Supplemental Appendix for: The Missing LTV Cycle

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Online Appendix

Appendix A – Supplemental Figures and Tables

A Supplemental Figures and Tables

Table A1: The Effects of Sample Restrictions on Counts of Transactions

Year	Ownership Changes with Mortgage	Of Which Deeds	Of Which Arms Length	Of Which Observed Sale Price
1999	3,688,537	3,268,282	2,567,662	1,957,541
2000	4,535,006	4,020,881	3,063,386	2,445,016
2001	4,800,039	4,214,311	3,104,345	2,531,670
2002	5,240,669	4,567,269	3,298,184	2,704,623
2003	5,835,021	5,043,732	3,608,697	2,982,644
2004	6,303,049	5,499,977	4,065,145	3,439,970
2005	6,634,075	5,820,059	4,393,517	3,818,459
2006	5,935,283	5,163,569	3,949,465	3,445,346
2007	5,136,650	4,361,993	3,236,920	2,784,147
2008	4,650,450	3,779,077	2,555,895	2,165,467
2009	4,737,622	3,792,989	2,384,476	2,073,550
2010	4,591,404	3,580,890	2,144,528	1,871,712
2011	4,503,120	3,512,335	2,048,173	1,784,057
2012	5,009,048	3,901,537	2,311,050	2,022,250
2013	5,331,886	4,230,128	2,654,277	2,355,661
2014	5,396,540	4,327,708	2,829,957	2,547,332
2015	5,840,951	4,751,598	3,202,795	2,922,820
2016	6,078,990	4,993,913	3,432,071	3,151,426
2017	6,155,983	5,086,444	3,538,169	3,223,622
2018	6,267,669	5,204,117	3,603,401	3,251,153
2019	6,440,899	5,366,766	3,780,980	3,448,528
2020	6,785,052	5,752,464	4,039,746	3,684,096
2021	7,671,047	6,485,544	4,440,810	3,986,155
2022	6,819,127	5,696,146	3,831,483	3,422,741
2023	5,841,985	4,761,225	3,046,607	2,697,075
Total	140,230,102	117,182,954	81,131,739	70,717,061

This table documents the sequential application of sample selection criteria used to construct the final analysis sample. We begin with the universe of ownership transfers recorded in CoreLogic and retain only those transactions that reflect mortgage-financed changes in ownership of parcels that remain physically and legally unchanged. These restrictions exclude all-cash transactions, mortgage refinancings, and parcel splits or mergers, respectively. Next, we restrict the sample to deed transfers, excluding quitclaims and foreclosures. We then remove all transactions flagged by CoreLogic as non-arm's-length. Finally, we exclude observations with missing sales prices. The resulting sample comprises 69,714,610 transactions with non-missing sales prices and mortgage amounts, and thus well-defined combined loan-to-value (CLTV) ratios. Additional details on the sample construction are provided in Section 3.1.

Table A2: Counts of Transactions with Missing Sales Price by State

State	Arms Length Deeds	Missing Sales Price	With Sales Price	Share With Sales Price	Non-Disclosure State
Alabama	883,362	245,170	638,192	0.72	0
Alaska	232,230	48,342	183,888	0.79	1
Arizona	2,445,054	46,937	2,398,117	0.98	0
Arkansas	561,955	115,320	446,635	0.79	0
California	9,387,184	170,438	9,216,746	0.98	0
Colorado	2,068,011	25,779	2,042,232	0.99	0
Connecticut	900,400	10,449	889,951	0.99	0
Delaware	217,152	4,908	212,244	0.98	0
District of Columbia	154,837	328	154,509	1.00	0
Florida	6,772,561	40,964	6,731,597	0.99	0
Georgia	2,629,607	140,017	2,489,590	0.95	0
Hawaii	308,224	12,971	295,253	0.96	0
Idaho	718,860	233,534	485,326	0.68	1
Illinois	2,930,674	56,722	2,873,952	0.98	0
Indiana	1,994,173	769,922	1,224,251	0.61	0
Iowa	660,411	66,558	593,853	0.90	0
Kansas	777,351	230,492	546,859	0.70	1
Kentucky	681,844	123,081	558,763	0.82	0
Louisiana	635,213	129,418	505,795	0.80	1
Maine	209,961	71,116	138,845	0.66	0
Maryland	1,762,156	3,498	1,758,658	1.00	0
Massachusetts	1,009,535	48,887	960,648	0.95	0
Michigan	1,700,629	77,968	1,622,661	0.95	0
Minnesota	954,077	15,359	938,718	0.98	0
Mississippi	553,395	435,505	117,890	0.21	1
Missouri	2,210,083	941,818	1,268,265	0.57	1
Montana	452,838	223,693	229,145	0.51	1
Nebraska	434,779	52,954	381,825	0.88	0
Nevada	1,065,808	15,300	1,050,508	0.99	0
New Hampshire	273,568	4,851	268,717	0.98	0
New Jersey	2,085,450	15,050	2,070,400	0.99	0
New Mexico	617,439	235,607	381,832	0.62	1
New York	2,194,111	102,394	2,091,717	0.95	0
North Carolina	2,516,461	169,850	2,346,611	0.93	0
North Dakota	156,837	29,065	127,772	0.81	1
Ohio	2,586,332	83,811	2,502,521	0.97	0
Oklahoma	892,293	86,141	806,152	0.90	0
Oregon	1,140,526	14,155	1,126,371	0.99	0
Pennsylvania	2,583,115	265,592	2,317,523	0.9	0
Rhode Island	252,807	1,600	251,207	0.99	0
South Carolina	1,154,551	90,470	1,064,081	0.92	0
South Dakota	26,921	22,533	4,388	0.16	0
Tennessee	1,744,753	88,201	1,656,552	0.95	0
Texas	10,801,655	4,160,504	6,641,151	0.61	1
Utah	1,234,228	338,801	895,427	0.73	1
Virginia	2,289,110	109,149	2,179,961	0.95	0
Washington	2,038,738	68,063	1,970,675	0.97	0
West Virginia	130,565	46,200	84,365	0.65	0
Wisconsin	936,469	50,957	885,512	0.95	0
Wyoming	163,446	74,236	89,210	0.55	1
Total	81,131,739	10,414,678	70,717,061	0.87	12

This table reports, by state, the number of arm's-length deed transactions with non-missing sales prices that comprise the final analysis sample. Vermont is excluded due to the absence of CoreLogic coverage. "Non-Disclosure States" refer to states where the disclosure of sales prices on deeds is not legally required.

Table A3: CoreLogic Coverage of U.S. Counties by Year

Year	Percent of U.S. Counties	Percent of U.S. Population
1999	19.9	71.2
2000	24.1	75.5
2001	25.3	76.6
2002	27.2	78.1
2003	29.4	79.5
2004	35.6	82.2
2005	41.6	84.7
2006	45.3	86.4
2007	47.8	87.5
2008	48.9	87.6
2009	49.3	87.8
2010	55.9	89.9
2011	59.7	91.0
2012	61.5	91.7
2013	66.5	92.7
2014	70.5	93.6
2015	70.6	93.8
2016	71.2	94.1
2017	71.8	94.4
2018	73.1	95.2
2019	75.9	95.8
2020	76.8	96.1
2021	77.1	96.2
2022	77.5	96.3
2023	77.5	96.4

This table first reports the share of counties with at least one transaction in the final analysis sample. Because CoreLogic coverage is closely tied to the digitization of county deed records, counties typically enter the dataset in discrete jumps. The second panel presents the same measure weighted by annual county-level population estimates.

Table A4: Counts of Transaction Type by Year

	CLTV < 94.5%		CLTV ≥ 94.5%		
Year	Private	FHA/VA	Private	FHA/VA	Total
1999	1,127,125	28,236	382,628	419,552	1,957,541
2000	1,418,492	30,912	502,156	493,456	2,445,016
2001	1,417,258	32,171	574,243	507,998	2,531,670
2002	1,576,170	24,497	665,741	438,215	2,704,623
2003	1,756,727	17,534	851,097	357,286	2,982,644
2004	2,037,079	12,996	1,127,252	262,643	3,439,970
2005	2,239,017	10,411	1,365,322	203,709	3,818,459
2006	1,895,266	11,270	1,333,647	205,163	3,445,346
2007	1,602,581	11,950	937,036	232,580	2,784,147
2008	1,188,403	38,429	316,273	622,362	2,165,467
2009	968,504	62,131	213,630	829,285	2,073,550
2010	914,976	54,886	182,426	719,424	1,871,712
2011	912,571	48,881	210,650	611,955	1,784,057
2012	1,082,008	43,989	280,879	615,374	2,022,250
2013	1,329,526	49,523	376,170	600,442	2,355,661
2014	1,418,481	54,700	443,439	630,712	2,547,332
2015	1,531,175	70,153	499,260	822,232	2,922,820
2016	1,622,953	72,853	587,416	868,204	3,151,426
2017	1,719,294	79,298	616,764	808,266	3,223,622
2018	1,795,566	70,420	687,769	697,398	3,251,153
2019	1,842,188	77,513	736,883	791,944	3,448,528
2020	1,990,223	69,469	801,746	822,658	3,684,096
2021	2,366,697	87,604	749,341	782,513	3,986,155
2022	2,069,905	95,364	592,133	665,339	3,422,741
2023	1,558,491	85,216	450,148	603,220	2,697,075
Total	39,380,676	1,240,406	15,484,049	14,611,930	70,717,061

This table reports, by year, the number of transactions in each of the four mutually exclusive and collectively exhaustive categories comprising our final dataset of mortgage-financed ownership transfers. Detailed definitions of these transaction types are provided in Section 3.1.

Table A5: Summary Statistics

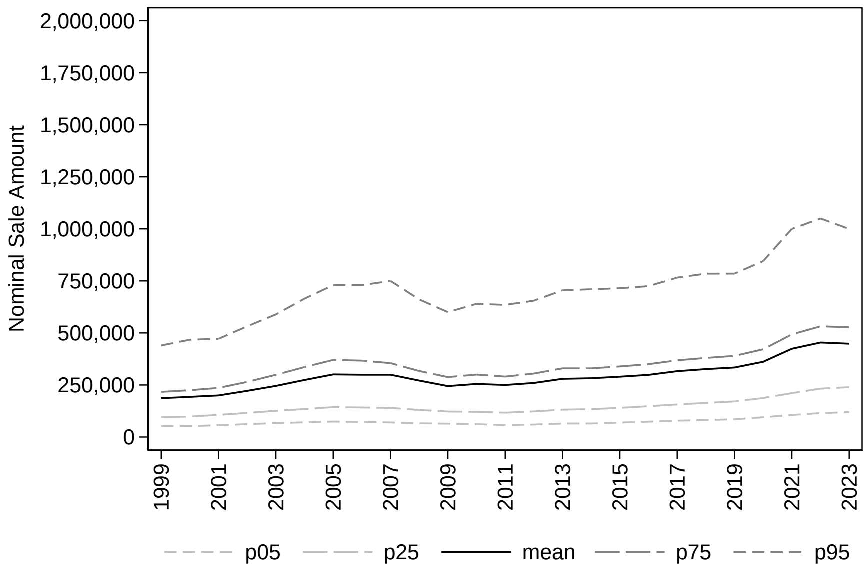
	Mean	Std Dev	10^{th} Pctile	25^{th} Pctile	75^{th} Pctile	90^{th} Pctile	Count
Loan Characteristics							
Combined Loan-to-Value Ratio	0.862	0.152	0.700	0.800	0.982	1.000	70,717,061
FHA or VA Guaranteed (=1)	0.224	0.417	0.000	0.000	0.000	1.000	70,717,061
ZIP Code Characteristics							
GNMS Gamma	1.044	0.580	0.388	0.553	1.399	1.639	66,067,050
AGI Per Capita, 1998	\$47,855	\$30,096	\$27,821	\$33,049	\$53,708	\$71,967	68,166,883
Lender Characteristics							
New Lender (=1)	0.024	0.154	0.000	0.000	0.000	0.000	68,571,704
Property Characteristics							
Square Footage	1894	1554	1015	1276	2270	3024	66,752,974
House Age	34	29	2	11	50	74	65,061,859

This table summarizes the final sample of mortgage-financed ownership transfers. Sample restrictions are described in Section 3.1, and loan characteristic definitions are provided in the main text. GNMS gamma, a measure of local house price sensitivity, is sourced from Guren et al. (2021). Adjusted Gross Income (AGI) per capita for 1998 is obtained from publicly available IRS data. A transaction is classified as involving a new lender if the lender on the first-lien mortgage is first observed in our data at some point in the preceding three years. Property characteristics are drawn from CoreLogic assessor files and reflect the most recent observation available for each parcel.

Figure A1: Sale Prices, Full Sample

Panel A plots the distribution of nominal house prices for the sample of transactions defined in Section 3.1 and described in Table A4 and Table A5. Panel B presents estimates from a standard house price index regression, in which house prices are regressed on year and property fixed effects. The figure plots the estimated year effects along with their corresponding confidence intervals.

Panel A. The Distribution of Nominal Sales Prices over Time



Panel B. Repeat-Sales Home Price Index

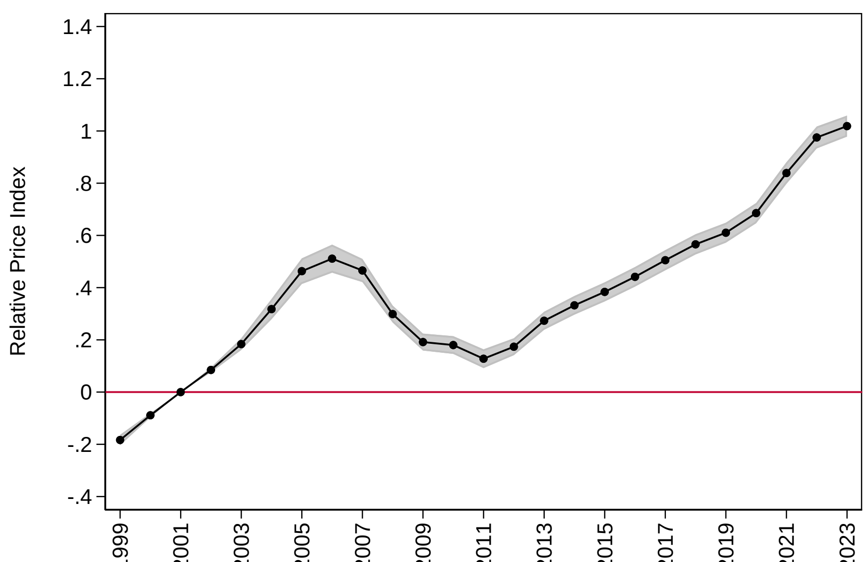
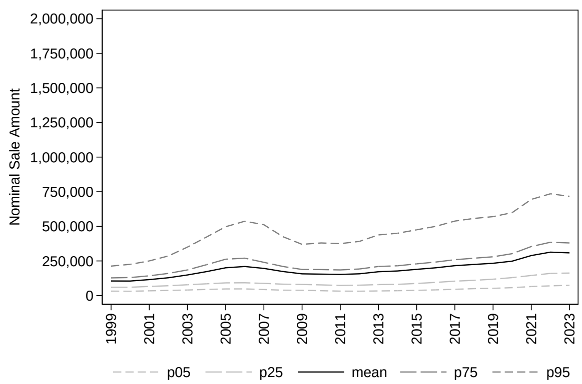


Figure A2: Low vs High Income Areas

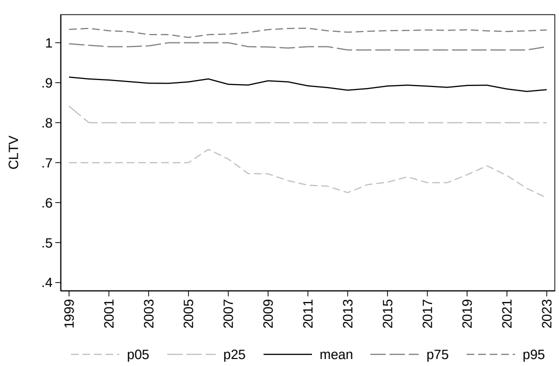
To create this figure, we split the sample used to create Figure 1 into five quintiles of 1998 adjusted gross income defined at the ZIP code level. The lowest income quintile is used in Panels A, B, and C and the highest income quintile of the sample is used in Panels D, E, and F.

Low Income

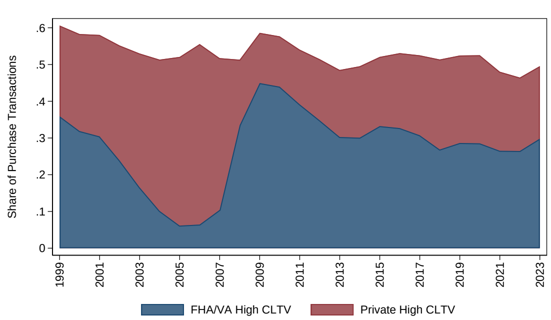
Panel A. House Price Distribution



Panel B. CLTV Distribution

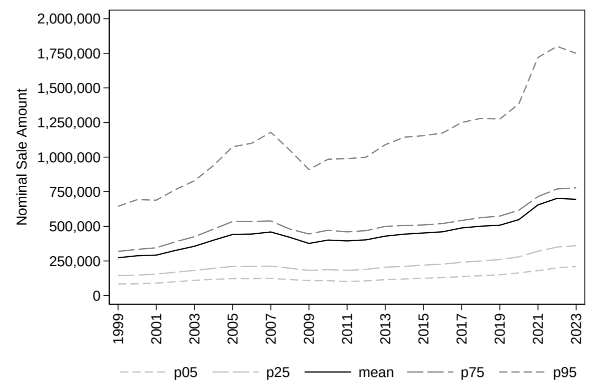


Panel C. FHA Share

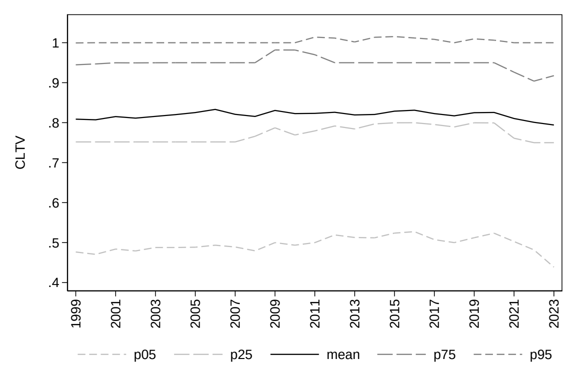


High Income

Panel D. House Price Distribution



Panel E. CLTV Distribution



Panel F. FHA Share

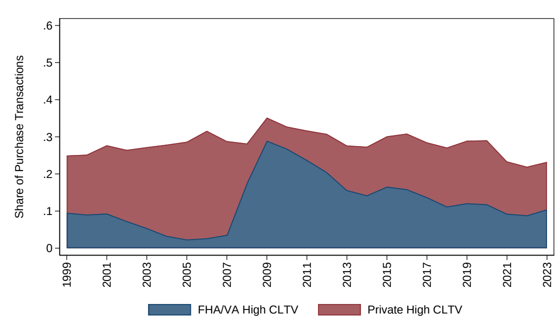
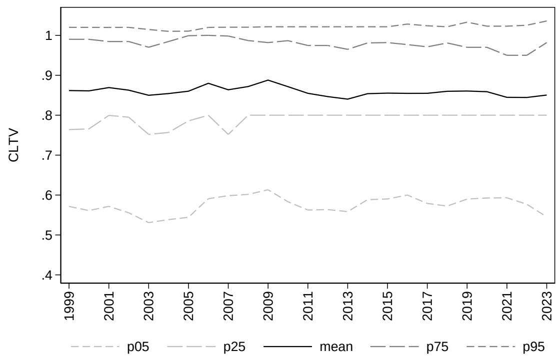


Figure A3: New vs Established Lenders

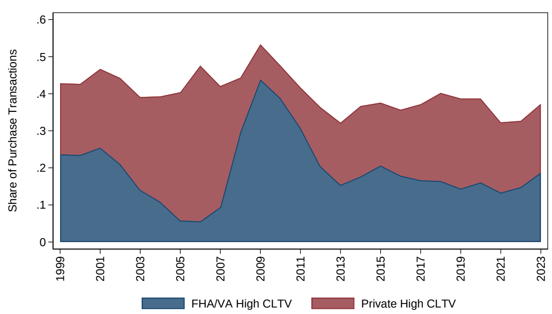
To create this figure, we split the sample used to create Figure 1 based on the age of the lender. Loans originated by lenders whose first loan is recorded in the most recent three years are used to create Panels A and B. Loans whose lenders made their first loan 3 or more years ago are used in Panels C and D.

New Lenders

Panel A. CLTV Distributions

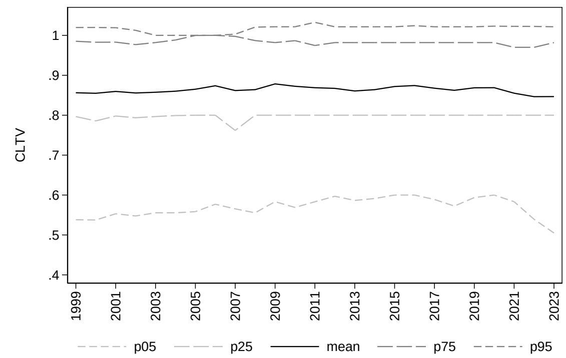


Panel B. FHA Share



Established Lenders

Panel C. CLTV Distributions



Panel D. FHA Share

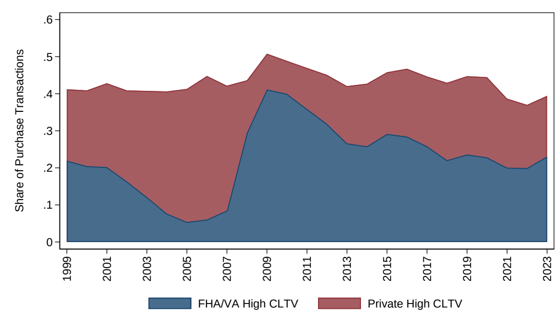


Figure A4: Pessimists vs Optimists

To create this figure, we split the SCF sample described in Section 3.3 into five quintiles of optimism as defined by Puri and Robinson (2007). The bottom quintile is used in Panels A and B and the top quintile of the sample is used in Panels C and D.

Pessimists | **Optimists**

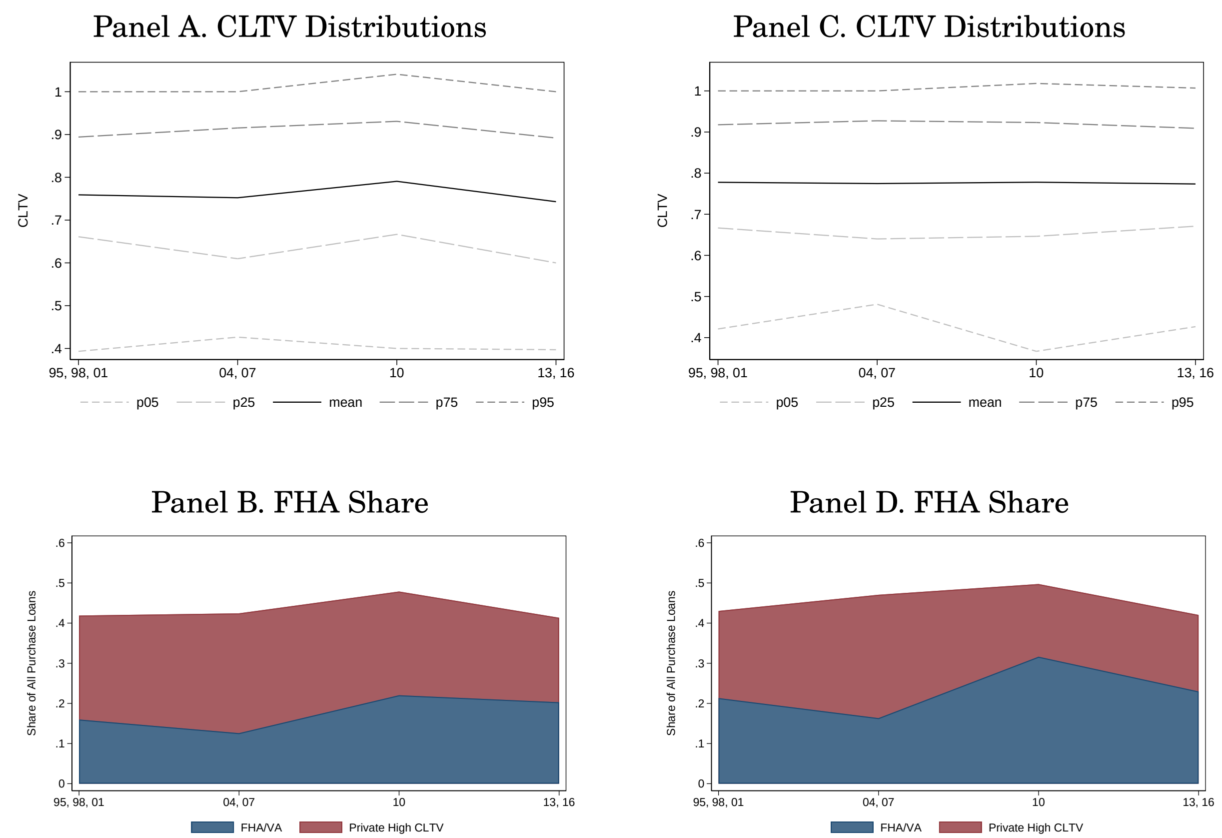
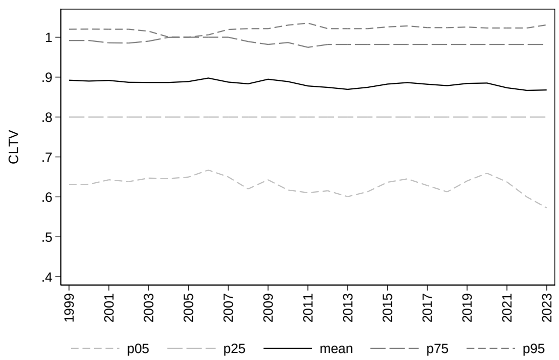


Figure A5: Small vs Large Homes

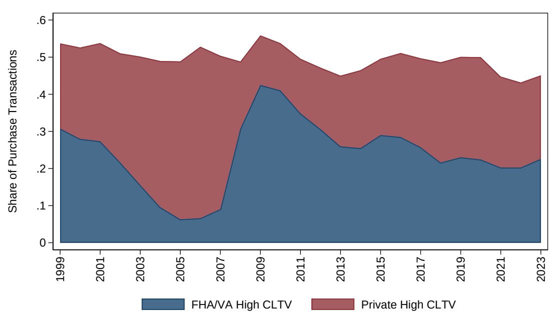
To create this figure, we split the sample used to create Figure 1 based on the size of the house. Homes with 1300 or fewer livable square feet are used to create Panels A and B. Homes with 2300 or more livable square feet are used in Panels C and D.

Small Homes

Panel A. CLTV Distributions

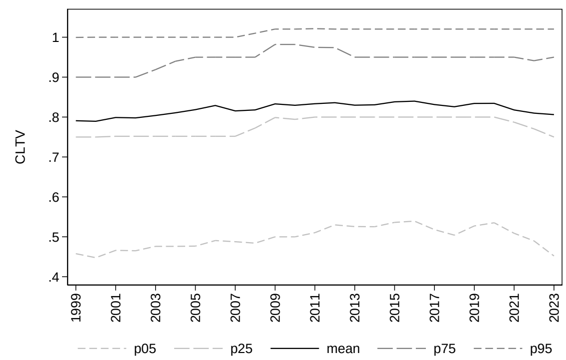


Panel B. FHA Share



Large Homes

Panel C. CLTV Distributions



Panel D. FHA Share

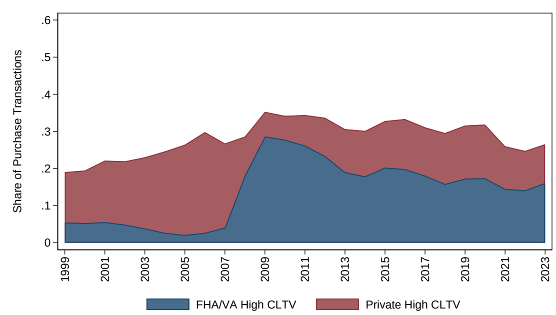
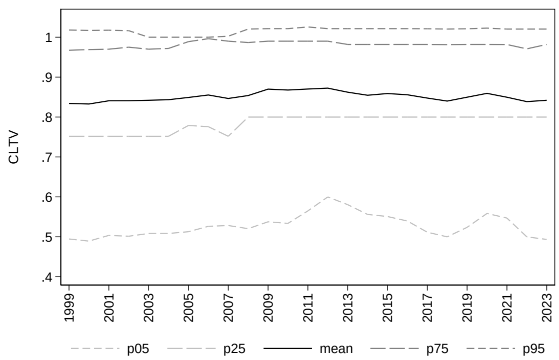


Figure A6: Young vs Old Homes

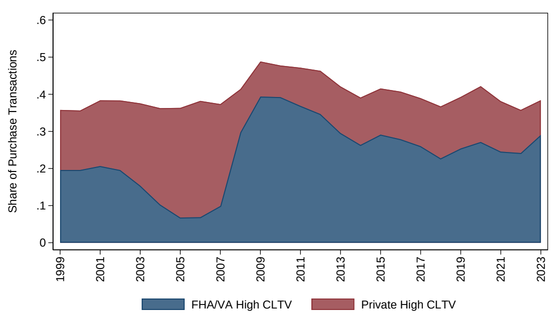
To create this figure, we split the sample used to create Figure 1 based on the age of the house. Homes constructed in the last two years are used to create Panels A and B. Homes built 20 or more years ago are used in Panels C and D.

Young Homes

Panel A. CLTV Distributions

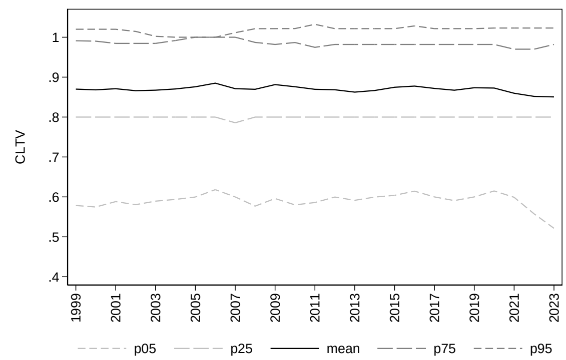


Panel B. FHA Share



Old Homes

Panel C. CLTV Distributions



Panel D. FHA Share

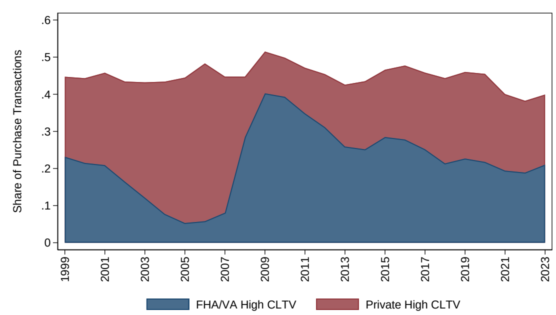
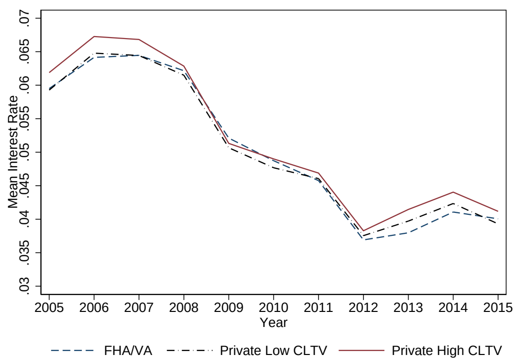


Figure A7: Excluding Loans with Non-missing Payment-to-Income and Non-missing Credit Score

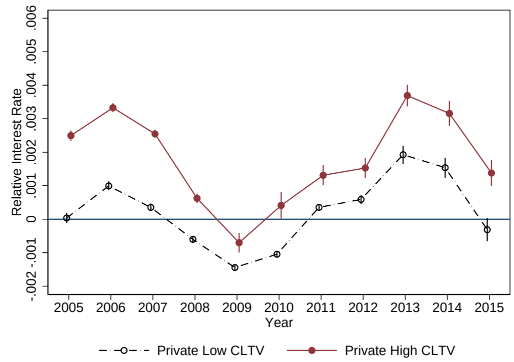
These figures are analogous to those presented in Figure 4, except these use just the sample of mortgages with non-missing payment-to-income and non-missing credit scores.

Panel A. Original Interest Rate

(i) Unconditional

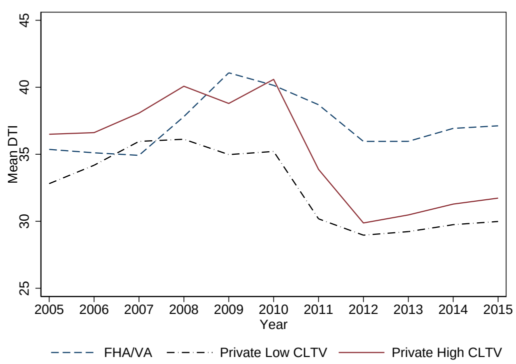


(ii) Within County-by-Year

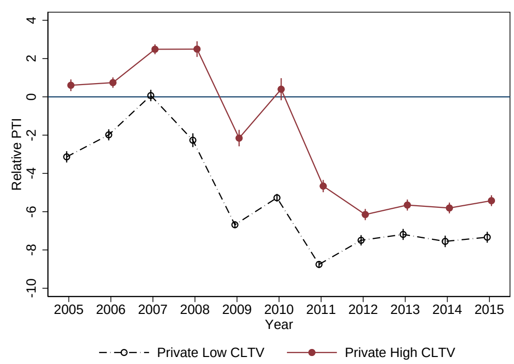


Panel B. Payment-to-Income Ratio

(i) Unconditional

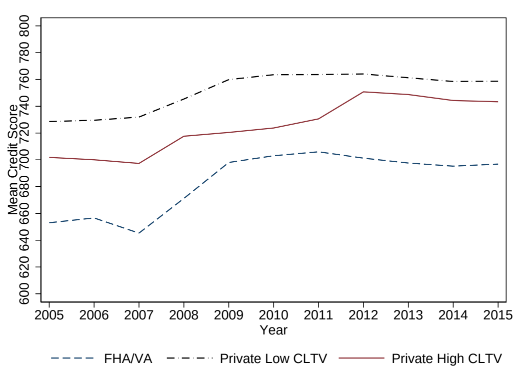


(ii) Within County-by-Year



Panel C. Credit Score

(i) Unconditional



(ii) Within County-by-Year

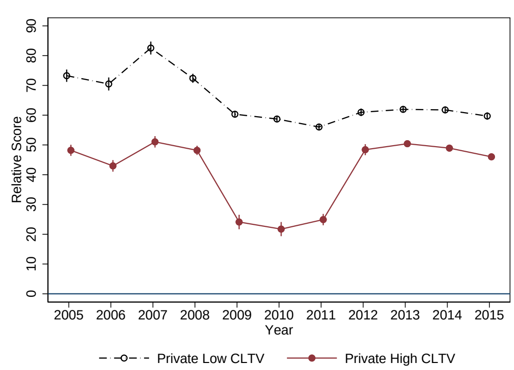
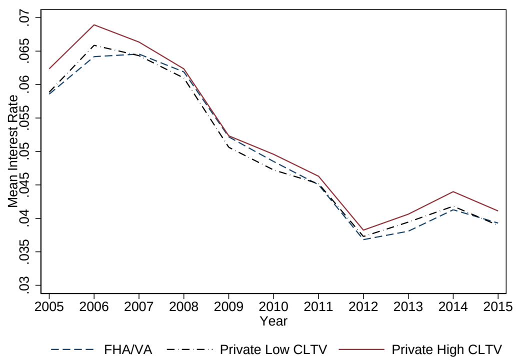


Figure A8: Including Adjustable-Rate Mortgages

These figures are analogous to those presented in the first panel of Figure 4, except these include adjustable-rate mortgages.

Panel A. Original Interest Rate

(i) Unconditional



(ii) Within County-by-Year

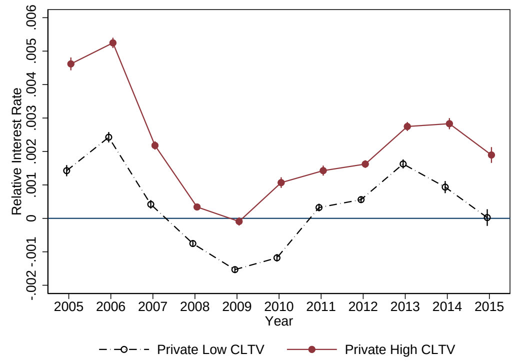
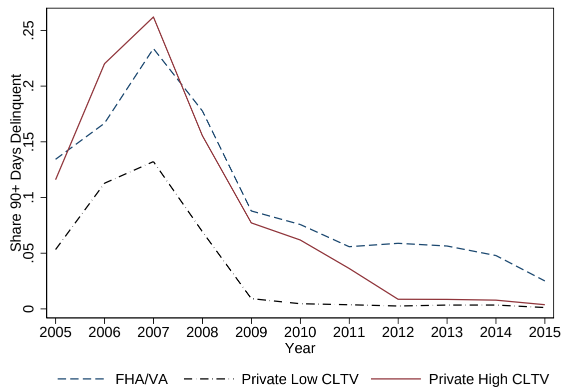


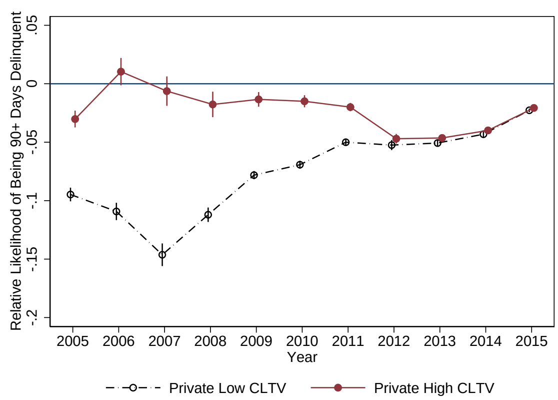
Figure A9: Excluding Loans with Non-missing Payment-to-Income and Non-missing Credit Score

These figures are analogous to those presented in Figure 5, except these use just the sample of mortgages with non-missing payment-to-income and non-missing credit scores.

Panel A: Unconditional Delinquency Share



Panel B: Within County-by-Year



Panel C: Full Credit Scoring Model