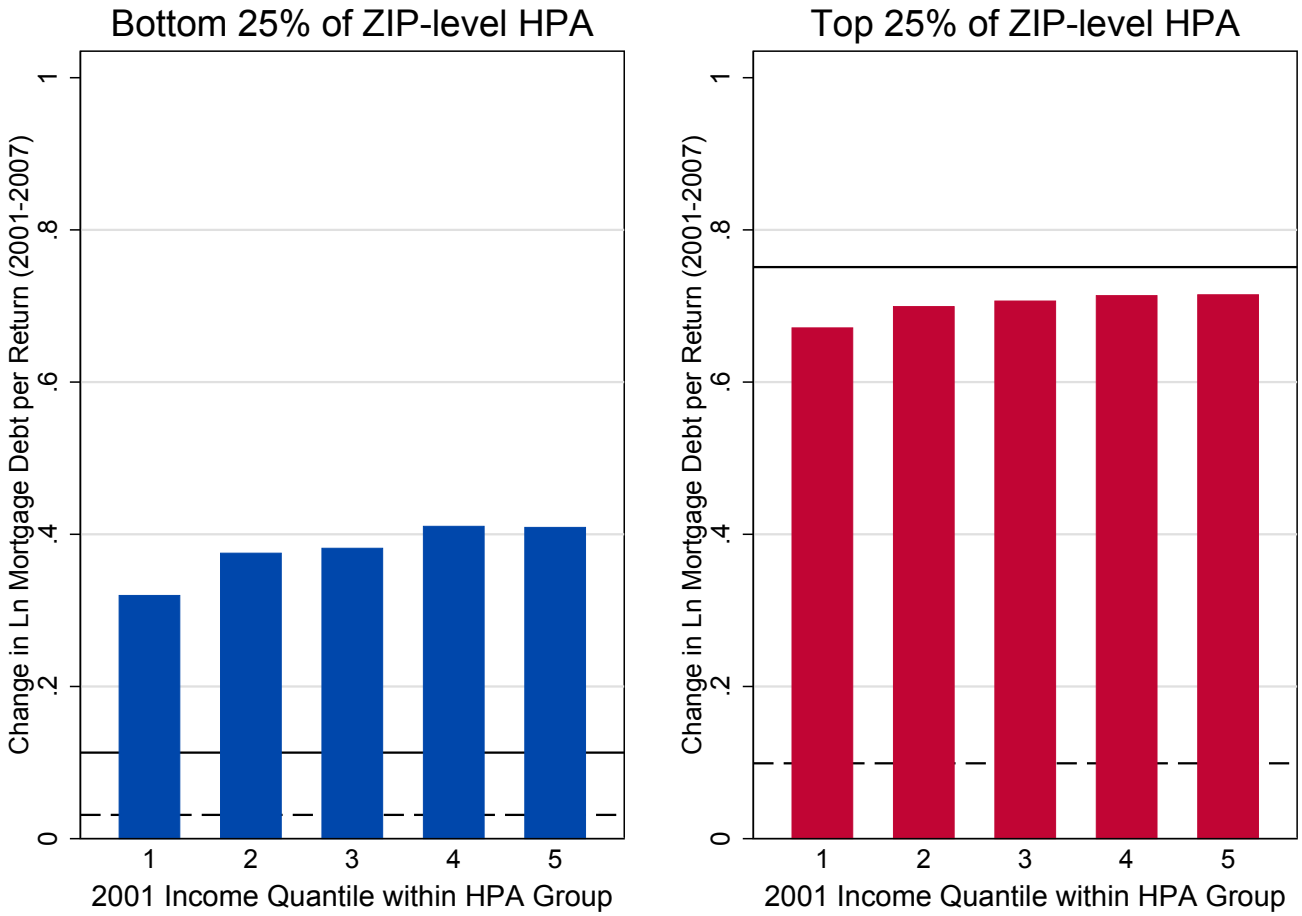
Adjusted Gross Income (AGI) vs. Salary and Wages



Source: NY Fed Consumer Credit Panel/Equifax and IRS.

Growth in ZIP-level Debt, House Prices, and Income

Solid line: House price appreciation (HPA); dashed line: income growth



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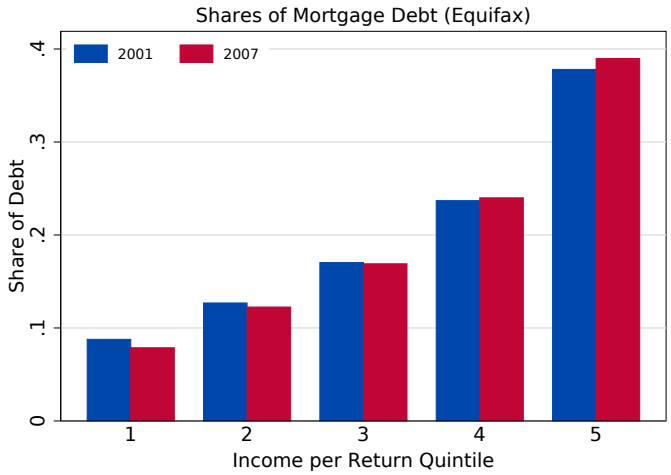
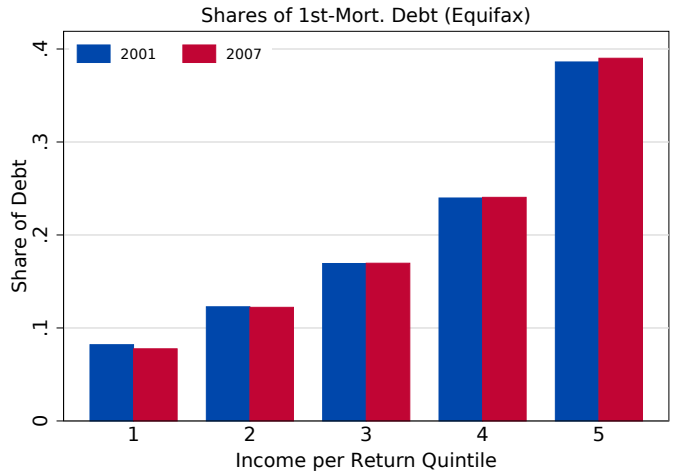
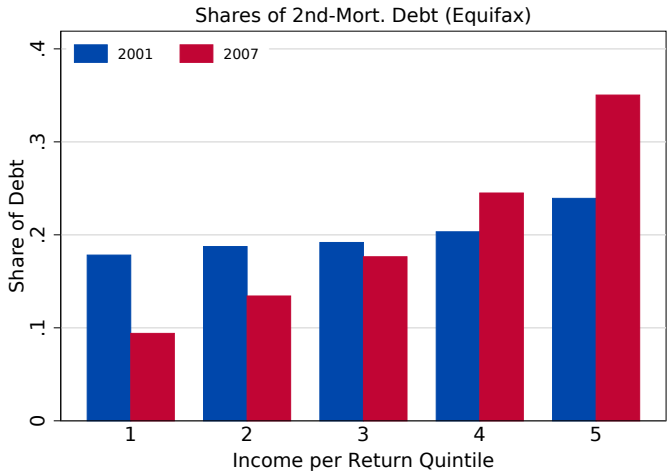
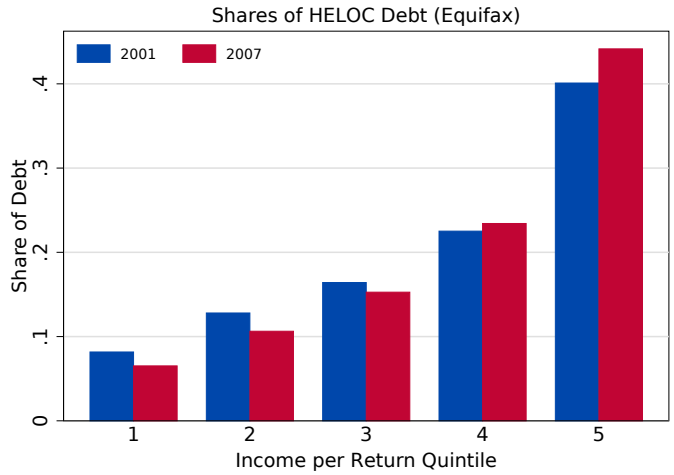
Distribution of Mortgage Debt by Type









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Comparing Debt Aggregates