

# "Cash on Hand" and Consumption: Evidence from Mortgage Refinancing

[PRELIMINARY AND INCOMPLETE]

Atif Mian  
Princeton University and NBER

Amir Sufi  
University of Chicago Booth School of Business and NBER

February 2014

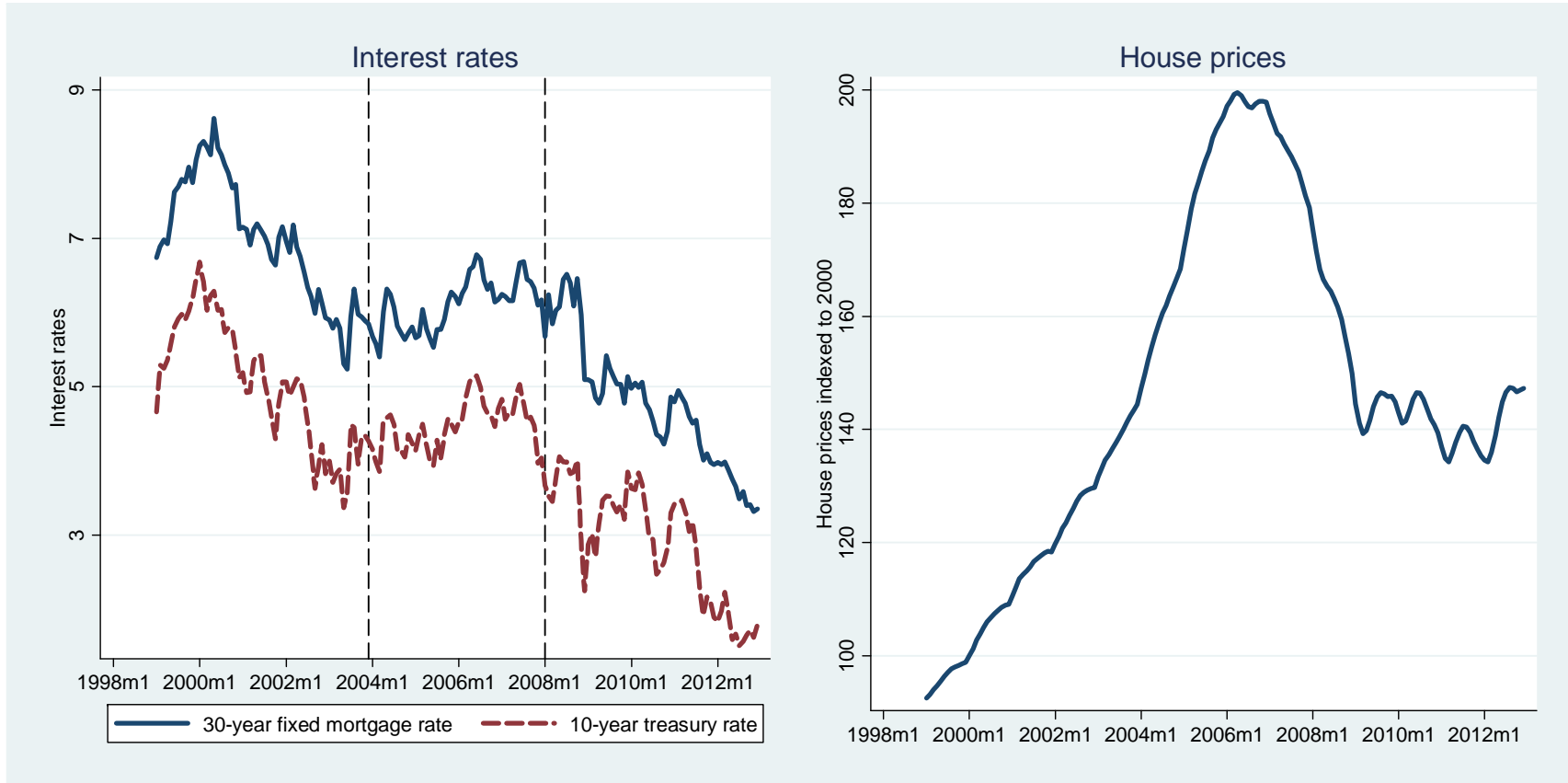
## Abstract

We investigate how house price and interest rate movements affect household spending through mortgage refinancing. Aggregate movements in house prices and interest rates generate sizable mortgage refinancing waves with a large amount of cross-sectional variation across U.S. zip codes in the share of mortgages that are refinanced. We use this cross-sectional variation across zip codes to examine the effect of refinancing--or "cash-on-hand" shocks--on household spending from 2000 to 2012. Cash-out refinancing in response to house price growth has a very large effect on household spending, particularly among low credit score, poorer zip codes. The effects of interest-rate driven mortgage refinancing are mixed. For the full sample, we find almost no effect of interest-rate driven mortgage refinancing on spending. However, we find a positive effect on spending during the 2008 to 2012 period. House-price growth-driven and interest-rate driven refinancing generate cash on hand shocks for different households, which is crucial for understanding these results.

\* This research was supported by funding from the Initiative on Global Markets at Chicago Booth, the Fama-Miller Center at Chicago Booth, and the Global Markets Institute at Goldman Sachs. Any opinions, findings, or conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the view of Goldman Sachs or the Global Markets Institute. We are very grateful to Doug McManus and his team at Freddie Mac for providing us with data. We thank Sydney Ludvigson, Jonathan Parker, and Luigi Pistaferri for helpful comments. Mian: (609) 258-6718, [atif@princeton.edu](mailto:atif@princeton.edu); Sufi: (773) 702 6148, [amir.sufi@chicagobooth.edu](mailto:amir.sufi@chicagobooth.edu)

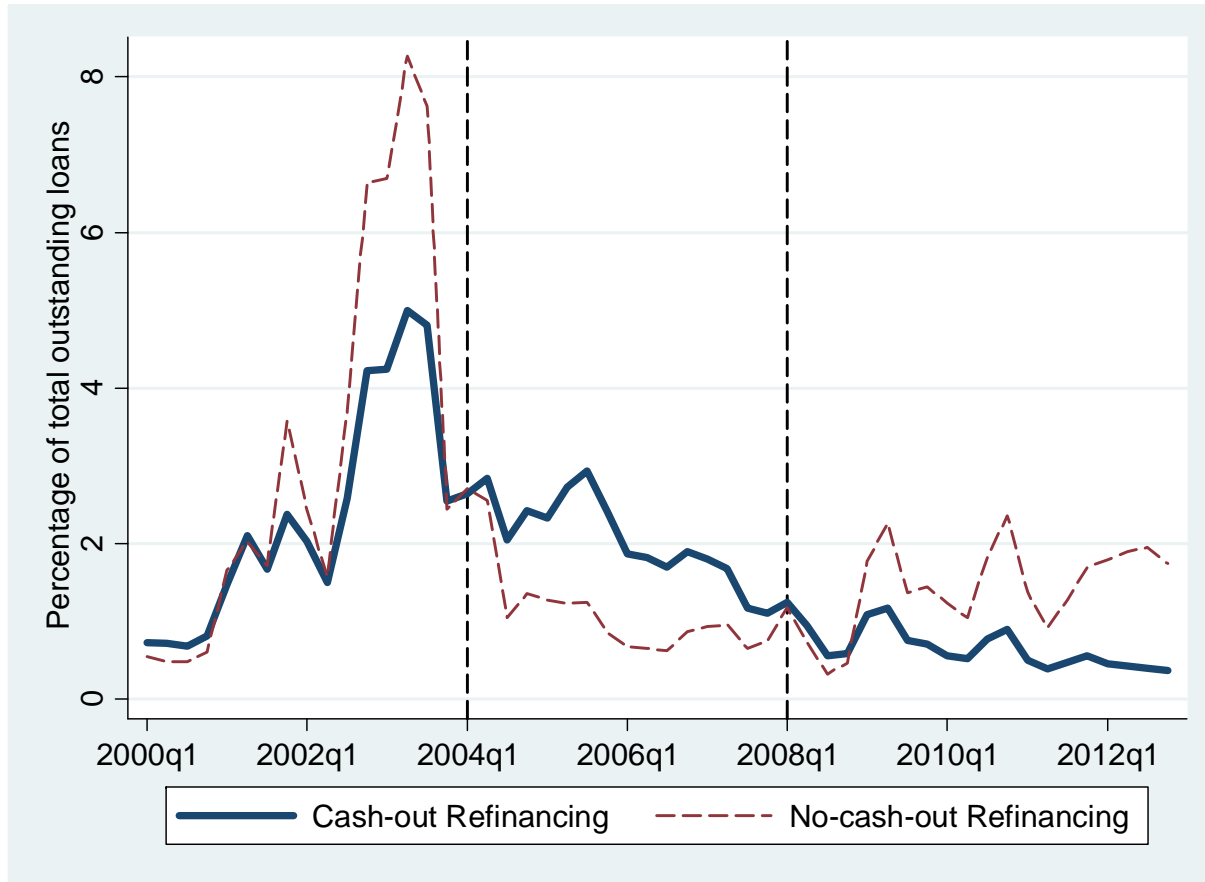
**Figure 1**  
**Interest Rates and House Prices, 2000-2012**

This figure plots interest rates and house prices from 1998 to 2012. Interest rate data are from FRED, and house price data is from CoreLogic.



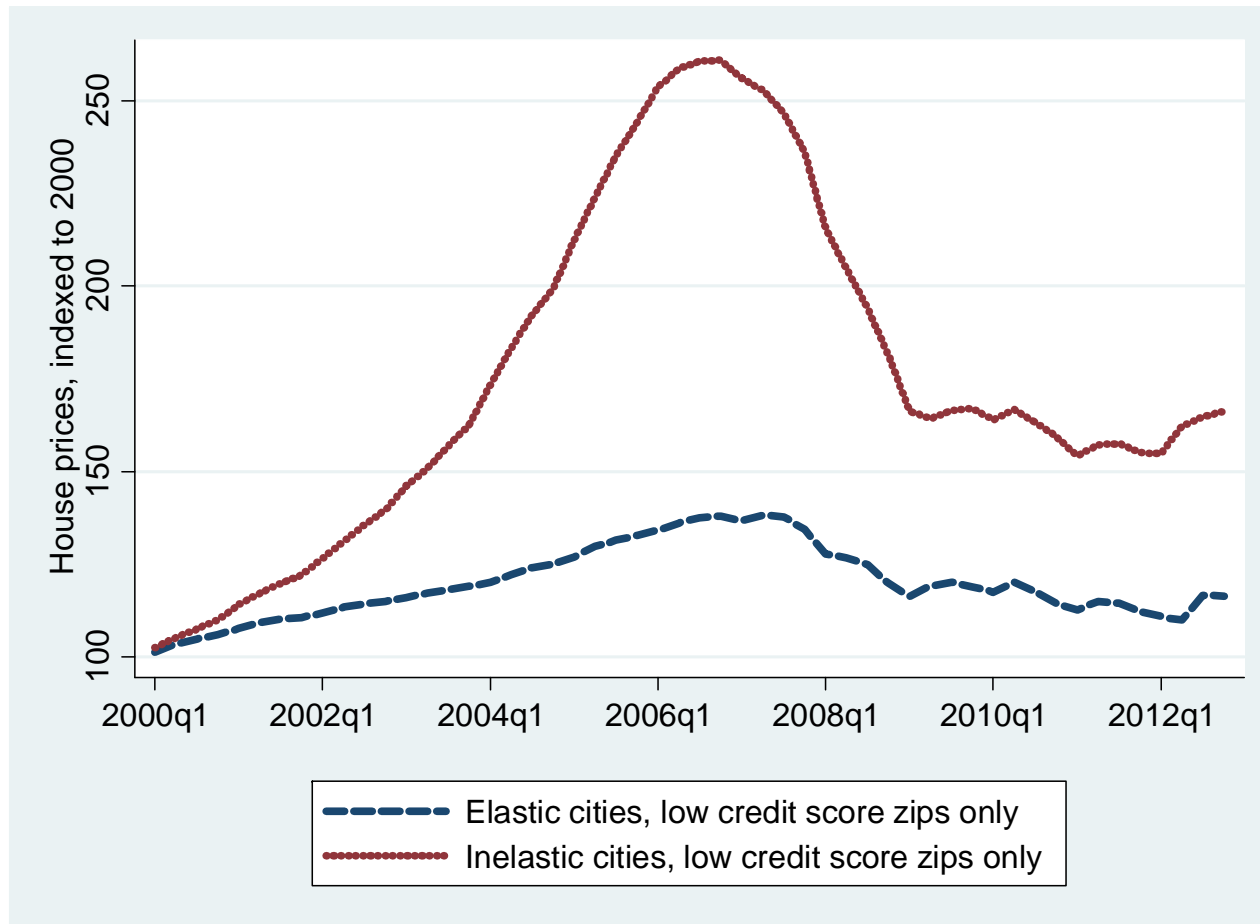
**Figure 2**  
**Aggregate Mortgage Refinancing**

This figure plots quarterly cash-out and no-cash-out mortgage refinancing, where the quarterly volume is scaled by the previous quarter's outstanding balance.



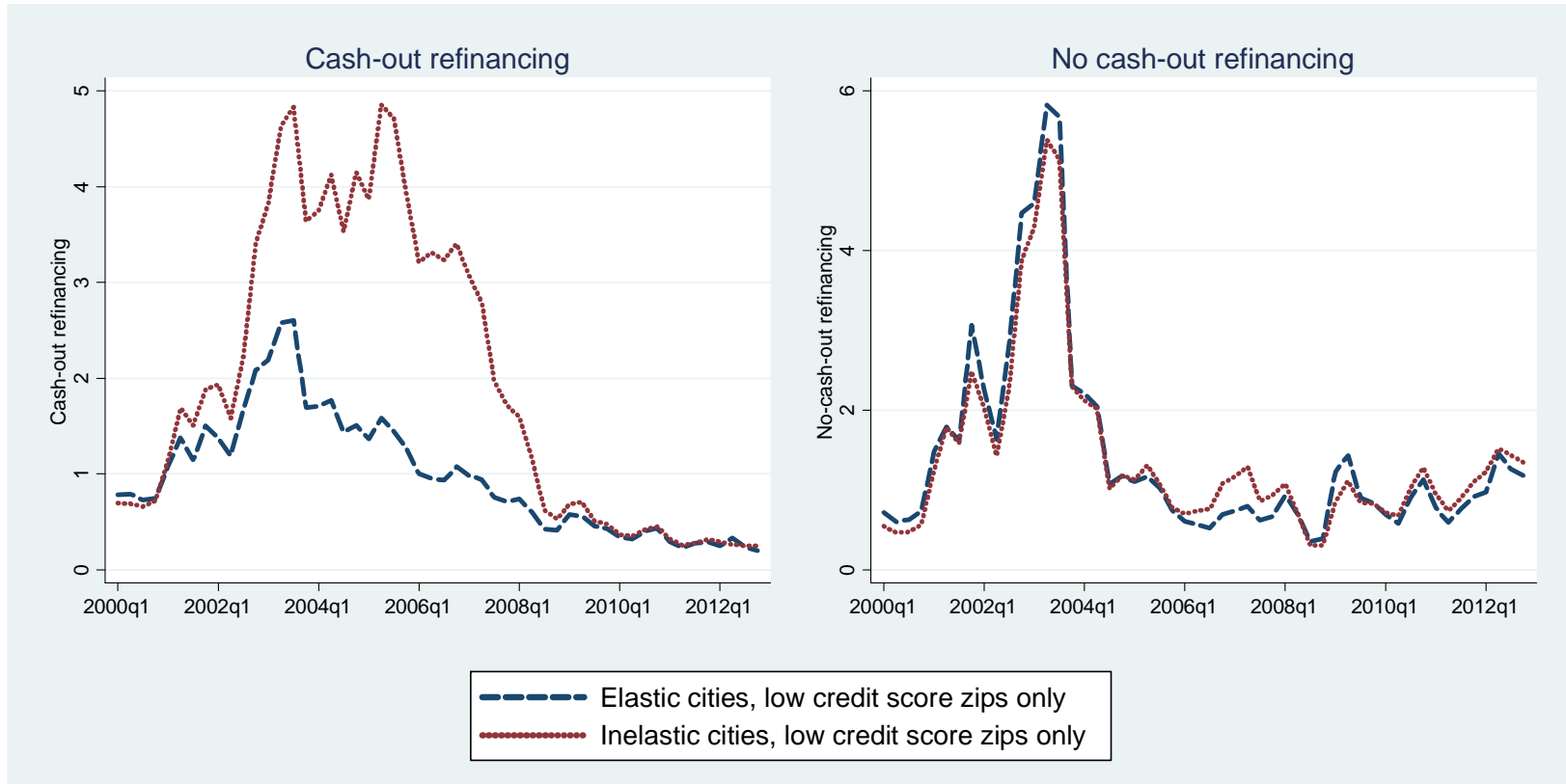
**Figure 3**  
**House Prices in Low Credit Score Zip Codes**  
**Elastic and Inelastic Housing Supply Cities**

This figure plots house price growth in low credit score zip codes, which are defined to be zip codes in the top population-weighted quartile of the low credit score fraction distribution. We split the sample of low credit score zip codes into top and bottom population-weighted quartiles based on their cities' housing supply elasticity.



**Figure 4**  
**Refinancing in Low Credit Score Zip Codes**  
**Elastic and Inelastic Housing Supply Cities**

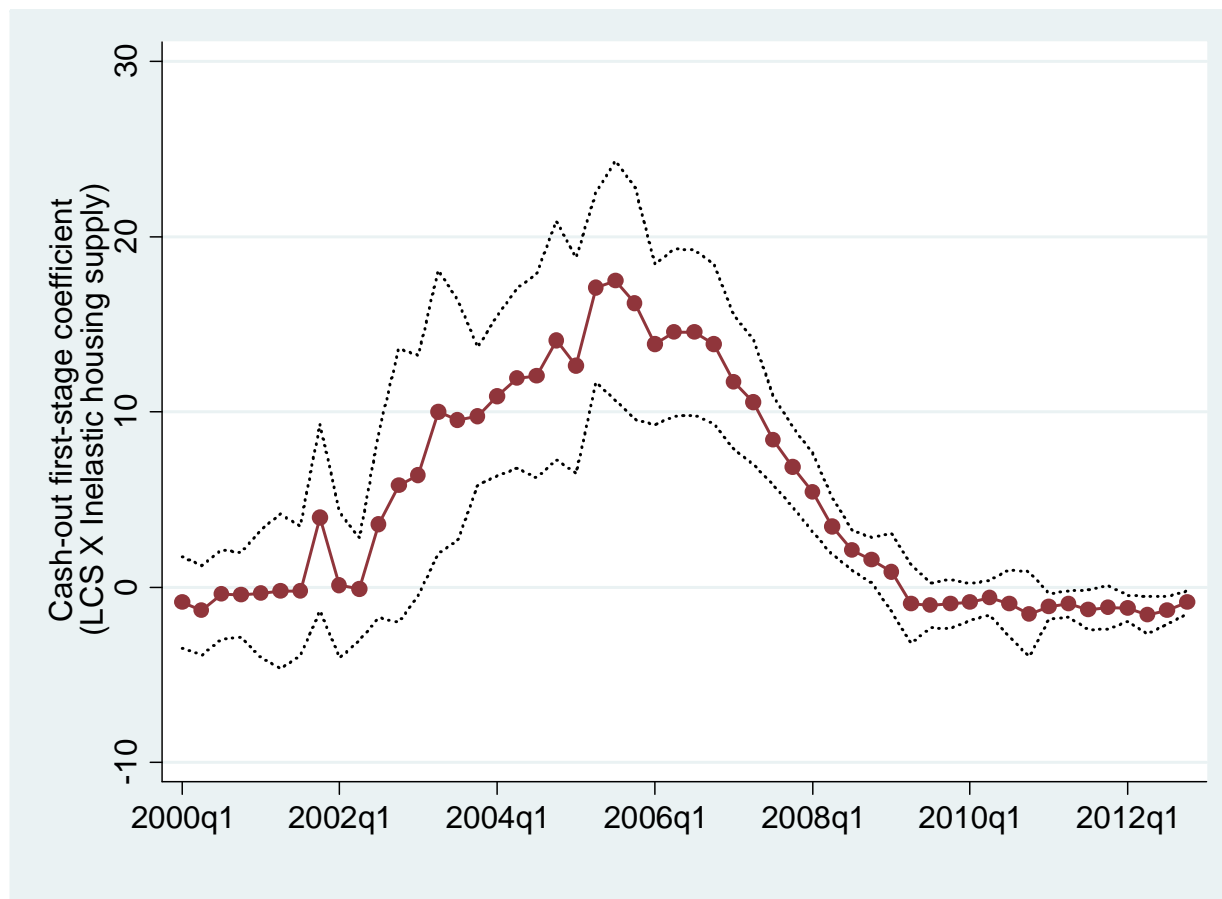
This figure plots refinancing activity in low credit score zip codes, which are defined to be zip codes in the top population-weighted quartile of the low credit score fraction distribution. We split the sample of low credit score zip codes into top and bottom population-weighted quartiles based on their cities' housing supply elasticity.



**Figure 5**

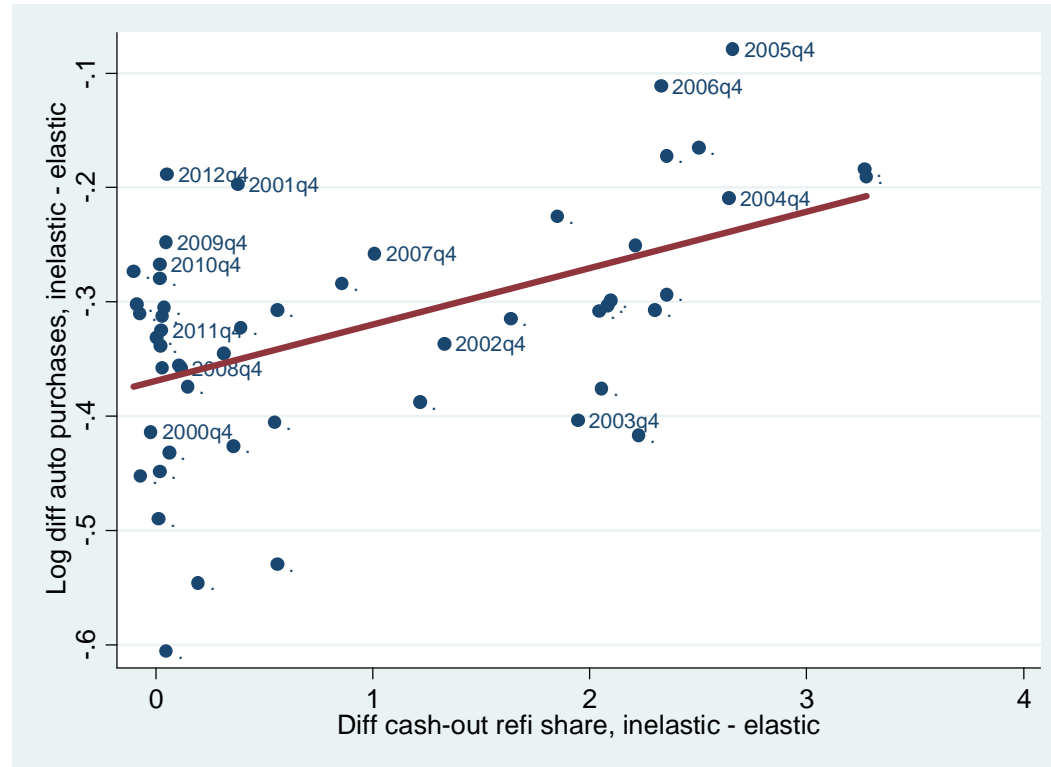
**First Stage Coefficients: Cash-out Refinancing and Low Credit Score \* Inelastic Housing Supply**

This figure plots the first stage coefficients of a regression relating the share of outstanding mortgages that are refinanced with cash out in a quarter to the interaction of low credit score fraction in a zip code and inelastic housing supply elasticity. The exact equation estimated in is in Equation (3) of the text. The dotted lines represent 95% confidence intervals.



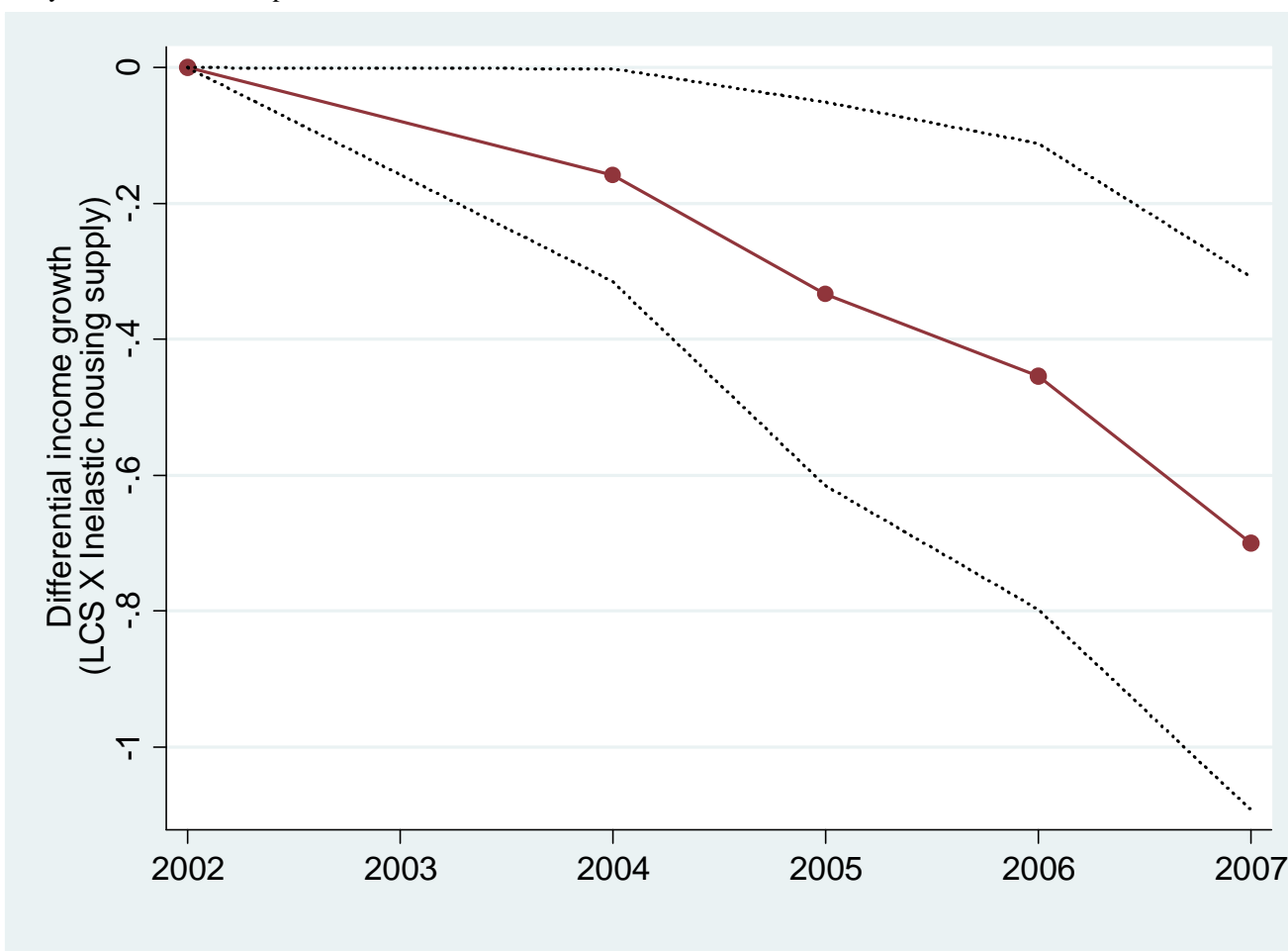
**Figure 6**  
**Cash-out Refinancing and Spending**  
**Second Stage Visualization**

The sample is limited to zip codes in the top quartile of the low credit score fraction distribution, and the sample is then split into the top and bottom quartile based on housing supply elasticity. Quartiles are population-weighted. Each dot represents a quarter in the sample. On the x-axis is the difference in the cash-out refinancing share of outstanding mortgages for zip codes in inelastic versus elastic housing supply cities for that quarter. On the y-axis is the natural logarithm difference of auto sales for zip codes in inelastic versus elastic housing supply cities for that quarter.



**Figure 7**  
**Differential Income Growth?**

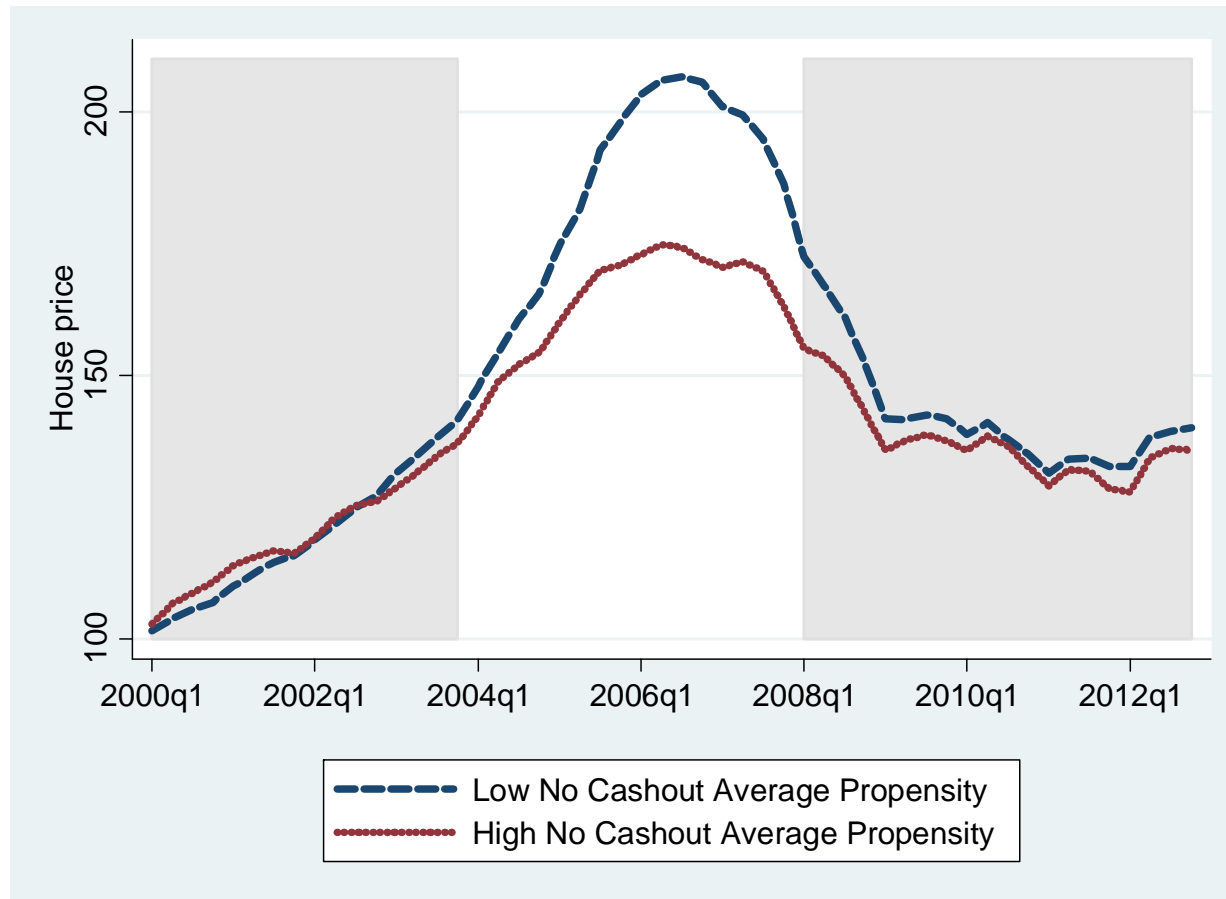
This figure plots the coefficients of a regression relating the income growth since 2002 to the interaction of low credit score fraction in a zip code and inelastic housing supply elasticity. The dotted lines represent 95% confidence intervals.





**Figure 8**  
**House Prices in High and Low No-Cash-Out Refinancing Zip Codes**

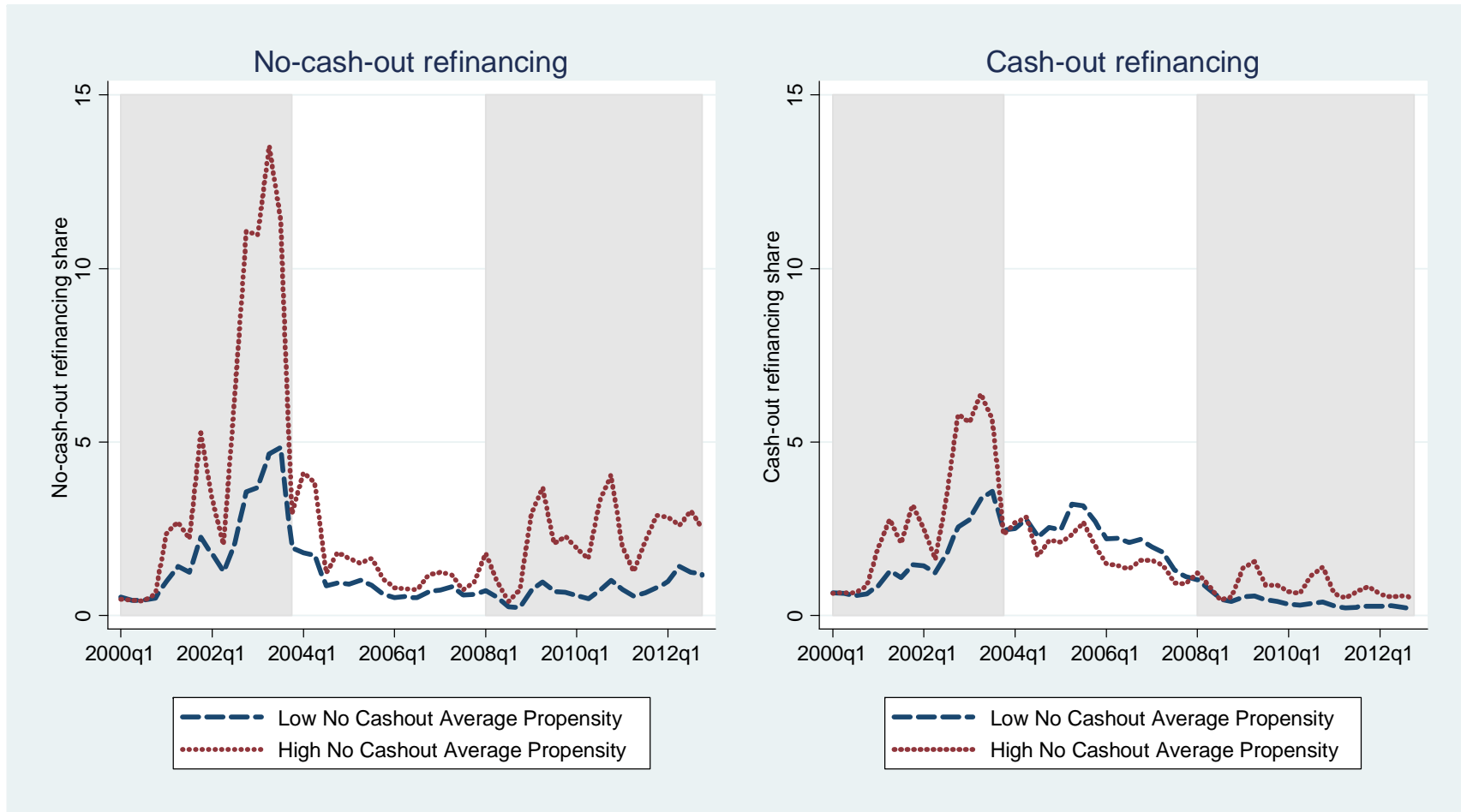
This figure plots house prices indexed to 2000 for the top and bottom population-weighted quartiles of the no-cash-out refinancing propensity distribution for zip codes.



**Figure 9**

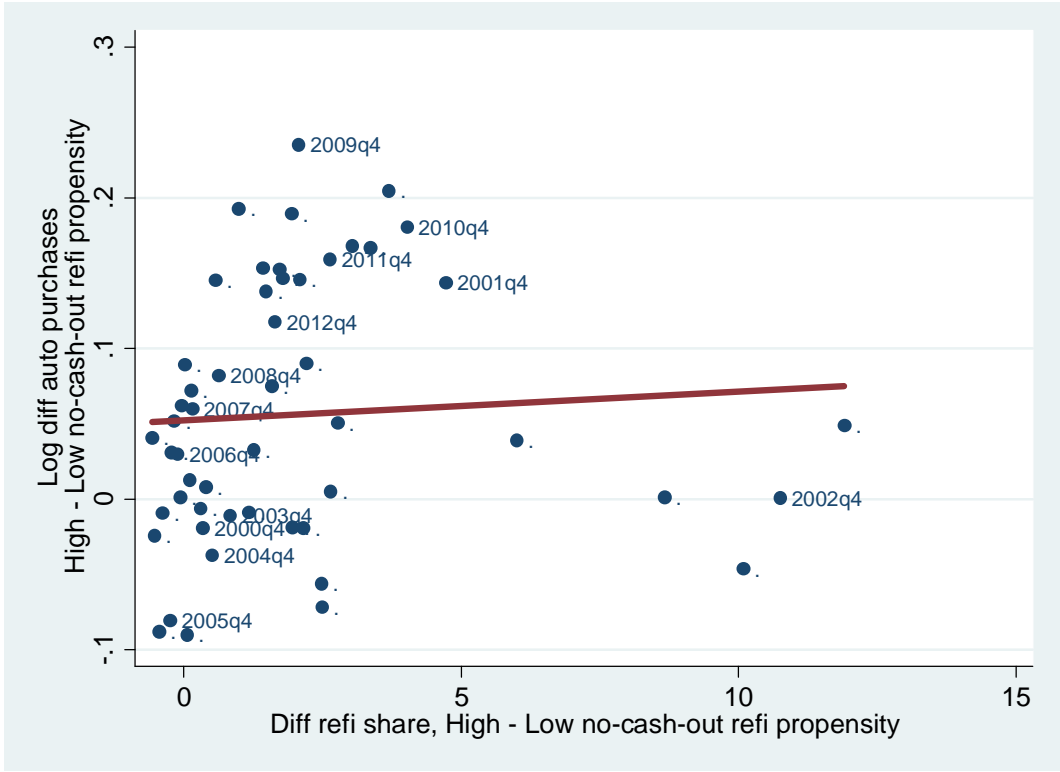
**Mortgage Refinancing in High and Low No-Cash-Out Refinancing Zip Codes**

This figure plots no-cash-out and cash-out mortgage refinancing for the top and bottom population-weighted quartiles of the no-cash-out refinancing propensity distribution of zip codes.



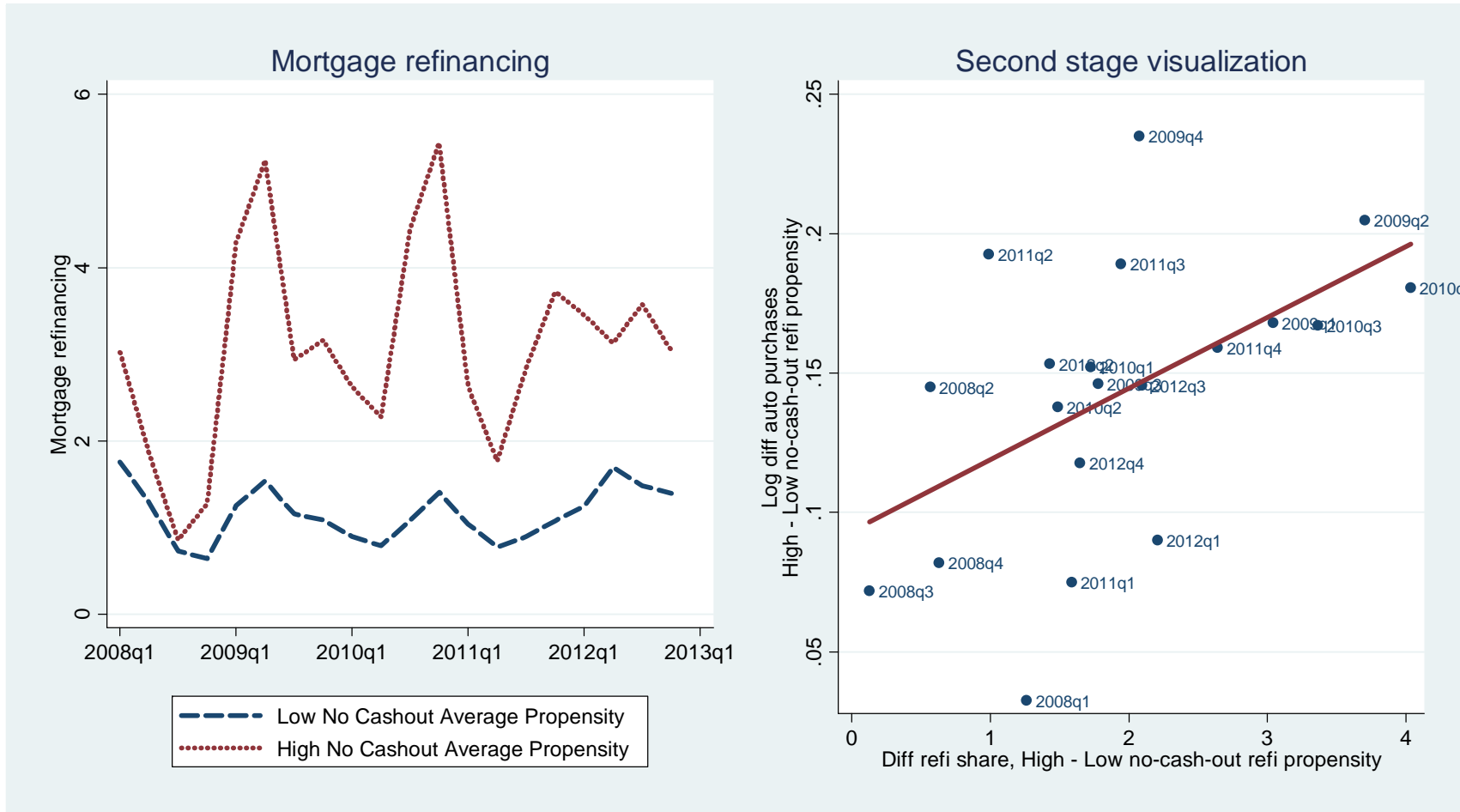
**Figure 10**  
**Interest Rate-Driven Refinancing and Spending**  
**Second Stage Visualization**

The sample is split into the top and bottom quartile based on no-cash-out refinancing propensity. Quartiles are population-weighted. Each dot represents a quarter in the sample. On the x-axis is the difference in the refinancing share of outstanding mortgages for zip codes in high and low no-cash-out propensity quartiles for that quarter. On the y-axis is the natural logarithm difference of auto sales for zip codes in high and low no-cash-out propensity quartiles for that quarter.



**Figure 11**  
**Interest-Rate Driven Refinancing and Spending, 2008-2012**

This figure replicates the left panel of Figures 9 and Figure 10 (left and right panel, respectively) where the sample is isolated to 2008 through 2012.



**Table 1**  
**Summary Statistics**

This table presents zip code level, quarter level, and zip code-quarter level summary statistics for our sample, which runs from 2000 to 2012. Low credit score fraction is the fraction of individuals in a zip code with a credit score below 620 as of 2000. Housing supply inelasticity is based on the Saiz (2010) measure. Our measure is  $(5\text{-elasticity})/5$  in order to make it vary between 0 and 1. The cash-out and no-cash-out refinancing shares are the quarterly flow of cash-out and no-cash-out refinancing scaled by outstanding mortgages at the beginning of the period. The last two columns present weighted means and standard deviations, where weights are given by the total number of households in the zip code.

	N	Mean	SD	10th	90th	Weighted mean	Weighted SD
<b>Zip code level</b>							
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
<b>Quarter level</b>							
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		
<b>Zip-code quarter level</b>							
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	282866	3242	2077	1103	6022	3850	2214
Total outstanding mortgage balance (\$ millions)	282866	504	461	104	1090	591	512

**Table 2**  
**Cross-Sectional Determinants of Cash-out Refinancing Share**

This table presents regressions of the average cash-out refinancing share of outstanding mortgages on CBSA-level housing supply inelasticity, the low credit score fraction of a zip code, and the interaction of the two. The observation is a zip code, and the refinancing share variables are zip code averages of quarterly observations from 2000 to 2012. In columns 5 and 6, the left hand side variable is the Bartik (1991) loading, or beta, of the zip code on cash-out refinancing aggregate shocks. Standard errors are heteroskedasticity-robust, clustered at the CBSA-level. All regressions are population-weighted.

	(1) House price growth, 2002-2007	(2) Cash-out refinancing share	(3) Cash-out refinancing share	(4) Cash-out refinancing share	(5) Cash-out refinancing beta (Bartik)	(6) 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

**Table 3****The Effect of House-Price Driven Refinancing on New Auto Purchases**

This table presents the second-stage estimates of log new auto purchases per capita on the cash-out refinancing share of outstanding mortgages. The sample includes zip-code quarterly observations from 2000 to 2012, and all specifications include both zip code and quarter fixed effects. All regressions are population-weighted. In columns 2 and 3, we instrument for the cash-out refi share using housing supply inelasticity of the CBSA, low credit score share in the zip code, and the interaction of these two variables. In column 4, the right hand side variable is average cash-out refinancing share of that zip code multiplied by the aggregate cash-out refinancing share in that quarter. In columns 5 and 6, we instrument the cash-out refi share with only the LCS\*housing supply inelasticity interaction variable, using the levels of these two variables as controls. In columns 3 through 6, we use the 2000 natural log of median household income and share with less than a high school education interacted with quarter fixed effects as controls. Standard errors are heteroskedasticity-robust, clustered at the CBSA-level.

	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

**Table 4****The Effect of House-Price Driven Refinancing on New Auto Purchases in First Difference Regressions**

This table presents cross-sectional first difference regressions of the growth in quarterly average per capita new auto purchases on the change in quarterly average cash-out refinancing share from the pre-treatment to the treatment period. The pre-treatment period runs from 2000q1 to 2002q2 and the treatment period runs from 2002q3 to 2008q1. Standard errors are heteroskedasticity-robust, clustered at the CBSA-level. All regressions are population-weighted.

Dependent variable	(1) OLS	(2) Reduced Form	(3) Reduced Form, CBSA-FE	(4) Second stage	(5) Second stage, CBSA-FE	(6) (5) with control variables	(7) (5) with HP growth RHS variable
	$\Delta \ln(\text{Average auto purchases per capita})$						
$\Delta$ Cash-out refinancing share	0.045** (0.009)			0.073** (0.026)	0.095** (0.031)	0.092** (0.031)	
LCS x inelasticity		0.790* (0.327)	0.836** (0.295)				
Low credit score fraction (LCS)		-0.650** (0.230)	-0.883** (0.199)	-0.190** (0.063)	-0.373** (0.051)	-0.281** (0.088)	-0.169* (0.073)
Housing supply inelasticity		-0.156 (0.080)		-0.128 (0.066)			
Ln(median household income)						0.111* (0.046)	0.195** (0.033)
Fraction with less than HS education						0.216 (0.129)	0.290* (0.130)
House price growth, 2002-2007							0.849** (0.238)
Constant	-0.139** (0.015)	0.043 (0.056)	-0.013 (0.012)	-0.038 (0.033)	0.025 (0.014)	-1.097* (0.514)	-2.160** (0.378)
Observations	5,244	5,240	5,240	5,240	5,240	5,159	5,159
R-squared	0.031	0.007	0.207	0.035	0.177	0.189	0.160

\*\* p<0.01, \* p<0.05



**Table 5**  
**Heterogeneity in Cash-Out Refinancing and Spending Response**

This table presents cross-sectional first difference regressions of the growth in quarterly average per capita new auto purchases and the change in quarterly average cash-out refinancing share from the pre-treatment to the treatment period on house price growth from 2002 to 2007. All columns report the second stage of an instrumental variables specification in which housing supply inelasticity and housing supply inelasticity interacted with the relevant measure of cash on hand are the instruments. The pre-treatment period runs from 2000q1 to 2002q2 and the treatment period runs from 2002q3 to 2008q1. Standard errors are heteroskedasticity-robust, clustered at the CBSA-level. All regressions are population-weighted.

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)
	Δ Cash-out refinancing share			ΔLn(Average auto purchases per capita)		
House price growth, 2002-2007	1.676 (0.954)	27.195** (9.130)	13.367** (1.945)	-0.264 (0.198)	5.953** (2.246)	1.358** (0.392)
LCS x HP growth, 2002-2007	9.403** (3.143)			1.232* (0.515)		
Low credit score fraction (LCS)	-2.728** (0.862)			-0.479** (0.144)		
Ln(median household income) x HP growth, 2002-2007		-2.157* (0.854)			-0.552* (0.215)	
Ln(median household income)		0.860** (0.244)			0.198** (0.055)	
Ln(net worth per household) x HP growth, 2002-2007			-1.543** (0.292)			-0.231** (0.070)
Ln(net worth per household)			0.311** (0.092)			0.112** (0.018)
Constant	0.526* (0.233)	-9.390** (2.626)	-2.011** (0.544)	0.011 (0.049)	-2.233** (0.581)	-0.749** (0.100)
Observations	5,240	5,163	5,102	5,240	5,163	5,102
R-squared	0.331	0.314	0.280	0.022	0.023	0.036

\*\* p<0.01, \* p<0.05

**Table 6**  
**Cross-Sectional Determinants of No-cash-out Refinancing Share**

This table presents regressions of the average no-cash-out refinancing share of outstanding mortgages on CBSA-level housing supply inelasticity, the low credit score fraction of a zip code, and the interaction of the two. The observation is a zip code, and the refinancing share variables are zip code averages of quarterly observations from 2000 to 2012. In column 3, the left hand side variable is the Bartik (1991) loading, or beta, of the zip code on no-cash-out refinancing aggregate shocks. Standard errors are heteroskedasticity-robust, clustered at the CBSA-level. All regressions are population-weighted.

	(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, 2000-2003				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

\*\* p<0.01, \* p<0.05

**Table 7**

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

This table presents estimate of the effect of no-cash-out refinancing on new auto purchases. The sample includes zip-code quarterly observations from 2000 to 2012, and all specifications include both zip code and quarter fixed effects. All regressions are population-weighted. Columns 1 through 3 present estimate from the first stage regression of refinancing share on the Bartik no-cash-out refinancing share. The Bartik no-cash-out refinancing share is defined as the average cash-out refi share of the zip code from 2000 to 2012 interacted with the aggregate no-cash-out refinancing share in that quarter. In column 5, we instrument for the total refinancing share of outstanding mortgages using the Bartik no-cash-out refinancing share. Columns 1 through 5 focus on the full sample, columns 6 and 7 on 2000 to 2003, and columns 8 and 9 on 2008 to 2012. Standard errors are heteroskedasticity-robust, clustered at the CBSA-level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable	No-cash-out refi share	Cash-out refi share	Total refi share	Ln(new auto purchases per capita) Reduced form	Ln(new auto purchases per capita) IV	Total refi share	Ln(new auto purchases per capita) IV	Total refi share	Ln(new auto purchases per capita) IV
Estimation type	First stage	First stage	First stage	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

**Table 8**  
**The Effect of Interest-Rate-Driven Refinancing on New Auto Purchases, 2008-2012**  
**Robustness**

This table replicates the instrumental variables specification of log new auto purchases per capita on total refinancing share of outstanding mortgages, where the latter is instrumented with the Bartik no-cash-out refinancing share, which is defined as the average cash-out refi share of the zip code from 2000 to 2012 interacted with the aggregate no-cash-out refinancing share in that quarter. The baseline specification is reported in column 9 of Table 5. Column 1 uses only the average cash-out refi share of the zip code from 2000 to 2007 as an out-of-sample test. Column 2 includes the 2000 natural log of median household income and share with less than a high school education interacted with quarter fixed effects as controls. Column 3 includes the combined loan-to-value ratio of the zip code and house price growth from 2006 to 2009 interacted with the quarter fixed effects as controls. Column 4 includes the interaction of zip code average cash-out refi share with quarter of year indicator variables. Column 5 includes the interaction of zip code average cash-out refi share with a linear time trend and the interaction with GDP growth in each quarter. In the last column, the left hand side variable is the natural logarithm of all other (non-mortgage) debt originations in a zip code, data we only have beginning in 2009q4. All specifications include both zip code and quarter fixed effects. All regressions are population-weighted, standard errors are heteroskedasticity-robust, clustered at the CBSA-level.

Dependent variable	Ln(new auto purchases per capita)						Ln(other originations)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Out of sample Bartik sort	Income and education controls	Housing market controls	Quarter of year interaction	Allowing differential time trend and GDP growth interaction	All (1) - (5) controls	
Total refi share	0.026** (0.009)	0.033** (0.012)	0.030** (0.007)	0.028** (0.006)	0.021** (0.005)	0.018** (0.007)	
Bartik no-cash-out refi share							0.002 (0.004)
Observations	104,860	103,241	99,627	104,860	104,860	98,088	68162
R-squared	0.884	0.887	0.887	0.884	0.884	0.890	0.974

\*\* p<0.01, \* p<0.05