

“Cash on Hand” and Consumption: Evidence from Mortgage Refinancing

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February 2014

Motivation

- What are the determinants of household consumption?
 - The “consumption function” plays a crucial role in modern business cycle theory
- With imperfect credit/insurance markets, theory suggests that “cash on hand” plays important role
 - Precautionary savings (Carroll (1992))
 - Borrowing constraints (Deaton (1991))
 - Hyperbolic discounting (Harris and Laibson (2002))
- How do macro movements such as changes in interest rates and house prices translate into cash on hand, and how does cash on hand in turn affect household spending?

Housing, Mortgages, and Refinancing

- We focus on housing and mortgage refinancing to empirically tackle this question
 - Primary residence is 60% of assets for households below the 80th percentile of wealth distribution (SCF)
 - Mortgages comprise 70 to 80% of household debt during our sample period (FOF)
- Aggregate house price and interest rate movements generate mortgage refinancing waves, leading to two (potential) types of cash-on-hand shocks:
 1. Ability to liquefy collateral value (“cash-out refinancing”)
 2. Lower interest payments (“no-cash-out refinancing”)

What We Do

- We utilize cross-sectional variation across U.S. zip codes from 2000 to 2012 in their “exposure” to aggregate mortgage refinancing waves
- We use this variation to estimate the response of spending on autos to cash-on-hand shocks
- Results:
 - Strong effect of house-price-driven refinancing on auto spending
 - Mixed results on interest-rate-driven refinancing, with no effect for 2000 to 2003 period, positive effect during the 2008 to 2012 period
 - The population margin matters – results imply that cash-on-hand shocks have heterogenous effects depending on household characteristics such as income, credit scores, and net worth

Data

- A zip code-quarter panel for the United States from 2000q1 to 2012q4
- House prices and mortgage refinancing from CoreLogic, credit scores and other debt variables from Equifax, demographics from Census and IRS, housing supply elasticity at CBSA level from Saiz (2011)
- Primary spending variable: purchases of new autos
- But also zip-code measure of credit card spending for 2008 -2012 (not yet approved for public version)
- 5,400 zip codes (80% of population)

Summary Statistics

(Table 1)

	N	Mean	SD	10th	90th	Weighted mean	Weighted SD
Zip code level							
Cash-out refinancing share	5440	1.594	0.607	0.845	2.323	1.558	0.551
No-cash-out refinancing share	5440	1.951	0.788	1.119	2.885	1.811	0.659
House price growth, 2000 to 2007	5440	0.430	0.248	0.114	0.751	0.445	0.258
House price growth, 2007 to 2012	5440	-0.217	0.176	0.461	0.004	-0.220	0.176
Number of households, thousands	5244	11.2	5.9	4.4	18.9	14.4	6.8
Housing supply inelasticity	5440	0.656	0.181	0.394	0.851	0.670	0.181
Low credit score fraction	5361	0.229	0.119	0.102	0.381	0.238	0.109
Ln(median household income)	5163	10.782	0.326	10.375	11.205	10.735	0.319
Less than high school education fraction	5163	0.161	0.105	0.052	0.302	0.173	0.110
Quarter level							
Cash-out refinancing share	52	1.621	1.161	0.470	2.840		
No-cash-out refinancing share	52	1.876	1.761	0.606	3.573		
Interest rate on refinancings	52	6.094	1.411	4.325	7.449		
Zip-code quarter level							
New auto purchases per capita	272676	0.015	0.092	0.004	0.022	0.012	0.033
Ln(New auto purchases per capita)	272667	-4.584	-0.695	-5.422	3.827	-4.714	0.674
Total outstanding mortgages (number)	282866	3242	2077	1103	6022	3850	2214
Total outstanding mortgages (\$ millions)	282866	504	461	104	1090	591	512

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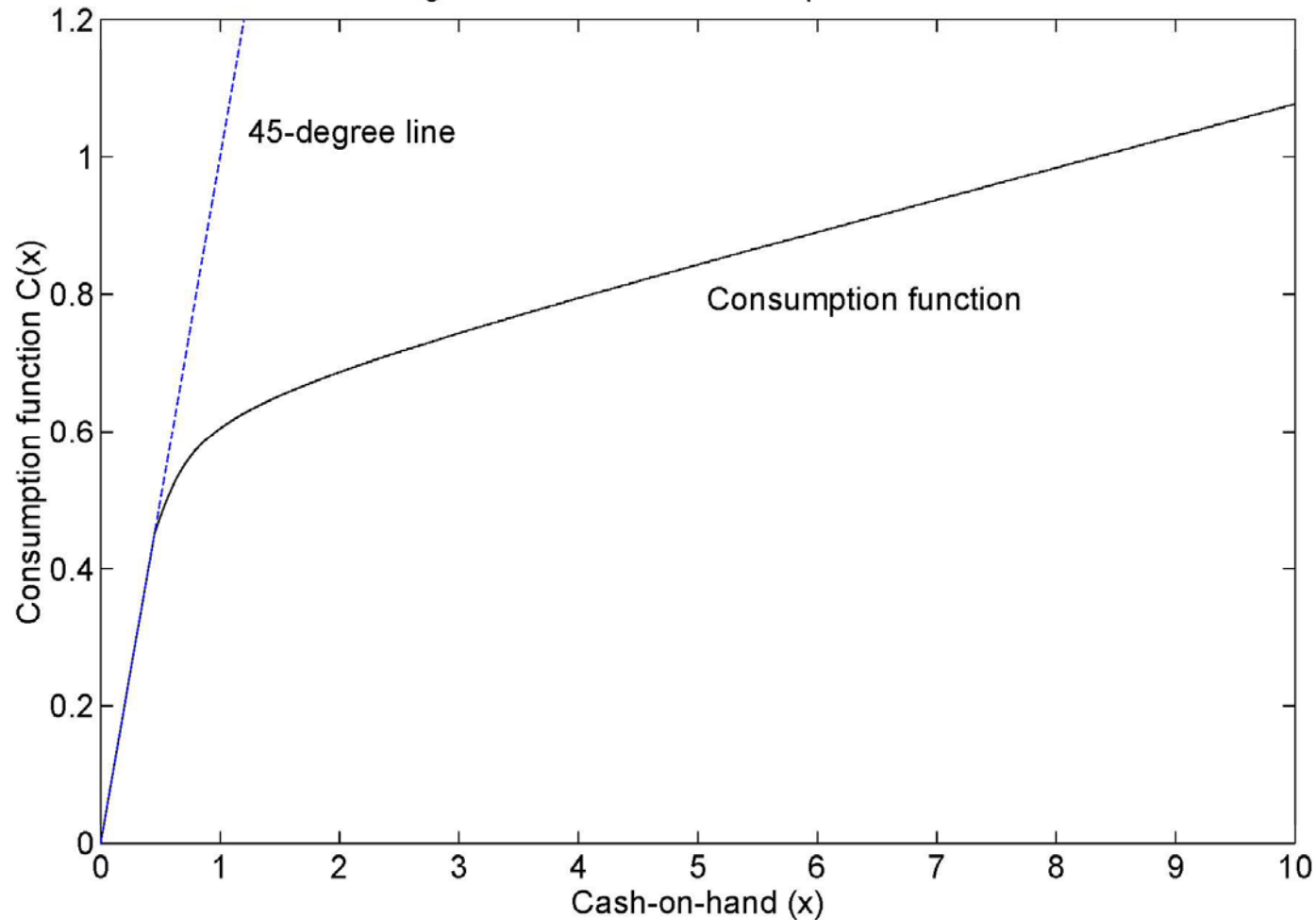
Theoretical Motivation for Estimation

- Benchmark model in which cash on hand plays small role in consumption function relies either on perfect foresight (no uncertainty) or quadratic utility (Carroll (2001))
- Three alternatives to the benchmark model:
 - Precautionary savings (Carroll (1992))
 - Borrowing constraints (Deaton (1991))
 - Hyperbolic discounting (Harris and Laibson (1992))
- All three frameworks produce a concave consumption function in which shocks to cash on hand can have large consumption effects for low cash on hand consumers

Concavity Illustration

Harris and Laibson (2002)
See also Carroll (2001)

Figure 2: Calibrated consumption function

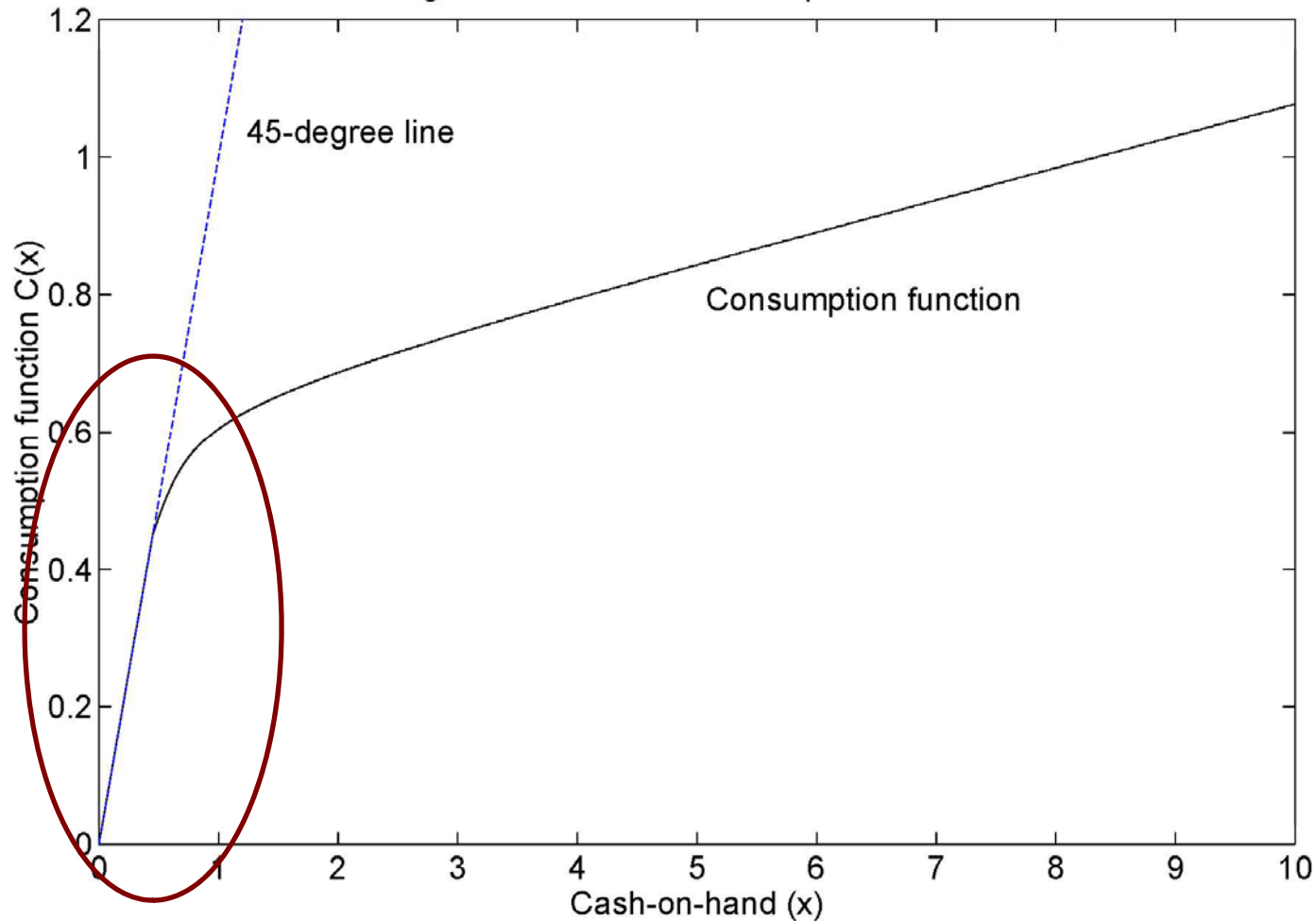


The consumption function is based on simulations in which $\beta = .7$, $\delta = .9571$, $\rho = 2$, $R = 1.0375$, $a = 5$.

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Implications

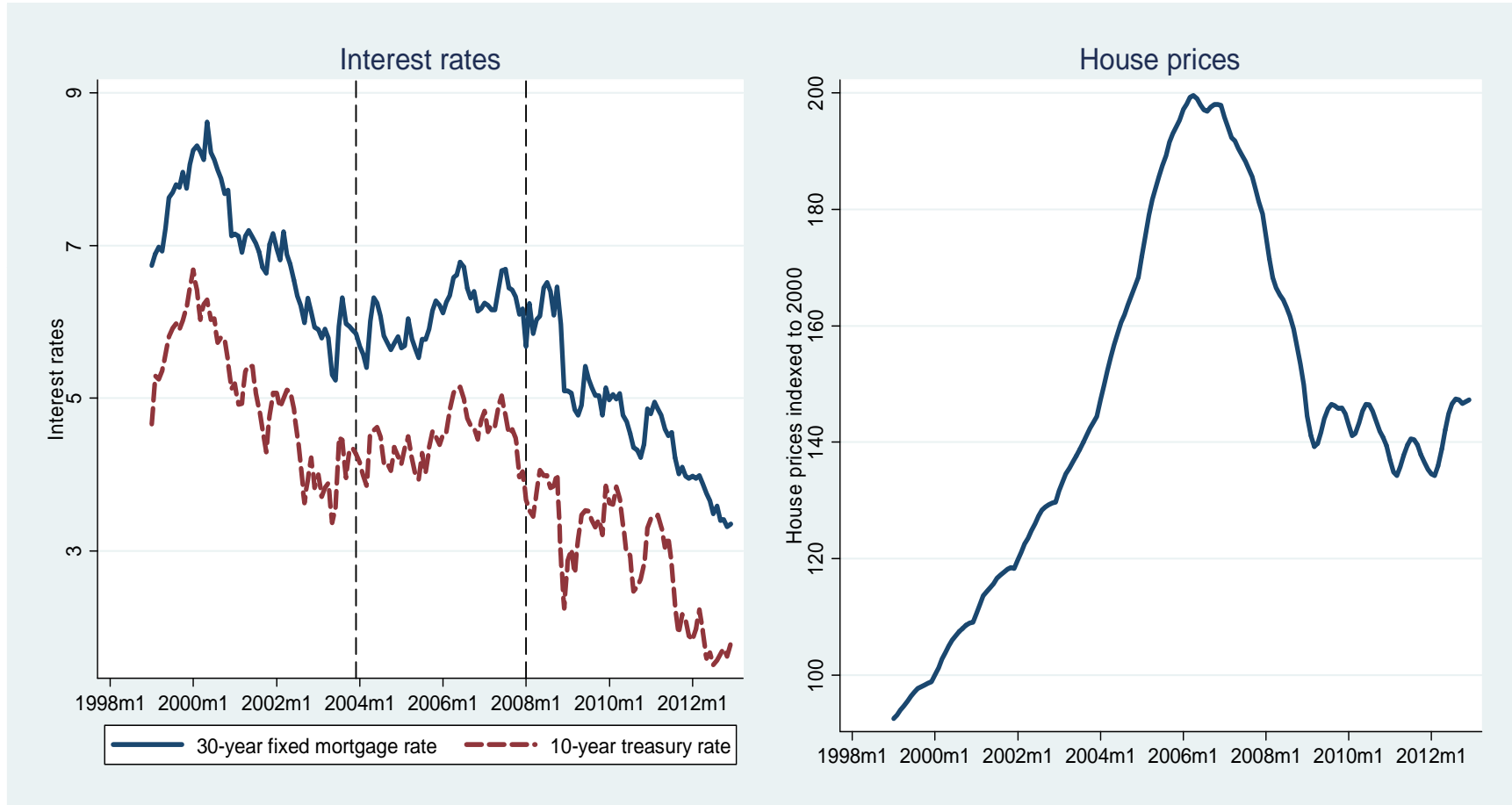
- Movements in interest rates and house prices have strongest effect if they lead to higher cash on hand
- This is different than other channels in literature ...
 - where interest rate movements affect current consumption because of inter-temporal substitution (as in NK models)
 - where house prices affect spending via “housing wealth effect”
 - In our framework, getting cash into hands of consumers has largest consumption effect
- The population margin for aggregate movements is crucial
 - Interest rates and house prices have largest effect if they lead to cash on hand for “constrained,” or “low cash-on-hand” households

Focus on Aggregate Refinancing Waves

- Cash on hand leads to a natural focus on mortgage refinancing waves which puts cash in hands of homeowner
- Aggregate house price and interest rate movements may or may not translate into cash-on-hand shocks, depending on factors such as credit supply frictions
 - Underwater homeowners unable to refinance in 2009-2011
 - Low cash-out refinancing despite strong HP growth, 2011-2013
- We split aggregate refinancing waves into two types
 - House-price driven refinancing (primarily “cash-out” refinancing)
 - Interest-rate driven refinancing (primarily “no-cash-out” refinancing)

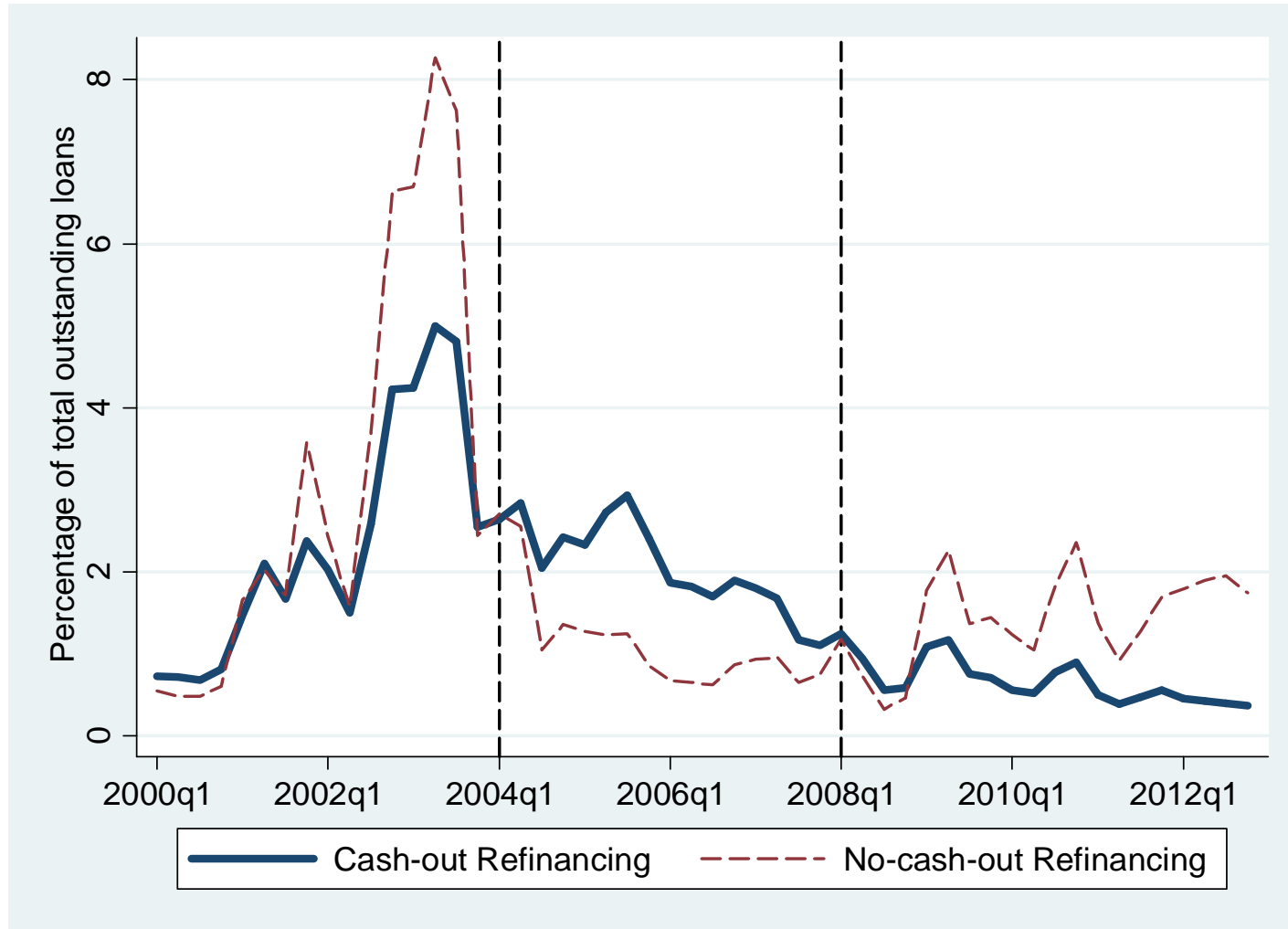
Interest Rates and House Prices, 2000 – 2012

(Figure 1)



Mortgage Refinancing Waves, 2000 – 2012

(Figure 2)



Empirical Specification

- Consumption function specification, where X represents cash-on-hand shocks coming from mortgage refinancing

$$\ln(C_{zt}) = \alpha_z + \eta_t + \beta * X_{zt} + \varepsilon_{zt}$$

- Identification concern:

$$E[\varepsilon_{zt} | \alpha_z, X_{zt}] \neq 0$$

- For example,
 - Lenders may decide to lend more freely into certain zip codes at time t because they see better income, which affects spending
 - House prices rise because of improved conditions which affects spending

Bartik Strategy

- Form control and treatment zip codes based on cross-sectional exposure to aggregate refinancing shocks:

$$X_{zt} = \widehat{X}_{zt} + X_t$$

$$\widehat{X}_{zt} = \delta_z^X X_t + X_{zt}^\varepsilon$$

- The term δ_z^X represents a cross-sectional fixed attribute of a zip code that makes it more subject to aggregate movements in X_t
- Bartik idea: variation in \widehat{X}_{zt} is driven by a cross-sectional fixed attribute multiplied by an aggregate shock – less likely to be polluted by omitted variables than X_{zt}

House-Price Driven Refinancing

Cross-Sectional Determinants of Cash-out Refinancing

(Table 2)

	(1)	(2)	(3)	(4)	(5)	(6)
	House price growth, 2002-2007	Cash-out refinancing share	Cash-out refinancing share	Cash-out refinancing share	Cash-out refinancing beta (Bartik)	Cash-out refinancing beta (Bartik)
Housing supply inelasticity	0.524** (0.085)		1.218** (0.247)	0.037 (0.314)	0.858** (0.188)	-0.003 (0.276)
Low credit score fraction (LCS)				-3.467** (0.722)		-3.084** (0.597)
LCS x inelasticity				4.786** (1.061)		3.373** (0.857)
House price growth, 2002-2007		0.559* (0.259)				
Constant	-0.054 (0.046)	1.392** (0.087)	0.742** (0.153)	1.603** (0.195)	0.376** (0.115)	1.155** (0.183)
Observations	5,244	5,244	5,244	5,243	5,244	5,243
R-squared	0.221	0.042	0.160	0.188	0.108	0.159

** p<0.01, * p<0.05

Cross-Sectional Determinants of Cash-out Refinancing

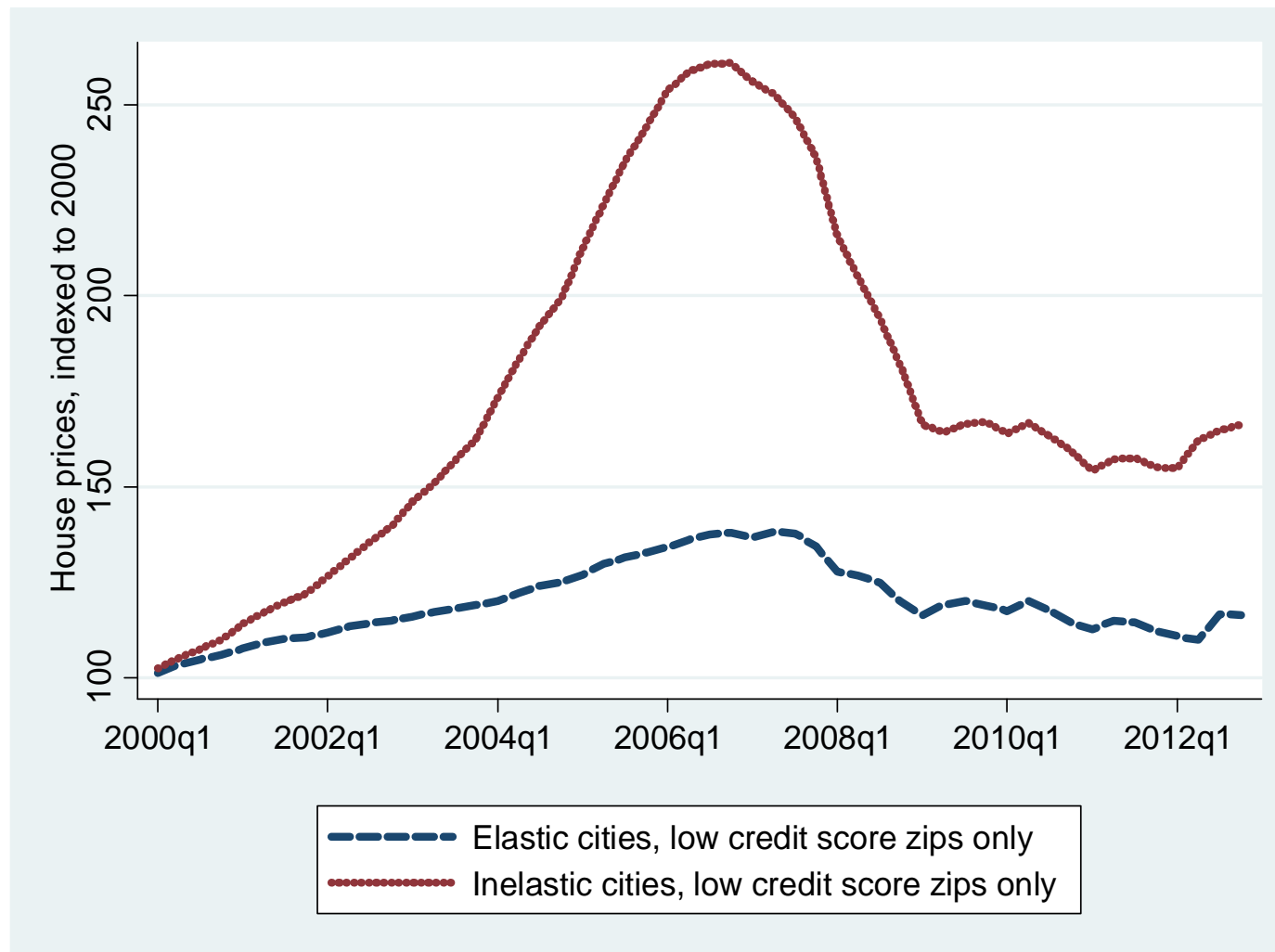
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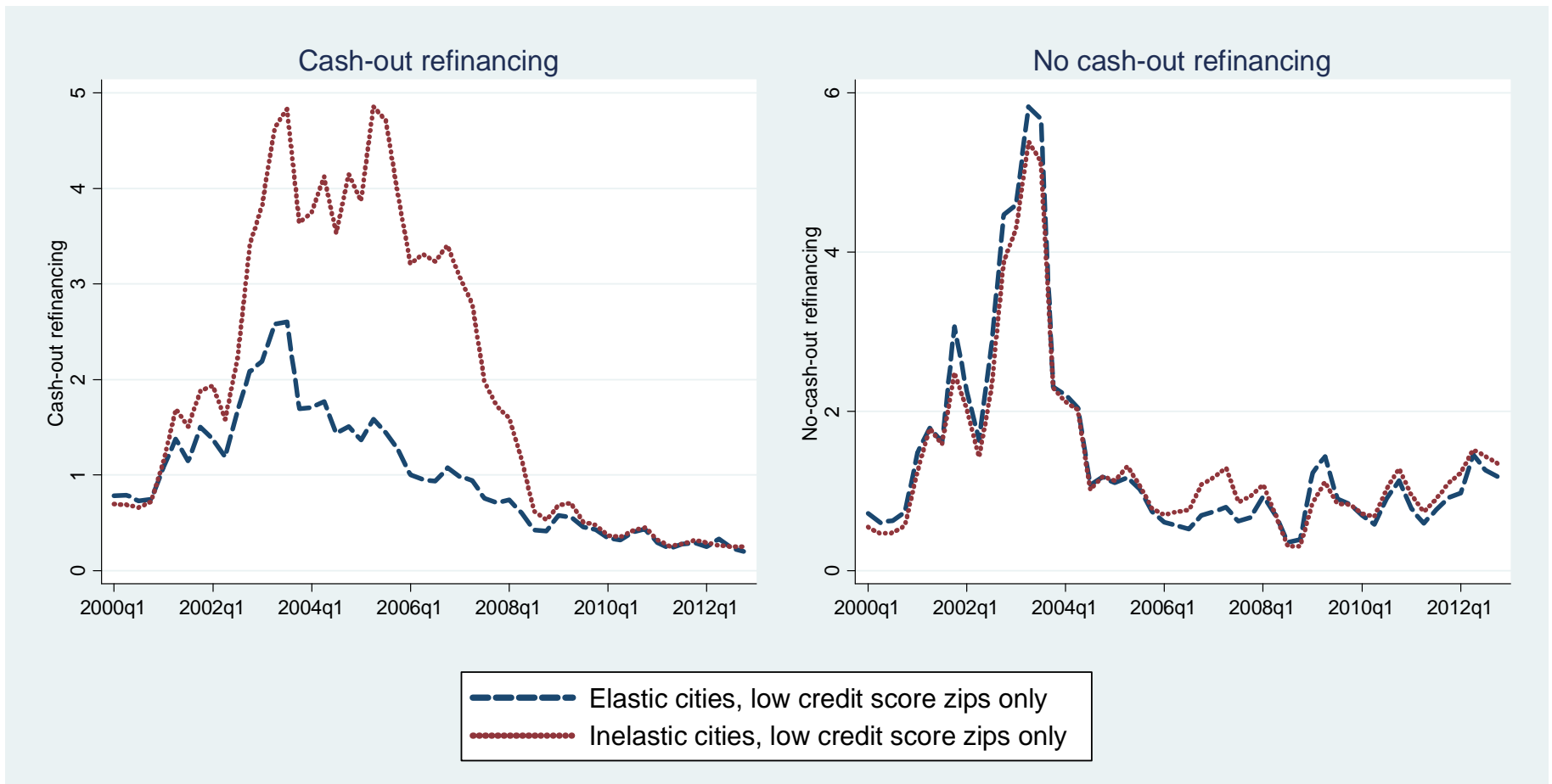
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δ_z^X

House Price Growth in Low Credit Score Zips Elastic and Inelastic Housing Supply Cities



Refinancing in Low Credit Score Zips Elastic and Inelastic Housing Supply Cities



House-Price Driven Refinancing Specification

- First stage:

$$X_{zt}^{HPdriven} = \alpha_z + \sum_{t=2000q1}^{2012q4} D_t + \sum_{t=2000q1}^{2012q4} D_t * Inelas_c * \beta_t^{inelas} +$$

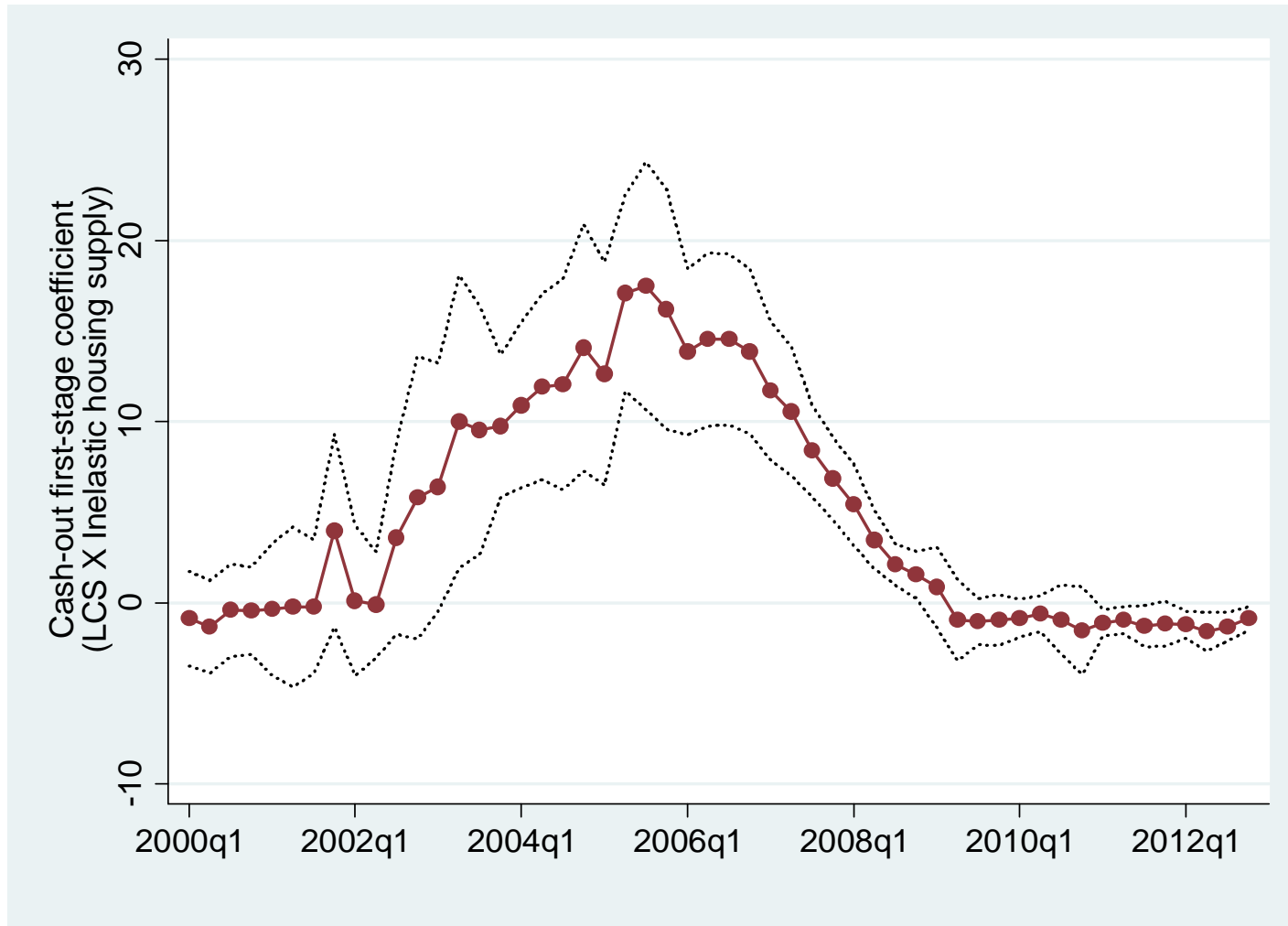
$$\sum_{t=2000q1}^{2012q4} D_t * LCS_z * \beta_t^{LCS} + \sum_{t=2000q1}^{2012q4} D_t * LCS_z * Inelas_c * \beta_t^{Inter} + \varepsilon_{zct}$$

- Second stage:

$$\ln(C_{zt}) = \alpha_z + \sum_{t=2000q1}^{2012q4} D_t + \beta^{HPdriven} * \widehat{X}_{zt}^{HPdriven} + \varepsilon_{zt}$$

First Stage Coefficients

Cash-out Refi and Low Credit Score * Inelastic Housing Supply



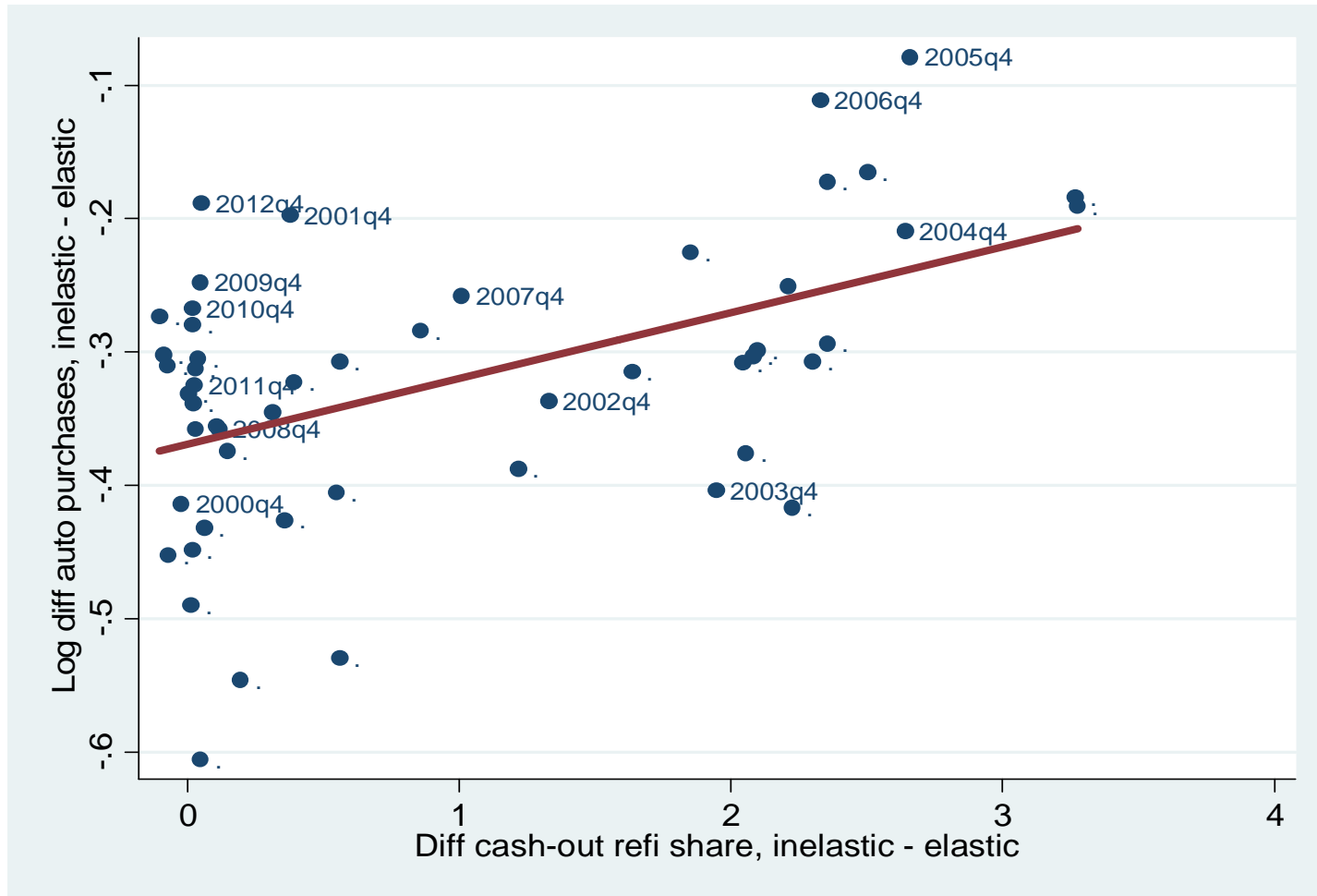
The Effect of House-Price Driven Refinancing on New Auto Purchases

(Table 3)

	Dependent variable: Ln(new auto purchases per capita)					
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	IV	IV	Bartik	IV, only LCS*inelastic as instrument	IV, only LCS*inelastic as instrument,
	Ln(New auto purchases per capita)					
Cash-out refinancing share	0.046** (0.005)	0.049** (0.010)	0.037** (0.012)		0.059* (0.024)	0.062* (0.026)
Bartik cash-out refinancing share				0.037** (0.007)		
CBSA x quarter FE?	No	No	No	No	No	Yes
Controls?	No	No	Yes	Yes	Yes	Yes
Observations	272,667	272,604	268,393	268,456	268,393	268,393
R-squared	0.849	0.846	0.850	0.850	0.852	0.858

** p<0.01, * p<0.05

Cash-out Refinancing and Spending Second Stage Visualization



Strong Heterogeneity in Effects

- Our data allow us to ask following question: for a given increase in house prices, how to “constrained” and “unconstrained” households respond differentially?
- At the 10th percentile of the credit score distribution, effect of house price growth on cash-out refinancing and auto sales about twice as large as at 90th percentile
- Same result using income or net worth as measure of “constraints”
- Strong heterogeneity of the effect, just as in theories!

Interest-Rate Driven Refinancing

Lesson Learned

- House-price driven refinancing matters for spending because they translate into higher cash-on-hand for “constrained,” or “low cash-on-hand” agents
- As we will see, interest-rate driven refinancing operates on completely different margin
- *Highest* credit score households most likely to refinance mortgages when interest rates collapse, which likely reflects tighter credit conditions in recessions
- Does interest-rate driven cash-on-hand shocks lead to higher spending despite operating on “wrong” margin?

Cross-Sectional Determinants of No-cash-out Refinancing

(Table 6)

	(1)	(2)	(3)	(4)
	No-cash-out refinancing share	No-cash-out refinancing share	No-cash-out refinancing beta (Bartik)	No-cash-out refinancing share, 2008-2012
Housing supply inelasticity	-0.007 (0.262)	0.413 (0.569)	-0.270 (0.377)	
Low credit score fraction (LCS)	-3.614** (0.250)	-2.447** (0.878)	-2.917** (0.598)	
LCS x inelasticity		-1.720 (1.449)	0.195 (0.973)	
No-cash-out refi share, 00-03				0.429** (0.043)
Constant	2.678** (0.117)	2.390** (0.319)	1.799** (0.213)	0.086 (0.148)
Observations	5,243	5,243	5,243	5,244
R-squared	0.356	0.358	0.462	0.510

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Interest-Rate Driven Refinancing Specification

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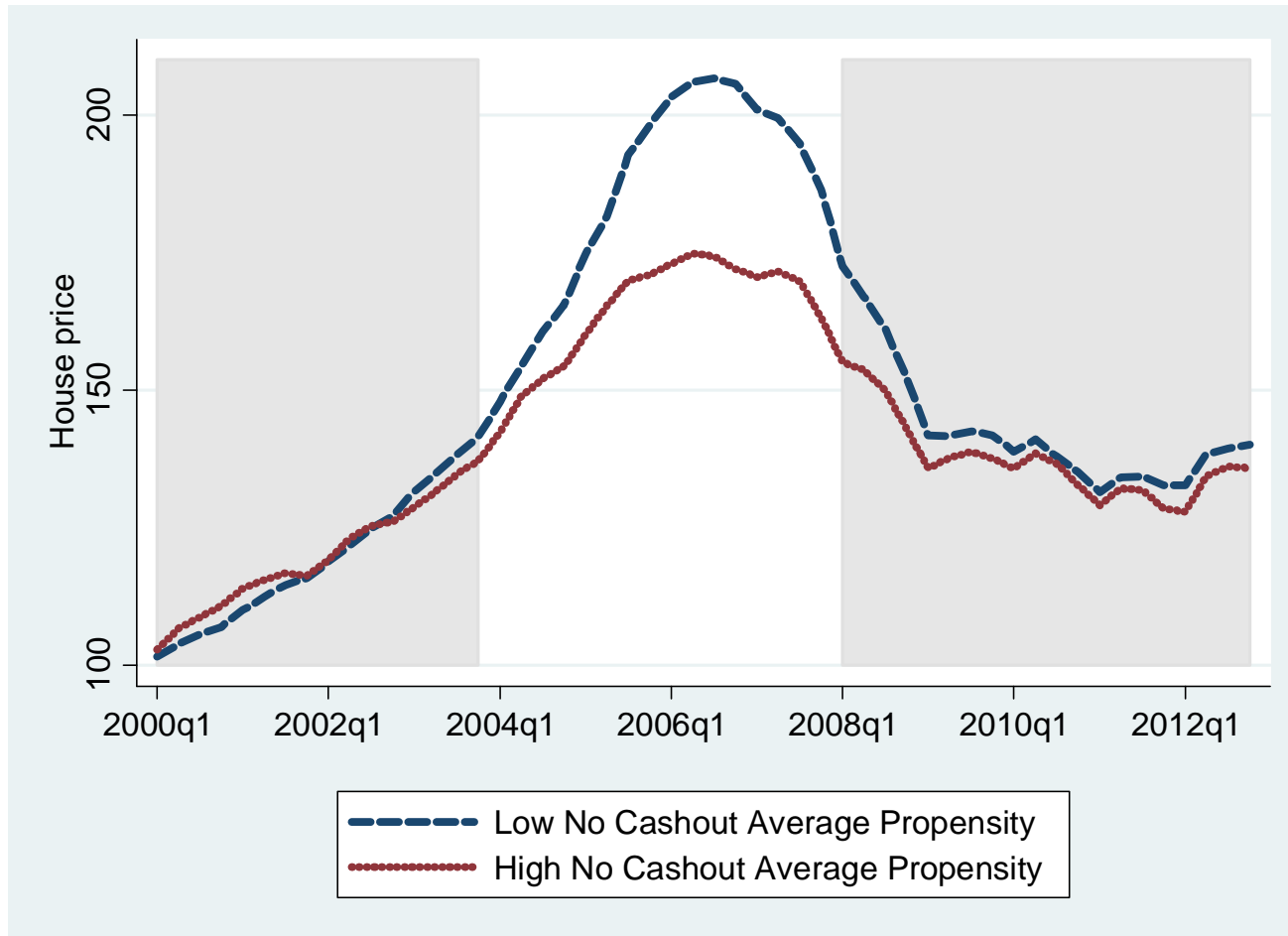
$$X_{zt}^{IRdriven} = \alpha_z + \sum_{t=2000q1}^{2012q4} D_t + \delta_z^{IRdriven} * X_t^{IRdriven} + \varepsilon_{zt}$$

- Second stage:

$$\ln(C_{zt}) = \alpha_z + \sum_{t=2000q1}^{2012q4} D_t + \beta^{HPdriven} * \widehat{X}_{zt}^{HPdriven} + \varepsilon_{zt}$$

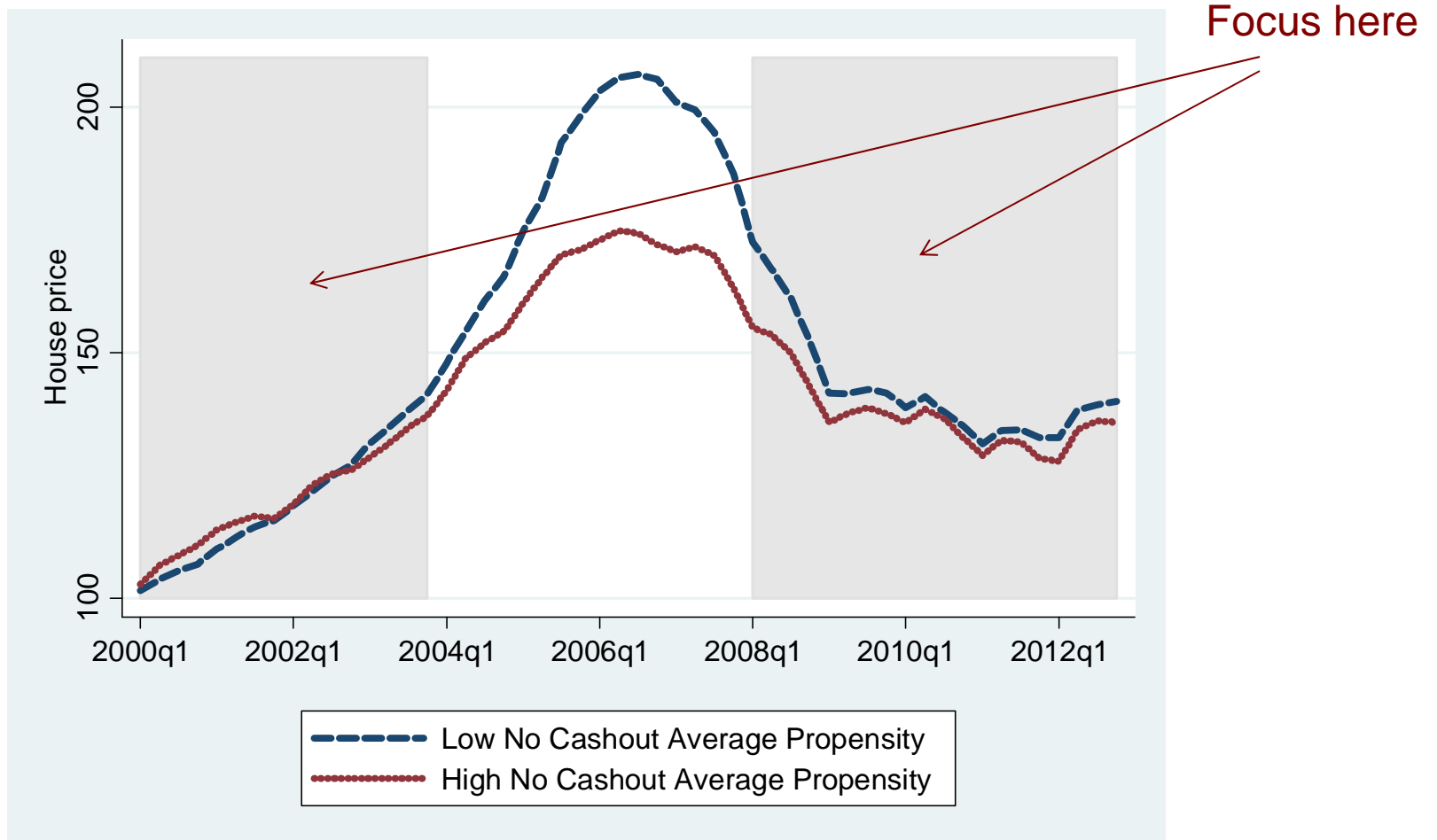
House Prices in High and Low No-Cash-Out Refinancing Zip Codes

(Figure 8)



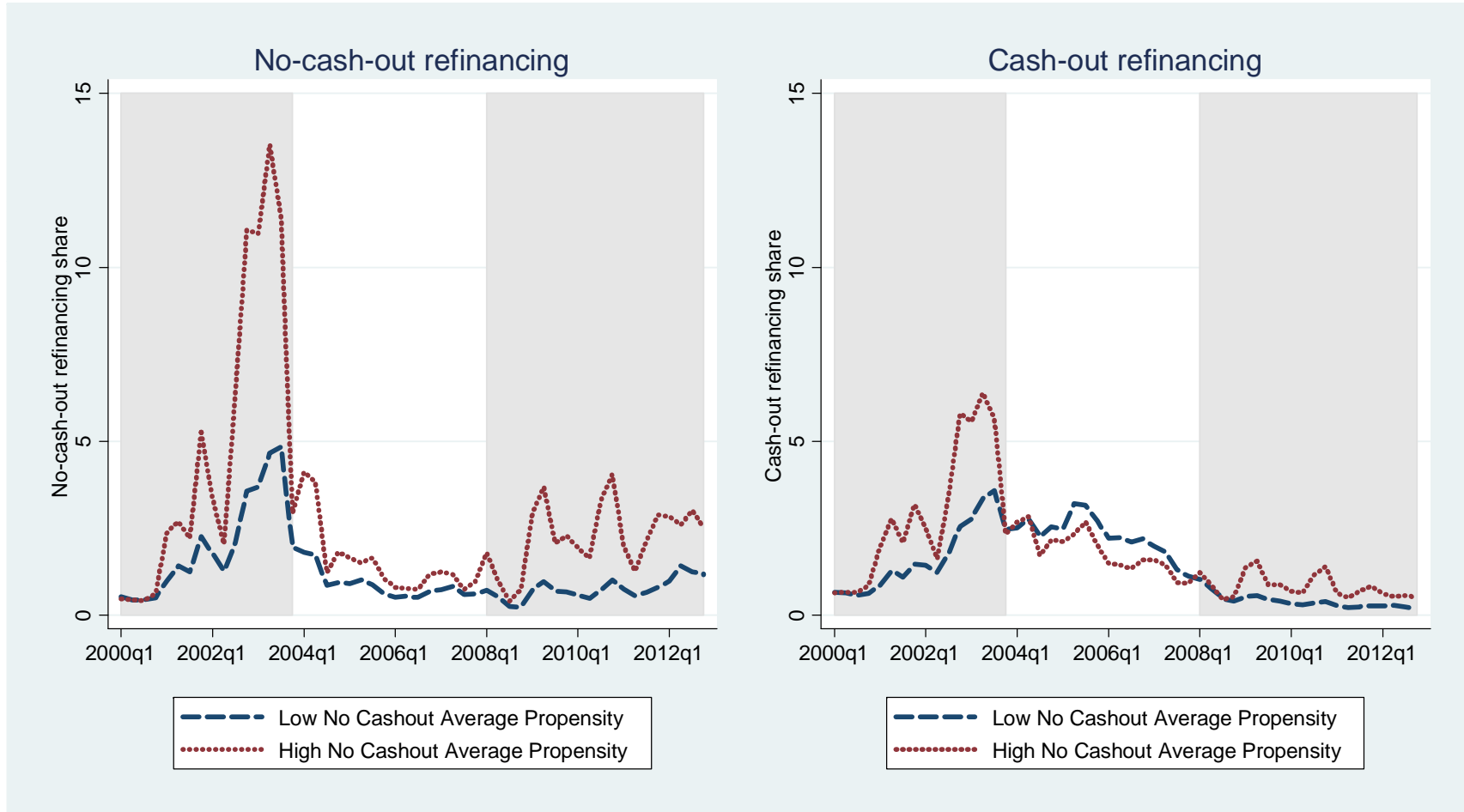
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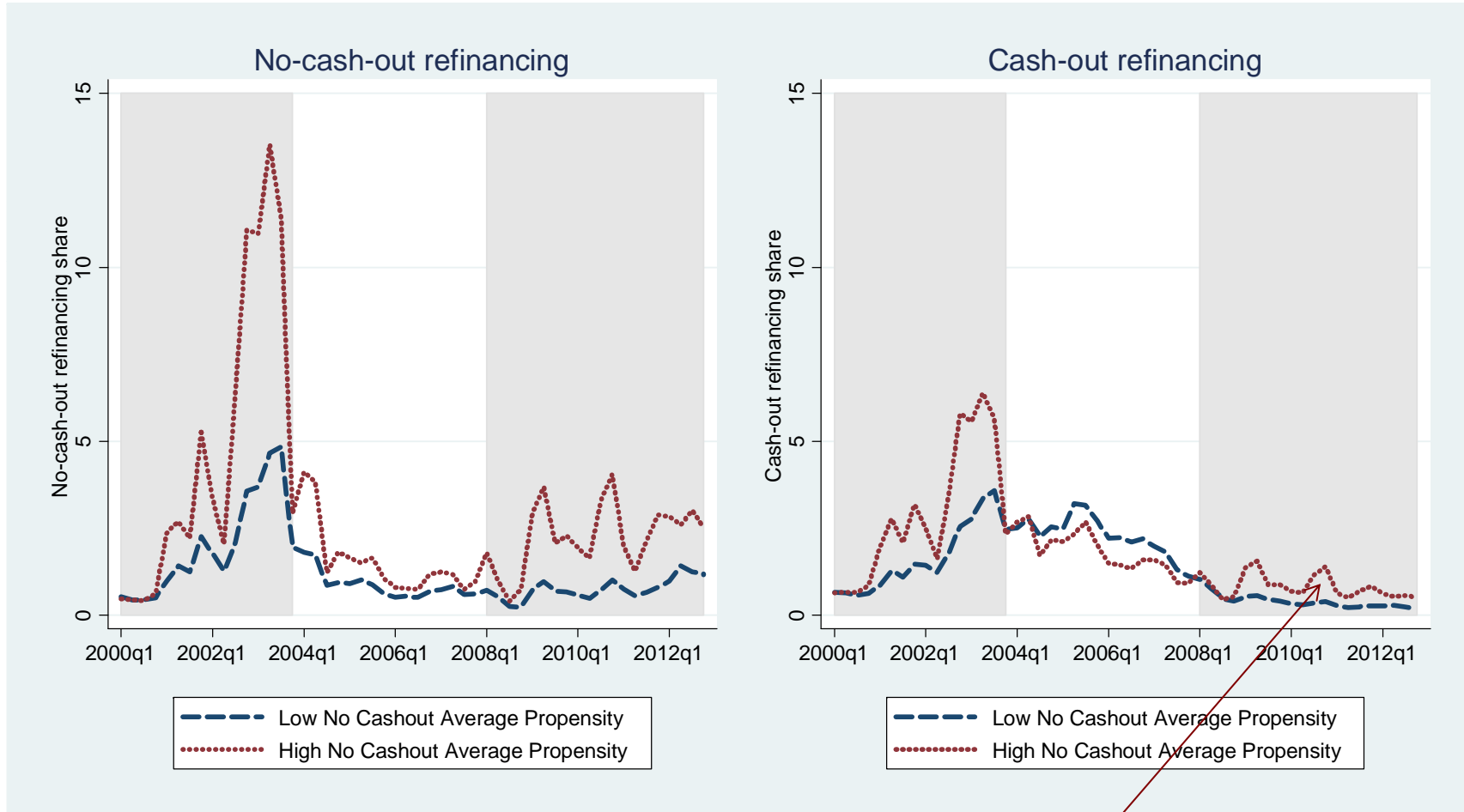
Mortgage Refinancing in High and Low No-Cash-Out Refinancing Zip Codes

(Figure 9)



Mortgage Refinancing in High and Low No-Cash-Out Refinancing Zip Codes

(Figure 9)



Even cash out refi responds!

The Effect of Interest-Rate-Driven Refinancing on New Auto Purchases

(Table 7)

Dependent variable	(1) No-cash-out refi share	(2) Cash-out refi share	(3) Total refi share	(4) Ln(new auto purchases per capita)	(5) Ln(new auto purchases per capita)	(6) Total refi share	(7) Ln(new auto purchases per capita)	(8) Total refi share	(9) Ln(new auto purchases per capita)
Estimation type	First stage	First stage	First stage	Reduced form	IV	First stage	IV	First stage	IV
Time period	2000-2012	2000-2012	2000-2012	2000-2012	2000-2012	2000-2003	2000-2003	2008-2012	2008-2012
Bartik no-cash-out refi share	0.635** (0.024)	0.264** (0.027)	0.900** (0.047)	0.000 (0.002)		0.883** (0.048)		0.992** (0.069)	
Total refi share					0.000 (0.003)		0.001 (0.003)		0.029** (0.007)
Observations	272,678	272,678	272,678	272,667	272,667	83,904	83,903	104,870	104,860
R-squared	0.905	0.686	0.856	0.845	0.845	0.920	0.888	0.790	0.884

** p<0.01, * p<0.05

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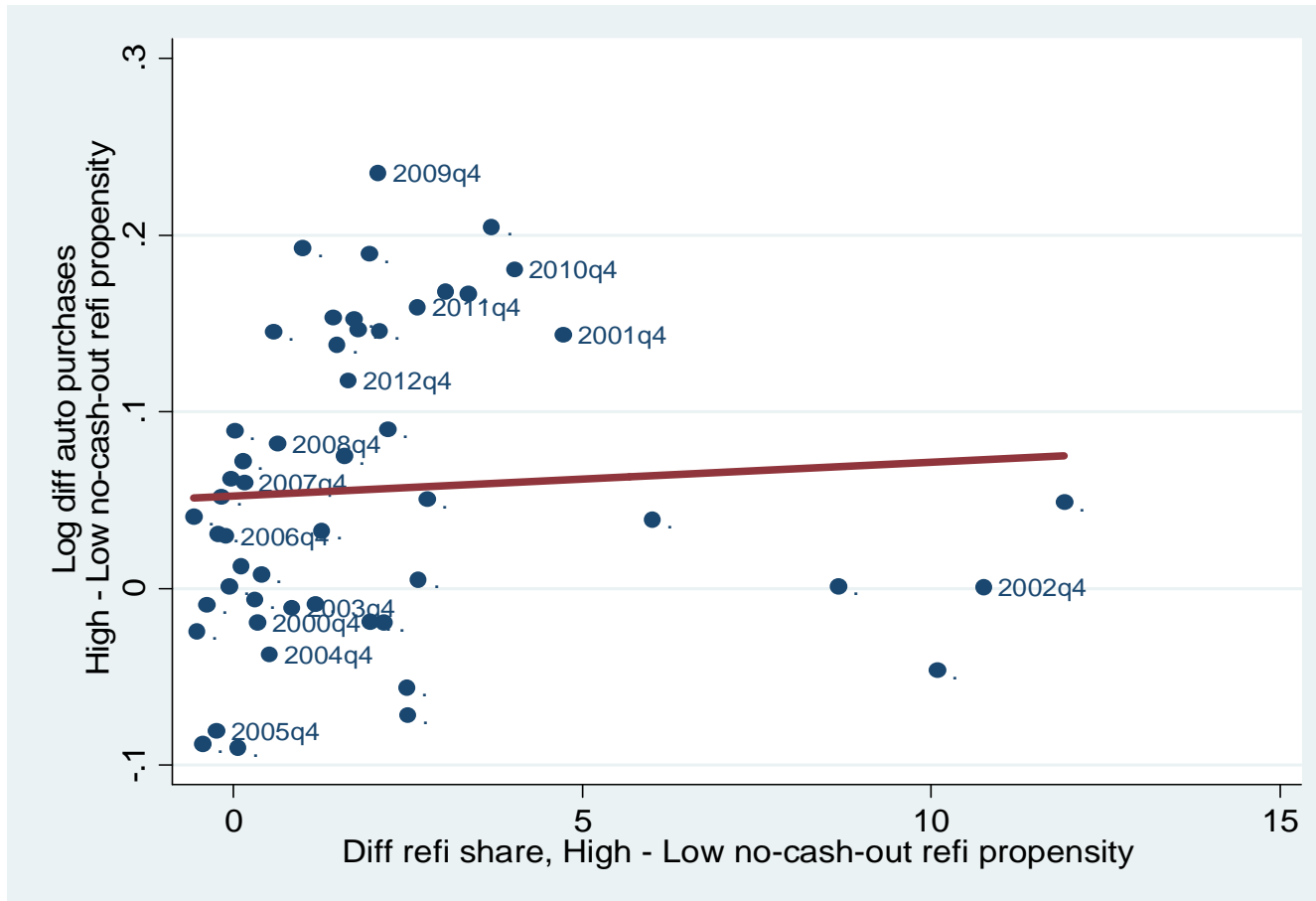
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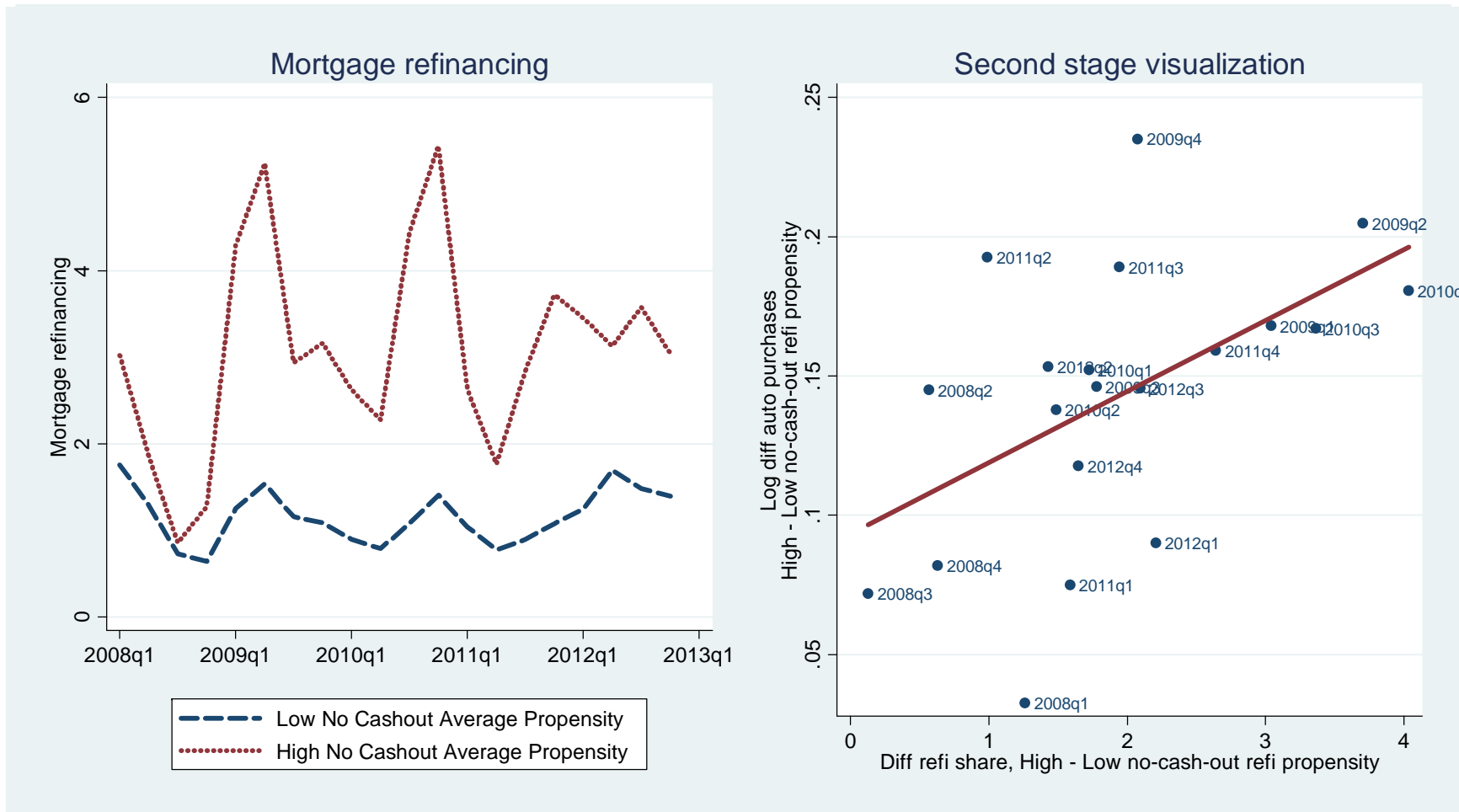
Interest Rate-Driven Refinancing and Spending Second Stage Visualization

(Figure 10)



Interest Rate-Driven Refinancing and Spending 2008 - 2012

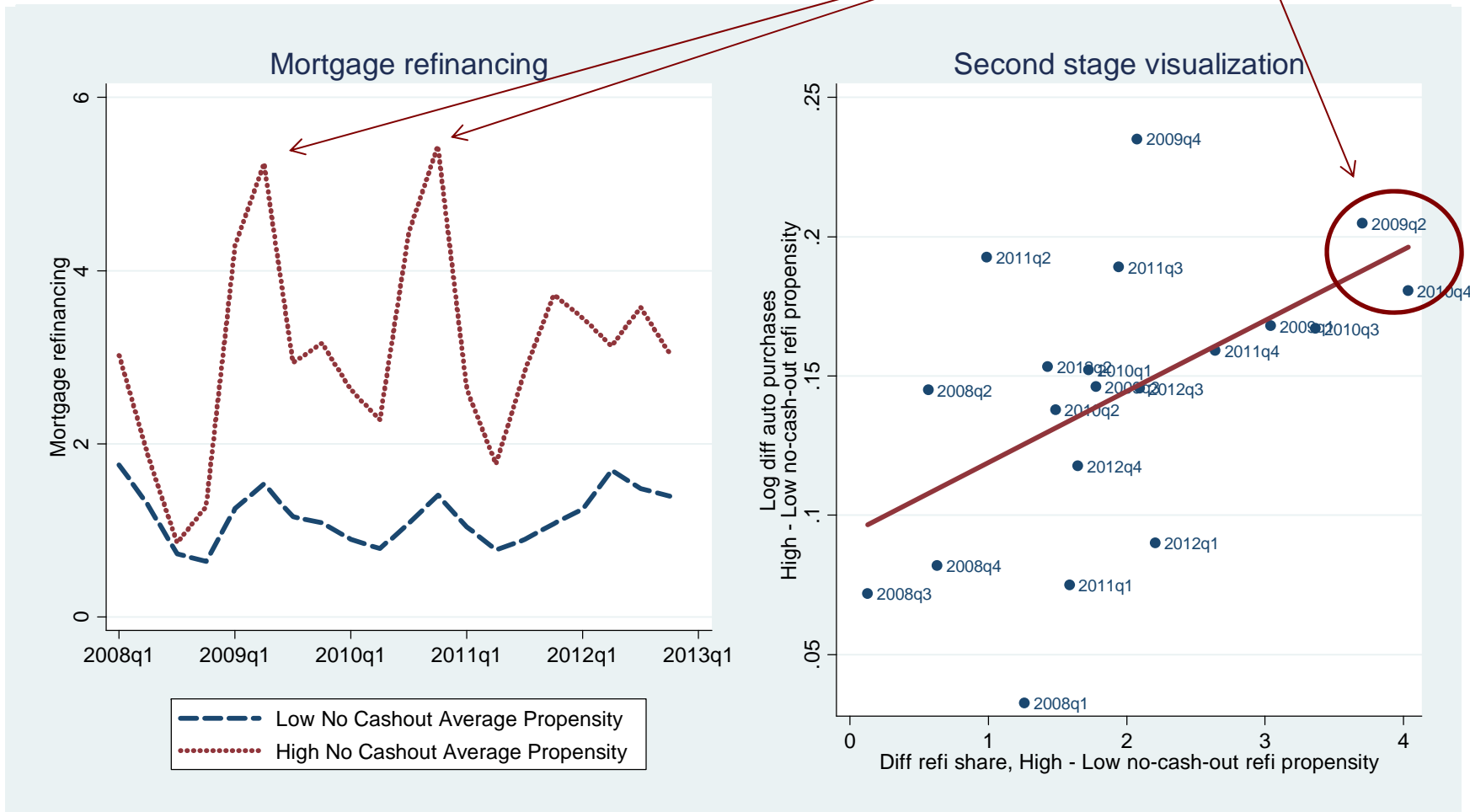
(Figure 11)



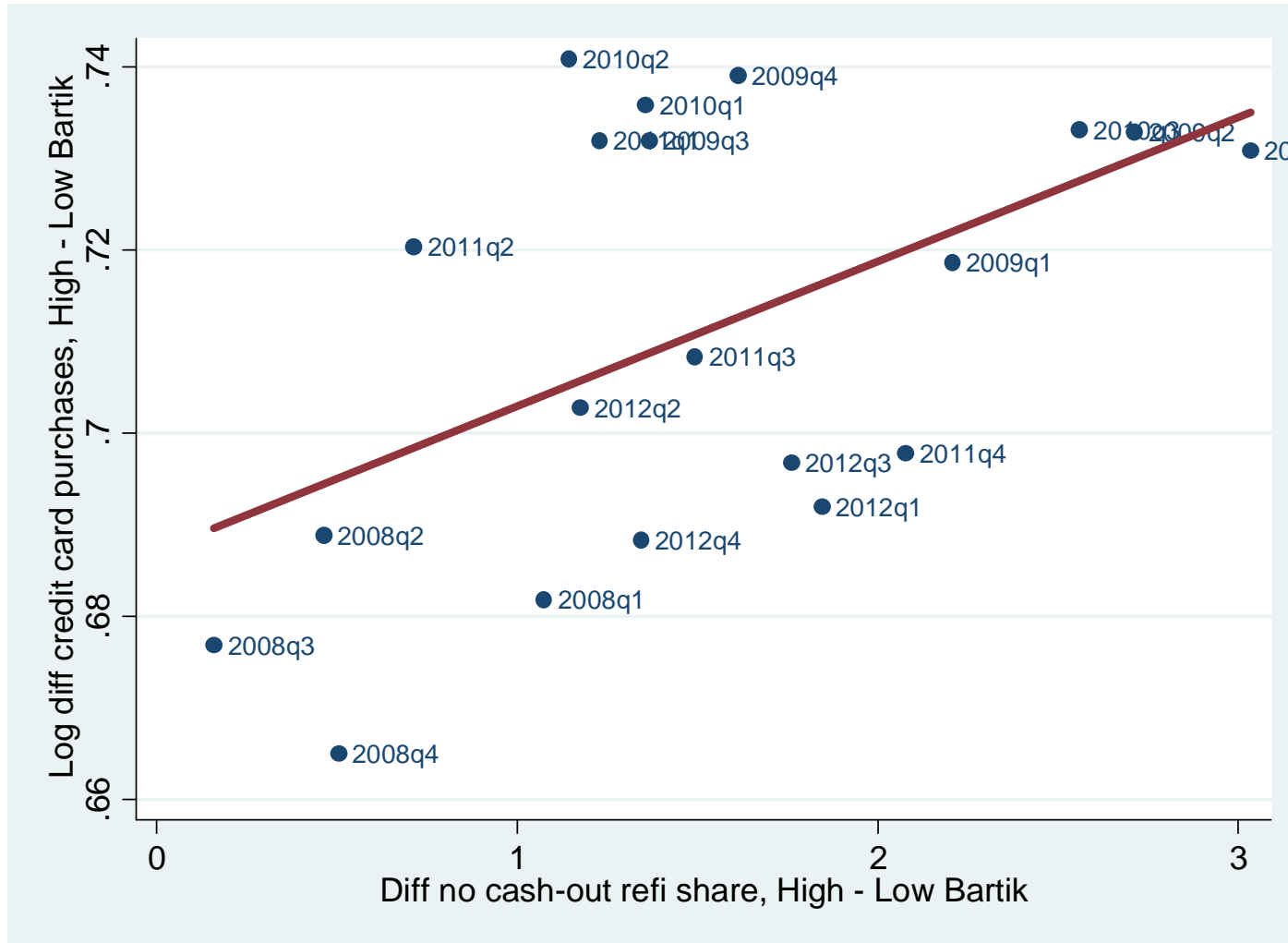
Interest Rate-Driven Refinancing and Spending 2008 - 2012

(Figure 11)

Refinancing peaks



Interest Rate-Driven Refinancing and Credit Card Spending 2008 – 2012



What Explains Spending Response in 2008-2012?

- Spending response to 2000 – 2003 interest rate-driven wave of refinancing was muted, which makes sense given highest credit score households affected most
- But why the strong effect in 2008 – 2012?
- In models of precautionary savings, a mean-preserving spread in income uncertainty will lead to depressed consumption today
- Given depressed level of current consumption, a positive cash-on-hand shock to high income households could theoretically boost spending significantly
- With enough income uncertainty, even the rich act “constrained”!

Conclusion

- Models where cash on hand matter for consumption suggest a focus on aggregate shocks that put cash in the hands of the most constrained borrowers
- We find evidence that house-price driven refinancing waves have strong effect on spending, which is due to the fact they operate on “right” population margin
- The evidence on interest-rate driven refinancing is mixed, with no effect from 2000 to 2003 but sizable effects from 2008 to 2012
- The latter hints at the importance of precautionary savings during Great Recession, even among higher income, higher credit quality households