House Prices, Home Equity-Based Borrowing, and the U.S. Household Leverage Crisis*

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Abstract

Using individual-level data on homeowner debt and defaults from 1997 to 2008, we show that borrowing against the increase in home equity by *existing* homeowners is responsible for a significant fraction of both the sharp rise in U.S. household leverage from 2002 to 2006 and the increase in defaults from 2006 to 2008. Employing land topology-based housing supply elasticity as an instrument for house price growth, we estimate that the average homeowner extracts 25 to 30 cents for every dollar increase in home equity. Money extracted from increased home equity is *not* used to purchase new real estate or pay down high credit card debt, which suggests that real outlays (i.e., consumption or home improvement) are likely uses of borrowed funds. Home equity-based borrowing is stronger for younger households, households with low credit scores, and households with high initial credit card utilization rates. Homeowners in high house price appreciation areas experience a relative decline in default rates from 2002 to 2006 as they borrow heavily against their home equity, but experience very high default rates from 2006 to 2008. Our estimates suggest that home equity-based borrowing is equal to 2.3% of GDP every year from 2002 to 2006, and accounts for over 20% of new defaults in the last two years.

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Table I
Summary Statistics

This table presents summary statistics for 96,496 individuals who have either an existing mortgage account with positive balance as of 1997 or a previous mortgage account. The sample is further restricted to individuals that do not move zip codes between 1997 and 1999. Individuals are sorted into groups of at least 5 individuals. Each group consists of individuals living in the same zip code as of 1997, and the individuals are sorted by 1997 credit score before groups are formed. The income in the denominator of the debt to income ratio comes from zip level IRS data. The zip code level median home value as of 2002 comes from the 2000 value reported in the decennial Census multiplied by the growth rate from 2000 to 2002 reported in the Fiserv Case Shiller Weiss data. The housing supply inelasticity measure we use is three – the Saiz (2008) measure. The Saiz (2008) measure is increasing in elasticity from 0 to 3. There are 3,016 zip codes and 83 MSAs that are represented in the sample.

	N	Mean	Median	St. Dev.
Equifax individual level data				
Total debt, 1997, $thousands	17347	101	95	72
Home debt, 1997, $thousands	17347	89	83	70
Growth in total debt, 1998-2002	17347	0.087	0.077	0.619
Growth in total debt, 2002-2006	17347	0.346	0.322	0.669
Growth in home debt, 1998-2002	17347	0.098	0.049	0.895
Growth in home debt, 2002-2006	17347	0.395	0.356	0.878
Total debt to income ratio, 1997	17054	2.468	2.450	1.495
Change in debt to income ratio, 1998-2002	17342	-0.006	-0.085	0.887
Change in debt to income ratio, 2002-2006	17346	0.733	0.420	1.346
Total debt default rate, 1997	17347	0.036	0.000	0.108
Change in default rate, 1998-2006	17342	-0.005	0.000	0.129
Change in default rate, 2006-2008	17336	0.035	0.000	0.162
Credit score, 1997	17347	783	792	94
Credit card utilization fraction, 1997	17346	0.327	0.255	0.253
Age, 1997	17345	58	57	7
Male	17330	0.512	0.500	0.255
Income, 1997, $thousands	17345	79	74	34
Fiserv Case Shiller Weiss zip level data				
House price growth, zip level, 1998-2002	17294	0.416	0.444	0.142
House price growth, zip level, 2002-2006	17347	0.440	0.442	0.222
Saiz (2008) MSA level elasticity measure				
Housing supply inelasticity	17347	2.004	2.080	0.438
Median home value, 2002, $thousands	17336	235	203	133
IRS zip level income data				
Per capita wage growth, 2002-2006	17346	0.115	0.111	0.060
Census business statistics zip level data				
Per capita payroll growth, 2002-2006	16936	0.117	0.116	0.118
Employment growth, 2002-2006	16936	0.078	0.067	0.188
Equifax zip level aggregate data				
Fraction of zip code with credit score under 659, 1997	17345	0.293	0.278	0.113

Table II
The Effect of House Prices on Household Borrowing for 1997 Homeowners

This table presents estimates of the effect of house prices on household borrowing for individuals who have either an existing mortgage account with positive balance as of 1997 or a previous mortgage account. Individual dummy variables are quintile indicator variables for 2% bins of the 1997 credit score, 2008 income, and 1997 age variables. Census controls are zip code level variables for the vacancy rate, fraction white, fraction black, education indicator variables for less than high school and high school diploma only, the unemployment rate, the poverty rate, and the fraction of households in the zip code living in an urban setting, all measured as of 2000. Income controls are zip code level variables from the IRS and Census business statistics for the logarithm of the 2002 employment, per capita wage, and per capita payroll level, and the growth in wage, payroll and employment from 1997 to 2000, 2000 to 2002, and 2002 to 2006. All standard errors are clustered at the MSA level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Left hand side variable	HP growth 2002-2006	Total debt growth 2002-2006				Change in total debt to income ratio 2002-2006			
Housing supply inelasticity	0.174**								
	(0.058)								
Instrumented HP growth, 2002-2006		0.703**	0.689**	0.697**	0.621**	1.605**	1.703**	1.720**	1.394**
		(0.213)	(0.189)	(0.186)	(0.120)	(0.366)	(0.371)	(0.370)	(0.248)
(Credit score, 1997)/100			-0.027*				-0.112**		
			(0.011)				(0.024)		
Ln(household income, 2008)			0.144**				0.212**		
			(0.018)				(0.037)		
Age, 1997			-0.011**				-0.034**		
			(0.001)				(0.003)		
Male dummy variable			0.005	0.008	0.001		0.147**	0.152**	0.087+
			(0.022)	(0.021)	(0.022)		(0.051)	(0.048)	(0.047)
Additional control variables				Individual dummy variables	Individual dummy, census, income variables			Individual dummy variables	Individual dummy, census, income variables
N	17347	17347	17328	17328	16526	17346	17327	17327	16526
R^2	0.12	0.00	0.00	0.01	0.03	0.00	0.04	0.06	0.11

**,*, + coefficient statistically distinct from 0 at the 1, 5, and 10% level, respectively.

Table III
The Effect of House Prices on Household Borrowing for 1997 Homeowners, Dollar for Dollar Changes

This table presents estimates of the effect of house prices on household borrowing for individuals who have either an existing mortgage account with positive balance as of 1997 or a previous mortgage account. Individual dummy variables are quintile indicator variables for 2% bins of the 1997 credit score, 2008 income, and 1997 age variables. Census controls are zip code level variables for the vacancy rate, fraction white, fraction black, education indicator variables for less than high school and high school diploma only, the unemployment rate, the poverty rate, and the fraction of households in the zip code living in an urban setting, all measured as of 2000. Income controls are zip code level variables from the IRS and Census business statistics for the logarithm of the 2002 employment, per capita wage, and per capita payroll level, and the growth in wage, payroll and employment from 1997 to 2000, 2000 to 2002, and 2002 to 2006. All standard errors are clustered at the MSA level. All standard errors are clustered at the MSA level.

Left hand side variable	(1) Change in home value 2002-2006 $thousands	(2)	(3)	(4)	(5)
		Change in total debt 2002-2006 $thousands			
Housing supply inelasticity	45.859*				
	(18.369)				
Instrumented change in home value, 2002-2006		0.236**	0.281**	0.296**	0.231**
		(0.067)	(0.075)	(0.080)	(0.073)
Median home value, 2002	0.480**	0.027	-0.012	-0.023	-0.043
	(0.085)	(0.038)	(0.048)	(0.045)	(0.074)
(Credit score, 1997)/100			-8.081**		
			(1.126)		
Ln(household income, 2008)			27.167**		
			(3.606)		
Age, 1997			-2.148**		
			(0.199)		
Male dummy variable			8.521*	8.839*	6.418+
			(4.041)	(3.910)	(3.737)
Additional control variables				Individual dummy variables	Individual dummy, census, income variables
N	17336	17336	17317	17317	16526
R^2	0.52	0.03	0.07	0.08	0.10

**,*, + coefficient statistically distinct from 0 at the 1, 5, and 10% level, respectively.

Table IV
Examining Exclusion Restriction for MSA-level Analysis

This table presents evidence on the exclusion restriction for the MSA-level analysis in Tables II and III. Panel A examines the correlation between economic activity and housing supply elasticity in the sample of homeowners. "Growth shocks" represent the differences in 1998 to 2002 and 2002 to 2006 growth rates for each respective variable. Panel B examines the home and credit card debt for homeowners and debt patterns for renters. Renters are defined as individuals that have no housing related debt from 1997 to 2006. All standard errors are clustered at the MSA level.

Panel A: Income and employment measures

Left hand side variable	(1) Business payroll growth 2002-2006	(2) IRS wage growth 2002-2006	(3) Employment growth 2002-2006	(4) Payroll growth shock	(5) Wage growth shock	(6) Employment growth shock
Housing supply inelasticity	0.004	0.024**	-0.020	-0.019*	-0.003	-0.015
	(0.009)	(0.005)	(0.019)	(0.009)	(0.007)	(0.016)
N	2938	3015	2938	2909	3013	2909
R^2	0.00	0.03	0.00	0.00	0.00	0.00

Panel B: Home, credit card, and renters' debt

Sample	(1) Homeowners	(2) Homeowners	(3) Homeowners	(4) Homeowners	(5) Renters	(6) Renters
Left hand side variable	Home debt growth 2002-2006	Credit card debt growth 2002-2006	Change in home debt to income 2002-2006	Change in credit card debt to income 2002-2006	Total debt growth 2002-2006	Change in total debt to income 2002-2006
Instrumented HP growth, 2002-2006	0.729**	0.327	1.461**	0.038	0.189	0.030
	(0.232)	(0.251)	(0.323)	(0.033)	(0.152)	(0.038)
N	17347	17347	17346	17346	6373	6372
R^2	0.00	0.00	0.01	0.00	0.00	0.00

**,*, + coefficient statistically distinct from 0 at the 1, 5, and 10% level, respectively.

Table V
Motivation for Within-MSA Test Based on 1997 Subprime Share of Zip Code Population

Panel A shows the effect of subprime fraction in the zip code on mortgage origination growth for home purchase at the zip code level by MSA housing supply elasticity. The zip code level mortgage origination growth data come from HMDA. Panel B shows the effect of the 1997 fraction of subprime individuals in the zip code on house price growth from 2002 to 2006 by MSA housing supply elasticity. Panel C shows the correlation between the instrument, subprime share of total population interacted with housing supple elasticity, and measures of debt as of 2002. Individual dummy variables are quintile indicator variables for 2% bins of the 2002 median home value in the zip code, 1997 credit score, 2008 income, and 1997 age variables. All specifications include MSA fixed effects and standard errors are clustered at the MSA level.

Panel A: Mortgage origination growth for new home purchase (HMDA), 2002-2006

	(1) Full	(2) Most elastic	(3) 2nd quartile	(4) 3rd quartile	(5) Most inelastic
Fraction in zip code with credit score under 660, 1997	1.385**	0.649*	0.739**	1.727**	1.751**
	(0.150)	(0.234)	(0.234)	(0.169)	(0.189)

Panel B: House price growth, 2002-2006

	(1) Full	(2) Most elastic	(3) 2nd quartile	(4) 3rd quartile	(5) Most inelastic
Fraction in zip code with credit score under 660, 1997	0.288**	-0.007	0.129*	0.356**	0.414**
	(0.044)	(0.021)	(0.047)	(0.042)	(0.064)

Panel C: Correlation of instrument with measures of debt as of 2002

	(1)	(2)	(3)	(4)
Dependent variable	Ln(total debt, 2002)		Total debt to income ratio, 2002	
Fraction in zip code with credit score under 660, 1997	-0.154	0.151	0.638+	0.332
*Housing supply inelasticity	(0.160)	(0.121)	(0.354)	(0.376)
Fraction in zip code with credit score under 660, 1997	-1.142**	-0.276	1.152+	1.937*
	(0.291)	(0.291)	(0.670)	(0.821)
Additional control variables		Individual dummy variables		Individual dummy variables

**,*, + coefficient statistically distinct from 0 at the 1, 5, and 10% level, respectively.

Table VI
The Effect of House Prices on Household Borrowing for 1997 Homeowners
Using Within-MSA Variation

This table presents second stage estimates from a within-MSA instrumental variables specification where the first stage instrument for house price growth from 2002 to 2006 is the fraction in the zip code with a credit score under 660 as of 1997 interacted with MSA level housing supply inelasticity. Individual dummy variables are quintile indicator variables for 2% bins of the 2002 median home value in the zip code, 1997 credit score, 2008 income, and 1997 age variables. All specifications (both first and second stage) include MSA fixed effects and standard errors are clustered at the MSA level.

Dependent variable	(1)	(2) Total debt growth 2002-2006	(3)	(4)	(5) Change in total debt to income 2002-2006	(6)
Instrumented house price growth, 2002-2006	1.068**	1.067**	1.090**	4.979**	4.110**	3.059**
	(0.334)	(0.299)	(0.293)	(1.317)	(1.139)	(0.943)
Fraction in zip code with credit score under 660, 1997	-0.274**	-0.074	-0.018	0.082	0.450	1.025**
	(0.088)	(0.079)	(0.094)	(0.337)	(0.276)	(0.287)
Median home value, 2002		0.000			-0.001**	
		(0.000)			(0.000)	
(Credit score, 1997)/100		-0.048**			-0.154**	
		(0.008)			(0.017)	
Ln(household income, 2008)		0.162**			0.523**	
		(0.021)			(0.042)	
Age, 1997		-0.009**			-0.028**	
		(0.001)			(0.002)	
Male dummy variable		0.001	0.005		0.104*	0.109*
		(0.021)	(0.020)		(0.047)	(0.044)
Additional control variables			Individual dummy variables			Individual dummy variables
N	17345	17315	17315	17344	17315	17315
R^2	0.01	0.03	0.05	0.04	0.10	0.12

**,*, + coefficient statistically distinct from 0 at the 1, 5, and 10% level, respectively.

Table VII
What Do Homeowners Do with Borrowed Money?

Panel A examines whether households in high house price growth areas are more likely to move to a new zip code and whether movers and non-movers experience differential growth rates in debt from 2002 to 2006. Panel B examines whether households in high house price growth areas are more likely to increase their number of mortgages, which is a proxy for the purchase of an investment property. Panel C isolates the sample to individuals in the top quartile of the 1997 credit card utilization distribution and examines whether households in high house price appreciation areas are more likely to pay down credit card debt. All specifications include control variables for individual 1997 credit score, 2008 income, age, and sex. Standard errors are clustered at the MSA level.

Panel A: Purchase of new homes?

	(1)	(2)	(3)	(4)
Sample	MSA averages	Full	Movers	Non-movers
Left hand side variable	Probability of moving	Probability of moving	Total debt growth 2002-2006	
HP Growth, 2002-2006	0.032			
	(0.028)			
Instrumented HP Growth, 2002-2006		-0.176	0.756**	0.607**
		(0.137)	(0.212)	(0.175)
N	83	17326	8596	8730
R^2	0.39	0.00	0.00	0.01

Panel B: Purchase of investment properties?

	(1)	(2)	(3)	(4)
Sample	Full	Full	Full	No change in # of mortgages
Left hand side variable	Change in # of mortgages 2001-2005		Total debt growth 2002-2006	
HP Growth, 2002-2006	-0.032+			
	(0.018)			
Instrumented HP Growth, 2002-2006		-0.202**	0.784**	0.810**
		(0.062)	(0.185)	(0.262)
Change in # of mortgages, 2001-2005			0.639**	
			(0.024)	
N	17008	17008	17008	5109
R^2	0.02	0.01	0.09	0.01

Panel C: Paying down credit card balances?

	(1)	(2)	(3)	(4)
Sample	Top quartile credit card utilization as of 1997			
Left hand side variable	Home debt growth 2002-2006	Credit card debt growth 2002-2006	Change in home debt to income 2002-2006	Change in credit card debt to income 2002-2006
Instrumented HP Growth, 2002-2006	0.893**	0.295	2.180**	0.046
	(0.208)	(0.239)	(0.433)	(0.035)
N	4324	4324	4324	4324
R^2	0.03	0.01	0.06	0.01

**,*, + coefficient statistically distinct from 0 at the 1, 5, and 10% level, respectively.

Table VIII
Cross-Sectional Heterogeneity in Effect of House Prices on Household Borrowing for 1997 Homeowners

This table presents estimates of the cross-sectional heterogeneity of the effect of house prices on household borrowing for individuals that have either positive outstanding mortgage debt as of 1997 or a previous mortgage account. In each column, we interact house price growth with the variable in the top of the column. The instruments in the first stage are MSA level housing supply elasticity and MSA level housing supply elasticity interacted with the interaction variable listed in the top of the column. In all columns, we use the data sorts that maximize variation in the interaction variable. More specifically, in columns 1 and 2 we use data sorted by credit score before groups are formed. In columns 3 to 6, we use data sorted by each interaction variable before groups are formed. All standard errors are clustered at the MSA level.

Interaction variable	(1) (Credit score, 1997)/100	(2) Credit card utilization, 1997	(3) Ln(household income, 2008)	(4) Age, 1997	(5) Age>=65, 1997	(6) Male
Left hand side variable			Total debt growth 2002-2006			
Instrumented house price growth, 2002-2006	3.084**	0.324*	1.349*	1.340**	0.764**	0.722**
	(0.696)	(0.136)	(0.645)	(0.471)	(0.184)	(0.186)
Instrumented house price growth, 2002-2006 *Interaction term (listed at top of column)	-0.311**	1.097**	-0.157	-0.012		0.005
	(0.076)	(0.313)	(0.126)	(0.008)		(0.156)
Age>=65 indicator					0.188+	
					(0.098)	
Instrumented house price growth, 2002-2006 *Age>=65					-0.463*	
					(0.211)	
(Credit score, 1997)/100	0.068+	-0.071**	-0.048	-0.029	-0.027	-0.087**
	(0.038)	(0.019)	(0.033)	(0.029)	(0.029)	(0.025)
Credit cart utilization, 1997	-0.183**	-0.678**	-0.113*	0.013	0.016	-0.201**
	(0.055)	(0.132)	(0.051)	(0.042)	(0.041)	(0.056)
Ln(household income, 2008)	0.152**	0.155**	0.265**	0.156**	0.154**	0.154**
	(0.020)	(0.020)	(0.059)	(0.018)	(0.017)	(0.019)
Age, 1997	-0.010**	-0.010**	-0.011**	-0.009**	-0.014**	-0.010**
	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)	(0.001)
Male dummy variable	0.007	0.007	-0.015	-0.019	-0.020	0.011
	(0.022)	(0.022)	(0.023)	(0.024)	(0.024)	(0.065)
N	17327	17327	16575	16932	16932	15469
R^2	0.00	0.00	0.02	0.05	0.05	0.00

**,*, + coefficient statistically distinct from 0 at the 1, 5, and 10% level, respectively.

Table IX
The Effect of House Prices on Default Rates from 2002-2006 for 1997 Homeowners

This table presents the effect of house price growth on default rates from 2002 to 2006. In columns 3 to 6, we interact house price growth with the variable in the top of the column. The instruments in the first stage are MSA level housing supply elasticity and MSA level housing supply elasticity interacted with the interaction variable listed in the top of the column. In all columns, we use the data sorts that maximize variation in the interaction variable. More specifically, in columns 3 and 4 we use the data sorted by credit score before groups are formed. In columns 5 to 7, we use the data sorted by each interaction variable before groups are formed. All standard errors are clustered at the MSA level.

Interaction variable	(1)	(2)	(3) (Credit score, 1997)/100	(4) Credit card utilization, 1997	(5) Ln(HH income, 2008)	(6) Age, 1997	(7) Male
Left hand side variable			Change in default rate, 2002-2006				
Instrumented house price growth, 2002-2006	-0.024*	-0.033**	-0.265*	-0.002	0.014	-0.068	-0.023
	(0.010)	(0.008)	(0.105)	(0.016)	(0.116)	(0.064)	(0.019)
Instrumented house price growth, 2002-2006			0.030*	-0.091+	-0.011	0.001	0.016
*Interaction term (listed at top of column)			(0.013)	(0.051)	(0.026)	(0.001)	(0.029)
(Credit score, 1997)/100		0.009**	-0.003	0.011**	0.010**	0.007*	0.009**
		(0.002)	(0.006)	(0.003)	(0.003)	(0.003)	(0.003)
Ln(household income, 2008)		0.001	0.000	0.000	0.004	-0.002	-0.003
		(0.002)	(0.002)	(0.002)	(0.013)	(0.003)	(0.002)
Age, 1997		0.000	0.000	0.000	-0.000	-0.000	0.000
		(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Male dummy variable		0.001	0.001	0.001	0.010+	0.007	-0.003
		(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.013)
Credit card utilization, 1997			0.007	0.048+	-0.003	-0.013	0.006
			(0.009)	(0.026)	(0.010)	(0.008)	(0.010)
N	17341	17325	17324	17324	16539	16924	15461
R^2	0.00	0.01	0.01	0.01	0.00	0.01	0.01

**,*, + coefficient statistically distinct from 0 at the 1, 5, and 10% level, respectively.

Table X
The Effect of House Prices from 2002-2006 on Default Rates from 2006-2008 for 1997 Homeowners

This table presents the effect of house price growth from 2002 to 2006 on default rates from 2006 to 2008. In columns 3 to 6, we interact house price growth with the variable in the top of the column. The instruments in the first stage are MSA level housing supply elasticity and MSA level housing supply elasticity interacted with the interaction variable listed in the top of the column. In all columns, we use the data sorts that maximize variation in the interaction variable. More specifically, in columns 3 and 4 we use the data sorted by credit score before groups are formed. In columns 5 to 7, we use the data sorted by each interaction variable before groups are formed. All standard errors are clustered at the MSA level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Interaction variable			Credit score, 1997	Credit card utilization, 1997	Ln(HH income, 2008)	Age, 1997	Male
Left hand side variable				Change in default rate, 2006-2008			
Instrumented house price growth, 2002-2006	0.085**	0.113**	0.758**	0.020	0.098	0.295**	0.093**
	(0.018)	(0.021)	(0.194)	(0.020)	(0.097)	(0.090)	(0.029)
Instrumented house price growth, 2002-2006			-0.085**	0.266**	0.001	-0.003*	0.018
*Interaction term (listed at top of column)			(0.024)	(0.076)	(0.023)	(0.002)	(0.039)
(Credit score, 1997)/100		-0.022**	0.020+	-0.018**	-0.020**	-0.017**	-0.023**
		(0.002)	(0.010)	(0.003)	(0.004)	(0.004)	(0.004)
Ln(household income, 2008)		-0.008*	-0.009**	-0.008*	-0.005	-0.014**	-0.013**
		(0.003)	(0.003)	(0.003)	(0.012)	(0.004)	(0.004)
Age, 1997		-0.001**	-0.001**	-0.001**	-0.001**	0.001	-0.001**
		(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Male dummy variable		0.000	0.001	0.001	0.006	0.008	-0.007
		(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.018)
Credit card utilization, 1997			0.017	-0.103**	0.006	0.012	0.009
			(0.012)	(0.033)	(0.013)	(0.011)	(0.014)
N	17336	17320	17319	17319	16522	16916	15454
R^2	0.02	0.04	0.05	0.04	0.02	0.03	0.03

**,*, + coefficient statistically distinct from 0 at the 1, 5, and 10% level, respectively.