Online Appendix to Accompany "Housing Wealth Reallocation between Subprime and Prime Borrowers during Recessions"

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A Appendix

A.1 Data

A.1.1 The American Housing Survey

The American Housing Survey (AHS) is a longitudinal housing unit survey conducted every two years. The AHS is based on the responses of either (i) household respondents of at least 16 years of age for occupied housing units or (ii) a landlord, owner, or knowledgeable neighbor who can provide data on the unit. The units whose owner's residence is elsewhere (URE) include properties that are seasonally vacant.

A.1.2 The Survey of Consumer Finances

We use 1995-2013 survey data from the Survey of Consumer Finances. While data before 1995 are available, we exclude them from the combined dataset because standardized weight files are not publicly available. Table A1 presents the survey questions of the selected variables. Table A2 shows the means and standard deviations of selected variables from the dataset. As expected, subprime borrowers are characterized by a higher rate of credit rejection and a higher rate of unemployment. These borrowers are also more likely to have a female household head and are relatively less educated. In terms of economic expectations, they are only slightly more optimistic about the current state of the economy than their prime counterparts.

Table A1: SCF Survey Questions for Selected Variables

Variables:	**Definitions and Questions:**
Investment Homeownership	Do you own any investment real estate such as a lot, vacation home, timeshare, apartment building, commercial property, or other investment property, including properties owned in partnership with other people? 1. Yes 0. No
Credit Rejected	In the past five years, has a particular lender or creditor turned down any request you made for credit, or not given you as much credit as you applied for? 1. Yes 0. No
Expectations	Over the next five years, do you expect the U.S. economy as a whole to perform better, worse, or about the same as it has over the past five years? 0. Worse 1. Same 2. Better
Gender	Sex of the respondent 1. Male 2. Female
Education	What is the highest grade of school or year of college the household head completed? 0. No Grades, 1. Until 12th Grade, 2. College (1-4 years), 3. Masters and higher
Household Size	Number of people in the household according to the HHL. Excludes people included in the household listing who do not usually live there and who are financially independent.
Age	What is your year of birth?

Table A2: Descriptive Statistics

	Subprime	Prime	Full Sample
Investment Homeownership (%)	30.76	44.65	38.80
	(46.15)	(49.71)	(48.73)
Credit Rejected (%)	31.55	15.64	21.44
	(46.47)	(36.32)	(41.04)
Current House Price (log)	11.24	12.44	12.09
	(3.349)	(2.102)	(2.608)
Economic Expectations (Highest=2)	1.156	1.052	1.168
	(0.764)	(0.741)	(0.759)
Employed (%)	87.95	90.65	89.49
	(32.55)	(29.12)	(30.67)
Male Household Head (%)	85.87	91.22	89.08
	(34.83)	(28.30)	(31.19)
Education (Years)	13.95	14.98	14.64
	(2.482)	(2.210)	(2.354)
Household Size	3.040	3.097	3.078
	(1.484)	(1.395)	(1.444)
Number of Households	22,730	29,202	70,412

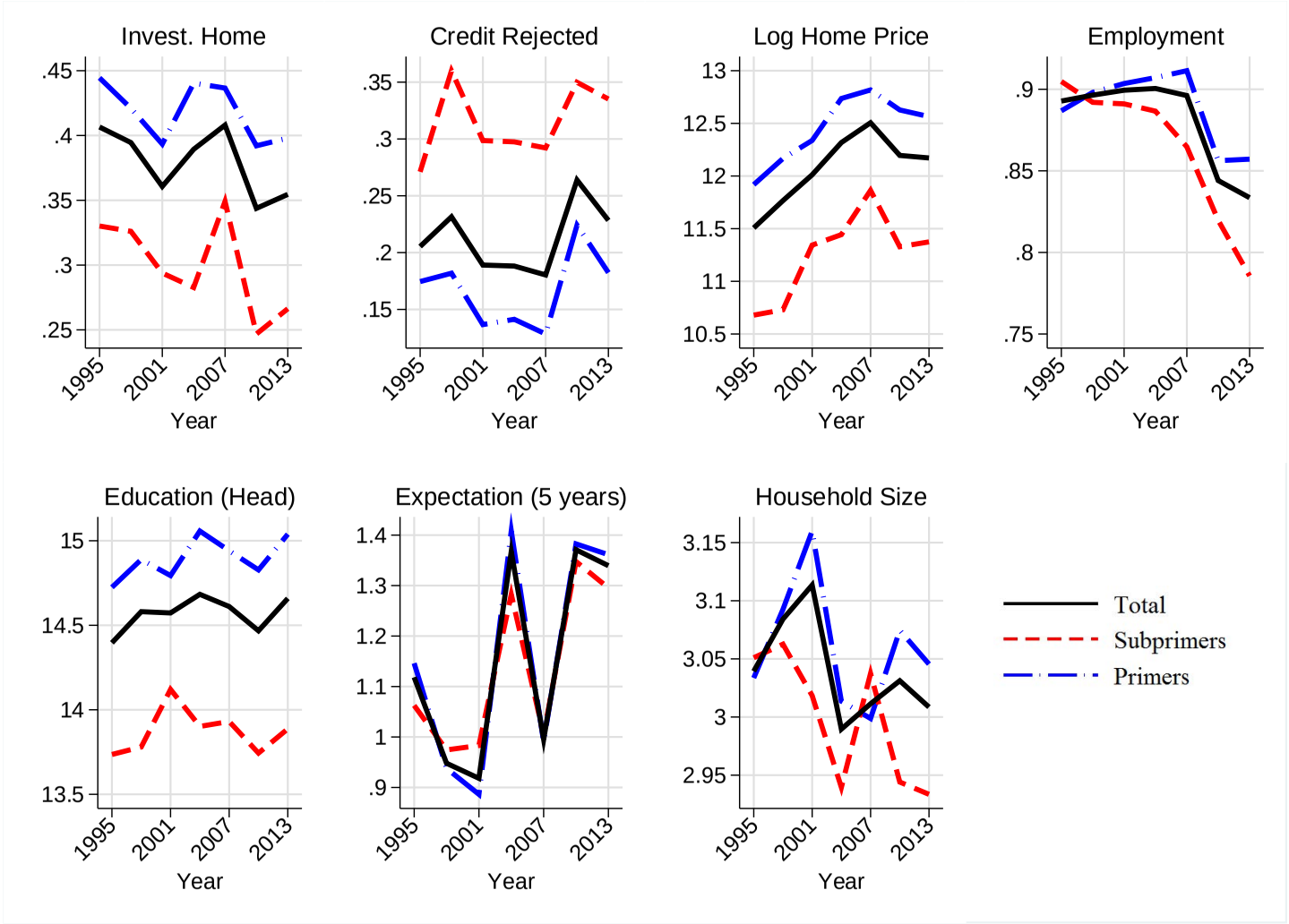
Note: The data are from the Survey of Consumer Finances. Standard deviations are in parenthesis. Prime and subprime borrowers are differentiated based on the current rates of their first mortgages.

Table A3: Investment Home Summary Statistics

Year	All Borrowers	Subprime	Prime
1995	0.407	0.330	0.445
	(0.491)	(0.470)	(0.497)
1998	0.395	0.326	0.421
	(0.489)	(0.469)	(0.494)
2001	0.361	0.294	0.393
	(0.480)	(0.456)	(0.489)
2004	0.389	0.283	0.440
	(0.488)	(0.450)	(0.496)
2007	0.408	0.349	0.437
	(0.491)	(0.477)	(0.496)
2010	0.344	0.247	0.392
	(0.475)	(0.431)	(0.488)
2013	0.355	0.266	0.398
	(0.478)	(0.442)	(0.490)
All Years	0.377	0.295	0.416
	(0.485)	(0.456)	(0.493)

Note: This table presents the summary statistics for second home owners across prime and subprime borrowers. Data are from the SCF.

Figure A1: Mean of Selected Variables over Time

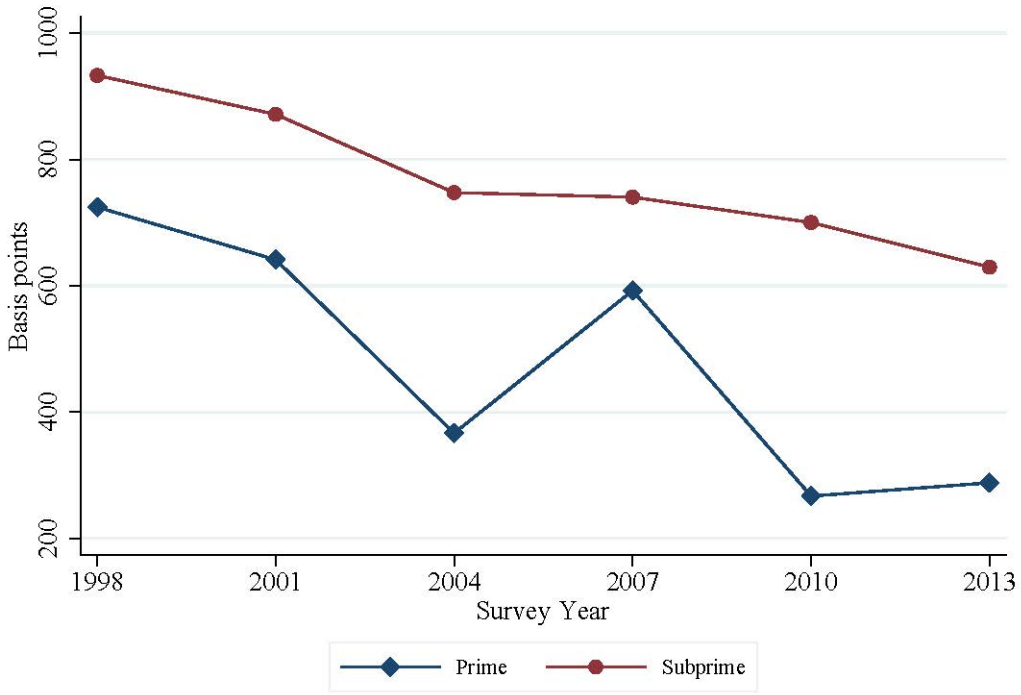


Note: This figure plots the descriptive statistics for selected variables over time. Prime and subprime borrowers are classified based on their primary home mortgage rates. Log home price is the log of current price of the primary residence. The education variable is modified so that it captures people who could not complete high school, who are high school graduates, who have college degree, and who have higher education degrees (masters or doctorate) rather than years of education.

Similar to Table A2, Figure A1 plots the means of selected variables over time. Prime borrowers are more likely to own investment homes, are less likely to have their credit applications rejected, and tend to own more expensive homes. They are also more likely to be employed and are more educated throughout the entire sample period.

To demonstrate how our choice of cutoff criteria divides the sample across the two groups, we plot the average loan rates for prime and subprime borrowers in Figure A2. As expected, subprime borrowers pay consistently higher loan rates for their first mortgages than their prime counterparts.

Figure A2: Average Loan Rates for the First Mortgages (1998-2013)



Note: This figure plots the average loan rates (in basis points) over time for prime and subprime borrowers using the SCF.

B Robustness Checks for the Empirical Evidence

B.1 Excluding Cash Purchases

Since there is no direct question regarding cash purchases in the Survey of Consumer Finances, we are unable to identify whether the borrowers already paid off their mortgages on their investment homes or made cash purchases at the time of the survey. Instead, we employ an indirect approach to pin down the cash purchases by finding the individuals who bought a house in the current year (for the corresponding year) but did not get any mortgages nor receive the investment home as a gift or inheritance. This way we can make sure that people who paid off their debts are not included in the analysis (assuming that the mortgage was not paid off in the same year). These households only account for 2% of the sample. As Table B1 shows, our baseline results are robust to excluding these homeowners who had cash purchases.

B.2 Adding Cash Purchases to Prime Borrowers

In Table B2, instead of excluding the cash purchases, we include them in the prime borrowers who are more likely to purchase their houses without the need for a mortgage. Overall, we find our baseline results to hold under this exercise. One caveat of this approach is that it might misclassify subprime borrowers who downsize their houses and thus do not need mortgages.

B.3 Alternative Definitions of Subprime Borrowers

In Table B3, we use two new categorizations for subprime borrowers: (1) categorization based on borrowers income and (2) categorization based on whether borrowers have a revolving balance in their credit cards. As Table B3 shows, our results are consistent with both of these new definitions.

B.4 Pooling the Data with Prime Borrower and Recession Dummies

In Table B4, we repeat our baseline regression with prime borrowers and recession dummies instead of year dummies. We find prime borrowers are, on average, more likely to own investment homes than subprime borrowers, as evidenced by the positive and significant estimates of the coefficient on the prime borrowers dummy. We also find that prime borrowers are even more likely to own investment homes during recessions, as evidenced from the positive and significant interaction term of the prime and recession dummies. This finding is consistent with our main result on the housing wealth redistribution across subprime and prime borrowers during recessions.

B.5 Bundling Survey Years into Recessions and Expansions

In Table B5, we repeat our baseline regression results, but with all recessions and expansions grouped together according to the official NBER dates. We find that our baseline results are insensitive to grouping recessions and expansions, instead of using individual year dummies.

B.6 Excluding Purchases by Businesses

In Table B6, we repeat our baseline regression results where we exclude purchases by businesses using micro-level data from the SCF. In the SCF, out of all investment homes, only 18% is owned by businesses. Overall, we find that the main results still hold that unlike subprime borrowers, prime borrowers increase their investment homeownership during recessions even after accounting for business ownership. In particular, prime borrowers are almost twice more likely to buy a house during the Great Recession than during the preceding and following recoveries.

B.7 A General Wealth Measure

Instead of using the current house value as a proxy for wealth, we create a more general wealth measure which includes stocks, mortgage-backed bonds, treasury bonds, certificates of deposits,

and the value of the primary residence. Table B7 shows that our baseline results are consistent, in fact stronger, with this general wealth measure.

B.8 Controlling for Debt

To control for liens information of households, we create a control variable, *Debt*, that includes outstanding first and second mortgages, and other non-mortgage loans on the primary residence. As Table B8 shows, our conclusion that prime borrowers are more likely to invest during recessions in the housing market persists after controlling for the debt information.

B.9 Alternative Interest Rate Thresholds and GSEs

The results in Section 2 on the divergence in homeownership between prime and subprime borrowers remain consistent after a number of robustness checks. For instance, Table B9 columns (1) estimate the Probit regression in Equation 1 with a 5% decrease in the loan rate cutoffs for prime and subprime borrowers. To illustrate, suppose that the prime rate - the cutoff in the baseline model for prime borrowers - is 600 basis points in a given year. A decrease of 5% means that the new cutoff for the prime borrowers would be 570 basis points for that year. This change in the cutoff rates implies a 43% increase in the number of subprime borrowers, and a 16% decrease that of the prime borrowers. The results on the asymmetry in housing investment ownership across borrowers are robust to these new cutoffs. Similarly, an increase of 5% in the cutoff rates of prime and subprime borrowers (columns 2) yields similar findings in terms of the asymmetry in housing investment.

Since a significant number of subprime mortgages are Federally guaranteed with fixed low interest rates, one natural robustness check is to account for these mortgages as borrowers might be self-selected into their categories and therefore could bias our results. In Table B9's columns (3), we exclude mortgages from government-sponsored enterprises such as the Federal Housing Administration, the Veteran's Administration, various state housing programs, and first-time buyer programs, etc. in our regressions.[1] Given these restrictions, about 27 percent of subprime mortgages and 19 percent of prime mortgages were backed by Federal programs.

Again, our results on the asymmetry in the housing wealth are robust to excluding Federally guaranteed loans.

B.10 Time-Varying Interest Rate Cutoffs

We also consider time-varying cutoffs for subprime borrowers' loan rates. We do so using the Fannie Mae Single-Family Loan Performance Dataset and calculate the corresponding average loan rate percentile for subprime borrowers - that is, borrowers with credit scores of 660 or less. We next re-estimate our baseline results where we allow the subprime borrowers' cutoff at the top 1/3 of the loan rate distribution to change over time using the Fannie Mae Single-Family Loan Performance Dataset. We present the results with time-varying cutoffs in Table B10. Overall, we find our results to be consistent regardless of whether a time-varying threshold or a fixed threshold is used to define subprime borrowers.

Even though this exercise is motivated by the possibility of misclassifying borrowers, having some subprime borrowers classified as prime borrowers would lead to an underestimation of the asymmetric responses documented in the paper. Even if some subprime borrowers are able to borrow at rates that are lower than the prime rate of that year, they are still subject to relatively worse credit access, and worse income and wealth. As a result, the probability of housing investment assigned to prime borrowers would normally be larger without this misclassification.

B.11 Expanding Control Variables

In this robustness check, we run the baseline regression by controlling for our usual variables (i.e., credit rejection, demographics, and wealth) as well as new control variables such as income, whether the borrower was on schedule with their payments or not, and whether the borrower had adjustable or fixed rate mortgages. As Table B11 shows, our results persist even after the addition of all these control variables.

Table B1: Robustness Check: Excluding Cash Purchases

	Dependent Variable: Investment Homeownership	
	(1)	(2)
	Prime Borrowers	Subprime Borrowers
1998	0.005	0.008*
	(0.002)	(0.003)
2001 (Dot-com Recession)	0.023***	-0.010*
	(0.002)	(0.004)
2004	0.101***	0.033***
	(0.006)	(0.002)
2007	0.076***	0.088***
	(0.001)	(0.004)
2010 (Great Recession)	0.126***	0.051***
	(0.006)	(0.003)
2013	0.105***	0.062***
	(0.003)	(0.003)
Credit Rejected	-0.080***	-0.026***
	(0.002)	(0.003)
1998 x Credit Rejected	0.064***	0.050***
	(0.003)	(0.003)
2001 x Credit Rejected	0.045**	0.068***
	(0.013)	(0.003)
2004 x Credit Rejected	0.141***	0.066***
	(0.006)	(0.001)
2007 x Credit Rejected	0.002	-0.067***
	(0.003)	(0.006)
2010 x Credit Rejected	-0.067***	0.023***
	(0.010)	(0.003)
2013 x Credit Rejected	0.065***	0.043***
	(0.004)	(0.003)
Sex	0.171***	0.107***
	(0.003)	(0.001)
Birth Year	-0.007***	-0.005***
	(0.000)	(0.000)
Education of Head of Households	0.002***	0.001***
	(0.000)	(0.000)
Employed	0.039***	0.063***
	(0.002)	(0.003)
Expectation on the Economy (5 years)	-0.001	0.002**
	(0.000)	(0.001)
Household Size	-0.008***	-0.009***
	(0.001)	(0.001)
Current Residence's Value (Log)	0.026***	0.012***
	(0.001)	(0.000)
Observations	25,032	18,367
F-test (Dotcom)	43.041	62.268
p-value (Dotcom)	0.003	0.001
F-test (GR)	100.688	192.681
p-value (GR)	0.001	0.000
F-test (All Recessions)	309.836	1219.576
p-value (All Recessions)	0.000	0.000

For F-tests:
$H0 : \beta^{\text{Pre-Recession}} = \beta^{\text{Recession}}$
$HA : \beta^{\text{Pre-recession}} \neq \beta^{\text{Recession}}$

Note: Standard errors in parentheses. ***, **, and * denote the 1%, 5%, and 10 % levels of significance, respectively. We report the marginal effects at the means using 1995 as the base year.

Table B2: Robustness Check: Adding Cash Purchases

	Dependent Variable: Investment Homeownership	
	(1)	(2)
	Prime Borrowers	Subprime Borrowers
1998	0.010**	0.002
	(0.002)	(0.003)
2001 (Dot-com Recession)	0.032***	-0.016**
	(0.002)	(0.004)
2004	0.146***	0.027***
	(0.005)	(0.002)
2007	0.073***	0.083***
	(0.001)	(0.004)
2010 (Great Recession)	0.192***	0.050***
	(0.006)	(0.003)
2013	0.110***	0.056***
	(0.003)	(0.003)
Credit Rejected	-0.090***	-0.032***
	(0.002)	(0.003)
1998 x Credit Rejected	0.061***	0.055***
	(0.003)	(0.002)
2001 x Credit Rejected	0.036**	0.073***
	(0.013)	(0.003)
2004 x Credit Rejected	0.147***	0.072***
	(0.005)	(0.001)
2007 x Credit Rejected	0.007*	-0.062***
	(0.003)	(0.006)
2010 x Credit Rejected	-0.075***	0.024***
	(0.010)	(0.003)
2013 x Credit Rejected	0.066***	0.049***
	(0.003)	(0.003)
Sex	0.174***	0.108***
	(0.003)	(0.001)
Birth Year	-0.007***	-0.005***
	(0.000)	(0.000)
Education of Head of Households	0.002***	0.002***
	(0.000)	(0.000)
Employed	0.041***	0.063***
	(0.002)	(0.003)
Expectation on the Economy (5 years)	-0.001*	0.002*
	(0.000)	(0.001)
Household Size	-0.007***	-0.009***
	(0.001)	(0.001)
Current Residence's Value (Log)	0.025***	0.012***
	(0.001)	(0.000)
Observations	25,510	18,422
F-test (Dotcom)	68.045	64.320
p-value (Dotcom)	0.001	0.001
F-test (GR)	636.494	149.926
p-value (GR)	0.000	0.000
F-test (All Recessions)	321.266	1081.904
p-value (All Recessions)	0.000	0.000

For F-tests:
$H0 : \beta^{\text{Pre-Recession}} = \beta^{\text{Recession}}$
$HA : \beta^{\text{Pre-recession}} \neq \beta^{\text{Recession}}$

Note: Standard errors in parentheses. ***, **, and * denote the 1%, 5%, and 10 % levels of significance, respectively. We report the marginal effects at the means using 1995 as the base year.

Table B3: Alternative Definitions of Subprime Borrowers

Dependent Variable: Investment Homeownership		
	(1)	(2)
	Income	**Revolving Balance**
1998	0.042***	-0.001
	(0.002)	(0.003)
2001 (Dot-com Recession)	0.019***	-0.012***
	(0.002)	(0.003)
2004	0.046***	0.037***
	(0.002)	(0.002)
2007	0.043***	0.067***
	(0.002)	(0.001)
2010 (Great Recession)	0.033***	0.052***
	(0.002)	(0.002)
2013	0.037***	0.093***
	(0.003)	(0.001)
Sex	0.058***	0.127***
	(0.002)	(0.001)
Birth Year	-0.003***	-0.009***
	(0.000)	(0.000)
Education of Head of Households	0.001***	0.003***
	(0.000)	(0.000)
Employed	0.005***	0.093***
	(0.001)	(0.001)
Expectation on the Economy (5 years)	0.002**	-0.015***
	(0.001)	(0.000)
Household Size	-0.010***	0.004***
	(0.000)	(0.000)
Current Residence's Value (Log)	0.005***	0.034***
	(0.000)	(0.000)
Observations	23,527	39,976
F-test (Dotcom)	221.434	37.733
p-value (Dotcom)	0.000	0.004
F-test (GR)	35.076	88.400
p-value (GR)	0.004	0.001
F-test (All Recessions)	562.644	2062.828
p-value (All Recessions)	0.000	0.000

Standard errors in parentheses

$H0 : \beta^{\text{Pre-Recession}} = \beta^{\text{Recession}}$

$HA : \beta^{\text{Pre-recession}} \neq \beta^{\text{Recession}}$

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B4: Robustness Check: Pooling the Data

	(1)	(2)
Recession	-0.082***	-0.042***
	(-17.466)	(-11.008)
Prime Dummy	0.069***	0.072***
	(20.227)	(21.297)
Prime x Recession	0.038***	0.016**
	(6.569)	(2.938)
Sex	0.459***	0.459***
	(81.299)	(81.024)
Birth Year	-0.017***	-0.017***
	(-175.715)	(-174.461)
Education of Head of Households	0.007***	0.007***
	(39.930)	(39.664)
Employed	0.115***	0.114***
	(31.279)	(30.528)
Expectation on the Economy (5 years)	0.017***	0.017***
	(12.761)	(12.321)
Household Size	-0.037***	-0.037***
	(-25.588)	(-25.626)
Current Residence's Value (Log)	0.062***	0.062***
	(78.798)	(79.015)
Credit Rejected	-0.102***	-0.077***
	(-28.696)	(-27.657)
Credit Rejected x Recession	0.121***	
	(14.480)	
Observations	40,358	40,358
F-test	39.428	40.493
p-value	0.003	0.003

For F-tests:
$H0 : \beta^{\text{Expansion}} = \beta^{\text{Recession}}$
$HA : \beta^{\text{Expansion}} \neq \beta^{\text{Recession}}$

Note: Standard errors in parentheses. ***, **, and * denote the 1%, 5%, and 10 % levels of significance, respectively. We report the marginal effects at the means using 1995 as the base year.

Table B5: Robustness Check: Bundling Survey Years into Recessions and Expansions

	Dependent Variable: Investment Homeownership	
	(1)	(2)
	Prime Borrowers	Subprime Borrowers
Pre-Dot-Com Expansion	0.010**	0.002
	(0.002)	(0.003)
Dot-com Recession	0.021***	-0.016**
	(0.002)	(0.004)
Pre-GR Expansion	0.074***	0.055***
	(0.002)	(0.003)
Great Recession	0.118***	0.050***
	(0.006)	(0.003)
Post-GR Expansion	0.099***	0.056***
	(0.003)	(0.003)
Credit Rejected	-0.088***	-0.032***
	(0.002)	(0.002)
Pre-Dot-Com Expansion x Credit Rejected	0.060***	0.055***
	(0.003)	(0.002)
Dot-com Recession x Credit Rejected	0.047**	0.073***
	(0.013)	(0.003)
Pre-GR Expansion x Credit Rejected	0.015***	0.006
	(0.003)	(0.003)
GR x Credit Rejected	-0.059***	0.024***
	(0.010)	(0.003)
Post-GR Expansion x Credit Rejected	0.072***	0.049***
	(0.004)	(0.003)
Sex	0.176***	0.108***
	(0.003)	(0.001)
Birth Year	-0.007***	-0.005***
	(0.000)	(0.000)
Education of Head of Households	0.002***	0.002***
	(0.000)	(0.000)
Employed	0.038***	0.061***
	(0.002)	(0.003)
Expectation on the Economy (5 years)	0.000	0.000
	(0.000)	(0.001)
Household Size	-0.007***	-0.010***
	(0.001)	(0.001)
Current Residence's Value (Log)	0.027***	0.012***
	(0.001)	(0.000)
Observations	25,307	18,422
F-test (Dotcom)	15.474	67.362
p-value (Dotcom)	0.017	0.001
F-test (GR)	92.673	5.794
p-value (GR)	0.001	0.074
F-test (All Recessions)	46.785	2175.738
p-value (All Recessions)	0.002	0.000

For F-tests:
$H0 : \beta^{\text{Pre-Recession}} = \beta^{\text{Recession}}$
$HA : \beta^{\text{Pre-recession}} \neq \beta^{\text{Recession}}$

Note: Standard errors in parentheses. ***, **, and * denote the 1%, 5%, and 10 % levels of significance, respectively. We report the marginal effects at the means using 1995 as the base year.

Table B6: Robustness Check: Excluding Business Ownership

	Dependent Variable: Investment Homeownership	
	(1)	(2)
	Prime Borrowers	Subprime Borrowers
1998	0.003	0.004
	(0.002)	(0.003)
2001 (Dot-com Recession)	0.000	-0.007
	(0.001)	(0.004)
2004	0.095***	0.024***
	(0.005)	(0.002)
2007	0.062***	0.081***
	(0.001)	(0.004)
2010 (Great Recession)	0.125***	0.054***
	(0.006)	(0.003)
2013	0.066***	0.053***
	(0.003)	(0.004)
Credit Rejected	-0.081***	-0.045***
	(0.002)	(0.004)
1998 x Credit Rejected	0.049***	0.073***
	(0.002)	(0.003)
2001 x Credit Rejected	0.037*	0.087***
	(0.013)	(0.005)
2004 x Credit Rejected	0.094***	0.075***
	(0.006)	(0.003)
2007 x Credit Rejected	0.011**	-0.040***
	(0.003)	(0.007)
2010 x Credit Rejected	-0.168***	0.023***
	(0.009)	(0.004)
2013 x Credit Rejected	0.099***	0.076***
	(0.002)	(0.004)
Sex	0.160***	0.092***
	(0.003)	(0.001)
Birth Year	-0.007***	-0.005***
	(0.000)	(0.000)
Education of Head of Households	0.002***	0.001***
	(0.000)	(0.000)
Employed	0.028***	0.061***
	(0.001)	(0.003)
Expectation on the Economy (5 years)	-0.004***	0.001
	(0.000)	(0.001)
Household Size	-0.007***	-0.010***
	(0.001)	(0.001)
Current Residence's Value (Log)	0.022***	0.010***
	(0.001)	(0.000)
Observations	23,046	17,423
F-test (Dotcom)	1.322	19.209
p-value (Dotcom)	0.314	0.012
F-test (GR)	165.414	126.360
p-value (GR)	0.000	0.000
F-test (All Recessions)	177.360	747.247
p-value (All Recessions)	0.000	0.000

For F-tests:
$H0 : \beta^{\text{Pre-Recession}} = \beta^{\text{Recession}}$
$HA : \beta^{\text{Pre-recession}} \neq \beta^{\text{Recession}}$

Note: Standard errors in parentheses. ***, **, and * denote the 1%, 5%, and 10 % levels of significance, respectively. We report the marginal effects at the means using 1995 as the base year.

Table B7: Robustness Check: A General Wealth Measure

	Dependent Variable: Investment Homeownership	
	(1)	(2)
	Prime Borrowers	Subprime Borrowers
1998	0.005*	0.000
	(0.002)	(0.003)
2001 (Dot-com Recession)	0.011***	-0.020***
	(0.002)	(0.004)
2004	0.084***	0.024***
	(0.006)	(0.002)
2007	0.059***	0.078***
	(0.002)	(0.004)
2010 (Great Recession)	0.107***	0.048***
	(0.006)	(0.003)
2013	0.081***	0.053***
	(0.004)	(0.003)
Credit Rejected	-0.082***	-0.032***
	(0.002)	(0.003)
1998 x Credit Rejected	0.062***	0.055***
	(0.003)	(0.003)
2001 x Credit Rejected	0.050**	0.076***
	(0.014)	(0.003)
2004 x Credit Rejected	0.144***	0.075***
	(0.005)	(0.001)
2007 x Credit Rejected	0.007	-0.059***
	(0.004)	(0.006)
2010 x Credit Rejected	-0.065***	0.025***
	(0.010)	(0.003)
2013 x Credit Rejected	0.070***	0.048***
	(0.004)	(0.003)
Sex	0.171***	0.108***
	(0.003)	(0.001)
Birth Year	-0.007***	-0.005***
	(0.000)	(0.000)
Education of Head of Households	0.002***	0.001***
	(0.000)	(0.000)
Employed	0.035***	0.063***
	(0.002)	(0.003)
Expectation on the Economy (5 years)	-0.002***	0.001
	(0.000)	(0.001)
Household Size	-0.007***	-0.009***
	(0.001)	(0.001)
Wealth (log)	0.040***	0.015***
	(0.002)	(0.000)
Observations	25,307	18,422
F-test (Dotcom)	4.518	90.358
p-value (Dotcom)	0.101	0.001
F-test (GR)	92.686	133.903
p-value (GR)	0.001	0.000
F-test (All Recessions)	160.596	1011.145
p-value (All Recessions)	0.000	0.000

For F-tests:
$H0 : \beta^{\text{Pre-Recession}} = \beta^{\text{Recession}}$
$HA : \beta^{\text{Pre-recession}} \neq \beta^{\text{Recession}}$

Note: Standard errors in parentheses. ***, **, and * denote the 1%, 5%, and 10 % levels of significance, respectively. We report the marginal effects at the means using 1995 as the base year.

Table B8: Robustness Check: Controlling for Debt

	Dependent Variable: Investment Homeownership	
	(1)	(2)
	Prime Borrowers	Subprime Borrowers
1998	-0.003	-0.008*
	(0.002)	(0.003)
2001 (Dot-com Recession)	0.002	-0.028***
	(0.002)	(0.004)
2004	0.059***	0.005*
	(0.006)	(0.002)
2007	0.033***	0.042***
	(0.002)	(0.004)
2010 (Great Recession)	0.075***	0.018***
	(0.008)	(0.003)
2013	0.045***	0.022***
	(0.003)	(0.003)
Credit Rejected	-0.097***	-0.037***
	(0.002)	(0.003)
1998 x Credit Rejected	0.073***	0.062***
	(0.004)	(0.002)
2001 x Credit Rejected	0.052**	0.070***
	(0.014)	(0.003)
2004 x Credit Rejected	0.150***	0.067***
	(0.006)	(0.001)
2007 x Credit Rejected	0.013**	-0.060***
	(0.004)	(0.007)
2010 x Credit Rejected	-0.062***	0.022***
	(0.010)	(0.003)
2013 x Credit Rejected	0.076***	0.048***
	(0.005)	(0.002)
Sex	0.165***	0.098***
	(0.003)	(0.001)
Birth Year	-0.008***	-0.005***
	(0.000)	(0.000)
Education of Head of Households	0.002***	0.001***
	(0.000)	(0.000)
Employed	0.022***	0.056***
	(0.001)	(0.004)
Expectation on the Economy (5 years)	-0.004***	0.001
	(0.000)	(0.001)
Household Size	-0.009***	-0.010***
	(0.001)	(0.001)
Current Residence's Value (Log)	0.013***	0.006***
	(0.001)	(0.000)
Debt (Log)	0.067***	0.050***
	(0.002)	(0.001)
Observations	25,307	18,422
F-test (Dotcom)	3.654	107.811
p-value (Dotcom)	0.129	0.000
F-test (GR)	40.343	79.104
p-value (GR)	0.003	0.001
F-test (All Recessions)	29.574	221.084
p-value (All Recessions)	0.006	0.000

For F-tests: $H0 : \beta^{\text{Pre-Recession}} = \beta^{\text{Recession}}$. $HA : \beta^{\text{Pre-recession}} \neq \beta^{\text{Recession}}$

Note: Standard errors in parentheses. ***, **, and * denote the 1%, 5%, and 10 % levels of significance, respectively. We report the marginal effects at the means using 1995 as the base year.

Table B9: Robustness Check: Varying Loan Thresholds and GSEs

	Subprime Borrowers			**Prime Borrowers**		
	(1)	(2)	(3)	(1)	(2)	(3)
1998	0.017***	-0.000	-0.038***	0.007***	0.008***	-0.000
	(0.003)	(0.004)	(0.005)	(0.002)	(0.002)	(0.003)
2001 (Dot-com Recession)	-0.001	0.008	-0.038***	0.017***	0.012***	0.023***
	(0.002)	(0.005)	(0.005)	(0.005)	(0.000)	(0.002)
2004	0.005***	0.008***	0.025***	0.155***	0.068***	0.080***
	(0.001)	(0.003)	(0.003)	(0.006)	(0.005)	(0.006)
2007	0.078***	0.057***	0.052***	0.073***	0.069***	0.053***
	(0.003)	(0.005)	(0.007)	(0.002)	(0.001)	(0.001)
2010 (Great Recession)	0.037***	0.043***	0.023***	0.108***	0.124***	0.191***
	(0.002)	(0.003)	(0.005)	(0.008)	(0.005)	(0.012)
2013	0.051***	0.047***	0.055***	0.126***	0.091***	0.106***
	(0.002)	(0.006)	(0.003)	(0.005)	(0.003)	(0.003)
Observations	26,219	13,800	13,564	21,243	29,276	20,654
F-test (Dotcom)	48.806	3.677	0.063	3.021	1.432	37.885
p-value (Dotcom)	0.002	0.128	0.814	0.157	0.297	0.004
F-test (GR)	352.807	30.758	57.982	23.346	145.651	130.212
p-value (GR)	0.000	0.005	0.002	0.008	0.000	0.000
F-test (All Recessions)	1031.180	75.344	180.020	296.966	210.413	1.666
p-value (All Recessions)	0.000	0.001	0.000	0.000	0.000	0.266

For F-tests:

$H0 : \beta^{\text{Pre-Recession Expansion}} = \beta^{\text{Recession}}$

$HA : \beta^{\text{Pre-Recession Expansion}} \neq \beta^{\text{Recession}}$

Note: Table B9 estimates the Probit regressions in Equation 1 with (1) a decrease of 5% in the cutoffs of prime and subprime borrowers, (2) an increase of 5% in the cutoffs of borrowers, and (3) the exclusion of the mortgages from government-sponsored enterprises. We report the marginal effects at the means using 1995 as the base year. ***, **, and * denote the 1%, 5%, and 10 % levels of significance, respectively.

Table B10: Robustness Check: Time-varying Subprime Cutoffs

	Dependent Variable: Investment Homeownership	
	(1)	(2)
	Prime Borrowers	Subprime Borrowers
1998	0.010**	0.024***
	(0.002)	(0.004)
2001 (Dot-com Recession)	0.020***	-0.021***
	(0.002)	(0.004)
2004	0.098***	0.021***
	(0.005)	(0.002)
2007	0.072***	0.076***
	(0.001)	(0.004)
2010 (Great Recession)	0.118***	0.021***
	(0.006)	(0.004)
2013	0.098***	0.060***
	(0.003)	(0.003)
Credit Rejected	-0.088***	-0.041***
	(0.002)	(0.003)
1998 x Credit Rejected	0.060***	-0.004
	(0.003)	(0.004)
2001 x Credit Rejected	0.046**	0.082***
	(0.013)	(0.003)
2004 x Credit Rejected	0.145***	0.081***
	(0.006)	(0.001)
2007 x Credit Rejected	0.006	-0.052***
	(0.003)	(0.006)
2010 x Credit Rejected	-0.059***	0.045***
	(0.010)	(0.006)
2013 x Credit Rejected	0.072***	0.024***
	(0.004)	(0.005)
Sex	0.176***	0.123***
	(0.003)	(0.001)
Birth Year	-0.007***	-0.005***
	(0.000)	(0.000)
Education of Head of Households	0.002***	0.002***
	(0.000)	(0.000)
Employed	0.037***	0.054***
	(0.002)	(0.003)
Expectation on the Economy (5 years)	-0.001**	0.000
	(0.000)	(0.001)
Household Size	-0.007***	-0.010***
	(0.001)	(0.001)
Current Residence's Value (Log)	0.027***	0.013***
	(0.001)	(0.000)
Observations	25,307	18,495
F-test (Dotcom)	15.118	544.343
p-value (Dotcom)	0.018	0.000
F-test (GR)	93.250	285.963
p-value (GR)	0.001	0.000
F-test (All Recessions)	321.537	1054.946
p-value (All Recessions)	0.000	0.000

For F-tests:
$H0 : \beta^{\text{Pre-Recession}} = \beta^{\text{Recession}}$
$HA : \beta^{\text{Pre-recession}} \neq \beta^{\text{Recession}}$

Note: Standard errors in parentheses. ***, **, and * denote the 1%, 5%, and 10 % levels of significance, respectively. We report the marginal effects at the means using 1995 as the base year.

Table B11: Controlling for Credit Rejection Rate, Income, Payment Schedule, and Adjustable Rate Mortgages

Dependent Variable: Investment Homeownership	
	Subprime Borrowers
1998	-0.019***
	(0.002)
2001 (Dot-com Recession)	-0.054***
	(0.004)
2004	0.007**
	(0.002)
2007	0.048***
	(0.004)
2010 (Great Recession)	0.020***
	(0.002)
2013	0.027***
	(0.003)
Credit Rejected	-0.007**
	(0.002)
1998 x Credit Rejected	0.068***
	(0.002)
2001 x Credit Rejected	0.082***
	(0.004)
2004 x Credit Rejected	0.067***
	(0.002)
2007 x Credit Rejected	-0.070***
	(0.007)
2010 x Credit Rejected	-0.007*
	(0.003)
2013 x Credit Rejected	0.046***
	(0.003)
Sex	0.034***
	(0.002)
Birth Year	-0.004***
	(0.000)
Education of Head of Households	-0.001***
	(0.000)
Employed	0.001
	(0.003)
Expectation on the Economy (5 years)	-0.003***
	(0.000)
Household Size	-0.019***
	(0.000)
Current Residence's Value (Log)	0.004***
	(0.000)
Real Income (log)	0.158***
	(0.002)
Payment Schedule	-0.007
	(0.005)
Adjustable Rate	0.059***
	(0.002)
Observations	17,964
F-test (Dotcom)	144.258
p-value (Dotcom)	0.000
F-test (GR)	77.155
p-value (GR)	0.001
F-test (All Recessions)	445.354
p-value (All Recessions)	0.000

Standard errors in parentheses
$H0 : \beta^{\text{Pre-Recession}} = \beta^{\text{Recession}}$
$HA : \beta^{\text{Pre-recession}} \neq \beta^{\text{Recession}}$
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

C Full Model

Patient Households:

$$C_{h,t} + D_t = \frac{R_{t-1} D_{t-1}}{\pi_t} + w_t l_{h,t} \tag{1}$$

$$\frac{1}{\beta_h C_{h,t} R_t} = E_t \left\{ \frac{1}{C_{h,t+1} \pi_{t+1}} \right\} \tag{2}$$

$$l_{h,t}^{\xi} = \frac{w_t}{C_{h,t}} \tag{3}$$

Prime Borrowers:

$$C_{p,t} + q_t^h H_{p,t+1} = q_t^h H_{p,t} - \frac{Z_{p,t-1} B_{p,t-1}}{\pi_t} + B_{p,t} + w_t l_{p,t} \tag{4}$$

$$B_{p,t} \leq m_{p,t} E_t \left\{ q_{t+1}^H H_{p,t+1} \frac{\pi_{t+1}}{Z_{p,t}} \right\} \tag{5}$$

$$l_{p,t}^{\xi} = \frac{w_t}{C_{p,t}} \tag{6}$$

$$E_t \frac{\beta_p \Gamma_p}{H_{p,t+1}} = E_t \left\{ \frac{q_t^h}{C_{p,t}} + (m_p - 1) \frac{\beta_p q_{t+1}^h}{C_{p,t+1}} - \frac{m_p q_{t+1}^h}{\frac{Z_{p,t}}{\pi_{t+1}} C_{p,t}} \right\} \tag{7}$$

Subprime Borrowers:

$$Z_{s,t} = Z_{p,t} + f_t \tag{8}$$

$$C_{s,t} + q_t^h (H_{s,t+1} - H_{s,t}) + \frac{Z_{s,t-1} B_{s,t-1}}{\pi_t} = B_{s,t} + w_t l_{s,t} \tag{9}$$

$$B_{s,t} \leq m_s E_t \left\{ q_{t+1}^h H_{s,t+1} \frac{\pi_{t+1}}{Z_{s,t}} \right\} \tag{10}$$

$$l_{s,t}^{\xi} = \frac{w_t}{C_{s,t}} \tag{11}$$

$$E_t \frac{\beta_s \Gamma_s}{H_{s,t+1}} = E_t \left\{ \frac{q_t^h}{C_{s,t}} + (m_s - 1) \frac{\beta_s q_{t+1}^h}{C_{s,t+1}} - \frac{m_s q_{t+1}^h}{\frac{Z_{s,t}}{\pi_{t+1}} C_{s,t}} \right\} \tag{12}$$

Entrepreneurs:

$$Y_t = A_t K_t^{\alpha} H_{e,t}^{\kappa} \left(L_{e,t} \right)^{(1-\alpha-\kappa)} \tag{13}$$

$$C_{e,t} + q_t^h H_{e,t+1} + \frac{Z_{e,t-1} B_{e,t-1}}{\pi_t} = \frac{Y_t}{X_t} + q_t^h H_{e,t} - w_t L_{e,t} - q_t I_{k,t} + B_{e,t} + F_t \tag{14}$$

$$L_{e,t} = \nu \left(\varrho L_{p,t} + (1-\varrho) L_{s,t} \right) + (1-\nu) L_{h,t} \tag{15}$$

$$B_{e,t} \leq m_e E_t \left\{ \left(q_{t+1}^h H_{e,t+1} + q_{t+1} K_{t+1} \right) \frac{\pi_{t+1}}{Z_{e,t}} \right\} \tag{16}$$

$$E_t \frac{\beta_e q_{t+1}}{C_{e,t+1}} \left(\frac{\alpha Y_{t+1}}{q_{t+1} K_{t+1}} + (1-\delta) - m_e \right) = \frac{1}{C_{e,t}} \left(q_t - E_t \frac{m_e q_{t+1}}{\frac{Z_{e,t}}{\pi_{t+1}}} \right) \tag{17}$$

$$E_t \frac{\beta_e q_{t+1}^h}{C_{e,t+1}} \left(\frac{\kappa Y_{t+1}}{q_{t+1}^h H_{e,t+1}} + (1-m_e) \right) = \frac{1}{C_{e,t}} \left(q_t^h - E_t \frac{m_e q_{t+1}^h}{\frac{Z_{e,t}}{\pi_{t+1}}} \right) \tag{18}$$

$$(1-\alpha-\kappa) \frac{Y_t}{L_{e,t}} = w_t \tag{19}$$

Retailers:

$$Y_t = \left(\int_0^1 Y_t(z)^{(\varepsilon-1)/\varepsilon} \, dz \right)^{\varepsilon/(\varepsilon-1)} \tag{20}$$

$$Y_t(z) = \left(\frac{P_t(z)}{P_t} \right)^{-\varepsilon} Y_t \tag{21}$$

$$P_t = \left[\theta P_{t-1}^{1-\epsilon} + (1-\theta) \left(P_t^* \right)^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}} \tag{22}$$

$$F_t = \left(1 - \frac{1}{X_t} \right) Y_t \tag{23}$$

Capital Producers:

$$E_t \left\{ q_t x_t^i - 1 - \chi \left(\frac{I_{k,t}}{K_t} - \delta \right) \right\} = 0 \tag{24}$$

$$x_t^i I_{k,t} = K_{t+1} - (1-\delta) K_t \tag{25}$$

House Producers:

$$x_t^h I_{h,t} = H_{t+1} - H_t \tag{26}$$

$$H_t = H_{p,t} + H_{s,t} + H_{e,t} \tag{27}$$

$$E_t \left\{ q_t^h x_t^h - 1 - \chi_h \left(\frac{I_{h,t}}{H_t} \right) \right\} = 0 \tag{28}$$

Monetary Policy:

$$R_t = \bar{R}\left(\left[\frac{Y_t}{\bar{Y}}\right]^{b_1}\left[\frac{1+\pi_t}{1+\bar{\pi}}\right]^{b_2}\right)e_t^R \tag{29}$$

$$R_t - 1 \geq 0 \tag{30}$$

Market Clearing Conditions:

$$Y_t = C_t + I_{k,t} + I_{h,t} \tag{31}$$

$$D_t = B_{p,t} + B_{s,t} + B_{e,t} \tag{32}$$

$$L_{e,t} = l_{h,t} + l_{s,t} + l_{p,t} \tag{33}$$

Shock Processes:

$$\log \beta_{h,t} = (1-\rho_{\beta_h})\,\beta_h + \rho_{\beta_h}\log \beta_{h,t-1} + \varepsilon_t^{\beta_h} \tag{34}$$

$$f_t = (1-\rho_f)\bar{f} + \rho_f f_{t-1} + \varepsilon_t^f \tag{35}$$

$$\log A_t = \rho_A \log A_{t-1} + \varepsilon_t^A \tag{36}$$

$$\log x_t^i = \rho_{x^i}\log x_{t-1}^i + \varepsilon_t^{x^i} \tag{37}$$

$$\log x_t^h = \rho_{x^h}\log x_{t-1}^h + \varepsilon_t^{x^h} \tag{38}$$

$$\log {e_t}^R = \rho_e \log {e_{t-1}}^R + \varepsilon_{e_t}^R \tag{39}$$

D Estimation

We estimate the model to fit the following five series: real output growth (GDPC96), bank prime loan rate (MPRIME), growth rate of private residential investment (PRFI), the growth rate of house prices (MSPUS), and real consumption growth (PCECC96), in which the codes in the brackets denote the corresponding codes from the St. Louis' FRED database. Data from 1984:Q1 to 2016:Q2 are retrieved from the St. Louis' FRED database, are of quarterly frequency, and are seasonally adjusted. Here we abstract from periods with high volatility before the Great Moderation by focusing on post-1984 data only. We define a set of auxiliary variables

in the model and then transform the data accordingly. In particular, we use the following four quantities $g^Y = \frac{Y' - Y}{Y}$; $g^C = \frac{C' - C}{C}$; $g^H = \frac{PRFI' - PRFI}{PRFI}$; $g^{PH} = \frac{P_H' - P_H}{P_H}$, where P_H denotes the series "Median Sales Price of Houses Sold for the United States (MSPUS)" from the U.S. Bureau of the Census. To match the growth rate of real house prices in the model, we deflate the variables using a common GDP deflator as in the case for output and consumption. For the growth rate of house prices and the borrowing rates for prime borrowers, we match the net rates with the ones obtained from the St. Louis' FRED.

Robustness of the Bayesian Estimation Here we verify the robustness of the model's estimation by running several alternative specifications. Table D1 presents the estimation results of the baseline model by removing or adding a number of parameters.

Table D1: Estimation using Alternative Specifications

Par.	Prior	Posterior	90% HPD	interval	Prior	Post. Std.	Prior	Posterior	90% HPD	interval	Prior	Post. Std.
β_H	0.99	0.9884	0.9816	0.9957	beta	0.005	0.99	0.9879	0.9798	0.9963	beta	0.005
β_S	0.950	0.9507	0.9432	0.9581	beta	0.005	0.950	0.9508	0.9434	0.9599	beta	0.005
β_P	0.97	0.9699	0.9617	0.9771	beta	0.005	0.970	0.9692	0.9607	0.9771	beta	0.005
β_e	0.98	0.9794	0.973	0.9889	beta	0.005	0.98	0.9804	0.9725	0.989	beta	0.005
ρ_A	0.90	0.9016	0.8704	0.9317	beta	0.02	0.90	0.8981	0.8636	0.9281	beta	0.02
χ_K	0.59	0.59	0.5848	0.5946	beta	0.003	0.59	0.5897	0.585	0.595	beta	0.003
χ_H	0.1	0.1	0.0956	0.1051	beta	0.003	0.10	0.0996	0.0939	0.1048	beta	0.003
m_e	0.80	0.7995	0.7583	0.8574	norm	0.03	0.80	0.7995	0.7583	0.8574	norm	0.03
m_s	0.80	0.796	0.751	0.8556	norm	0.03	0.80	0.796	0.751	0.8556	norm	0.03
m_p	0.80	0.8015	0.7594	0.8509	norm	0.03	0.80	0.8015	0.7594	0.8509	norm	0.03
θ	0.75	0.7456	0.7159	0.7775	norm	0.02	0.75	0.7478	0.7129	0.7779	norm	0.02
$\bar{f}$	0.05	0.0502	0.0451	0.0543	norm	0.003	-	-	-	-	-	-
e	0.6	0.5999	0.5411	0.657	norm	0.03	-	-	-	-	-	-
s	0.4	0.3994	0.3477	0.437	norm	0.03	-	-	-	-	-	-
p	2.5	2.5015	2.4565	2.557	norm	0.03	-	-	-	-	-	-
ρ_f	0.5	0.5066	0.3495	0.6608	beta	0.1	0.5	0.4856	0.3297	0.6808	beta	0.1
ρ_X	0.5	0.5135	0.3824	0.6329	beta	0.1	0.5	0.5259	0.4035	0.6524	beta	0.1
ρ_{XI}	0.5	0.5415	0.4201	0.6498	beta	0.1	0.5	0.4826	0.3077	0.6417	beta	0.1

Standard Deviation of Shocks

Shocks	Prior	Posterior	90% HPD	interval	Prior	Post. Std.	Prior	Posterior	90% HPD	interval	Prior	Post. Std.
ε_A	0.01	0.0343	0.032	0.0365	invg	Inf	0.01	0.0357	0.0344	0.037	invg	Inf
ε_e	0.01	0.0409	0.0376	0.0444	invg	Inf	0.01	0.0431	0.0401	0.0454	invg	Inf
ε_f	0.02	0.0075	0.0046	0.0105	invg	Inf	0.02	0.0087	0.0042	0.0125	invg	Inf
ε_X	0.01	0.0378	0.0355	0.0396	invg	Inf	0.01	0.0378	0.034	0.0402	invg	Inf
ε_{XI}	0.01	0.0283	0.0265	0.0313	invg	Inf	0.01	0.0282	0.0266	0.0303	invg	Inf
ε_P	0.01	0.0093	0.0085	0.0103	invg	Inf	0.01	0.0094	0.0083	0.0104	invg	Inf

Note: We estimate the model to fit five series: real output growth (GDPC96), bank prime loan rate (MPRIME), growth rate of the private residential investment (PRFI), the growth rate of house prices (MSPUS), and real consumption growth (PCECC96). Data are all seasonally adjusted, and transformed in a way such that the variable definitions match ours in the model. Here we re-estimate our baseline model with different sets of parameters.

E Extension to the Model: Adding a Rental Market

E.0.1 Model:

In this exercise, we add a rental market to our baseline model. We allow both prime and subprime borrowers to choose how much housing to own and how much to rent to the patient households at any time. Here, we only highlight the differences from the baseline model.

Patient Households: Patient households obtain some utility from renting a house as below.

$$\max_{C_{h,t},l_{h,t},D_t,H_{h,t+1}} E_t \left\{ \sum_{k=0}^{\infty} \beta_h^k \left[\ln(C_{h,t+k}) + \zeta \ln(H_{h,t+k}) - \frac{l_{h,t+k}^{1+\xi}}{1+\xi} \right] \right\},$$

where ζ denotes the utility of housing services for rental houses and $0 < \zeta < 1$.

Budget constraint:

$$C_{h,t} + D_t + R_{h,t} H_{h,t} = \frac{(R_{t-1} D_{t-1})}{\pi_t} + W_t l_{h,t}.$$

First order conditions:

$$\frac{1}{\beta_h C_{h,t} R_t} = E_t \left\{ \frac{1}{C_{h,t+1} \pi_{t+1}} \right\}.$$

$$l_{h,t}^{\xi} = \frac{w_t}{C_{h,t}}.$$

and

$$C_{h,t} = \frac{1}{\zeta} R_{h,t} H_{h,t}.$$

Prime and Subprime Borrowers:

$$\max_{C_{i,t},H_{i,t+1},l_{i,t},B_{i,t},\omega_{i,t}} E_t \left\{ \sum_{k=0}^{\infty} \beta_p^k \left[\ln(C_{i,t+k}) + \Gamma_p \ln(\omega_{i,t+k} H_{i,t+k}) - \frac{l_{i,t+k}^{1+\xi}}{1+\xi} \right] \right\}$$

Here $i \in \{s, p\}$, where s and p denote subprime and prime borrowers, respectively. $0 \leq \omega_{i,t} \leq 1$

shows the amount of housing that borrowers prefer to hold (own), and therefore, $1-\omega_{i,t}$ represents the amount of housing each borrower choose to rent. The budget constraint is given by

$$C_{i,t}+q_t^h H_{i,t+1}=q_t^h H_{i,t}-\frac{(Z_{i,t-1}B_{i,t-1})}{\pi_t}+B_{p,t}+W_t l_{p,t}+R_{h,t}(1-\omega_{p,t})H_{p,t}$$

The borrowing constraints remain the same as the baseline model.

$$B_{i,t}\leq m_{i,t}E_t\left\{q_{t+1}^H H_{i,t+1}\frac{\pi_{t+1}}{Z_{i,t}}\right\}$$

First order conditions are:

$$l_{i,t}^{\xi}=\frac{w_t}{C_{i,t}}$$

$$E_t\frac{\beta_i\Gamma_i}{H_{i,t+1}}=E_t\left\{\frac{q_t^h}{C_{i,t}}+(m_{i,t}-1)\frac{\beta_i q_{t+1}^h}{C_{i,t+1}}-\frac{m_{i,t}q_{t+1}^h}{\frac{Z_{i,t}}{\pi_{t+1}}C_{i,t}}-\frac{R_{h,t+1}\beta_i(1-\omega_{i,t+1})}{C_{i,t+1}}\right\}$$

and

$$\omega_{i,t}=\frac{\Gamma_i C_{i,t}}{R_{h,t}H_{i,t}}$$

Market Clearing Conditions Additional to the regular market clearing conditions, the following represents the rental market equilibrium condition.

$$\sum_i(1-\omega_{i,t})H_{i,t}=H_{h,t}$$

where $i\in\{s,p\}$ as above.

E.0.2 Static Analysis

The following analysis shows some key relationships in the rental market.

Lemma E.1 *Subprime borrowers' renting decisions are less sensitive to their housing investment changes than those of prime borrowers.*

Using the definitions of ω_s and ω_p, we get

$$\begin{aligned}\frac{\partial \omega_s}{\partial s} &= \frac{\Gamma_s}{R_h s}\left(-\frac{C_s}{Y}\frac{1}{s} - \frac{C_s}{Y}\frac{1}{R_h}\frac{\partial R_h(p)}{\partial p} + \frac{\partial \frac{C_s}{Y}(s)}{\partial s}\right)\\ \text{and}\\ \frac{\partial \omega_p}{\partial p} &= \frac{\Gamma_p}{R_h p}\left(-\frac{C_p}{Y}\frac{1}{p} - \frac{C_p}{Y}\frac{1}{R_h}\frac{\partial R_h(p)}{\partial p} + \frac{\partial \frac{C_p}{Y}(p)}{\partial p}\right)\end{aligned}$$

Given

$$\frac{\partial R_h(p)}{\partial p} = \frac{1}{\beta_p}\frac{m_p}{Z_p^2}\frac{\partial Z_p}{\partial p} > 0$$

and

$$\frac{\partial Z_p}{\partial p} > 0$$

$$\frac{\partial \omega_s}{\partial s}, \frac{\partial \omega_p}{\partial p} < 0$$

Moreover, given that

$$p > s,$$

under any reasonable parametrization, we thus have

$$\frac{\partial \omega_s}{\partial s} > \frac{\partial \omega_p}{\partial p}.$$

Given that $\frac{\partial \omega_p}{\partial p}$ and $\frac{\partial \omega_s}{\partial s} < 0$, we can conclude that subprime borrowers' rental decisions are less sensitive to their housing investment changes under any reasonable parametrization.

Lemma E.2 *As the risk premium increases, subprime borrowers reflect this increase to renters.*

Using

$$R_h = \frac{1}{\beta_s}\left(\beta_s(m_s - 1) + 1 - \frac{m_s}{\left(Z_p + \bar{f}\right)}\right)$$

We get

$$\frac{\partial R_h}{\partial \bar{f}} = \frac{m_s}{\beta_s\left(Z_p + \bar{f}\right)^2} > 0.$$

Lemma E.3 *As the risk premium increases, prime borrowers demand less consumption. In particular, prime borrowers take advantage of relatively better credit access and increase their housing demand rather than consume. Whereas, when risk premium increases the subprime borrowers decrease their housing demand therefore they rather consume more. Additionally, as the risk premium increases prime borrower rent more than subprime borrowers.*

Using the definitions of ω_s and ω_p yields

$$\frac{\partial \omega_p}{\partial \bar{f}} = \frac{\Gamma_p}{p}\frac{1}{R_h}\left(\frac{\partial R_h}{\partial \bar{f}} - \frac{C_p}{Y}\frac{1}{R_h}\frac{\partial\left(\frac{C_p}{Y}\right)}{\partial \bar{f}}\right)$$

and

$$\frac{\partial \omega_s}{\partial \bar{f}} = \frac{\Gamma_s}{s}\frac{1}{R_h}\left(\frac{\partial R_h}{\partial \bar{f}} - \frac{C_s}{Y}\frac{1}{R_h}\frac{\partial\left(\frac{C_s}{Y}\right)}{\partial \bar{f}}\right)$$

Using the definition of $\frac{C_p}{Y}$, we get

$$\frac{\partial \frac{C_p}{Y}}{\partial \bar{f}} = \frac{1}{(\Gamma_p - \Gamma_s)}\left(-1 + \left(\left(1-\bar{f}\right)Z_s\right) + \frac{1}{\beta_s}\frac{(p+s)}{s} - (1+\Gamma_s)\frac{(R-1)}{(1+\zeta)}\right)\frac{m_s}{Z_s^2}s$$

with any reasonable parametrization $\frac{\partial \frac{C_p}{Y}}{\partial \bar{f}} < 0$, and therefore, $\frac{\partial \omega_p}{\partial \bar{f}} > 0$.

Using the definition of $\frac{C_s}{Y}$, we get

$$\frac{\partial\left(\frac{C_s}{Y}\right)}{\partial \bar{f}} = \frac{(R-1)}{(1+\zeta)}\frac{m_s}{Z_s^2}s - \frac{\partial \frac{C_p}{Y}}{\partial \bar{f}} > 0.$$

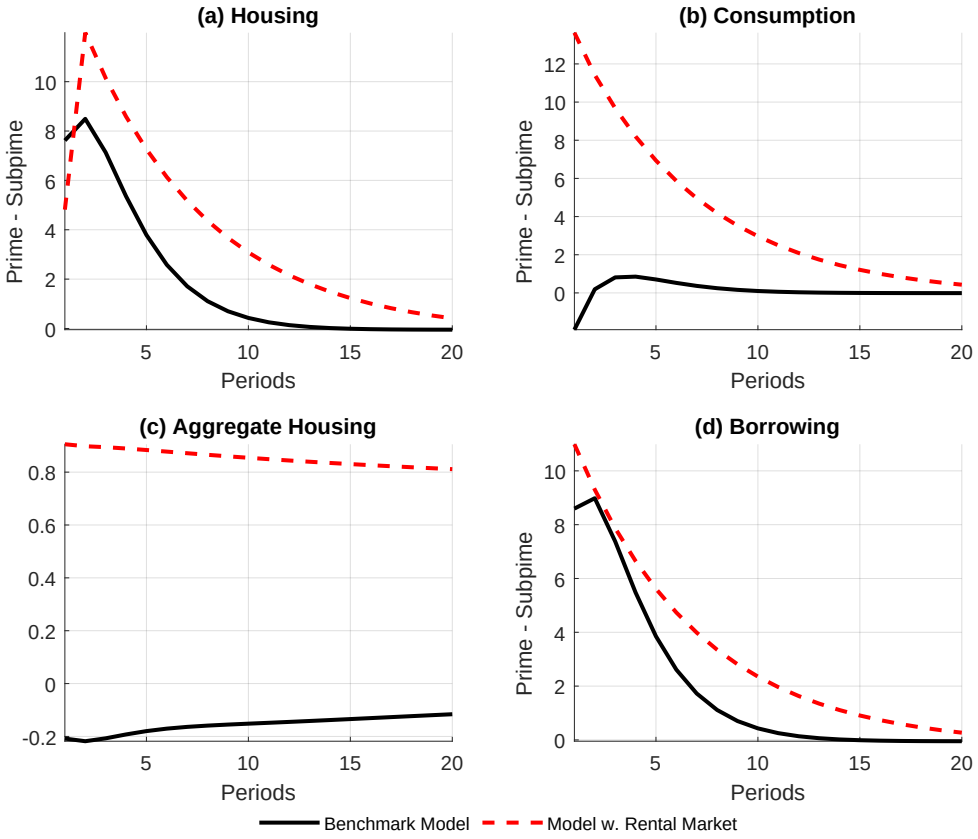
Thus,

$$\frac{\partial \omega_s}{\partial \bar{f}} < \frac{\partial \omega_p}{\partial \bar{f}}.$$

E.0.3 Dynamic Responses under the Model with a Rental Market

This section presents the dynamic responses of selected variables from our benchmark model without the rental market and the model with the rental market.

Figure E.1: Responses to an Adverse Financial Shock

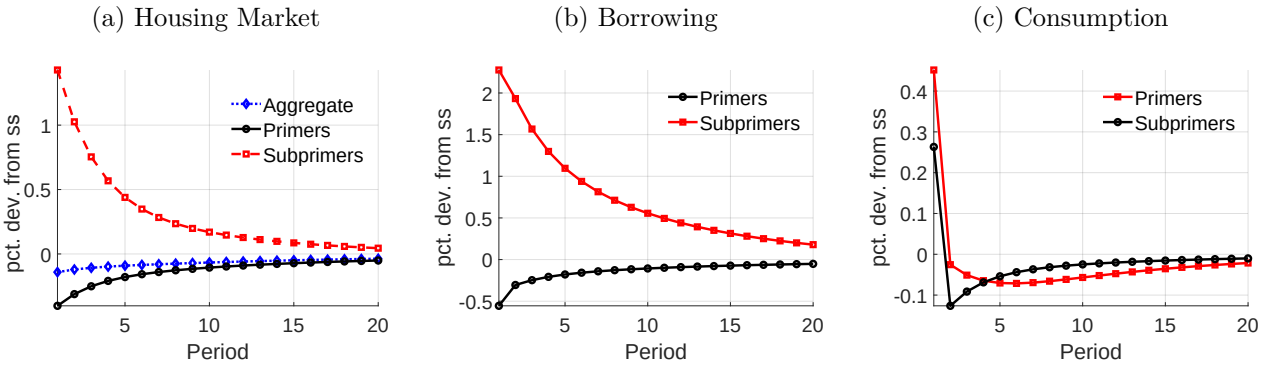


Note: This figure plots aggregate housing responses and the difference in the responses of prime and subprime borrowers and to a one-standard-deviation risk premium shock across the benchmark model and the variant with rental market. All responses are normalized so that the units of the vertical axes represent percentage deviations from the steady state.

Adding one more market for rental housing made the model quite complicated which resulted in two downsides for the paper. First, we lost the ability to have a closed-form solution for the steady state of the model. Second, we were not able to estimate the model using Bayesian techniques as the rest of our paper. Therefore, we had to calibrate the model where we used the values described in Table 2 or the mode of the posterior estimations from our baseline model. For the new parameters related to the rental market, we had to either rely on the data or solve for the implied values for parameters that are deeply dependent on the remaining parameters.

Figure E.1 plots the impulse responses of housing, consumption and borrowing across the benchmark model and the one with the rental market to a one-percent increase in risk premium between prime and subprime borrowers. Figure E.1 shows that including the rental market only

Figure E.2: Responses to a One-percent Increase in the LTV of the Subprime Borrowers



Note: All responses are normalized so that the units of the vertical axes represent percentage deviations from the steady state.

amplifies the asymmetric responses in housing across the two types of borrowers, compared to the baseline model. Intuitively, due to additional gains from renting, prime borrowers are even more incentivized to invest in housing since they are better positioned to do so than their subprime counterparts.

E.1 Extension to the Model: Incorporating LTV Shock

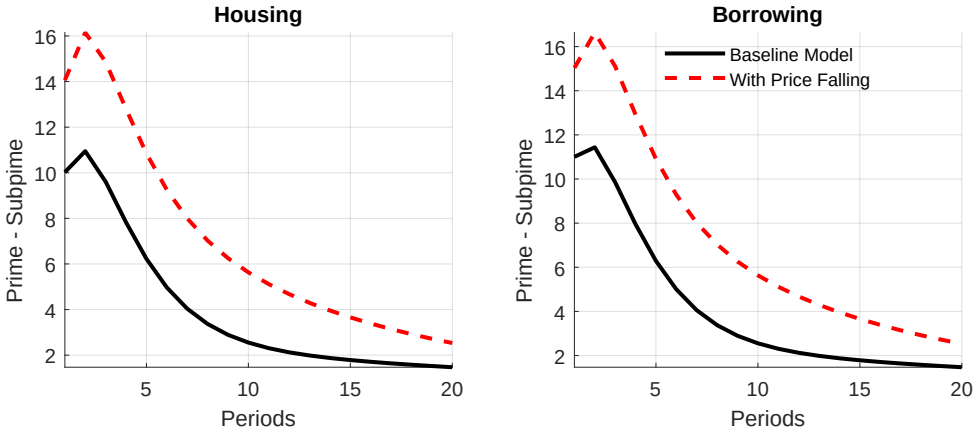
In this section, we examine the extent to which investment decisions of prime and subprime borrowers respond to an unexpected increase in the loan-to-value (LTV) ratio. To that end, we replace the parameter that represents the LTV ratio of the subprime borrowers, m_s, with a variable $m_{s,t}$, which is governed by the following mean-reverting AR(1) process:

$$\log m_{s,t} = (1 - \rho_{m_s}) \log \bar{m}_s + \rho_{m_s} \log m_{s,t-1} + \varepsilon_{m_s,t} \tag{40}$$

in which $\rho_{ms} = 0.9$ dictates the persistence of unexpected LTV shock arising from ε_{st} i.i.d. $\sim$ N(0, σ^2_{ms}). For the purpose of this section, we set $\sigma_{ms} = 0.01$ to examine how the model responds to an unexpected one-percent increase in the LTV of the subprime borrowers. All other parameter values follow our estimation results in the main text.

Figure E.2 plots the impulse responses of housing investment, borrowing, and consumption of the borrowers to a one-percent increase in the LTV ratio of subprime borrowers. An increase

Figure E.3: Effects of an Adverse Financial Shock when House Prices Fall



Note: The figure shows the responses of housing and borrowing to a one-percent risk premium shock under the model with and without (i.e., baseline) a 20% fall in house prices. All responses are normalized so that the units of the vertical axes represent percentage deviations from the steady state.

in LTV for subprime borrowers help these borrowers overcome the negative effects of the risk premium. Therefore, with the lax credit constraints the subprime borrowers start to have significantly better credit access than prime borrowers, switching the direction of the wealth redistribution. In particular, a positive shock to the LTV here increases housing investment, consumption, and borrowing, keeping the risk premium constant for the subprime borrowers. An increase in LTV relaxes the borrowing constraint for the subprime borrowers, allowing these borrowers to ramp up their housing investment and consumption, while crowding out those of the prime borrowers.

E.2 Extension to the Model: Unexpected Regime Changes

We next study how housing investment responds to an unexpected regime change in which borrowers anticipate a fall in house prices. To that end, we simulate a regime change in which agents anticipate that house prices will fall by 20% and not recover. As shown in Figure E.3, prime borrowers are able to take advantage of decreasing house prices. In fact, wealth redistribution is amplified when house prices stay low. This result confirms our intuition that prime borrowers are able to take advantage of lower house prices, which is a key feature of the Great Recession.