

What Fueled the Financial Crisis?

An Analysis of the Performance of Purchase and Refinance Loans

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Abstract

There is a good deal of debate on the causes of the housing crisis. Using Freddie Mac and Fannie Mae loan level data, this paper compares the default and loss behaviors of purchase, rate refinance and cash out refinance loans. Our results show that cash out refinances have the poorest performance, especially during the financial crisis. Purchase loans exhibit much better performance than rate refinances before and during the financial crisis; this pattern is weaker thereafter. Furthermore, we also show that First-Time-Home-Buyers have similar loan performance as that of repeat buyers. This evidence indicates that the expansion of lending to include more marginal borrowers may not be the main cause of the financial crisis. Instead, the poor performance of the cash out refinances and refinances more generally, are more important contributing factors.

Introduction

There are two very different narratives in the literature to explain the housing crisis that led to the Great Recession. One school of thought argues that government policies aimed at increasing the number of homebuyers, especially first-time homebuyers, were at the root of the housing crisis (Mian and Sulfi, 2009; Pinto, 2010; Wallison, 2015). The theory is that Federal Housing Policies, including Fannie Mae and Freddie Mac's housing goals encouraged the private sector to make home mortgages of increasingly poor credit quality to people who could not afford them. By 2008, some 56 percent of the mortgages purchased by the GSEs counted were required to count toward the goals. There is a similar narrative that it was the lending to subprime borrowers with lower credit scores that leads to the crisis (Demyanyk and Van Hemert, 2009).

More recently, researchers have found that the largest contributors to poor credit performance was not first time home buyers; rather it was borrowers who chose to obtain cash out refinances and second liens; many of these borrowers had stronger credit profiles (Mian and Sulfi, 2011; Adelino, Schoar and Sevino, 2016; Brown, Stein, and Zafar, 2015). Moreover, extracted home equity is not used to purchase homes but for other consumptions or home improvement (Mian and Sulfi, 2011). Note also that these borrowers often used non-traditional instruments such as Interest Only loans and negative amortization loans to stretch their buying power (Haugh and Lo, 2001; Khandani, Lo and Merton, 2013).

To summarize all those narratives, we believe it is necessary to do a default comparison between purchase mortgages and refinance (refi) mortgages, especially cash out refinances. We want to explore whether the increase in defaults was fueled by a riskier set of purchase borrowers or by a set of refinance borrowers with a little bit stronger credit characteristics, or the cash out refinance borrowers. or some combination? In this paper, we try to shed some light on this issue by examining the Fannie Mae and Freddie Mac loan level credit database. We show that leading up to the crisis, there was a huge increase in cash out refinance activity, and these mortgages performed much worse than either purchase loans or rate refinances. We also show that purchase loans have weaker characteristics than rate refinances, but performed better. To measure performance, we look at losses; we break the calculations down into delinquencies, the

percentage of seriously delinquent loans that end up in liquidation, and the loss severity of the loan if it is liquidated.

The Data and Summary Statistics

Data Description

The data set used in our analysis consists of detailed loan level information from Fannie Mae and Freddie Mac loan level credit database in support of their credit risk transfer transactions: Fannie Mae's Connecticut Avenue Securities (CAS) and Freddie Mac's Structured Agency Credit Risk Transfer (STACR) notes. The database is comprised only of full documentation, fully amortizing fixed rate loans. As such, adjustable rate mortgages are excluded, as are loans with interest only features and negative amortization features. In addition, the database does not include loans purchased under special affordability programs geared such as Fannie Mae's My Community or Freddie Mac's Home Possible. As such, the loans are very homogeneous.

We have pooled the originations over the period 1999-2016, restricted the sample to 30-year fixed term mortgages, and looked at the characteristics as well as the delinquency and loss behavior. We separate the sample into three subsamples: purchase loans, rate refi and cash out refi. To qualify a rate refi, the borrower must use the proceeds only to pay off the first mortgage; the cash out to the borrower cannot exceed 2 percent of the new refi mortgage or \$2,000, whichever is less. Otherwise, the new mortgage will be considered as cash out refi (Freddie Mac, 2017).

Exhibit 1 summarizes the number and distribution of observations. As can be seen from the table, we have 44.3 million observations over the period; 44 percent are purchase and 56 percent are refi. The refi observations are comprised of 30 percent rate refi and 26 percent cash out refi. Every origination year has at least 1.2 million observations and the single largest year 2003 has 4.9 million observations.

Exhibit 1, Panel A: Loan Count in the Sample

	Purchase	Rate Refi	Cash-out Refi	All
1999	703,984	299,911	203,501	1,207,396
2000	1,364,344	228,853	222,800	1,815,997
2001	1,581,582	1,373,914	1,088,522	4,044,018
2002	1,423,431	1,442,126	1,169,883	4,035,440
2003	1,342,811	2,154,083	1,410,853	4,907,747
2004	1,039,563	612,712	651,713	2,303,988
2005	1,067,902	462,786	910,571	2,441,259
2006	939,905	299,669	715,747	1,955,321
2007	919,387	400,073	772,051	2,091,511
2008	936,649	542,871	660,981	2,140,501
2009	874,127	1,435,038	971,527	3,280,692
2010	781,592	714,527	504,417	2,000,536
2011	724,313	518,319	326,203	1,568,835
2012	973,469	1,095,611	455,039	2,524,119
2013	1,240,877	731,699	418,359	2,390,935
2014	1,236,107	307,278	304,185	1,847,570
2015	1,382,588	554,634	445,180	2,382,402
2016	816,575	339,300	280,679	1,436,554
All	19,349,206	13,513,404	11,512,211	44,374,821

Exhibit 1, Panel B: The Distribution of Loans in the Sample

	Purchase	Rate Refi	Cash-out Refi	All
1999	58%	25%	17%	100%
2000	75%	13%	12%	100%
2001	39%	34%	27%	100%
2002	35%	36%	29%	100%
2003	27%	44%	29%	100%
2004	45%	27%	28%	100%
2005	44%	19%	37%	100%
2006	48%	15%	37%	100%
2007	44%	19%	37%	100%
2008	44%	25%	31%	100%
2009	27%	44%	30%	100%
2010	39%	36%	25%	100%
2011	46%	33%	21%	100%
2012	39%	43%	18%	100%
2013	52%	31%	17%	100%
2014	67%	17%	16%	100%
2015	58%	23%	19%	100%
2016	57%	24%	20%	100%
All	44%	30%	26%	100%

A few points to note from this table. In 2000, a period of very high interest rates, purchase loans represent 75 percent of the total volume. The percentage drops to 27 percent in 2003 as the interest rate was low in that year and refinance volume is high (44 percent for rate refi and 29 percent for cash out refi). In general, purchase volume is less variable from year to year than is refi volume; refinance volume is high when rates are low and vice versa.

Now, if we focus on the periods lead to the financial crisis, we can see that purchase loans consist around 44-48 percent of the market. For the refinance activities, cash out refi volume was especially strong relative to rate refinances during the 2005-2008 period (37 percent versus 15 percent in 2006), In every other period, the two have been similar or rate refi has dominated.

Summary Statistics

Exhibit 2 shows the summary statistics for the loan characters in our sample by origination year and loan purpose (purchase, rate refi and cash out refi). The rate refinances have the lowest interest rates of the three categories for a given origination year. Cash out refinances generally had a lower interest rate than purchases in 2012 and earlier, except for the 2005-2007 period. This pattern reversed in 2013, with cash out refinances having higher interest rates than purchase loans, most likely due to the imposition of higher loan level pricing adjustments.¹

The loan amounts, or the unpaid principal balance (UPB), were similar in 2007 and before. (Purchase loans were slightly smaller, but the differences were relatively muted.) However, beginning in 2008, the UPB on rate refinances became much larger than on either purchase loans or cash out refinances. In fact, over the 2008 and later period, cash out refinances had the smallest UPB of the three groups.

The loan to value ratio (LTV) for purchase loans has always been considerably higher than refinances. It has averaged about 10 percent higher than rate refinances over the entire period, 13 percent higher than cash out refinances. And rate refinances have, on average, had LTVs 3 percent higher than cash out refinances.

¹ Beginning in 2008, the GSEs introduced a set of risk based pricing adjustments, administered on a loan by loan basis, so that loans with more risky characteristics paid more. These loan level pricing adjustments have changed over time; the charges on cash out refinances were gradually increased to compensate for their greater risk. In order to see these patterns, it is important to look year by year, rather than focusing on the aggregate category, and the distribution of loans is not constant through time.

Exhibit 2: Loan Characteristics: Summary Statistics

Year	Interest Rate			UPB			LTV		
	Purchase	Rate Refi	Cash-out Refi	Purchase	Rate Refi	Cash-out Refi	Purchase	Rate Refi	Cash-out Refi
1999	7.45	7.21	7.28	127,816	126,674	118,880	81.07	73.34	67.43
2000	8.16	8.17	8.22	133,320	133,534	122,485	80.50	73.69	67.85
2001	7.06	6.96	7.00	145,228	151,403	150,220	80.77	73.83	69.43
2002	6.65	6.46	6.55	151,636	158,885	159,064	80.34	70.66	67.86
2003	5.83	5.72	5.81	161,491	163,182	166,943	79.97	69.00	66.29
2004	5.90	5.80	5.89	165,256	167,134	171,976	78.08	69.89	66.92
2005	5.86	5.86	5.90	177,764	176,662	190,648	76.78	70.19	66.06
2006	6.44	6.44	6.47	186,449	189,917	193,124	76.62	70.54	65.98
2007	6.38	6.40	6.42	195,014	201,543	195,899	78.46	72.01	67.33
2008	6.19	5.94	6.09	214,291	236,631	207,227	78.81	69.70	66.16
2009	5.13	4.94	5.01	218,398	251,049	218,780	76.54	65.35	62.59
2010	4.84	4.67	4.82	223,491	272,183	209,814	76.38	66.81	63.44
2011	4.68	4.45	4.66	216,680	277,837	207,502	78.35	67.53	63.70
2012	3.87	3.81	3.91	220,364	274,573	219,958	80.12	67.94	63.79
2013	4.17	3.86	4.08	224,923	259,015	216,502	81.41	69.61	64.89
2014	4.46	4.45	4.57	223,081	260,153	215,850	82.13	72.55	67.19
2015	4.14	4.08	4.24	230,050	266,384	231,852	82.50	71.75	66.21
2016	3.97	3.91	4.12	239,713	276,414	244,112	82.56	70.68	66.07
All	5.69	5.47	5.76	188,992	208,529	187,876	79.74	69.70	66.21

Year	FICO			Owner-occupied (%)			DTI		
	Purchase	Rate Refi	Cash-out Refi	Purchase	Rate Refi	Cash-out Refi	Purchase	Rate Refi	Cash-out Refi
1999	716	706	708	92.1%	93.8%	95.1%	33.48	31.83	32.72
2000	720	702	700	91.4%	93.3%	90.3%	35.02	34.85	34.88
2001	722	715	711	90.4%	94.5%	92.5%	34.32	32.29	33.62
2002	722	722	714	88.4%	93.8%	92.2%	34.80	31.83	33.98
2003	726	729	717	87.1%	93.9%	92.7%	34.82	30.61	34.04
2004	728	718	706	86.7%	94.0%	92.9%	36.06	33.35	36.56
2005	735	720	712	85.8%	94.3%	94.4%	36.87	35.36	37.39
2006	735	717	707	85.4%	92.0%	92.7%	37.60	37.42	38.25
2007	736	718	708	83.7%	89.5%	90.0%	37.66	37.74	38.35
2008	748	743	728	81.3%	90.0%	88.0%	37.97	36.28	38.21
2009	761	767	757	83.0%	93.8%	94.0%	34.74	31.47	33.84
2010	764	769	758	81.0%	91.6%	91.1%	33.46	31.24	33.03
2011	764	769	756	79.3%	90.2%	88.4%	33.57	31.54	33.60
2012	764	773	761	81.4%	91.0%	89.3%	32.78	30.51	32.49
2013	759	764	751	84.6%	88.9%	86.5%	33.57	31.62	33.78
2014	754	750	737	86.0%	89.6%	85.7%	34.19	33.77	35.57
2015	754	754	741	86.1%	90.3%	86.8%	34.22	33.21	35.26
2016	752	754	741	87.1%	91.8%	87.6%	34.49	33.39	35.33
All	741	740	725	86.0%	92.5%	91.3%	34.95	32.33	35.15

For most years prior to and in the crisis, the FICO scores on purchase borrowers was considerably higher than for rate refi borrowers. The differential was largest in 2000, a period of high interest rates and very limited refi activity. In 2002-2003, when originators were capacity constrained, the FICO scores of purchase and refi borrowers was very similar. After the crisis, rate refi borrowers have similar or even higher FICO scores than purchase borrowers. Cash out refinance borrowers have always had lower FICO scores than their rate refinance counterparts, averaging a 15-point differential over the period.

The Debt-To-Income (DTI) for rate refis have been consistently lower than those for purchase borrowers, and the DTI for purchase borrowers have averaged marginally lower than cash out refis. All three categories have higher owner-occupied percentages, averaging 92.5 percent for rate refis, 91.3 percent for cash out refis and 86 percent for purchase loans. While there is year to year variation, purchase loans have the lowest owner-occupied component in most years.

Overall, rate refinances have much less risky characteristics than purchase loans: they have much lower LTVs, similar FICO scores, lower debt to income ratios and a higher owner occupied percentage. Cash out refinances have lower LTVs than their purchase counterparts, but also lower FICO scores and marginally higher debt to income ratios.

Loan Performance

Default Behavior Analysis

In this analysis, a loan is defined as having defaulted if it has gone 180 days delinquent (D180) or has been liquidated from a delinquent state prior to the D180 point. Exhibit 3 shows the percent of loans that has gone D180 for each year. Note that for most years (2003 is the only exception) purchase loans have much better performance than either rate refinances or cash out refinances. For example, in 2004, the D180 rate was 5.3 percent for purchase loans, 5.8 percent for rate refinances and 7.3 percent for cash out refinances. We observe the same pattern during the financial crisis. For 2007 originations, purchase loans have lower default rates (9.6 percent) than rate refi (15.9 percent) or cash out refis (17.1 percent). Thus, inconsistent with their weaker credit profile, purchase loans have stronger performance than rate refis. The default rate on cash out refis is much worse than either purchase loans or rate refinances.

Exhibit 3: Default Rates(D180) by Loan Purpose and Origination Year

Year	Purchase	Rate Refi	Cash-out Refi	All
1999	1.8%	2.5%	2.6%	2.1%
2000	1.5%	3.2%	3.2%	1.9%
2001	1.9%	2.3%	2.3%	2.1%
2002	2.5%	2.6%	2.8%	2.6%
2003	4.1%	3.3%	4.1%	3.7%
2004	5.3%	5.8%	7.4%	6.0%
2005	8.1%	9.0%	12.0%	9.7%
2006	9.3%	12.9%	16.1%	12.3%
2007	9.6%	15.9%	17.1%	13.6%
2008	5.8%	8.0%	10.4%	7.8%
2009	1.2%	1.2%	1.9%	1.4%
2010	0.7%	0.6%	1.3%	0.8%
2011	0.5%	0.5%	1.0%	0.6%
2012	0.3%	0.2%	0.5%	0.3%
2013	0.3%	0.2%	0.4%	0.3%
2014	0.3%	0.2%	0.4%	0.3%
2015	0.1%	0.1%	0.1%	0.1%
2016	0.0%	0.0%	0.0%	0.0%
All	2.9%	3.0%	5.5%	3.6%

It is useful to break the analysis down into FICO/LTV buckets, as is done in Exhibit 4. We show 4 origination years representing before the financial crisis (2002), in the crisis (2006 and 2007), and after the crisis (2012). First, let's take a close look at purchase versus rate refi for the 2006 vintage (in the crisis). For the (≤ 70 LTV, 700-750 FICO) bucket, the default rates for the loans are 4 percent for purchase loans, versus 8 percent for rate refi loans, a 4 percent difference. In the 70-80 LTV bucket with the same FICO cutoff, the default rate is 9 percent for purchase loans versus 14 percent for refi loans, a 5 percent difference. The difference is smaller for high LTV bucket: 15 percent for purchase loans, 17 percent for rate refi loans, and 21 percent for cash out refi loans.

Moreover, the proportional differences between purchase and rate refi loans becomes even more dramatic in the < 70 LTV, > 750 LTV bucket. The purchase loans have a default rate of 1 percent versus 3 percent for their rate refi counterparts.

Exhibit 4: D180 Rates by LTV and FICO Categories

Orig Year	FICO	Purchase					Rate Refi					Cash-out Refi				
		<=70	70-80	80-90	>90	All	<=70	70-80	80-90	>90	All	<=70	70-80	80-90	>90	All
2002	<=700	3%	3%	6%	7%	5%	3%	5%	9%	11%	6%	4%	5%	8%	11%	5%
	700-750	1%	1%	3%	3%	2%	1%	2%	4%	5%	2%	1%	2%	5%	2%	2%
	>750	0%	1%	1%	2%	1%	0%	1%	2%	3%	1%	0%	1%	3%	4%	1%
	All	1%	2%	3%	5%	3%	1%	3%	6%	8%	3%	2%	3%	6%	7%	3%
2006	<=700	9%	16%	22%	26%	18%	15%	22%	24%	27%	21%	19%	27%	27%	39%	23%
	700-750	4%	9%	13%	15%	9%	8%	14%	15%	17%	12%	10%	18%	19%	21%	14%
	>750	1%	5%	8%	9%	4%	3%	7%	9%	10%	5%	4%	10%	13%	19%	7%
	All	3%	9%	14%	19%	9%	8%	15%	19%	22%	13%	12%	20%	23%	29%	16%
2007	<=700	9%	15%	22%	28%	19%	17%	25%	30%	34%	25%	21%	27%	33%	35%	25%
	700-750	3%	8%	13%	16%	10%	8%	16%	20%	23%	15%	10%	18%	23%	15%	15%
	>750	1%	4%	8%	10%	4%	3%	9%	14%	15%	6%	4%	11%	16%	15%	7%
	All	3%	8%	14%	20%	10%	8%	17%	25%	28%	16%	12%	20%	27%	23%	17%
2012	<=700	1%	1%	2%	2%	2%	1%	1%	1%	2%	1%	2%	2%	3%	.	2%
	700-750	0%	0%	1%	1%	1%	0%	0%	1%	1%	0%	0%	1%	2%	.	1%
	>750	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%
	All	0%	0%	0%	1%	0%	0%	0%	0%	1%	0%	0%	0%	1%	1%	0%

On the other hand, cash out refinances have much higher default rates for all FICO/LTV buckets. Even that, the largest percentage differential in defaults is in the lowest LTV bucket. The overall default rate for this bucket is 3 percent for purchase loans, 8 percent for rate refis and 12 percent for cash out refinances. In the >90 LTV bucket, the overall default rate is 19%, 22% and 29 percent respectively.

This pattern in which purchase loans far better than refi loans for every FICO/LTV bucket, with particularly large differentials in the lowest LTV buckets hold across the 2002, 2006 and 2007 vintages. The performance of the 2012 vintage has been so pristine that there have been virtually no delinquencies with which to make the comparison.

Loss Behavior

Mortgage default may not result in loss. We need to consider loss given default (LGD) as to see a broad picture of the loan performance. In this paper, we calculate losses as follows:

$$\text{Losses} = \text{Default Rate} * \text{Liquidation Rate} * \text{loss severity if liquidated} \quad (1)$$

To be more specific, we consider four possible paths after one loan goes to D180: Self-cure (current), prepaid, liquidated or persistent delinquent. We define self-cure as making the payments for the most recent three months. Being persistent delinquent is defined to mean the loan is not resolved; it is not current, not prepaid, and not liquidated.

Exhibit 5 shows the paths by vintage year. The purchase loans have a slightly smaller chance of becoming current and a slightly larger probability of liquidation, but the differences are quite small.

Exhibit 5: Analysis of Outcomes after Default (D180) by Loan Purpose

Orig Year	Current				Prepaid			
	Purchase	Rate Refi	Cash-out Refi	All	Purchase	Rate Refi	Cash-out Refi	All
1999	6.6%	6.9%	7.6%	6.9%	31.4%	29.4%	32.0%	30.9%
2000	5.7%	6.9%	6.7%	6.2%	29.6%	24.1%	29.9%	28.5%
2001	8.7%	8.6%	9.4%	8.9%	25.3%	20.5%	23.5%	23.0%
2002	11.3%	11.5%	12.5%	11.7%	19.7%	17.3%	20.1%	19.0%
2003	14.6%	15.5%	17.0%	15.7%	16.1%	17.3%	19.2%	17.6%
2004	15.2%	16.1%	17.8%	16.3%	12.4%	14.5%	14.8%	13.8%
2005	12.9%	16.2%	18.6%	16.1%	8.3%	10.3%	10.1%	9.5%
2006	12.3%	16.8%	19.1%	16.3%	7.1%	8.3%	8.5%	8.0%
2007	14.1%	17.6%	20.7%	17.9%	7.8%	7.7%	8.9%	8.3%
2008	17.4%	19.0%	21.2%	19.4%	11.6%	9.3%	11.2%	10.8%
2009	16.9%	15.4%	18.2%	16.9%	17.7%	13.3%	16.3%	15.5%
2010	18.8%	15.3%	17.5%	17.3%	18.8%	14.5%	16.2%	16.6%
2011	20.2%	17.5%	19.7%	19.3%	19.9%	12.7%	16.9%	17.0%
2012	19.1%	17.3%	19.5%	18.7%	16.3%	15.0%	16.7%	16.0%
2013	17.2%	17.0%	17.2%	17.2%	11.6%	13.3%	16.1%	13.0%
2014	12.3%	15.5%	14.3%	13.2%	9.5%	9.2%	12.8%	10.2%
2015	8.5%	10.3%	7.2%	8.5%	5.2%	5.7%	11.7%	6.8%
2016	6.7%	6.3%	4.2%	6.0%	5.6%	2.1%	4.2%	4.7%
All	13.3%	15.2%	18.3%	15.8%	12.9%	13.4%	12.6%	12.9%

Orig Year	Already Liquidated				Persistently Delinquent			
	Purchase	Rate Refi	Cash-out Refi	All	Purchase	Rate Refi	Cash-out Refi	All
1999	56.0%	58.6%	54.4%	56.4%	5.9%	5.2%	6.0%	5.7%
2000	59.7%	63.5%	58.3%	60.2%	5.0%	5.6%	5.2%	5.2%
2001	59.2%	64.4%	60.5%	61.4%	6.9%	6.5%	6.6%	6.7%
2002	59.9%	62.5%	58.9%	60.5%	9.0%	8.7%	8.5%	8.8%
2003	58.8%	57.2%	53.0%	56.4%	10.5%	10.0%	10.8%	10.4%
2004	62.2%	58.8%	56.1%	59.2%	10.1%	10.6%	11.3%	10.6%
2005	70.7%	63.2%	61.0%	64.9%	8.1%	10.2%	10.2%	9.4%
2006	72.7%	65.5%	62.0%	66.4%	7.9%	9.3%	10.2%	9.2%
2007	68.5%	65.3%	59.0%	63.4%	9.6%	9.4%	11.3%	10.3%
2008	59.4%	61.4%	54.7%	58.0%	11.5%	10.2%	12.8%	11.7%
2009	45.8%	56.5%	46.8%	50.1%	19.6%	14.8%	18.7%	17.5%
2010	35.5%	49.6%	41.2%	41.6%	26.8%	20.6%	25.1%	24.5%
2011	26.3%	42.8%	31.6%	32.4%	33.6%	27.0%	31.8%	31.3%
2012	22.2%	34.4%	26.4%	26.9%	42.4%	33.4%	37.4%	38.4%
2013	21.2%	26.7%	19.1%	22.0%	50.0%	43.0%	47.6%	47.9%
2014	15.7%	21.2%	14.8%	16.2%	62.5%	54.1%	58.0%	60.4%
2015	11.0%	13.2%	7.4%	10.6%	75.3%	70.8%	73.7%	74.1%
2016	2.8%	0.0%	6.9%	3.3%	85.0%	91.7%	84.7%	86.0%
All	63.2%	61.1%	57.6%	60.5%	10.5%	10.2%	11.4%	10.8%

In order to calculate losses, we must make an assumption about the loans still in the persistently delinquent bucket; we assume that 50 percent of these loans will eventually be liquidated. The following equation summarizes the liquidation rate calculation:

$$\text{Liquidation Rate} = \text{Percent of loans already liquidated} + 50 \text{ percent of persistently delinquent loans} \quad (2)$$

The loss severities by vintage year and loan purpose are shown in Exhibit 6. In general, for every vintage year, purchase loans have lower loss severities than their refinance counterparts. And rate refis have a lower severity than cash out refis.

Exhibit 6: Loss Severity by Loan Purpose and Origination Year

Orig Year	Purchase	Rate Refi	Cash-out Refi	All
1999	14.3%	22.0%	34.1%	20.3%
2000	15.4%	27.7%	40.6%	22.4%
2001	19.6%	30.6%	39.8%	29.2%
2002	25.8%	34.7%	43.5%	34.2%
2003	28.5%	34.2%	38.4%	33.6%
2004	34.3%	39.4%	43.7%	38.6%
2005	41.9%	44.7%	48.8%	45.4%
2006	44.9%	50.8%	55.4%	50.6%
2007	39.5%	50.1%	54.4%	48.4%
2008	34.1%	42.9%	49.2%	42.3%
2009	29.0%	30.2%	37.0%	32.4%
2010	19.3%	25.0%	34.5%	27.0%
2011	14.3%	21.1%	31.6%	22.0%
2012	10.9%	15.7%	22.5%	15.7%
2013	5.9%	13.4%	19.7%	10.3%
2014	4.4%	7.7%	17.1%	7.1%
2015	1.7%	4.7%	5.0%	2.9%
2016	0.0%	0.0%	0.0%	0.0%
All	36.7%	41.5%	49.8%	43.0%

One can argue that this is not a fair comparison, as loans with mortgage insurance tend to have lower severities than those without (Goodman and Kaul, 2017; Goodman and Zhu, 2015). That is, the standard coverage is to reduce a 95 percent LTV loans to a 67 LTV, much lower than a loan originated at 80 LTV without mortgage insurance. Thus, in Exhibit 7, we compare severities by FICO and LTV buckets. Again, we find the same result. The loss severities are considerably lower for purchase loans than for rate refi or cash out refi loans, and the differences are the largest for the lowest LTV buckets. For example, in 2007, the loss severity for the ≤ 70 LTV bucket, 700-750 FICO was 36 percent for purchase loans, 40 percent for rate refis and 50 percent for cash out refinances.

Exhibit 7: Loss Severity by LTV and FICO Categories

Orig Year	FICO	a. purchase					b. Reg_Refi					c. Cash_Refi				
		<=70	70-80	80-90	>90	All	a.<70	c.70<-80	d.80<-90	e.>90	All	a.<70	c.70<-80	d.80<-90	e.>90	All
2002	<=700	29%	36%	29%	20%	25%	36%	44%	33%	23%	35%	41%	51%	34%	16%	45%
	700-750	17%	32%	33%	20%	26%	29%	39%	32%	22%	33%	34%	47%	32%	21%	41%
	>750	25%	35%	34%	23%	30%	30%	41%	32%	23%	35%	35%	45%	35%	0%	41%
	All	26%	35%	30%	20%	26%	33%	43%	33%	23%	35%	39%	49%	33%	14%	43%
2006	<=700	43%	51%	39%	33%	43%	49%	56%	45%	35%	51%	53%	61%	47%	37%	57%
	700-750	42%	50%	42%	36%	46%	46%	54%	43%	35%	50%	50%	58%	44%	29%	54%
	>750	41%	49%	40%	34%	46%	45%	53%	43%	33%	49%	46%	56%	42%	33%	51%
	All	42%	50%	40%	34%	45%	47%	55%	44%	35%	51%	52%	60%	46%	35%	55%
2007	<=700	42%	49%	37%	32%	39%	51%	58%	45%	37%	51%	54%	61%	45%	42%	56%
	700-750	36%	46%	38%	31%	40%	47%	56%	44%	36%	51%	50%	58%	43%	38%	54%
	>750	36%	45%	37%	30%	40%	43%	53%	40%	34%	48%	46%	55%	40%	14%	51%
	All	38%	47%	37%	32%	39%	48%	56%	44%	36%	50%	52%	59%	44%	38%	54%
2012	<=700	14%	26%	7%	6%	13%	20%	22%	19%	6%	19%	20%	24%	9%	0%	22%
	700-750	13%	21%	6%	6%	10%	16%	23%	8%	7%	15%	19%	25%	15%	0%	23%
	>750	21%	21%	4%	4%	9%	18%	20%	12%	9%	15%	30%	22%	15%	0%	23%
	All	16%	23%	6%	5%	11%	18%	22%	11%	8%	16%	21%	24%	15%	0%	23%

With default rate, liquidation rate and loss severity at hand, we calculate the loss rate by year, shown in Exhibit 8. In every single vintage year 2011 and earlier, purchase loans have a lower loss rate than rate refis. And rate refis have a much lower loss rate than cash out refis. For example, for loans originated in 2007, the average loss rate for purchase loans is 2.78 percent. The number is 5.58 percent for rate refi loans and 6.02 percent for cash out refis. For 2012 and later, losses are negligible across the board.

Exhibit 8: Losses by Loan Purpose and Origination Year

Orig Year	Purchase	Rate Refi	Cash-out Refi	All
1999	0.15%	0.33%	0.51%	0.25%
2000	0.15%	0.59%	0.78%	0.27%
2001	0.24%	0.47%	0.58%	0.40%
2002	0.42%	0.61%	0.76%	0.59%
2003	0.74%	0.71%	0.93%	0.78%
2004	1.22%	1.48%	2.00%	1.51%
2005	2.55%	2.76%	3.86%	3.08%
2006	3.18%	4.60%	5.99%	4.43%
2007	2.78%	5.58%	6.02%	4.50%
2008	1.28%	2.28%	3.14%	2.10%
2009	0.20%	0.22%	0.40%	0.27%
2010	0.06%	0.09%	0.25%	0.12%
2011	0.03%	0.05%	0.15%	0.06%
2012	0.02%	0.02%	0.05%	0.02%
2013	0.01%	0.01%	0.04%	0.01%
2014	0.01%	0.01%	0.03%	0.01%
2015	0.00%	0.00%	0.00%	0.00%
2016	0.00%	0.00%	0.00%	0.00%
All	0.72%	0.83%	1.74%	1.02%

Deep Dive Using Empirical Models

In this section, we use a logit model to further control loan characteristics and test the performance among purchase, rate refi and cash out refi. We first test the hypothesis if the performance of the purchase loans is not different from that of refinance loans. The results are shown in Exhibit 9.

Exhibit 9: Logit Regression for Default

	Estimate	T value	Hazard Ratio
Intercept	-4.8836	-80.59	-99%
Rate Refi	0.4356	184.75	55%
Cash-out Refi	0.6801	302.34	97%
Orig_UPB	-8.3E-07	400	-0.00008%
INT_RT	0.3013	143.5	35%
FICO	-0.0108	-688.09	-1%
LTV	0.03457	449.45	4%
1 Unit	-0.2699	-52.16	-24%
Owner	-0.09867	-32.09	-9%
DTI	0.01977	262.01	2%
Year Fixed Effect		Yes	
Likelihood		10511529	
Obs		44374821	

The coefficients before the loan characteristics all have the correct signs. For example, higher LTV loans are more likely to default, borrowers with higher FICO scores are less likely to default, borrowers having higher DTIs are more likely to default, loans with higher interest rates are more likely to default, 1-family structures are less likely to default, and owner-occupied units are less likely to default.

Now, focus on the loan purchase category indicators. Our results strongly suggest that purchase loans perform better than refi loans, holding all other characteristics constant. Rate refis have a 55 percent higher probability of defaulting than a purchase origination. And cash out refis have a 97 percent higher probability of defaulting than a purchase origination.

The Impact of First-Time Home Buyers on Financial Crisis

There are a couple studies showing that First-Time-Home-Buyer (FTHB) are different from the existing mortgage borrowers. A part of the financial crisis may due the fact that the credit box was extended to those people with low credit profiles (Mian and Sufi, 2009; Pinto, 2010; Wallison, 2015). Moreover, FTHB have long been an important focus of the housing policy (Bai, Zhu, and Goodman, 2015).

In this section, we separate the purchase loans into FTHB and existing mortgage borrowers (i.e., Repeat buyers) and compare the credit characteristics and default performance of these two groups.

Exhibit 10 shows the results. First, we notice that there is shift in the purchase loan distribution. The percentage of FTHB increases over time, from 20 percent in 2003 to 27 percent

in 2007 and 38 percent in 2015. Before and during the crisis, FTHB took similar size or a little bit smaller loans than repeat borrowers. FTHB's LTV is higher, coupled with a lower FICO score. A comparison between average default rate for FTHB and repeat buyers, reviews that FTHB have experienced a higher default rates than repeat buyers before and during the crisis.

Exhibit 10: Loan Characteristics for FTHB versus Repeat Homebuyer

Orig Year	% FTHB	Interest Rate		UPB		LTV		FICO		Owner-occupied (%)		Default Rate	
		FTHB	Repeat	FTHB	Repeat	FTHB	Repeat	FTHB	Repeat	FTHB	Repeat	FTHB	Repeat
1999	24%	7.46	7.45	122,252	129,529	85.59	79.67	707.68	718.84	33.65	33.42	2.3%	1.6%
2000	24%	8.17	8.16	127,300	135,249	84.72	79.14	712.03	722.48	34.96	35.04	2.0%	1.4%
2001	21%	7.06	7.06	139,084	146,906	84.64	79.70	714.05	723.57	34.25	34.33	2.4%	1.8%
2002	21%	6.67	6.65	145,974	153,144	84.18	79.31	714.49	724.42	34.68	34.84	3.2%	2.4%
2003	20%	5.84	5.83	153,905	163,337	83.79	79.04	718.88	727.70	34.69	34.85	5.1%	3.8%
2004	22%	5.90	5.90	157,212	167,589	82.21	76.88	720.67	729.74	35.98	36.09	6.6%	4.9%
2005	23%	5.86	5.86	167,669	180,734	80.97	75.53	725.52	737.36	36.64	36.94	9.6%	7.7%
2006	24%	6.43	6.44	176,514	189,609	80.50	75.38	724.64	738.94	37.28	37.70	11.0%	8.7%
2007	27%	6.36	6.38	192,441	195,966	81.54	77.33	725.01	740.10	37.56	37.69	11.6%	8.9%
2008	29%	6.16	6.21	216,730	213,283	81.70	77.61	739.86	750.83	37.72	38.07	6.8%	5.3%
2009	33%	5.11	5.14	216,257	219,470	78.85	75.39	754.76	763.94	34.48	34.88	1.4%	1.1%
2010	34%	4.83	4.85	226,406	221,980	78.31	75.39	757.01	767.82	33.41	33.49	0.9%	0.6%
2011	31%	4.65	4.69	216,019	216,972	80.89	77.23	755.80	767.63	33.13	33.77	0.7%	0.4%
2012	32%	3.85	3.88	217,307	221,811	83.31	78.61	755.29	767.48	32.27	33.02	0.5%	0.3%
2013	35%	4.18	4.17	219,155	228,097	84.94	79.47	751.13	763.59	33.16	33.80	0.4%	0.3%
2014	37%	4.46	4.45	214,543	228,041	85.76	80.02	745.11	759.15	33.73	34.46	0.4%	0.2%
2015	38%	4.15	4.14	221,402	235,324	86.59	80.00	745.02	759.41	33.76	34.50	0.2%	0.1%
2016	38%	3.97	3.97	233,207	243,638	86.44	80.21	744.42	757.32	33.90	34.84	0.0%	0.0%
All	28%	5.45	5.78	190,944	188,222	83.44	78.29	735.67	742.52	34.56	35.10	3.1%	2.8%

We use an augmented logit model to test if FTHB are more likely to default, compared to repeat buyers, controlling for all the credit characteristics for different year periods. In exhibit 11 we show the estimation results for the interaction terms between year and loan purpose indicators, which are separated into FTHB, repeat buyer, rate refi and cash out refi. In this regression, the repeat buyer's category serve as the reference category. The results indicate that after controlling for all the credit characteristics, FTHB's performance were insignificantly different from that of repeat buyers before and during the financial crisis. After the crisis, FTHB are more likely to default than their repeat homebuyer counterparts, although all default rates are very low. Note that both FTHB loans and repeat buyer's loans perform much better than rate refi and cash out refi loans. And the largest differentials between refi loans and purchase loans were during the crisis years 2007 and 2008.

Exhibit 11: Estimates for the Interaction of Issue Year and Loan Purpose

Year	First Time Homebuyer			Rate Refi			Cash out Refi		
	Estimate	Std Error	Hazard Ratio	Estimate	Std Error	Hazard Ratio	Estimate	Std Error	Hazard Ratio
Fixed Effect	-0.04631	-0.31	-5%	0.000539	0	0%	0.4665	3.04	59%
1999	0.1956	1.29	22%	0.6438	3.67	90%	0.4323	2.79	54%
2000	0.2262	1.49	25%	0.8706	4.96	139%	0.5497	3.56	73%
2001	0.1782	1.18	20%	0.379	2.17	46%	0.06824	0.44	7%
2002	0.1673	1.11	18%	0.4392	2.51	55%	0.03398	0.22	3%
2003	0.1471	0.97	16%	0.2681	1.53	31%	-0.02145	-0.14	-2%
2004	0.1506	1	16%	0.3726	2.13	45%	0.1093	0.71	12%
2005	0.06269	0.42	6%	0.2082	1.19	23%	0.1267	0.82	14%
2006	0.05731	0.38	6%	0.4267	2.44	53%	0.2862	1.86	33%
2007	0.1238	0.82	13%	0.6718	3.84	96%	0.3578	2.33	43%
2008	0.1595	1.06	17%	0.7223	4.13	106%	0.4722	3.07	60%
2009	0.1817	1.2	20%	0.5511	3.14	74%	0.4926	3.19	64%
2010	0.3846	2.51	47%	0.4917	2.79	64%	0.6545	4.22	92%
2011	0.3923	2.54	48%	0.5348	3.02	71%	0.6343	4.06	89%
2012	0.361	2.33	43%	0.1862	1.05	20%	0.4377	2.79	55%
2013	0.2835	1.84	33%	0.3131	1.76	37%	0.3049	1.94	36%
2014	0.3208	2.08	38%	0.257	1.43	29%	0.2475	1.57	28%
2015	0.3529	2.22	42%	0.3332	1.81	40%	0.1779	1.09	19%

Why Purchase Loans Perform Better Than Refi Loans

Why do purchase loans perform so much better than refi loans? It is clear from exhibit 4, exhibit 7 and the regression results that the biggest difference is in the low LTV borrowers. Part of the answer is that the LTV on a purchase loan is derived from a transaction; there is less scope for appraisal bias. If a home trades at a value lower than the appraisal, the actual home value will be used in the LTV calculation. It is important to realize that appraisal bias was a very serious issue before and leading up to the crisis; post-crisis regulations especially the Home Valuation Code of Conduct have reduced the bias appreciably (Agarwal, Ambrose, and Yao, 2017).

Another important issue is that full documentation is not always true “full documentation”. At various points in time, for certain loan types, the GSEs have waived their right to look at specific documents for existing mortgage borrowers. For example, during the years leading up to the crisis, the GSE waived income verification for certain high FICO or low LTV borrowers. More recently, post crisis, the GSEs have selectively waived property appraisals for the refinancing of low LTV loans.

Conclusion

This paper empirically compares the loan characteristics and performance for purchase (both FTHB and repeat buyers), rate refi and cash out refis. Our results reveal that cash out refinances have the poorest behavior on every dimension, especially during the financial crisis. Purchase loans behaved much better than loans with rate refis---they had lower D180 rates, lower severities, and lower losses. We also show that FTHB have similar loan performance as that of repeat buyers. Thus, our results show it was not the expansion of lending to include more marginal borrowers that caused the financial crisis.² Rather, contributing factors to the crisis include the performance of the cash out refinances in particular, and refinances more generally. Purchase borrowers were not the culprit!

² Note that we used prime mortgage data from GSE, thus ignored the impact of subprime borrowers and private securitizations.

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