RESEARCH REPORT

Measuring Mortgage Credit Availability Using Ex-Ante Probability of Default

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Measuring Mortgage Credit Availability Using Ex-Ante Probability of Default

How to strike a balance between credit availability and risk to achieve a sustainable housing market is a much-debated topic today, but these discussions are not grounded in good measurements of credit availability and risk. We address this problem below with a new index that measures credit availability and risk simultaneously.

The first section of the paper discusses the limitations of the existing measures. The second section describes our development of the new index, which distills borrower credit profiles, loan products and terms, and macroeconomic conditions into a measurement of the weighted average probability of default for mortgages originated at a given time. The third section illustrates the value of this measure by empirically exploring the varying risk appetites of the market as a whole, and of market segments, which directly aids evidence-based policymaking on how to open the tight credit box. The final section discusses the limitations of this new index.

Four Commonly Cited Measures of Credit Availability

The four most commonly cited indicators of mortgage credit accessibility are the Federal Reserve's Senior Loan Officer Opinion Survey on Bank Lending Practices (SLO),[1] the mortgage application denial rates based on annual Home Mortgage Disclosure Act (HMDA) data,[2] the Mortgage Credit Availability Index by the Mortgage Bankers Association (MBA),[3] and the median borrower's credit score at origination.[4]

Federal Reserve's Senior Loan Officer Survey

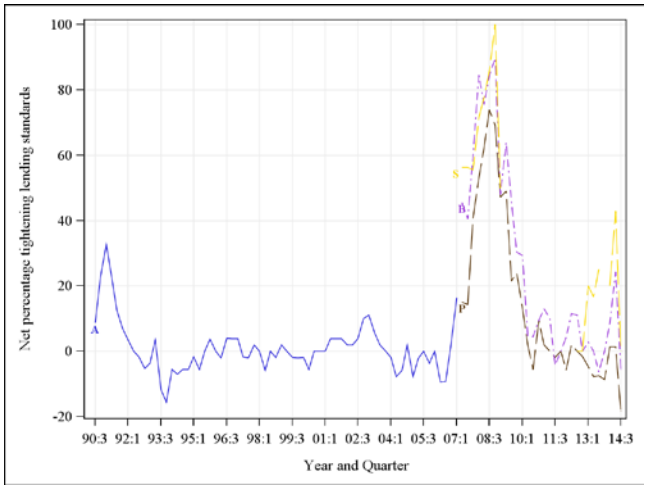
The SLO, usually conducted four times a year by the Board of Governors of the Federal Reserve System, is designed to measure credit accessibility qualitatively by asking banks to report changes in their lending practices over the previous three months. A senior loan officer at each respondent bank completes this voluntary survey electronically. Currently, up to 60 large domestically chartered commercial banks respond to the SLO.

Using the SLO, researchers can calculate the net share of domestic respondents tightening lending standards for residential mortgage loans: the fraction of banks that reported having tightened standards "considerably" or "somewhat" minus the fraction of banks that reported having eased standards "considerably" or "somewhat,"[5] as shown in figure 1.A. Thus, the SLO provides five categorical measures on lending standard changes perceived by the banks for the past three months. Because this measure compares the current month against the last three, however, it is unable to offer much sense of the change in credit accessibility over a longer period, such as a year or several years.

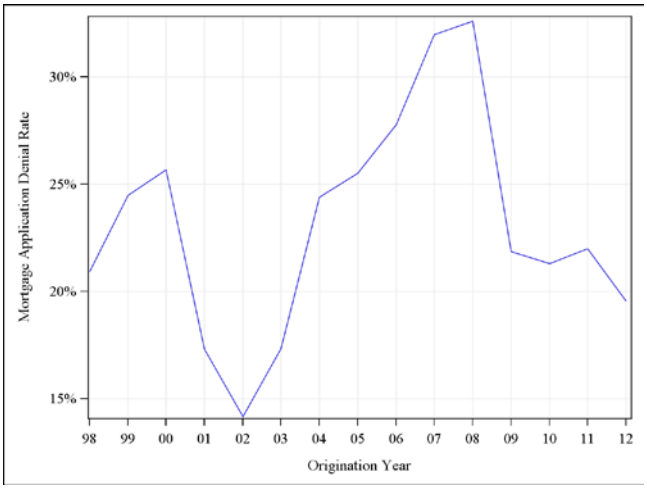
FIGURE 1

Four Commonly Cited Measures of Mortgage Credit Availability

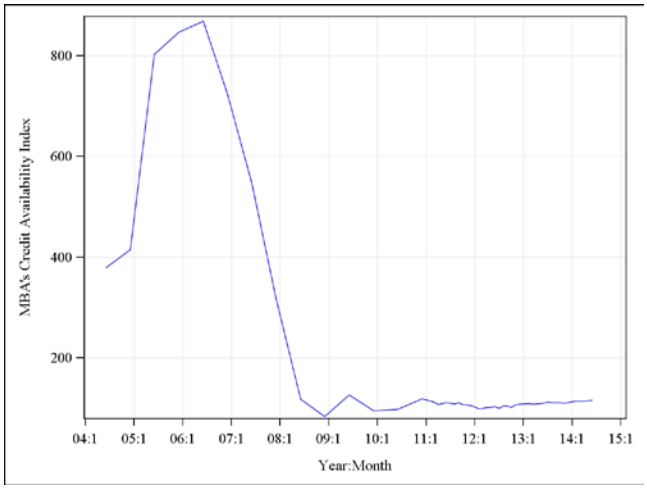
A. Federal Reserve's Senior Loan Officer Opinion Survey



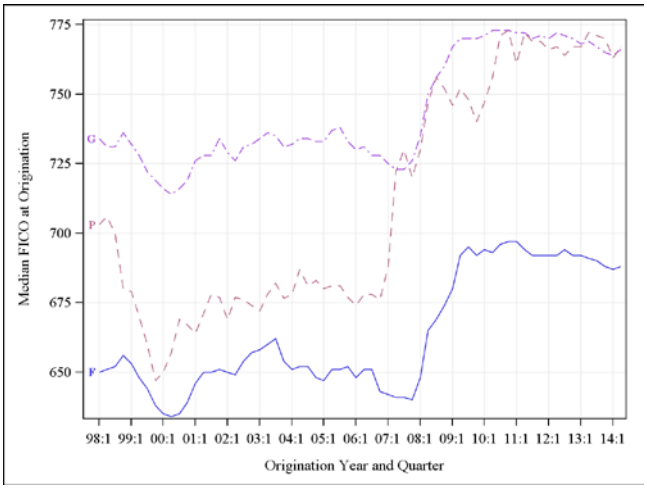
B. Mortgage application denial rates (HMDA data)



C. MBA's Mortgage Credit Availability Index



D. Median borrower's credit score (CoreLogic data)



As also shown in figure 1.A, in the second quarter (Q2) of 2007, the net share of banks tightening credit standards for prime mortgages was only 15 percent. This number climbed steadily after that and peaked in Q3 2008 at 74 percent, revealing continuous tightening of mortgage credit after the financial crisis.

The SLO is less successful at capturing the loosening of mortgage credit standards between 2003 and 2007. During these four years, the net share of banks tightening standards was zero or positive for nine quarters and negative for eight quarters,[6] and the magnitude was well below 10 percent for most quarters.

The SLO also failed to recognize the popularity of risky products as a sign of loosening credit standards before the financial crisis. The SLO did not begin asking separately about changes in lending standards for prime, nontraditional,[7] and subprime mortgage loans until Q2 2007. Accordingly, it missed a critical change in credit accessibility: many banks that answered that they did not originate nontraditional or subprime residential mortgages were actually active subprime lenders.[8] Moreover, the 60 large domestically chartered commercial banks in the SLO's reporting panel excluded some of the major lenders in the mortgage market before the financial crisis, such as Countrywide, Ameriquest, and New Century.

Mortgage Application Denial Rate Using HMDA Data

Researchers have also used HMDA data to calculate denial rates as a measure of credit accessibility. They tend to calculate the denial rate as the number of applications denied by the lender, divided by the total number of applications. This too falls short as a measure of credit accessibility, as it fails to consider applicants' credit profiles.[9] Denial rates are a function not only of the credit environment, but also of who happens to be applying for loans. An increase in applications by weaker-credit borrowers could increase the denial rate even where the credit environment has not changed, creating a false impression of the accessibility of credit at a given time. Thus, the counterintuitive trend in figure 1.B: denial rates increase each year from 2002 through the boom, reaching a peak in 2007 and 2008, and fall again as the bottom falls out of the market in 2009.

MBA's Mortgage Credit Availability Index

The monthly credit availability index produced by the Mortgage Bankers Association is a relatively new measure.[10] AllRegs[11] scans the credit guidelines for a large number of lenders, and the results are aggregated by the MBA into a single number, as shown in figure 1.C. The resulting trend between 2004 and now is quite reasonable, but this index lacks transparency. Though we know, for example, that this index takes many factors into account (such as loan purpose, amortization type, and property type) we have no way to know how numbers are assigned to these factors or to assess the formula that converts these many factors into a single index number.[12]

Median Borrowers' Credit Score

Another common metric for credit accessibility is the credit characteristics of loans made to the median borrower. This measure has some intuitive appeal because it reflects the amount of risk the market is willing and expected to take at a given time. For example, many have observed the big jump in borrowers' credit scores after the financial crisis, and hence support the view that the current credit box is too tight. Figure 1.D shows the median borrower FICO score for loans originated each quarter for the past 17 years.

But this measure has two weaknesses. First, a borrower's credit score alone is insufficient as a measure of credit availability; loan-to-value (LTV), debt-to-income (DTI), and other factors also help a lender determine whether to make a loan to a particular borrower. Second, the results with this measure are counterintuitive: they show a slight increase in median FICO scores for the private-label and bank portfolio channel between 2000 and 2006, indicating declining credit accessibility over a period widely perceived as driven by increasing accessibility. The rise was driven by a range of factors having less to do with accessibility of credit in the market than with who was applying for loans and what kinds of loans they were applying for.

A New Measure of Credit Availability That Quantifies the Risk Taken by the Market

Conceptually, the market increases credit availability by taking more default risk. Therefore, an alternative way to measure credit availability is by measuring the amount of default risk the market takes on at a given time based on a set of prescribed typical macroeconomic conditions. This measure offers two advantages.

First, it is a single comprehensive picture of the market at any given moment in time that simultaneously takes into account credit accessibility and credit risk. Compare this with the other traditional measures, which require a separate examination of multiple risk factors (FICO, LTV, DTI, etc.) and offer no good way to aggregate these factors.

Second, this measure more directly tracks the reality seen in the market. A lower value of the measure indicates that the market is taking less risk and hence making credit less accessible to consumers. A higher value indicates that the market is taking more risk and hence making credit more accessible to consumers.

This analysis is limited to owner-occupied purchase mortgages, which allows a more accurate comparison over time. The underwriting for a non-owner-occupied home is sufficiently different that we exclude these loans from our analysis. Similarly, refinance volume is heavily a function of interest rates, and various streamlined programs have allowed loans to refinance that would not meet prevailing credit criteria for a new loan, on the grounds that a refinance not only helps the borrowers but also reduces the probability of the loan defaulting, to the benefit of the holder of the risk.

Calculation of the Expected Default Risk

To calculate the expected default risk for loans originated at any given time, we take lessons from the past and assume that loans with the same risk factors will perform similarly under the same macroeconomic conditions.

First, we simplify and sort all possible macroeconomic conditions into two scenarios: "normal" and "stressed."[13] For the normal scenario, we use the default experience of loans originated in 2001 and 2002 (pre-bubble years) to construct a "lookup" table containing the actual default rates for 360 different risk combinations of FICO, LTV, DTI, and product type. A similar lookup table is constructed for the stressed scenario, using the default experience of loans originated in 2005 and 2006 (late-

bubble years). Both vintage groups have payment histories long enough to calculate actual default rates.[14]

Then, for loans originated at any given time, their expected default risk equals the actual default rate of the loans used to construct the lookup tables, with a matching set of risk factors.

For each of the two vintage groups (2001 and 2002, 2005 and 2006) we divide the loans into two buckets: loans without and with risky features. Loans without risky features include fixed-rate mortgages and all hybrid adjustable-rate mortgages with an initial fixed-interest-rate period of five years or longer, without any of the following features: prepayment penalty, balloon terms, interest-only terms, and negative amortizations. All other loans are loans with risky features. We make this division because loans with risky features considerably increase both credit availability and the default risk the market takes.[15]

We then divide each of the four buckets of loans into 180 smaller buckets of loans based on borrowers' credit profiles. We divide FICO and LTV into six buckets each and DTI into five buckets,[16] creating 180 combinations of the three risk factors (6 × 6 × 5) for each of the four sets of (vintage year/loan type [traditional or risky]) combinations.

For each of these 180 smaller buckets of loans, we calculate an actual default rate: the ratio between the number of defaults and the number of loans originally in the bucket.[17] A default is defined as 90 days or more delinquent, including various stages of foreclosure and termination due to foreclosure, by the end of March 2014.[18]

Thus, we constructed two lookup tables, one for a stressed macroeconomic scenario and one for a normal macroeconomic scenario, each containing the actual default rates for 360 different risk combinations (tables A.1 and A.2).[19] These 720 default rates allow us to calculate the amount of expected default risk of loans originated with given characteristic when followed by either a stressed or normal economic environment.

To assess the risk taken by the market at any point in time, we divide all loans originated at that time into the same 360 buckets as those in the lookup tables. We then know the expected default rate for every loan under either a normal or stressed scenario.

Data

Our analysis is limited to first-lien loans borrowed to purchase owner-occupied single-family properties.[20]

DATA SOURCES TO CREATE LOOKUP TABLES OF ACTUAL DEFAULT RATES

We use two loan-level databases to calculate the 720 actual default rates (tables A.1 and A.2):

1. Fannie Mae and Freddie Mac's single-family loan performance data[21] to calculate the default rate for 30-year, fully amortizing, full-documentation, single-family, fixed-rate GSE loans; and
2. CoreLogic's Prime/Subprime Servicing and ABS/MBS loan data[22] to calculate default rates for similar non-risky loans from channels other than the GSEs, for other loans with non-risky terms, and for all loans with risky terms.

Both databases contain detailed loan-level information on monthly loan performance, and borrower's credit profiles such as FICO score, combined loan-to-value ratio, and backend debt-to-income ratio.

DATA SOURCES TO CALCULATE MARKET SHARES BY CHANNELS

Home Mortgage Disclosure Act data[23] provide annual origination volume information by two channels: government loans (FVR)[24] and conventional loans.[25] For the conventional loans, origination volumes of the government-sponsored enterprises' (GSE) loans are obtained from the Securities Industry and Financial Markets Association (SIFMA),[26] which provides the annual dollar volume of single-family mortgage-backed securities (MBS) issuances of the GSEs.[27] The difference between the volume of the conventional loans and the volume of the GSE loans is the volume of the PP (bank portfolio and private-label securities, or PLS) loans.[28] Quarterly allocation of the annual volumes for each of the three channels is based on CoreLogic's mortgage databases.

DATA SOURCES TO CALCULATE THE TOTAL EXPECTED DEFAULT RATES FOR THE MARKET UNDER EACH SCENARIO

Within each of the three channels, we use CoreLogic's Prime/Subprime Servicing and ABS/MBS loan databases to calculate quarterly origination shares for each of the 360 cells of the lookup tables for that channel.[29]

The total expected default risk each channel takes at any given quarter, under each macroeconomic scenario, equals the average expected default rate of the 360 buckets weighted by the number of loans

originated by the channel at that time in each bucket.[30] The quarterly total expected default risk for the whole mortgage market equals the average of the quarterly total expected default risk each channel takes weighted by the quarterly market share of the channel.

A New Credit Availability Index

To create a new credit availability index that quantifies the amount of risk taken by the market, we need to combine the expected default rates under the stressed and normal scenarios. This requires assigning appropriate weights to each scenario. According to NBER's Business Cycle Dating Committee,[31] there have been 19 business cycles between 1913 and 2013. Only 2 of these 19 caused severe housing market collapses: the Great Depression and the Great Recession (Shiller 2005). So, over the past 100 years, the chance of a severe housing market stress has been approximately 10 percent. Therefore, we assign a weight of 10 percent to the expected default risk under the stressed scenario, and 90 percent to the expected default risk under the normal condition.[32] We call the weighted average of expected default rates HFPC's Credit Availability Index, or HCAI.

Mortgage Credit Availability Over Time

Trends Revealed by HFPC's Credit Availability Index

The HCAI more accurately tracks lending patterns in the real world than any existing measure of credit availability (figure 2).

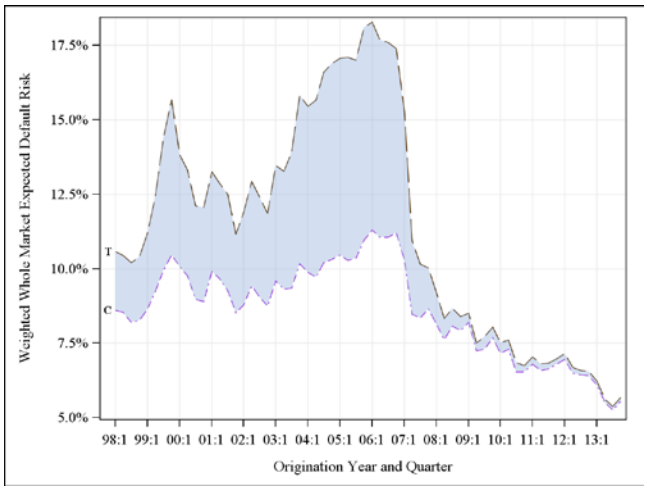
The HCAI (curve T in figure 2.A) shows two peaks in access to mortgage credit: one is around 2000, at 15.7 percent, and the second is between 2004 and 2007, at 18.3 percent. The latter is much longer and more severe than the first.

To assist our discussion, we divide the period between 1998 and 2013 into four shorter periods[33] as shown in table 1. The pre–housing bubble period, bubble period, crisis period, and post-crisis period correspond to the following four periods respectively: 98Q1 to 03Q4, 04Q1 to 07Q2, 07Q3 to 09Q2, and 09Q3 to 13Q4. It is useful to decompose these periods in order to appreciate that during the bubble period, the issue was increases in product risk, not borrower risk.

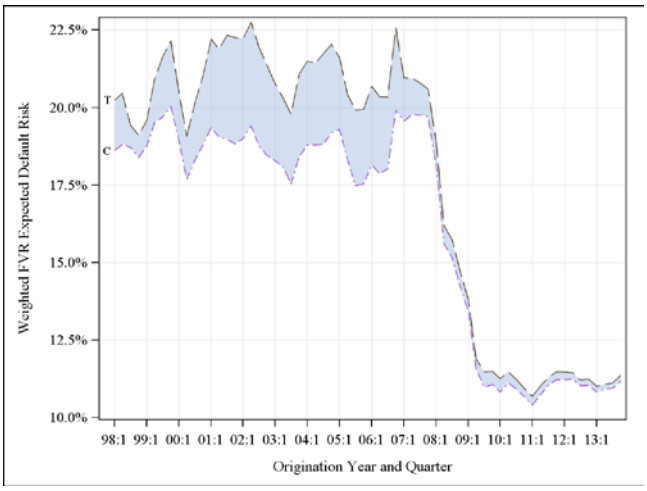
FIGURE 2

Weighted Expected Default Risk by Channels (10 Percent Stressed Scenario Plus 90 Percent Normal Scenario)

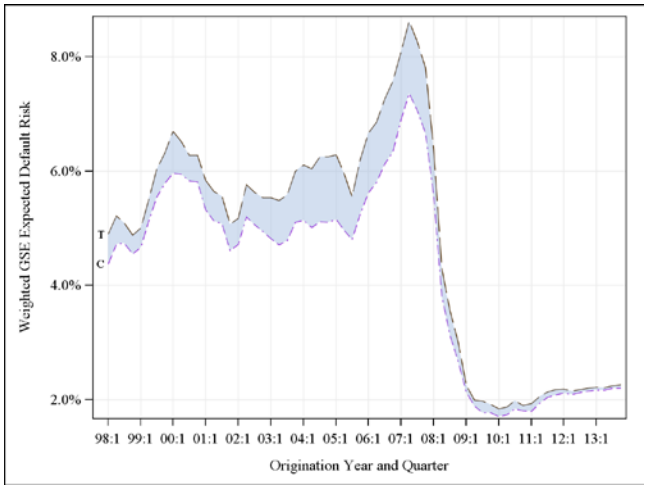
A. The whole market (HCAI)



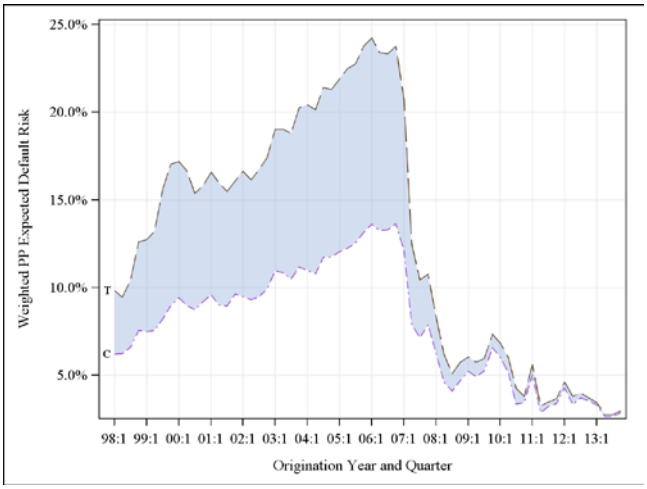
B. Government loans (FVR)



C. GSE loans



D. PP loans



Sources: CoreLogic and HMDA.

Notes: T: total expected default risk; C: expected default risk without risky products. Shaded areas represent expected default risk due to risky products. Default risks are weighted average of two scenarios: the bubble scenario and the pre-bubble scenario.

TABLE 1

Measuring Credit Availability by the Expected Default Risk the Market Takes (percent)

Origination period	Channel	Total Risk				Risk due to Weak Borrower Credit				Risk due to Risky Product			
		Period total	Qtr min	Qtr p50	Qtr max	Period total	Qtr min	Qtr p50	Qtr max	Period total	Qtr min	Qtr p50	Qtr max
		Weighted over two scenarios (10 percent stressed scenario plus 90 percent normal scenario)											
Pre-bubble	FVR	20.9	19.1	21.0	22.8	18.8	17.5	18.8	20.0	2.2	0.7	2.2	3.4
	GSE	5.6	4.9	5.6	6.7	5.1	4.4	5.1	6.0	0.5	0.3	0.5	0.9
	PP	15.6	9.5	16.1	20.3	8.9	6.2	9.1	11.2	6.7	3.2	7.0	9.1
	All	12.6	10.2	12.5	15.8	9.2	8.2	9.2	10.5	3.4	1.9	3.2	5.7
Bubble	FVR	21.1	19.9	21.0	22.6	18.7	17.5	18.8	19.9	2.4	1.2	2.5	2.9
	GSE	6.8	5.6	6.3	8.6	5.7	4.8	5.2	7.4	1.1	0.8	1.1	1.3
	PP	22.0	12.5	22.2	24.2	12.3	7.9	12.2	13.7	9.7	4.6	9.9	10.6
	All	16.6	11.0	17.0	18.3	10.4	8.5	10.3	11.3	6.2	2.5	6.6	7.2
Crisis	FVR	15.6	11.9	16.0	20.8	15.0	11.6	15.4	19.8	0.6	0.3	0.6	1.0
	GSE	5.6	2.0	3.9	8.3	4.9	1.9	3.5	7.1	0.7	0.1	0.5	1.2
	PP	8.2	5.1	6.1	10.8	6.0	4.1	5.1	7.9	2.2	0.8	1.3	3.3
	All	9.0	7.5	8.6	10.2	8.0	7.2	8.1	8.7	0.9	0.3	0.7	1.8
Post-crisis	FVR	11.3	10.7	11.3	11.5	11.0	10.4	11.0	11.2	0.3	0.2	0.2	0.5
	GSE	2.1	1.8	2.1	2.3	2.0	1.7	2.1	2.2	0.1	0.0	0.1	0.2
	PP	3.7	2.7	3.8	7.3	3.4	2.6	3.4	6.6	0.3	0.1	0.3	0.9
	All	6.7	5.4	6.8	8.0	6.5	5.3	6.6	7.7	0.2	0.1	0.2	0.4
		Stressed scenario											
Pre-bubble	FVR	34.6	31.8	34.9	37.3	31.4	29.8	31.4	32.3	3.2	1.0	3.4	5.2
	GSE	15.5	13.7	15.6	17.3	14.3	12.6	14.4	15.7	1.2	0.7	1.1	2.2
	PP	32.8	22.1	33.3	41.8	20.3	16.4	20.6	23.8	12.5	5.7	12.9	18.0
	All	26.1	21.9	26.0	33.0	19.9	18.3	20.0	21.8	6.2	3.3	6.0	11.2
Bubble	FVR	35.0	33.8	35.0	35.9	31.3	30.2	31.5	32.4	3.7	1.4	4.1	4.5
	GSE	17.6	15.6	17.1	20.2	15.2	13.7	14.5	17.8	2.4	1.8	2.4	2.8
	PP	44.1	30.2	44.6	47.1	25.6	19.6	25.5	27.6	18.6	10.6	18.9	20.0
	All	34.2	24.8	35.1	36.9	22.4	19.5	22.3	23.7	11.9	5.3	12.4	13.6
Crisis	FVR	28.8	25.1	29.5	33.5	28.1	24.6	28.6	32.3	0.8	0.6	0.8	1.3
	GSE	15.1	7.8	12.4	19.9	13.6	7.6	11.3	17.5	1.5	0.3	1.0	2.4
	PP	20.0	13.4	15.2	25.3	15.2	11.3	12.6	18.5	4.8	1.6	2.9	7.5
	All	20.0	17.4	18.9	22.8	18.1	16.9	18.0	19.2	1.9	0.5	1.3	3.8
Post-crisis	FVR	24.7	23.8	24.7	25.2	24.1	23.2	24.2	24.7	0.6	0.3	0.5	0.9
	GSE	8.5	7.7	8.7	8.9	8.2	7.3	8.5	8.7	0.3	0.1	0.3	0.6
	PP	10.4	8.9	10.5	16.4	9.7	8.5	9.5	14.8	0.7	0.3	0.8	2.0
	All	16.5	14.2	16.6	18.5	16.0	13.9	16.1	17.8	0.5	0.3	0.4	0.9
		Normal scenario											
Pre-bubble	FVR	19.4	17.7	19.5	21.1	17.4	16.1	17.4	18.7	2.0	0.7	2.1	3.2
	GSE	4.5	3.9	4.5	5.5	4.1	3.5	4.0	4.9	0.5	0.3	0.4	0.8
	PP	13.7	8.0	14.1	17.9	7.6	5.1	7.8	9.8	6.1	3.0	6.4	8.1
	All	11.1	8.9	11.0	14.0	8.0	7.1	8.1	9.2	3.1	1.8	2.9	5.0
Bubble	FVR	19.5	18.3	19.5	21.1	17.3	16.1	17.4	18.5	2.2	1.1	2.3	2.7
	GSE	5.6	4.4	5.1	7.3	4.6	3.8	4.2	6.2	0.9	0.6	0.9	1.1
	PP	19.5	10.5	19.7	21.7	10.8	6.6	10.7	12.1	8.7	3.9	9.0	9.6
	All	14.6	9.4	15.0	16.2	9.1	7.3	9.0	9.9	5.5	2.2	5.9	6.4
Crisis	FVR	14.1	10.4	14.5	19.4	13.6	10.1	13.9	18.4	0.5	0.3	0.6	1.0
	GSE	4.5	1.3	3.0	7.0	3.9	1.3	2.6	5.9	0.6	0.1	0.4	1.1
	PP	6.8	4.2	5.1	9.2	5.0	3.3	4.3	6.7	1.9	0.7	1.1	2.8
	All	7.8	6.4	7.5	8.7	6.9	6.2	7.0	7.5	0.8	0.2	0.6	1.6
Post-crisis	FVR	9.8	9.2	9.8	10.0	9.5	9.0	9.5	9.8	0.3	0.1	0.2	0.4
	GSE	1.4	1.2	1.4	1.5	1.3	1.1	1.4	1.5	0.1	0.0	0.1	0.2
	PP	3.0	2.1	3.1	6.3	2.7	2.0	2.8	5.7	0.3	0.1	0.3	0.8
	All	5.6	4.4	5.7	6.9	5.5	4.3	5.5	6.6	0.2	0.1	0.2	0.4

Sources: HMDA and CoreLogic.

Over the 17-year period, the average expected default risk taken by the market is 12.7 percent. In the pre–housing bubble period, 11 quarters are above this average and 13 quarters are below it. In the bubble period, 13 quarters are above the average and only 1 quarter is below it. For the crisis and post-crisis periods, all quarters are below the average.

The total expected default risks taken by the market in the four periods under HCAI's weighted analysis are 12.6 percent, 16.6 percent, 9.0 percent, and 6.7 percent (table 1). Post-crisis, the market takes less than half the risk it takes during the bubble period and a little more than half the risk it takes during the pre-bubble period.

When we further break down the source of default risk into borrower credit risk and product risk, we see that it was product risk, not credit risk, that significantly changed during the bubble. Curve C in the figure 2.A shows the expected default risk due to weak borrower credit; the shaded area between curves T and C shows the expected default risk due to products. In the pre-bubble period, the market took three times more credit risk than product risk (9.2 percent vs. 3.4 percent; see table 1). In the bubble period, the market took only 1.7 times more credit risk than product risk (10.4 percent versus 6.2 percent).

In other words, the mortgage market took the same level of credit risk during the bubble period as it did during the pre-bubble period. However, the amount of product risk it almost doubled from the pre-bubble period to the bubble period. Credit risk peaked at 10.5 percent in Q4 1999 and 11.3 percent in Q1 2006, but product risk peaked at 5.2 percent in Q4 1999 and 7.2 percent in Q1 2006.

After the crisis, the mortgage market almost ceased to provide loans with risky terms (table 1 and figure 2). At the same time, the market sought to slash its credit risk by imposing higher lending standards. The credit risk the market took over the four periods was 9.2, 10.4, 8, and 6.5 percent, respectively, for the pre-bubble, bubble, crisis, and post-crisis periods. Comparing this with the total expected default risks the market took over the four periods (12.6 percent, 16.6 percent, 9 percent, and 6.7 percent), one can see that the evaporation of risky loans contributed more than half of the lost mortgage credit availability after the crisis, compared with the pre-bubble and bubble periods.

Indeed, the public policy dilemma is how much credit risk one should allow. Lender overlays, as a result of concerns about both repurchase risk and the uncertain costs associated with servicing delinquent loans have resulted in a credit box that is very restrictive.

Trends under the Stressed Scenario

By plugging the quarterly originations into the lookup table for the stressed scenario, we see the amount of expected default risk the whole mortgage market takes under the stressed scenario, which is weighted 10 percent in the index (figure 3.A).

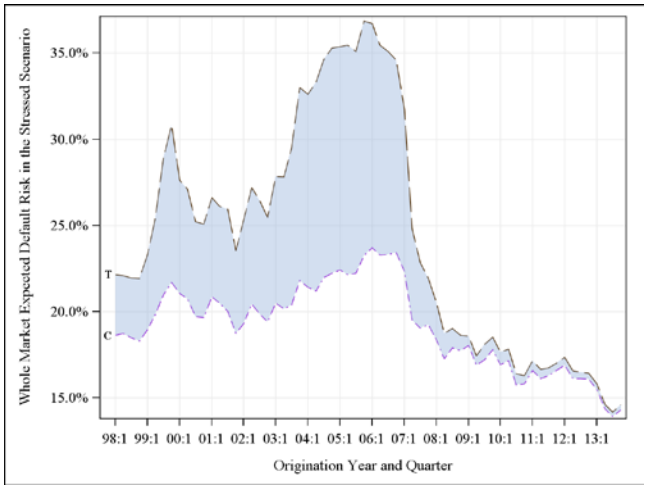
Curve T shows the total expected default risk. Curve C shows the expected default risk due to weak borrower credit only by assuming loans have no risky terms. Therefore, as in figure 2, the shaded area between the two curves shows the expected default risk solely due to risky loan terms. The general pattern under the stressed scenario mirrors the pattern shown by the HCAI, which indicates that the general trend does not depend much on which scenario we use to calculate the expected default risk the market takes.

However, the magnitude of the expected default risk under the stressed scenario is much bigger than that under the weighted HCAI scenario. Under the stressed condition, the total expected default risks the market took over the pre-bubble, bubble, crisis, and post-crisis periods were 26.1, 34.2, 20, and 16.5 percent, respectively. The credit risks the market took over the four periods were 19.9 percent, 22.4 percent, 18.1 percent, and 16 percent. The product risks the market took over the four periods were 6.2 percent, 11.9 percent, 1.9 percent, and 0.5 percent. Compared to HCAI's weighted scenarios, the amount of expected default risk the market takes under the stressed scenario doubles for both the credit risk and the product risk. It again shows that under the stressed condition, the vanishing of risky loans contributes more than half of the lost mortgage credit availability after the crisis, compared with the pre-bubble and bubble periods.

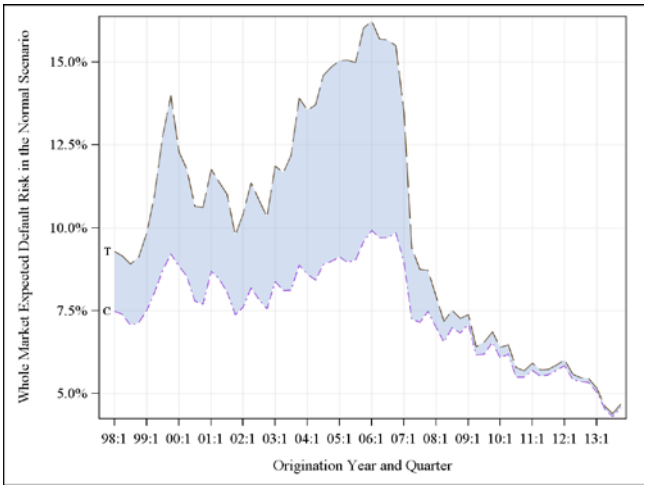
FIGURE 3

Expected Default Risk by Scenarios and Channels

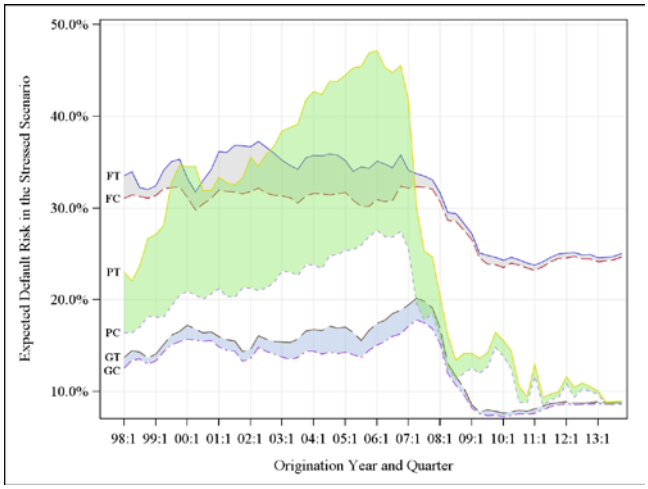
A. The whole market, stressed scenario



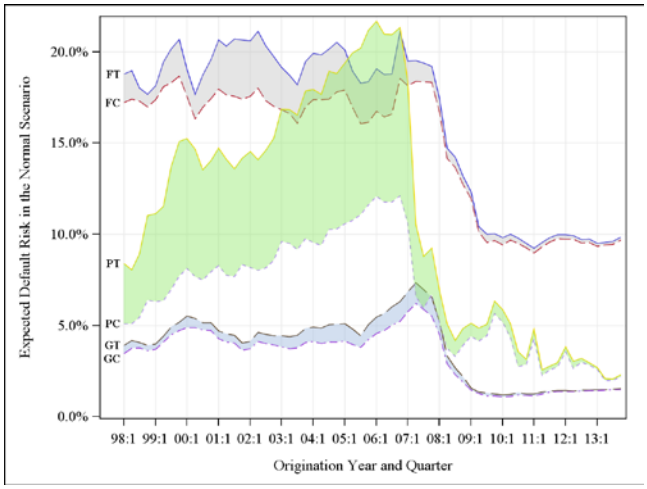
B. The whole market, normal scenario



C. Three channels, stressed scenario



D. Three channels, normal scenario



Sources: CoreLogic and HMDA.

Notes FT: total expected default risk for FVR loans; FC: expected default risk due to weaker borrower credits for FVR loans; PT: total expected default risk for PP loans; PC: expected default risk due to weaker borrower credits for PP loans; GT: total expected default risk for GSE loans; GC: expected default risk due to weaker borrower credits for GSE loans; T: total expected default risk for the whole market; C: expected default risk due to weaker borrower credits for the whole market; shaded areas stand for expected default risk due to risky loan products.

Origination Volumes of Owner-Occupied, Purchase Loans

The HCAI and the other expected default risks measure only the borrower credit profile and risky loan terms of loans originated at a given time. These indices don't measure the change in origination volumes over time (table 2 and figure 4).

Curve T of figure 4.A shows the number of loans originated quarterly to purchase owner-occupied single family properties. This curve reveals strong seasonal origination patterns and increasing volume leading to the boom years. After the housing crisis, volume dropped significantly. Less than 1 million owner-occupied purchase loans were originated in only 4 of 24 quarters during the pre-bubble period and none of the 14 quarters during the bubble. After the housing crisis, mortgage originations surpassed 870,000 owner-occupied purchase loans per quarter in only 1 of 26 quarters. The average number of owner-occupied purchase loans originated quarterly for the four periods are 1.2 million, 1.5 million, 723,000 and 573,000, respectively, for the pre-bubble, bubble, crisis, and post-crisis periods (table 2).

TABLE 2

Quarterly Origination Volumes of Owner-Occupied, Purchase Loans

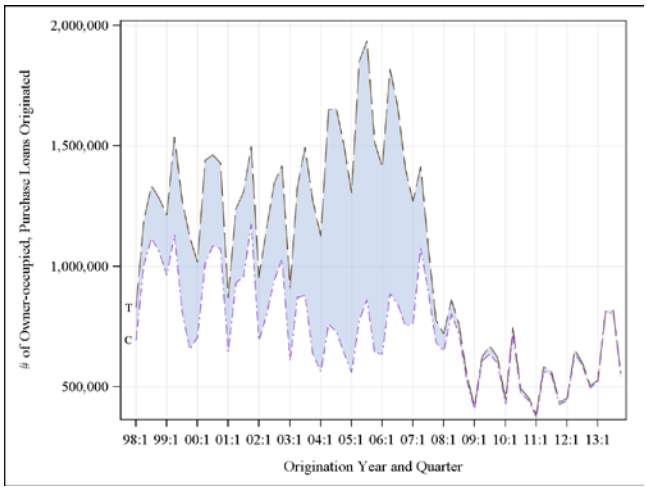
	Period	Minimum	Mean	Median	Maximum
Total loans originated	Pre-bubble	828,952	1,247,180	1,279,616	1,536,192
	Bubble	1,126,040	1,538,132	1,510,303	1,936,966
	Crisis	418,036	723,052	738,506	1,076,122
	Post-crisis	384,029	573,695	559,844	818,788
Total non-risky loans originated	Pre-bubble	609,345	895,810	938,203	1,174,993
	Bubble	560,887	749,892	757,422	1,075,426
	Crisis	407,462	661,228	666,806	892,826
	Post-crisis	372,453	559,164	549,160	807,179
Total risky loans originated	Pre-bubble	134,014	351,370	352,650	637,743
	Bubble	338,674	788,241	841,753	1,077,271
	Crisis	10,574	61,824	49,521	183,296
	Post-crisis	7,555	14,530	11,593	33,387
% of risky loans	Pre-bubble	15.4%	28.1%	27.1%	50.0%
	Bubble	23.9%	50.8%	54.4%	58.1%
	Crisis	2.5%	7.5%	6.1%	17.0%
	Post-crisis	1.3%	2.6%	2.3%	5.0%

Sources: HMDA, CoreLogic, and SIFMA.

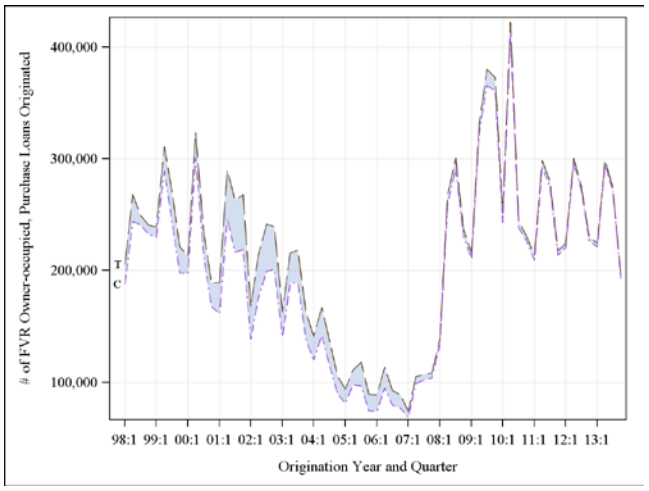
FIGURE 4

Origination Volume: Loans Originated to Purchase Owner-Occupied Single-Family Properties

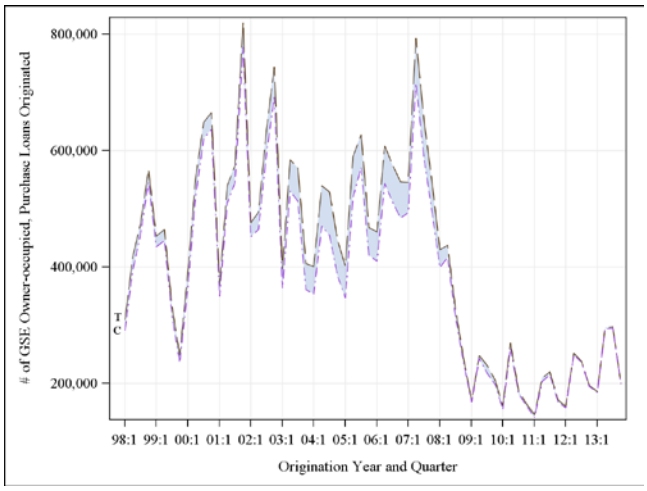
A. Three channels together



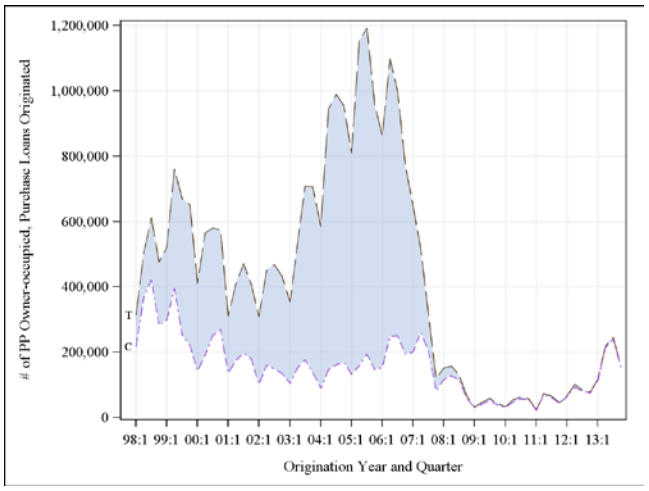
B. FVR loans



C. GSE loans



D. PP loans



Sources: CoreLogic, HMDA, and SIFMA.
Notes: T: Total originations; C: number of originations without risky products; shaded areas stand for number of originations with risky products.

Curve C of figure 4.A shows the quarterly originations of owner-occupied, purchase loans without risky terms; thus, the shaded area represents the number of originations of loans with risky terms. As one would expect, the number of loans with risky product terms was relatively small pre-bubble (28 percent), grew appreciably during the bubble period (51 percent), and has nearly disappeared entirely today (7.5 percent during the crisis and only 2.6 percent post-crisis). The average number of owner-occupied purchase loans without risky terms originated quarterly for the four periods are 896,000, 750,000, 661,000, and 560,000, respectively, for the pre-bubble, bubble, crisis, and post-crisis periods (see table 2). Excluding risky loans, to reach the average pre-bubble/bubble level, the current market still needs to originate 300,000 more owner-occupied purchase loans per quarter—a more than 50 percent increase. The bottom line: a tight credit box means very limited issuance.

Trends by the Three Channels

So far, we have been looking at the mortgage market as a whole. But our methodology also allows us to look at credit availability and default risk by each of the three channels: government (FVR loans), GSE loans, and PP (bank portfolio and PLS) loans.[34] Each channel exhibits very different behavior over time, but a dramatic tightening is evident in all channels.

UNDER THE WEIGHTED SCENARIOS

Figures 2.B, 2.C, and 2.D on page 9 show the expected default risk under the weighted scenarios for the FVR, GSE, and PP channels, respectively. Curves T and C stand for total expected default risk and expected default risk due to weak borrower credits only, respectively. The shaded area stands for product risk. Table 1 summarizes these measures by four periods.

The FVR channel shows two distinct periods in the amount of default risk taken over the past 17 years: before and after the housing crisis. Within each period, the amount of credit and product risk FVR took fluctuated around a constant level. Before the crisis, the credit risk the FVR channel took fluctuated around 18.7 percent, and the product risk fluctuated around 2.2 percent. After the crisis, these numbers were 11 and 0.3 percent, respectively.[35] Therefore, the post-crisis credit risk taken by the FVR channel is almost half of pre-crisis levels, making it much less available to borrowers with weaker credits.

For the GSE channel before the crisis, the risk it took peaked in 2000–01 and 2007–08. After the crisis, the GSE channel accepted much less risk. For the pre-bubble, bubble, crisis, and post-crisis periods, the credit risk taken by the GSE channel was 5.1, 5.7, 4.9, and 2.0 percent, respectively; the

product risk was 0.5, 1.1, 0.7, and 0.1 percent, respectively. Therefore, the post-crisis credit risk taken by the GSE channel was approximately one-third of the pre-crisis credit risk, making the loans much less available to borrowers with weaker credits.

For the PP channel, from Q1 1998 until the peak of the market in Q1 2007, the risk it took increased almost constantly from 6 percent to 14 percent for credit risk, from 3 percent to 11 percent for product risk, and from 9.5 percent to 24.2 percent for total risk. Note that at its peak, the PP channel only took about two-thirds of the credit risk the FVR channel took. However, since the PP channel took much more product risk than the FVR channel, in the peak years, the total amount of expected default risk the PP channel took well exceeded that of the FVR channel. After the crisis, the amount of product risk taken by the PP channel approached zero, while the amount of credit risk was reduced to 3.4 percent.

Finally, the three channels show different peaks and troughs in their risk acceptance. Ultimately, the PP channel had the promptest response to the housing market changes, whereas the GSE and FVR channels had delayed responses, lagging by five and six quarters, respectively.

UNDER THE STRESSED AND THE NORMAL SCENARIOS

Figures 3.C and 3.D on page 13 show the expected default risk the three channels take over time under the stressed and the normal market conditions. The patterns under the normal conditions are almost the same as the patterns shown by the weighted scenarios, but they have a noticeable difference from the patterns under the stressed conditions: under the stressed scenario, in the peak years, the total amount of risk the PP channel took exceeded that the FVR channels took by more than 10 percentage points. Under the normal scenario, the two values are almost the same. Clearly, product risk is amplified under stressed market conditions.

OWNER-OCCUPIED, PURCHASE LOAN ORIGINATION VOLUME BY CHANNEL

Before the housing crisis, FVR played a relatively minor role in the owner-occupied purchase loan market. FVR loans accounted for 18.7 and 7.1 percent, respectively, of total owner-occupied, purchase loans for the pre-bubble and bubble periods, with a declining market share leading to the peak of the housing market (table 3 and figure 4.B). During and after the crisis, however, FVR became a major player, accounting for 30 and 48 percent, respectively, of total owner-occupied, purchase loans.

TABLE 3

Quarterly Owner-Occupied, Purchase Loan Originations by Channel

		% of Total Originations				% Loans with Risky Terms				% of All Risky Loans				% of All Non-Risky Loans			
Channel	Period	Period total	Qtr min	Qtr p50	Qtr max	Period total	Qtr min	Qtr p50	Qtr max	Period total	Qtr min	Qtr p50	Qtr max	Period total	Qtr min	Qtr p50	Qtr max
FVR	Pre-bubble	18.7	12.8	18.7	24.8	11.4	3.4	11.9	18.3	7.5	3.6	6.0	15.3	23.1	15.6	22.3	30.2
	Bubble	7.1	5.6	6.3	12.5	14.1	5.7	14.9	17.6	1.9	1.1	1.8	3.7	12.5	9.0	11.6	21.3
	Crisis	29.5	10.0	35.4	52.9	3.1	2.2	3.3	5.1	10.8	3.0	20.4	48.1	31.3	11.4	36.4	53.2
	Post-crisis	47.8	33.5	49.6	60.0	2.1	1.1	1.8	3.8	39.7	29.5	39.0	49.0	48.0	33.6	49.9	60.4
GSE	Pre-bubble	40.5	22.2	42.5	54.8	6.0	3.8	5.5	10.9	8.6	2.9	8.7	13.6	53.1	35.9	55.7	67.2
	Bubble	35.0	29.6	32.6	56.1	11.3	8.9	11.2	14.1	7.7	5.2	7.5	22.9	63.6	59.8	63.4	67.0
	Crisis	52.8	39.6	47.7	70.8	6.5	1.5	4.6	10.0	39.9	24.1	35.3	56.2	54.0	39.9	48.4	72.7
	Post-crisis	36.8	33.1	36.3	39.9	2.1	0.7	1.8	5.5	30.1	18.7	31.5	41.2	36.9	33.2	36.5	40.2
PP	Pre-bubble	40.8	27.3	39.5	58.1	58.0	26.9	60.2	80.5	83.9	71.2	84.1	92.1	23.8	13.2	20.8	37.7
	Bubble	58.0	36.5	60.1	63.4	79.9	49.4	83.0	86.2	90.4	75.4	90.9	92.9	23.9	16.0	23.8	29.8
	Crisis	17.7	7.5	16.3	29.5	23.9	9.1	15.3	35.5	49.4	27.8	38.3	61.6	14.7	6.9	14.0	23.0
	Post-crisis	15.4	6.2	12.7	30.1	5.0	2.4	5.5	12.3	30.3	17.4	29.9	51.8	15.1	5.8	12.3	29.8

Sources: HMDA, CoreLogic and SIFMA.

The PP channel shows the opposite pattern to the FVR channel. Its market share increased from 41 percent to 58 percent from the pre-bubble period to the bubble period. After the crisis, its market share fell to 15 percent of total owner-occupied, purchase loans. The market share of the GSEs is relatively constant over time, accounting for about 40 percent of the owner-occupied, purchase loan market for each of the four periods.

Both the GSE and the FVR channels originate relatively few risky loans than the PP channel. Risky loans account for 58, 80, 24, and 5 percent, respectively, of all owner-occupied, purchase PP loans, for the pre-bubble, bubble, crisis, and post-crisis periods.

Conclusion

Measuring a concept as complicated and varied as credit access is no easy task. Yet this is an important time to ensure that it is being measured accurately. As we seek to reform the housing finance system, Congress, the housing finance industry, advocacy groups, policymakers, and even the general public need to clearly understand how well the market is providing access to mortgage credit for borrowers.

The four commonly cited measures of credit availability each fall short on some dimension:

- **The Federal Reserve's Senior Loan Officer's Survey** offers a subjective view by loan officers about the loosening of credit, comparing the current credit conditions to the previous three

months. It fails, however, to offer a robust and objective view of credit accessibility over any period longer than three months. Notably, this measure failed to capture the significant loosening of credit standards between 2003 and 2007.

- Calculating a denial rate based on **Home Mortgage Act Disclosure data** offers a longer-term, more objective view of credit accessibility than the SLO survey. Yet this rate also falls short because it fails to consider the credit profiles of loan applicants and, thus, cannot on its own distinguish a tight credit environment from an environment where a larger percent of low-credit applicants are applying for loans. Notably, this measure indicates that credit access was tight from 2002 to 2007 and loose after the bust—a conclusion we know is inaccurate.

- Another common metric of credit accessibility is **the median FICO score of existing loans**. This measure, like the HMDA measure, gives us an objective measure and a view of longer periods. It also has some intuitive appeal because it reflects the amount of risk the market is willing and expected to take at a given time. However, because FICO is such a small part of a borrower's credit profile, the median FICO score is not a robust measurement.

- Finally, the **MBA's Credit Availability Index** is based on the credit guidelines of a number of lenders, collected by AllRegs, and weighted by the MBA. This relatively new measure seems to accurately track the tightening and loosening of credit in recent years and may be both robust and objective. But it lacks transparency: we just don't know how it is calculated.

Given the shortfalls in these measures, we set out to create a measure of credit availability that is robust, intuitive, objective, longitudinal, and transparent. Our new measure, the HCAI, allows users to determine how much risk the market is taking at any given time by determining the specific default risk of all the loans made at that point. Because this measure takes several borrower's characteristics as well as loan characteristics into account and is weighted for the likelihood of economic downturns, it is extremely robust and objective and produces intuitive results. Because we have published the lookup tables with 720 buckets, it is also completely transparent.

The HCAI tells us more about recent lending history, including the following:

- Product risk—not borrower credit risk—changed significantly during the bubble.

- After the crisis, the mortgage market almost ceased to provide loans with risky terms and sought to slash its credit risk by imposing higher lending standards.

- The total expected default risk in the post-crisis period is half of what it was in the pre-bubble years.
- The Government channel today (FHA, VA, RDS) represents the only segment of the market that is serving less than pristine borrowers.

The HCAI also allows interested stakeholders to develop more accurate answers to such questions as the following:

- What percentage of the FHA-guaranteed loans made last year (or at any point in time) will default?
- How much will defaults rise if we loosen GSE lending standards?
- How tight are credit standards today?

The HCAI is still an imperfect measure because it fails to take into account two factors that are important measures of credit accessibility:

- **Failed applicants.** The HCAI lookup tables are based on loan performance and therefore do not incorporate any information about unsuccessful applications. Accordingly, the HCAI tells us nothing about applicants who are denied loans.
- **Deterrence.** Some borrowers who otherwise would apply for a loan are discouraged from applying for various reasons, including the assumption that they would not receive the loan. Again, because the HCAI is based on loan performance, it tells us nothing about these borrowers.

One commonly cited measure of mortgage credit availability—denial rates based on HMDA data—allows some insight into failed applicants, but no current measure offers any insight into deterred applicants. Our paper on measuring mortgage credit accessibility (Li et al. 2014) discusses new metrics for denial and deter rates. Our real denial rate, which takes into account an applicant's credit profile, better measures denial rates than the traditional measure widely used for decades. We also provide a solution for the deter rate.

We hope that by adding the HCAI, the real denial rate, and the deter rate to the existing measures of mortgage credit accessibility, we can help policymakers better understand the housing finance environment and develop policies that best support a healthy housing system.

Appendix A

TABLE A.1

Lookup Table under the Stressed Scenario Showing Actual Default Rate (%) for Loans Originated in 2005 and 2006.

Backend DTI	CLTV	Non-Risky Loan Products							Risky Loan Products						
		FICO							FICO						
		Average	>740	(700,740]	(660,700]	(620,660]	(580,620]	≤580	Average	>740	(700,740]	(660,700]	(620,660]	(580,620]	≤580
Average	Average	15	8	16	20	26	32	43	50	31	46	52	56	59	58
	(0,68]	4	2	5	7	11	14	19	14	6	13	17	21	23	26
	(68,78]	10	5	13	16	21	21	29	29	16	29	34	39	37	40
	(78,82)	13	7	15	18	23	24	30	41	26	39	44	48	48	51
	[82,90]	16	9	17	21	25	27	34	48	34	47	52	51	51	55
	(90,95]	16	9	16	19	25	29	42	48	34	45	47	50	55	64
	>95	29	19	26	29	34	41	52	61	47	56	60	64	67	75
Full doc & (0,30)	Average	7	3	7	10	17	26	42	39	12	26	36	46	54	57
	(0,68]	2	1	2	3	6	11	19	8	2	7	9	16	25	29
	(68,78]	4	2	6	7	11	16	25	17	6	12	21	31	35	41
	(78,82)	5	3	7	8	13	17	25	29	10	22	32	42	51	46
	[82,90]	7	4	7	10	16	20	32	41	17	29	34	40	47	56
	(90,95]	9	4	7	12	18	21	40	43	17	29	37	45	53	62
	>95	20	7	12	19	29	40	51	49	22	35	44	51	58	73
Full doc & [30,40)	Average	11	5	10	14	22	32	47	45	19	33	41	50	58	61
	(0,68]	3	1	3	5	8	12	18	12	5	10	14	20	21	24
	(68,78]	7	3	7	10	15	19	26	22	9	18	23	33	42	41
	(78,82)	9	5	9	13	17	21	28	36	16	28	36	46	53	50
	[82,90]	9	5	9	13	19	24	33	43	19	30	39	44	47	57
	(90,95]	11	6	9	14	21	28	43	46	22	34	39	46	55	64
	>95	23	9	15	22	33	43	55	52	27	38	46	53	62	74
Full doc & [40,50)	Average	15	7	12	18	25	34	45	54	25	39	48	56	64	64
	(0,68]	4	2	4	6	10	13	17	15	5	12	16	18	27	27
	(68,78]	9	5	9	13	18	20	23	28	11	22	29	37	42	41
	(78,82)	11	6	12	16	20	25	28	46	20	33	44	52	60	55
	[82,90]	13	7	12	17	23	29	34	49	22	34	43	47	51	59
	(90,95]	15	8	13	18	26	32	45	52	25	34	43	50	58	67
	>95	27	13	19	26	35	45	55	59	35	45	51	59	67	75
Full doc & ≥50	Average	14	7	13	18	27	32	39	56	27	42	50	59	66	62
	(0,68]	4	2	4	6	11	16	20	21	9	16	21	28	32	32
	(68,78]	10	5	10	13	21	24	25	33	12	32	37	48	45	38
	(78,82)	12	6	11	16	22	25	28	45	21	36	42	51	60	53
	[82,90]	16	8	13	20	27	30	33	51	26	44	45	49	52	60
	(90,95]	18	10	15	22	29	34	41	56	35	41	46	56	62	67
	>95	28	14	20	28	37	45	50	62	40	48	54	61	69	75
Low or no doc	Average	20	12	23	27	31	34	42	49	34	48	54	57	53	51
	(0,68]	5	2	7	10	14	18	21	14	6	14	18	21	21	26
	(68,78]	14	8	17	22	28	25	34	30	18	30	35	40	35	40
	(78,82)	17	11	20	24	30	28	34	42	29	40	45	48	42	50
	[82,90]	23	16	26	31	33	31	36	48	37	48	53	52	52	51
	(90,95]	24	17	27	29	31	29	41	47	38	47	49	50	52	59
	>95	35	29	36	36	35	38	48	64	53	60	65	70	75	79

Sources: SFPD and CoreLogic.

TABLE A.2

Lookup Table under the Normal Scenario Showing Actual Default Rate (%) for Loans Originated in 2001 and 2002.

Backend DTI	CLTV	Non-Risky Loan Products							Risky Loan Products						
		FICO							FICO						
		Average	>740	(700,740]	(660,700]	(620,660]	(580,620]	≤580	Average	>740	(700,740]	(660,700]	(620,660]	(580,620]	≤580
Average	Average	4	1	2	5	9	15	27	19	4	8	13	20	26	38
	(0,68]	1	0	1	2	4	6	14	8	2	4	7	10	12	23
	(68,78]	2	1	1	3	5	9	18	14	3	5	10	14	19	31
	(78,82]	2	1	1	3	5	8	15	14	3	6	10	16	21	34
	[82,90]	4	1	2	4	7	12	20	21	6	9	13	18	24	35
	(90,95]	5	2	3	5	9	13	20	22	9	12	16	23	30	47
	>95	15	4	7	11	20	30	44	37	11	16	26	36	54	72
Full doc & (0,30)	Average	2	1	1	3	6	11	18	18	2	7	12	21	26	35
	(0,68]	1	0	0	1	3	5	11	6	1	3	5	11	11	19
	(68,78]	1	0	1	2	3	7	12	12	2	4	11	11	16	30
	(78,82]	1	0	1	2	3	6	10	13	2	5	8	16	23	33
	[82,90]	2	1	1	2	5	9	13	23	5	9	13	18	24	32
	(90,95]	4	1	2	4	8	12	16	21	7	10	18	22	28	40
	>95	11	3	5	9	17	31	43	38	7	15	25	40	53	78
Full doc & [30,40)	Average	3	1	2	3	7	11	19	22	4	7	13	21	28	38
	(0,68]	1	0	1	1	3	5	9	8	1	3	4	9	10	20
	(68,78]	1	0	1	2	4	7	12	15	2	4	8	13	21	32
	(78,82]	1	0	1	2	4	6	11	15	2	4	7	14	24	36
	[82,90]	3	1	1	3	5	9	14	25	4	7	14	19	24	34
	(90,95]	4	1	2	4	7	11	14	23	8	13	17	20	27	43
	>95	10	3	5	8	17	29	43	36	9	14	22	36	50	73
Full doc & [40,50)	Average	3	1	2	4	7	12	19	23	4	8	12	20	27	37
	(0,68]	1	0	1	2	3	4	8	11	1	3	6	14	13	21
	(68,78]	2	1	1	2	4	7	12	19	2	4	8	15	19	32
	(78,82]	2	1	1	2	4	7	12	18	3	5	9	16	25	37
	[82,90]	3	1	2	3	5	10	15	27	5	8	12	18	26	34
	(90,95]	5	2	2	4	8	12	15	24	8	13	12	21	27	42
	>95	11	3	5	9	18	29	44	31	9	13	21	28	37	65
Full doc & ≥50	Average	3	1	2	4	6	10	13	26	6	8	13	21	28	41
	(0,68]	1	0	1	1	3	5	8	11	2	7	10	7	14	19
	(68,78]	2	1	1	2	3	6	12	20	3	2	11	13	19	33
	(78,82]	2	1	1	2	4	6	8	20	3	6	10	16	24	38
	[82,90]	3	1	2	4	6	9	14	30	10	9	13	19	27	38
	(90,95]	5	2	3	5	8	14	17	28	13	13	15	24	30	49
	>95	8	4	6	8	15	20	20	39	17	15	19	30	45	63
Low or no doc	Average	8	2	4	9	16	25	40	16	4	8	13	20	25	37
	(0,68]	2	1	2	4	6	12	26	7	2	4	7	10	12	25
	(68,78]	4	1	3	5	10	16	29	13	3	6	10	15	19	31
	(78,82]	4	1	3	5	11	18	31	13	3	6	10	16	19	31
	[82,90]	8	3	6	10	15	22	35	17	6	10	13	17	23	38
	(90,95]	10	4	7	11	16	23	37	20	10	12	17	25	42	59
	>95	21	6	10	15	22	30	45	39	13	17	29	43	73	77

Sources: SFPD and CoreLogic.

TABLE A.3

Origination Volume and Market Share for Loans to Purchase Owner-Occupied Single-Family Properties

Origination year: quarter	Total # of loans	% of FVR loans	% of GSE loans	% of PP loans	% loans with risky terms	% FVR loans with risky terms	% GSE loans with risky terms	% PP loans with risky terms
1998:1	828,952	24.8	37.3	37.9	16.2	8.6	5.9	31.2
1998:2	1,189,216	22.5	35.1	42.4	15.4	8.9	5.7	26.9
1998:3	1,334,664	18.7	35.5	45.8	16.2	3.4	3.8	31.1
1998:4	1,283,863	18.7	44.2	37.0	17.3	3.4	3.8	40.4
1999:1	1,212,953	19.7	37.3	43.0	20.5	3.7	4.0	42.5
1999:2	1,536,192	20.2	30.2	49.5	26.4	7.0	4.2	47.9
1999:3	1,272,642	21.3	26.1	52.6	36.2	9.9	5.4	62.2
1999:4	1,122,349	19.7	22.2	58.1	41.5	10.4	5.4	65.8
2000:1	1,017,298	21.0	38.6	40.4	30.7	7.5	7.1	65.2
2000:2	1,441,587	22.4	38.3	39.3	29.6	6.9	5.6	66.1
2000:3	1,463,135	16.0	44.3	39.7	25.8	9.1	4.3	56.5
2000:4	1,428,349	13.2	46.6	40.2	24.8	11.3	4.4	53.0
2001:1	868,908	21.8	42.4	35.8	25.6	14.9	5.1	56.5
2001:2	1,238,489	23.4	43.6	33.0	24.7	14.9	5.5	57.0
2001:3	1,309,043	20.1	43.9	36.0	26.8	17.7	5.2	58.1
2001:4	1,495,872	17.9	54.8	27.3	21.5	18.3	5.3	56.0
2002:1	953,384	17.6	49.9	32.5	27.4	17.1	5.0	67.3
2002:2	1,159,557	18.5	42.6	38.9	30.9	17.7	6.1	64.3
2002:3	1,347,638	17.9	47.3	34.7	29.9	17.5	6.5	68.3
2002:4	1,416,864	16.9	52.5	30.6	27.4	16.0	7.0	68.7
2003:1	911,963	17.8	43.5	38.7	33.2	13.7	8.3	70.2
2003:2	1,328,536	16.2	44.0	39.8	34.4	12.5	9.2	71.3
2003:3	1,495,499	14.6	38.1	47.3	41.2	13.1	10.0	74.9
2003:4	1,275,369	12.8	31.8	55.4	50.0	15.0	10.9	80.5
2004:1	1,126,040	12.5	35.6	51.9	50.0	14.9	11.8	84.6
2004:2	1,650,826	10.1	32.7	57.2	54.0	14.9	12.8	84.4
2004:3	1,656,058	8.3	31.9	59.8	55.9	16.3	14.1	83.7
2004:4	1,504,753	7.0	29.6	63.4	57.3	15.4	13.8	82.3
2005:1	1,304,380	7.2	30.8	62.0	57.0	13.0	13.5	83.7
2005:2	1,853,009	6.0	31.8	62.2	58.1	11.9	11.9	86.2
2005:3	1,936,966	6.1	32.4	61.5	55.5	17.6	8.9	83.7
2005:4	1,515,854	5.9	30.9	63.3	57.6	16.6	10.1	84.6
2006:1	1,411,554	6.3	32.6	61.1	54.9	16.6	10.9	82.2
2006:2	1,821,015	6.2	33.4	60.4	51.3	16.3	10.6	77.4
2006:3	1,664,434	5.6	34.6	59.9	49.3	14.0	11.0	74.8
2006:4	1,405,978	6.3	38.8	54.9	46.3	13.0	11.4	74.8
2007:1	1,268,886	5.8	43.0	51.2	39.9	7.6	9.7	69.0
2007:2	1,414,099	7.4	56.1	36.5	23.9	5.7	9.8	49.4
2007:3	1,076,122	10.0	60.5	29.5	17.0	5.1	10.0	35.5
2007:4	776,526	13.9	70.8	15.3	11.8	4.1	9.4	30.0
2008:1	719,780	19.3	59.7	21.0	9.9	3.8	7.1	23.4
2008:2	862,789	31.0	50.7	18.3	6.9	3.3	4.8	18.9
2008:3	757,233	39.8	43.0	17.2	5.2	3.4	4.4	11.3
2008:4	548,636	43.3	44.6	12.1	4.1	2.9	3.2	11.7
2009:1	418,036	51.6	40.7	7.8	2.5	2.4	1.5	9.1
2009:2	625,296	52.9	39.6	7.5	2.6	2.2	1.8	10.2
2009:3	670,614	56.7	34.5	8.8	5.0	3.8	5.5	10.8
2009:4	622,041	60.0	33.1	6.9	3.9	3.2	3.7	11.1
2010:1	447,347	56.2	36.1	7.7	4.0	3.3	3.5	11.2
2010:2	746,565	56.6	36.1	7.3	3.6	2.6	3.5	12.3
2010:3	493,546	49.4	37.9	12.7	3.3	2.2	2.7	9.0
2010:4	454,456	50.9	36.4	12.7	2.4	1.9	2.2	5.4
2011:1	384,029	55.7	38.1	6.2	3.0	2.2	3.3	8.5
2011:2	581,385	51.4	36.0	12.7	2.8	2.1	2.8	5.7
2011:3	565,784	49.6	38.8	11.6	2.2	1.8	2.0	4.6
2011:4	436,172	50.0	39.4	10.7	2.0	1.8	1.7	4.4
2012:1	452,582	49.6	35.5	14.9	2.3	1.8	1.4	6.2
2012:2	653,707	46.0	38.5	15.5	2.3	1.5	1.1	7.5
2012:3	597,886	45.9	39.9	14.2	1.7	1.4	0.9	4.7
2012:4	504,925	45.6	39.0	15.4	1.5	1.5	0.8	3.1
2013:1	528,477	42.5	35.3	22.2	1.6	1.4	0.9	3.0
2013:2	814,298	36.7	36.3	27.0	1.3	1.1	0.7	2.4
2013:3	818,788	33.5	36.3	30.1	1.4	1.2	0.7	2.4
2013:4	553,904	35.3	36.3	28.4	1.6	1.4	0.9	2.8

Sources: HMDA, CoreLogic, and SIFMA.

Notes

1. See detailed information at http://www.federalreserve.gov/boarddocs/snloansurvey/about.htm.
2. For each mortgage loan application, four possible outcomes are reported in HMDA data: application denied, application approved but not accepted, loan originated, and application withdrawn by applicant or file closed for incompleteness.
3. See http://www.mbaa.org/ResearchandForecasts/MCAI.htm.
4. See, for example, http://www.urban.org/publications/413187.html, page 14.
5. The survey asks the following question: "Over the past three months, how have your bank's credit standards for approving applications from individuals for mortgage loans to purchase homes changed?" Banks may respond that their lending standards "remained basically unchanged," "tightened considerably," "tightened somewhat," "eased considerably," or "eased somewhat."
6. A positive percentage means tightening and zero means unchanged lending standards in the past three months. A negative percentage means loosening lending standards in the past three months.
7. The nontraditional category of residential mortgages includes adjustable-rate mortgages with multiple payment options, interest-only mortgages, and Alt-A products such as mortgages with limited income verification and mortgages secured by non-owner-occupied properties.
8. Notice the disconnection before and after Q2 2007 in figure 1.A.
9. This is because credit profile information tends to be available to researchers only after the loan has been originated.
10. See http://www.mbaa.org/ResearchandForecasts/MCAI.htm for a more complete description.
11. AllRegs is a publisher of underwriting and loan product guidelines for Fannie Mae, Freddie Mac, Federal Home Loan Bank of Chicago, Wells Fargo Home Mortgage, JPMorgan Chase, and other mortgage lenders.
12. It is unclear what the pool of surveyed lenders looks like and how each lender's answers are weighted relative to other lenders' answers.
13. Our results show that the choice of scenarios actually won't change the general trends of the credit.
14. We recognize that the default rate on the later vintages is still increasing, albeit much more slowly, so we do not use the term lifetime default rates. We plan to update and publish the up-to-date numbers and entire history regularly.
15. Many risky terms, such as optional ARM loans with teaser rates, reduce the amount of payments for the early life of the loan, making it more affordable than loans without these terms, with the cost of much higher payments thereafter; create significant risk of payment shock leading to higher default risk.
16. Borrower's FICO score at origination is divided into six levels: >740, 700–740, 660–700, 620–660, 580–620, and ≤ 580. Borrower's combined LTV is divided into six levels: 0–68, 68–78, 78–82, 82–90, 90–95, and > 95. Borrower's back-end DTI is divided into four levels if the borrower's income is fully documented: ≥ 50, 40–50, 30–40, and 0–30; it is placed in the fifth level if the borrower's income is not fully documented.
17. Missing values are common in CoreLogic's loan databases for borrower's FICO score, LTV, and DTI at origination. To calculate expected default risk for loans with missing values on any of the three risk factors, we calculated average default rates for the lookup table as shown in the appendix. For example, if a borrower's FICO score is missing, then the loan's expected default rate equals the average default rate of loans with FICO score not missing in the lookup table and with LTV and DTI values matching the borrower's. If both FICO and LTV are missing, then the expected default rate of the loans is the average default rate of loans in the lookup table with neither FICO nor LTV missing and with a DTI value matching the borrower's. If all three risk factors are missing in the database, then the expected default rate equals the average of default rate of loans in the lookup table with nonmissing values for all three factors.

18. A loan that was 90 days delinquent but has recovered would be included as a default; a loan that received a modification before missing three payments would not.

19. Two type of products × 180 credit profile combinations.

20. Single-family properties include single-family residences, condominiums, townhouses, and planned unit developments, which accounted for 94 percent of all first-lien loans borrowed to purchase owner-occupied properties reported by CoreLogic's PLS and Servicing Database.

21. For more details about what loans are included in the dataset, see documentation at https://loanperformancedata.fanniemae.com/lppub-docs/lppub_glossary.pdf and http://www.freddiemac.com/news/finance/pdf/user_guide.pdf.

22. CoreLogic, Inc., is a US corporation providing financial, property and consumer information, analytics and business intelligence. According to CoreLogic's data dictionary, its loan database covers approximately 75 percent to 90 percent of all residential mortgages including both outstanding and terminated loans, although the percentage varies by market. As of March 2013, the database covers approximately 85 percent of all outstanding residential mortgages. We believe the default rates of the mortgages that are included are representative of mortgages with the denoted credit characteristics; we are very careful with our weighting to insure the proper mix of loans.

23. HMDA is considered the "universe" of mortgage loans, as federal law requires that almost all mortgage originations, except some small lenders exempted from reporting, be reported in HMDA. For detailed discussion on the coverage of HMDA on residential mortgages, see Avery, Brevoort, and Canner (2007) and McCoy (2007).

    Under HMDA reporting, if a lender sells a loan in the same calendar year in which it was originated or purchased, the lender must identify the type of purchaser to whom it was sold. However, if the lender sells the loan in a succeeding year, the lender need not report the sale in the succeeding year, and the lender does not go back to previous years to show it as sold. Therefore, HMDA's coverage on secondary market activities is incomplete.

24. Government loans include those guaranteed by the Federal Housing Administration (FHA), the Department of Veterans Affairs (VA), and the Department of Agriculture's Rural Development (RD) Program. Jointly we call them FVR loans.

25. Conventional loans include those guaranteed by Fannie Mae and Freddie Mac (the government-sponsored enterprises, or GSEs) as well as loans funded through private-label securities and portfolio loans on the books of financial institutions (PP).

26. See the original numbers at http://www.sifma.org/uploadedfiles/research/statistics/statisticsfiles/sf-us-agency-mbs-sifma.xls.

27. Dollar volume is divided by average loan amount to calculate loan counts. Average loan amount of the GSE loans is obtained from HMDA data.

28. The share of owner-occupied, purchase loans out of all loans for each channel is obtained from HMDA data.

29. That is, we use CoreLogic data to figure out the distribution of loan characteristics separately for each of the three channels.

30. We can also weight by loan amount, but loan count is a more natural unit for measuring credit availability.

31. See http://www.nber.org/cycles.html.

32. Essentially we treat periods for the past 100 years during all other economic stresses than the two severe housing downturns as normal housing market conditions, since they have little impact on housing prices, as evidenced in Shiller (2005). Meanwhile, the vintage used for the normal conditions covers loans originated in 2001 and 2002, which happens to be the same year as the 2001 economic crisis.

33. According to the Bureau of Economic Analysis (BEA), the peak of the latest economic cycle is Q4 2007, and the trough is Q2 2009. Meanwhile, according to BEA, another recession occurred over the past 17 years with a peak in Q1 2001 and a trough in Q4 2001. However, it doesn't change the course of the housing market by

examining housing price index changes. We added another cutting point of Q1 2004 to divide the 17-year period into four periods, as shown in table 1.

34. To promote credit accessibility to applicants with weaker credit profiles, the US government provides various forms of credit support for residential mortgages. This support falls into two broad categories: direct intervention through 100 percent or close to 100 percent guarantees or insurance by government agencies, such as the FHA, VA, and RD, and a formerly implicit (now explicit) government guarantee of lending done through the GSEs. The rest of the market is the third channel (PP), consisting of loans funded through private-label securities and loans on the books of financial institutions. The FVR channel traditionally has had the broadest credit box and higher pricing than the other two channels, and thus has been used disproportionately by weaker-credit-profile consumers. In the PP loan market, private-sector actors bear all the credit risk; therefore, the availability and pricing of credit through this channel has varied widely over time. The GSE market sits in between in terms of the government's intervention on credit accessibility, but it usually sets credit standards tighter than the private market.

35. Risky products in the FVR channel are primarily ARMs with resets shorter than five years.

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