Actuarial Review of the Federal Housing Administration Mutual Mortgage Insurance Fund Forward Loans for Fiscal Year 2013

December 11, 2013

Prepared for

U.S. Department of Housing and Urban Development

By

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Integrated Financial Engineering, Inc.

December 11, 2013

The Honorable Carol J. Galante
Assistant Secretary for Housing – Federal Housing Commissioner
U.S. Department of Housing and Urban Development
451 Seventh Street, SW, Room 9100
Washington, DC 20410

Dear Ms. Galante:

IFE Group has completed and, along with this letter, is submitting the fiscal year 2013 Actuarial
Review of the Mutual Mortgage Insurance Fund Forward Loans (the Fund).

We estimate that the Fund's economic value as of the end of fiscal year 2013 was *negative* $7.87
billion and the unamortized insurance in force was $1,173.04 billion. We project that at the end
of fiscal year 2020 the Fund's economic value will be $84.87 billion and the unamortized
insurance in force will be $1,535.56 billion. We also estimate that the economic value could be
positive in FY 2013 if there is a stronger economic recovery than was forecasted by Moody's
Analytics. On the other hand, the economic value could remain negative through FY 2020, under
more pessimistic economic scenarios than those represented by the base-case assumptions.

The financial estimates presented in this Review require projections of events more than 30 years
into the future. These projections are dependent upon the validity and robustness of the
underlying model and assumptions about the future economic environment and loan
characteristics. These assumptions include economic forecasted by Moody's Analytics and the
assumptions concerning compositions of future endorsement portfolios projected by FHA. To the
extent that actual events deviate from these or other assumptions, the actual results may differ,
perhaps significantly, from our current projections. The models used for this Review are, by
nature, large and complex. We applied an extensive validation process to assure that the results
reported in this Review are accurate and reliable.

The full actuarial report explains these projections and the reasons for the changes since last
year's actuarial review.

Very truly yours,

Tyler T. Yang, Ph.D.
Chairman and CEO
Integrated Financial Engineering, Inc.

Actuarial Review of the
Federal Housing Administration
Mutual Mortgage Insurance Fund
Forward Loans
for Fiscal Year 2013

I have reviewed the "Actuarial Review of the Federal Housing Administration Mutual Mortgage Insurance Fund, Forward Loans, for Fiscal Year 2013 ". The purpose of my review was to determine the soundness of the methodology used, the appropriateness of the underlying assumptions applied, and the reasonableness of the resulting estimates derived in the Review

The Review was based upon data and information prepared by the Federal Housing Administration (FHA). I have relied upon the FHA for the accuracy and completeness of this data. In addition, I also relied upon the reasonableness of the assumptions used in the economic projections prepared by Moody's Analytics, from which the base case used in the Review was derived.

It is my opinion that on an overall basis the methodology and underlying assumptions used in the Review are reasonable and appropriate in the circumstances. In my opinion the estimates in the Review lie within a reasonable range of probable values as of this time although the actual experience in the future will not unfold as projected.

Phelim Boyle, Ph.D., FIA, FCIA
Fellow of the Institute of Actuaries (UK)
Fellow of the Canadian Institute of Actuaries
December 11, 2013

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Executive Summary

The 1990 Cranston-Gonzalez National Affordable Housing Act (NAHA) requires an independent actuarial analysis of the economic net worth of the Federal Housing Administration's (FHA's) Mutual Mortgage Insurance Fund. The Housing and Economic Recovery Act of 2008 (HERA) moved the requirement for an independent actuarial review into 12 USC 1708(a)(4). This report presents the results of our analysis for fiscal year (FY) 2013.

HERA also moved several additional programs into the Mutual Mortgage Insurance Fund. One of them, Home Equity Conversion Mortgages (HECMs, which are reverse mortgages) is analyzed separately and is excluded from this Review. ***In the remainder of this Review, the term "the Fund" refers to the MMI Fund excluding HECMs.***

The primary purpose of this Actuarial Review is to estimate:

- the *economic value* of the Fund, defined as the existing capital resources, or total assets less total liabilities of the Fund, plus the net present value (NPV) of the current books of business, **excluding HECMs**, and

- the *total insurance-in-force (IIF)* of the Fund*,* **excluding HECMs**.

This year, we followed last year's approach and used a stochastic method to estimate the net present value of future cash flows. In 2011 and previous Reviews, the net present value of the cash flows was computed along a single, deterministic path of house prices and interest rates. Starting from the 2012 Review, instead of a single path, we generated 100 equally likely paths to conduct a Monte Carlo simulation, and computed the net present value of the cash flows for each of the paths. Then we averaged these 100 numbers to obtain our estimate of the expected net present value of the future cash flows under our simulation procedure. This is our baseline estimate. In this year's Review, we have improved our Monte Carlo approach to make it more flexible and more efficient.

Based on our stochastic simulation analysis, we estimate that the economic value of the Fund as of the end of FY 2013 is *negative* $7.87 billion. This represents a $5.61 billion improvement from the *negative* $13.48 billion economic value estimated in the FY 2012 Review. Because the HECM portfolio is excluded from this analysis, we do not report the capital ratio of the Fund.

We project that there is approximately a 22 percent probability that the FY 2013 economic value is positive. We also estimate that under the worst path among the simulated stochastic scenarios, the economic value could stay negative through FY 2020.

A. Status of the Fund

Exhibit ES-1 reports the estimates of the Fund's current and future economic value and insurance-in-force (IIF) using 100 simulated paths and taking the average of the resulting 100 economic values. Both the economic value and the IIF of the Fund are expected to increase each year over the next seven years.

Exhibit ES-1: Projected Fund Performance for FYs 2013 through 2020 ($Millions)

Fiscal Year	Economic Value of the Fund[a]	Unamortized Insurance-in-Force[b]	Amortized Insurance-in-Force[b]	Economic Value of Each New Book of Business	Volume of New Endorse-ments[c]	Investment Earnings on Fund Balances
2013	-7,871	1,173,038	1,090,482	14,304	241,195	
2014	7,838	1,266,026	1,166,530	15,725	190,977	-16
2015	18,711	1,313,592	1,195,266	10,842	136,615	31
2016	29,696	1,355,513	1,219,277	10,787	138,704	198
2017	42,283	1,392,485	1,238,942	12,023	148,027	564
2018	56,033	1,436,408	1,264,467	12,647	156,002	1,104
2019	70,262	1,483,728	1,291,881	12,606	158,104	1,623
2020	84,866	1,535,564	1,322,615	12,464	162,608	2,140

[a] All values are as of the end of each fiscal year. The economic value for FYs 2013 through 2020 is equal to the economic value of the Fund at the end of the previous year, plus the current year's interest earned on the previous Fund balance, plus the economic value of the new book of business.
[b] Estimated based on the data extract as of June 30, 2013, our model of new endorsement volumes, and projected loan performance.
[c] Based on our endorsement volume forecast model described in Appendix F.

In defining the statutory capital ratio, NAHA stipulates the use of unamortized insurance-in-force as the denominator. However, "unamortized insurance-in-force" is defined in the legislation as "the remaining obligation on outstanding mortgages" – which is generally understood to describe amortized IIF. To allow flexibility to calculate the capital ratio under either definition, both the unamortized and amortized IIFs are reported in this Review. Following the convention of previous Actuarial Reviews, most of our discussion in this Review focuses on the unamortized IIF.

The capital resources of the Fund at the end of FY 2013 were estimated to be $20.56 billion. We simulated the capital resources over the next seven years along the 100 possible future economic scenarios of the stochastic simulation. From the 95th percentile path shown in Exhibit ES-2, we

infer that there is approximately only a 5 percent chance that the capital resources may fall to around $12 billion during the next seven years.

Exhibit ES-2: Mean and Selected Monte Carlo Percentiles for MMI Capital Resources
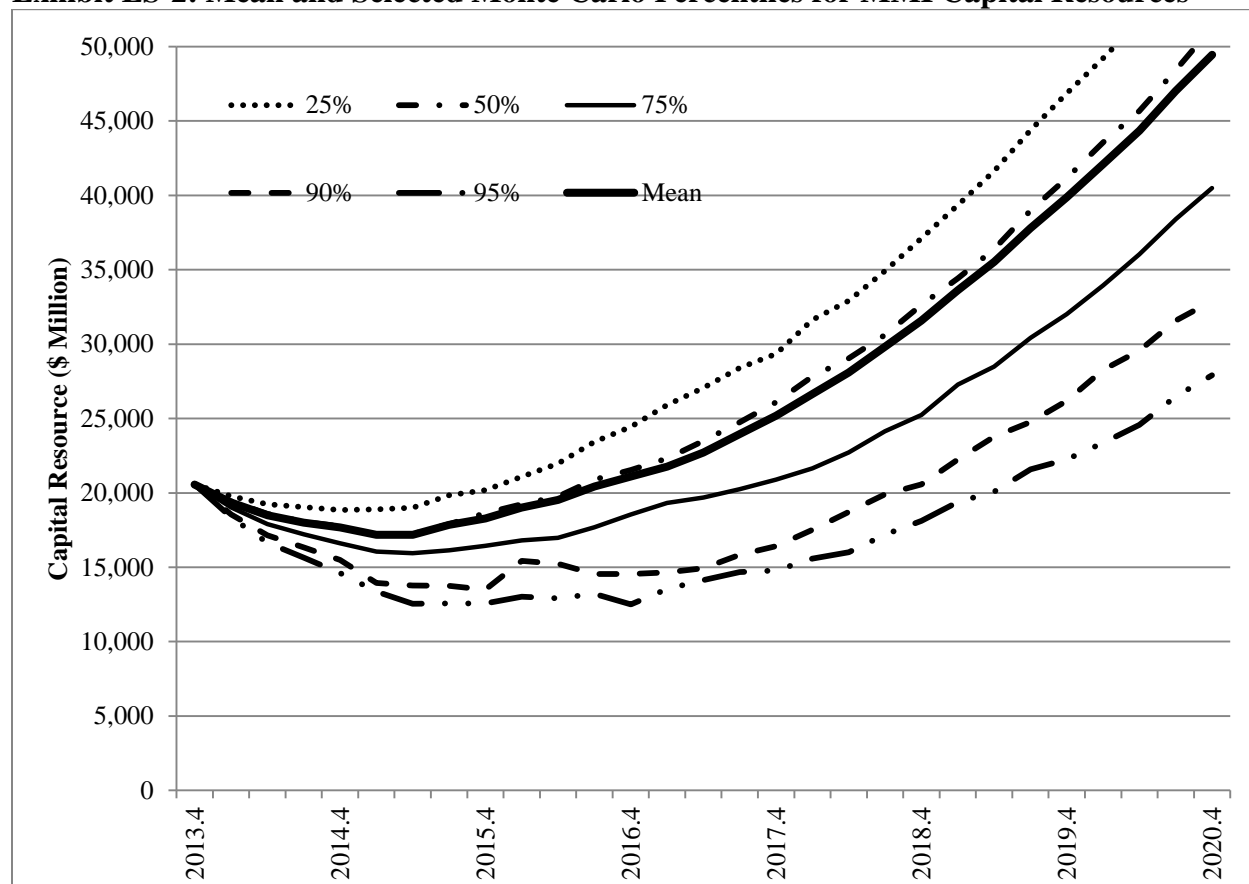
B. Sources of Change in the Status of the Fund

Change in Economic Value from FY 2012 to FY 2013

We estimate that the economic value of the Fund was *negative* $7.87 billion as of the end of FY 2013, which represents an increase of $5.61 billion compared to the FY2012 economic value of *negative* $13.48 billion. Meanwhile, there has been a $47 billion increase in the estimated unamortized IIF from the FY2012 value of $1,126 to $1,173 billion.

Current Estimate of FY 2013 Economic Value Compared with the Estimate Presented in the FY 2012 Actuarial Review

Our current estimate of the FY 2013 economic value is $5.28 billion lower than the economic value projected for FY 2013 in the FY 2012 Actuarial Review. Our current estimate of the FY 2019 economic value is $70.26 billion, which is $16.01 billion higher than estimated in the FY 2012 Actuarial Review. The FY 2013 differences are attributed to the following changes, with the magnitude of the change in the estimated FY 2013 economic value shown in parentheses for each source:

- including the Fund transfer to the HECM Financing Account (-$4.26 billion)
- using updated data to estimate origination volume of the FY 2012 and FY 2013 books of business (+$1.08 billion)
- updating the discounting factors published by OMB (-$0.37 billion)
- updating actual performance in FY2012-FY2013 (+$2.82 billion)
- updating the econometric models (+$2.11 billion)
- updating the interest rate forecast (-$4.40 billion)
- updating the house price forecast (-$3.98 billion)
- updating FHA's new mortgage insurance premium schedule for FY 2013 and future endorsements (+$0.48 billion)
- adjusting the claim/prepay projections for delayed claims, and the actual prepay/claim of the last three quarters (-$0.82 billion)
- adjusting the loss severity rate forecast with third party sale policy (+$2.06 billion)

In total, the estimated economic value of the Fund increased during FY 2013 but is $5.28 billion lower than that estimated last year. Without the transfer to HECM, the Fund would have been $1.02 billion lower than what was estimated in last year's Review.

Additional Comments

The estimates presented in this Review reflect projections of events more than 30 years into the future. These projections are dependent upon a number of assumptions, including economic trend forecasts by Moody's Analytics and the assumption that FHA does not change its policies regarding refunds, premiums, distributive shares, underwriting or servicing rules, and administrative expenses. To the extent that these or other assumptions are subject to change, the actual results may vary, perhaps significantly, from our current projections.

Estimation of the variables in the models used for predicting prepayments and claims depends on large amounts of loan-level data, requiring extensive data processing. To complete the Review within the timeframe required by HUD, we used the actual historical loan-level data as of

February 28, 2013 provided by HUD. We supplemented that with various updates up to August 2013. Although we have not audited the data for accuracy, we have reviewed the data provided by HUD for integrity and consistency and believe it to be reasonable. However, the information contained in this report may not correspond exactly with other published analyses that rely on HUD data compiled at different times or obtained from other systems.

The economic value estimate reported in this Actuarial Review is based on many components, including behavioral models derived from historical data, forecasts for major macroeconomic drivers, stochastic paths generated by Monte Carlo simulation algorithms. Our modeling approach is based on our experience in this field, our research in this area and the relevant literature. However, it is not the uniquely accurate way to build such models. We recognize that other capable modelers may use different assumptions, get different models and obtain different estimates.

C. Impact of Economic Forecasts

The economic value of the Fund and its pattern of capital accumulation to FY 2020 depend on many factors. One of the most important factors is the prevailing economic conditions over the next 37 years, and most critically during the first 10 years of that time period. We captured the most significant factors in the U.S. economy affecting the performance of the loans insured by the Fund through the use of the following variables in our models:

- 30-year fixed-rate home mortgage commitment rates
- Ten-year Treasury rates
- One-year Treasury rates
- Growth rate of local house prices
- Local unemployment rates

The projected performance of FHA's books of business, measured by their economic value, is affected by changes in these economic variables. The baseline results of this report are based on Monte Carlo simulations centered on Moody's Analytics quarterly forecasts for interest rates and MSA-level house price appreciation rates, which Moody's Analytics forecasted simultaneously along with other macroeconomic and regional variables, as of July 2013.

We also estimated the economic value of the Fund under six additional economic scenarios. They are:

- 10th Best Path in Simulation
- 25th Best Path
- 25th Worst Path

- 10th Worst Path
- Worst Path
- Moody's Protracted Slump Scenario

These six scenarios do not represent the full range of possible experience, but they represent different levels of variation under different economic conditions, and hence provide insights into the projected performance of the Fund under a range of economic environments. Using the results shown in Exhibit ES-3, we infer that there is an 80 percent chance that the FY 2013 economic value would be in the range of *negative* $22.89 billion and positive $5.91 billion. From the worst path in the simulation, we infer that there is a 99.5 percent probability the FY 2013 economic value would be better than *negative* $86.53 billion. Under Moody's protracted slump scenario the FY 2013 economic value would be *negative* $69.95 billion. Also from our simulated scenarios, we infer that there was approximately a 22 percent chance the FY 2013 economic value would be positive.

Exhibit ES-3: Projected Fund's Economic Value Under Alternative Economic Scenarios ($ Millions)

Fiscal Year	Baseline Monte Carlo	10th Best Path	25th Best Path	25th Worst Path	10th Worst Path	Worst Path	Protracted Slump
2013	-7,871	5,914	-156	-14,613	-22,893	-86,534	-69,952
2020	84,866	109,888	88,598	71,700	61,495	-67,061	-15,866

Impact of Downpayment Assistance Program

The passage of HERA prohibits FHA's endorsement of seller-financed downpayment assistance loans on or after October 1, 2008. These loans experienced claim rates that were considerably higher than otherwise comparable non-assisted loans. The share of loans with downpayment assistance from non-profit organizations quickly diminished after the passage of HERA. The significance of eliminating these types of loans is highlighted by our estimate that if non-profit assisted loans had always been excluded, the economic value of the Fund would have improved by $16.74 billion, resulting in a value of positive $8.87 billion in FY 2013.

Section I: Introduction

The 1990 Cranston-Gonzalez National Affordable Housing Act (NAHA) mandated that the Federal Housing Administration's (FHA's) Mutual Mortgage Insurance (MMI) Fund maintain a capital ratio of 2 percent from October 1, 2000 forward. The capital ratio is defined by NAHA as the ratio of the Fund's economic value to its unamortized insurance-in-force (IIF). NAHA also established the requirement for the MMI Fund to undergo an annual independent actuarial review. The Housing and Economic Recovery Act of 2008 (HERA) moved the requirement for an independent actuarial review into 12 USC 1708(a)(4).

IFE Group was engaged by the Department of Housing and Urban Development (HUD) to conduct the independent actuarial review to estimate the economic value and IIF of the forward mortgages in the MMI Fund for FY 2013. One of the programs that were moved into the MMI Fund, Home Equity Conversion Mortgages (HECMs), is analyzed in a separate report and is excluded from this document. HUD will combine the results from the two separate reports to compute the consolidated economic value and capital ratio of the entire MMI Fund. The combined economic value and capital ratio of the entire MMI Fund are the measures specified by Congress to assess whether the MMI Fund meets the capital standards set forth in NAHA. We will refer to the forward mortgage portfolio excluding HECMs as "the Fund" in this report.

The analysis in this Review relies on information provided by HUD, such as the historical performance of the existing loans in the Fund and the projected composition of future mortgage originations. It also relies on future economic conditions based on forecasts published by Moody's Analytics. IFE Group has created a distribution of simulation paths around Moody's baseline forecast to estimate the economic value of the Fund.

A. Implementation of NAHA

Following release of the FY 1989 Actuarial Review and the ensuing debate, Congress mandated various changes to the MMI Fund. The required revisions focused on five major issues: (1) development of an actuarial standard, (2) modification of the minimum borrower downpayment requirement, (3) changes in insurance premiums, (4) limitations on distributive shares and (5) modification of underwriting standards and data requirements.

The changes called for in the Act were specifically designed to remedy the financial difficulties encountered by the Fund during the 1980s. Each change was intended either to reduce risks inherent in new books of business or to adjust premiums to more adequately compensate for the risks.

The NAHA legislation required that the Fund be operated on an actuarially sound basis. It provided specific capital standards and timeframes over which those standards should initially be met. It also defined the critical actuarial measure as the ratio of the Fund's capital, or economic value, to its unamortized IIF, defined by the legislation as the remaining obligation on outstanding mortgages. This ratio thus established the capital standard for the Fund.

To further strengthen the capital position of the Fund, the NAHA legislation linked FHA's ability to pay distributive shares to the actuarial soundness of the entire MMI Fund (as defined in the legislation), rather than solely considering the performance of the loans endorsed during a particular year, as had been done in years prior to 1990. This amendment allowed distributive share payments only if the Fund achieved the capital standard established by the legislation, and then at the discretion of the Secretary of HUD. No distributive shares have been paid since the passage of NAHA. In all our prior analyses of Fund performance, IFE has assumed continuation of the current HUD policy that no distributive shares will be paid, and we continue to make that assumption in the 2013 Review.

B. FHA Policy Developments and Underwriting Changes

Since the mid-1990's, FHA has implemented a number of policy changes that affected the financial strength of the MMI Fund. Major changes have included revised underwriting guidelines, changes to homeownership counseling requirements, implementation of automated underwriting systems, changes to upfront and annual mortgage insurance premium schedules, changes in loan limits, elimination of seller-financed downpayment assistance, and foreclosure avoidance and loss mitigation programs, including loan modification, expanded eligibility for pre-foreclosure sales, new property disposition via third-party sales. Each of these developments is summarized below.

1. Revised Underwriting Guidelines and Other Policy Issues

In 1995, FHA introduced several changes in their underwriting guidelines to eliminate unnecessary barriers to homeownership, provide flexibility to underwrite creditworthy non-traditional and underserved borrowers, and clarify certain underwriting requirements so that they would not be applied in a discriminatory manner. While these modifications enabled many additional households to become homeowners, the relaxation of the underwriting rules also contributed to an increase in FHA claim rates for loans originated after 1995.

Changes were made in 1998 to the underwriting guidelines for adjustable rate mortgages (ARMs) to address the high losses on ARMs that FHA was experiencing. Based on FHA's study of ARM claim rates, it was deemed necessary to change credit policies to maintain the MMI Fund's actuarial soundness. As a result of these changes, ARM borrowers must qualify using a

mortgage payment level based on the maximum possible second-year interest rate. Also, any form of temporary interest rate buy-down for ARMs could no longer be used to create qualifying payment ratios.

In 2008, HERA increased the minimum borrower cash equity investment requirement to 3.5 percent for purchase loans.[1] FHA also established a minimum FICO score of 500 for loans with 90 percent or higher loan-to-value ratios. This rule was further tightened in 2010.[2] Starting October 4, 2010, borrowers with credit scores below 500 are no longer eligible for FHA insurance, and the maximum loan-to-value ratio for borrowers with credit scores between 500 and 579 is limited to 90 percent. In 2011, FHA removed eligibility for loans with investor property.[3] In 2012, FHA modified documentation requirements for self-employed borrowers. Starting from April 1, 2012, profit-loss and balance sheets of these self-employed borrowers have been required in most cases.[4] Also for the purpose of identity-of-interest transactions, the family member definition was expanded to include the extended family, including brothers, sisters, uncles, and aunts.

2. Changes to the Homeownership Counseling Discount

Another focus of the 1998 revisions was homeownership counseling. Previously, first-time homebuyers receiving counseling were eligible for a reduced upfront FHA insurance premium. While FHA permitted HUD-approved homeownership counseling programs, unacceptable practices were observed, such as borrowers simply being asked to complete homeownership workbooks without any additional interaction with the counseling program. The new rule required that the type of homeownership counseling obtained by first-time homebuyers must be examined by FHA's quality assurance staff as part of its regular reviews of lenders. FHA required that counseling be delivered in a classroom setting, face-to-face or via electronic media, and involve 15 to 20 hours of instruction. When the upfront premium was reduced in 2001 for all FHA borrowers, there was no longer a separate discount for borrowers who went through homeownership counseling programs. The discount is only required by law if FHA charges the maximum upfront premium.

3. Automated Underwriting Systems

In 1998, FHA approved Freddie Mac's Loan Prospector for underwriting FHA-insured mortgages. FHA also made a substantial number of revisions to its credit policies and reduced

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[1] Mortgagee Letter 2008-23, September 5, 2008: Revised Downpayment and Maximum Mortgage Requirements.

[2] Mortgagee Letter 2010-29, September 3, 2010: Minimum Credit Scores and Loan-to-Value Ratios.

[3] HUD 4155.1, Section B. Property Ownership Requirements and Restrictions. 4155.1 4.B.1.a: Occupancy Restrictions

[4] Mortgagee Letter 2012-03, February 28, 2012: Miscellaneous Underwriting Issues.

documentation requirements for loans assessed by Loan Prospector. This was the first time that FHA incorporated an automated underwriting system (AUS) in its insurance endorsement process. Fannie Mae's Desktop Underwriter and PMI Mortgage Services' pmiAURA were approved to underwrite FHA mortgages in 1999, followed soon thereafter by Countrywide Funding Corporation's CLUES and JP Morgan-Chase's Zippy. Beginning in May 2004, all approved AUSs applied FHA's Technology-Open-To-Approved-Lenders (TOTAL) mortgage scorecard to evaluate loan applications for possible automated approval for FHA insurance. Initially, more than two-thirds of loans submitted generally received automated approval, eliminating the need for manual underwriting reviews. Since May 2004, HUD required lenders to submit borrower credit scores. Starting from July 2008, all loans must be submitted through FHA's TOTAL scorecard.

4. Changes in Mortgage Insurance Premiums

In response to the FY 2009 estimate that the capital ratio had fallen below the statutory two percent level, FHA made several changes to the mortgage insurance premium structure. Effective for the loans endorsed after April 5, 2010, FHA increased the upfront mortgage insurance premium from 1.75 percent to 2.25 percent.[5]

On Aug 12, 2010, Public Law 111-229 provided the Secretary of HUD with additional flexibility regarding the mortgage insurance premiums for FHA loans. Specifically, the law increased the upper limit of annual mortgage insurance premiums. Starting October 4, 2010, the upfront premium was reduced to 1.00 percent for all mortgage types, while the annual premium for loans with 30-year terms was increased to 85 basis points for LTV ratios less than or equal to 95 percent, and to 90 basis points for LTV ratios exceeding 95 percent. For loans with 15-year terms, an annual premium of 25 basis points was charged on loans with LTVs higher than 90 percent.[6] The annual insurance premium was further increased by another 25 basis points for all loans starting April 18, 2011.[7] On December 23, 2011, the President signed into law the Temporary Payroll Tax Cut Continuation Act of 2011 (Public Law 112-78), which included a provision that required FHA to increase the annual MIP it collects by an additional 10 basis points. This change was effective for case numbers assigned on or after April 9, 2012.[8] For loans exceeding $625,000, an extra 25 bps annual MIP was added starting June 11, 2012. The up-front premium was increased from 1 percent to 1.75 percent starting April 9, 2012. Certain exceptions

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[5] Mortgagee Letter 2010-02, January 21, 2010: Increase in Upfront Premiums for FHA Mortgage Insurance.
[6] Mortgagee Letter 2010-28, September 1, 2010: Changes to FHA Mortgage Insurance Premiums.
[7] Mortgagee Letter 2011-10, February 14, 2011: Annual Mortgage Insurance Premium Changes and Guidance on Case Numbers.
[8] Mortgage Letter 2012-04, March 6, 2012: Single Family Mortgage Insurance: Annual and Up-Front Mortgage Insurance Premium-Changes.

were made for streamline refinance loans if the original FHA loan was endorsed on or before May 31, 2009 and starting with loan applications taken on June 11, 2012.

Under Public Law 111-229 (1)(b), FHA adjusted its annual MIP rates effective from April 1, 2013.[9] The annual premium for loans with 30-year terms and base loan amount below $625,500 was increased to 130 bps for LTV ratios up to 95 percent, and to 135 bps for LTV ratios greater than 95 percent. The annual premium for 30-year loans with base loan amount above $625,500 was increased to 150 bps for LTV ratios up to 95 percent, and to 155 bps for LTV ratios greater than 95 percent. For loans with 15-year terms and base loan amount below $625,500, the annual premium was increased to 45 bps for LTV ratios up to 90 percent, and to 70 bps for LTV ratios greater than 90 percent; for 15-year loans with base loan amount above $625,500, the annual premium was increased to 70 bps for LTV ratios up to 90 percent, and to 95 bps for LTV ratios greater than 90 percent. This increase was effective for all forward mortgages except single family forward streamline refinance transactions that refinance existing FHA loans that were endorsed on or before May 31, 2009. Effective on June 3, 2013, FHA eliminated the cancellation of annual MIP for loans with an LTV less than or equal to 78 percent and with terms up to 15 years. The annual MIP becomes 45 bps for loans with 15-year terms and with LTV $\leq$ 78%, if their case numbers is assigned on or after June 3, 2013. In addition, the new duration of annual MIP for loans with an LTV up to 90 percent is 11 years, and it is for the life of the loan for LTV greater than 90 percent.

5. FHA Single-Family Loan Limits

In early March 2008, FHA announced a temporary loan limit increase as a result of the enactment of the Economic Stimulus Act of 2008 (ESA). The ESA provided that the mortgage limit for any given area shall be set at 125 percent of the median house price in that area, except that the FHA mortgage limit in any given area can neither exceed 175 percent of the 2008 Government Sponsored Enterprise (GSE)[10] conforming loan limit of $417,000, nor be lower than 65 percent of the same 2008 GSE conforming loan limit for a single-family, one-unit residence. FHA's single-family national loan limit ceiling for 2008 was revised to $729,750. These loan limit increases were effective for mortgages endorsed for FHA insurance on or after March 6, 2008.[11]

Under HERA, the Federal Housing Finance Agency (FHFA) was established and directed to set GSE conforming loan limits each year for the nation as a whole, as well as for high-cost areas. HERA stipulated that the national loan limit for the GSEs during 2009 should remain at

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[9] Mortgagee Letter 2013-04, January 31, 2013: Revision of Federal Housing Administration (FHA) policies concerning cancellation of the annual Mortgage Insurance Premium (MIP) and increase to the annual MIP.
[10] The GSEs are Fannie Mae, Freddie Mac, and the Federal Home Loan Banks.
[11] Mortgagee Letter 2008-06, March 6, 2008, Temporary Loan Limit Increase for FHA.

$417,000. Effective January 1, 2009, and per HERA the FHA mortgage limit for any given area was set at 115 percent of the area median house price, with a ceiling of 150 percent of the GSE conforming loan limit, or $625,000.[12]

In February 2009, the FHA single-family loan limits changed as a result of the American Recovery and Reinvestment Act of 2009 (ARRA, February 17, 2009). Those limits were effective for loans with credit approved in calendar year 2009.[13] Under ARRA, the revised FHA loan limits for 2009 were set at the higher of the loan limits established for 2008 under ESA and those established for 2009 under HERA.

Under the authority of the Continuing Appropriations Act 2011, Public Law 111-242, the loan limits authorized by ARRA were extended to the end of FY 2011.[14] Since both the ESA and HERA set the FHA national loan limit floor at 65 percent, the FHA loan limit floor also remained at the FY 2009 level, $271,050. For the FHA national loan limit ceiling, the limit based on ESA (175 percent) was higher than that based on HERA (150 percent), and the national loan limit ceiling was set at $729,750, which was again the same as in the previous year. Between October 1st, 2011, and November 18th, 2011, the national loan limit was reduced to $625,500, which was the same as the GSE's national limit.[15] The national loan limit for loans endorsed after November 18th, 2011 reverted to $729,750, which was higher than Fannie Mae's and Freddie Mac's conforming loan limit.[16]

6. Concentration of Loans with Downpayment Assistance in Recent Books

Non-profit-organization-assisted mortgages represented over twenty percent of the entire FY 2005, FY 2006, and FY 2007 books of business, and the percentage still exceeded fifteen percent in FY 2008. The prevailing FHA guidelines allowed such borrowers to use outright gifts of cash as downpayment assistance.[17] A 2005 report by the Government Accountability Office (GAO) documented that many downpayment gifts provided by non-profit organizations were contributed by the home sellers involved in the specific transactions, and possibly through

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[12] Mortgagee Letter 2008-36, November 7, 2008, 2009 FHA Maximum Mortgage Limits.

[13] Mortgagee Letter 2009-07, February 24, 2009 Loan Limit Increases for FHA.

[14] Mortgagee Letter 2010-40, December 1, 2010: 2011 FHA Maximum Loan Limits.

[15] Mortgagee Letter 2011-29, August 19, 2011: Federal Housing Administration's (FHA) Maximum Loan Limits Effective October 1, 2011 through December 31, 2011.

[16] Mortgagee Letter 2011-39, December 2, 2011: Federal Housing Administration Maximum Loan Limits Effective October 1, 2011 through December 31, 2012

[17] Eligible gift sources included: relatives, employers or labor unions, tax-exempt charitable organizations, governmental agencies, public entities that have programs to provide homeownership assistance to low- and moderate-income families or first-time homebuyers, or close friends with a clearly defined and documented interest in the borrower.

financing based on inflated house prices.[18] The Passage of HERA on July 30, 2008 officially terminated the eligibility of loans with seller-funded downpayment assistance for FHA endorsements. Subsequently, the origination volume of such loans diminished rapidly and new endorsements with non-profit gifts have been virtually non-existent since the second quarter of FY 2009. The elimination of seller-financed downpayment assistance has had and will continue to have a significant effect in reducing losses on future FHA books.

7. Foreclosure Avoidance and Loss Mitigation Program

One of the consequences of the severe housing recession has been the incidence of high foreclosure rates. FHA took actions to help families avoid foreclosure through loan modifications and partial claim initiatives, as well as default counseling provided by HUD-approved counseling agencies.

Since its introduction as a national program in 1994,[19] the pre-foreclosure sale (PFS) program has allowed mortgagors in default to sell their homes and use the sales proceeds in satisfaction of their mortgage debt even when the proceeds are less than the amount owed.[20] This approach has the benefit of reducing the total credit costs to FHA.

In 1996, as FHA terminated the loan assignment program, it also issued a series of initiatives to encourage servicers to apply various loss mitigation tools to avoid foreclosure.[21] This approach proved to be an effective way of keeping financially stressed borrowers in their homes and reducing credit losses. The implementation of loss mitigation tools ramped up quickly and became a significant part of FHA's risk management practices by FY 2002.

On May 20, 2009, President Obama signed into law the Helping Families Save Their Homes Act of 2009. The law permitted FHA lenders to offer families more substantial loan modifications and provided FHA with additional loss mitigation authority to assist FHA borrowers under the umbrella of the Home Affordable Modification Program (HAMP). Mortgagee letter 2009-23, effective August 15, 2009, announced an FHA Loss Mitigation option, or FHA-Home Affordable Modification Program (FHA-HAMP). FHA-HAMP provided opportunities to reduce mortgage payments of delinquent borrowers to sustainable levels. This program was designed to

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[18] "Mortgage Finance Additional Action Needed to Manage Risks of FHA-Insured Loans with Downpayment Assistance," Government Accountability Office, November 2005.
[19] The regulations for the PFS Program are codified in 24 CFR 203.370.
[20] Mortgagee Letter 2008-43, December 24, 2008, Utilizing the PFS Loss Mitigation Option.
[21] Mortgagee Letter 96-25, May 8, 1996, Existing Alternatives to Foreclosure – Loss Mitigation; Mortgagee Letter 96-23, June 28, 1996, Loss Mitigation – Mortgage Modification; Mortgagee Letter 96-61, November 12, 1996, FHA Loss Mitigation Procedures – Special Instruction.

help FHA borrowers already in default or at "imminent" risk of default with opportunities to reduce payments by loan modification with principal deferment.

On March 26, 2010, HUD and the Department of the Treasury announced enhancements to the existing Making Home Affordable Program (MHA) and FHA refinance program that may give a greater number of responsible borrowers an opportunity to remain in their homes.[22] These enhancements were designed to maintain homeownership by providing borrowers, who owe more on their mortgage than the value of their home, opportunities to refinance into an affordable FHA loan. This opportunity allows borrowers who are current on their conventional mortgage to qualify for an FHA refinance loan, provided that the lender or investor writes down the unpaid principal balance of the original first-lien mortgage by at least 10 percent and borrower payment ratios meet program requirements.

On August 15, 2011, FHA issued servicing guidelines requiring trial payment plans for loan modification and partial claim actions.[23] Loans with certain high-risk characteristics are required to complete a minimum of a three-month trial period before a permanent standard modification and/or partial claim can be granted.

In 2013, FHA also extended its PFS eligibility for delinquent loans. Compared to the previous guideline in ML 2008-43,[24] the new PFS guideline in ML 2013-23[25] has less restrictive eligibility criteria for PFS approval, regarding to non-owner occupied homes. In ML 2008-43, the subject properties must have not been rental homes for more than 18 months prior to PFS acceptance. In ML 2013-23, all non-owner-occupants with more than 90 days delinquent and credit score less than 620 are qualified for streamlined PFS. Also the consideration fee was increased from $1,000 to $3,000 to give borrowers more incentive to take this program.

In November 2011, under a pilot program, FHA started allowing Third Party Sale (TPS) auctions as an alternative to REO disposition. The pilot program was expanded into a national program in 2013. By the end of May 2013, nine major national lenders signed into the implementation of the TPS program. Conceptually, a TPS execution could help reduce loss severity by avoiding the additional carrying and disposition costs in an otherwise identical REO case.

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[22] Mortgagee Letter 2010-23, August 6, 2010, FHA Refinance of Borrowers in Negative Equity Positions.

[23] Mortgagee Letter 2011-28, August 15, 2011, Trial Payment Plan for Loan Modifications and Partial Claims under Federal Housing Administration's Loss Mitigation Program.

[24] Mortgage Letter 2008-43, December 24, 2008, Pre-Foreclosure Sale (PFS) Program - - Utilizing the PFS Loss Mitigation Option to Assist Families Facing Foreclosure.

[25] Mortgage Letter 2013-23, July 9, 2013, Updated Pre-Foreclosure Sale (PFS) and Deed in Lieu (DIL) of Foreclosure Requirements

Starting from 2009, FHA has aggressively engaged in loan modification program, including rate reduction, term extension, and principal forbearance, in addition to traditional repayment plan. The post modification data has been included in the loan status transition model to accurately capture the future behavior for modified loans.

C. Current and Future Market Environment

1. Interest Rates

Due to the current weak economy and the Fed's active monetary policies, the one-year Treasury rate has fallen to a historically low level: from 2.18 percent in August 2008 to 0.23 percent in July 2013. Similarly, the ten-year Treasury yield also declined from 3.59 percent in August 2009 to 2.39 percent in July 2013. The average conventional 30-year fixed-rate mortgage commitment rate posted by Freddie Mac also declined from 5.19 percent in August 2009 and to 3.91 percent in July 2013. These realized 2013 rates are lower than those projected in last year's Review.

Moody's July 2013 economic forecast projected that future mortgage rates will steadily rise to 6.53 percent by Calendar Year (CY) 2016Q2, and then stabilize around 5.90 percent afterward. The one-year Treasury rate was projected to rise to 3.87 percent by CY 2017Q3, and the ten-year Treasury rate was projected to rise to 5.02 percent by CY 2016Q3. Moody's July 2013 forecasted rates for the one-year Treasury rate, the ten-year Treasury rate and mortgage rates are generally lower than those in the June 2012 forecast.

Exhibit I-1 shows forecasts of the 10-year Treasury rate used in this year and in the prior year Reviews. As mentioned, the realized 10-year Treasury rates during the past year turned out to be much lower than what were forecasted in the previous year. This is likely due to the persistent economic recession and the extension of quantitative easing policies of the Federal Reserve.

Exhibit I-1: 10-Year Treasury Rate Forecasts for the Current and Prior Review
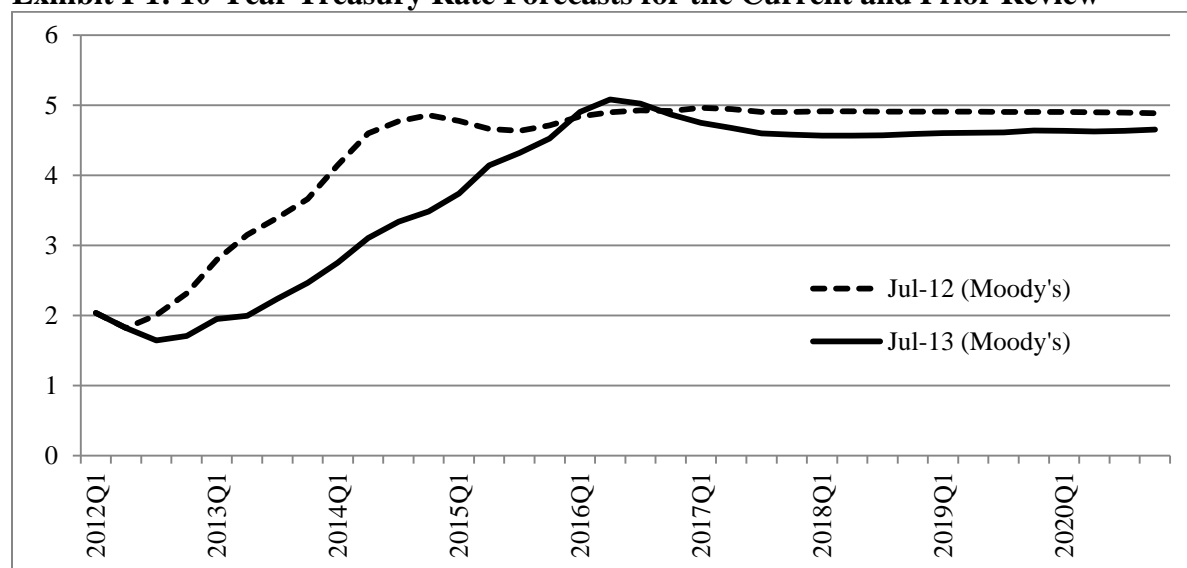
2. House Price Growth Rates

Federal Housing Finance Agency (FHFA) published the Purchase-Only (PO) Home Price Index of 75 MSAs for the first time in 2013. This allowed us to replace the all-transaction HPI which was used in previous Reviews. The PO Index is based on repeat sales of actual housing sale prices and does not involve any appraised values. As such it provides a more direct and accurate measure of housing market conditions.

Moody's forecasts the PO HPI at the local level, including metropolitan areas and states. Moody's publishes its forecasting methodology and provides a description of the rationale behind their assumptions. In addition to their baseline forecast, Moody's also provides alternative scenarios, one of which we used in Section V.

Exhibit I-2 presents the July 2013 Moody's baseline national house price growth rate forecast as compared to the one used in the 2012 Review. According to this year's forecast, the annualized national house price growth rate during the remainder of CY 2013 is 5.31 percent and is 5.00 percent through the first quarter of CY 2015. Then the rate drops to positive 0.85 percent per annum by the second quarter of CY 2017, representing a minor recession. After that, the house price growth rate gradually rises to a long-run average annual rate of around 3.50 percent.

The Exhibit also shows the difference between the all-transaction house price index used for last year's Review and the PO index for this year's Review. We show the prior actual values of each

series up to the respective forecasted values. Compared with the all-transaction house price index, the PO index shows a deeper drop during the 2008 recession and a stronger recovery since 2011. Even though a recession is forecasted in this year's Review for CYs 2016-2017, the average growth rate over the forecast horizon is now 3.5 percent, compared with last year's 3.4 percent.

Importantly, the below exhibit shows the upward trend for the nation's housing market over the past year, which has been well documented in other major house price indices, such as Case-Shiller and CoreLogic.[26]

Exhibit I-2: House Price Appreciation Forecasts for FY 2012 and FY 2013

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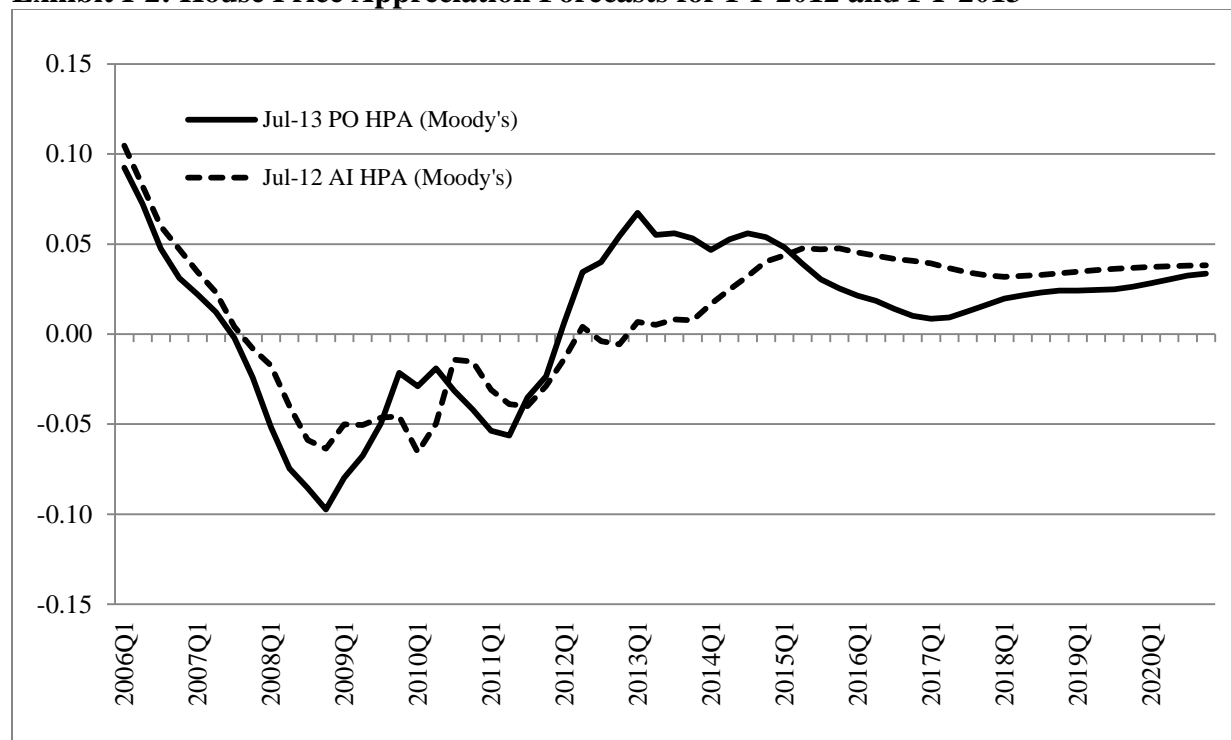
[26] The baseline house price forecast used by the Actuarial Review shifted from Global Insights to Moody's Analytics in 2010. The switch was made especially to capture the MSA-level house price forecasts available only by Moody's Analytics at that time. The upward trend is documented by the Case-Shiller and CoreLogic indexes in the chart "Three House Price Measures Compared" in the report
http://www.moodysanalytics.com/~/media/Brochures/Economic-Consumer-Credit-Analytics/brochures/case-shiller.ashx.

3. Mortgage Demand

FHA's market share has increased dramatically from its low of 2.04 percent in FY 2007. Before that time, FHA's market share declined in concert with the expansion of the subprime mortgage market (2003-2007). Upon the financial crisis of 2008, capital left the subprime mortgage market. Private mortgage insurers also became capital-constrained after facing heavy losses. Thus, FHA had become the primary source for high-LTV lending, with a share of 15 percent to 16 percent of the entire single-family first-lien mortgage market in fiscal year 2011 and 2012. Origination volume during FY 2009 reached a record high of $330 billion, up from $176 billion in FY 2008. The FY 2010 volume was $295 billion and the volume for FY 2011 was $214 billion, while FY 2012 continued to be a high volume year with $218 billion. The estimate for FY 2013 volume is $241 billion, due primarily to the record low mortgage rate in first half of this year.[27] The origination volume in the last fiscal quarter dropped significantly, as the mortgage rate increased rapidly during the summer.

Any forecast of future FHA endorsement volumes depends critically on what the future holds for conventional mortgage lenders, private mortgage insurers, and Fannie Mae and Freddie Mac. If these institutions reestablish their prior roles and levels in the markets, FHA market share would likely revert to its historical norm of around 8 to 10 percent. With an assumed prolonged impairment of the role of other mortgage market institutions, we project the FHA market share to settle in around 15 percent of the total single-family mortgage market.

Moody's July 2013 baseline scenario projects positive near-term house price growth at the national level and a near-term rapid rise in mortgage rates. These factors lead us to estimate a reduction of FHA volume to $191 billion in FY 2014. We then expect FHA endorsement volume to revert to the $137 billion range for FY 2015 and beyond, given Moody's baseline scenario for the economy and the housing market.

D. Structure of this Report

We again emphasize that the results reported in this Review pertain to the MMI Fund performance excluding HECMs.

The remainder of this report is divided into the following sections:

Section II. Summary of Findings and Comparison with FY 2012 Actuarial Review – presents the Fund's estimated economic value and insurance-in-force for FY 2013 through

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[27]Based on FHA data warehouse as of the end of August 2013.

FY 2020. This section also provides a reconciliation and explanation of the major differences between the FY 2012 and FY 2013 Reviews.

Section III. Current Status of the MMI Fund – presents the estimated economic value and IIF for the Fund at the end of FY 2013 and provides an analysis of the performance of the FY 1983 through FY 2013 books of business.

Section IV. Characteristics of the Fiscal Year 2013 Insurance Portfolio – describes the FY 2013 insurance portfolio and compares the risk characteristics of the origination books of business across historical fiscal years.

Section V. Fund Performance under Alternative Scenarios – presents analyses of the Fund performance using a range of alternative economic environments.

Section VI. Summary of Methodology – presents an overview of the econometric and cash flow models used in the Review.

Section VII. Qualifications and Limitations – describes the main assumptions and the limitations of the data and models relevant to the results presented in this Review.

Section VIII. Conclusions – provides a summary of the report's results and the conclusions we draw from those results.

Appendix A. Econometric Analysis of Mortgage Status Transitions and Terminations – provides a technical description of our econometric models of claim and prepayment for individual mortgage product types.

Appendix B. Cash Flow Analysis – provides a technical description of our cash flow model.

Appendix C. Data for Loan Performance Simulations – explains the procedures used to transform the raw data into the data used to simulate future mortgage and Fund performance.

Appendix D. Economic Forecasts – describes the forecast of future economic factors that affect the performance of the Fund and the alternative economic scenarios underlying the selected sensitivity analyses.

Appendix E. Loss Severity Model – provides a technical description of our econometric model of FHA mortgage loss severity rates.

Appendix F. FHA Volume Model – explains our econometric model used to project future FHA loan volumes.

Appendix G. Stochastic Simulation – provides a technical description of the econometric model developed to project house price appreciation, interest rate changes and unemployment rate changes into the future.

Appendix H. Historical and Projected Loan Termination Rates – contains historical and projected claim and prepayment rates.

Section II: Summary of Findings and Comparison with FY 2012 Actuarial Review

This section presents the economic value and insurance-in-force of the Fund for FY 2013 and provides an explanation of how the economic value of this year's Review compares with that of the FY 2012 Review.[28]

A. The FY 2013 Actuarial Review

The FY 2013 Actuarial Review estimates the economic value of the Fund as of the end of FY 2013 (September 30, 2013) and projects the status of the Fund through FY 2020. The objectives of our analysis include:

- Evaluating the historical experience of the Fund, including loan termination experience due to claims and prepayments, and losses associated with claims;

- Projecting future loan termination rates and their corresponding cash flows of the existing Fund portfolio and of future books of business; and

- Estimating the economic value and the insurance-in-force of the Fund.

We conducted this Review by analyzing the historical loan performance using data provided by FHA, developing econometric models and estimating their parameters and making forecasts of future economic conditions. Econometric models were used to project the future cash flows of the Fund, and their present value was combined with estimates of capital resources to estimate the economic value of the Fund.

The econometric models are similar in many respects to those of the FY 2012 Review, but with some enhancements implemented for the current Review. These enhancements included:

- Dynamic simulation of future mortgage loan behavior: instead of carrying transition probabilities forward, we currently simulate the loan's transition incidence, which replicates path-dependent behavior. Dynamic simulation actively tracks the status of each loan along each simulation path, and provides much more modeling flexibility, which enhances simulation accuracy.

- Transition Model improvements: we added loan modification variables to differentiate the future behavior between self-cured loans and loans cured through modification

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[28] The Fund in this Review refers to the MMI Fund excluding HECMs.

programs. We also introduced several path-dependent variables, such as the time since last default and the time spent in a default episode, to improve model accuracy.

- The Federal Housing Finance Agency (FHFA) released the Purchase-Only (PO) Home Price Index (HPI) of 75 MSAs for the first time in 2013. Meanwhile, Moody's Analytics published forecasts of the national and local indices. This allowed us to replace the all-transaction HPI which was used in previous Reviews. The PO Index is based on repeat sales of actual housing sale prices and does not involve any appraised values. As such it provides a more direct and accurate measure of housing market conditions.

The estimation of the loan status transition models utilizes loan-level data on the Fund's experience recorded by HUD since FY 1996 and extending through the second quarter of FY 2013. The performance of the loans during the recent housing recession enabled us to refine the econometric estimation results, especially for the most-stressed locations.

Appendices A through H describe the individual models, the assumptions used, and the econometric results in detail. Our main findings are as follows:

- As of the end of FY 2013, the Fund is projected to have an estimated economic value of *negative* **$7.87 billion**, an unamortized insurance-in-force of **$1,173.04 billion**, and an amortized insurance-in-force of $**1,090.48 billion**.

- The FY 2013 book of business is projected to contribute an estimated $**14.30 billion** in present value to the economic value of the Fund.

Our current projections indicate that the Fund's economic value will increase in the future, rising by an average of $13.25 billion per year through FY 2020. With the expected slower prepayment rates of the existing books of business caused by the rapidly rising projected interest rates, the continuation of a higher than historical average (1995-2008) FHA share in home purchase mortgage market and a strong housing market recovery, the unamortized IIF is expected to increase by an average rate of 3.92 percent per year through FY 2020. The economic value is expected to grow at a substantially faster rate than that of the IIF. Exhibit II-1 provides estimates of the Fund's economic value and IIF through the end of FY 2020. In summary, the economic value is projected to steadily increase over the next 7 years to reach $84.87 billion by the end of FY 2020.

Exhibit II-1: Projected Fund Performance for FY 2013 to FY 2020 ($Millions)

Fiscal Year	Economic Value of the Fund[a]	Unamor- tized Insurance in Force[b]	Amortized Insurance in Force[b]	Economic Value of Each New Book of Business	Volume of New Endorse -ments[c]	Investment Earnings on Fund Balances
2013	-7,871	1,173,038	1,090,482	14,304	241,195	
2014	7,838	1,266,026	1,166,530	15,725	190,977	-16
2015	18,711	1,313,592	1,195,266	10,842	136,615	31
2016	29,696	1,355,513	1,219,277	10,787	138,704	198
2017	42,283	1,392,485	1,238,942	12,023	148,027	564
2018	56,033	1,436,408	1,264,467	12,647	156,002	1,104
2019	70,262	1,483,728	1,291,881	12,606	158,104	1,623
2020	84,866	1,535,564	1,322,615	12,464	162,608	2,140

[a] All values are as of the end of each fiscal year. The economic value for FY 2013 through FY 2020 is equal to the economic value of the Fund at the end of the previous year, plus the current year's interest earned on the previous Fund economic value, plus the economic value of the new book of business.
[b] Estimated based on the data extract as of June 30, 2013 and projections of new endorsements and loan performance.
[c] Based on our volume forecast.

B. Change in the Economic Value of the Fund

Exhibit II-2 displays the components leading to our estimate of the Fund's current economic value, with comparisons between values in the FY 2012 and FY 2013 Reviews. The FY 2012 Review estimated that the Fund had *negative* $13.48 billion in economic value at the end of FY 2012.

FHA estimated that the Fund has total capital resources of $20.56 billion at the end of FY 2013. The present value of future cash flows is estimated to be *negative* $28.43 billion. Thus, as of the end of FY 2013, the Fund is estimated to have an economic value of *negative* $7.87 billion.

Exhibit II-2: Estimate of Fund Economic Value as of the End of FY 2013 ($ Millions)

Item	End of FY 2012[a]	End of FY 2013
Cash	$33,348	
Investments	2,770	
Properties and Mortgages	2,065	
Other Assets and Receivables	14	
Total Assets	$38,197	
Liabilities	(9,098)	
Total Capital Resources	$29,099	
Net Gain from Investments		939 [b]
Net Insurance Income in FY 2013		(6,368)[c]
Net Change in Properties and Mortgages		670[b]
Net Change in Accounts Payable		485[b]
Transfer to HECM Financing Account		(4,263)[b]
Total Capital Resources		**20,561**
PV of Future Cash Flows on Outstanding Business		(28,432)
Economic Value	**$ (13,478)[d]**	**(7,871)**
Unamortized Insurance-In-Force	1,126,267[d]	1,173,038
Amortized Insurance-In-Force	1,053,329[d]	1,090,482

[a] Source: Audited Financial Statements for FY 2012.
[b] Estimated based on unaudited investment income provided by FHA.
[c] Estimated based on unaudited net non-HECM operating cash flow through end of July 2013 provided by FHA and FHA-projected net cash flow for the remaining two months.
[d] From the FY 2012 Actuarial Review.

As seen in Exhibit II-2, the estimated FY 2013 economic value of the Fund increased by $5.61 billion from the FY 2012 level of *negative* $13.48 billion to *negative* $7.87 billion. The IIF increased by 4.15 percent − from $1,126.27 billion to $1,173.04 billion. The change in the estimated economic value represents the net impact of several significant factors, which are described in detail below.

C. Sources of Change from the FY 2012 Review to the FY 2013 Review

This section describes the sources of change in estimates of economic value between this year's Review and last year's Review for FY 2013 and FY 2019. Separating out the specific impacts of interrelated approaches and assumptions can be done only up to a certain degree of accuracy. The interdependency among the various components of the analysis prevents us from identifying

and analyzing these as purely independent effects. Furthermore, the order in which we do the analysis affects the results. With these caveats, this section presents an approximate decomposition of differences in the FY 2013 and FY 2019 economic values from those presented in the FY 2012 Review, by source of change.

1. Change in Economic Value from FY 2012 to FY 2013

The FY 2012 Review estimated the economic value of the Fund as of the end of FY 2012 to be *negative* $13.48 billion, and the projected FY 2019 economic value to be $54.25 billion. In this Review, we estimate the end-of-FY 2013 economic value for the Fund to be *negative* $7.87 billion, which represents an increase of $5.61 billion from the FY 2012 economic value reported in the FY 2012 Review.

2. Current Estimate of FY 2013 Economic Value Compared with the Estimate Presented in the FY 2012 Actuarial Review

The FY 2012 Review projected that the FY 2013 investment earnings on Fund balances and the present value of the FY 2013 book of business would add *negative* $0.10 billion and positive $10.99 billion, respectively, to the economic value of the Fund, resulting in a projected FY 2013 economic value of *negative* $2.59 billion. As shown in Exhibit II-2, with the updated financial statements and data extract we now observe the end-of-FY 2012 capital resources to be $29.10 billion and estimate net insurance income in FY 2013 in FY 2013 to be *negative* $6.37 billion, thus the estimated end-of-FY 2013 capital resources is $20.56 billion. Details on the net income in FY 2013 are provided in Section III of this Review. Combining this estimate of capital resources with the estimated present value of future cash flows of the outstanding portfolio of *negative* $28.43 billion, this year's estimate of the FY 2013 economic value is *negative* $7.87 billion. Thus, this year's estimate of the FY 2013 economic value is $5.28 billion lower than the economic value of *negative* $2.59 billion projected for FY 2013 in last year's Review, as shown in Exhibit II-3.

Exhibit II-3 also provides a summary of the decomposition of changes in the current economic value of the Fund as of the end of FYs 2013 and 2019 from the FY 2012 Review as compared to the FY 2013 Review. The overall net change in economic value, reflecting several offsetting factors, is positive for FY 2013 and negative for FY 2019.

Exhibit II-3: Changes in Fund Estimated Economic Value Between FY 2012 and 2013 ($ Millions)

	Change in FY 2013 Economic Value	FY 2013 Economic Value[a]	Change in FY 2019 Economic Value	Corresponding FY 2019 Economic Value[b]
FY 2012 Economic Value Presented in the FY 2012 Review		-13,478		
FY 2013 Economic Value Presented in the FY 2012 Review, Excluding the FY 2013 Book of Business:	-95	-13,573		
Plus: Forecasted Economic Value of the FY 2013 Book of Business Presented in the FY 2012 Review	10,987			
Equals: FY 2013 Economic Value Presented in the FY 2012 Actuarial Review		-2,585		54,251
Plus: a. Fund Transfer to HECM Financing Account	-4,263	-6,848	-5,036	49,214
Plus: b. Update volume of FY 2012-2013 books	1,080	-5,768	1,276	50,491
Plus: c. Update discount factors	-367	-6,135	-1,080	49,411
Plus: d. Update actual performance in FY2012-FY2013	2,821	-3,315	3,084	52,495
Plus: e. Update econometric models	2,113	-1,202	-1,213	51,282
Plus: f. Update interest rate forecast	-4,402	-5,604	-3,915	47,367
Plus: g. Update house price growth rate forecast	-3,983	-9,586	-7,603	39,764
Plus: h. Incorporate changes of mortgage insurance premium schedule	483	-9,103	28,323	68,087
Plus: i. Adjustment for inventory of delayed claims	-823	-9,926	-949	67,138
Plus: j. Adjustment for 2013 third party sale policy	2,055	-7,871	3,124	70,262
Equals: Estimate of Economic Value	**-5,285**	**-7,871**	**16,011**	**70,262**

[a] Shows the progression of economic values as of the end of FY 2013 as incremental changes are made.
[b] The FY 2019 economic values are the latest year that can be directly compared between the FY 2012 and FY 2013 Reviews.

3. Decomposition of the Differences in Economic Value of the Current Review versus the FY 2012 Review

We now present a step-by-step analysis of the differences between the FY 2012 and FY 2013

Reviews, shown in Exhibit II-3.

a. Fund Transfer to HECM Financing Account

In 2013, FHA made a transfer of $4.26 billion to HECM financing account. This change lowers the FY 2013 economic value by the corresponding amount, and lowers the FY 2019 economic value by $5.04 billion due to compounding interest.

b. Update Origination Volume of FY 2012 and FY 2013

The second component of change depicted in Exhibit II-3 relates to the updated origination volume and composition for the FY 2012 and FY 2013 books of business. The actual realized origination volume of the FY 2012 book and updated estimate of the FY 2013 book as of September 2013 are larger than what were projected in last year's Review. The greater realized volume caused an increase of $1.08 billion in the estimated FY 2013 economic value. The projected economic value due to the updated volume and composition projections through FY 2019 were also higher by $1.28 billion.

c. Update FY 2013 Discount Factors

The Office of Management and Budget (OMB) discount factors are used to discount the projected cash flows to their present values. The OMB FY 2014 discount factors continue to reflect a low interest rate environment. Updating the discounting factors caused the estimated FY 2013 economic value to decrease by $0.37 billion, due to the front-loaded claim losses in the past books. The estimated FY 2019 economic value decreased by $1.08 billion, mainly due to the lower reinvestment return from the Fund.

d. Update actual performance in FY2012-FY2013

The projected economic value change in 2013 and 2019 due to the update of actual performance in FY2012 and FY2013 was $2.82 billion and $ 3.08 billion, respectively. This was mainly due to the continued delay of claims from large inventory of foreclosed properties, causing realized claim loss to be lower than what was projected in 2012.

e. Update Econometric Models

As a result of our continuing effort to improve the accuracy of the analysis, several model enhancements were implemented this year. The major model changes included: (1) model structure update, (2) addition of new explanatory variables, (3) new specifications of existing variables, (4) loss severity and (5) volume forecast.

The change in the transition models was to separate the re-performing loan population into self-cured loans and modified loans. The modified loans incorporate their payment reductions in future transitions.

We added the following new variables into the transition models:
- Switching from All-Inclusive HPI to Purchase-Only HPI
- Loan modification flag
- Magnitude of payment reduction from modification
- Magnitude of FHA Refinance incentive
- Magnitude of GSE Refinance incentive
- Time since last default episode
- Time in default episode

For the following existing variables, we changed the specification from categorical to linear or spline functions:
- Borrower credit score
- Mortgage spread
- Yield curve slope
- Prepayment burnout factor
- Probability of negative equity

For details about these model enhancements, refer to Appendices A, E, and F.

The modeling changes led to an increase in estimated economic value in FY 2013 by $2.11 billion, and a decrease in estimated economic value of $1.21 billion in FY 2019. The added variables "loan modification flag" and "payment reduction from modification" in our model enabled more accurate loan performance forecast of the loan modification population in the future. Loss severity models are also updated with more recent data, which show an increasing use of alternative disposition methods than REO sales. This trend also helps to explain the increase in the economic value of FY 2013. The drop in the FY 2019 value is mainly driven by the decreasing share of FHA mortgages in future years.

f. Updated Economic Forecasts – Interest Rates

The mortgage interest rate continued to drop to historical lows after the summer of 2012. This is opposite to Moody's July 2012 forecast, where the interest rates were forecasted to rise sharply after FY 2012 Q3. As shown in the low-interest-rate scenario analysis of the 2012 Review, an extended low interest rate environment tends to adversely impact the Fund's economic value. The change of interest rate forecast also has two negative impacts on the FHA portfolio: (1) a

lower interest rate environment would induce higher prepayments and thus reduce the future mortgage insurance premium income and (2) for borrowers having difficulty to refinance, the existing mortgage becomes a premium mortgage and the effective loan to value ratio increases. That is, when future mortgage payments of the higher coupon loan are discounted using the current lower market interest rate, the value of the loan will be higher than its unpaid balance. Thus, the higher value of the loan causes the higher effective loan to value ratio, which induces higher default rates. Combining these two reductions in FY 2013 present values, the negative effect of interest rate changes in the economic forecast caused the estimated FY 2013 economic value to decrease by $4.40 billion, and the FY 2019 economic value to decrease by $3.92 billion.

g. Update Economic Forecasts – House Price Growth Rate

For this decomposition analysis, we updated the HPI forecast from Moody's July 2012 forecast to July 2013 forecast. Moody's updated forecast showed lower house price growth rates in the long run than those of last year's forecast. There was a second housing recession between FY 2015-2017 predicted in Moody's national house price index forecast in July 2013. Also the 2013 forecast shows lower house price growth rate even after the second housing recession for an extended period, compared to last year's forecast. As a result, the impacts of these changes are a decrease of $3.98 billion in the estimated FY 2013 economic value and a decrease of $7.60 billion in the estimated FY 2019 economic value.

h. Mortgage Insurance Premium Changes in FY 2013

In addition to the mortgage insurance premiums (MIPs) outlined in last year's Review, further changes have been imposed. FHA raised the annual insurance premium rates, differentiated premium between loans with initial balance above and below $625,000, and also eliminated the automatic cancelation of annual premium when the unpaid balance is reduced to 78 percent of the original house value. Details of these changes can be found in Appendix B.

The new annual mortgage premium structure led to an increase in the estimated FY 2013 economic value of $0.48 billion, and an increase in the estimated FY 2019 economic value of $28.32 billion.

i. Adjustment for Inventory of Delayed Claims

Our model projected more claims than actually occurred during the FY 2012 to FY 2013 time period. This is a consequence of the delay by servicers in the foreclosing process and in filing claims since late FY 2009 moratorium. As a result of this delayed claim phenomenon, there is an unusually large inventory of loans deep into the foreclosure process or even with complete auctions but no claims had been filed when this Review was prepared. These loans in foreclosure

process should have already been claimed by now under normal market operations. However, they continue to remain in the Fund as non-performing loans and no losses have been recorded yet. We projected the industry will accelerate the claim filing process to reduce these excessive foreclosure inventory. To reflect this effect, we identified 19,861 loans that have already been foreclosed but have not yet filed claims. We assume that all these loans will be claimed based on a state-level empirical distribution estimated from historical data, starting from 2014Q1. This state-level estimation is based on all loans that terminated between 1990Q1 to 2013Q2.[29] Please refer to Appendix B for the estimation details. Also we used a short-term error correction model to calibrate the short-term claim and prepay forecast from 2013Q3 to 2014Q1. Further adjustments from 2014Q1 to 2015Q2 were made to reflect the capacity limit in the market to process defaulting loans and file claims. These combined market calibration adjustments resulted in a $0.82 billion reduction in estimated economic value in FY 2013 and a $0.95 billion reduction in FY 2019.

j. Adjustment for 2013 Third Party Sale Policy

In November 2011, under a pilot program, FHA started allowing Third Party Sale (TPS) auctions as an alternative to REO disposition. The pilot program was expanded into a national program in 2013. By the end of May 2013, nine major national lenders signed into the implementation of the TPS program. Conceptually, a TPS execution could help reduce loss severity by avoiding the additional carrying and disposition costs in an otherwise identical REO case.

Based on the recent trend of TPS disposition, and historical experience of GSEs which have consistently held this type of program, we project that the share of TPS, as a percentage of the model projected foreclosure liquidations would increase gradually from 10 percent to 15 percent in 8 quarters, starting from 2013Q3. We further assume that TPS liquidations would have a 22.5 percent haircut in loss rate, compared to standard conveyances. Based on these assumptions, the TPS program was estimated to increase FY 2013 economic value by $2.06 billion and increase FY 2019 economic value by $3.12 billion.

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[29] Data source: FHA default episode datasets.

Section III: Current Status of the MMI Fund[30]

As of the end of FY 2013, the Fund has an estimated economic value of *negative* $7.87 billion. The estimated economic value at the end of FY 2012 was *negative* $13.48 billion. The current estimated economic value is $5.61 billion higher than what it was at the end of FY 2012, and $5.28 billion lower than the *negative* $2.59 billion economic value projected for FY 2013 in the FY 2012 Review. At the same time, the unamortized IIF of the Fund increased 4.15 percent, from $1,126.27 billion in FY 2012 to $1,173.04 billion in FY 2013.

In this section, we present an analysis of the Fund's current status. The analysis examines the status of the Fund at the end of FY 2013 and the projected future performance of new books of business through FY 2020. This section describes the basic components of the Fund's economic value and how they are expected to change through FY 2020.

A. The Current Economic Value of the Fund

According to the NAHA legislation, the economic value of the Fund is defined as the "cash available to the Fund, plus the net present value of all future cash inflows and outflows expected to result from the outstanding mortgages in the Fund." We base our estimate of this value on the level of capital resources projected for the end of FY 2013, plus the present value of expected future cash flows of the existing loan portfolio as estimated by our financial models. This year we still projected the cash flows based on a Monte Carlo simulation of 100 possible future economic scenarios that are centered on Moody's baseline economic projections. Our estimate was computed as the average economic value from each of these 100 simulated paths. See Appendix G for more details about this stochastic Monte Carlo approach.

The present value of expected future cash flows is calculated based on a financial model that uses the most current information available to estimate future cash inflows and outflows. Cash inflows include upfront and annual premiums and projected investment income. Cash outflows include net claim losses, premium refunds and loss mitigation expenses. These calculations include all cash flows that occur from the valuation date to the termination of the loan or the scheduled maturity (*e.g.*, 30 years for 30-year mortgages).

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[30] The MMI Fund in this Review refers to MMI Fund excluding HECMs.

1. Capital Resources

Capital resources are the net assets of the Fund that, if necessary, could be converted into cash to meet the Fund's obligations, including payment of claims as they arise. They are computed by subtracting total liabilities from total assets. The assets consist of cash, Treasury investments, properties and mortgages, other assets and miscellaneous receivables net of payables. Exhibit III-1 indicates that the Fund's audited capital resources at the end of FY 2012 was $29.10 billion.

The next step in estimating the capital resources as of the end of FY 2013 is to estimate the sources and uses of funds generated by the Fund so as to compute the net change in funds over the year. These include the following five factors:

(1) Net gain/loss from investment: FHA estimates a net gain of $0.94 billion for FY 2013.
(2) Net insurance cash flow for FY 2013: the net insurance cash flow was estimated by combining FHA's reported net cash flow for the period from October 2012 through July 2013 with FHA's projected August and September 2013 net cash flows. The net cash flow is computed as the sum of upfront and annual premium revenues, claim loss payments, premium refunds, and loss-mitigation-related expenses, with the last three being negative cash flows. The resulting insurance-related cash flow for FY 2013 was estimated to be *negative* $6.37 billion.
(3) The real estate owned (REO) and mortgage inventory was estimated to increase by $0.67 billion in FY 2013.
(4) An estimated net change in accounts payable of *negative* $0.49 billion.
(5) A transfer to the HECM Financing Account of $4.26 billion.

From these five factors the change in capital resources for the year is *negative* $8.54 billion. As a result, the capital resources of the Fund as of the end of FY 2013 were estimated to be $20.56 billion.

Exhibit III-1: Estimate of Fund Economic Value as of the End of FY 2013 ($ Millions)

Item	End of FY 2012[a]	End of FY 2013
Cash	$33,348	
Investments	2,770	
Properties and Mortgages	2,065	
Other Assets and Receivables	14	
Total Assets	$38,197	
Liabilities	(9,098)	
Total Capital Resources	$29,099	
Net Gain from Investments		939 [b]
Net Insurance Income in FY 2013		(6,368)[c]
Net Change in Properties and Mortgages		670[b]
Net Change in Accounts Payable		485[b]
Transfer to HECM Financing Account		(4,263)[b]
Total Capital Resources		**20,561**
PV of Future Cash Flows on Outstanding Business		(28,432)
Economic Value	**$ (13,478)[d]**	**(7,871)**
Unamortized Insurance-In-Force	1,126,267[d]	1,173,038
Amortized Insurance-In-Force	1,053,329[d]	1,090,482

[a] Source: Audited Financial Statements for FY 2012.
[b] Estimated based on unaudited financial statements for FY 2013 provided by FHA.
[c] Estimated based on unaudited net non-HECM operating cash flow through end of July 2013 provided by FHA and projected net cash flow for the remaining two months
[d] From the FY 2012 Actuarial Review.

2. Present Value of Future Cash Flows in FY 2013 and Future Years

The present value of future cash flows of the Fund is aggregated from separate estimates of the present value of future cash flows from each book of business and for each of the six major mortgage product types. Exhibit III-2 shows the present values of future cash flows for each of the six mortgage product types from the FY 1984 through the FY 2013 books of business that have survived to the end of FY 2013. The present values are computed from the projected cash flows occurring during FY 2013 and future years. They are computed by taking the average over a set of simulated economic scenarios. This exhibit is offered to facilitate comparison among books of business and mortgage types based on cash flows that have not yet been realized as of the end of FY 2013. From Exhibit III-2, the total present value of these future cash flows is *negative* $28.43 billion. Compared to the corresponding figure estimated in the FY 2012 Review, the current liability decreased by $10.62 billion.

The sharply negative house price growth rates since 2007 suggest that in general mortgages originated during the years from 2005 to 2009 are likely to face higher claim rates during the next few years. Given that their upfront premiums were already collected and are included as part of the current capital resources, and due to their large origination volume, the FY 2008 and FY 2009 books are estimated to experience larger negative present values than any other books, *negative* $10.91 billion and *negative* $12.48 billion, respectively. However, at the end of the housing recession, house prices bottomed out and turned slightly positive, giving the FY 2011 through FY 2013 books a positive initial start, and their present values are positive.

Exhibit III-2: Present Value of Future Cash Flows by Origination Fiscal Year & Mortgage Type as of the End of FY 2013 ($ Millions)

Fiscal Year	FRM 30	FRM 15	ARM	SR 30	SR 15	SR ARM	Total
1984	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0
1987	-1	0	0	0	0	0	-1
1988	-1	0	0	0	0	0	-2
1989	-2	0	0	0	0	0	-2
1990	-2	0	0	0	0	0	-3
1991	-4	0	-1	0	0	0	-5
1992	-5	0	-5	0	0	0	-11
1993	7	0	-5	-6	0	-1	-5
1994	9	0	-12	-11	0	-2	-16
1995	3	0	-12	-1	0	0	-10
1996	-2	0	-19	-4	0	-1	-26
1997	-10	0	-38	-1	0	-1	-49
1998	-26	0	-24	-12	0	-2	-64
1999	-73	0	-16	-30	0	-2	-122
2000	-124	0	-42	-3	0	-2	-171
2001	-350	0	-18	-70	0	-4	-441
2002	-598	0	-71	-135	0	-24	-829
2003	-1,264	-1	-82	-612	-2	-40	-2,001
2004	-1,874	-2	-213	-356	-2	-65	-2,511
2005	-1,711	-3	-303	-270	-1	-52	-2,341
2006	-2,466	-7	-110	-144	-1	-6	-2,733
2007	-3,917	-12	-73	-214	-1	-3	-4,219
2008	-9,702	-42	-195	-934	-3	-31	-10,908
2009	-7,244	-46	-136	-4,899	-15	-138	-12,478
2010	-3,298	-32	-367	-2,189	-12	-329	-6,227
2011	2,029	-20	-141	-386	-2	-186	1,293
2012	4,596	5	-26	932	2	-57	5,451
2013[a]	7,020	66	6	2,887	18	2	9,999
Total[b]	-19,009	-94	-1,906	-6,458	-20	-946	-28,432

[a] Based on projected volume as of August 2013 and FHA's origination composition forecasts.
[b] Numbers may not add up due to rounding errors.

3. Amortization of Outstanding Books of Business

Both the unamortized and the amortized IIF are presented in this Review. Exhibit III-3 shows the total volume of new mortgage endorsements for each book of business, the unamortized IIF and the amortized IIF as of the end of FY 2013.

As can be inferred from Exhibit III-3, the FY 2009 to FY 2013 books of business constitute approximately 13.6, 17.2, 13.6, 17.0 and 21.4 percent of the Fund's total end-of-FY 2013 amortized IIF, respectively. Loans endorsed during FYs 2005-2009 are expected to suffer the most from the recent national housing recession. Also, the surviving mortgages originated between FY 2009 and FY 2013 will enter their peak default periods during FY 2013 through FY 2018. With over 83 percent of the entire Fund concentrated in mortgages originated during the past five years, the Fund is expected to realize their highest claim losses during FY 2014 through FY 2018, as captured by our models.

The projected endorsement volume of the FY 2013 book remains high, making it the third largest book in FHA history, after the peak volumes endorsed in FY 2009 and FY 2010. This most recent book has the best credit quality composition among all books, as well as higher annual insurance premium rates. Meanwhile, as the housing market is forecasted to move slowly out of its worst period, the FY 2013 book of business is projected to generate a positive $14.30 billion of economic value to the Fund, as shown in Exhibit II-2, including the upfront insurance premiums.

Exhibit III-3: Endorsements and Insurance-in-Force as of End of FY 2013 ($ Millions)

Book of Business[a]	Mortgage Endorsements	Unamortized Insurance-in-Force[b]	Amortized Insurance-in-Force[b]
1984	15,929	259	16
1985	24,085	484	80
1986	57,746	1,530	350
1987	70,229	2,251	627
1988	37,427	1,081	389
1989	39,760	988	414
1990	47,125	1,013	472
1991	44,065	964	493
1992	45,090	1,336	706
1993	73,796	2,296	1,285
1994	79,689	3,319	1,902
1995	41,527	1,419	906
1996	61,694	2,322	1,548
1997	65,466	2,493	1,737
1998	88,591	4,323	3,119
1999	110,063	6,768	4,878
2000	86,803	3,534	2,739
2001	119,890	6,394	5,046
2002	128,890	11,013	8,661
2003	150,584	28,437	22,407
2004	92,893	23,339	19,021
2005	57,711	21,343	18,053
2006	50,138	18,398	16,195
2007	57,667	21,406	19,386
2008	176,108	62,376	57,383
2009	329,823	160,659	148,828
2010	295,403	199,715	187,325
2011	214,187	155,912	148,048
2012	217,842	191,151	184,920
2013[c]	241,195	236,517	233,550
Total[d]	3,121,414	1,173,038	1,090,482

[a] End of year insurance-in-force
[b] Based on June 30, 2013 data extract from HUD and the performance of outstanding loans projected by the econometric models for the fiscal year 2013
[c] Based on HUD's August 2013 projection.
[d] Numbers may not add up due to rounding error.

B. Projected Future Economic Values

The economic value of the Fund is projected over FY 2013 through FY 2020 based on: (a) our time-series regression model that projects FHA's mortgage volume, (b) FHA's forecast of future endorsement composition, (c) our stochastic economic forecasts that are centered on Moody's July 2013 economic forecasts and (d) cash flow projections based on the loan status transition, loss severity rate and cash flow models. The initial and subsequent annual economic values of each individual future book of business are first projected, and then combined to estimate the total economic value of the Fund in each year of the forecast period.

The present values of future books discounted to the end of each corresponding future fiscal year are presented in Exhibit III-4. Due to policy changes, FHA projects that the credit quality of the FY 2014 and future mortgages will continue to be better than the historical average. At the same time, insurance premiums of these future books of business are higher than their historic levels. All these changes have positive impacts on the expected present values of the future books. The economic values of the FY 2014 to 2019 books together increased by 49.7 percent or $23.94 billion from last year's projection, significantly improved economic value of the Fund at the end of FY 2019.

Exhibit III-4: Present Value of Future Books of Business by Mortgage Type ($ Millions) [a]

Fiscal Year	FRM 30	FRM 15	ARM	SR 30	SR 15	SR ARM	Total
2014	10,755	232	17	4,662	40	18	15,725
2015	9,690	210	11	917	9	4	10,842
2016	9,824	215	11	727	7	3	10,787
2017	10,661	235	13	1,100	9	5	12,023
2018	10,819	238	14	1,557	13	6	12,647
2019	10,881	241	13	1,453	13	5	12,606
2020	10,868	244	14	1,323	12	3	12,464

[a.] Present values are estimated as of the end of each respective fiscal year.

C. Projected Future Capital Resources

In this section we project potential alternative future capital resources based on our 100 Monte Carlo simulation paths. All the paths start from the $20.56 billion of capital resources at the end of FY 2013. Going forward, the capital resources were updated with investment returns and future insurance net cash flows, including upfront premiums, annual premiums, premium refunds, loss mitigation costs, and net claim losses. Exhibit III-5 displays the variations in the capital resources under a wide range of possible economic scenarios, derived according to selected percentiles of our 100-path Monte Carlo simulation. The projected future capital resources in Exhibit III-5 are plotted for the selected percentiles on a quarterly basis. The expected/mean capital resources would reach its lowest point of $17.18 billion in FY 2015Q2 and recover after that. The capital resources are expected to return to the FY 2013Q4 level by FY 2016Q3. At the 95 percentile level, the capital resources drop to $12.51 billion, and they are projected to climb back to $27.90 billion by the end of FY 2020, which implies that there is less than a 5 percent chance that capital resources would drop below $12 billion in future years.

Exhibit III-5: Mean and Selected Percentile Projections of the Fund's Capital Resources
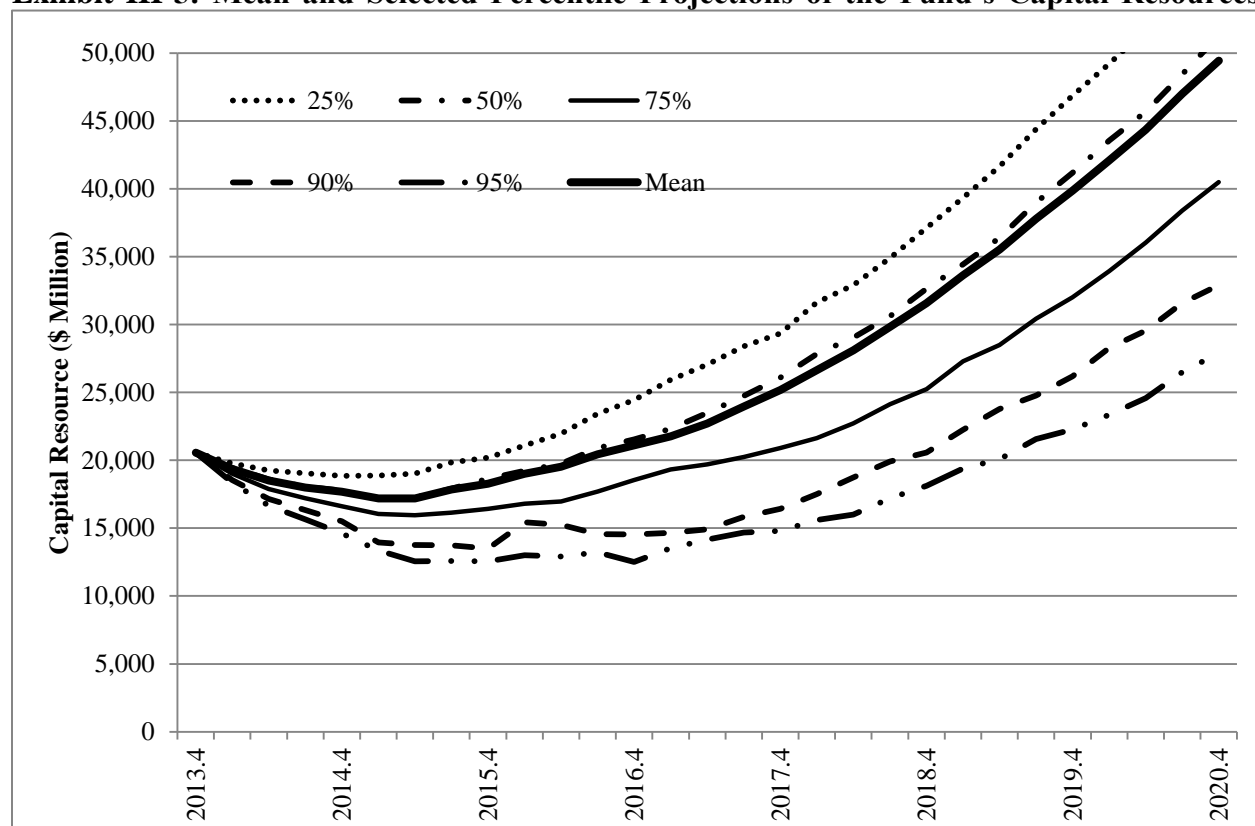
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Section IV: Characteristics of the Fiscal Year 2013 Insurance Portfolio

This section analyzes the characteristics of the loan portfolio insured by the Fund at the end of FY 2013. [31] This discussion covers the following three areas: (1) analysis of the volume and composition of loan types, (2) comparison of new purchase loans versus refinances, and (3) the distribution of loans by initial relative loan size, loan-to-value ratios, and borrower credit scores. This section also examines and compares the FY 2013 book with previous books in order to gain insights into how the FY 2013 book is likely to influence the future performance of the Fund. Because the data used for this analysis are an extract as of June 30, 2013, the characteristics for the FY 2013 book reflect only loans originated in the first three quarters of FY 2013 -- between October 1, 2012 and June 30, 2013. The year-end portfolio size was estimated by an endorsement volume model as described in Appendix F.

In the rest of this section, we examine FHA's business concentration profile to identify indicators that could have significance for the FY 2013 Actuarial Review.

A. Volume and Share of Mortgage Originations

We project FHA to endorse $241.20 billion in single-family forward mortgages in FY 2013, bringing the Fund's total unamortized IIF to $1,173.04 billion. Exhibit IV-1 shows the annual FHA origination counts as of June 30, 2013 for fully underwritten loans and for streamline refinancing loans, for FY 1981 through FY 2013.

Exhibit IV-1 shows that FHA's originations by number of loans, which had dropped significantly from FY 2003 to FY 2006, has increased dramatically through FY 2009, then returned to levels similar to those in FYs 2001-2003. The decline and subsequent rise were due, respectively, to the GSEs' and non-conforming lenders' aggressive marketing strategies during the subprime era, and their capital limitations when the bubble burst. FHA's rising volume after the bubble burst was also partially due to the capital impairment of the private mortgage insurance companies. As the private mortgage insurance industry faces severe capital constraint, the GSEs have been unable to purchase or guarantee loans with less than 20 percent down. FHA became the primary source of higher LTV loans since FY 2009.

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[31] The Fund in this Review refers to the MMI Fund excluding HECMs.

Exhibit IV-1: Total Count of FHA-Insured Originations
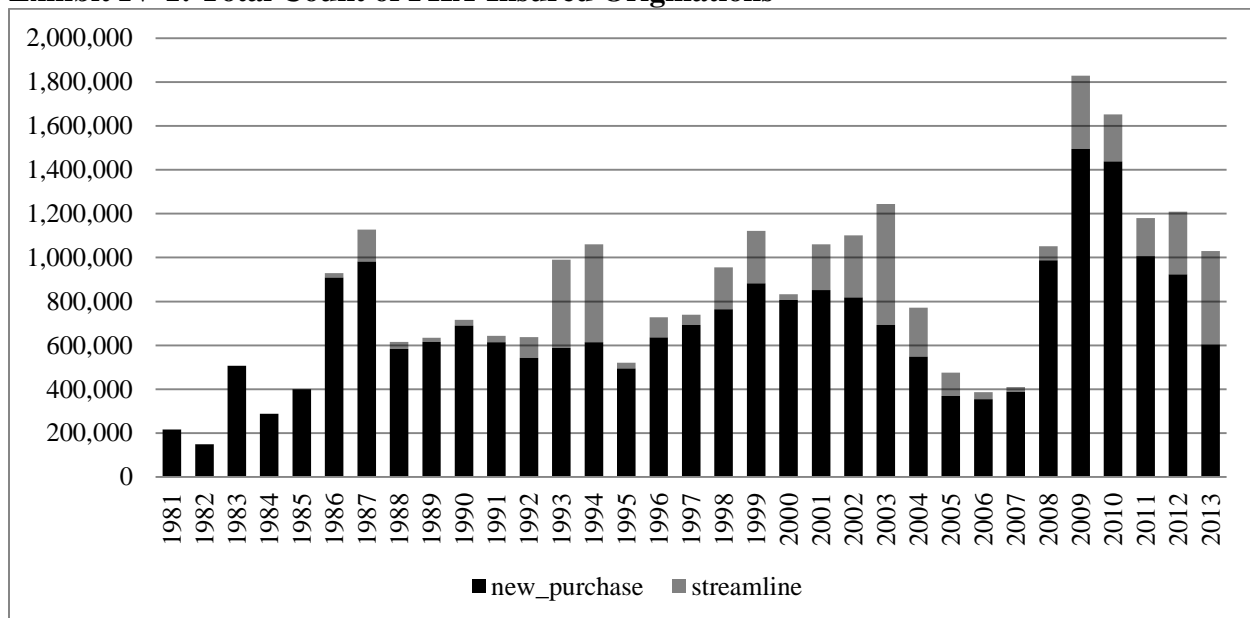
Source: FHA data warehouse, June 30, 2013 extract. 2013 numbers represent activities in first 3 quarters.

Exhibit IV-2 shows FHA's origination volume and market share in home sales from FY 1995 through FY 2013. The market share in terms of home sales declined during FYs 2004-2007, then subsequently resurged, and then returned to the pre-subprime level. FHA's market share, which had averaged about 13 percent during the period from FY 1995 through FY 2002, declined to a low of 3.77 percent in FY 2006. This trend has reversed during the past several years and by FY 2008, FHA's market share was back to 1990's levels. FHA's share by count increased from 4.12 percent in FY 2007 to 19.13 percent in FY 2010, and its share by dollar volume increased from 2.04 percent in FY 2007 to 14.66 percent in FY 2010. Subsequently, the shares have settled back to a slightly lower level: the partial-year data shows that the FHA share in FY 2013 by count was 14.29 percent and the share by dollar volume was 10.66 percent.

Exhibit IV-2: FHA's Market Share in the Home Purchase Mortgage Market

Fiscal Year	Number of Home Sales (Thousands)			Volume of Mortgages Originated ($Billions)		
	FHA[a]	Market[b]	FHA Share (%)	FHA	Market	FHA Share (%)
1995	556	4,845	11.48	45	689	6.46
1996	686	5,289	12.97	58	784	7.43
1997	751	5,467	13.74	66	854	7.73
1998	789	6,084	12.96	71	1,004	7.12
1999	909	6,463	14.06	89	1,124	7.96
2000	856	6,335	13.52	89	1,157	7.71
2001	869	6,405	13.57	96	1,221	7.87
2002	806	6,615	12.18	94	1,356	6.93
2003	655	7,148	9.16	80	1,578	5.09
2004	505	7,901	6.40	63	1,914	3.28
2005	345	8,454	4.08	43	2,247	1.89
2006	301	7,979	3.77	39	2,201	1.75
2007	288	6,992	4.12	39	1,920	2.04
2008	719	5,688	12.64	118	1,453	8.14
2009	994	5,315	18.70	171	1,196	14.27
2010	1,069	5,589	19.13	183	1,252	14.66
2011	766	5,236	14.63	130	1,148	11.35
2012	734	4,523	16.23	124	999	12.41
2013[c]	516	3,610	14.29	91	854	10.66

Sources: FHA Share of Home Purchase Activity Report for cohorts before 2011,[32] Quarterly Report to Congress on FHA Single-Family Mutual Mortgage Insurance Fund Programs for 2012-2013 cohorts.[33] Existing Home Sales are from the National Association of Realtors; New Homes Sales are from the U.S. Census Bureau and include manufactured housing; FHA numbers are from HUD.
[a] Home purchase loans endorsed by FHA under either the General Insurance Fund or the MMI Fund.
[b] Total number of home sales in the nation.
[c] FY 2013 numbers are through June 2013.

B. Originations by Location

FHA insures loans in all regions of the U.S., but about half of FHA's total dollar volume is concentrated in only ten states. Exhibit IV-3 shows the percentage of FHA's total dollar volume originated in these ten states from FY 2009 through FY 2013. The states are ordered based on the dollar volume endorsed during FY 2013.

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[32] http://portal.hud.gov/hudportal/HUD?src=/program_offices/housing/rmra/oe/rpts/fhamktsh/fhamkt
[33] http://portal.hud.gov/hudportal/HUD?src=/program_offices/housing/rmra/oe/rpts/rtc/fhartcqtrly

Exhibit IV-3: Percentage of Origination Volume by the Top-10 States

State Location[a]	2009	2010	2011	2012	2013
California	12.80	15.11	17.48	18.91	18.05
Texas	5.51	6.11	5.99	6.57	6.35
Florida	3.87	4.21	4.27	4.14	4.43
Virginia	4.28	4.07	4.12	3.91	3.82
New York	3.54	4.13	4.58	4.21	3.64
Illinois	4.08	3.61	3.28	3.21	3.49
Maryland	4.19	3.63	3.63	3.50	3.46
New Jersey	4.50	3.94	3.86	3.84	3.40
Colorado	3.23	3.11	3.06	3.12	3.30
Pennsylvania	3.47	3.73	3.55	3.36	3.28

Source: FHA data warehouse, June 30, 2013 extract.
[a] States are ranked according to their share of FY 2013 origination volume in the Fund.

The percentage share of FHA loans originated in California increased significantly from 12.80 percent in FY 2009 to 18.05 percent in FY 2013, likely due to the decrease in average house prices in most parts of California which resulted in more mortgages being below the FHA loan size limit. Currently, loans in California comprise the largest percentage of all FHA loans in dollar volume.

Historical house prices in the local housing markets are captured by our econometric models through the variables measuring recent home price appreciation, current loan-to-value ratios, and the dispersion of house price growth rates within a location. The geographic concentration of the Fund and projected values of these variables in the various locations have been reflected in the actuarial simulation model.

C. Originations by Mortgage Type

Exhibit IV-4 shows that the fully underwritten 30-year fixed-rate mortgage (FRM) has comprised the majority of FHA's single-family business, representing an average share of approximately 74.2 percent of the business over the period 1984-2013. The share of total mortgages represented by 30-year FRMs began to change in the early 1990s when FHA started insuring the adjustable-rate mortgage (ARM) and the streamline-refinancing mortgage (SR). For the next few years, ARM and SR mortgages gradually assumed a bigger share of annual loan originations and the 30-year FRM share decreased. FY 1993, FY 1994, and FY 2003 recorded the lowest shares of 30-year FRMs. An opposite trend has emerged from FY 2003 through FY 2007, in which 30-year FRM endorsements increased from 51.42 percent to 92.14 percent, while 30-year SR endorsements dropped from 36.95 percent to 5.12 percent. However, the share of 30-year FRMs endorsed in FY 2009 through FY 2013 dropped to an average level of 69.54

percent. During the last two years there has been a significant increase in the volume of 30-year SRs and for FY 2013 this volume is estimated to reach 40.62 percent of total volume.

The ARM share of the portfolio, including both ARMs and ARM SRs, shrank dramatically from 11.52 percent in FY 2005 to 1.05 percent in FY 2009. It subsequently rose to 6.03 percent in FY 2011, but declined again to 0.71 percent in FY 2013. The decline in ARM share is likely a result of borrowers trying to lock into the recent record low mortgage rates. The 15-year FRMs have increased from 1.22 percent in FY 2007 to 3.14 percent in FY 2013. The 15-year SR continues to be a relatively minor product type in the Fund.

The impacts of the dynamics of the concentrations of product types on the economic value of the Fund are captured by our econometric models, which are estimated separately for each of the six individual mortgage product types.

Exhibit IV-4: Percentage of Origination Volume by Mortgage Type

Fiscal Year	Fully Underwritten Mortgages			Streamline Refinancing		
	30-Year FRMs	15-Year FRMs	ARMs	30-Year SRs	15-Year SRs	ARMs SRs
1984	94.28	5.68	0.01	0.02	0.01	0.00
1985	92.00	7.75	0.14	0.08	0.03	0.00
1986	88.93	8.07	0.74	1.90	0.36	0.00
1987	80.44	4.97	1.47	11.22	1.84	0.06
1988	86.30	3.59	4.98	4.64	0.45	0.04
1989	92.95	2.69	1.52	2.64	0.19	0.00
1990	93.09	2.77	0.80	3.09	0.25	0.00
1991	88.20	3.14	4.43	3.63	0.57	0.04
1992	66.79	2.51	16.35	10.84	2.17	1.34
1993	45.78	2.25	12.14	29.96	7.75	2.13
1994	42.49	1.81	16.97	27.95	8.06	2.72
1995	65.10	1.28	29.25	2.78	0.94	0.65
1996	61.09	1.29	25.42	8.65	1.72	1.83
1997	57.18	1.10	35.06	3.62	0.69	2.35
1998	65.56	1.16	11.93	17.78	1.39	2.18
1999	73.57	1.13	4.24	18.35	1.74	0.98
2000	85.36	0.71	11.04	2.06	0.26	0.57
2001	75.84	0.94	2.08	19.77	0.65	0.73
2002	66.96	1.21	6.05	21.11	1.57	3.09
2003	51.42	1.34	3.89	36.95	3.12	3.29
2004	63.62	1.36	8.70	19.53	2.43	4.36
2005	69.55	1.26	8.67	16.30	1.37	2.85
2006	88.66	1.35	2.65	6.66	0.48	0.21
2007	92.14	1.22	1.34	5.12	0.11	0.07
2008	90.78	1.59	1.54	5.80	0.14	0.15
2009	76.78	2.20	0.73	19.58	0.38	0.32
2010	78.70	3.63	2.85	13.43	0.36	1.03
2011	72.63	5.68	4.22	15.03	0.63	1.81
2012	65.05	6.34	1.40	25.08	1.17	0.96
2013[a]	54.54	3.14	0.33	40.62	0.98	0.38

Source: FHA data warehouse, June 30, 2013 extract.
[a] Based on partial year data.

D. Initial Loan-to-Value Distributions

Based on previous econometric studies of mortgage behavior, a borrower's equity position in the mortgaged house is one of the most important drivers of default behavior. The larger the equity position a borrower has, the greater the incentive to avoid default on the loan. The original LTV is an inverse measure of the borrower's equity at origination. Exhibit IV-5 shows the distribution of mortgage originations by original LTV categories for the period from FY 1984 through FY 2013.

As Exhibit IV-5 indicates, the distribution among original LTV categories shifted significantly after FY 1999. Over half of the loans insured during the period of FY 2000 to FY 2005 were concentrated in the category of LTVs greater than or equal to 97 percent. This concentration in the highest risk category gradually declined during the next four years. In 2008, HERA placed a limit of 96.5 percent on original LTV, with no additional allowance for the financing of closing costs. During FY 2009, 20.5 percent of mortgages had LTV ratios of 97 percent or more. This is a 63 percent reduction from the share in FY 2005, where over 55.52 percent of that book of business was concentrated in this highest LTV category. In FY 2010 to FY 2013, this concentration further dropped to only 4.48, 5.12, 4.29 and 3.44 percent, respectively. Thus the relative percentage of mortgages in this highest original LTV category in FY 2013 was less than one-tenth of the corresponding percentage in FY 2005.

The original LTV concentration of individual books of business affects the econometric models in two ways. First, it serves as the starting position for updating the current LTV variable. Holding everything else constant, loans with higher original LTVs will experience a higher current LTV in future years. Second, the original LTV itself is also included in the models for fully underwritten products to capture potential behavioral differences among borrowers who self-select into different original LTV categories. For a streamline refinance loan, we use the original LTV of the prior fully underwritten mortgage, updated for local house price index and amortization, as a proxy for this variable.

Exhibit IV-5: Percentage of Origination Volume by Original LTV Category

Books of Business	Unknown LTV	≤ 80%	> 80% ≤ 90%	> 90% ≤ 95%	> 95% < 97%	≥ 97%
1984	2.77	16.20	26.17	26.32	21.52	7.03
1985	1.11	16.19	31.22	27.14	21.69	2.64
1986	0.56	18.26	30.33	27.35	20.51	3.00
1987	0.18	15.57	27.26	29.84	24.02	3.13
1988	0.13	8.01	19.72	35.57	31.87	4.71
1989	8.90	6.79	16.86	33.13	29.89	4.43
1990	11.90	6.15	16.20	32.21	29.13	4.40
1991	1.79	5.59	15.74	29.70	30.07	17.11
1992	1.76	4.39	13.99	28.03	38.26	13.57
1993	0.31	3.65	12.85	25.76	32.72	24.73
1994	0.24	3.46	11.70	24.43	32.77	27.40
1995	0.07	2.75	10.36	24.46	34.31	28.05
1996	0.03	2.84	11.10	25.50	34.72	25.81
1997	0.01	3.26	11.43	26.18	34.67	24.45
1998	0.01	3.55	12.23	26.46	34.85	22.91
1999	0.00	3.17	9.10	13.29	30.59	43.84
2000	0.00	2.34	6.23	6.81	32.54	52.07
2001	0.00	3.27	7.56	6.85	25.32	57.00
2002	0.00	3.88	8.09	6.84	24.23	56.96
2003	0.00	5.47	9.61	7.11	24.18	53.63
2004	0.01	5.56	9.17	7.23	23.66	54.38
2005	0.01	5.80	9.22	6.81	22.65	55.52
2006	0.01	6.81	10.06	13.88	19.91	49.34
2007	0.01	7.34	11.46	20.91	18.04	42.24
2008	0.01	6.17	12.05	24.04	13.41	44.31
2009	0.01	5.35	14.10	19.62	40.40	20.52
2010	0.01	5.01	14.97	11.44	64.09	4.48
2011	0.01	5.08	14.58	11.23	63.99	5.12
2012	0.02	5.61	11.31	10.00	68.77	4.29
2013[a]	0.01	4.80	10.94	9.81	71.01	3.44

Source: FHA data warehouse, June 30, 2013 extract
[a] Based on partial year data.

E. Borrower Credit History Distributions

Credit score data were collected through two different channels. The first channel includes credit scores collected for a sample of FHA applications from FY 1992, FY 1994, and FY 1996, and subsequently extended to loan applications during FY 1997 through FY 2004. This set of credit score data is particularly useful because these loans have existed for many years and provide valuable historical delinquency, claim and prepayment performance information. The limitation of this data source is that it covers only a limited sample of FHA loans. In addition, the sample was originally collected for policy research purposes and represents a choice-based sample. For example, there was over-sampling of early-default loans among applications over FY 1997 through FY 2004.

Since May 2004, all lenders originating loans for FHA insurance have been required to report borrower credit scores directly to HUD if any credit scores were ordered as part of the underwriting process. All loans going through the FHA TOTAL scorecard have credit scores obtained electronically by the affiliated automated underwriting systems. This is the second source of credit score data. As there are no exceptions to this requirement, the credit scores collected through this channel are considered to be comprehensive and unbiased. These loans have grown to be the dominant source of credit score information for our analysis.

Exhibit IV-6 shows the distributions of fully underwritten FHA mortgage loans by borrower credit score categories and origination years. The distribution among credit score categories remained stable during the FY 2005 through FY 2008 books. For loans originated after FY 2008, the credit score distribution showed significant improvement over the previous years. Approximately 55.3 percent of the FY 2013 loans have credit scores above 680. Loans with credit scores below 600 are only 0.6 percent of the loans originated in FY 2013, which is a substantial decline from the FY 2008 book, where 22.7 percent of the loans had credit scores below 600.

In the econometric models, we also controlled for missing and uncollected credit scores. In Exhibit IV-6, the category "Missing" refers to loans with insufficient borrower credit history to generate a credit score, and the category "Not Collected" refers to loans where no attempt was made to obtain the credit score for some of the FY 2004 and earlier loans.

Exhibit IV-6: Percentage of Origination Volume by Credit Score among Fully Underwritten Loans

Books of Business	Missing	300-499	500-559	560-599	600-639	640-679	680-850	Not Collected
1996[a]	3.92	0.03	0.71	1.89	3.81	4.50	8.23	76.91
1997[a]	2.37	0.19	1.39	2.56	4.17	3.98	5.60	79.73
1998[a]	1.81	0.24	1.84	3.19	5.23	4.70	5.52	77.47
1999[a]	1.71	0.22	1.83	3.32	5.40	4.67	4.99	77.86
2000[a]	1.89	0.33	2.44	3.47	5.00	4.01	4.01	78.85
2001[a]	1.37	0.27	2.14	3.31	4.64	3.78	3.92	80.58
2002[a]	1.33	0.31	2.33	3.58	5.09	4.22	4.57	78.58
2003[a]	1.45	0.32	2.69	4.29	6.18	5.18	5.63	74.27
2004[b]	3.05	0.51	4.93	8.64	12.58	10.43	11.71	48.15
2005	5.02	0.93	9.33	16.95	24.56	20.24	22.98	
2006	4.72	0.92	8.68	16.54	24.37	20.68	24.09	
2007	4.52	1.43	11.63	19.41	24.80	18.80	19.41	
2008	2.28	0.81	7.11	14.76	24.64	22.40	28.00	
2009	0.92	0.05	1.20	5.60	19.35	25.34	47.53	
2010	0.85	0.01	0.19	1.04	14.34	26.64	56.92	
2011	0.61	0.00	0.08	0.59	10.03	29.09	59.60	
2012	0.35	0.00	0.11	0.62	9.54	32.31	57.07	
2013	0.24	0.00	0.10	0.49	7.21	36.64	55.31	

[a] Credit score data are obtained from the previous FHA special data collection project. Problematic loans were over-sampled during the years 1997 to part of 2004.
[b] Starting May 2004, lenders were required to report credit score data directly to FHA.

F. Initial Relative Loan Size Distributions

The relative loan size variable is computed by comparing the mortgage origination amount with the average loan size of all other FHA-insured loans originated within the same period and in the same state. Empirical results show that this variable is very significant in prepayment-related terminations.

FHA experience indicates that larger loans tend to perform better compared with smaller loans in the same geographical area, all else being equal. Larger loans incur claims at a lower rate and in those cases where a claim occurs, loss severity tends to be lower. Prior to the increase in FHA's loan limits in FY 2008, houses securing larger FHA loans tended to fall into the average house

price range within their surrounding areas. Since this market is relatively liquid and there are a relatively large number of these similar-quality homes in the area, the house price volatility of these houses tends to be relatively smaller in comparison to the house price volatility of extremely low- and high-priced houses. With the increased FHA loan size limit, FHA endorsements during these past few years included some higher-priced houses.

Exhibit IV-7 shows the percentage of new fully underwritten mortgage originations within each relative loan size category. The distribution has been reasonably stable over time with the largest share in the 75-to-125 percent of area average loan size categories. However, since FY 2000, there has been a trend of a steady increase in the dispersion among loan size categories. The proportion in the highest loan size category increased from 9.84 percent in FY 2008 to 13.43 percent in FY 2013. On the other hand, the share in lowest loan size category also increased from 6.96 percent in FY 2008 to 10.28 percent in FY 2013. The increase in both the highest and lowest loan size categories demonstrate the penetration of FHA products into the high loan balance loans and the resurgence of the low loan balance loans.

Exhibit IV-7: Percentage of Origination Volume by Relative Loan Size

Books of Business	0-50% of Average Loan Size	50-75% of Average Loan Size	75-100% of Average Loan Size	100-125% of Average Loan Size	125-150% of Average Loan Size	>150% of Average Loan Size
1982	5.45	16.68	28.07	29.10	15.50	5.21
1983	3.98	16.22	29.41	31.23	15.39	3.75
1984	4.20	16.81	29.27	30.30	14.97	4.45
1985	4.16	16.60	29.02	30.44	15.96	3.83
1986	3.15	15.61	30.38	33.72	14.56	2.59
1987	2.92	16.06	30.42	33.24	14.85	2.49
1988	3.77	17.34	29.10	29.70	15.46	4.64
1989	4.22	17.69	28.82	29.38	14.35	5.54
1990	4.44	18.32	28.69	26.93	15.49	6.13
1991	4.54	18.27	28.70	26.59	15.52	6.38
1992	4.21	17.60	29.21	28.02	15.20	5.76
1993	3.69	17.41	29.91	28.75	15.53	4.72
1994	3.74	17.82	29.52	28.20	15.96	4.76
1995	3.99	18.43	28.85	27.52	15.84	5.38
1996	3.96	18.11	28.78	28.19	16.20	4.77
1997	4.05	18.12	28.62	28.22	16.07	4.92
1998	4.00	17.69	28.77	29.08	15.68	4.78
1999	4.44	18.36	29.03	27.26	14.84	6.07
2000	4.94	18.71	28.53	26.02	14.87	6.93
2001	4.98	18.37	28.85	26.27	14.63	6.89
2002	5.14	18.09	28.97	26.42	14.49	6.89
2003	4.97	17.86	28.84	27.26	14.63	6.43
2004	5.30	18.46	28.17	26.53	14.63	6.91
2005	5.31	19.11	27.78	26.06	14.64	7.09
2006	5.70	19.86	26.96	25.19	14.39	7.90
2007	6.15	20.07	26.43	24.58	14.21	8.55
2008	6.96	20.46	27.58	22.69	12.47	9.84
2009	8.84	21.67	26.17	19.69	11.37	12.27
2010	9.72	22.31	25.55	18.60	10.77	13.05
2011	10.95	22.67	24.29	17.68	10.47	13.94
2012	10.61	22.69	24.31	18.10	10.67	13.61
2013 [a]	10.28	22.20	24.98	18.41	10.71	13.43

Source: FHA data warehouse, June 30, 2013 extract
[a] Based on partial year data.

G. Initial Contract Interest Rate

Exhibit IV-8 shows the average mortgage contract rate by mortgage type since FY 1994. Average contract rates in FY 2013 are the lowest of this entire time period.

In general, an FRM with a lower initial contract rate tends to prepay at a slower speed. As interest rates are projected to rise eventually after the next two years, the prepayment rates of the FY 2012 and FY 2013 originations are likely to remain low. As these loans will have longer durations, more insurance premium income will be generated, thus tending to improve the economic value of these recent books.

Also, a mortgage with a contract rate lower than the market rate tends to experience lower probability of default. This tendency is reflected in our econometric models. As mortgage rates rise in the future, the recent low-interest-rate books are projected to incur fewer defaults and claims.

Exhibit IV-8: Average Contract Interest Rate by Loan Type (Percent)

Fiscal Year	30-Year FRMs	15-Year FRMs	ARMs	30-Year SRs	15-Year SRs	ARM SRs	Book of Business
1994	7.56	7.12	6.06	7.76	7.43	6.09	7.36
1995	8.39	8.23	7.18	8.70	8.74	7.34	8.10
1996	7.84	7.53	6.49	8.01	7.69	6.79	7.53
1997	7.97	7.75	6.53	8.29	8.04	6.81	7.51
1998	7.37	7.18	6.12	7.58	7.18	6.48	7.25
1999	7.24	6.95	6.00	7.17	6.89	6.05	7.16
2000	8.30	8.07	6.95	8.31	8.05	6.19	8.16
2001	7.56	7.12	6.19	7.42	6.85	6.12	7.49
2002	7.00	6.53	5.28	6.95	6.42	5.31	6.84
2003	6.07	5.50	4.38	6.01	5.49	4.44	5.91
2004	6.12	5.57	4.46	5.98	5.52	4.39	5.88
2005	5.92	5.63	4.79	5.85	5.65	4.67	5.79
2006	6.33	6.18	5.42	6.14	6.04	5.13	6.28
2007	6.51	6.40	5.62	6.38	6.25	5.59	6.49
2008	6.33	5.95	5.40	6.08	5.63	5.33	6.29
2009	5.60	5.11	4.94	5.26	4.80	4.52	5.51
2010	5.13	4.62	3.97	5.12	4.65	4.26	5.07
2011	4.65	4.16	3.51	4.62	4.16	3.68	4.56
2012	3.97	3.46	3.13	3.97	3.53	3.37	3.92
2013[a]	3.47	3.11	2.80	3.67	3.31	2.96	3.54

Source: FHA data warehouse, June 30, 2013 extract.
[a] Based on partial year data.

H. Source of Downpayment Assistance

Exhibit IV-9 reports the distribution of annual loan endorsements by source of downpayment assistance since FY 2001. Secondary loans provided by local governments were included in the category of downpayment assistance by government in this year's Review. Starting in FY 2001, there was a rapid increase in the share of loans with gift letters from non-profit, religious, or community institutions. This concentration increased dramatically to almost 25 percent in the FY 2005 to FY 2007 books of business. Following the passage of HERA, which effectively terminated seller-financed downpayment assistance effective October 1, 2008, the share of loans with this type of assistance declined to negligible after FY 2008.

Exhibit IV-9: Percentage of Downpayment Assistance Loans by Source[a]

Origination Fiscal Year	No Gift	Relative	Non-profit, Religious, or Community	Government	Employer
2001	83.23	11.08	4.25	1.36	0.07
2002	82.26	9.15	7.05	1.48	0.06
2003	81.35	7.41	9.76	1.42	0.06
2004	70.24	9.59	18.05	2.04	0.08
2005	63.87	9.50	23.52	3.03	0.08
2006	62.03	9.39	24.30	4.18	0.10
2007	65.58	7.80	23.14	3.40	0.08
2008	72.21	7.12	18.91	1.71	0.06
2009	85.27	11.55	2.52	0.59	0.07
2010	82.05	16.95	0.12	0.79	0.08
2011	83.48	15.17	0.17	1.11	0.07
2012	84.21	14.57	0.17	0.99	0.06
2013[b]	87.29	11.61	0.10	0.94	0.06

Source: FHA data warehouse, June 30, 2013 extract.
[a] As a percentage of all Fund endorsed loans, including purchase and refinance loans. The rate of downpayment assistance would be much higher if refinance loans were excluded from this calculation.
[b] Based on partial year data.

Exhibit IV-10 shows the cumulative claim rates realized since FY 2001 on loans by downpayment gift source and origination year. Loans with any form of downpayment assistance performed worse across all origination years than loans receiving no downpayment assistance. In order to reflect this differential performance of loans with alternative downpayment assistance sources, our econometric models incorporated a series of categorical variables to reflect this

important characteristic. The estimated coefficients of these downpayment assistance-source variables are both economically and statistically significant.

Exhibit IV-10: Cumulative-to-Date Percentage Claim Rates by Downpayment Assistance Source

Origination Fiscal Year	No Gift	Relative	Non-profit, Religious, or Community	Government	Employer
2001	6.37	8.19	18.94	16.69	9.83
2002	5.78	6.88	17.54	15.20	8.06
2003	5.79	7.89	19.44	16.24	11.27
2004	7.48	9.12	20.82	14.89	12.20
2005	10.43	12.08	23.52	18.16	15.04
2006	12.90	14.31	24.41	17.26	21.84
2007	13.89	14.22	24.19	18.20	17.15
2008	10.44	9.26	16.59	13.61	9.82
2009	4.89	3.89	11.09	6.31	4.43
2010	1.74	1.34	1.30	1.69	1.22
2011	0.57	0.37	0.35	0.39	0.35
2012	0.07	0.04	0.05	0.03	0.13
2013	0.00	0.00	0.00	0.00	0.00

Source: FHA data warehouse, June 30, 2013 extract.

Among the different downpayment assistance sources, loans with gifts from non-profit organizations have the highest cumulative claim rates for all origination years. GAO reported that the downpayment assistance loans had been misused by many non-profit organizations, with the assistance being funded by home sellers. [34] The high concentration of the FY 2004 to FY 2008 books in loans with downpayment assistance from non-profit organizations makes the claim risk of these books of business particularly high.

These loans have contributed significant negative economic value to the Fund in recent years, as shown by Exhibit IV-11, which reports the present value of the cash flows of these loans since their origination by downpayment assistance sources. While loans funded with assistance from non-profit organizations accounted for about 13.5 percent of the total origination volume of FY 2001 through FY 2008, they generated 33.6 percent of the negative present value of the cash flows from these books of business.

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[34] "Mortgage Finance Additional Action Needed to Manage Risks of FHA-Insured Loans with Downpayment Assistance," Government Accountability Office, November 2005.

Exhibit IV-11: Present Value of Cash Flows since Endorsement, by Downpayment Assistance Source as of the End of FY 2013 ($Millions)[a]

Origination Year	No Gift	Relative	Non-Profit, Religious, or Community	Government	Employer	Total
2001	-408	-130	-347	-73	0	-958
2002	-505	-92	-633	-91	0	-1,321
2003	-588	-127	-872	-123	0	-1,709
2004	-1,755	-323	-1,838	-238	0	-4,154
2005	-2,548	-584	-2,717	-498	0	-6,348
2006	-2,904	-520	-2,130	-584	0	-6,138
2007	-4,733	-576	-2,715	-663	0	-8,688
2008	-11,941	-963	-4,757	-710	0	-18,372
2009	-9,337	-592	-733	-356	0	-11,018
2010	1,158	185	-16	-205	0	1,123
2011	6,149	1,095	3	180	0	7,427
2012	9,390	1,679	9	388	0	11,466
2013	11,964	1,881	7	452	0	14,304
Total	-6,059	933	-16,740	-2,521	0	-24,387

[a] Numbers may not add up due to rounding error.

These costly non-profit down payment assistance loans have a significant negative impact on the financial state of the Fund. Exhibit IV-11 shows that, since their initial endorsement through the eventual termination, these loans contribute *negative* $16.74 billion to the economic value of the MMI Fund as of the end of FY 2013. We also estimated that these loans accounted for $32.67 billion of the amortized IIF as of the end of FY 2013. Therefore, if these loans had been excluded from the Fund, the revised economic value and the amortized IIF of the Fund would have been $8.87 billion and $1,057.81 billion, respectively. On the positive side, following the elimination of seller-funded high-risk loans by HERA in 2008, the performance of recent and future books of business are improved over what would have been the case if these loans had still been underwritten in significant amounts.

Section V: Fund Performance under Alternative Scenarios

The realized economic value of the Fund will vary from the Review's estimate if the actual drivers of loan performance deviate from the baseline projections. In this section, we present the baseline economic value from the Monte Carlo simulation and six alternative scenarios. The base case of the Review is the mean of the economic values of the Fund from the 100 simulated paths. Each alternative scenario estimates the performance of the Fund using the future interest and house price appreciation rates simulated for that path.

The first five alternative economic scenarios were selected from our 100 simulated paths; in particular, the paths that yielded the 10th best, 25th best, 25th worst, 10th worst and the worst projected economic values. The sixth alternative path is the most stressful scenario among Moody's Analytics alternative forecasts published in July 2013. The six alternative scenarios are

- 10th Best Path in Simulation, the path that resulted in the 10th highest economic value in the Monte Carlo simulation.
- 25th Best Path in Simulation, the path that resulted in the 25th highest economic value in the Monte Carlo simulation.
- 25th Worst Path in Simulation, the path that resulted in the 25th lowest economic value in the Monte Carlo simulation.
- 10th Worst Path in Simulation, the path that resulted in the 10th lowest economic value in the Monte Carlo simulation.
- The Worst Path in Simulation, the path that resulted in the lowest economic value in the Monte Carlo simulation.
- Moody's Protracted Slump Scenario, the most stressful alternative scenario forecasted by Moody's Analytics in July 2013.

The values of the projected house price indices and unemployment and interest rates for individual scenarios are described in Appendix D.

Exhibit V-1 reproduces the baseline projected Fund performance under the average of our Monte Carlo simulation paths as shown in Exhibit II-1. The estimated economic value of the Fund as of the end of FY 2013 is negative $7.87 billion, and the projected economic value for FY 2020 is positive $84.87 billion. These projections constitute the baseline, against which the projections from the alternative scenarios are to be compared. The economic values and IIFs of the Fund for FY 2013 through FY 2020 under the six alternative scenarios are presented in Exhibits V-2 to V-7. While the baseline projection is based on a stochastic Monte Carlo simulation, each of the alternative scenarios is based on a single specified path of HPI and unemployment and interest rates. We discuss the results of these alternative simulations in order.

Exhibit V-1: Projected Baseline Fund Performance ($ Millions)

Fiscal Year	Economic Value of the Fund	Unamortized Insurance-in-Force	Amortized Insurance-in-Force	Economic Value of Each New Book of Business	Volume of New Endorse-ments	Investment Earnings on Fund Balances
2013	-7,871	1,173,038	1,090,482	14,304	241,195	
2014	7,838	1,266,026	1,166,530	15,725	190,977	-16
2015	18,711	1,313,592	1,195,266	10,842	136,615	31
2016	29,696	1,355,513	1,219,277	10,787	138,704	198
2017	42,283	1,392,485	1,238,942	12,023	148,027	564
2018	56,033	1,436,408	1,264,467	12,647	156,002	1,104
2019	70,262	1,483,728	1,291,881	12,606	158,104	1,623
2020	84,866	1,535,564	1,322,615	12,464	162,608	2,140

A.   Selected Scenarios from Monte Carlo Simulation

The Monte Carlo simulation approach provided additional information about the probability distribution of the economic value of the MMI Fund (excluding HECMs) with respect to different possible future economic conditions and the corresponding prepayments and claims. In addition to the estimation of the expected economic value of MMI Fund, the simulation also provided the economic values associated with each one of the 100 possible future economic paths. The distribution of economic values based on these scenarios allowed us to gain insights into the sensitivity of the Fund's economic value to different economic conditions.

Exhibits V-2 to V-6 report the projection of the economic value of the Fund under five alternative future economic conditions from the 100 simulated paths. Exhibit V-2 is based on the path that produces the 10th best result for the FY 2013 economic value. This scenario results in the highest economic value among alternative paths presented in this section from FY 2013 to FY 2020. Under this path, the economic value of the Fund is $5.91 billion at the end of FY 2013. This is $13.78 billion higher than that of the mean across the 100 paths. The high economic value in this path resulted from a moderate house price appreciation rate prior to FY 2016 and a stable house price appreciation rate after FY 2016. This creates low claim losses. There is approximately a 10 percent chance the FY 2013 economic value of the Fund can be higher than $5.91 billion.

Exhibit V-2: Fund Performance: 10th Best Simulation Path ($ Millions)

Fiscal Year	Economic Value of the Fund	Unamortized Insurance-in-Force	Amortized Insurance-in-Force	Economic Value of Each New Book of Business	Volume of New Endorse-ments	Investment Earnings on Fund Balances
2013	5,914	1,185,725	1,102,095	15,828	241,195	
2014	20,430	1,289,453	1,187,957	14,504	188,019	12
2015	29,927	1,344,305	1,222,897	9,416	130,430	82
2016	39,343	1,397,236	1,256,766	9,099	133,849	317
2017	50,068	1,434,259	1,275,485	9,978	144,778	747
2018	63,962	1,447,779	1,273,116	12,588	167,910	1,307
2019	83,702	1,463,912	1,275,535	17,886	205,858	1,853
2020	109,888	1,498,136	1,297,684	23,637	242,144	2,549

Exhibit V-3 demonstrates that under the 25th best simulation path, the economic value of the fund at the end of FY 2013 would be negative $0.16 billion, which is $7.71 billion higher than the baseline. The FY 2020 economic value would be $88.60 billion, which is $3.73 billion higher than the baseline.

Exhibit V-3: Fund Performance: 25th Best Simulation Path ($ Millions)

Fiscal Year	Economic Value of the Fund	Unamortized Insurance-in-Force	Amortized Insurance-in-Force	Economic Value of Each New Book of Business	Volume of New Endorse-ments	Investment Earnings on Fund Balances
2013	-156	1,167,425	1,085,989	17,258	241,195	
2014	19,657	1,261,803	1,163,490	19,813	187,037	0
2015	33,862	1,315,482	1,197,600	14,126	127,727	79
2016	43,579	1,369,976	1,233,000	9,359	124,162	358
2017	51,350	1,430,758	1,273,157	6,944	117,934	827
2018	62,799	1,471,444	1,292,446	10,108	123,799	1,340
2019	76,474	1,537,426	1,335,831	11,855	149,880	1,819
2020	88,598	1,601,717	1,376,269	9,795	138,977	2,329

Exhibit V-4 shows that the FY 2013 economic value under the 25th worst simulation path would be *negative* $14.61 billion, while the FY 2020 economic value would be positive $71.70 billion, which are $6.74 billion and $13.17 billion below the baseline, respectively.

Exhibit V-4: Fund Performance: 25th Worst Simulation Path ($ Millions)

Fiscal Year	Economic Value of the Fund	Unamortized Insurance-in-Force	Amortized Insurance-in-Force	Economic Value of Each New Book of Business	Volume of New Endorse-ments	Investment Earnings on Fund Balances
2013	-14,613	1,187,105	1,103,366	14,344	241,195	
2014	4,318	1,257,847	1,158,026	18,960	184,938	-29
2015	15,035	1,313,605	1,194,403	10,700	132,746	17
2016	23,475	1,359,222	1,220,361	8,280	113,351	159
2017	31,902	1,402,299	1,242,790	7,982	109,649	445
2018	46,232	1,428,621	1,250,407	13,497	145,397	833
2019	61,074	1,494,711	1,295,738	13,502	162,220	1,339
2020	71,700	1,559,065	1,335,002	8,766	126,485	1,860

Exhibit V-5 shows the 10th worst result of FY 2013 economic value among the 100 simulated paths. Under this more pessimistic path, the economic value of the Fund is *negative* $22.89 billion at the end of FY 2013, which is $15.02 billion worse than the baseline expected economic value. There is approximately a 10 percent probability that the realized economic value to be even more stressful than this path, and result in even a lower economic value.

Exhibit V-5: Fund Performance: 10th Worst Simulation Path ($ Millions)

Fiscal Year	Economic Value of the Fund	Unamortized Insurance-in-Force	Amortized Insurance-in-Force	Economic Value of Each New Book of Business	Volume of New Endorse-ments	Investment Earnings on Fund Balances
2013	-22,893	1,166,454	1,084,090	11,588	241,195	
2014	-9,116	1,247,796	1,149,163	13,823	191,960	-46
2015	-289	1,296,492	1,178,983	8,863	137,026	-37
2016	9,901	1,313,487	1,179,867	10,192	138,926	-3
2017	19,403	1,341,107	1,190,859	9,315	138,588	188
2018	29,483	1,356,200	1,188,639	9,574	127,893	506
2019	42,035	1,361,455	1,178,590	11,697	149,219	854
2020	61,495	1,365,104	1,170,254	18,181	188,359	1,280

Exhibit V-6 shows the worst result from our Monte Carlo simulation. Under this scenario, the economic value of the Fund can be *negative* $86.53 billion. This is a very stressful scenario, where house prices drop 20 percent from FY 2014 to FY 2020, and house prices would remain 15 percent below the level of end of FY 2013 even by FY 2024. This worst path in the Monte Carlo simulations can be considered as a 99.5 percent event, meaning that there is a 99.5 probability that the economic value of the Fund is better than -$86.53 billion.

Exhibit V-6: Fund Performance: Worst Simulation Path ($ Millions)

Fiscal Year	Economic Value of the Fund	Unamortized Insurance-in-Force	Amortized Insurance-in-Force	Economic Value of Each New Book of Business	Volume of New Endorse-ments	Investment Earnings on Fund Balances
2013	-86,534	1,167,305	1,085,435	3,108	241,195	
2014	-81,977	1,255,793	1,156,775	4,731	182,133	-173
2015	-79,469	1,309,253	1,189,230	2,836	111,779	-329
2016	-77,204	1,336,108	1,196,482	3,106	93,538	-841
2017	-76,133	1,354,585	1,194,712	2,536	75,393	-1,465
2018	-73,545	1,353,935	1,174,274	4,576	76,287	-1,987
2019	-70,105	1,378,839	1,177,920	5,571	92,882	-2,131
2020	-67,061	1,400,465	1,176,457	5,179	82,716	-2,135

B. Moody's Protracted Slump Scenario

Exhibit V-7 presents the estimated economic value of the Fund based on Moody's "protracted slump" economic scenario. Under Moody's protracted slump scenario, the level of the house price index converges to the long-term index level of its baseline forecast. As a result, this scenario shows low house price growth rates in the short-term, followed by higher growth rates. We applied the adjustment as we did last year, where the growth rates of this scenario converge to the long-run growth rates of Moody's baseline scenario, instead of the indices themselves converging to their long-term levels. This adjustment avoids having the stress scenarios show exuberant growth after the initial stress period. As a result, the protracted slump scenario analyzed in this Review is more stressful than the original Moody's protracted slump scenario.

Exhibit V-7 shows that the FY 2013 economic value would be *negative* $69.95 billion under this most pessimistic alternative scenario published by Moody's in July 2013, which is $62.08 billion lower than the stochastic baseline. This is between the 10th worst and the worst path in our Monte Carlo simulation. Under this scenario, the FY 2020 economic value would be *negative* $15.87 billion, which is $100.73 billion lower than the stochastic baseline.

Exhibit V–7: Fund Performance: Moody's Protracted Slump Scenario ($ Millions)

Fiscal Year	Economic Value of the Fund	Unamortized Insurance-in-Force	Amortized Insurance-in-Force	Economic Value of Each New Book of Business	Volume of New Endorse-ments	Investment Earnings on Fund Balances
2013	-69,952	1,184,898	1,101,409	5,818	241,195	
2014	-56,809	1,254,171	1,153,547	13,283	173,032	-140
2015	-48,343	1,235,494	1,118,030	8,694	91,649	-228
2016	-40,955	1,231,764	1,097,957	7,899	89,324	-512
2017	-35,076	1,245,964	1,094,325	6,656	85,277	-777
2018	-29,633	1,273,384	1,102,253	6,359	87,547	-916
2019	-23,337	1,314,561	1,121,830	7,155	96,387	-859
2020	-15,866	1,365,651	1,149,841	8,182	106,904	-711

C. Summary

Exhibit V-8 shows the Fund's projected economic values from the baseline Monte Carlo simulation and those of the six alternative single-path scenarios: the 10th best path in the

simulation, the 25th best path, the 25th worst path, the 10th worst path, the worst path and Moody's protracted slump.

Exhibit V-8: Projected Fund Economic Values by Alternative Scenarios ($ Millions)

Fiscal Year	Baseline Monte Carlo	10th Best Path	25th Best Path	25th Worst Path	10th Worst Path	Worst Path	Protracted Slump
2013	-7,871	5,914	-156	-14,613	-22,893	-86,534	-69,952
2014	7,838	20,430	19,657	4,318	-9,116	-81,977	-56,809
2015	18,711	29,927	33,862	15,035	-289	-79,469	-48,343
2016	29,696	39,343	43,579	23,475	9,901	-77,204	-40,955
2017	42,283	50,068	51,350	31,902	19,403	-76,133	-35,076
2018	56,033	63,962	62,799	46,232	29,483	-73,545	-29,633
2019	70,262	83,702	76,474	61,074	42,035	-70,105	-23,337
2020	84,866	109,888	88,598	71,700	61,495	-67,061	-15,866

Combining Exhibits V-3 and V-4, the Fund's FY 2013 economic value has approximately a 50 percent probability of being in the range of *negative* $14.61 billion to *negative* $0.16 billion. Combining the 10th best path and the 10th worse path, the Monte Carlo simulation results indicate that there is an 80 percent chance that the economic value of the Fund would be between *negative* $22.89 billion and positive $5.91 billion. Further, among the 100 simulated paths, there are 22 paths yield positive economic value as of the end of FY 2013. As a result, we conclude that there was approximately a 22 percent chance that the FY 2013 economic value of the Fund to be positive, or conversely a 78 percent chance to be negative.

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Section VI: Summary of Methodology

This section provides an overview of the analytical approach used in this Review. Appendix A provides an expanded explanation of the status transition models, as well as a description of the variables used in those models and how the loan status transition events were constructed. Appendices B, C, and D provide details on the cash flow model and the scenarios for sensitivity analyses. Appendix E describes the loss severity rate model, Appendix F the volume forecast model and Appendix G the equations used to model and project the economic variables in the Monte Carlo simulation.

A. Specification of FHA Mortgage Status Transition and Termination Models

This Review applies statistical techniques consistent with the literature and applicable to the FHA experience. The purpose of the analysis is to estimate the future incidence of claim and prepayment terminations for FHA forward loans in the mutual mortgage insurance portfolio, so as to compute future outstanding balances, cash flows, and economic values.

The statistical analysis is complicated by the fact that mortgage borrowers possess two mutually exclusive options, one to prepay the loan and the other to default by permanently ceasing payment. From FHA's point of view, prepayment and claim events are the corresponding outcomes of "competing risks" in the sense that they are mutually exclusive, and realization of one of these events precludes the other. Prepayment means cessation of cash flows from mortgage insurance premiums, but at the same time eliminating any chance of incurring claim losses. Conversely, termination through foreclosure or pre-foreclosure sales means claim costs are incurred, but uncertainty about the possibility and timing of prepayment is eliminated.

The models implemented for this Review extend beyond the prepay-claim competing risk framework. The major new transition stage since the 2009 Actuarial Review is the transition from current to 90-days or more delinquent, which we call default. Since the 2012 Review, cures from default were separated into cures by modification and cures by no or light modification. This year, we also model the post-cure behavior of modified loans and self-cured loans separately with modification-related variables, namely a modification flag and the payment reduction ratio.

Another major enhancement introduced this year to model "blemished" current loans is the treatment of post-default status. Instead of simply marking a previously defaulted loan with a "prior_default" flag, we used the duration of post-default time to capture the decaying effect of a prior default.

Following the same procedure as last year, we separated out the transition from current to prepayments that are recaptured into FHA endorsements via streamline refinancing. This transition is used for estimating the origination volume of streamline refinance loans in future books. By making streamline refinancing endogenous, we more accurately capture the future profit and losses of those loans after the current loan is prepaid by the subsequent streamline refinance mortgage.

There are now five possible transitions from a loan in current status: remain current, become blemished current, default (enter 90+ days delinquent), prepay by streamline refinancing and prepay by a standard refinancing. Given that these are mutually exclusive and exhaustive outcomes, the sum of the probabilities for all five transitions is unity. Thus, only four transition equations need to be estimated and the fifth thereby inferred.

For a loan in default status at the beginning of a particular time period, it may prepay (streamline refinance is not allowed if delinquent), be claimed, be cured, or remain in default. As we did last year, cures are separated into two types, cures by modification and self-cures.

As a result, instead of estimating the probabilities of two termination events in the original Calhoun and Deng (2002) model, four probabilities of transition are estimated conditional on whether a loan is in current or default status.

Following the approach developed by Begg and Gray (1984), we estimated separate conditional binomial logistic models for each transition out of the current or default statuses and then mathematically recombined the parameter estimates to compute the corresponding multinomial logistic probabilities for the various competing risks of default, cure, claim, and prepayment.

The multinomial logistic models have several benefits over traditional linear regression. First, they ensure that the event probabilities sum to unity. This means that at any point in time, a loan can experience only one of the five possible transitions over the next period. Second, the possible values of each probability are constrained to be between zero and one. Third, as the probability of one transition type increases, the probabilities of the others are automatically reduced, reflecting the competing-risk nature among the transition events. Finally, they allow the conditional termination rates using loan-level data to be estimated. With loan-level observations, the possible outcomes at each point in time are either 0, the event did not happen, or 1, the event happened. Standard multivariate linear regression analysis is unsuitable for estimating discrete dependent variable models, whereas logistic models are specifically designed to handle these types of observations.

We applied a series of piece-wise linear spline functions to model the impact of some continuous variables, including mortgage age, current LTV, payment-to-income ratio, spread at origination, short-term home price appreciation, relative loan size, original LTV, refinance incentive, and

borrower's credit score. An important benefit of the spline specification over categorical variable approach is that it allows changing marginal effects over the range of values of the variable while avoiding sudden jumps. For qualitative or categorical variables, such as season, judicial states and number of units, we necessarily adopted the dummy variable specification.

Similar to the post-default time variable while in current status, default duration takes the form of a linear spline specification instead of the categorical variables of last year. Due to the enhancement we made to the Monte Carlo simulation framework, we are now able to handle path-dependent variables more efficiently, and achieve more accurate results. See Appendix G.

B. Loan Event Data

We used loan-level data to reconstruct quarterly loan-event histories by relating mortgage origination information to contemporaneous values of time-dependent factors. In the process of creating quarterly event histories, each loan contributed an observed "transition" for every quarter from origination up to and including the period of mortgage termination, or until the third quarter of FY 2013 if the loan remained active. The term "transition" is used here to refer to what happens to the loan from the start of one quarter to the start of the next quarter.

The FHA single-family data warehouse records each loan for which insurance has been endorsed and includes additional data fields updating the timing of termination by claim or prepayment. The data warehouse also maintains a record of loans entering and exiting from the default status. See Appendix A for the details of classifying mortgages over time according to their default status.

C. Statistical Sample

The entire population of loan-level data from the FHA single-family data warehouse was extracted for the FY 2013 analysis. This produced a population of over 27 million single-family loans originated between FY 1975 through the second quarter of FY 2013. Among these loans, historical status transition records during FY 1996 and later years were reconstructed to estimate the loan status transition models. Our model estimation dataset did not include pre-1996 data due to the limited availability of reliable 90-day default episode data and major change in FHA underwriting policies in FY 1996. The resulting dataset was used to generate loan-level transition event histories until the end of the observed data period.

Estimation and forecasting were completed separately for each of the following six FHA mortgage product types:

Product 1	FRM30	Fixed-rate 30-year fully underwritten purchase and refinance
Product 2	FRM15	Fixed-rate 15-year fully underwritten purchase and refinance

Product 3   ARM   Adjustable-rate fully underwritten purchase and refinance
Product 4   FRM30_SR   Fixed-rate 30-year streamlined refinance
Product 5   FRM15_SR   Fixed-rate 15-year streamlined refinance
Product 6   ARM_SR   Adjustable-rate streamlined refinance

In all, there are 8 transition equations to estimate for each of the 6 loan product types, for a total of 48 equations. Appendix A provides additional details on each of the transition types and reports the estimated coefficients for the transition probabilities.

This year, we applied choice-based sampling to improve model estimation efficiency. Appendix A describes the theoretical background and technical details. Based on the absolute number of observations by loan type, the following sampling rates were used which varied by product to produce the estimation dataset:

Product Number	Product Type	Sampling Scheme
Product 1	FRM30	1) Clean Loans[35]: 10% 2) Clean periods of non-clean loan[36]: 10% 3) Non-clean periods of non-clean loan[37]: 100%
Product 2	FRM15	100% for all loans
Product 3	ARM	100% for all loans
Product 4	FRM30_SR	1) Clean Loans: 25% 2) Clean periods of non-clean loan: 25% 3) Non-clean periods of non-clean loan: 100%
Product 5	FRM15_SR	100% for all loans
Product 6	ARM_SR	100% for all loans

D. Cash Flow Model

After we projected the future default, claim and prepayment rates using the econometric models, we then used this information to project the corresponding cash flows. The cash-flow model includes the calculation of five types of cash flows: (1) upfront mortgage insurance premiums,

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[35]"Clean Loans" means loans which have never defaulted, prepaid, claimed or cured throughout the entire history or up to the most current time.
[36] "Clean periods of non-clean loan" means the periods before a loan first becomes default, prepay, claim or cured during the life of the loan.
[37] "Non-clean periods of non-clean loan" means the periods after a loan first becomes default, prepay, claim or cured during the life of the loan.

(2) annual mortgage insurance premiums, (3) net claim losses, (4) loss-mitigation-related expenses and (5) premium refunds. Two other cash flows were modeled in some previous Reviews, but are not expected to occur in the future. The administrative expense was discontinued according to Federal credit reform requirements, and distributive shares were suspended in 1990. There is no indication that either of these will be resumed in the foreseeable future. The Federal credit subsidy present value conversion factors published by the Office of Management and Budget are used in discounting future cash flows to determine their present value as of the end of FY 2013.

We also implemented a foreclosure backlog adjustment to estimate the processing of the accumulation of loans whose processing after foreclosure had been delayed due to lenders' concerns about applying proper foreclosure procedures. The purpose of this adjustment is to simulate the processing of about twenty thousand loans (versus seventy-five thousand loans in Actuarial Review 2012) on the books at the end of the observation period, July 31, 2013, that had already held a foreclosure auction at least six months prior to this time, or completed the foreclosure at least four quarters prior to this date, but had not yet been claimed by the end of this data extraction date. State-level econometric analyses were performed to estimate the conditional termination speed. The corresponding cumulative probability function was used to simulate the timing of the claims of this extra foreclosure inventory; Appendix B provides the technical details.

E. Loss Severity Rate Model

FHA incurs a loss from a mortgage claim event. This loss amount is highly dependent on many risk factors. The loss severity rate, defined as the loss amount divided by the unpaid principal balance of a loan at the time of claim is highly dependent on the disposition channel. In practice, foreclosed (FC) properties generally have higher severity compared to pre-foreclosure-sales (PFS). FC loans can be further segregated into real-estate-owned (REO) and third party sales (TPS). We developed a conditional multiple regression framework to estimate the loss severity rate that endogenizes the proportion of claims settled by REO and PFS, but not TPS, because of the relative short history of the TPS program and the sparse data. Thus, this framework consists of three sub-models: an FC/PFS selection model, which predicts the probability a claim will be disposed as FC or PFS, and separate loss severity rate models for REO and PFS properties. Based on the current level of the TPS share of total FC loans and the long-term TPS trend from other major financial institutions that have actively engaged in TPS program for relatively longer periods, we derived assumptions for TPS ratio and TPS loss rates. The effective loss rate is the weighted average of the three separate loss severity rates. The loss severity models captures characteristics of the loan, the collateral, the borrower, and the housing market environment when a claim occurs. The FC/PFS selection model was estimated using logistic regression, while ordinary least square regressions were applied for the two loss severity rate models. Details of these models are provided in Appendix E.

F. Volume Forecast Model

We also enhanced the FHA mortgage volume model in order to better project future FHA loan origination volumes. The modeling approach first predicts the national purchase mortgage market volume and the national refinance market volume. Then the third equation projects FHA's fully underwritten refinance share of the national refinance volume. This share is applied to the national refinance volume to project the dollar volume of FHA's fully underwritten refinances. Similarly, FHA's purchase origination volume is calculated from FHA's purchase share of the national purchase volume and the estimated national purchase mortgage volume. This year we have made some enhancements in the volume forecast model, by including a HPI variable. Also we have included FHA refinance spread in the FHA refinance share model. Appendix F provides the technical details.

The prediction volumes vary according to alternative scenarios for interest rates and home prices in our Monte Carlo simulations. For example, a forecast of higher interest rates would depress refinancing volume. Same as last year, we endogenously estimate FHA's streamline refinance volume.

G. Monte Carlo Simulation

In 2012, we estimated the economic value of the Fund using a stochastic, Monte Carlo approach for the first time. This year we used the same approach and updated the Monte Carlo simulation with enhancements, including dynamic simulation and the incorporation of antithetic variates to improve the model convergence. In Reviews prior to 2011, we calculated the present value (PV) of future cash flows based on a single, deterministic path. The Monte Carlo approach uses multiple paths, where a "path" is a set of economic variables whose values are projected out into the future. The set of economic variables that "drive" our behavioral equations—that is, they are critical explanatory variables in our transition, loss severity and volume models—are as follows:

- 1-year Treasury rates,
- 10-year Treasury rates,
- 30-year fixed rate mortgage (FRM) rates,
- FHFA national Purchase Only house price index (HPI), and
- Unemployment rates.

We used the Moody's baseline forecast as the median path for the simulations. We then constructed the random paths by applying historical dispersion behavior from the mean to the Moody's baseline forecast. The degree of dispersion is determined by the variances we estimated for the models for each of these five risk drivers. The result is a collection of paths that are denser close to the median path and less dense further away from the median path. The models described in Appendix G explain how we generated these multiple random paths.

Each of the multiple paths is equally likely to occur. Once the PVs are computed for each path they are averaged to compute the economic value of the future cash flows. In the literature, this approach is considered the preferred way to compute present values under uncertainty about future values of the critical driver variables. In particular, this approach accounts for nonlinearities in the way the present values respond to alternative paths.

Using a stochastic approach requires a great deal of computational power, with the computational time increasing roughly proportional to the number of paths. We used 100 simulated paths to estimate the economic value of the future cash flows.

One enhancement we made in this year's Monte Carlo simulation framework was to use dynamic simulation, or simulated incidence. In last year's simulation framework, we captured the randomness from the macroeconomic drivers, and carried forward the calculated transition probabilities. When these probabilities depend on the history of the loan they are said to be path dependent. The way we did it in prior years, the calculations of the economic value can become very computationally burdensome. This is because the state space grows very quickly requiring large amounts of computer memory. Dynamic simulation provides a method of reducing the memory requirement. Under this approach we used a sequence of random numbers to directly simulate the future evolution of a loan and hence explicitly incorporate the loan's previous path history into the simulation. Because we do not need to carry the past history and enumerate all the previous possible transitions, the dynamic simulation is much more efficient in computation memory and time, and this technique allows us to utilize more path-dependent variables in the model estimation, which had been infeasible in the past.

Another major simulation enhancement we introduced in this year's Review is the adoption of the antithetic variates method. Dynamic simulation can greatly increase simulation flexibility, but it can still subject to material residual estimation error from the Monte Carlo simulation unless we use a very large number of simulation runs. Antithetic variates can be used to significantly reduce the simulation standard error and thus improve the convergence of the result. Thus by combining these two enhancements, we are able to simultaneously improve simulation flexibility and accuracy.

Simulated random drivers of fundamental economic variables, combined with the detailed transition model, and the enhanced Monte Carlo simulation framework, has improved the performance and efficiency of this year's model. Further details of the simulation enhancements can be found in Appendix G.

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Section VII: Qualifications and Limitations

The actuarial models used in this analysis are based on a theoretical framework and certain assumptions. This framework relates the rates of default, claim, loss and prepayment to a number of individual loan characteristics and certain key macroeconomic variables. The models are calibrated using advanced econometric regression techniques based on data from actual historical experience regarding the performance of FHA-insured mortgage loans. The parameters of the econometric models are estimated over a wide variety of loans originated since 1996 and their performance under the range of economic conditions and mortgage market environments experienced during the past 15 years. The estimated models are used together with assumptions about future loan portfolios and certain key economic assumptions to produce future projections of the performance of the Fund.

The financial estimates presented in this Review require projections of events up to 37 years into the future. These projections are dependent upon the validity and robustness of the underlying models and the assumptions about future economic environments and loan characteristics. These assumptions include economic forecasts by stochastic simulation models and Moody's Economy.com, and assumptions concerning the composition of FHA's future endorsement portfolio supplied by HUD. To the extent that the realized experience deviates from these or other assumptions, the actual results may differ, perhaps significantly, from current projections.

This report analyzes the future financial evolution of the MMI fund. Our approach is based on our experience in this field, our research in this area and the relevant literature. The structural framework we use is based on certain historic relationships and theoretical models that enable us to project the future cash flows. We use econometric techniques to estimate the parameters of our models from empirical data to the extent this data is available. We project a range of possible outcomes by simulating the macroeconomic drivers of the future cash flows. We recognize that other competent experts may use different assumptions and different models and obtain different results.

As of this writing, the U.S. housing and mortgage markets are recovering from the most stressful economic conditions since the Great Depression. Such extreme conditions have occurred in the last 30 years, but were restricted to certain regions of the country, such as Texas in the mid-1980s, New England in the late 1980s, or California in the early 1990s. It is necessary to go back to the Great Depression to find a housing recession of the magnitude and scale that has been recently experienced. The model used in this Review takes the future projected house price growth rates, as well as the realized house price growth rates, both short-term and long-term, into account when computing default, claim, loss and prepayment rates.

A. Model Sensitivity to Economic Projections

The main purpose of this Review is to assess the long-term financial performance of the Fund. Two of the critical economic variables used in making these projections are future house prices and future interest rates. This year we have developed stochastic models to project the future distribution of house prices and interest rates using Monte Carlo simulation. Our stochastic models have been calibrated so that they are centered on Moody's July 2013 base case economic forecasts. Hence the estimated results captured the impact of future deviations from Moody's base case projections.

Our estimate of the Fund's economic value depends on our projected distribution of house prices and interest rates. This dependence is captured mostly by the central core of the distribution which is anchored on Moody's baseline projections. If future realized house prices and interest rates turn out to be more favorable than Moody's projections the Fund will perform better than our base case predicts. Conversely, if future realized house prices and interest rates turn out to be more severe than Moody's projections the Fund will perform worse than our base case predicts.

The results of the stress scenario analyses in Section V represent adverse outcomes in the tail of the projected distribution of house prices and interest rates. The estimates of tail behavior and in particular the estimated probabilities depend on our stochastic models and the procedure we use for fitting the tail behavior.

B. Basic Data Inputs

The econometric analysis in this Review uses a data extract from FHA's data warehouse as of June 30, 2013. The volume and composition of the existing portfolio are also based on FHA data as of June 30, 2013. The future trends of economic conditions are based on July 2013 forecasts by Moody's Analytics. Future endorsement composition data are based on HUD's projections as of August 2013. While we have reviewed the integrity and consistency of these data and believe the data to be reasonable, we have not audited them for accuracy. The information contained in this Review may not correspond exactly with other published analyses that rely on FHA data compiled at different dates or obtained from other data sources.

Section VIII: Conclusions

This Review presents the results of IFE's analysis of the MMI Fund, excluding loans insured under the Home Equity Conversion Mortgage (HECM) Program. The HECM program was included in the MMI Fund starting in FY 2009, but is analyzed in a separate report. Throughout this Review, we have computed the economic value and the unamortized and amortized IIF for the "Fund," which for the purposes of this report includes all forward loans in the MMI Fund and excludes HECMs.

According to our estimates using a stochastic simulation approach, the Fund has an economic value of *negative* $7.87 billion and unamortized IIF of $1,173.04 billion as of the end of FY 2013. Furthermore, we project that the economic value will steadily increase after FY 2013 at an average of $13.25 billion per year to $84.87 billion by the end of FY 2020. Meanwhile, the unamortized IIF will also increase, at an average compound rate of 3.92 percent per year to the end of FY 2020. The faster rate of increase in economic value than in the IIF primarily reflects the stronger financial performance of new books of business projected to be added to the Fund during the next 7 years. The estimate of the FY 2013 economic value is $5.61 billion lower than projected in last year's Review and the estimated FY 2019 economic value is $16.01 billion higher than projected in last year's Review.

Regarding the housing market recovery observed in FY 2013, Moody's projects a second mild housing recession in FY 2015-2017. This projected slowdown in housing market recovery cause a negative impact of the estimated economic value. Furthermore, under some of the alternative scenarios the economic value of the Fund is projected to be significantly negative and to remain negative for several years.

The credit quality of recent endorsements under the Fund has shown significant improvement over the average credit quality of historical books. HUD forecasts that the credit quality of future books will gradually return to the compositions experienced in the mid-1990s, before the emergence of the subprime markets. The improved credit-risk profile compared to historical levels significantly improves the projected performance of the Fund in the most recent books.

On Aug 12, 2010, Public Law 111-229, was signed to provide the Secretary of HUD with additional flexibility regarding the mortgage insurance premiums for FHA loans. Specifically, the law increased the limit on the size of the annual mortgage insurance premium that HUD is authorized to charge. FHA subsequently increased both the upfront and the annual mortgage insurance premium rates. The increased annual premiums and slow projected prepayment rates help make the FY 2012 and projected FY 2013 endorsement books the two most financially robust in FHA's portfolio. HUD also terminated the policy of automatically cancellation of

annual insurance premium when the unpaid balance drops below 78 percent of the initial house value. This rule now further enhances the financial strength of future books.

As a result of our continuing effort to improve the accuracy of the analysis, several major model enhancements were implemented this year. We adopted dynamic simulation to replace the prior static simulation, which allowed us to model the effects of unlimited default durations. A new variable was introduced to model the refinancing incentive by calculating the payment change that is available by refinancing, and the payment change included the mortgage insurance premium. Cures from default have been separated into self-cures and cures with modification. The severity model now includes a choice of a foreclosure going to ROE or being sold by a third party. We switched from the all-transaction house price index to the purchase-only HPI, and used this index at the metro-area level. These enhancements and others are described in Appendices A, E and G, and all the new variables introduced this year and the switch of many categorical variables to a linear or spline form are summarized in Section II.

The passage of HERA prohibited FHA's endorsement of seller-financed downpayment assistance loans as of October 1, 2008. These loans experienced claim rates that are considerably higher than otherwise comparable non-assisted loans. The share of loans with downpayment assistance from non-profit organizations has declined significantly after the passage of HERA and has been almost zero since FY 2010. If non-profit-assisted loans had always been excluded, the economic value of the Fund would have been positive $8.87 billion in FY 2013, instead of the *negative* $7.87 billion estimated in this report.

Appendix A

Econometric Analysis of

Mortgage Status

Transitions and Terminations

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Appendix A: Econometric Analysis of Mortgage Status Transitions and Terminations

This appendix describes the technical details of the econometric models used to estimate the historical and future performance of FHA single-family loans for the FY 2013 Review. The models follow those implemented in FY 2012, with a number of enhancements.

For the transition equations, we made seven major enhancements. The first was the introduction of new explanatory variables, in particular, we included the number of quarters since the latest default episode, an indicator of historical loan modification, the percentage of monthly payment reduction resulting from loan modification and the expected percentage of monthly payment reduction resulting from the difference between the effective mortgage coupon rate and the prevailing market rate, after adjustment for the FHA mortgage insurance premium (MIP).

Second, we split the transition states of self-cure and loan-modification cure ("mod-cured") into two separate paths. Last year, loans that are cured by themselves or by loan modification share the same path of future transitions. For example, if a cured loan stays in the cured status in the next period, the type of the cure at the next period is not specified. In AR 2013, we separate the path of loans which are cured in different ways--a self-cured loan which stays in the cured status is now identified as self-cured rather than cured, and a mod-cured loan which stays in the cured status is now identified as mod-cured; and their subsequent transition probabilities are now different.

Third, we used the purchase-only (PO) home price indices (HPIs) in AR 2013. In previous years, the FHFA (formerly OFHEO) all-transaction HPIs were used in model estimation and forecasting. In 2013, FHFA released its PO HPIs by excluding refinance transactions. Since the PO HPIs are calculated by excluding appraised values and relying instead exclusively on actual sales prices, it is considered more reflective of actual market conditions. By using the PO HPIs, variables such as current LTV are thus calculated more accurately.

Fourth, we included the mortgage insurance premium (MIP) in calculating the effective coupon rate and refinance rate, which affect the refinance incentive calculation. We also included the FHA-GSE spread for the FHA refinance rate and included the GSA mortgage rate to represent the market refinance rate. In previous years, we ignored these components in the coupon rate and refinance rate calculation, which was reasonable when the MIP and spreads were relatively stable. However, when facing rapidly increasing MIP, this could lead to an over-prediction of the future refinance rate. We used this more-encompassing rate to compute the potential mortgage payment change by refinancing into an FHA mortgage, for the refinancing incentive variable.

Fifth, we adjusted the weights of default-to-default transitions during FY 2009Q4 to FY 2012Q3, which enabled us to utilize this period to estimate other default transitions, such as default-to-

prepay, default-to-self cure and default-to-modification. The weight adjustment algorithm helped to mitigate the biases introduced by artificially low default-to-claim transitions during this period, which were due to foreclosure moratoria, court backlogs and other policy impacts.

Sixth, we included choice-based sampling. In previous Reviews a 20 percent random sample was constructed for product type 1 (FRM30) and 100 percent for other product types. In AR 2013, a two-stage choice-based sampling scheme was applied to construct the estimation sample, while the sampling rates are determined by the terminal status of each loan and its status at each period. The reason for applying the choice-based sampling scheme is to capture all of the rare events (viz., default, claim and cure) to obtain more robust estimation result.

Seventh, we modified the estimation period. For the default transitions equations (viz., default to prepay, default to claim, default to self-cured and default to mod-cured), the observations between the second quarter of FY 2006 to the third quarter of FY 2007 were excluded. During 2006 and 2007, the database was under transformation. During the system transformation, information regarding certain state transitions was lost for defaulted loans. We excluded these observations to avoid biased and hence inaccurate estimation.

Section I of this appendix summarizes the model specification and estimation issues arising from the analysis of FHA mortgage status transitions and ultimate claim and prepayment rates. We discuss issues related to the measurement of borrower default episodes and prepayment and claim terminations. In AR 2013, we continue to apply a similar multinomial logistic probability framework that is used to deal with competing risks. This model is "built up" by estimating separate binomial logistic models for each type of mortgage status transition. We present the mathematical derivation of the multinomial logistic probabilities from the separate binomial logit estimates.

Section II describes the historical loan event history data needed for estimation. The future loan records required for forecasting future loan performance are described in Appendix C. The econometric estimates of the binomial logistic model coefficients are presented in Section III.

I. Model Specification and Estimation Issues

A. Specification of FHA Mortgage Status Transition and Termination Models

Prior to the FY 2010 Review, we used a competing-risk framework based on multinomial logistic models for quarterly conditional probabilities of prepayment and claim terminations. The general approach was based on the multinomial logistic models developed by Calhoun and Deng (2002). The multinomial model recognizes the competing risks of prepayment and claim terminations.

Starting in the FY 2010 Review, we introduced a third "competing risk," 90-day delinquency, which we call "default." It is a competing risk in the sense that if the loan is in default for a given quarter, it was not prepaid or claimed in that quarter. This new transition state was possible because, combining multiple data sources, FHA developed historical data on new 90-day default episodes that have occurred on outstanding mortgages since FY 1990 Q1. The date on which a loan is first reported to be 90-or-more days in arrears is used to identify the start of a default episode. This default episode continues until the default episode ends or the loan terminates through claim or prepayment. Under our approach, loans that start a quarter 90-days or more delinquent are deemed to be in default status. Similarly, active loans that are not in a 90-day default episode at the beginning of the quarter are classified as current, even if they go 90-days delinquent during that quarter.

Exhibit A-1 highlights the status transitions and the loss severity model components that we have modeled for the FY 2013 Review. Two enhancements are evident when compared to last year's Exhibit A-1:

1. In addition to the flag for a prior default for loans that recovered to current status or have re-defaulted, we have similarly added a prior modification flag. These flags attach to the particular loans so that their subsequent transition probabilities can be distinguished from the loans that had not previously defaulted or were not modified. This is accomplished by using these flags as explanatory variables in the transition equations. We also added other explanatory variables for these loans that further distinguish their future transition probabilities from the loans without such prior experiences. These additional variables are discussed below.

2. In the loss severity model, in addition to separating pre-foreclosure sales from real estate owned (REO) by HUD, we have separated third party sales from REOs. This is discussed in Appendix E.

Tracking loans with and without prior default episodes or prior loan modification as separate loan status categories introduces a form of path dependency into the analysis; that is, subsequent behavior depends on whether they were previously in default or were modified. Loans originating in current status (C) either transition to default status (D) at the start of the next quarter, terminate as a prepayment to an FHA streamline refinance product (SR) or as a prepayment (PRE) that is not an SR, default and cure in the same quarter (CX) or continue in current status.

The transition from current into SR rather than into a non-FHA prepayment allows feedback into an on-going portfolio where future additions to the portfolio are accounted for. Both types exit the portfolio, but when we simulate the future economic values of the MMIF, the SR loans are brought back into these future books of business. This mechanism does not apply, however,

when the current value of the MMIF is computed, because future books are not included in the analysis.

All loans that have been in 90-days delinquency in their history and that have returned to current status are flagged with an "X" and are assigned to a separate current status CX: this is the prior default flag. This also applies when a loan goes into and out of 90-days in the same quarter. Loans transition from default status D to status CX along two possible paths, depending on whether they self-cure (CX_S) or cure with a loan modification (CX_M). Self-cures give rise to repayment plans to account for the arrearages, and loan modifications that have principal forgiveness give rise to partial claims.

The separation of the path of CX_S and CX_M loans is new this year. Last year, loans returning to current status along either of these two paths were combined into the single current status CX for modeling subsequent transitions to default or prepayment. This year, a prior loan modification flag is included to identify the cure type. Once a loan is modified, the prior modification flag is permanently turned on to distinguish between self-cured and mod-cured. While this approach models the transition to these cure types so that the mix of cure types can be identified and modeled, it stops short of expanding the state space to include separate loan statuses for the two cure types; that is, an equation to project future transitions for these loans is not estimated, rather we rely on the flag as an explanatory variable in the equations that start from the current status.

Similarly, loans in current status CX with prior default episodes that re-default are assigned to status DX, the status of default with a prior default episode. As with loans in status D, loans in status DX may also terminate as claims or prepayments. Note that the prior default episode and prior loan modification are modeled as flags that enter the transition models as explanatory variables. Transitions from these statuses are not separately modeled; instead, the flagged loans are added to the un-flagged loans for the next transition. In particular, CX_S is combined with CX_M to form the generic CX, and all the CXs are combined with C. The flags are kept on these loans so that their transition probabilities can be distinguished from the loans without these flags. Similarly, DX is combined with D, for purposes of modeling the transitions to the next quarter. Managing the number of transitions to model is very important for the efficiency of model estimation and especially in the simulations of future performance.

Exhibit A-1: Loan Status Transitions Framework
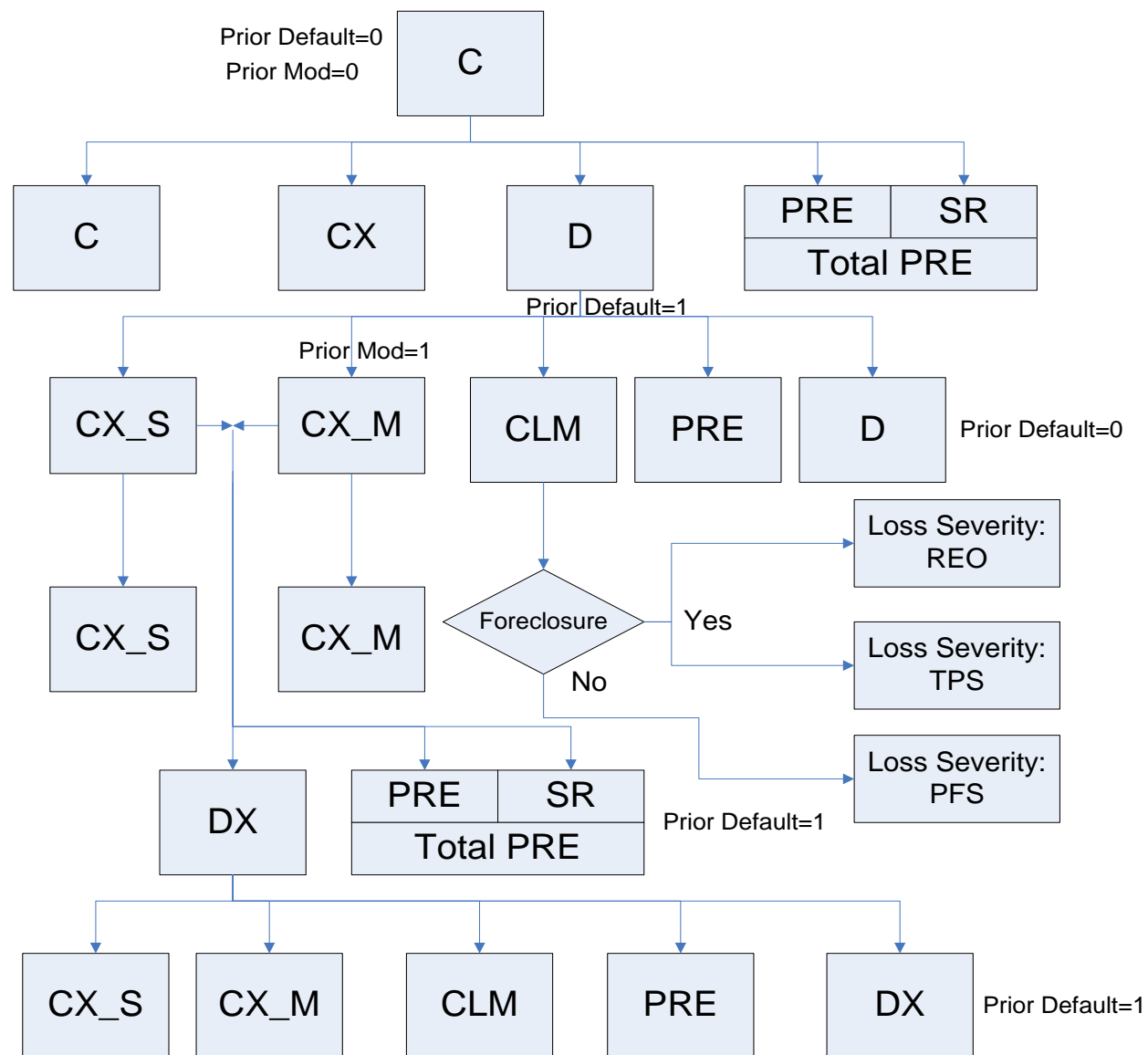
In summary, from the current status, there are five possible transitions: CUR_CUR, CUR_CX (a loan that goes 90 days delinquent within a quarter but is less than 90 days delinquent at the beginning of the next quarter; typically this is a self-cure, because modifications normally take longer to execute), CUR_D, CUR_PRE and CUR_SR. Notice the underlining means "transition to" as in CUR (current) transitions to D (default). Since the probabilities for each of these transitions must sum to unity, only four of these transition probabilities need to be estimated and the fifth inferred. We chose to not estimate the CUR_CUR transition probability, inferring it instead from the other four. Also, we do not introduce separate transitions if the loan starts in a CX status, as that would require three more transition probabilities to estimate and manage in the simulations. Instead, we incorporated right-hand indicator variables that account for prior default episodes and prior loan modifications. In other words, we have not expanded the state space to keep track of the complete information set of prior default episodes, accounting for the different behavior of these loans. In the case of the current status (CUR), we distinguish between "clean" current status (C) and "blemished" current status (CX).

Similarly, there are five possible transitions from a default status: D_D, D_CLM, D_PRE, D_CX_S and D_CX_M, the latter two reflecting self-cure and mod-cure. The D_SR transition is not allowed, because loans in default status cannot streamline refinance. Since the sum of the transition probabilities must sum to unity, we did not estimate the D_D transition, but inferred its probability from the other four. And as above, we used right-hand variables to indicate prior default and modification statuses.

In all there are ten transitions. There are five possible transitions from current status and five from default. Two of the transition probabilities are inferred from the others, so there are eight transition probabilities to estimate for each of the 6 product types. Hence there are 48 equations to estimate.

Exhibit A-2 shows five examples of when a loan starts a 90+ episode ("start_dt") and when it ends ("term_dt"): when it ends in a claim as in Example 1 or ends as a prepayment in Example 3, "end_dt" when it cures as in Example 2, or "censored" if it does not end at the end of the sample observation period as in Example 4. Note that these examples also help illustrate the notion of default duration ("dur"), which was introduced in the 2010 Review as an explanatory variable in the transition equations. Example 5 illustrates the situation when a loan goes a 90-day episode within a quarter but it is not 90+ at the end of the quarter. Based on our framework, the loan would be in status CX_S, a self-cure, without the status D. In this situation, we call the subsequent status CX_S a "blemished" current status. An example of this situation is that a loan is 60-days delinquent prior to the quarter, goes to 90- or even 120-days delinquent in the first months of the quarter and then the arrearages are paid in the last month of the quarter.

Exhibit A-2: Examples of Loan Transition Types

Example 1 : current-to-default / default-to-claim
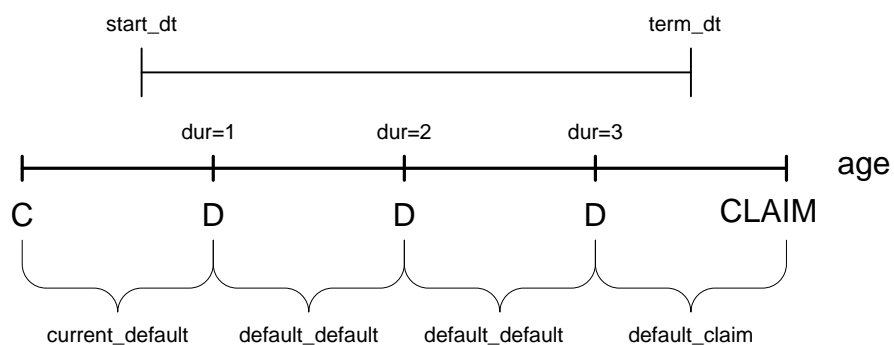
Example 2 : current-to-default / default-to-current
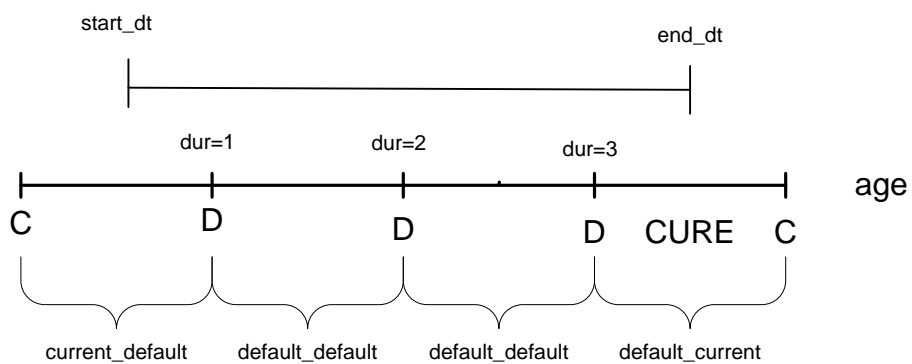
Example 3: current-to-default / default-to-prepay
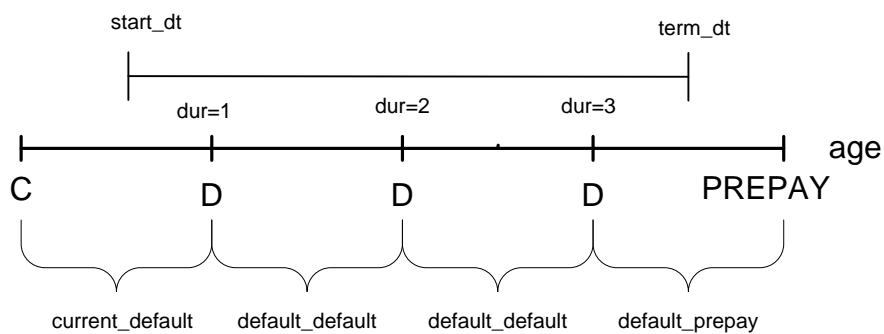
Example 4: current-to-default / censored
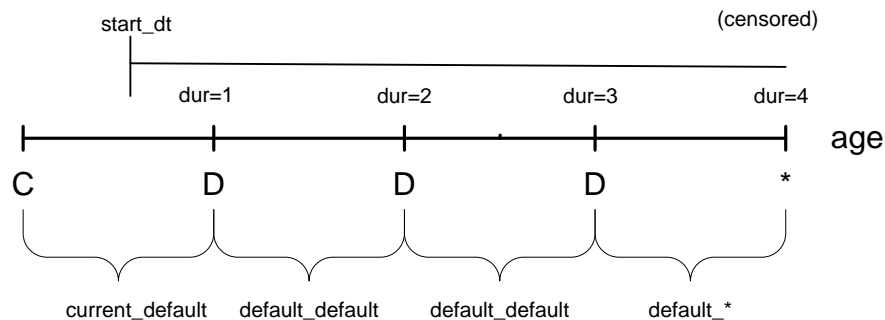
Example 5: current-to-current
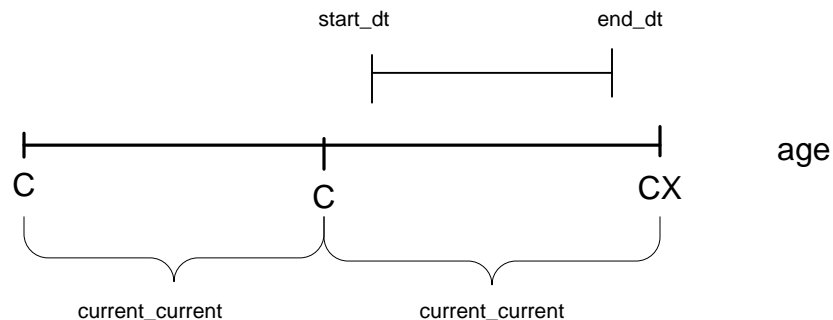
B. Specification of Multinomial Logistic Models

As summarized above, the status transition framework results in two sets of competing risks: one for loans in current status and the other for loans in default status. For loans currently at the start of the quarter, the competing risks are prepayment, transition to default status, or remaining current, as was shown above in Exhibit A-1 in the first layer of transitions. For loans in default status at the start of a quarter, the competing risks are claim, prepayment (delinquent borrowers are ineligible for streamline refinance), transition to current statuses (self-cure or cured by a loan modification), or remain in default status, as shown in the second layer of transitions in Exhibit A-1. The number of competing risks includes three possible current types C, CX_S and CX_M, where CX_S and CX_M are current but with a prior 90+ default episode; and two possible prepayment types, streamline refinance (SR), and other prepayment (PRE), the sum of which is Total PRE. These are shown in the first layer of transitions of Exhibit A-1. There are also two possible cure types, self-cure (s) and loan modification (m), as shown in the second layer of

transitions of Exhibit A-1. This gives rise to eight possible transition probabilities requiring estimation.

We specified multinomial logistic models of quarterly conditional probabilities for transitions from current to prepayment, default, or remaining current; and for transitions from default to claim, prepayment, back to current, or remaining in default. The corresponding mathematical expressions for the conditional probabilities over the time interval from t to $t+1$ for loans starting in a "clean" current status in a quarter t to other types of prepayment, streamline refinance, default, blemished current, remain "clean" current, respectively, in the subsequent quarter $t + 1$ are given by:

$$\pi_{PRE}^{CUR}(t) = \frac{e^{\alpha_{PRE}^{CUR} + X_{PRE}^{CUR}(t)\beta_{PRE}^{CUR}}}{1 + e^{\alpha_{PRE}^{CUR} + X_{PRE}^{CUR}(t)\beta_{PRE}^{CUR}} + e^{\alpha_{SR}^{CUR} + X_{SR}^{CUR}(t)\beta_{SR}^{CUR}} + e^{\alpha_{DEF}^{CUR} + X_{DEF}^{CUR}(t)\beta_{DEF}^{CUR}}} \tag{1a}$$

$$\pi_{SR}^{CUR}(t) = \frac{e^{\alpha_{SR}^{CUR} + X_{SR}^{CUR}(t)\beta_{SR}^{CUR}}}{1 + e^{\alpha_{PRE}^{CUR} + X_{PRE}^{CUR}(t)\beta_{PRE}^{CUR}} + e^{\alpha_{SR}^{CUR} + X_{SR}^{CUR}(t)\beta_{SR}^{CUR}} + e^{\alpha_{DEF}^{CUR} + X_{DEF}^{CUR}(t)\beta_{DEF}^{CUR}}} \tag{1b}$$

$$\pi_{DEF}^{CUR}(t) = \frac{e^{\alpha_{DEF}^{CUR} + X_{DEF}^{CUR}(t)\beta_{DEF}^{CUR}}}{1 + e^{\alpha_{PRE}^{CUR} + X_{PRE}^{CUR}(t)\beta_{PRE}^{CUR}} + e^{\alpha_{SR}^{CUR} + X_{SR}^{CUR}(t)\beta_{SR}^{CUR}} + e^{\alpha_{DEF}^{CUR} + X_{DEF}^{CUR}(t)\beta_{DEF}^{CUR}}} \tag{1c}$$

$$\pi_{CUR}^{CUR}(t) = \frac{1}{1 + e^{\alpha_{PRE}^{CUR} + X_{PRE}^{CUR}(t)\beta_{PRE}^{CUR}} + e^{\alpha_{SR}^{CUR} + X_{SR}^{CUR}(t)\beta_{SR}^{CUR}} + e^{\alpha_{DEF}^{CUR} + X_{DEF}^{CUR}(t)\beta_{DEF}^{CUR}}} \tag{1d}$$

We further expand quarterly conditional probabilities (1d) into two types, C ("clean current") and CX ("blemished current"), by using nested logistic models:

$$\pi_{CX}^{C}(t) = \frac{e^{\alpha_{CX}^{C} + X_{CX}^{C}(t)\beta_{CX}^{C}}}{1 + e^{\alpha_{CX}^{C} + X_{CX}^{C}(t)\beta_{CX}^{C}}} \tag{1e}$$

$$\pi_{C}^{C}(t) = \frac{1}{1 + e^{\alpha_{CX}^{C} + X_{CX}^{C}(t)\beta_{CX}^{C}}} \tag{1f}$$

The corresponding probabilities for loans starting in a default status transitioning to claim, prepayment, current (self-cured without a partial claim, such as with a repayment plan), current (via a partial-claim modification), and continuing in default status are given by, respectively:

$$\pi_{CLM}^{DEF}(t) = \frac{e^{\alpha_{CLM}^{DEF} + X_{CLM}^{DEF}(t)\beta_{CLM}^{DEF}}}{1 + e^{\alpha_{CLM}^{DEF} + X_{CLM}^{DEF}(t)\beta_{CLM}^{DEF}} + e^{\alpha_{PRE}^{DEF} + X_{PRE}^{DEF}(t)\beta_{PRE}^{DEF}} + e^{\alpha_{CUR\_S}^{DEF} + X_{CUR\_S}^{DEF}(t)\beta_{CUR\_S}^{DEF}} + e^{\alpha_{CUR\_M}^{DEF} + X_{CUR\_M}^{DEF}(t)\beta_{CUR\_M}^{DEF}}} \tag{2a}$$

$$\pi_{PRE}^{DEF}(t) = \frac{e^{\alpha_{PRE}^{DEF} + X_{PRE}^{DEF}(t)\beta_{PRE}^{DEF}}}{1 + e^{\alpha_{CLM}^{DEF} + X_{CLM}^{DEF}(t)\beta_{CLM}^{DEF}} + e^{\alpha_{PRE}^{DEF} + X_{PRE}^{DEF}(t)\beta_{PRE}^{DEF}} + e^{\alpha_{CUR\_S}^{DEF} + X_{CUR\_S}^{DEF}(t)\beta_{CUR\_S}^{DEF}} + e^{\alpha_{CUR\_M}^{DEF} + X_{CUR\_M}^{DEF}(t)\beta_{CUR\_M}^{DEF}}} \tag{2b}$$

$$\pi_{CUR\_S}^{DEF}(t) = \frac{e^{\alpha_{CUR\_S}^{DEF}+X_{CUR\_S}^{DEF}(t)\beta_{CUR\_S}^{DEF}}}{1+e^{\alpha_{CLM}^{DEF}+X_{CLM}^{DEF}(t)\beta_{CLM}^{DEF}}+e^{\alpha_{PRE}^{DEF}+X_{PRE}^{DEF}(t)\beta_{PRE}^{DEF}}+e^{\alpha_{CUR\_S}^{DEF}+X_{CUR\_S}^{DEF}(t)\beta_{CUR\_S}^{DEF}}+e^{\alpha_{CUR\_M}^{DEF}+X_{CUR\_M}^{DEF}(t)\beta_{CUR\_M}^{DEF}}} \quad (2c)$$

$$\pi_{CUR\_M}^{DEF}(t) = \frac{e^{\alpha_{CUR\_M}^{DEF}+X_{CUR\_M}^{DEF}(t)\beta_{CUR\_M}^{DEF}}}{1+e^{\alpha_{CLM}^{DEF}+X_{CLM}^{DEF}(t)\beta_{CLM}^{DEF}}+e^{\alpha_{PRE}^{DEF}+X_{PRE}^{DEF}(t)\beta_{PRE}^{DEF}}+e^{\alpha_{CUR\_S}^{DEF}+X_{CUR\_S}^{DEF}(t)\beta_{CUR\_S}^{DEF}}+e^{\alpha_{CUR\_M}^{DEF}+X_{CUR\_M}^{DEF}(t)\beta_{CUR\_M}^{DEF}}} \quad (2d)$$

$$\pi_{DEF}^{DEF}(t) = \frac{1}{1+e^{\alpha_{CLM}^{DEF}+X_{CLM}^{DEF}(t)\beta_{CLM}^{DEF}}+e^{\alpha_{PRE}^{DEF}+X_{PRE}^{DEF}(t)\beta_{PRE}^{DEF}}+e^{\alpha_{CUR\_S}^{DEF}+X_{CUR\_S}^{DEF}(t)\beta_{CUR\_S}^{DEF}}+e^{\alpha_{CUR\_M}^{DEF}+X_{CUR\_M}^{DEF}(t)\beta_{CUR\_M}^{DEF}}} \quad (2e)$$

The constant terms α_f^i and coefficient vectors β_f^i are the unknown parameters to be estimated for the multinomial logistic model for starting status i indicating current (CUR) or default (DEF); and ending status f indicating claim (CLM), prepayment (PRE), streamline refinance (SR), default, remain current without getting into 90-day delinquency (C), and self-cure in the same quarter (CX), two types of current/cure (CUR) if coming from a default status in the previous quarter, or default (DEF). We denote by $X_f^i(t)$ the vector of explanatory variables for the conditional probability of making a transition from starting status i to ending status f. Some components of the $X_f^i(t)$ are constant over the life of the loan and therefore do not vary with time period t. The "dynamic" or time-varying explanatory variables in $X_f^i(t)$ include mortgage age, the duration of the default episode for loans in default status and the existence of prior default episodes.

As illustrated in Exhibit A-1, for the FY 2013 Actuarial Review projections we ultimately stratified initial current status (CUR) by whether the loan had a prior default episode (CUR_X). As discussed further below, the econometric equations (1a) - (1d) and (3a) - (3c) for loans in current status (CUR) presented above were estimated using pooled samples of loans with and without prior default episodes or prior loan modification. The explanatory variables in $X_f^i(t)$ include (1) an indicator (dummy variable) for whether the loans had a prior loan modification and (2) a continuous variable representing the number of quarters since a loan exits the last default episode (cx_time).

We distinguish the current-to-current status transition into three possible ending statuses – whether the loan experienced (1) both prior default episodes and loan modifications (CX_M) (2) prior default episodes but not loan modifications and (3) none of the above. As noted, subsequent transitions from current status only use a current status (C) with no 90-day delinquency and prior loan modification distinction. The econometric equations (1a – 1d) for loans in current status (C) presented above were estimated using pooled samples of loans with or without prior default episodes or loan modifications. Thus, modeling two types of current-to-current transitions C to C

and C to CX is a nested logistic model [Equations (1e) and (1f)] while modeling the first level current-to-current transition is treated as an alternative event of current-to-default, current-to-streamline refinance, current-to-prepayment and current-to-claim.

As noted, this year we have expanded the possible ending statuses for cures to include two possible cure types – self-cure or non-mod foreclosure alternative (CUR_S) and modification cure (CUR_M) and subsequent transitions from current status we use a combined current status (CUR) definition. However, the prior default episode and loan modification flags identify the sub-type of the current status. Below are the three sub-types of a loan with current status related to the loan modification flag:

Current Transitions (Current to Default, Prepay, SR)		
CX_Time	Prior Loan Modification Flag	Sub-Type
0	0	Current loan which was never in default episode or loan modification **(C)**
>0	0	Current loan which had been in default episodes but self-cured **(CX_S)**
>0	1	Current loan which had been in default episodes but cured by loan modification **(CX_M)**

C. Computation of Multinomial Logit Parameters from Binomial Logit Parameters

As in prior-year Reviews, we apply the approach developed by Begg and Gray (1984), in which we estimate separate binomial logistic models for each possible transition type and then recombine the estimates to derive the multinomial logistic probabilities. Begg and Gray (1984) applied Bayes Law for conditional probabilities to demonstrate that the values of parameters α_f^i and β_f^i estimated from separate binomial logistic (BNL) models are parametrically equivalent to those for the corresponding multinomial logistic (MNL) model once appropriate calculations are performed. Assume that the conditional probabilities for current-to-prepay and current-to-default transitions for separate BNL models for loans in current status at the start of quarter t are given, respectively, by:

$$\Pi_{PRE}^{CUR}(t) = \frac{e^{\alpha_{PRE}^{CUR} + X_{PRE}^{CUR}(t)\beta_{PRE}^{CUR}}}{1 + e^{\alpha_{PRE}^{CUR} + X_{PRE}^{CUR}(t)\beta_{PRE}^{CUR}}} \tag{3a}$$

$$\Pi_{SR}^{CUR}(t) = \frac{e^{\alpha_{SR}^{CUR} + X_{SR}^{CUR}(t)\beta_{SR}^{CUR}}}{1 + e^{\alpha_{SR}^{CUR} + X_{SR}^{CUR}(t)\beta_{SR}^{CUR}}} \tag{3b}$$

$$\Pi_{DEF}^{CUR}(t) = \frac{e^{\alpha_{DEF}^{CUR} + X_{DEF}^{CUR}(t)\beta_{DEF}^{CUR}}}{1 + e^{\alpha_{DEF}^{CUR} + X_{DEF}^{CUR}(t)\beta_{DEF}^{CUR}}} \tag{3c}$$

$$\Pi_{CX}^{C}(t) = \frac{e^{\alpha_{CX}^{C} + X_{CX}^{C}(t)\beta_{CX}^{C}}}{1 + e^{\alpha_{CX}^{C} + X_{CX}^{C}(t)\beta_{CX}^{C}}} \tag{3d}$$

where we have used upper-case Π to indicate the binomial logistic probability and distinguish it from the lower-case π that was used above to denote the multinomial logistic probabilities. The corresponding binomial probabilities for transitions from default status to claim, prepayment, or current status are given by:

$$\Pi_{CLM}^{DEF}(t) = \frac{e^{\alpha_{CLM}^{DEF} + X_{CLM}^{DEF}(t)\beta_{CLM}^{DEF}}}{1 + e^{\alpha_{CLM}^{DEF} + X_{CLM}^{DEF}(t)\beta_{CLM}^{DEF}}} \tag{4a}$$

$$\Pi_{PRE}^{DEF}(t) = \frac{e^{\alpha_{PRE}^{DEF} + X_{PRE}^{DEF}(t)\beta_{PRE}^{DEF}}}{1 + e^{\alpha_{PRE}^{DEF} + X_{PRE}^{DEF}(t)\beta_{PRE}^{DEF}}} \tag{4b}$$

$$\Pi_{CUR\_S}^{DEF}(t) = \frac{e^{\alpha_{CUR\_S}^{DEF} + X_{CUR\_S}^{DEF}(t)\beta_{CUR\_S}^{DEF}}}{1 + e^{\alpha_{CUR\_S}^{DEF} + X_{CUR\_S}^{DEF}(t)\beta_{CUR\_S}^{DEF}}} \tag{4c}$$

$$\Pi_{CUR\_M}^{DEF}(t) = \frac{e^{\alpha_{CUR\_M}^{DEF} + X_{CUR\_M}^{DEF}(t)\beta_{CUR\_M}^{DEF}}}{1 + e^{\alpha_{CUR\_M}^{DEF} + X_{CUR\_M}^{DEF}(t)\beta_{CUR\_M}^{DEF}}} \tag{4d}$$

Estimation of the binomial logistic (BNL) probabilities in (3a) - (3c) and (4a) - (4d) produces estimates of parameters α_f^i and β_f^i that can be substituted directly into equations (1a) - (1c) and (2a) - (2d) to derive the corresponding multinomial logistic (MNL) probabilities. Also, estimation of nested logistic probabilities in (3d) and along with the first level of probability (1d) can derive the corresponding multinomial logistic (MNL) probabilities.

D. Loan Transition and Event Data

We used loan-level data to construct quarterly loan event histories by combining mortgage origination information with contemporaneous values of time-dependent factors. In the process of creating quarterly event histories, each loan contributed an observed "transition" for every quarter from origination up to and including the period of mortgage termination, or until the last time period of the historical data sample. The term "transition" is used here to refer to any

situation in which a loan remains active and the loan status changes prior to the start of the next quarter, or in which terminal claim or prepayment events are observed in the current quarter.

The FHA single-family data warehouse records each loan for which insurance was endorsed and includes data fields that record changes in the status of the loan. The historical data used in model estimation for this Actuarial Review is based on an extract from FHA's database as of June 30, 2013.

E. Data Samples

There are approximately 27.06 million single-family loans originated between the first quarter of FY 1975 and the second quarter of FY 2013. Sampling enhances the efficiency of model estimation. In credit risk modeling, a choice-based sample is commonly used for large populations with relatively rare events of interest. For this year's Review, we used a two-stage choice-based sampling process for estimating the transition equations where the sampling rates are determined by the terminal status of each loan and its status at each period.

Selected Literature Review

The sampling approach we used this year is supported by the literature, which is summarized here.

Manski and Lerman (1977)'s *Econometrica* paper "The Estimation of Choice Probabilities from Choice Based Samples" is one of the first papers to address the topic of choice-based samples. Before that, sampling was mainly used on independent variables, instead of on dependent variables. Because the parameters of a probabilistic choice model are estimated conditional on the independent variables, the sampling technique generally does not produce bias. Manski and Lerman prove that for a general probabilistic choice model, when the choice-based samples are weighted correspondingly, the MLE estimator is consistent and converges to the un-sampled estimator.

Scott and Wild (1985) discuss the response-based sample in a logistic model framework, and found that although the weighted estimators might be less efficient, the sampling produces unbiased parameter estimates of the logistic coefficients.

Xie and Manski (1988, 1989) argue that although under the logistic model, the random sampling and response-based sampling maximum likelihood estimators coincide for all parameters except the intercept, modelers should avoid assuming the logistic model form and analyzing the response-based samples without adjusting the sample weights. The weighted maximum likelihood method estimates a constrained best predictor of the binary response.

Choice-Based Sample for MMI Transition Models

For 30-year FRMs and FRM-SR, this year we used a two-stage process to implement choice-based sampling:
1. Over sample the bad loans, where a bad loan is defined as a loan that has ever been 90-day delinquent:
    a. Loan-level sampling rate of good loans = 10%
    b. Loan-level sampling rate of bad loans = 100%
2. Over sample in the bad quarters, where a bad quarter is defined as the quarter that a loan becomes a first-time 90-day delinquent and all subsequent performance quarters:
    a. Quarterly loan-level sampling rate of non-default quarters = 10%
    b. Quarterly loan-level sampling rate of default and subsequent quarters = 100%

With this two-stage sampling process, we calculate the following sampling probability matrix that shows the ultimate sampling probability for loan-quarter combinations. The corresponding weights we used are the reciprocal of the probabilities of selection.

Sampling Rate	Good Loan	Bad Loan
Good Quarter	10%	10%
Bad Quarter	N/A	100%

The following table shows that the new sampling technique reduced the total sample size by about 25 percent, while the bad-events sample size increased by almost 400 percent. The total observations count is almost identical to the count in last year's estimation dataset. We have fewer prepayments and streamline refinance observations, which leads to an increase in the standard error of the transition equations of prepayment and streamline refinance by about 32 percent. On the other hand, the standard error of "bad" transition equation was reduced by more than 50 percent.

Status	AR 2012		AR 2013			
	Sample Observations	Total Original Observations	Sample Observations	Ratio to 2012	Total Original Observations	Ratio to 2012
C to C	31,759,186	158,795,930	20,024,231	63.1%	158,984,465	100.1%
C to CX	37,437	187,185	186,815	499.0%	186,815	99.8%
C to D	517,695	2,588,475	2,550,952	492.8%	2,586,844	99.9%
C to PRE	752,149	3,760,745	584,758	77.7%	3,756,763	99.9%
C to SR	346,690	1,733,450	201,556	58.1%	1,741,915	100.5%
D to PRE	32,155	160,775	159,939	497.4%	159,939	99.5%
D to CLM	139,072	695,360	658,541	473.5%	694,433	99.9%
D to CX_M	65,198	325,990	324,789	498.2%	324,789	99.6%
D to CX_S	149,531	747,655	747,035	499.6%	747,035	99.9%
Total	33,799,113	168,995,565	25,438,616	75.3%	169,182,998	100.1%

We used loans originated from FY 1996 through FY 2012Q3 to estimate the status transition models starting in current and default statuses that transition to other statuses, corresponding to the loan cohorts for which complete data were available on new 90-day default episodes. These data were used to generate quarterly loan-level event histories to the end of the sampling period or when the loan claimed, fully prepaid or matured.

Estimation and forecasting was undertaken separately for each of the following six FHA mortgage product types:

Product 1	FRM30	Fixed-rate 30-year fully underwritten purchase and refinance
Product 2	FRM15	Fixed-rate 15-year fully underwritten purchase and refinance
Product 3	ARM	Adjustable-rate fully underwritten purchase and refinance
Product 4	FRM30_SR	Fixed-rate 30-year streamlined refinance
Product 5	FRM15_SR	Fixed-rate 15-year streamlined refinance
Product 6	ARM_SR	Adjustable-rate streamlined refinance

The sampling rate scheme used for each product to produce the estimation dataset is summarized in Exhibit A-3. Recall that the sampling scheme used in the FY 2012 Review was a 20 percent sample for FRM30 and 100 percent for all other products.

Exhibit A-3: Choice-Based Sampling Scheme

Product Number	Product Type	Sampling Scheme
Product 1	FRM30	1) Clean Loans[38]: 10% 2) Clean periods of non-clean loans[39]: 10% 3) Non-clean periods of non-clean loans[40]: 100%
Product 2	FRM15	100% for all loans
Product 3	ARM	100% for all loans
Product 4	FRM30_SR	1) Clean Loans: 25% 2) Clean periods of non-clean loans: 25% 3) Non-clean periods of non-clean loans: 100%
Product 5	FRM15_SR	100% for all loans
Product 6	ARM_SR	100% for all loans

F. Weight Adjustment for Default Transitions

In order to limit the impact of policy actions, such as the foreclosure moratorium and mass modification programs taken by government agencies, lender/servicers and other mortgage market participants--which is likely to under-estimate the true default-to-claim transition--we cut off the default transition data at FY 2009Q3 for this year's estimation.

However, by cutting off the estimation data at such an early time, we would likely omit legitimate observations of transitions, such as default-to-prepay, default-to-self cure and default-to-modification, which are competing transitions vs. default-to-claim. If we were to add these back in, this would create an under-estimation bias, because of the artificially high default inventory due to foreclosure moratoria and other factors including a high rate of new foreclosures. We used the following approach to correct this bias:

1. Estimate the default-to-claim transition using observations up to 2009Q3.
2. Using this equation, generate an out-of-sample estimation for default-to-claim transition until 2012Q3 and then:

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[38] "Clean Loans" means loans which have never defaulted, prepaid or claimed throughout the entire history or up to the most current time.

[39] "Clean periods of non-clean loan" means the periods before a loan first becomes default, prepay or claim during the life of the loan.

[40] "Non-clean periods of non-clean loan" means the periods after a loan first becomes default, prepay or claim during the life of the loan.

    a. Adjust the default-to-default transition weight, using the cumulative difference between the predicted and actual default-to-claim transition and

    b. Estimate the remaining default-to-prepay, default-to-self cure and default-to-modification cure equations over the entire period with the adjusted weight for the default-to-default transition, which transition is the residual one not estimated directly.

This procedure allows the latter three transition probabilities to be estimated over the entire period not biased by the out-of-the-ordinary loans that had accumulated in the default status instead of going to claim.

II. Explanatory Variables

Five categories of explanatory variables were used to estimate the various transition equations:

- Fixed initial loan characteristics including mortgage product type, property type, purpose of loan (home purchase or refinance), amortization term, origination year and quarter, original loan-to-value (LTV) ratio, original loan amount, original mortgage interest rate, spread at origination (SATO) and relative house price level by geographic location (MSA, state or Census division);

- Fixed initial borrower characteristics including borrower credit scores and indicators of the source of downpayment assistance;

- Dynamic variables based entirely on loan information including mortgage age, duration of default episode, whether a loan has had a prior default episode, number of quarters since the end of the latest default episode, season of the year, scheduled amortization of the loan balance, whether a loan has had a prior loan modification, percentage of monthly payment reduction resulting from loan modifications, the number of prior quarters the prepayment option was in the money, and the cumulative number of quarters that a property has been "underwater"; and

- Dynamic variables derived by combining loan information with external economic data, e.g., refinance incentive, which is the difference between monthly payments calculated by the (contract) mortgage interest rate and the prevailing market rate.

- Dynamic macroeconomic variables including the unemployment rate, the spread of the mortgage rate to the 10-year Constant Maturity Treasury rate, and house price indexes.

In some cases the two types of dynamic variables are combined, as in the case of adjustable-rate mortgages (ARMs) where external data on changes in 1-year Treasury yields are used to update the original coupon rates and payment amounts in accordance with standard FHA loan contract features. This in turn affects the amortization schedules of the loans.

We account for variation in FHA loss mitigation activities by estimating two separate cure-type equations, equations (2c), and (2d) above. The model estimates the impact of prior default episodes and develops separate actuarial projections for loans with and without prior default episodes and is therefore more sensitive to the conditions during the recent housing crisis.

Exhibits A-7.1 through A-7.6 summarize the explanatory variables that were used in the statistical modeling of loan status transitions and present the coefficient estimates for the 48 binomial logistic models. While we continue to employ categorical (dummy) variables for those variables that are binary, such as the indicator of prior default episodes, we converted most categorical variables into continuous linear or linear spline variables, such as the refinance incentive, the burnout factor and the yield curve slope. Linear forms were used when they seemed reasonable and improved statistical fit; otherwise the spline forms were used to reflect nonlinearities. Also we constrained some variables, such as the current loan-to-value ratio, at certain levels because of thin data for these variables in the extreme regions. At some point, the borrower is sufficiently underwater and incremental "underwaterness" does not matter.

This year we have included several new explanatory variables, which improve the in-sample fit significantly. Most of these variables were introduced as splines. Additional details on each set of variables are provided below, with the newly added variables first.

Purchase-Only HPI

One of the most significant changes this year is that we now use the Purchase-Only (PO) Home Price Index (HPI) to replace the all-transaction HPI which was used in previous Reviews. The PO series was not available from FHFA for prior Reviews. The PO Index is based on repeat sales at market prices and does not use any appraised values. As such, it provides a more reliable measure of housing market conditions. Evidence cited below has found appraisal bias, albeit not from all appraisers. We want a house price series that accurately estimates CLTVs and thus what defaulted properties would sell for.

There is documented evidence of bias in residential appraisals so that the PO Index is a more accurate representation of market values. Chinloy, Cho and Megbolugbe (1997) compared the

purchase prices against appraisals and found a two percent upward bias. In addition they found that appraisal prices exceed the purchase prices in 60 percent of the cases. They postulated that the existence of a moral hazard incentive to complete the deal might be the reason for the bias.

More recent papers provide additional empirical support for the existence of appraisal bias. Agarwal, Ben-David and Yao (2012) used a sample of over one million pairs of conforming mortgage transactions that were originated between 1990 and 2011 and concluded that the average valuation bias for residential refinance transactions is about 5 percent. Tzioumis (2013) using data from a large mortgage lender during 2005-2006 and found that a minority of appraisers systematically inflated house price values. Pace and Zhu (2012) analyzed appraisals on foreclosed properties in New Orleans. They found that the relation between the client and the appraiser affects the valuation bias. Pace and Zhu also found that experienced appraisers produced less biased valuations. In summary, these papers provide evidence of the existence of bias in house price appraisals.

Bias of the all-transaction HPI is also found in industry studies. The Collateral Assessment and Technologies Committee, an industry trade group, provided a report in 2005 regarding appraisal bias. The report compared the prices generated by "full" appraisals with home prices from "non-full" appraisals, including house prices evaluated by automated valuation models (AVMs). The report concluded that there is material bias within the full appraisal prices.

The Home Affordable Refinance Program (HARP) was introduced by FHFA in March, 2009 to assist underwater and near-underwater homeowners to refinance their mortgages. One of the requirements of HARP is that the loan is needed to be owned or guaranteed by Freddie Mac or Fannie Mae. Since HARP was introduced, refinances through HARP have become a major component of the entire refinance market. For example, in the first quarter of 2013, HARP had a market share of 22 percent of all refinance loans in the U.S.[41] Since HARP has a significant market share and was not used by FHA, by excluding all refinance transactions the impact of HARP is mitigated, hence making the PO HPI more representative of the FHA portfolio.

The construction of the PO HPI is based on the exclusion of appraised home values, which are also higher-valued properties. Research by the FHFA suggested that the home prices of refinanced homes are 12 – 14 percent higher than non-refinanced homes.[42] Exhibit A-4 compares the median home sales prices between FHA loans and conventional loans. It is shown that home

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[41] http://www.fhfa.gov/webfiles/25319/March2013Refinancerelease061213.pdf

[42] The research could be found at http://www.fhfa.gov/webfiles/1050/Focus1Q07.pdf

prices are lower for FHA loans than for conventional loans. Therefore, the PO HPI represents the composition of the FHA portfolio better than the all-transaction HPI.

Another reason for using the PO HPI is that in recent years, industry practices are leaning toward the PO HPI. The most commonly used indices, such as Case-Shiller Home Price Index and CoreLogic HPI, are all constructed based on a purchase-only methodology. Exhibit A-5 compares the historical trends of different HPIs at the national level. It is shown that all indices have a similar trend, although the run-up during the housing boom was less for the FHFA PO HPI index. Since FHFA released their PO HPI at the MSA level this year, it is consistent with general industry practices to use the PO HPI, and is a major reason we were able to use it this year for the first time.

Exhibit A-4: Comparison of Median Home Prices
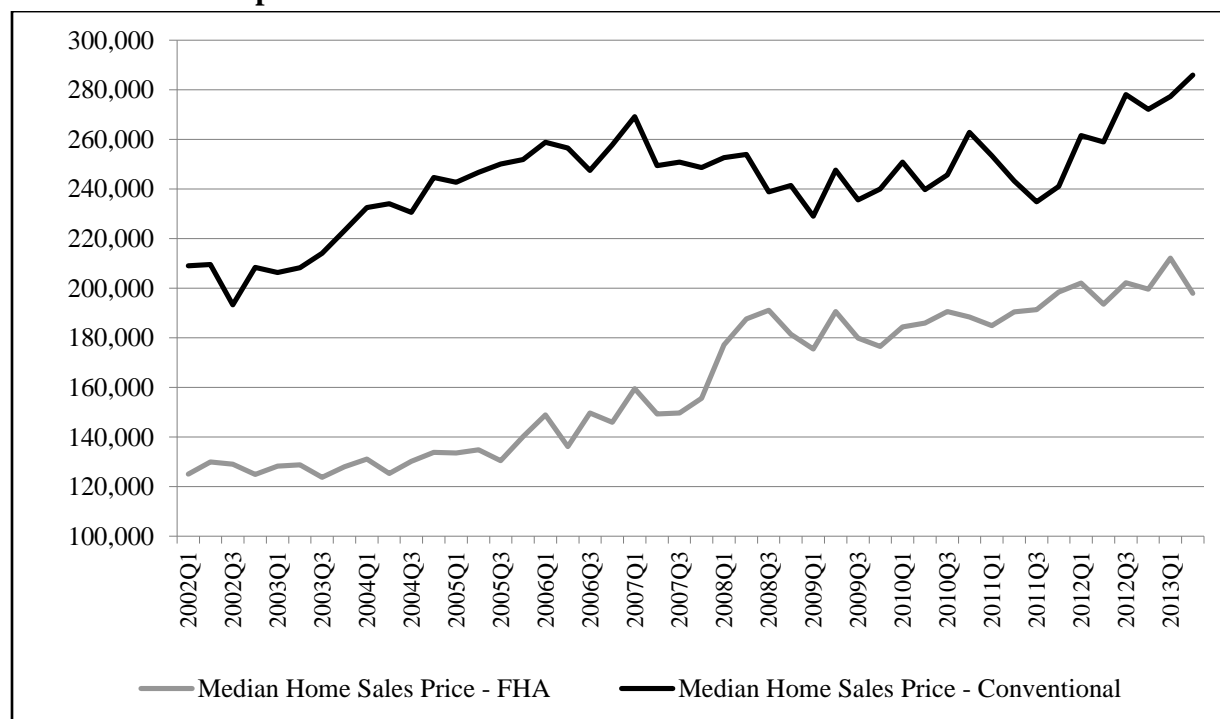
Exhibit A-5: Comparison of PO HPI Indices
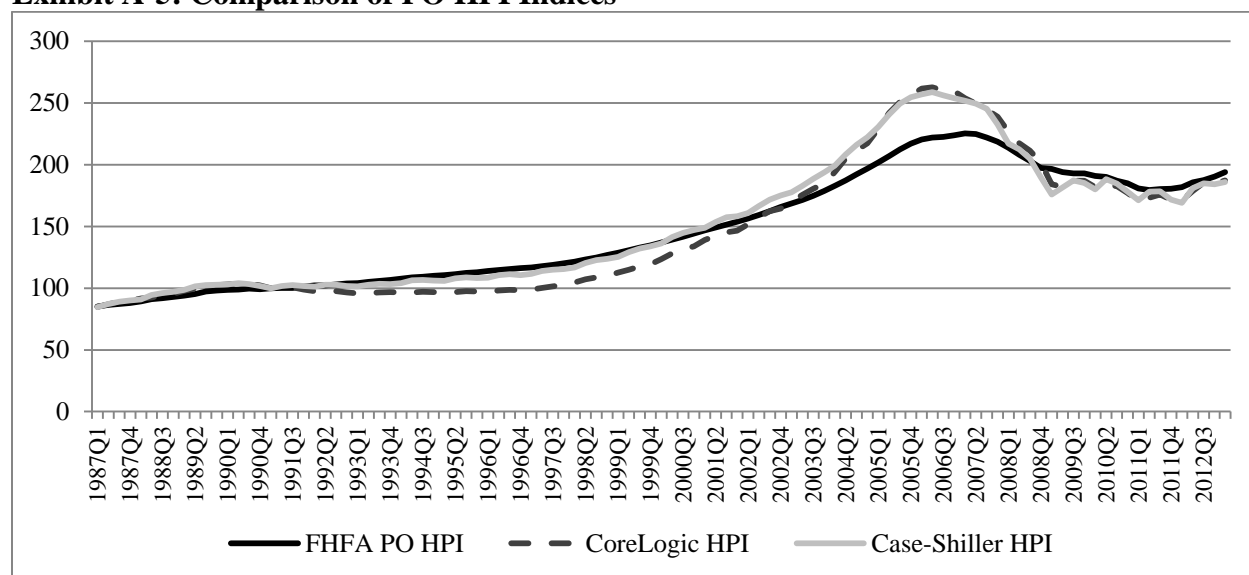
HPI = 100 at Q1, 1991

Exhibit A-6 compares the PO HPA with the all-transaction HPA at the national level. Over the long run, they are similar but there are short-run differences, which we state as a matter of fact.

Exhibit A-6: Comparison of FHFA PO HPA and All-Transaction HPA
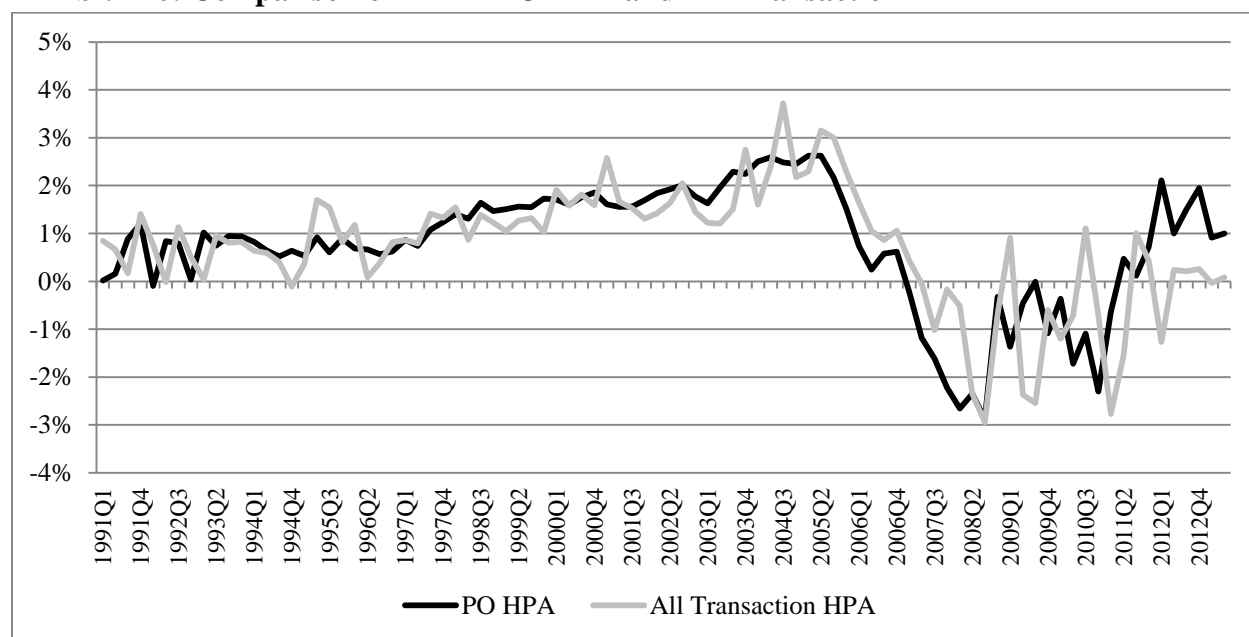
Prior Loan Modification Indicator

As specified in section I, we separated the transition paths of loans which were cured by themselves or by loan modification and for the latter we introduced a prior loan modification indicator. The prior loan modification indicator is equal to 1 after the flag of loan modification cure is turned on (i.e., CX_M = 1), and remains at 1 until the termination or payoff of the loan. For example, if a loan receives a loan modification and is cured from default in its 20th quarter, the prior loan modification indicator is equal to 1 and remains 1 starting from the 21st quarter.

Loan Modification Payment Change

This year, we received additional information regarding loan modification, including the change of monthly payment resulting from each loan modification. The purpose of loan modification is to change one or more of the terms of a loan. This allows the loan to be reinstated, and results in a payment the borrower can afford. Therefore, the percentage change of monthly payment resulting from a loan modification will affect the borrower's capacity to service the loan, and hence impact the future transition of the loan.

Since the financial crisis and the crash of the U.S. housing market, loan modification has been widely used to reduce foreclosures. At the beginning of the financial crisis, most loan modifications were in the form of forbearance, resulting in monthly payment increases. In the subsequent years, modifications of the terms such as interest rate and amortization schedule became the most frequent types of modification. Within all the major types of loan modifications, forbearance is the only type which would result in monthly payment increases. As mentioned above, most of the forbearances occurred at the beginning of the financial crisis and the number of forbearances became insignificant since 2010. Since forbearance is not expected to be a major modification type in the future time horizon, we floor the percentage of monthly payment change to zero so that the monthly payment change resulting from forbearance will not impact the estimation and forecast of the model.

The details of the loan modification payment change are not retrievable for some of the modified loans. In such a case, we created an indicator specifying this missing information.

Number of Quarters Since the End of Last Default Episode

This year we replaced the prior default episode indicator by the number of quarters since the end of the latest default episode (CX_TIME) for transitions in the current status. The reason is that we believe the duration since the latest default episode will affect future transitions. For example, a loan which is just cured from a default episode may have a higher probability of re-defaulting compared to a loan which has been cured for a long time. Evidence shows that not only past

default experience, but also the duration of time since its cure affects the probabilities of future transitions.

The CX_TIME is set to zero at the origination of each loan until the end of its first default episode. It becomes 1 after the end of the default episode, and keeps increasing quarterly until the start of next default. For example, if a loan experiences a second default episode, CX_TIME continues to increase until the start of the second default episode, and it is set to 0 during the second default episode. After the end of the second default episode, it is reset to 1 and continues to accumulate until the next default. We modeled this variable as a spline function, which depicts its declining marginal effect as the time since the last default increases.

Mortgage Premium (Refinance Incentive)

In previous Reviews, the refinance incentive was proxied by the relative spread between the mortgage contract interest rate and the current market mortgage rate. This year, we use the percentage difference, specified by $Refi\_incentive(t)$, between the monthly payment of a potential refinance $PMT_1(t)$ relative to the current payment $PMT_0(t)$:

$$Refi\_incentive(t) = 100 * \frac{PMT_0(t) - PMT_1(t)}{PMT_0(t)}. \tag{5}$$

This variable is an approximation to the call option value of the mortgage given by the difference between the present value of the "anticipated" future stream of mortgage payments discounted at the current market rate of interest and the present value of the mortgage evaluated at the current note rate. Additional details are given in Deng, Quigley, and Van Order (2000) and Calhoun and Deng (2002).

For the transition into the FHA streamline refinance mortgage, we use as the refinancing option for a FHA mortgage, by definition. For all other transitions we use the payment from a market mortgage, assumed to be a GSE mortgage.

Also, for the first time, we added the annual FHA mortgage insurance premium (MIP) to the mortgage rate, in both the current FHA loan and the potential new FHA loan (for SR), as follows:

$$effect\_coupon\_rate(t) = C(t) + annual \ MIP(t), \tag{6}$$

where $C(t)$ is the coupon rate for extant FHA loans.

For the effective GSE refinancing rate, we want to add the effective refinancing points to the contract rate, which translates the one-time points to an equivalent interest rate spread over time. FHFA publishes both the contract rate and this effective rate, and we calculated the spread

difference and project it in our analysis. Therefore, we define the effective refinancing cost *avg_refi_cost* as the spread between the FRM30 effective rate and the contract rate provided in the FHFA survey:

$$GSE\_refi\_rate(t) = R(t) + avg\_refi\_cost, \tag{7}$$

Assuming refinancing costs are the same for both the GSE and FHA refinancings, the effective rate for refinancing into an FHA loan is then built onto this GSE refinancing rate, by adding the average FHA to GSE spread and the new annual MIP:

$$FHA\_refi\_rate(t) = GSE\_refi\_rate(t) + avg\_FHA\_GSE\_sprd + annual\_MIP, \tag{8}$$

The payment on the current FHA loan is $PMT_0(t)$. Using the above effective refinance rates, we compute "effective" monthly mortgage payments for the current and the prospective new refinancing loans $PMT_1(t)$, which have a prefix denoting whether they are the GSE or FHA loan options. The refinance incentive for a GSE refinancing loan is:

$$GSE\_Refi\_incentive(t) = 100 * \frac{PMT_0(t) - GSE\_PMT_1(t)}{PMT_0(t)}. \tag{9}$$

The GSE refinance incentive variable is used in transitions other than current-to-SR. The refinance incentive for a loan refinanced from FHA in the transition current-to-SR is:

$$FHA\_Refi\_incentive(t) = 100 * \frac{PMT_0(t) - FHA\_PMT_1(t)}{PMT_0(t)}. \tag{10}$$

Unemployment Rate

There is ample literature that indicates job loss, or loss of income, is one of the major trigger events for mortgage default. The natural choice of macroeconomic variables to capture this effect is the unemployment rate. However, during the period of 1994-2008, when the U.S. economy grew at a steady rate and only experienced a minor recession, the variation in the unemployment rate was extremely small, which makes it difficult to demonstrate that it is a significant factor: the national unemployment rate in that period was almost always between 4% and 6%. That is part of the reason why previous attempts to use this variable showed it as not statistically significant. After 2008, the unemployment rate rose rapidly, and consequently we have found that this variable is both statistically and economically significant in the borrower's default behavior.

The FY 2012 Review introduced two types of unemployment rates: the short-term unemployment rate change, *Delta_UE(t)*, and a relative unemployment rate, *Relative_UE(t)*. The short-term unemployment rate change is measured as the change in the unemployment rate level between last quarter and the level three quarters ago, which indicates the direction of change in unemployment. The relative unemployment rate is measured as the ratio between the unemployment rate level in last quarter, *UE(t-1)*, and the moving average over the last 10 years, *UE_10yr_avg(t)*, which indicates the current inventory of unemployment. For example, although the quarterly change in the unemployment rate did not vary much after year 2008, the relative unemployment rate continued to climb due to the recession. The formulas for computing these two measures are:

$$Delta\_UE(t) = UE(t-1) - UE(t-3), \tag{11}$$

$$Relative\_UE(t) = \frac{UE(t-1)}{UE\_10yr\_avg(t)}. \tag{12}$$

Debt-to-Income (DTI) Ratio

The DTI ratio measures the ratio of monthly debt payment to before-tax total household income at origination. There are two ratios available: the front-end ratio, which counts only the mortgage-related housing cost, i.e., PITI (principal, interest, tax and insurance); and the back-end ratio, which includes payments for all other regular monthly debt, including car loans, student loans, and credit cards. We use the front-end ratio to capture the debt burden effect for the borrower, because it is better documented and measured more accurately than the back-end ratio.

Current Loan-to-Value (CLTV) Ratio

This variable is calculated as the origination Loan-to-Value (OLTV), divided by the appreciation factor since origination (i.e., inflating—or deflating—the denominator, the house price), adjusted for amortization. Empirical results show that the mortgage default rate is very sensitive to the CLTV ratio, when the property value moves into the negative equity range (at a CLTV near to or greater than 100%). This empirical result is consistent with option theory, when the put/default option is in-the-money when the property is "underwater," and the borrower would have a financial incentive to exercise this option. The CLTV variable is a more direct way to capture the borrower's incentive to default than is the probability of negative equity variable (PNEQ) used in prior Reviews. However, PNEQ was included in the ARM current-to-prepay equation. In general, ARM transitions are more difficult to predict than FRM's.

CLTV was used as a continuous variable for transitions to prepayment and to cure (both self and modifications), but to capture nonlinearities and because of thin data at high CLTVs, we otherwise used splines, and constrained the CLTV function at a fixed level for transitions to

default and to claim (all such transitions except for FRM15, FRM SR and ARM SR, where one of the transitions current to default and default to claim was not capped). For example, we applied a piece-wise linear spline function for the default-to-claim transition for FRM30 loans with knots (the k's) of 0.6 and 1.0 and constrained the CLTV function at its value at knot 1.0 for CLTVs above 1.0. The spline function with two knots k_1 and k_2 is specified as follows, where cltv is the continuous CLTV variable:

$$cltv1 = \begin{cases} cltv & \text{if } cltv \leq k_1 \\ k_1 & \text{if } cltv > k_1 \end{cases}$$

$$cltv2 = \begin{cases} 0 & \text{if } cltv \leq k_1 \\ cltv \text{-} k_1 & \text{if } k_1 < cltv \leq k_2 \\ k_2 \text{-} k_1 & \text{if } cltv > k_2 \end{cases}$$

$$cltv3 = \begin{cases} 0 & \text{if } cltv \leq k_2 \\ cltv \text{-} k_2 & \text{if } cltv > k_2 \end{cases}$$

Coefficient estimates for each variable are the incremental slopes of the line segments between each knot point. They were estimated for each product and transition type combination, except for the exceptions noted above that use the linear form. The overall generic CLTV function for the 3-cltv segment example is given by:

$$\text{CLTV Function} = \beta_1 \cdot cltv1 + \beta_2 \cdot cltv2 + \beta_3 \cdot cltv3 \tag{13}$$

This function is estimated as a set of three variables in each binomial equation. For those cases where we capped the effect of CLTV at high levels (above the last knot point), we set the estimate of β_3 to zero.

Loan-to-Value Ratio

The initial LTV is recorded in FHA's data warehouse. For fully underwritten mortgage products and streamline refinance loans with required appraisals these LTV values are used directly to compute the CLTV. Following the approach adopted for the FY 2011 Review, for streamline refinance loans without required appraisals, we have linked the streamline refinance loans with the original fully underwritten FHA mortgage to the same borrower, and used the information from this original loan as the starting point for updating CLTVs. If the previous mortgage was also a streamline refinance mortgage we kept going back until we reached the original fully underwritten mortgage.

Indicator variables were used in transitions: ltv100 is unity if the original LTV is greater than 95 percent, and ltv95 is unity if the LTV is greater than 90 but less than or equal to 95 percent; otherwise, these variables are zero.

Home Price Volatility

Option theory predicts that the put (default) option value increases when the volatility of the collateral increases, everything else equal. Empirical results show the marginal effect of home price volatility on default behavior is generally positive, which is consistent with option theory. An easier way to interpret this phenomenon is that the home price volatility measures our uncertainty in calculating the updated property value; higher volatility would introduce more error on both positive and negative sides. However, the loss introduced on the negative side is not compensated by the gain on the positive side, due to the asymmetric nature of mortgage credit risk.

The home price volatility is the same as the measurement of parameters "*a*" calculated in the Probability of Negative Equity, which indicates uncertainty with regard to the dispersion of individual house price appreciation rates around the market average, represented by the local-level HPI. The parameter "*a*" is estimated by FHFA when applying the three-stage weighted-repeat-sales methodology advanced by Case-Shiller (1987, 1989). See Appendix C.II below.

Home Price Appreciation

The home price enters the model via two variables, each of which has a different interpretation. Home price appreciation since origination (at the metro/non-metro area level) determines the CLTV ratio, which is used to measure the current equity in the property. Short-term house price appreciation, which proxies for people's expectation of future house price movements, is also used. The rationale for this variable is that borrowers make their decisions not only on the realized historical information, but also on their expectation about future house price appreciation. Short-term home price appreciation, HPA2y(t), is calculated as the projected house price index one year ahead, HPI(t+4), divided by historical house price index one year ago, HPI(t-4), measured at both the national level and at the Metropolitan Statistical Area (MSA) level, HPI(i):

$$HPA2Y(t,i) = \frac{HPI(t+4,i)}{HPI(t-4,i)}.$$ (14)

When historical observations are used to estimate the transition equations, actual four-quarter-ahead observations are used to measure this variable. For simulations along future HPA/interest rate paths, the same measurement is made, using the projected HPAs four-quarters ahead.

The variable hpa2y_n = min(0, hpa2y). It differentiates the response when the anticipated HPA is negative compared to positive.

Relative Loan Size

This variable is proxied by the mortgage origination amount, divided by the average loan origination amount in the same state for the same fiscal year. It replaces the relative house price variable used in previous Reviews. Empirical results show this variable is very significant in prepayment-related termination. This is consistent with option theory, since loans with higher loan size could achieve higher monetary savings, given the same relative mortgage spread. For hypothetical loans originated after FY 2013Q2, we applied relative loan size assumptions consistent with the loans originated during FY 2012Q3 to FY 2013Q2.

Spread at Origination/SATO

SATO is measured as the spread between the mortgage note rate, C, and the prevailing mortgage rate, R, at the time of origination. It is widely regarded as the lender surcharge for additional borrower risk characteristics, which are not captured by standard underwriting hard data such as FICO score, OLTV, DTI ratio, documentation level, etc. A high SATO loan is generally more risky, compared to a similar loan with a low SATO. Some researchers also argue that a high SATO is an indicator of predatory lending, which also tends to increase credit risk.

$$SATO = C - R. \tag{15}$$

Burnout Factor

A burnout factor is included to identify borrowers who have foregone opportunities to refinance. It is measured as the accumulation of the positive spreads between the coupon rate and new refinance mortgage rate throughout the life of loan. The burnout factor is included to account for individual differences in propensity to prepay, often characterized as unobserved heterogeneity. In addition, unobservable differences in borrower equity at the loan level may give rise to heterogeneity that can impact both prepayment and claim rates. Only the FRM30 equations exhibit this effect.

For 30-year FRMs, we observed that burnout increases the likelihood of default, most likely because the borrowers did not lower their mortgage payments when the current market rate was lower than their contract rate, possibly because they had negative equity. However, after a number of quarters, the effect may be reversed, showing a lower propensity to default, as if their attitude toward not refinancing carries over to a tendency not to default.

When the refinance option is foregone over a long period of time, especially when the magnitude of the quarterly observed spreads are large, it is very likely that the probability of exercising the refinance option would not continue to decrease with an even larger refinance incentive. To capture this feature, we forced the slope of the impact of burnout to zero when it reached a certain level. The 95th percentile of the latest observations on each loan for all loans experiencing burnout is the cut-point, which turns out to be 96.3 percent. Therefore, we are assuming that once a loan has the value of the burnout factor larger than 96.3 percent, increased burnout would not further impact the probabilities of the various transitions anymore.

Credit Burnout

Burnout is a relatively well-understood concept in prepayment modeling. Borrowers who have forgone refinance opportunities in the past are less likely to refinance in the future. Similarly, borrowers who have forgone a default option and showed resilience by making uninterrupted payments in the past are less likely to default in the future. We use the cumulative number of quarters that a property has been "underwater" to proxy this effect.

When the default option has not been exercised for a long period, it is very likely that the probability of exercising the default option would not continue to decrease in the future. To capture this feature, we force the slope of the impact of credit burnout to zero when it reaches a certain level. The 95th percentile of the latest observations on each loan for all loans experiencing credit burnout is the cut-point, which turns out to be 14 quarters. That is, effects beyond this point were not observed sufficiently to rely on any non-zero estimate we may have derived. Therefore, we assumed that once a loan has been underwater for more than 14 quarters, credit burnout would no longer impact the transition probabilities.

Property Type

We include property type (number of units) into our transition model framework. Multi-unit single-family properties (2, 3, 4 units) are generally at least partially rental properties. The volatility of the rental income, combined with idiosyncratic risk of the properties, tends to increase the default risk for these loans and reduce the prepayment propensity.

FHA Score Indicator

FHA adopted a number of changes in FY 2005 with potential impacts on underwriting, including implementation of its TOTAL scorecard. So this dummy variable is defined as unity if the loan was originated after FY 2004, zero otherwise.

Specification of Piece-Wise Linear Age Functions

Exhibit A-7 lists the series of piece-wise linear age functions that were used for each of the loan status transitions for each of the six different mortgage product types. For example, we used a piece-wise linear age function for current-to-streamline refinance transitions of FRM30 loans with knots (the k's) at ages 2, 5 and 10 quarters by generating 4 new age variables age1 to age4 defined as follows:

$$
age1 = \begin{cases} AGE & \text{if } AGE \leq k_1 \\ k_1 & \text{if } AGE > k_1 \end{cases}
$$

$$
age2 = \begin{cases} 0 & \text{if } AGE \leq k_1 \\ AGE - k_1 & \text{if } k_1 < AGE \leq k_2 \\ k_2 - k_1 & \text{if } AGE > k_2 \end{cases} \tag{16}
$$

$$
age3 = \begin{cases} 0 & \text{if } AGE \leq k_2 \\ AGE - k_2 & \text{if } k_2 < AGE \leq k_3 \\ k_3 - k_2 & \text{if } AGE > k_3 \end{cases}
$$

$$
age4 = \begin{cases} 0 & \text{if } AGE \leq k_3 \\ AGE - k_3 & \text{if } AGE > k_3 \end{cases}
$$

Coefficient estimates for each variable are the incremental slopes of the line segments between each knot point and for the last open-ended segment. They were estimated for each product and transition type combination and reported in Exhibit A-5. The overall generic AGE function for the 4-age segment example described above is given by:

$$
\text{Age Function} = \beta_1 \cdot age1 + \beta_2 \cdot age2 + \beta_3 \cdot age3 + \beta_4 \cdot age4 \tag{17}
$$

Age functions with fewer numbers of segments were developed in a similar manner. The number of segments and the selection of the knot points were determined by testing alternative specifications and assessing the reasonableness of the resulting functions. For some products and transition types the age functions were omitted altogether due to the instability or statistical insignificance of the estimated parameters.

Specification for Default Durations

We changed the specification for default durations this year. In previous years, the default durations interacted with the judicial state indicator in a categorical format. The reason for specifying the variable in a categorical format is that we needed to limit the dimensions of the

matrix of transition probabilities. This year we changed the forecasting methodology to a dynamic simulation, as described in Appendix G, which enabled us to increase the dimension of default durations, which we made into a continuous variable and put into a spline form.

Judicial State Indicators

As mentioned above, judicial state indicators are separated from the default durations this year. If the collateral property is in a judicial state, the indicator is equal to 1, otherwise it equals zero.

Seasonality Indicators

The season of an event observation quarter is defined as the season of the year corresponding to the calendar quarter, where season 1 = Winter (January, February, March), 2 = Spring (April, May, June), 3 = Summer (July, August, September), and 4 = Fall (October, November, December). All categorical (0-1 dummy) variables take on the value of 1 for the specified quarter; and one of the categories is omitted as the reference category.

ARM Payment Shock

This variable is an approximation to the call option value of the quarterly mortgage payment, PMT, calculated by amortization schedule and driven by the difference between the ARM coupon rates, C(t) (that are updated over the life of mortgage as described below) and initial contract rates, C(0):

$$pmt\_shock(t) = \left\{ 100 * \frac{PMT(t) - PMT(0)}{PMT(0)} \right\}. \tag{18}$$

This variable is typically reserved to predict defaults, but over most of the estimation period, rates have fallen, and it is not statistically significant in the equation. However, we found it useful for the ARM prepayment transition, and it was used along with the above mortgage premium variable.

ARM Coupon Rate Dynamics

To estimate the current financial value of the prepayment option for ARM loans, and to compute amortization rates that vary over time, we tracked the path of the coupon rate over the active life of individual ARM loans. The coupon rate resets periodically to a new level that depends on the underlying index, plus a fixed margin, subject to periodic and lifetime caps and floors that specify the maximum and minimum amounts by which the coupon can change on each

adjustment date and over the life of the loan. Accordingly, the ARM coupon rate at time $t, C(t)$, was computed as follows:

$$
\begin{aligned}
C(t) = max\{ &min[\,Index(t-S) + Margin, \\
&C(t-1) + A(t) \cdot Period\_UpCap, C(0) + Life\_UpCap\,], \\
&C(t-1) - A(t) \cdot Period\_DownCap(t), max(C(0) - Life\_DownCap, Life\_Min)\}
\end{aligned}
$$

(19)

where $Index(t)$ is the underlying rate index value at time t, S is the "look back" period, and *Margin* is the amount added to $Index(t-S)$ to obtain the "fully-indexed" coupon rate. The periodic adjustment caps are given by $Period\_UpCap$ and $Period\_DownCap$, and are multiplied by dummy variable $A(t)$ which equals zero except during scheduled adjustment periods. Maximum lifetime adjustments are determined by $Life\_UpCap$ and $Life\_DownCap$, and $Life\_Min$ is the overall minimum lifetime rate level. Any initial discounts in ARM coupon rates are reflected in the original interest rate represented by *C(0)* in equation (19).

Yield Curve Slope

Expectations about future interest rates and differences in short-term and long-term borrowing rates associated with the slope of the Treasury yield curve influence the choice between ARM and FRM loans and the timing of refinancing. We used the spread of the 10-year Constant Maturity Treasury (CMT) yield over the 1-year CMT yield to measure the slope of the Treasury yield curve.

Exposure Year/Quarter FRM Rate

A variable measuring the market average FRM mortgage rate is included to distinguish high-rate and low-rate market environments. This variable was entered as a continuous linear variable in the ARM equations.

Source of Downpayment Assistance

As documented in the FY 2006 and FY 2007 Reviews, the FHA single-family program experienced a significant increase in the use of downpayment assistance from relatives, non-profit organizations, and government programs. Following the approach first applied in the FY 2006 Review, we have included a series of indicators to control for the use of different types of downpayment assistance by FHA borrowers. Loans to borrowers utilizing downpayment assistance from non-profit organizations have experienced significantly higher claim rates than otherwise comparable loans without this type of downpayment assistance. Although this particular form of downpayment assistance is now prohibited, it is still necessary to control for

their impact on historical and future loan performance for those loans that received such assistance. An omitted category does not apply here, because not all borrowers use downpayment assistance.

Borrower Credit Scores

Borrower credit scores at the loan level were first included in the models estimated for the FY 2007 Review and continue to be an important predictor of claim and prepayment behavior. FHA has relatively complete data on borrower FICO scores for loans originated since May 2004. In addition, FHA retroactively obtained borrower credit history information for selected samples of FHA loan applications submitted as far back as FY 1992. These data provide an additional source of loan-level information on borrower FICO scores that are used for estimation. Historical FICO score data was collected for HUD by Unicon Corporation for FHA applications submitted during FY 1992, FY 1994, and FY 1996. FICO scores of the primary borrower and up to two co-applicants were collected from a single credit data repository for a random sample of approximately 20 percent of loan applications. Since the estimation dataset for the transition equations starts in FY 1996, only the latter sample is relevant for this Review.

A second set of sample data was collected for loan applications over the period from FY 1997 to FY 2001. FICO scores for up to three co-applicants were collected from up to two credit data repositories for about 20 percent of the loans in each year, with over-sampling of loans defaulted by April 2003. A third and final set of data, similar to the second set, was collected for FY 2002 to FY 2005 applications, with over-sampling of loans defaulted by February 2005. The over-sampling of historical borrower credit scores for default outcomes introduces issues of choice-based sampling. These issues are addressed in a separate section below.

These three sets of FICO data represent the most reliable sources of borrower credit history information available for historical FHA-endorsed loans prior to FY 2005. Following the methodology adopted by Freddie Mac and Fannie Mae, the FICO score of each individual borrower or co-borrower, respectively, is the median (of three) or minimum (of two) scores when scores are provided by multiple credit data repositories. The final FICO score assigned to a loan is the simple average of these individual FICO scores for the borrower and up to four co-borrowers.

Additional indicator variables were specified to represent two particular forms of missing data on FICO scores. The categorical outcome 000 was defined corresponding to loans in the Unicon sample known to have been submitted for scoring to one more credit data repository, but for which the borrower credit history was insufficient to generate a FICO score. The categorical outcome 999 was defined corresponding to loans originated prior to FY 2005 for which no attempt was made to obtain a FICO score, due either to exclusion from the Unicon sample or because they were originated prior to the availability of FHA FICO scores.

Through the process of linking streamline refinance loans to the original fully underwritten FHA mortgages to the same borrowers, we developed a parallel set of FICO score indicators for streamline refinance loans and included these as explanatory variables when estimating the transition probability models for these products.

Finally, an indicator was defined to distinguish loans with FICO scores obtained through the normal FHA loan approval process from loans for which FICO scores were obtained from the retrospective historical sampling procedure conducted by Unicon Corporation. This variable was included to control for the potential effect of choice-based sampling due to the oversampling of defaulted loans in the Unicon project.

Choice-Based Sampling of Historical FICO Scores and Random Sampling of FHA Loans

As described in Section I of this Appendix, random samples of less than 100 percent of the available data were used for the estimation of the loan status transition models for some loan products. In prior years, a stratified random sampling scheme was applied to assure adequate representation of loans with historical FICO score data. Starting from the FY 2012 Review, we have elected to utilize simple random sampling for those products utilizing less than 100 percent samples. The number of years of relatively complete credit score data from FHA now includes FY 2004 to FY 2013, and since estimation is now based on data for loans endorsed during FY 1996 to FY 2013, a greater reliance is placed on FHA's own credit score information. In recognition of the potential impact of choice-based sampling of the Unicon-supplied credit scores, we continue to include the indicator of whether the loan was included in the Unicon loan subsample.

Variables for Streamline Refinance Mortgages

The current Review follows the same logic used in the FY 2012 Review that linked streamlined refinance mortgages to their original fully underwritten FHA loans previously issued to the same borrower. Many FHA borrowers receive multiple streamline refinances over time, so the process of linking any given streamline refinance mortgage with its original ancestor loan sometimes requires establishing prior linkages through a sequence of FHA loans. We were able to identify the original fully underwritten FHA mortgage for about 98 percent of all streamline refinance mortgages originated and endorsed for FHA insurance since FY 1990.

For the streamline refinance mortgages that were not traceable back to original fully underwritten FHA mortgage, we imputed the loan attributes of original fully underwritten FHA mortgage with median values of ones that do trace back to original fully underwritten FHA mortgage.

The main benefit of linking streamline refinance mortgages with their original fully underwritten loans is that it enables us to improve the estimation of the current LTVs and probabilities of negative equity for the subsequent streamline refinance mortgages. The process of updating current LTVs begins at loan origination and proceeds period-by-period over the life of the loan. In the case of the streamline refinance mortgage, we obtained the original LTV and property values and updated them from that point forward, as if the current streamline refinance was a continuation of the original mortgage (for this purpose only, not for amortization and other dynamic processes specific to the current loan). We only applied this process to streamline refinance mortgages without required appraisals. In those cases where appraisals were required, we used the information from the appraisals to compute the current LTVs for the streamline mortgage; and we used the variable appraisal_req, which is unity when an appraisal was required for the SR loan, zero when it was not required. This variable showed that transition probabilities to default, to claim, and from current to SR are less when an appraisal is required; and the other transition probabilities are increased, other things held constant.

We were also able to assign indicators of original LTV, relative loan size, and downpayment assistance type to current streamline mortgages based on the original fully underwritten mortgage and to include these values for the respective variables in the models for streamline refinance mortgage products.

Finally, we developed indicators of the loan product type of the prior mortgages to include as an explanatory variable in the status transition models for streamline refinance loans. The baseline category is 30-year fixed-rate mortgages.

III. Logistic Model Estimation Results

Exhibit A-7 (parts A-7.1 to A-7.6) present the coefficient estimates for the binomial logistic models for all of the product and transition type combinations of the model. We included the explanatory variable descriptions and value definitions directly alongside the parameter estimates to facilitate comparison of the models.

Exhibit A-7.1 Product 1 (FRM30) Binomial Logit Model Coefficient Estimates

Description	Name	Values	current_default	current_currentX	current_prepay	current_SR	default_claim	default_prepay	default_cure_m	default_cure_s
Mortgage age function	age1 / age2 / age3 / age4	Spline function knot values shown next to the corresponding coefficient estimates	2: 1.4014; 5: 0.1524; >5: -0.0030	2: 1.7918; 10: 0.0634; >10: -0.0377	4: 0.6151; 10: 0.0141; >10: -0.0574	2: 0.9783; 5: 0.0003; 10: -0.1229; >10: -0.0703	8: 0.1519; >8: 0.0194	8: -0.0464; >8: -0.0540	6: 0.3162; >6: 0.0008	8: 0.0448; >8: 0.0087
Burnout factor. Cumulative amount of quarterly positive refinance incentives	burnout	linear function		0.0150	-0.0123					
	burnout1 / burnout2	Spline function	9: 0.0007; >9: -0.0015							
Credit burnout factor. Prior cumulative number of quarters default option is underwater	c_burnout1	linear function	6: 0.0077							
	c_burnout2	Spline function	>6: -0.0252							
Credit score	credit_score / credit_score1 / credit_score2 / credit_score3	linear function / Spline function	600: -0.0025; 660: -0.0094; >660: -0.0128	600: -0.0038; >660: -0.0157	600: 0.0015; >660: 0.0025	660: 0.0019; >660: 0.0031	660: 0.0021; >660: 0.0039	0.0019	600: 0.0002; >600: -0.0035	600: 0.0010; >600: -0.0020
Missing credit score	credit_score_000	X=0/1	-0.1338	-0.4143	0.0211	-0.1859	0.2999	0.0751	-0.1668	-0.1356
No credit score returned	credit_score_999	X=0/1	-0.6088	-0.5132	0.2048	0.2492	-0.6905	0.2594	-0.0301	0.0749
Unemployment rate change in last two quarters	delta_ue	linear function				0.2097				
	delta_ue1 / delta_ue2	Spline function	0: 0.1183; >0: 0.1771							
Downpayment assistant types	dpa_govt	X=0/1	0.1726	0.2589	-0.0677	-0.4261	0.0207	-0.0838	-0.0734	0.0427
	dpa_nonprof	X=0/1	0.3402	0.3900	-0.1384	0.1776	0.2588	-0.3255	0.1106	-0.1155
	dpa_relative	X=0/1	0.1097	0.1670	0.0347	-0.0315				
Missing front-end ratio	dti000	X=0/1	-0.0691	-0.0743	-0.0017	-0.1758				-0.0440
Duration of default episodes	dur_def_episode_1 / dur_def_episode_2 / dur_def_episode_3 / dur_def_episode_4	Spline function					2: 0.0553; 4.5: 0.2962; 12: -0.0647; >12: 0.0000	12: -0.0954; 20: 0.0751; >20: 0.0000	3: 0.2616; 10: -0.1845; 20: -0.0835; >20: 0.0000	10: -0.1750; 20: 0.0624; >20: 0.0000
Indicator of duration of default episodes > 20	dur_def_episode_du	X=0/1					0.1558			
FHA credit score indicator	fha_score	X=0/1	-0.1757		-0.6671	-0.0221	-0.8022		0.0853	0.2450
House price appreciation local level	hpa2y / hpa2y_n	linear function	-0.0128	0.0077	0.0102				0.0067	
House price appreciation national level	hpa2y_usa	linear function				0.0214		0.0360	-0.0307	0.0118
Judicial state	judicial	X=0/1		-0.2138			-0.2506	-0.1994	-0.1921	-0.1583
Number of living units	liv_units_2	X=0/1	0.0789		-0.0476	-0.4632		0.1694	-0.3697	
	liv_units_34	X=0/1			-0.1004	-0.3834		0.1365	-0.6625	
Relative loan size	loansize / loansize1 / loansize2 / loansize3 / loansize4	linear function / Spline function	0.0007	50: 0.0039; >50: -0.0015	100: 0.0118; 180: 0.0051; >180: 0.0005	100: 0.0288; 140: 0.0094; >140: 0.0034	-0.0028	40: -0.0065; 110: 0.0091; 120: -0.0007; >120: 0.0000	120: 0.0051; >120: 0.0000	-0.0011
LTV	ltv100	X=0/1	-0.0290		0.3316	0.1084	0.1979	0.4598	-0.0296	0.0206
	ltv95	X=0/1	0.0720		0.2152	0.1428	0.1733	0.3355	-0.0558	-0.0470

Category	Variable	Function	V1	V2	V3	V4	V5	V6	V7	V8
Current LTV	ltv_current	linear function			0.7801					
	ltv_current1		1: 1.3791	0.6: -3.1648	0.6: 6.5200	0.6: -5.9573			-0.4185	-1.1456
	ltv_current2	Spline function	1.2: 0.8968	>0.6: -5.9009	1: 2.3302	>0.6: -9.3672				
	ltv_current3		1.4: 1.4451		>1.0: 0.0000					
	ltv_current4		>1.4: 0.0000							
Spread of mortgage rate to 10-year CMT rate	mspread	linear function		-0.0468	0.7046	-0.3462			-0.6938	
Prior default episode	prior_default	X=0/1		0.0162		-0.3287			0.1436	0.1266
Front-end ratio	ratio_tmp_tei	linear function	0.0196							-0.0095
	ratio_tmp_tei1		28: 0.0296	28: -0.0131			30: 0.0105			
	ratio_tmp_tei2	Spline function	>28: 0.0095	>28: -0.0009	-0.0048		>30: -0.0015			
Refinance loan	refinance	X=0/1		0.3123						
Relative unemployment rate	rel_ue_p	linear function							-0.3703	
	rel_ue_p1	Spline function	1.9: 0.1184							
	rel_ue_p2		>1.9: -2.0585							
Spread at origination	sato	linear function	0.2760							
	sato1		0: -0.0596	0: 0.1044			0: 0.4018			-0.0106
	sato2	Spline function	>0: 0.3891	>0: 0.0000			>0: -0.0299			
Season of year	season_fall	X=0/1	0.3024	0.1634	0.0115	-0.0014	0.1446		-0.4253	-0.0106
	season_spring	X=0/1	-0.0726	0.2269	0.0783	-0.0213	0.1838		0.5130	-0.3280
	season_summer	X=0/1	0.1606	0.2454	-0.1127	0.0706	0.2198		0.4689	-0.5622
Cross section house price volatility	sigma_parm_a	linear function		-0.0436						-0.0358
Yield curve slope measured as difference of 10 year CMT to 1 year CMT rates	ycslope	linear function	0.0280	0.0909	0.1378	-0.2563				
FHA refinance incentive	FHA_refi_ince_PMT1		-2: 0.0342							
	FHA_refi_ince_PMT2	Spline function	13: 0.2323							
	FHA_refi_ince_PMT3		>13: 0.0205							
GSE refinance incentive	GSE_refi_ince_PMT	linear function					0.0031			-0.0110
	GSE_refi_ince_PMT1		0: 0.0082	-2: 0.0027						
	GSE_refi_ince_PMT2	Spline function	25: 0.0234	13: 0.0670						
	GSE_refi_ince_PMT3		>25: -0.0317	24: 0.0569						
	GSE_refi_ince_PMT4			>24: -0.0312						
Number of quarters since end of last default episode	cx_time1		1: 2.2639	1: -0.5540	1: -1.8666					
	cx_time2	Spline function	10: -0.1108	10: 0.0306	5: 0.3058					
	cx_time3		25: -0.0286	25: -0.0071	15: 0.0569					
	cx_time4		>25: -0.0041	>25: 0.0044	>15: -0.0137					
Prior loan modification	prior_mod	linear function	0.1446	-1.5086		-1.3115		-0.6737	-0.3772	-0.3451
Percentage monthly payment reduction of loan modification	mod_pay_pct_rdct	linear function	-5.7670	-3.3307		-4.9908				
	mod_pay_pct_rdct1		0.16: 3.1272							
	mod_pay_pct_rdct2	Spline function	0.36: 1.8231							
	mod_pay_pct_rdct3		>0.36:							
Missing of percentage monthly payment reduction of loan modification	mis_mod_pay_pct_rdct	X=0/1	-0.1508	1.2358	0.6538					
Intercept Term	contstant		-7.9545	-7.9520	-4.9239	-14.9507	-7.6041	0.0570	-4.5700	-1.1266

Exhibit A-7.2 Product 2 (FRM15) Binomial Logit Model Coefficient Estimates

Description	Name	Values	current_default	current_currentX	current_prepay	current_SR	default_claim	default_prepay	default_cure_m	default_cure_s
Mortgage age function	age1	Spline function knot values shown next to the corresponding coefficient estimates	2 / 1.3745	2 / 1.9613	4 / 0.5186	2 / 1.1558	8 / 0.1915	8 / 0.0491	6 / 0.3613	8 / 0.0423
	age2		6 / 0.1495	10 / 0.0671	10 / 0.0446	5 / 0.0488	>8 / 0.0047	20 / -0.0655	>6 / -0.0093	>8 / -0.0156
	age3		12 / -0.0272	>10 / -0.0267	20 / -0.0682	10 / -0.1905		>20 / -0.0389		
	age4		>12 / 0.0194		>20 / -0.0080	>10 / -0.1019				
Credit burnout factor. Prior cumulative number of quarters default option is underwater	c_burnout1	Spline function	6 / -0.0332							
	c_burnout2		>6 / -0.0502							
Credit score	credit_score	linear function		-0.0123	0.0004	0.0019	0.0017	0.0009	-0.0017	-0.0005
	credit_score1	Spline function	600 / -0.0044							
	credit_score2		>600 / -0.0139							
Missing credit score	credit_score_000	X=0/1	-0.5342	-0.6542	0.0208	-0.5217	0.0557	0.4414	-0.2168	0.1348
No credit score returned	credit_score_999	X=0/1	-0.6181	-0.4591	0.1089	0.3301	-0.5468	0.4422	0.0093	0.1209
Unemployment rate change in last two quarters	delta_ue	linear function	0.2183			0.1739				
Downpayment assistant types	dpa_govt	X=0/1	0.4248	0.2362	-0.0597	0.0258	0.1367	-0.5253	0.2799	-0.1512
	dpa_nonprof	X=0/1	0.6613	0.7410	-0.2087	1.0784	0.2288	-0.4513	-0.0916	-0.1966
	dpa_relative	X=0/1	0.2466	0.4957	0.0264	0.0547				
Missing front-end ratio	dti000	X=0/1	-0.1908	-0.3993	-0.1338	-0.6579				0.0175
Duration of default episodes	dur_def_episode_1	Spline function					5 / 0.2339	12 / -0.1006	3 / 0.2597	10 / -0.1655
	dur_def_episode_2						20 / -0.0572	20 / 0.0980	12 / -0.1626	20 / 0.0877
	dur_def_episode_3						>20 / 0.0000	>20 / 0.0000	>12 / 0.0000	>20 / 0.0000
Indicator of duration of default episodes > 20	dur_def_episode_du	X=0/1					1.0575			
FHA credit score indicator	fha_score	X=0/1	0.0755		-0.2653	1.5583	-0.6980			
House price appreciation local level	hpa2y	linear function		0.0057					0.0084	
	hpa2y_n	linear function	-0.0057							
House price appreciation national level	hpa2y_usa	linear function	0.0164			0.0534		0.0397	-0.0393	0.0086
Judicial state	judicial	X=0/1					-0.4341	-0.1706	-0.1745	-0.1713
Number of living units	liv_units_2	X=0/1			-0.0501	-0.2570		0.0929	-0.0712	
	liv_units_34	X=0/1			-0.1290	-0.4294		0.3635	-0.3229	
Relative loan size	loansize	linear function	-0.0004		0.0050		-0.0040	0.0024	0.0036	-0.0003
	loansize1	Spline function				100 / 0.0308				
	loansize2					140 / 0.0143				
	loansize3					>140 / 0.0044				
LTV	ltv100	X=0/1	0.0765		0.2111	-0.0388	0.6111	0.4118	-0.0005	0.0879
	ltv95	X=0/1	0.0944		0.1832	0.1050	0.4065	0.2337	-0.1528	0.0200
Current LTV	ltv_current	linear function	1 / 1.8520		0.6 / -2.2298		1.2 / 2.3335	-5.7709	-0.2859	-1.6889
	ltv_current1	Spline function	1.2 / 1.0711		0.9 / -3.1425		>1.2 / 0.0000			
	ltv_current2		>1.2 / 0.0000		>0.9 / -2.7464					

Description	Variable	Function	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Spread of mortgage rate to 10-year CMT rate	mspread	linear function			0.0726	0.5032	-0.2610		-0.6539	
Prior default episode	prior_default	X=0/1					-0.2747	-0.2366	0.1069	0.0822
Front-end ratio	ratio_tmp_tei	linear function	0.0209	0.0137	-0.0025	0.0212				-0.0121
Refinance loan	refinance	X=0/1				0.5136				
Relative unemployment rate	rel_ue_p	linear function				0.0353			-0.4614	
Spread at origination	sato	linear function	0.2008	0.3779					-0.0149	
Season of year	season_fall	X=0/1	0.2642	-0.3724	0.1300	-0.0535	-0.0522	0.0640	-0.1734	-0.0700
	season_spring	X=0/1	-0.0641	-0.6633	0.1364	0.1107	0.0303	-0.0537	0.6238	-0.2560
	season_summer	X=0/1	0.1138	-0.4651	0.1720	-0.2881	0.0228	0.0848	0.5612	-0.4443
Cross section house price volatility	sigma_parm_a	linear function			-0.0419					
Yield curve slope measured as difference of 10 year CMT to 1 year CMT rates	ycslope	linear function	0.0032		0.0861	0.1698	-0.2471			0.0068
FHA refinance incentive	FHA_refi_ince_PMT1	Spline function	0.0591 (knot -5)			0.2619 (knot -2)				
	FHA_refi_ince_PMT2	Spline function	0.0328 (knot >5)			0.1699 (knot 13)				
	FHA_refi_ince_PMT3	Spline function				-0.4268 (knot >13)				
GSE refinance incentive	GSE_refi_ince_PMT	linear function		0.0173			-0.0156	-0.0426	-0.0056	-0.0208
	GSE_refi_ince_PMT1	Spline function			0.0851 (knot -7)					
	GSE_refi_ince_PMT2	Spline function			0.0406 (knot 15)					
	GSE_refi_ince_PMT3	Spline function			-0.1692 (knot >15)					
Number of quarters since end of last default episode	cx_time1	Spline function	2.5893 (knot 1)		-0.3195 (knot 1)	-1.4320 (knot 1)				
	cx_time2	Spline function	-0.1105 (knot 10)		0.0051 (knot 10)	0.1426 (knot 5)				
	cx_time3	Spline function	-0.0322 (knot 25)		-0.0094 (knot 25)	0.1045 (knot 15)				
	cx_time4	Spline function	-0.0115 (knot >25)		0.0541 (knot >25)	0.0598 (knot >15)				
Prior loan modification	prior_mod	X=0/1	-0.2954		-0.5298	-1.0552				-0.3068
Intercept term	Constant		-7.0025	-3.6190	-4.3782	-13.8325	-5.5758	-0.8031	-3.5727	0.1537

Exhibit A-7.3 Product 3 (ARM) Binomial Logit Model Coefficient Estimates

Description	Name	Values	Status Transition (from_to)							
			current_default	current_currentX	current_prepay	current_SR	default_claim	default_prepay	default_cure_m	default_cure_s
Mortgage age function	age	linear function						-0.0543	-0.0104	-0.00045
	age1	Spline function knot values shown next to the corresponding coefficient estimates	2: 1.2974	2: 1.7762	4: 0.6271	2: 1.1589	4: 0.1613			
	age2		6: 0.1180	6: 0.1496	10: 0.0512	5: 0.2581	12: 0.0832			
	age3		10: -0.0015	12: 0.0474	20: -0.0636	10: -0.1236	>12: 0.0210			
	age4		>10: 0.0092	>12: -0.0235	>20: -0.0645	>10: -0.1428				
Credit burnout factor. Prior cumulative number of quarters default option is underwater	c_burnout1	Spline function	6: 0.0224							
	c_burnout2		>6: -0.0472							
Credit score	credit_score	linear function		-0.0105	0.0020	0.0011	0.0025	0.0014	-0.0021	-0.0011
	credit_score1	Spline function	600: -0.0029							
	credit_score2		>600: -0.0095							
Missing credit score	credit_score_000	X=0/1	-0.0624	-0.2127	-0.0037	-0.0595	0.3391	0.0205	-0.1545	-0.0867
No credit score returned	credit_score_999	X=0/1	-0.7533	-0.5574	0.1663	0.1711	-0.7354	0.2704	0.0463	0.1321
Unemployment rate change in last two quarters	delta_ue	linear function	0.0545			0.0699				
Downpayment assistant types	dpa_govt	X=0/1	0.1972	0.3118	-0.1186	-0.0933	0.1672	-0.2784	-0.0921	-0.0323
	dpa_nonprof	X=0/1	0.2471	0.3058	-0.1128	0.0365	0.2634	-0.2691	0.1167	-0.0399
	dpa_relative	X=0/1	0.1308	0.1623	-0.0005	-0.1694				
Missing front-end ratio	dti000	X=0/1	0.0838	0.0005	-0.1060	-0.0299				-0.0003
Duration of default episodes	dur_def_episode_1	Spline function					5: 0.1833	12: -0.0983	3: 0.3261	10: -0.2006
	dur_def_episode_2						20: -0.0338	20: 0.0768	12: -0.1786	20: 0.0894
	dur_def_episode_3						>20: 0.0000	>20: 0.0000	>12: 0.0000	>20: 0.0000
Indicator of duration of default episodes > 20	dur_def_episode_d	X=0/1					0.3341			
Current mortgage rate level	ey_rate	linear function	0.1100		-0.2487	-0.2455				
FHA credit score indicator	fha_score	X=0/1	-0.1387		-0.2741	-0.4617	-0.6231		-0.0751	0.0170
Housing price appreciation local level	hpa2y	linear function		0.0084						
	hpa2y_n	linear function							-0.0055	
	hpa2y_n1	Spline function	-20: 0.0081							
	hpa2y_n2		>20: -0.0126							
House price appreciation national level	hpa2y_usa	linear function			0.0087			0.0303	-0.0408	0.0093
Judicial state	judicial	X=0/1					-0.1206	-0.1687	-0.1102	-0.2041
Number of living units	liv_units_2	X=0/1			-0.1424	-0.4097		-0.0142	-0.3723	
	liv_units_34	X=0/1	0.3195		-0.3621	-0.4640		-0.1705	-0.8559	
Relative loan size	loansize	linear function			0.0060	0.0093	-0.0031	0.0044	0.0030	-0.0005
	loansize1	Spline function	120: -0.0024							
	loansize2		>120: 0.0026							

Description	Variable	Functional form	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LTV	**ltv100**	X=0/1	0.0907		0.1594	0.2973	0.1656	0.2274	0.0382	-0.0484
	ltv95	X=0/1	0.0844		0.1000	0.2313	0.1721	0.1706	-0.0442	-0.0201
Current LTV	**ltv_current**	linear function							-0.7629	-1.2392
	ltv_current1	Spline function	1 : 1.4875		0.6 : -3.1367	0.8 : 4.0852	0.6 : -5.6681			
	ltv_current2		1.4 : 0.5301		>0.6 : -4.2971	1 : 0.8023	>0.6 : -8.9392			
	ltv_current3		>1.4 : 1.4323			>1 : 0.0000				
Spread of mortgage rate to 10-year CMT rate	**mspread**	linear function	0.1507		0.0243	0.6040	-0.2212		-0.5421	
ARM payment shock	**pmt_shock**	linear function					-0.0020			
	pmt_shock1	Spline function			0 : 0.0003	0 : -0.0362			0 : -0.0066	0 : 0.0055
	pmt_shock2				>0 : 0.0084	>0 : -0.0112			>0 : -0.0007	>0 : -0.0004
Probability of negative equity	**pneq**	linear function			-1.2805					
Prior default episode	**prior_default**	X=0/1					-0.3762	-0.1922	0.2524	0.1169
Front-end ratio	**ratio_tmp_tei**	linear function	0.0179		-0.0058	0.0149				-0.0093
Refinance loan	**refinance**	X=0/1	0.0086		0.1023					
Relative unemployment rate	**rel_ue_p**	linear function						-0.1439		
Spread at origination	**sato**	linear function	0.1535	0.2095					-0.0529	
Season of year	**season_fall**	X=0/1	0.2154	-0.4459	0.1178	-0.1530	0.0141	0.2064	-0.6201	0.2636
	season_spring	X=0/1	-0.1094	-0.5801	0.2364	0.0707	0.0280	0.2248	0.4471	-0.2238
	season_summer	X=0/1	0.0947	-0.4682	0.1782	-0.1953	0.0341	0.3132	0.3754	-0.3522
Cross section house price volatility	**sigma_parm_a**	linear function			-0.0166					
Yield curve slope measured at difference of 10 year CMT to 1 year CMT rates	**ycslope**	linear function	0.1128		0.0177	0.1153	-0.2327			-0.0262
Effective FHA refinance interest rate	**FHA_refi_ince_PMT**	linear function			0.1026					
Effective GSE refinance interest rate	**GSE_refi_ince_PMT**	linear function	0.0142		0.0215				-0.0077	-0.0029
Number of quarters since end of last default episode	**cx_time1**	Spline function	1 : 2.4470		1 : -0.6691	-2.0599				
	cx_time2		10 : -0.1364		10 : 0.0503	0.4045				
	cx_time3		25 : -0.0320		25 : 0.0093	0.0541				
	cx_time4		>25 : -0.0098		>25 : -0.0241	0.0520				
Prior loan modification	**prior_mod**	X=0/1	0.0857		-0.2161	-0.6035	-0.0594			-0.4795
Intercept term	**Constant**		-7.0979	-3.4722	-3.0367	-7.7141	-6.9971	0.2076	-1.2038	0.3559

Exhibit A-7.4 Product 4 (FRM30 SR) Binomial Logit Model Coefficient Estimates

Description	Name	Values	current_default	current_currentX	current_prepay	current_SR	default_claim	default_prepay	default_cure_m	default_cure_s
Mortgage age function	age / age1 / age2 / age3 / age4	linear function; Spline function knot values shown next to the corresponding coefficient estimates	2: 1.4139; 5: 0.1465; 10: -0.0124; >10: -0.0009	2: 1.7816; 6: 0.1625; >6: -0.0557	2: 1.0579; 6: 0.1169; 18: -0.0199; >18: -0.0501	2: 0.9757; 10: -0.1554; >10: -0.0736	8: 0.0740; >8: 0.0190	-0.0543	6: 0.3403; 10: -0.0329; >10: 0.0011	0: -0.0005
Loan with appraisal value	appraisal_req	X=0/1	-0.1991	0.0191	0.1700	-0.7511	-0.1816	0.3676	0.0033	0.0739
Burnout factor. Cumulative amount of quarterly positive refinance incentives	burnout	linear function	0.0009	0.0237	-0.0038					
Credit burnout factor. Prior cumulative number of quarters default option is underwater	c_burnout1 / c_burnout2	Spline function	6: -0.0154; >6: -0.0263							
Credit score	credit_score	linear function	-0.0058	-0.0094	0.0006	0.0006	0.0035	0.0017	-0.0024	-0.0012
Missing credit score	credit_score_000	X=0/1	-0.0833	-0.5168	-0.0521	-0.0055	0.0243	-0.7207	0.0132	-0.0133
No credit score returned	credit_score_999	X=0/1	-0.3478	-0.3284	0.1867	0.2461	-0.5931	0.2742	0.0272	0.0502
Unemployment rate change in last two quarters	delta_ue	linear function	0.1869			-0.0143				
Downpayment assistant types	dpa_govt	X=0/1	0.2214	0.3151	0.0305	-0.0579	0.1167	-0.1397	0.1097	-0.0146
	dpa_nonprof	X=0/1	0.2752	0.3869	0.0583	0.0325	0.1635	-0.1747	0.1014	-0.0667
	dpa_relative	X=0/1	0.0984	0.2509	0.1832	-0.0428				
Missing front-end ratio	dti000	X=0/1	0.1502	0.1165	-0.0957	0.2021				-0.0537
Duration of default episodes	dur_def_episode_1 / dur_def_episode_2 / dur_def_episode_3 / dur_def_episode_4	Spline function					2: -0.0961; 4.5: 0.3564; 12: -0.0916; >12: 0.0000	12: -0.0961; 20: 0.0838; >20: 0.0000	3: 0.2200; 12: -0.1837; >12: 0.0000	10: -0.1409; 20: 0.0596; >20: 0.0000
Indicator of duration of default episodes > 20	dur_def_episode_d	X=0/1					0.3341			
FHA credit score indicator	fha_score	X=0/1	0.0471		-0.3373	0.6176	-0.6730		0.0503	0.0506
Housing price appreciation local level	hpa2y	linear function		0.0012						
	hpa2y_n	linear function	-0.0145						0.0036	
House price appreciation national level	hpa2y_usa	linear function			0.0240	0.0238		0.0388	-0.0297	0.0097
Judicial state	judicial	X=0/1					-0.2996	-0.2225	-0.1782	-0.1810
Number of living units	liv_units_2	X=0/1			-0.1555	-0.5106			-0.4019	
	liv_units_34	X=0/1			-0.3122	-0.7534			-0.6286	
Relative loan size	loansize	linear function	0.0014		120: 0.0000	0.0144	-0.0036	0.0062	0.0033	-0.0007
	loansize1				0.0109					
	loansize2	Spline function			>120: 0.0043					

Category	Variable	Function	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LTV	ltv100	X=0/1	0.0147	-0.0091	0.0753	0.1766	0.1331	0.1518		-0.0620
	ltv95	X=0/1	-0.0413	-0.0203	-0.0845	0.1542	0.1449	-0.0078		0.0419
Current LTV	ltv_current	linear function	-1.4659	-0.5761	-7.3531					
	ltv_current1	Spline function				0.8: 4.9194		0.6: -2.0611		1.2: 1.8235
	ltv_current2					1: 0.3653		>0.6: -5.0177		>1.2: 0.8053
	ltv_current3					>1.0: 0.0000				
Spread of mortgage rate to 10-year CMT rate	mspread	linear function		-0.7479		-0.5466	1.2623	-0.0764		
Prior default episode	prior_default	X=0/1	0.1979	0.1787	-0.2380	-0.4081				
Prior product type	prior_prod_2	X=0/1	0.0465	-0.0433	-0.1390	-0.1196	-0.3323	0.1118	0.3094	0.2122
	prior_prod_3	X=0/1	-0.0179	-0.0938	0.0888	0.0432	-0.0664	0.0251	-0.2772	-0.1172
	prior_prod_4	X=0/1	-0.0402	0.0896	-0.0770	0.0271	0.3377	0.1631	0.1740	0.0906
	prior_prod_5	X=0/1	-0.0852	-0.1441	0.1781	-0.2540	-0.0578	-0.0429	-0.2443	-0.1435
	prior_prod_6	X=0/1	-0.1053	0.0198	-0.1223	0.2239	0.1200	0.1852	0.1778	0.1202
Front-end ratio	ratio_tmp_tei	linear function	-0.0033			0.0051	0.0059	-0.0016		0.0069
Relative unemployment rate	rel_ue_p	linear function		-0.3224			0.5874			
Spread at origination	sato	linear function		-0.0137		0.0777				0.0750
Season of year	season_fall	X=0/1	0.0421	-0.3509	0.2053	0.0206	0.0820	0.1821	-0.3798	0.2241
	season_spring	X=0/1	-0.3334	0.5282	0.1944	-0.0779	0.0590	0.2445	-0.6385	-0.1117
	season_summer	X=0/1	-0.5592	0.5080	0.2491	0.0749	-0.0131	0.2704	-0.5168	0.0834
Cross section house price volatility	sigma_parm_a	linear function						-0.0302		
Yield curve slope measured as difference of 10 year CMT to 1 year CMT rates	ycslope	linear function	-0.0318			-0.2214	0.2040	0.0543		0.0453
FHA refinance incentive	FHA_refi_ince_PMT	linear function					0.1622	0.0430	0.0184	
GSE refinance incentive	GSE_refi_ince_PMT	linear function	-0.0079	0.0066	-0.0013			-0.0087		
	GSE_refi_ince_PMT1	Spline function								0: 0.0188
	GSE_refi_ince_PMT2									25: 0.0322
	GSE_refi_ince_PMT3									>25: -0.0899
Number of quarters since end of last default episode	cx_time1	Spline function					1: -1.9355	1: -0.4397		1: 2.2680
	cx_time2						5: 0.3040	10: 0.0359		10: -0.0895
	cx_time3						15: 0.0700	25: -0.0197		25: -0.0440
	cx_time4						>15: -0.0120	>25: 0.0149		>25: 0.0012
Prior loan modification	prior_mod	X=0/1	-0.2995			-0.0698	-1.2154	-0.4607		0.0373
Percentage of monthly payment reduction of loan modification	mod_pay_pct_rdct	linear function								-2.0395
Missing of percentage of monthly payment reduction of loan modification	mis_mod_pay_pct_rdct	X=0/1								-0.0086
Intercept term	Constant		0.3902	-2.4745	0.4017	-6.3217	-11.3039	-5.5582	-4.7184	-6.1888

Exhibit A-7.5 Product 5 (FRM15 SR) Binomial Logit Model Coefficient Estimates

Description	Name	Values	current_default	current_currentX	current_prepay	current_SR	default_claim	default_prepay	default_cure_m	default_cure_s
Mortgage age function	age	linear function						-0.0267		-0.0242
	age1	Spline function knot values shown next to the corresponding coefficient estimates	2 | 1.1692	6 | 0.2933	2 | 1.0914	2 | 1.3791	6 | 0.2389		6 | 0.1835	
	age2		6 | 0.0902	>6 | -0.0289	10 | 0.0945	5 | 0.0049	>6 | 0.0475		>6 | -0.0268	
	age3		20 | -0.0009		20 | -0.0400	10 | -0.1648				
	age4		>20 | 0.0020		>20 | 0.0066	>10 | -0.0898				
Loan with appraisal value	appraisal_req	X=0/1	-0.0673	0.0327	0.2850	-0.5844	-0.3380	0.5265	0.2924	0.2380
Credit burnout factor.	c_burnout1	Spline function	6 | 0.0127							
Prior cumulative number of quarters default option is underwater	c_burnout2		>6 | -0.0609							
Credit score	credit_score	linear function	600 | -0.0033	-0.0128	-0.0003	0.0015	0.0049	0.0030	-0.0025	-0.0009
	credit_score1	Spline function	>600 | -0.0116							
Missing credit score	credit_score_000	X=0/1	-0.3825	-0.6866	-0.2099	-1.1565	-0.1624	-0.6367	0.0306	-0.2361
No credit score returned	credit_score_999	X=0/1	-0.5346	-0.7490	0.0455	0.2349	-0.0648	0.1778	-0.0349	-0.0831
Unemployment rate change in last two quarters	delta_ue	linear function	0.1772			-0.1350				
Downpayment assistant types	dpa_govt	X=0/1	0.2798	0.0928	0.1153	0.4873	0.5586	-0.2299	0.4977	0.0936
	dpa_nomprof	X=0/1	0.2738	0.1982	0.2225	0.1621	0.7575	-0.0397	0.0081	-0.3155
	dpa_relative	X=0/1	0.2102	0.4019	0.2347	0.0945				
Missing front-end ratio	dti000	X=0/1	0.2229	0.1154	-0.1292	-0.3997				0.1184
Duration of default episodes	dur_def_episode_1	Spline function				5	12 | 0.2641	12 | -0.1145	3 | 0.2120	10 | -0.1573
	dur_def_episode_2					20	20 | -0.0388	20 | 0.0456	12 | -0.1385	20 | 0.0492
	dur_def_episode_3					>20	>20 | 0.0000	>20 | 0.0000	>12 | 0.0000	>20 | 0.0000
FHA credit score indicator	fha_score	X=0/1	0.1504		-0.1341	2.3687				
Housing price appreciation local level	hpa2y	linear function		0.0055						
	hpa2y_n	linear function	-0.0045						0.0123	
House price appreciation national level	hpa2y_usa	linear function			0.0259	0.0756	0.0460	0.0356	-0.0273	0.0087
Judicial state	judicial	X=0/1						-0.2210	-0.1507	
Number of living units	liv_units_2	X=0/1			-0.0963	-0.3860		-0.6077	-0.0040	
	liv_units_34	X=0/1			-0.3256	-0.7438		0.1760	-0.9864	
Relative loan size	loansize	linear function	0.0004		0.0048	0.0129	-0.0077	0.0035	0.0026	0.0001
LTV	ltv100	X=0/1	0.0262		0.1326	-0.0073	0.2998	0.0421	0.1632	0.0169
	ltv95	X=0/1	0.0909		0.0490	-0.0453	0.3051	-0.0853	0.1405	-0.0321
Current LTV	ltv_current	linear function						-4.5628	-0.9933	-1.9094
	ltv_current1	Spline function	1 | 1.2796		0.8 | -1.8888		0.8 | 5.8786			
	ltv_current2		1.1 | 1.4815		>0.8 | -2.5542		>0.8 | 0.0000			
	ltv_current3		>1.1 | 0.0000							
Spread of mortgage rate to 10-year CMT rate	mspread	linear function			0.0434	1.5042	-0.2128	-0.4258	-0.5090	
Prior default episode	prior_default	X=0/1					-0.3904		0.0245	0.1431

Status Transition (from to)

Category	Variable	Form								
Prior product type	prior_prod_2	X=0/1	0.1239	-0.0426	0.3766	1.3197	0.0351	0.2386	-0.1390	-0.1159
	prior_prod_3	X=0/1	-0.0117	-0.2585	0.2221	0.2310	0.2608	0.2154	0.0590	-0.1523
	prior_prod_4	X=0/1	-0.1232	-0.4547	0.1067	0.5130	0.0593	-0.1075	-0.0157	-0.1939
	prior_prod_5	X=0/1	-0.0462	0.4300	0.2952	0.6059	0.1302	-0.1906	-0.0755	-0.1488
	prior_prod_6	X=0/1	0.1358	-1.0942	0.3092	0.1856	0.2855	-1.0051	-1.0258	0.1441
Front-end ratio	ratio_tmp_tei	linear function	0.0060	0.0089	-0.0034	0.0055				-0.0070
Relative unemployment rate	rel_ue_p	linear function	0.3055			0.6581			-0.0608	
Season of year	season_fall	X=0/1	0.2714	-0.2555	0.0750	-0.1417	0.0003	0.1373	-0.4367	-0.0450
	season_spring	X=0/1	-0.1240	-0.4855	0.1517	0.0439	0.0693	0.1642	0.4119	-0.1990
	season_summer	X=0/1	0.0338	-0.4893	0.1734	-0.0825	0.0249	0.2355	0.4815	-0.3667
Cross section house price volatility	sigma_parm_a	linear function			-0.0203					
Yield curve slope measured as difference of 10 year CMT to 1 year CMT rates	ycslope	linear function	0.0294	0.0214		0.2727	-0.2811			-0.0573
FHA refinance incentive	FHA_refi_ince_PMT1	Spline function	0 / 0.0380		-7 / 0.0675	-2 / 0.2210				
	FHA_refi_ince_PMT2	Spline function	25 / 0.0329		>-7 / 0.0330	13 / 0.2234				
	FHA_refi_ince_PMT3	Spline function	>25 / 0.0000			>13 / -0.1929				
GSE refinance incentive	GSE_refi_ince_PMT	linear function				1 / -0.5092				
	GSE_refi_ince_PMT1	Spline function				5 / 0.1272			-0.0125	-0.0038
	GSE_refi_ince_PMT2	Spline function				15 / 0.0623				
	GSE_refi_ince_PMT3	Spline function				>15 / -0.0100				
Number of quarters since end of last default episode	cx_time1	Spline function	0 / 3.3151		1 / -0.1074					
	cx_time2	Spline function	10 / -0.1415		10 / -0.0045					
	cx_time3	Spline function	25 / -0.0471		25 / -0.0209					
	cx_time4	Spline function	>25 / -0.0515		>25 / 0.0428					
Prior loan modification	prior_mod	X=0/1	0.0296		-0.6135	-0.6074				-0.3853
Intercept term	Constant		-7.1208	-0.6720	-5.4858	-14.2410	-10.0796	-2.7624	-1.6289	0.9356

Exhibit A-7.6 Product 6 (ARM SR) Binomial Logit Model Coefficient Estimates

Description	Name	Values	Status Transition (from_to)								
			current_default	current_currentX	current_prepay	current_SR	default_SR	default_claim	default_prepay	default_cure_m	default_cure_s
Mortgage age function	age	linear function									-0.0012
	age1	Spline function	2: 1.3550	2: 1.9628	6: 0.2075	2: 1.1700		8: 0.1287	6: -0.0607	5: 0.2302	
	age2		6: 0.1153	8: 0.0623	12: -0.0576	5: -0.0406		>8: 0.0221	>6: -0.0594	>5: -0.0116	
	age3		20: -0.0017	>8: -0.0444	>12: -0.0500	10: -0.2149					
	age4		>20: 0.0052			>10: -0.0960					
Loan with appraisal value	appraisal_req	X=0/1	-0.0030	0.1623	0.1919	-0.4108		-0.2634	0.2872	0.1798	0.1349
Credit burnout factor. Prior cumulative number of quarters default option is underwater	c_burnout1	Spline function	6: 0.0016								
	c_burnout2		>6: -0.0463								
Credit score	credit_score	linear function		-0.0090	0.0013	0.0003		0.0034	0.0004	-0.0022	-0.0007
	credit_score1	Spline function	600: -0.0028								
	credit_score2		>600: -0.0087								
Missing credit score	credit_score_000	X=0/1	-0.2657	-0.5168		0.0758		-0.0428	-0.2541	-0.0669	-0.0101
No credit score returned	credit_score_999	X=0/1	-0.4165	-0.3257		0.0752		-0.3741	0.2040	0.0599	0.1916
Unemployment rate change in last two quarters	delta_ue	linear function	0.0912			0.0030					
Downpayment assistant types	dpa_govt	X=0/1	0.1858	0.4026	0.1314	0.0760		0.2064	0.1937	0.1948	-0.0781
	dpa_nomprof	X=0/1	0.2602	0.3457	0.0509	0.0380		0.2095	-0.2088	0.0585	-0.0392
	dpa_relative	X=0/1	0.0741	0.2068	0.1262	-0.1945					
Missing front-end ratio	dti000	X=0/1	0.1550	0.3290	-0.0662	0.2468					-0.0905
Duration of default episodes	dur_def_episode_1	Spline function						4: 0.2246	12: -0.1029	3: 0.2253	10: -0.1488
	dur_def_episode_2							20: -0.0235	20: 0.1131	20: -0.1548	20: 0.0653
	dur_def_episode_3							>20: 0.0000	>20: 0.0000	>20: 0.0000	>20: 0.0000
Current mortgage rate level	ey_rate	linear function			-0.0837	-0.0559					
FHA credit score indicator	fha_score	X=0/1	0.1291		-0.0985	-0.1320		-0.3134			0.0690
Housing price appreciation local level	hpa2y	linear function		0.0045							
	hpa2y_n	linear function	-0.0102							0.0017	
House price appreciation national level	hpa2y_usa	linear function			0.0200				0.0355	-0.0269	0.0093
Judicial state	judicial	X=0/1			-0.0978			-0.3659	-0.1055	-0.1454	-0.2105
Number of living units	liv_units_2	X=0/1				-0.1144			0.3557	-0.6324	
	liv_units_34	X=0/1	0.0931		-0.4110	-0.1274			-0.3453	-0.3960	
Relative loan size	loansize	linear function	0.0006		0.0087			-0.0011	0.0068	0.0027	-0.0002
	loansize1	Spline function				120: 0.0156					
	loansize2					>120: 0.0028					
LTV	ltv100	X=0/1	0.0375		0.0759	0.1862		0.0325	-0.0433	0.0546	0.0092
	ltv95	X=0/1	0.0589		-0.0350	0.1863		0.0361	0.0494	-0.0020	-0.0437

Description	Variable	Function	Breakpoint(s)	Coefficient(s)
Current LTV	ltv_current	linear function		-8.4994, -1.1316, -1.8029
	ltv_current1	Spline function	1	2.1334
	ltv_current2	Spline function	1.2 / 0.6 / 0.9	1.3274, -1.8404, 4.0441
	ltv_current3	Spline function	>1.2 / >0.6 / >0.9	0.6168, -5.3682, 0.0000
Spread of mortgage rate to 10-year CMT rate	mspread	linear function		-0.1809, -0.1671, 0.4551, -0.6341
ARM payment shock	pmt_shock1	Spline function	0	-0.0007, -0.0012, -0.0635, 0.0039, 0.0156
	pmt_shock2	Spline function	>0	0.0075, 0.0147, -0.0032, 0.0032, 0.0005
Prior default episode	prior_default	X=0/1		-0.4127, -0.3056, 0.1886
Prior product type	prior_prod_2	X=0/1		0.4056, -0.0009, -0.1171, -0.2203, 0.7326, -0.3541
	prior_prod_3	X=0/1		-0.2625, -0.0708, 0.1232, 0.4095, 0.0678, 0.0629
	prior_prod_4	X=0/1		0.1991, 0.0931, 0.1401, 0.4392, 0.0653, 0.0461
	prior_prod_5	X=0/1		0.1932, -1.3102, 0.0566, -0.2110, -9.7719, -9.3419
	prior_prod_6	X=0/1		0.2880, 0.1635, 0.2671, 0.6991, 0.1257, -0.0956
Front-end ratio	ratio_tmp_tei	linear function		0.0035, 0.0051, -0.0030, 0.0019, -0.0067
Relative unemployment rate	rel_ue_p	linear function		-0.0455
Spread at origination	sato	linear function		0.1317, 0.0430, 0.0799, 0.0176
Season of year	season_fall	X=0/1		-0.3008, 0.2149, 0.1724, -0.1307, 0.1728, 0.1988
	season_spring	X=0/1		-0.5839, -0.1154, 0.2675, -0.0042, 0.1888, -0.2573
	season_summer	X=0/1		-0.4325, 0.0787, 0.2877, -0.0941, 0.2178, -0.4525
Cross section house price volatility	sigma_parm_a	linear function		-0.0240
Yield curve slope measured as difference of 10 year CMT to 1 year CMT rates	yslope	linear function		0.1146, -0.0506, 0.1527, -0.2999, 0.0071
FHA refinance incentive	FHA_refi_ince_PMT	linear function		0.1622
GSE refinance incentive	GSE_refi_ince_PMT	linear function		0.0133, 0.0032, -0.0016, 0.0123, -0.0009, -0.0030
	GSE_refi_ince_PMT1	Spline function	-7	0.0090
	GSE_refi_ince_PMT2	Spline function	15	0.0191
	GSE_refi_ince_PMT3	Spline function	>15	0.0061
Number of quarters since end of last default episode	cx_time1	Spline function	1	2.0846, -0.5189, -1.5429
	cx_time2	Spline function	10 / 5	-0.1124, 0.0430, 0.3390
	cx_time3	Spline function	25 / 15	-0.0320, -0.0074, 0.0070
	cx_time4	Spline function	>25 / >15	0.0021, 0.0043, 0.0278
Prior loan modification	prior_mod	X=0/1		0.1082, -0.3863, -1.0206, 0.1638, -0.4099
Intercept term	Constant			-7.4751, -4.5360, -2.8934, -7.7415, -7.4657, 2.0700, -1.7524, 0.1356

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Appendix B

Cash Flow Analysis

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Appendix B: Cash Flow Analysis

I. Introduction

The calculation of the economic value of the Fund involves the estimation of the present value of future cash flows generated by the existing portfolio and future books of business. The analysis requires the projection of future prepayment and claim incidence and severity and cash flow items associated with each type of outcome. This appendix describes the components of these cash flows.

The evaluation of the Fund's economic value at a point in time (e.g., end-of-year FY 2013) requires incorporating the value of net assets plus the expected present value of future cash flows. The latter comprises future revenue and expenses. Similarly, the evaluation of the Fund's economic value in future years (FY 2014 through FY 2020) requires the same type of calculation but also requires specification of the size and composition of the future book of endorsements for the relevant years.

In order to analyze future changes in the Fund's economic value, our model incorporates projections of loan performance and information about the existing portfolio composition to project the Fund's various cash flow sources. The actuarial model uses projections from econometric models as discussed in Appendices A (transitions), E (loss rates), F (future volume projections) and G (future economic projections and simulation methodology). We estimated econometric models for conditional transition probabilities for individual loans depending on the loan type, origination year, age, interest rate, loan purpose, initial and current LTV ratio, credit score, refinancing incentive, relative loan size, probability of negative equity, loan term, burnout, and other characteristics. The models also used data on serious delinquency status and default history. Using detailed loan-level characteristics, we estimated the various transition probabilities and then generated respective cash flows for individual loans (Appendix A).

We estimated loss severity rates based on an econometric model that predicts future loss severity rates (Appendix E). The loss rate model distinguishes between foreclosure, pre-foreclosure, and third-party sales. We estimated future FHA mortgage volumes for purchase, refinance and streamline refinance mortgages that vary with alternative house price and interest rate paths (Appendices F and G).

Based on the mortgage termination rates projected by the econometric models, individual components of cash flows are projected into the future. These cash flows are discounted to the present time based on the OMB discount factors. The relevant cash flow components are itemized in Exhibit B-1.

Exhibit B-1: Cash Flow Components

Cash Flow Components	Cash Inflow	Cash Outflow
Upfront Premiums	√	
Annual Premiums	√	
Investment Earnings	√	
Net Claim Payments		√
Loss Mitigation Expenses		√
Refunded Upfront Premiums		√
Administrative Expenses[a]		√
Distributive Shares[b]		√

[a] The administrative expense was discontinued since the FY 2002 Actuarial Review according to the Federal credit reform requirement.
[b] The distributive share has been suspended since 1990. There is no indication that it would be resumed in the foreseeable future.

These components were projected quarterly for individual loans and then aggregated according to the product type and origination year, and also policy year for reporting purposes. Below, we discuss the derivation of each of these cash flows.

II. Background Information

The following definitions and background information clarify our discussion of the cash flow components:

- **Insurance-in-Force (IIF):** the nominal value of the unamortized original mortgage loan balances of the surviving mortgages insured by FHA. This is distinct from the conventional notion of amortized insurance-in-force, which includes only the current outstanding balances on surviving loans.

- **Conditional Claim Rate (CCR):** the number of loans that become claims during a time period divided by the number of surviving loans-in-force at the beginning of that period.

- **Conditional Prepayment Rate (CPR):** the number of loans being completely prepaid during a time period divided by the number of surviving loans-in-force at the beginning of that period.

- **Policy Year:** measures the number of fiscal years since origination. The year in which the mortgage is originated is assigned as fiscal policy year one, even though it may not be

a complete year.

- **Termination Year:** the fiscal year in which a mortgage terminates through a claim, prepayment or other reasons.

- **Unpaid Principal Balance (UPB) Factor:** the principal balance outstanding at a given time divided by the original mortgage amount. The UPB factor is calculated based only on amortization, given the original maturity, the type of mortgage, and the mortgage contract rate. For FRMs, the UPB factor for each quarter in the future can be directly computed using the initial contract rate and the amortization term. For ARMs, the UPB factor changes at different rates depending on the interest rate of the particular loan, which is updated according to the contractual rate-adjustment rule. In our model, the contract interest rates of ARM loans are updated by using changes in the one-year Treasury rate as an approximation for changes in the underlying index, subject to limits implied by FHA annual and lifetime rate-adjustment caps.

III. Cash Flow Components

We now describe the different cash flow components.

A. Premiums

1. Premium Structure

The primary source of revenue to the Fund is insurance premiums. If the Fund's mortgage insurance is priced to meet the expected liabilities, the insurance premiums collected and interest earned on them will, on average, cover all costs associated with mortgage loans insured by the Fund. The insurance premium has been structured in different ways during different time periods. Details of the evolvement of the premium structure are shown in Exhibits B-2, B-3 and B-4, and are as follows:

- For loans originated prior to September 1, 1983, the mortgage premium was collected on a monthly basis at an annualized rate of 0.50 percent of the outstanding principal balance for the period. To align this change with fiscal quarters, we assumed that this annual premium policy was in effect through September 30, 1983. There are very few loans of this vintage in the current portfolio.

- Between September 1, 1983 and June 30, 1991, the mortgage premium was charged only upon loan origination and was based on a percentage of the original mortgage amount at the time of origination. This amount was 3.80 percent for 30-year mortgages and 2.40 percent for 15-year mortgages.

- Effective July 1, 1991, the National Affordable Housing Act specified a new premium structure. This structure specified an upfront premium of 3.80 percent for all product types except for 15-year non-streamline refinance loans (for which the upfront premium was set at 2.00 percent) and an annual renewal premium of 0.50 percent per year on the outstanding balance. The annual premium would cease at different policy years depending on the initial LTV of the loan.

- On October 1, 1992, the upfront premium for 30-year mortgages was reduced from 3.80 percent to 3.00 percent. The annual premium for 30-year mortgages was extended for a longer time period, while for 15-year mortgages, it was lowered to 0.25 percent for a shorter time period or completely waived if the initial LTV ratio was less than 90 percent.

- As of April 17, 1994, FHA lowered the upfront premium rate on 30-year mortgages from 3.00 percent to 2.25 percent. To align this change with fiscal quarters, we started applying this policy change on April 1, 1994.

- Starting from October 1, 1996, FHA lowered the upfront premium rate on 30-year mortgages for first-time homebuyers who receive homeowner counseling from 2.25 percent to 2.00 percent. This rate was further reduced to 1.75 percent for mortgages executed on or after September 22, 1997. This favorable treatment for borrowers with homeownership counseling was terminated shortly thereafter.

- Effective January 1, 2001, FHA lowered the upfront premium rate for all mortgages to 1.50 percent. The annual premium would stop as soon as the current LTV ratio of the loan was below 78 percent according to the home price as of the loan origination date. The annual premium was required to be paid for a minimum of five years for 30-year mortgages.

- Effective October 1, 2008, FHA charged an upfront premium rate of 1.75 percent for purchase money mortgages and full-credit qualifying refinances; and 1.50 percent for all

types of streamline refinance loans. A varying annual premium, remitted on a monthly basis, was charged based on the initial loan-to-value ratio and maturity of the mortgage.

- Effective April 1, 2010, FHA changed the upfront premium to 2.25 percent for all mortgages executed after Apr 1, 2010.

- Effective October 4, 2010, FHA lowered the upfront premium of all mortgages to 1.0 percent. The annual premium for loans with 30-year terms was increased to 0.85 percent for LTV ratios up to 95 percent and to 0.90 percent for LTV ratios greater than 95 percent. For loans with 15-year terms, an annual premium of 0.25 percent was set for LTV ratios greater than 90 percent.

- Effective April 18, 2011, the annual premium for loans with 30-year terms was increased to 1.10 percent for LTV ratios up to 95 percent and to 1.15 percent for LTV ratios greater than 95 percent. For loans with 15-year terms, the annual premiums were increased to 0.25 percent for LTV ratios up to 90 percent and to 0.50 percent for LTV ratios greater than 90 percent.

- Effective April 9, 2012, FHA increased the upfront premium of all mortgages to 1.75 percent. The annual premium for loans with 30-years terms was increased to 1.20 percent for LTV ratios up to 95 percent, and to 1.25 percent for LTV ratios greater than 95 percent. For loans with 15-year terms, the annual premiums were increased to 0.35 percent for LTV ratios up to 90 percent, and to 0.60 percent for LTV ratios greater than 90 percent.

- Effective June 11, 2012, the annual premium for loans with 30-year terms and base loan amounts above $625,500 was increased to 1.45 percent for LTV ratios up to 95 percent, and to 1.50 percent for LTV ratios greater than 95 percent. For loans with 15-year terms, and base loan amount above $625,500, the annual premium was increased to 0.60 percent for LTV ratios up to 90 percent, and to 0.85 percent for LTV ratios greater than 90 percent.

- Effective June11, 2012, for all single family Forward Streamline Refinance which are refinancing existing FHA loans that were endorsed on or before May 31, 2009, the upfront premium will decrease to 0.01 percent of the base loan amount, and the annual premium was set at 0.55 percent, regardless of the base loan amount.

- Effective April 1, 2013, the annual premium for loans with 30-year terms and base loan amounts below $625,500 was increased to 1.30 percent for LTV ratios up to 95 percent, and to 1.35 percent for LTV ratios greater than 95 percent. The annual premium for loans with 30-year terms and base loan amounts above $625,500 was increased to 1.50 percent for LTV ratios up to 95 percent, and to 1.55 percent for LTV ratios greater than 95 percent. For loans with 15-year terms and base loan amounts below $625,500, the annual premium was increased to 0.45 percent for LTV ratios up to 90 percent, and to 0.70 percent for LTV ratios greater than 90 percent. For loans with 15-year terms and base loan amounts above $625,500, the annual premium was increased to 0.70 percent for LTV ratios up to 90 percent, and to 0.95 percent for LTV ratios greater than 90 percent. This increase was effective for all forward mortgages except single family forward streamline refinance transactions that refinance existing FHA loans that were endorsed on or before May 31, 2009.

- Effective June 3, 2013, the annual premium rates for loans with an LTV of less than or equal to 78 percent and with terms of up to 15 years was 0.45 percent.

- The new duration of annual premiums for loans with case numbers assigned on or after June 3, 2013 and with an LTV up to 90% was 11 years, and the annual premium applies for the life of the loan for LTVs greater than 90%.

Exhibit B-2: Upfront Premium Rates for Fully Underwritten FHA Loans

Fiscal Year	30yr Loans, Fixed or Adjustable Rate (%)	15yr Loans, Fixed or Adjustable Rate (%)
9/1/83 to 6/30/91	3.8	2.4
7/1/91 to 9/30/92	3.8	2.00
10/1/92 to 4/16/94	3	2
4/17/94 to 9/30/96	2.25	2
10/1/96 to 9/21/97	2.25/2.00[a]	2
9/22/97 to 12/31/00	2.25/2.00/1.75[a]	2
1/1/01 to 9/30/08	1.5	1.5
10/1/08 to 4/4/10	1.75	1.75
4/5/10 to 10/3/10	2.25	2.25
10/4/10 and 4/8/12	1	1
4/9/12 and later	1.75	1.75

[a] For first-time homebuyers who received homeowner counseling.

Exhibit B-3: Annual Premium Rate for 15- and 30-Year Fully Underwritten Mortgages

Fiscal Year	30yr Loans, Fixed or Adjustable	15yr Loans, Fixed or Adjustable
Prior to 9/1/1983	0.5% for life of loan	0.5% for life of loan
9/1/83 to 6/30/91	None	None
7/1/91 to 9/30/92	varies by LTV category[a]	varies by LTV category[a]
10/1/92 to 12/31/00	varies by LTV category[b]	varies by LTV category[c]
1/1/01 to 9/30/08	0.5% until loan balance reaches 78% of original property value, minimum of 5 years	varies by LTV category[d]
10/1/08 to 10/3/10	0.50% if LTV≤ 95% 0.55% if LTV > 95% until loan balance reaches 78% of original property value, minimum of 5 years	0% if LTV ≤ 90% 0.25% if LTV > 90% until loan balance reaches 78% of original property value
10/4/10 to 4/17/11	0.85% if LTV≤ 95% 0.90% if LTV > 95% until loan balance reaches 78% of original property value, minimum of 5 years	0% if LTV≤ 90% 0.25% if LTV > 90% until loan balance reaches 78% of original property value
4/18/11 to 4/8/12	1.10% if LTV≤ 95% 1.15% if LTV > 95% until loan balance reaches 78% of original property value, minimum of 5 years	0.25% if LTV≤ 90% 0.50% if LTV > 90% until loan balance reaches 78% of original property value
4/9/12 to 6/10/12	1.20% if LTV≤ 95% 1.25% if LTV > 95% until loan balance reaches 78% of original property value, minimum of 5 years	0.35% if LTV≤ 90% 0.60% if LTV > 90% until loan balance reaches 78% of original property value
6/11/12 to 3/31/13	1.20% if LTV≤ 95% & base loan amount ≤ $625,500 1.25% if LTV > 95% & base loan amount ≤ $625,500 1.45% if LTV≤ 95% & base loan amount > $625,500 1.50% if LTV > 95% & base loan amount > $625,500 until loan balance reaches 78% of original property value, minimum of 5 years	0.35% if LTV≤ 90% & base loan amount ≤ $625,500 0.60% if LTV > 90% & base loan amount ≤ $625,500 0.60% if LTV ≤ 90% & base loan amount > $625,500 0.85% if LTV > 90% & base loan amount > $625,500 until loan balance reaches 78% of original property value
4/1/13 to 6/2/13	1.30% if LTV≤ 95% & base loan amount ≤ $625,500 1.35% if LTV > 95% & base loan amount ≤ $625,500 1.50% if LTV≤ 95% & base loan amount > $625,500 1.55% if LTV > 95% & base loan amount > $625,500 until loan balance reaches 78% of original property value, minimum of 5 years	0.45% if LTV≤ 90% & base loan amount ≤ $625,500 0.70% if LTV > 90% & base loan amount ≤ $625,500 0.70% if LTV ≤ 90% & base loan amount > $625,500 0.95% if LTV > 90% & base loan amount > $625,500 until loan balance reaches 78% of original property value

6/3/13 and later	1.30% if LTV ≤ 95% & base loan amount ≤ $625,500 1.35% if LTV > 95% & base loan amount ≤ $625,500 1.50% if LTV≤ 95% & base loan amount > $625,500 1.55% if LTV > 95% & base loan amount > $625,500 If LTV≤ 90%, 11 years; if LTV> 90%, life of loan		0.45% if 78%<LTV≤ 90% & base loan amount ≤ $625,500 0.70% if LTV > 90% & base loan amount ≤ $625,500 0.70% if 78%<LTV≤ 90% & base loan amount >$625,500 0.95% if LTV > 90% & base loan amount > $625,500 0.45% if LTV≤78% If LTV≤ 90%, 11 years; if LTV> 90%, life of loan	
LTV Range:	**a**	**b**	**c**	**d**
below 90%	0.5% for 5 yrs	0.5% for 7 yrs	0%	0%
Between 90%~95%	0.5% for 8 yrs	0.5% for 12 yrs	0.25% for 4 yrs	0.25% until LTV reaches 78%
above 95%	0.5% for 10 yrs	0.5% for 30 yrs	0.25% for 8 yrs	0.25% until LTV reaches 78%

Insurance premium rules for streamline refinance (SR) loans are summarized in Exhibit B-4.

Exhibit B-4: Premium Rates for Streamline Refinance Loans

Period of Origination	30-Year Mortgages		15-Year Mortgages	
	Upfront Premium	Annual Premium	Upfront Premium	Annual Premium
7/1/91 to 9/30/92	3.80%	0.5% for first 7 years	3.80%	0.5% for first 7 years
10/1/92 to 4/16/94	3.00%	0.5% for first 7 years	2.00%	None
4/17/94 to 12/31/00	2.25%	0.5% for first 7 years	2.00%	None
1/1/01 to 9/30/08	1.50%	0.5% until loan balance reaches 78% of original property value, minimum of 5 years	1.50%	0.25% if LTV > 90%[a] until loan balance reaches 78% of original property value
10/1/08 to 3/31/10	1.50%	0.50% if LTV≤95%, 0.55% if LTV > 95% until loan balance reaches 78% of original property value, minimum of 5 years	1.50%	0.25% if LTV > 90%[a] until loan balance reaches 78% of original property value
4/1/10 to 10/3/10	2.25%	0.50% if LTV≤95%, 0.55% if LTV > 95% until loan balance reaches 78% of original property value, minimum of 5 years	2.25%	0.25% if LTV > 90%[a] until loan balance reaches 78% of original property value
10/4/10 to 4/17/11	1.00%	0.85% if LTV≤95%, 0.90% if LTV>95% until loan balance reaches 78% of original property value, minimum of 5 years	1.00%	0.25% if LTV > 90%[a] until loan balance reaches 78% of original property value
4/18/11 to 3/31/13	1.00%	1.10% if LTV≤ 95% & base loan amount ≤ $625,500 1.15% if LTV > 95% & base loan amount ≤ $625,500 1.35% if LTV ≤ 95% & base loan amount > $625,500 1.40% if LTV > 95% & base loan amount > $625,500 until loan balance reaches 78% of original property value, minimum of 5 years	1.00%	0.25% if LTV≤ 90% & base loan amount ≤ $625,500 0.50% if LTV > 90% & base loan amount ≤ $625,500 0.5% if LTV ≤ 95% & base loan amount > $625,500 0.75% if LTV > 95% & base loan amount > $625,500 until loan balance reaches 78% of original property value
4/1/13 to 6/2/13 [b]	1.00% [b]	1.30% if LTV≤ 95% & base loan amount ≤ $625,500	1.00% [b]	0.45% if LTV≤ 90% & base loan amount ≤ $625,500

		1.35% if LTV > 95% & base loan amount ≤ $625,500 1.50% if LTV ≤ 95% & base loan amount > $625,500 1.55% if LTV > 95% & base loan amount > $625,500, until loan balance reaches 78% of original property value, minimum of 5 years [b]		0.70% if LTV > 90% & base loan amount ≤ $625,500 0.70% if LTV ≤ 95% & base loan amount > $625,500 0.95% if LTV > 95% & base loan amount > $625,500, until loan balance reaches 78% of original property value [b]
6/3/13 and later [b]	1.00% [b]	1.30% if LTV≤ 95% & base loan amount ≤ $625,500 1.35% if LTV > 95% & base loan amount ≤ $625,500 1.50% if LTV ≤ 95% & base loan amount > $625,500 1.55% if LTV > 95% & base loan amount > $625,500, If LTV≤ 90%, 11 years; if LTV> 90%, life of loan [b]	1.00% [b]	0.45% if 78%<LTV≤ 90% & base loan amount ≤ $625,500 0.70% if LTV > 90% & base loan amount ≤ $625,500 0.70% if 78%<LTV≤ 90% & base loan amount >$625,500 0.95% if LTV > 90% & base loan amount > $625,500 0.45% if LTV≤78% If LTV≤ 90%, 11 years; if LTV> 90%, long term [b]
6/11/12 and later [c]	0.01% [c]	0.55% until loan balance reaches 78% of original property value, minimum of 5 years [c]	0.01% [c]	0.55% until loan balance reaches 78% of original property value [c]

[a] 0% if original LTV is equal to or below 90 percent.
[b] Applies to all forward mortgages except single family forward streamline refinance transactions that refinance existing FHA loans that were endorsed on or before May 31, 2009 (see ML 2012-4).
[c] Only applies to SF Forward Streamline Refinance transactions that are refinancing existing FHA loans that were endorsed before May 31, 2009.

2. Upfront Premium

The upfront premium is assumed to be fully paid at the mortgage origination date and the amount is calculated as follows:

*Upfront Premium Payment = Origination Loan Amount * Upfront Insurance Premium Rate*

In practice, FHA offers a premium finance program to those qualified for mortgage insurance, so that borrowers do not have to pay the upfront premium at the beginning of the contract. Instead, the borrower can add it to the original loan balance, in essence paying the upfront premium at the same schedule as their principal balance. The annual premium is charged based on the unpaid

principal balance excluding the financed upfront premium. Almost all borrowers finance their upfront premiums in this fashion. However, the LTV including refinanced upfront premiums cannot exceed 97.5 percent.

3. Quarterly Premium

The quarterly premium is calculated as follows:

Quarterly Premium =
*Amortized UPB (excluding any upfront premiums) * Annual Insurance Premium Rate / 4*

The premium is actually collected on a monthly basis. The above formula models the premium as being collected at the beginning of each quarter for purposes of our analysis. In addition, the termination rate will have impacts on future premium flows. In particular, all potential future premium income would no longer be paid when the particular mortgage loan is prepaid or becomes a claim.

Although FHA is effectively insuring the financed upfront premiums, the quarterly premium is not assessed on the amount of the financed upfront premium.

B. Losses Associated with Claims

The Fund's largest expense component comes in the form of payments arising from claims. FHA pays the claim to the lender after a lender files a claim. In most cases, FHA takes possession of the foreclosed property and sells the property to partially recover the loss. This particular type of claim is called a conveyance.

Based on this practice, claim cash flows can be decomposed into two components:

- Cash outflow of the claim payment at the claim date including expenses incurred, and

- Cash inflow of any net proceeds received in selling the conveyed property at the property disposition date.

For tractability, we simplify this two-step cash flow into one lump-sum amount. We also separately estimate losses from pre-foreclosure sales, wherein the property is sold prior to the completion of a foreclosure and the property is not conveyed to HUD (see Appendix E). The claim loss payment estimated in our model at time *t* is

*Claim Loss$_t$ = Amortized Surviving UPB$_t$ * 1(Conditional Claim Rate$_t$)* Loss Rate$_t$*

For this review, we introduced a dynamic simulation approach that simulates loan transitions to default, claim and prepayment that reflect the probabilities of the various transitions (see Appendix B). The *Amortized Surviving UPB$_t$* is the amount of the unpaid balance of the loan after amortization conditional on that the loan will survive until the beginning of time *t*. The *1(Conditional Claim Rate$_t$)* is an indicator function, which represents the outcome of a random draw based on the default-to-claim transition model presented in Appendix A.

The loss rate is usually referred to as the loss given default (LGD) or "severity" in the banking industry. It measures the amount of principal not recovered divided by the unpaid principal balance at the time of claim. The loss rate is predicted as weighted average loss rates among conveyance, pre-foreclosure sales, and the newly implemented policy of third party sale where the weights are the probabilities that a claim is associated with the respective type of claim. For additional technical details, see Appendix E.

C. Loss Mitigation Expenses

HUD initiated a loss mitigation program in 1996 in an effort to provide opportunities for distressed FHA insured borrowers to retain homeownership. Loss mitigation also reduces foreclosure costs. In the standard process, the mortgagees provide default counseling for borrowers who are behind in their payments, and offer appropriate loss mitigation options to prevent borrowers from losing their homes.

The loss mitigation program include: (1) special forbearance, (2) loan modification, and (3) partial claim. A special forbearance is a written repayment agreement between the mortgagee and the borrower that contains a plan to reinstate a loan. A loan modification modifies the contractual terms of mortgage permanently, such as lowering the interest rate, increasing the loan term, or reducing the principal balance. Under the partial claim option, a mortgagee will advance funds on behalf of a mortgagor in an amount necessary to reinstate a delinquent loan. The borrowers are required to sign a promissory note and a subordinated mortgage in the amount of the partial claim payable to FHA.

Loss mitigation cases increased dramatically from FY 2000 to FY 2009, the latest fiscal year with reliably finalized cash flows. There were 11,402 loss mitigation claims in FY 2000 which increased to 122,912 cases in FY 2009. The amount FHA paid in these cases after all adjustments and curtailments was $21.88 million in FY 2000 which increased to $265.5 million in FY 2009. Loss mitigation payments made by FHA include administrative fees, the cost of title searches, recording fees, and subordinated mortgage note amounts.

To estimate the loss mitigation payment, we estimated a linear regression model with zero constant term and the total claim payment during the quarter as the explanatory variable:

$$Loss\ Mitigation\ Payment = 0 + b*\ Claim\ Payment$$

The estimation uses quarterly aggregated data for loss mitigation payment amounts and total claim payments from FY 2002 through FY 2009. The estimated coefficient of claim payment is 0.058, meaning that loss mitigation expenses are typically about 5.80 percent of the total claim losses during an exposure quarter.

D. Refunded Premiums

FHA first introduced the upfront premium refund program in 1983. It specified that FHA would refund a portion of the upfront premium when a household prepaid its mortgage. The upfront premium was considered to be "earned" over the life of the loan. Upon prepayment, an approximation of the unearned upfront premium is returned to the borrower. Therefore, the amount of the refund depends on the time from origination to when the mortgage is prepaid. For modeling purposes, the refund payments are calculated as follows:

Refund Payments =
*Original UPB * Upfront Premium Rate * Conditional Prepayment Rate * Refund Rate*

In the past, borrowers could receive the upfront premium refund when they prepaid their mortgages before the maturity of the mortgage contract. In 2000, FHA changed its policy so that borrowers would obtain refunds only if they prepaid within the first five years of their mortgage contracts. The most recent policy change at the end of 2004 eliminated refunds for early prepayments of any mortgages endorsed after that date, except for those borrowers who refinanced into a new FHA loan within 3 years following the original endorsement date. We assume that about nineteen percent of future prepayments are refinanced into another FHA loan, following the average historical rate.

The upfront premium refund rate schedules for different endorsement dates are presented in Exhibit B-5.

Exhibit B-5: Percentage of Upfront Premium Refunded

Years since Origination	9/1/83~12/31/93		1/1/94~ 12/31/00[a]	1/1/01 and later[b]	12/8/2004 and later[c]
	30-Year Mortgages	**15-Year Mortgages**	**All Mortgages**	**All Mortgages**	**If Refinanced into Another FHA Loan**
1	0.99	0.99	0.95	0.85	0.58
2	0.94	0.93	0.85	0.65	0.34
3	0.82	0.81	0.70	0.45	0.10
4	0.67	0.66	0.49	0.25	0.00
5	0.54	0.51	0.30	0.10	
6	0.43	0.39	0.15	0.00	
7	0.35	0.29	0.04		
8	0.29	0.21	0.00		
9	0.24	0.15			
10	0.21	0.11			
11	0.18	0.08			
12	0.16	0.06			
13	0.15	0.04			
14	0.13	0.03			
15	0.12	0.02			
16	0.11	0.00			
17	0.10				
18	0.09				
19	0.09				
20	0.08				
21	0.07				
22	0.07				
23	0.06				
24	0.05				
25	0.05				
26	0.04				
27	0.04				
28	0.04				
29	0.04				
30	0.00				

[a] Based on Mortgagee Letter 94-1, which provided a monthly schedule of refund rates
[b] Based on Mortgagee Letter 00-38
[c] Based on Mortgagee Letter 05-03, which provided a monthly schedule of refund rates. Applicable only if refinanced into a new FHA loan.

IV. Economic Value

Once all the above future cash flow components are estimated, their present value can be computed through discounting them at an appropriate rate. The economic value is the sum of the present value of future cash flows plus the current capital resources.

A. Discount Factors

The discount factors applied in computing the present value of cash flows are the official quarterly Federal credit subsidy present value conversion factors. The discount factors vary depending on how far into the future a cash flow will occur. The discount factors are shown in Exhibit B-6. As an example, a cash flow occurring at the end of FY 2014 is multiplied by 0.9980 to convert it into a present value for year-end FY 2013. The discount factors used in this Review are higher than the corresponding discount factors in last year's Review.

Exhibit B-6: Discount Factors

Year that Cash Flow Occurs	Discount Factor	Year that Cash Flow Occurs	Discount Factor	Year that Cash Flow Occurs	Discount Factor
2014	0.9980	2025	0.7423	2036	0.4900
2015	0.9940	2026	0.7150	2037	0.4717
2016	0.9836	2027	0.6887	2038	0.4541
2017	0.9653	2028	0.6632	2039	0.4371
2018	0.9407	2029	0.6387	2040	0.4207
2019	0.9142	2030	0.6151	2041	0.4049
2020	0.8872	2031	0.5923	2042	0.3897
2021	0.8590	2032	0.5703	2043	0.3751
2022	0.8298	2033	0.5491	2044	0.3610
2023	0.7999	2034	0.5287	2045	0.3475
2024	0.7706	2035	0.5090	2046	0.3344

B. Calculating the Economic Value

The economic value of the Fund as of the end of FY 2013 was calculated first by determining the present value of the future cash flows for all surviving loans as of September 30, 2013. This figure was then added to the capital resources of the Fund, estimated as of the same date.

For each fiscal year beyond 2013, the economic value of the fund as of the end of the fiscal year is calculated by the following equation:

Year End Economic Value =
Economic Value at the beginning of the year + Total Investment Earnings on the Beginning Economic Value + Economic Value of the New Book of Business

The earnings on investment of the beginning economic value for each of the future fiscal years is assumed to equal the one-year Treasury forward rates implied by the most recent Federal credit subsidy discount factors. Specifically, these rates are shown in Exhibit B-7.

Exhibit B-7: Interest Rate Earned by the Fund

Fiscal Year	Interest Rate (%)
2014	0.20%
2015	0.40%
2016	1.06%
2017	1.90%
2018	2.61%
2019	2.90%
2020	3.05%

V. Foreclosed Loans and Delayed Claim Override

After the U.S. mortgage market meltdown, the number of delinquent loans increased dramatically. Starting in 2008, banks sometimes did not follow appropriate formal procedures to foreclose a mortgage and they were penalized. Since then many banks took extra precautions in the foreclosure procedures to avoid the risk of not being paid by mortgage insurers. As of June 30, 2013, FHA had a large inventory of loans than had begun the foreclosure process, or even had completed the foreclosure process but had not yet been filed as claims. We had observed a large decrease in claim cases after FY 2009, attributable to the backlog of inventory in the foreclosure process. In this year's model, we identified 19,861 loans (versus 74,915 loans in 2012 Actuarial Review) in default that had completed foreclosure but had not yet been filed as claims. We assume these loans will become claims starting in FY 2014Q1.

We adjusted the termination process for these loans that had completed foreclosure but had not claimed. Same as last year, all of these loans are assumed to move into claim eventually. However, the timing of when they will claim is what we have modeled here.

First, we used information from all loans terminated between 1990Q1 and 2013Q2 to estimate the termination process. Specifically, we assumed the termination likelihood follows an exponential distribution after the auction is held or the foreclosure is completed. Two transitions are modeled, from auction to termination and from foreclosure to termination. The exponential density function we modeled is in the following form:

$$f(x; \theta, \sigma) = \begin{cases} \frac{1}{\sigma} e^{-\frac{x-\theta}{\sigma}}, & x \geq \theta \\ 0, & x < \theta \end{cases}.$$

These two transitions are estimated separately at the state level.

After modeling the termination process, we used the following rule to identify the loans that needed adjustment: a foreclosed loan auction was held at least 6 quarters before July 31, 2013 or its foreclosure was completed at least 4 quarters before July 31, 2013.

For each loan, we simulated its termination quarter using the corresponding estimated exponential distribution. The following table summarizes the simulated termination result.

Exhibit B-8: Special Treatment for Foreclosure Backlog

Termination Quarter	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	8401	42.3	8401	42.3
1	6643	33.45	15044	75.75
2	2359	11.88	17403	87.62
3	1105	5.56	18508	93.19
4	526	2.65	19034	95.84
5	338	1.7	19372	97.54
6	190	0.96	19562	98.49
7 to 20	299	1.54	19861	100

In our simulation model, we overrode the forecasted claim date from the econometric model with the above simulated claim date, if the latter occurs earlier. Otherwise, we made no adjustment.

Appendix C

Data for Loan Performance Simulations

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Appendix C: Data for Loan Performance Simulations

This appendix describes the methodology used to produce the data necessary for the forecasts of future loan performance. We first describe how loan event data for future time periods were generated to project future loan performance and mortgage-related cash flows. This required creating future event data both for existing books of business and for future loan cohorts not yet originated. Then we summarize how the economic forecasts were applied. The economic forecasts are discussed in Appendix D.

I. Future Loan Event Data

The development of future loan event data was closely integrated with the development of the data used in the statistical estimation of loan performance. As described in Appendix A, the process of building the historical loan event data entailed expanding FHA loan origination records into dynamic quarter-to-quarter event data from loan origination up to and including the period of loan termination. The loan event data were used to derive a number of conditional loan status transition rates. The transition events are current-to-default (default is 90+ days delinquent), current-to-current_X (default and cure within the same quarter), current-to-streamline refinance, current-to-prepay, default-to-claim, default-to-prepay, default-to-cure by significant modification assistance, and default-to-cure with low or no modification assistance.

For loans that did not terminate and are still in either current or in default status as of FY 2013Q2, the process of building the future quarter-by-quarter event data followed the same procedure as for terminated loans, but used forecasted values of external economic factors to project future loan termination rates and cash flows.

In addition, for the purpose of projections of future economic values, we forecasted the loan performance of future FHA books originated through FY 2020. The dollar endorsement volumes for FY 2013 through FY 2020 are provided by our FHA mortgage volume model described in Appendix F. Based on Moody's baseline economic forecasts, Exhibit C-1 shows the volume model's projected dollar volumes and product share distribution.

These forecasted volumes are allocated among the six loan-product types following their distribution in the most recent endorsements over FY 2012Q3 to FY 2013Q2. HUD provided detailed projections of the compositions of these future books of business by LTV and credit score. Exhibits C-2 and C-3 present HUD's projected composition for purchase and fully underwritten mortgages. Also, we assumed stable proportions of product types for fully underwritten mortgages over FY 2013 to FY 2020 as presented in Exhibit C-4.

Exhibit C-1: Forecasted FHA Dollar Volumes ($million) and Shares

Period	FHA Purchase Volume	FHA Fully Underwritten Refi Volume	FHA Streamline Refi Volume	Total FHA Volume
FY2013	$116,569	$22,309	$102,316	$241,195
FY2014	$110,986	$6,445	$73,546	$190,977
FY2015	$115,113	$6,385	$15,117	$136,615
FY2016	$116,213	$11,046	$11,445	$138,704
FY2017	$114,080	$19,238	$14,710	$148,027
FY2018	$115,442	$19,785	$20,775	$156,002
FY2019	$118,850	$18,749	$20,505	$158,104
FY2020	$123,022	$17,940	$21,646	$162,608

Period	FHA Purchase Share	FHA Fully Underwritten Refi Share	FHA Streamline Refi Share
FY2013	48.33%	9.25%	42.42%
FY2014	58.12%	3.37%	38.51%
FY2015	84.26%	4.67%	11.07%
FY2016	83.79%	7.96%	8.25%
FY2017	77.07%	13.00%	9.94%
FY2018	74.00%	12.68%	13.32%
FY2019	75.17%	11.86%	12.97%
FY2020	75.66%	11.03%	13.31%

Exhibit C-2: Base-Case Composition of For-Purchase Mortgages

Loan-to-Value Ratio	Term	Projected Composition of FY 2013 Purchase Loans							
		FICO Score Range							
		Missing	300-499	500-579	580-619	620-659	660-679	680-719	720-850
X ≤ 90	30 Yr	0.04%	0.00%	0.01%	0.11%	0.96%	0.73%	1.25%	1.37%
	15 Yr	0.57%	0.00%	0.01%	0.50%	4.31%	4.51%	11.12%	14.02%
90 < X ≤ 95	30 Yr	0.04%	0.00%	0.00%	0.16%	1.35%	1.17%	2.24%	2.66%
	15 Yr	0.12%	0.00%	0.00%	0.13%	1.45%	1.67%	3.53%	4.37%
95 < X	30 Yr	0.31%	0.00%	0.00%	1.00%	17.71%	14.85%	25.21%	28.84%
	15 Yr	0.40%	0.00%	0.00%	0.21%	7.35%	7.46%	15.34%	22.93%

Loan-to-Value Ratio	Term	Projected Composition of FY 2014 Purchase Loans							
		FICO Score Range							
		Missing	300-499	500-579	580-619	620-659	660-679	680-719	720-850
X ≤ 90	30 Yr	0.03%	0.00%	0.00%	0.10%	0.94%	0.74%	1.34%	1.30%
	15 Yr	0.75%	0.00%	0.00%	0.35%	4.08%	4.79%	11.99%	12.03%
90 < X ≤ 95	30 Yr	0.05%	0.00%	0.00%	0.13%	1.46%	1.33%	2.43%	2.57%
	15 Yr	0.18%	0.00%	0.00%	0.18%	1.76%	1.98%	4.26%	4.22%
95 < X	30 Yr	0.31%	0.00%	0.00%	0.70%	17.85%	15.91%	26.27%	26.55%
	15 Yr	0.35%	0.00%	0.00%	0.18%	7.77%	8.96%	16.07%	20.11%

Loan-to-Value Ratio	Term	Projected Composition of FY 2015 Purchase Loans							
		FICO Score Range							
		Missing	300-499	500-579	580-619	620-659	660-679	680-719	720-850
X ≤ 90	30 Yr	0.06%	0.00%	0.50%	0.20%	0.94%	0.78%	1.34%	1.18%
	15 Yr	0.96%	0.00%	0.50%	0.68%	4.29%	5.13%	12.67%	10.32%
90 < X ≤ 95	30 Yr	0.08%	0.00%	0.00%	0.28%	1.45%	1.40%	2.43%	2.34%
	15 Yr	0.23%	0.00%	0.00%	0.34%	1.85%	2.12%	4.50%	3.62%
95 < X	30 Yr	0.55%	0.00%	0.00%	1.48%	17.73%	16.81%	26.25%	24.18%
	15 Yr	0.45%	0.00%	0.00%	0.34%	8.17%	9.61%	16.99%	17.25%

Loan-to-Value Ratio	Term	Projected Composition of FY 2016 - 2020 Purchase Loans							
		FICO Score Range							
		Missing	300-499	500-579	580-619	620-659	660-679	680-719	720-850
X ≤ 90	30 Yr	0.08%	0.00%	1.00%	0.31%	0.93%	0.82%	1.34%	1.07%
	15 Yr	1.17%	0.00%	1.00%	1.00%	4.50%	5.48%	13.35%	8.60%
90 < X ≤ 95	30 Yr	0.12%	0.00%	0.00%	0.42%	1.45%	1.48%	2.43%	2.11%
	15 Yr	0.28%	0.00%	0.00%	0.50%	1.94%	2.26%	4.74%	3.01%
95 < X	30 Yr	0.80%	0.00%	0.00%	2.27%	17.62%	17.70%	26.23%	21.82%
	15 Yr	0.55%	0.00%	0.00%	0.50%	8.56%	10.26%	17.90%	14.38%

Exhibit C-3: Base-Case Composition of Fully Underwritten Refinance Loans

Loan-to-Value Ratio	Term	Projected Composition of FY 2013 Fully Underwritten Refinance Loans							
		FICO Score Range							
		Missing	300-499	500-579	580-619	620-659	660-679	680-719	720-850
X ≤ 90	30 Yr	0.06%	0.00%	0.34%	1.04%	13.00%	11.15%	16.78%	14.15%
	15 Yr	0.04%	0.00%	0.03%	0.68%	10.84%	10.23%	19.82%	30.20%
90 < X ≤ 95	30 Yr	0.01%	0.00%	0.00%	0.30%	3.02%	2.93%	5.61%	7.26%
	15 Yr	0.01%	0.00%	0.00%	0.03%	1.28%	1.43%	3.28%	7.23%
95 < X	30 Yr	0.01%	0.00%	0.00%	0.94%	3.59%	3.65%	6.56%	9.60%
	15 Yr	0.00%	0.00%	0.00%	0.03%	1.23%	1.49%	3.67%	8.48%

Loan-to-Value Ratio	Term	Projected Composition of FY 2014 Fully Underwritten Refinance Loans							
		FICO Score Range							
		Missing	300-499	500-579	580-619	620-659	660-679	680-719	720-850
X ≤ 90	30 Yr	0.06%	0.00%	0.34%	1.12%	15.59%	12.69%	18.47%	13.01%
	15 Yr	0.05%	0.00%	0.01%	0.75%	12.44%	12.55%	22.07%	27.12%
90 < X ≤ 95	30 Yr	0.01%	0.00%	0.00%	0.32%	3.21%	2.87%	5.07%	5.70%
	15 Yr	0.02%	0.00%	0.00%	0.01%	1.41%	1.54%	3.22%	5.55%
95 < X	30 Yr	0.00%	0.00%	0.00%	0.92%	3.45%	3.59%	6.00%	7.58%
	15 Yr	0.00%	0.00%	0.00%	0.06%	1.36%	1.60%	3.82%	6.44%

Loan-to-Value Ratio	Term	Projected Composition of FY 2015 Fully Underwritten Refinance Loans							
		FICO Score Range							
		Missing	300-499	500-579	580-619	620-659	660-679	680-719	720-850
X ≤ 90	30 Yr	0.03%	0.00%	1.25%	1.59%	17.30%	13.18%	19.42%	11.87%
	15 Yr	0.02%	0.00%	0.01%	1.34%	13.96%	13.85%	24.19%	24.13%
90 < X ≤ 95	30 Yr	0.01%	0.00%	0.00%	0.40%	3.25%	2.73%	4.88%	4.83%
	15 Yr	0.01%	0.00%	0.00%	0.02%	1.38%	1.48%	3.07%	4.42%
95 < X	30 Yr	0.00%	0.00%	0.00%	1.10%	3.31%	3.25%	5.48%	6.14%
	15 Yr	0.00%	0.00%	0.00%	0.09%	1.37%	1.59%	3.78%	5.29%

Loan-to-Value Ratio	Term	Projected Composition of FY 2016-2020 Fully Underwritten Refinance Loans							
		FICO Score Range							
		Missing	300-499	500-579	580-619	620-659	660-679	680-719	720-850
X ≤ 90	30 Yr	0.00%	0.00%	2.17%	2.06%	19.00%	13.67%	20.36%	10.74%
	15 Yr	0.00%	0.00%	0.00%	1.93%	15.48%	15.14%	26.31%	21.15%
90 < X ≤ 95	30 Yr	0.00%	0.00%	0.00%	0.49%	3.29%	2.59%	4.69%	3.95%
	15 Yr	0.00%	0.00%	0.00%	0.02%	1.34%	1.42%	2.92%	3.30%
95 < X	30 Yr	0.00%	0.00%	0.00%	1.28%	3.16%	2.90%	4.96%	4.70%
	15 Yr	0.00%	0.00%	0.00%	0.12%	1.39%	1.59%	3.75%	4.14%

Exhibit C-4: Product Type Distribution of Fully Underwritten Mortgages for FY 2013Q2-2020Q4

Product Type	Proportion
Fixed-Rate 30 Year Mortgages	93.66%
Fixed-Rate 15 Year Mortgages	5.51%
Adjustable Rate Mortgages	0.83%

The development process of the loan-level data for future loans is as follows. Each future loan cohort is based on duplication of the loan-level data records for the last full year of historical data – corresponding to the last two quarters of FY 2012 and the first two quarters of FY 2013. While this basic approach imposes the assumption that future detailed loan characteristics occur with the same distribution as for recent FHA endorsements, several adjustments are made to ensure consistency with future economic conditions and volume forecasts. For example, the starting mortgage coupon rates for all products are updated to reflect forecasted market conditions at the time of origination of these projected future cohorts. This is achieved by

adjusting the loan-level coupon rates up or down by the same percentage change as occurred for the average market mortgage rate.

Streamline refinance (SR) loans require some additional adjustments specific to those products. For SR loans, current LTV values are based on linking the SR loan to the prior fully underwritten mortgage loan that was made to the same FHA borrower and same house. If a future loan origination is duplicated from an FY 2012-2013 SR origination that is linked to a fully underwritten loan originated two years earlier, the future SR loan origination uses the original LTV of that prior loan and the HPI of the specific MSA of the house to estimate the original and current LTV of the new SR loan.

II. Future Economic Forecasts

Moody's Analytics serves as our source for the quarterly economic forecast of interest rates and house price appreciation rates. For the projection of future changes in housing values, we used Moody's forecast of the FHFA MSA-level and state-level purchase only housing price indices. Because the Moody's baseline HPI forecast is an expected trend forecast, it tends to smooth out intertemporal volatility in house price appreciation rates. There is also an additional layer of uncertainty with regard to the dispersion of individual house price appreciation rates around the market average, represented by the local-level HPI. When using Moody's local house price forecasts to compute the probability of negative equity, it is important to take into account both sources of uncertainty. We adopt the Yang, Lin, and Cho (2011) methodology to incorporate these two sources of dispersion of future house price indices at each location. [43] Specifically, Equation (8) in Appendix A of this Review is modified as follows for all future time periods:

$$\sigma(t) = \sqrt{a \cdot t + b \cdot t^2}$$

where parameters "*a*" and "*b*" were estimated by FHFA for each location.

Local purchase-only HPI is published by FHFA. In assigning metropolitan area indexes, we first used the Metropolitan Statistical Area Division (MSAD) index if the index exists for the loan's Federal Information Processing Standards (FIPS) state-county code. If MSAD doesn't exist, we used the Core Based Statistical Area (CBSA) index if that index is available. In case neither the MSAD nor CBSA index is available, we applied the corresponding state-level HPIs.

As described in Appendix A, the indices are used in conjunction with estimates of house price diffusion parameters to compute probabilities of negative equity at each loan age for individual

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[43] See Equation (20) in Yang, Tyler T., Che-Chun Lin, and Man Cho, "Collateral Risk in Residential Mortgage Defaults," *Journal of Real Estate Finance and Economics*, Vol. 42, No. 2, pp. 115-142, 2011.

borrowers. The dispersion estimates reflect the deviations among individual house price appreciation rates around the MSA or state average appreciation rates computed retrospectively by the HPIs.

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Appendix D

Economic Forecasts

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Appendix D: Economic Forecasts

In order to measure the Fund's resilience against potential future losses on current and future portfolios, the economic value of the Fund was estimated under the Monte Carlo simulation framework and also for six alternative deterministic economic scenarios. Our Monte Carlo paths are centered on Moody's base forecast in the sense that our values are just as likely to lie above the Moody's forecast as they are to lie below them. For this calibration we used the July 2013 forecast of the U.S. economy published by Moody's Analytics. For purposes of our Review, the components of Moody's forecast are:

- FHFA Purchase-Only Home Price Index (HPIs) at the MSA and Census division levels

- Unemployment rates at the MSA and Census division levels

- Ten-year constant maturity Treasury rate

- One-year constant maturity Treasury rate

- Commitment rate on 30-year fixed-rate mortgages

A summary of these time series data, used in the baseline simulation is presented in Exhibit D-1. We used the quarterly local HPIs and unemployment rates to derive the economic value of the MMI Fund under alternative scenarios. The quarterly economic factors forecasted by Moody's are available from FY 2013 through FY 2043.

Exhibit D-1: Summary of Moody's Baseline Forecasts

		Economic Forecast[a]			
Fiscal Year	**FHFA Purchase-Only Home Price Index**	**Commitment Rate on 30-Year Fixed-Rate (%)**	**1-Year Treasury Rate (%)**	**10-Year Treasury Rate (%)**	**National Unemploy-ment Rate**
2013	197.10	4.01	0.20	2.16	7.52
2014	207.41	5.21	0.47	3.17	6.87
2015	214.79	5.99	1.21	4.18	6.21
2016	218.23	6.39	3.09	4.97	5.76
2017	220.76	6.07	3.80	4.65	5.38
2018	225.64	5.90	3.75	4.57	5.32
2019	231.27	5.86	3.70	4.62	5.32
2020	238.48	5.87	3.79	4.64	5.30
2021	246.96	5.86	3.95	4.70	5.26
2022	256.14	5.85	4.05	4.73	5.27
2023	265.68	5.86	4.06	4.75	5.32

[a] Source: Moody's Analytics July 2013 Forecast. Numbers are average levels during each fiscal year.

I. Alternative Scenarios

To assess the effect of stress scenarios on the Fund's economic value, six alternative scenarios were used. These six scenarios are:

- 10th Best Path in Simulation (of 100 paths)

- 25th Best Path in Simulation

- 25th Worst Path in Simulation

- 10th Worst Path in Simulation

- Worst Path in Simulation

- Moody's Protracted Slump Scenario

The details of constructing different stochastic simulation paths are presented in Appendix G. The sixth scenarios were based on modified versions of the July 2013 alternative economic

forecasts published by Moody's Analytics. Moody's projection of alternative future scenarios assumes that the local house price appreciation rate (HPA) will change from that of the baseline scenario by a constant rate from the base forecast scenario across all locations for each future quarter.

Moody's also assumes that future HPI levels will converge to those of the baseline scenario. This assumption implies that under pessimistic scenarios, the lower short-term HPA will be followed by a period of stronger HPA. Instead of assuming that the HPI will converge to a stable level in the long run, an alternative assumption widely used in the mortgage industry is that HPA will converge to a stable rate. As in last year's Review, we modified Moody's alternative HPI scenario to be consistent with this view. Specifically, the quarterly HPA rates were computed for the baseline and the Moody's alternative scenario. The alternative scenario follows the original Moody's HPA path until the quarterly HPA crosses that of the baseline scenario. Following the quarter of the HPA's cross-over, the HPA of the baseline scenario is applied to generate the remainder of the scenario. The cross-over quarter is FY 2016 Q2. This modification ensures that the HPA rate in a pessimistic scenario never exceeds that of the baseline scenario.

II. Graphical Depiction of the Scenarios

Exhibit D-2 shows the future movements of the national HPI under the baseline and the six alternative economic scenarios. This graph shows that the differences among these scenarios depend on the severity and duration of the housing recession. Under the baseline scenario, the HPI does not return to its FY 2007 level until FY 2018, and this does not happen throughout the next 30 years for the most pessimistic scenario.

Exhibit D-2: Paths of the Future National House Price Index in Different
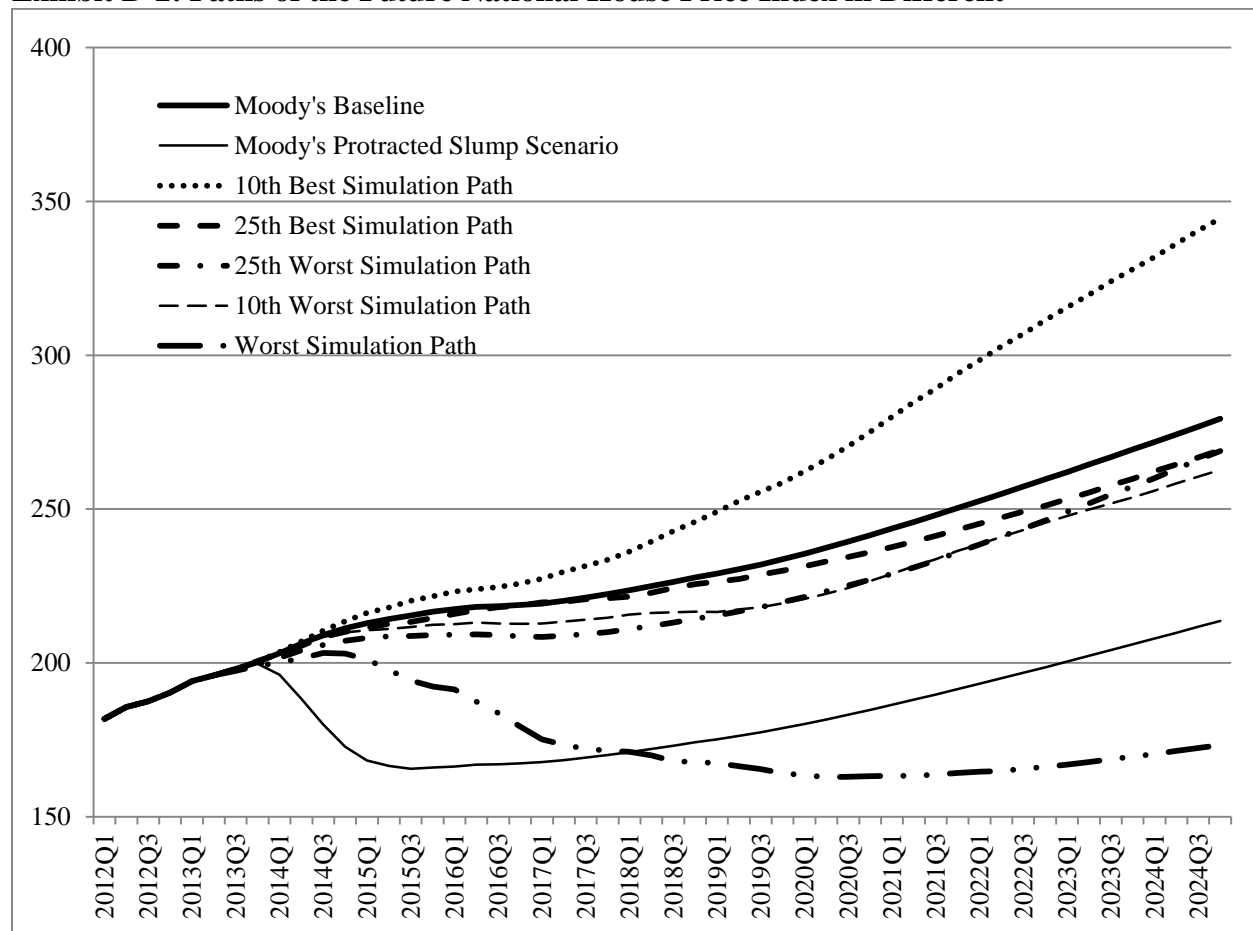
Exhibits D-3a and D-3b show the forecasted mortgage rate of 30-year fixed-rate mortgages in the baseline and the six alternative scenarios. Moody's projected the mortgage rates rising to around 6.4 percent within three years and reverting to around 5.8 percent in FY 2017. In addition, Moody's forecasts suggest stagflation wherein the protracted slump scenario coincides with the highest levels of rates.

Exhibit D-3a: Paths of the Future Mortgage Rate (%) in Different Scenarios
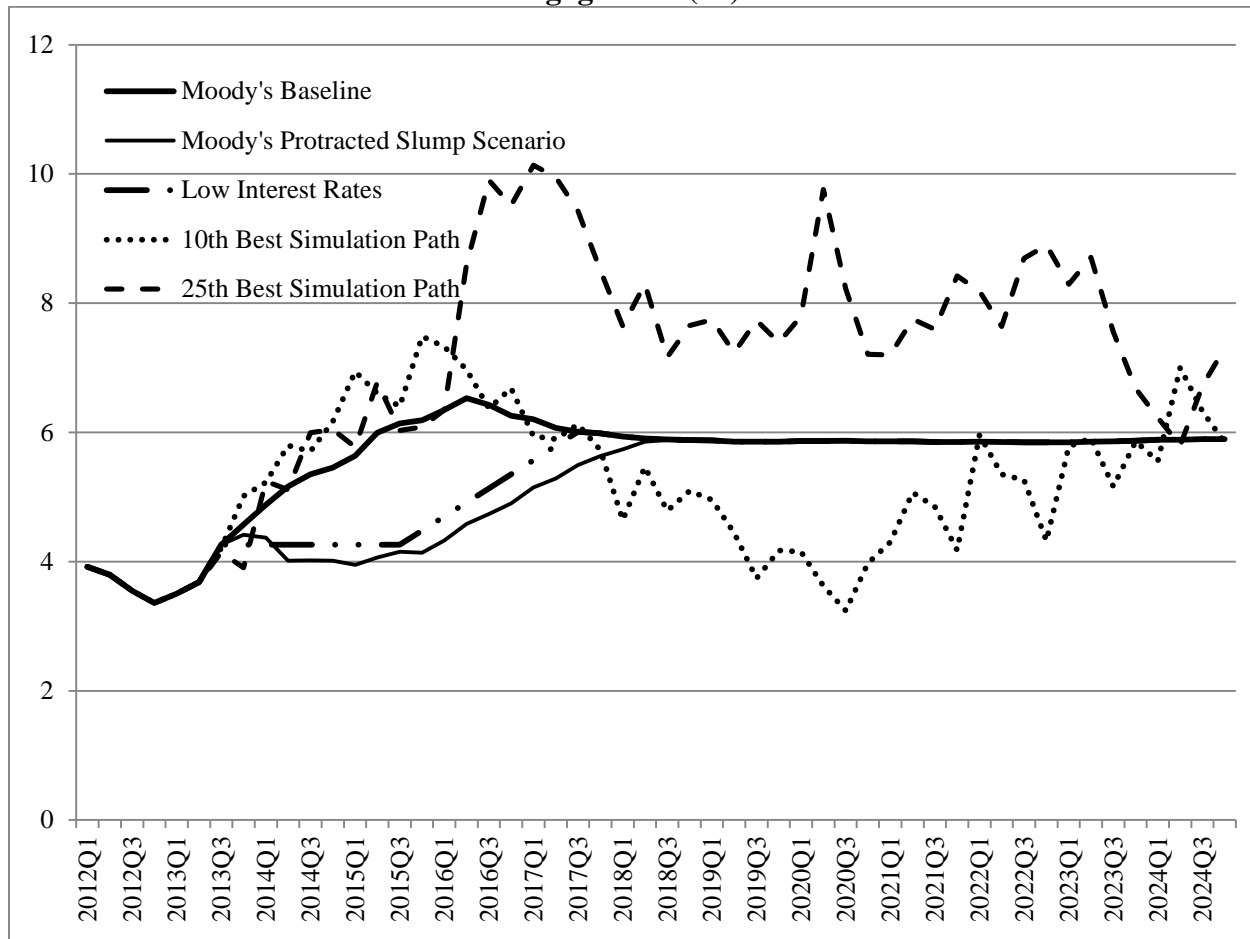
Exhibit D-3b: Paths of the Future Mortgage Rate (%) in Different Scenarios
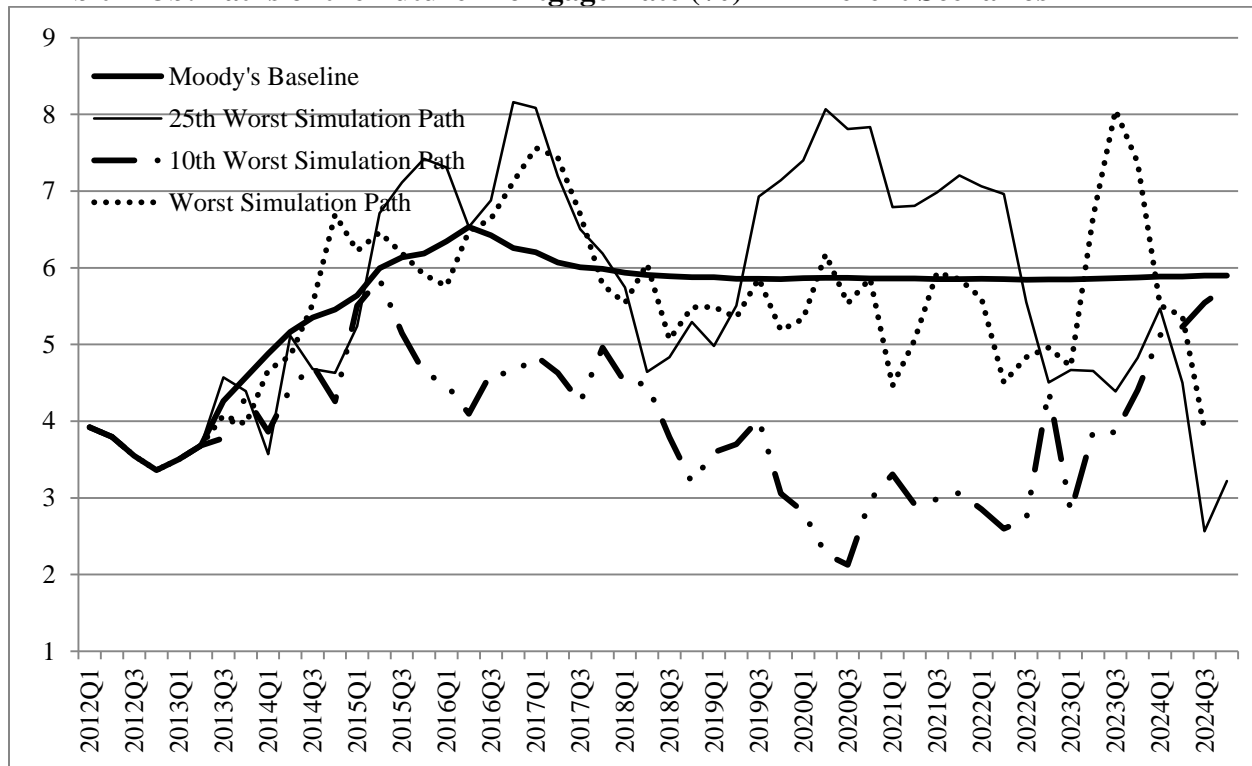
Exhibit D-4 shows the forecasted unemployment rate under different scenarios.

Exhibit D-4: Paths of the Future National Unemployment Rate in Different Scenarios
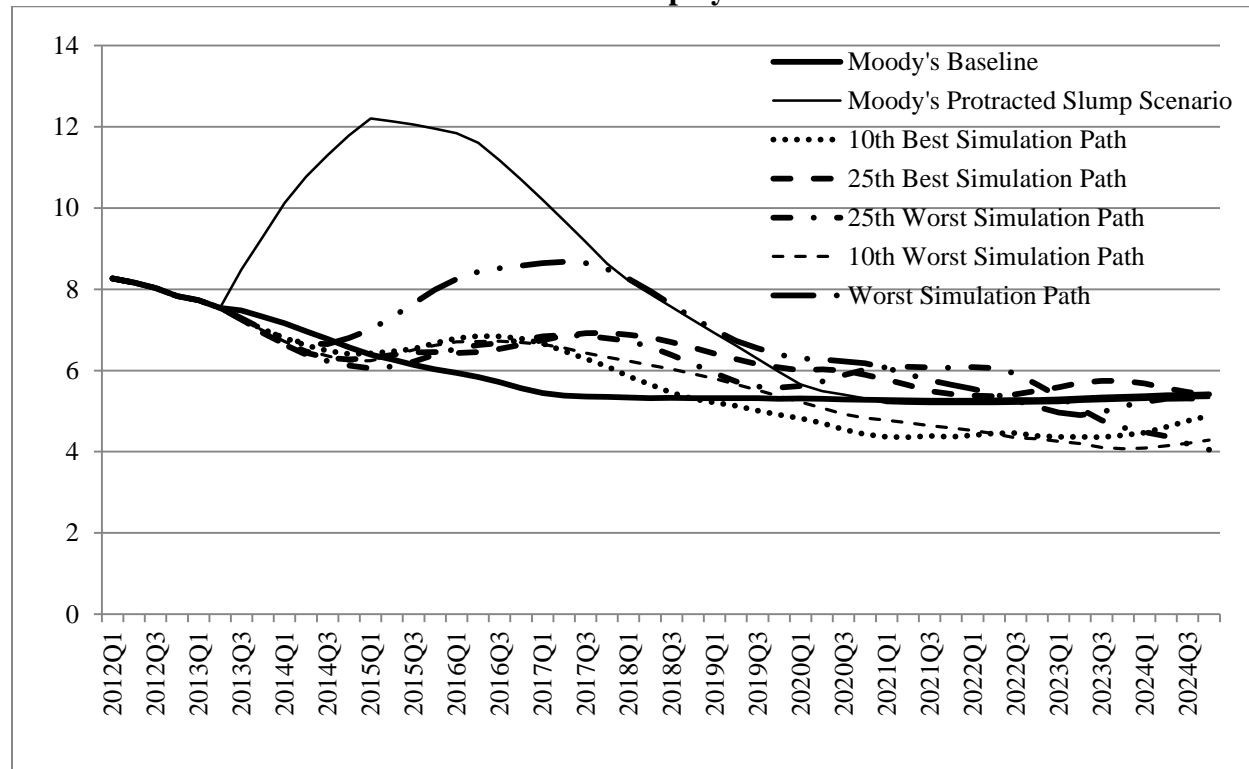
The projected performance of the Fund corresponding to each selected scenario described above is presented in Section V of this Review.

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Appendix E

Loss Severity Model

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Appendix E: Loss Severity Model

This appendix describes the loss severity model used in the FY 2013 Review. One of the primary sources of variation in the MMI Fund performance has been the loss severity experienced on loans that terminate as claims. In the case of a single loan, this loss, expressed as a percentage of the remaining unpaid principal balance at the claim date, is referred to as the "loss rate" or the "loss severity rate."[44] The loss rate model used in this Review includes the following structure: (1) a two-stage model, including both disposition type selection model and loss rate given disposition type model and (2) conditional loss rate model based on different disposition types. Section I summarizes the specification and estimation approaches in the model, Section II outlines and describes the explanatory variables used in this model, and Section III presents the estimation results.

I. Model Specification and Estimation Approaches

Typically, when an FHA-endorsed loan terminates as a claim; the property is "conveyed" to FHA and FHA makes a payment to the lender to settle the claim and acquires the underlying property—that is, it becomes real estate owned, or REO. The claim payment FHA makes to the servicer, known as the "acquisition cost," consists of three components: the outstanding unpaid principal balance on the loan; the foregone interest advanced by the servicer as a result of the loan default; and legal and administrative costs paid by the servicer associated with foreclosure, including any expenses associated with the cost of repairing or maintaining the property prior to conveyance of the property. We thus have:

Acquisition Cost = Unpaid Principal Balance + Foregone Interest + Foreclosure Expense

Following acquisition, FHA attempts to sell the property, sometimes at a reduced price in order to assist low-income prospective homebuyers to buy a house. During the period when the property is held by FHA, but not yet sold, FHA incurs various holding costs associated with maintenance, repairs, tax payments and expenses incurred in preparing the property for sale. Upon sale of the collateral property, FHA receives the sale price less any sales expenses. In sum, the loss amount is the net amount that FHA incurs from this process:

Loss Amount = Acquisition Cost + Holding Cost - Sale Price + Sale Expense

---

[44] This definition is different from HUD's definition, which uses the acquisition cost as the denominator of the loss rate.

FHA permits pre-foreclosure sales (PFS) as an alternative to the foreclosure process. In pre-foreclosure sales, the property is sold by the borrower without the foreclosure process being completed or even started in some cases. Instead of acquiring the foreclosed house, FHA directly pays the loss amount claimed by the servicer. The loss amount of a pre-foreclosure sale case is reported as the acquisition cost to FHA.

For both foreclosures and pre-foreclosure sales, the loss amount expressed as a percentage of the unpaid principal balance is referred to as the loss rate:

$$Loss\ Rate = \frac{Loss\ Amount}{Unpaid\ Principal\ Balance}$$

Exhibit E-1 shows the distribution of different types of FHA claim terminations. Conveyance refers to the foreclosure procedure discussed above, wherein the property is conveyed to FHA after foreclosure is completed. This is the most common type of claim.

There was a significant volume of note (non-performing loan) sales from FY 2003 through FY 2006. In these cases, the remaining foreclosure procedures or house sales were avoided by FHA. Since September 2012, FHA resumed the note sales activities and completed a few deals. For model estimation purposes, note sales are treated like REO. The Coinsurance and Without Conveyance categories have been insignificant in volume over the last fifteen years and are also omitted from our analysis. The consistent stable pattern of pre-foreclosure sales suggests that they are likely to continue to be used as the dominant form of non-conveyance claim settlement going forward. Consequently, the loss severity rate that we model is based only on the losses observed under the Conveyance and Pre-Foreclosure Sales categories.

FHA changed its servicing guide in 2013 to allow foreclosure without conveyance. This refers to the allowance of third-party-sale (TPS) during the foreclosure auction. Instead of FHA acquiring the title, a third party acquires the property directly from the foreclosure auction. This process allows FHA to avoid additional process in property disposition after conveyance and any associated holding cost. This new procedure splits a foreclosure into conveyance or TPS cases.

Exhibit E-1: Percentages of Claim Termination Types by Fiscal Year

Claim Year	Open Foreclosure	Conveyance (REO)	Note Sales	Third Party Sale (TPS)	Pre-Foreclosure Sale (PFS)
1999	0.00	94.45	0.08	0.00	5.46
2000	0.00	94.72	0.07	0.00	5.21
2001	0.00	94.69	0.00	0.00	5.31
2002	0.00	94.10	0.00	0.00	5.90
2003	0.00	86.50	8.60	0.00	4.90
2004	0.00	85.96	8.32	0.00	5.72
2005	0.01	84.39	9.16	0.00	6.43
2006	0.02	90.04	2.70	0.00	7.23
2007	2.14	91.08	0.00	0.00	6.77
2008	3.01	90.35	0.00	0.06	6.59
2009	0.99	89.10	0.00	0.04	9.87
2010	0.83	84.27	0.31	0.00	14.59
2011	0.63	77.41	1.08	0.00	20.89
2012	0.71	74.00	1.23	2.12	21.94
2013	1.19	67.68	14.19	2.52	14.43

Exhibit E-2 presents the average loss severity rates over Conveyance and Pre-foreclosure sale claims by termination fiscal year over the 1991-2012 period. The loss rate has increased steadily from FY 2003, reaching a level of 67.32 percent in FY 2009. It has remained above 60 percent since then.

Exhibit E-2: Historical Loss Rates

Termination Year	Loss Rate	Termination Year	Loss Rate	Termination Year	Loss Rate
1991	41.65%	2001	36.90%	2011	63.94%
1992	43.58%	2002	36.09%	2012	66.76%
1993	44.51%	2003	37.42%		
1994	45.85%	2004	40.20%		
1995	46.06%	2005	43.10%		
1996	44.99%	2006	48.59%		
1997	44.64%	2007	58.07%		
1998	44.14%	2008	66.38%		
1999	43.17%	2009	67.32%		
2000	40.08%	2010	62.13%		

A. Specification of the Loss Severity Model

As described above, there are several components of the total loss amount, and each component can be influenced by a number of factors. Foregone interest depends on the interest rate on the mortgage and on the length of the default-to-claim lag. Foreclosure expenses can vary depending on whether a judicial foreclosure process is used that can shorten the foreclosure process time and this varies by state. Repair expenses may be a function of the financial condition of the borrower, which we proxy by the credit score. Sale prices are influenced by the house price appreciation since origination and by the prevailing local housing market conditions during the default and property disposition periods. Several components of the loss amount involve expenses that are fixed across foreclosed properties. Hence, loans with relatively smaller unpaid principal balances are more likely to realize higher loss rates since the denominator of the loss ratio will be smaller relative to these fixed components of the numerator.

As shown in Exhibit E-1, the distribution between conveyance/TPS (foreclosure) and pre-foreclosure sales (PFS) was relatively stable through FY 2009. Due to recent widespread house price declines and the higher volume of defaults, starting from FY 2010, the foreclosure claim process was lengthened and the foreclosure claims were delayed, while the pre-foreclosure sale process was relatively stable. Since FY 2010, the pre-foreclosure sale share increased significantly. Moreover, the proceeds recovered from those conveyance and pre-foreclosure sales differ significantly. To accommodate more accurate estimates of loss rates, we adopted a two-stage model: (1) a model to account for the choice between a pre-foreclosure sale (PFS) and foreclosure and (2) their different loss rates conditional on being PFS or REO. The following flowchart describes the major components of the FY 2013 Review loss severity model.

Exhibit E-3: Choice-Based Loss Severity Model
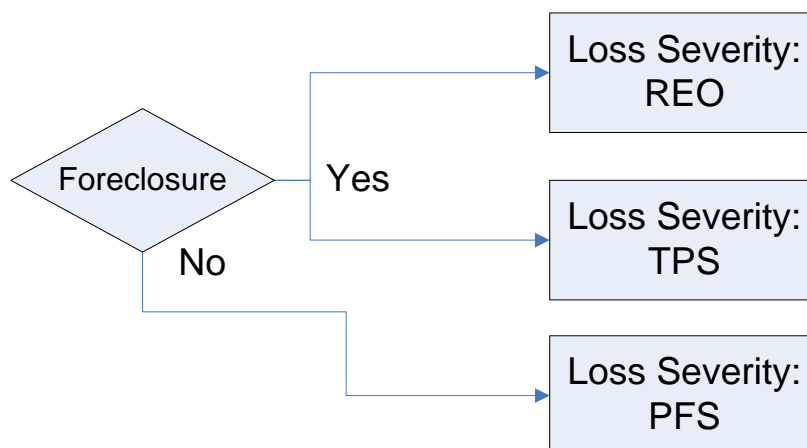
First, we estimate the probability that a claim is settled by the foreclosure process versus the pre-foreclosure sale (PFS) process. The foreclosure outcome is further split into conveyance (REO) and Third Party Sale (TPS). To model this choice event, we used a standard binary logit model to predict the probability that a property would be conveyed to FHA. The functional form is given by the following logit equation.

$$logit(x) = \ln \frac{\pi(x_i)}{1 - \pi(x_i)} = \beta_0 + \sum_k \beta_k X_{ki} + e_i$$

Where x_i denotes that the outcome of the claim i is conveyance;
X_{ki} is the value of explanatory variable k for claim i;
and e_i is the error term.

For claim i, the foreclosure and PFS probabilities are calculated as the following:

$$Probability\ of\ Foreclosure = \frac{e^{\beta_0 + \Sigma \beta_k X_{ki}}}{1 - e^{\beta_0 + \Sigma \beta_k X_{ki}}},$$
$$Probability\ of\ PFS = 1 - Probability\ of\ Foreclosure.$$

Further the probability of foreclosure is split into REO and TPS, where the TPS probability is assumed to gradually increase in the future (*TPS_N*) from its current level (*TPS_Init_Ratio*) to

long-term average (*TPS_Perm_Ratio*) suggested by the GSEs' current TPS level, published by FHFA.[45]

$$
\begin{aligned}
Probability\ of\ TPS \\
= Probability\ of\ Foreclosure \\
* \Bigg(TPS\_Init\_Ratio + (TPS\_Perm\_Ratio - TPS\_Init\_Ratio\ ) \\
* \frac{\min(N_{qtr}, TPS\_N)}{TPS\_N} \Bigg).
\end{aligned}
$$

And REO probability is simply

$$
Probability\ of\ REO = Probability\ of\ Foreclosure - Probability\ of\ TPS.
$$

Second, we estimate the loss rate as a function of all the same explanatory factors used in the above model of the choice of foreclosure or PFS depending on whether the claim disposition is by foreclosure or PFS. That is, there are two loss rate equations. The loss rate is not bounded between zero and one. It can be more than one hundred percent if the loss amount is more than the unpaid principal balance; it can also be less than zero if the sale price of the house is more than enough to cover the unpaid principal balance and all associated costs to FHA. The loss rate appears to be a smooth and continuous function of the underlying explanatory variables. We used ordinary least squares (OLS) linear regression to estimate the parameters of the two loss rate models. Conditional on whether the claim is a conveyance or a pre-foreclosure sale, the specification of the regression model is:

$$
LossRate_{REO}(X_i | i \in REO) = f(X_i) + \varepsilon_i
$$
$$
LossRate_{PFS}(X_i | i \in PFS) = g(X_i) + \varepsilon_i
$$

where *LossRate(X_i)* is the realized loss rate of claim *i*, which emanates from REO (conveyance) or PFS;

    X_i includes all explanatory variables for claim *i*;
    and ε_i is the error term.

For TPS, because we currently do not have enough data to estimate an econometric model, we applied a haircut to the REO loss rate to get the TPS loss rate:

$$
LossRate_{TPS} = LossRate_{REO} * (1 - TPS\_LR\_haircut\ ).
$$

---

[45] Foreclosure Prevention Report, First Quarter 2013, FHFA Federal Property Manager's Report. This report contains data on foreclosure prevention activity of Fannie Mae and Freddie Mac (the Enterprises) through March 2013. http://www.fhfa.gov/webfiles/25340/ForeclosurePreventionReport1q2013FINAL.pdf

Thus, the estimated loss rate in the fund is the weighted average of loss rate depending on different claim types.

$$Loss\ Rate = Probability\ of\ REO * LossRate_{REO} + Probability\ of\ TPS * LossRate_{TPS}$$
$$+ Probability\ of\ PFS * LossRate_{PFS}.$$

Where the probabilities of foreclosure and PFS are predicted from the loss selection model, the probability of REO vs. TPS follows the model described above, and *LossRate (X$_i$)* is predicted from one of the two loss rate models above, as appropriate.

In this year's Review, we used the following parameters for the TPS-related loss rate calculation:

TPS_Init_Ratio	=	10%;
TPS_N	=	8;
TPS_Perm_Ratio	=	15%;
TPS_LR_haircut	=	22.5%.

B. Estimation Sample

The sample used to estimate the loss severity model for the FY 2013 Review consists of loan-level data from the FHA single-family data warehouse for the categories conveyance and pre-foreclosure sales. The available data cover the period from the first quarter of FY 1975 to the second quarter of FY 2013. The FHA loss mitigation program was initiated in 1996 and fully implemented in 2002. Due to the recent lengthening of foreclosure timelines and also the lengthening of the time from REO to the sale of the property (due to the market being saturated with foreclosure sales), for the selection model our analysis used the sample with termination years from FY 2006 through FY 2013 Q2 by including open foreclosure cases as foreclosure disposition type to overcome the foreclosure backlog issue. We also included accelerated claims and claims without conveyance (TPS) as foreclosure sales. The final sample used for the selection estimation includes 603,422 loans claimed over these past years. Exhibit E-4 shows the impact of the various sample exclusions for the choice model and the two loss rate models.

Many claims associated with foreclosures in FY 2011 or later have not yet been fully resolved, so the conveyance loss rate for these claims will be biased by including the faster property disposition cases, which tend to incur lower losses. REO claims after FY 2011 are excluded from the REO loss rate estimation sample. Given the differences in the disposition process and the recording process between conveyance and pre-foreclosure sale claim types, the REO loss rate model used the sample with termination years from FY 2000 through FY 2010, while the PFS loss rate model used the sample with termination years from FY 2000 through FY 2013 Q2. Only the claim cases with completed claim data for which loss rates have been recorded were included in the sample. The data used in these two loss rate models are processed using the same

exclusion rules as for the selection model. The final samples used for the REO and PFS loss rate model estimation included 610,311 and 110,945 claimed loans, respectively.

Exhibit E-4: Claim Counts for the Three Loss Severity Models

	Loan Count
Original Total Claims or Open Foreclosure	1,583,755
Drop cases with UPB = 0 or loan age < 0	211,438
Drop cases with missing LTV data	120,285
Observations Surviving First Round of Exclusions	1,252,032
Drop cases with missing loss rate or claim type	179
Drop with other miscellaneous data quality issues	801
Observations Eligible for Severity Models	1,251,052
Observations Eligible for Selection Model (FY 2006Q1 – FY 2013Q2, all the open foreclosure, conveyance, accelerated claims, non-conveyance claims without conveyance of title, pre-foreclosure cases)	603,422
Observations Eligible for Conveyance Loss Rate Model (FY 2000Q1 – FY 2010Q4, all conveyance cases)	610,311
Observations Eligible for Selection Model (FY 2000Q1 – FY 2013Q2, all pre-foreclosure cases)	110,945

II. Explanatory Variables

There are six main categories of explanatory variables applied in the loss severity analysis:

- Fixed initial loan characteristics, including mortgage product type, non-owner occupied;

- Fixed initial borrower characteristics, including borrower credit scores and indicators of the source of downpayment assistance where relevant;

- Fixed property characteristics, including number of units;

- Fixed property state characteristics, including indicators of judicial foreclosure process and whether deficiency judgments are allowed;

- Dynamic variables based entirely on loan information, including mortgage age, scheduled amortization of the loan balance relative to loan size, current loan-to-value, default episode duration; and

- Dynamic variables derived by combining loan information with economic time series such as house price appreciation rates (e.g., as it influences the REO sale price) and interest rates (e.g., as used to indicate the refinance incentive).

Exhibit E-5 summarizes the explanatory variables that were used in the loss severity model. All the continuous variables are linear or piece-wise linear variables, while all the indicator variables are 0-1 dummies with one classification of a given set of dummy variables omitted during estimation, corresponding to the baseline category. Many variables are similar as those used in the loan status transition models, including: refinance incentive, source of downpayment assistance, judicial foreclosure process, loan age, mortgage type, borrower credit scores, mortgage rate spread and number of units. Only the indicator of non-owner occupied, deficiency judgment state, current loan-to-value ratio and the foreclosure-period house price appreciation rate are created especially for the loss severity model. We now describe the rationale for these four latter variables.

- Non-owner occupied indicator: An investor's house seems to be more risky, because the owner is not living in the house and is therefore less likely to maintain the property.

- Deficiency Judgment State: Some states allow lenders to sue borrowers for the lender's losses after foreclosure. We used the website http://www.foreclosurelaw.org/ to identify such "deficiency judgment" states. The possibility of recourse is expected to reduce losses, all else equal. This is a variable newly introduced this year.

- Current Loan-to-Value Ratio (CLTV): The CLTV is calculated from the initial LTV according to the amortization schedule and by updating the underlying property value with state-level house price indices. Since CLTV has significant explanatory power for estimating the loss rate, the original LTV was dropped from loss severity model for this year, as it was for last year's Review.

- House Price Appreciation Rate: The house price appreciation rate is measured at the state level during the foreclosure period, between default and disposition. This variable is strongly related to the sale price when HUD disposes of the property. In a declining/improving housing market, the loss rate is relatively high/low. We assume that the foreclosure process (from default to claim) takes 4 quarters, and the period the real estate is owned by FHA (from claim to disposition) is also 4 quarters. Thus, the appreciation is measured over 8 quarters before the claim date.

Exhibit E-5: Explanatory Variables in the Loss Rate Model

Variable Name	Value	Description
Refinance		
Refinance	1 = Refinance loan; 0 = Non-refinance loan	Indicates whether the purpose of the loan was for refinancing.
Judicial		
Judicial	1 = Judicial state; 0 = Non-judicial state	Indicates whether property is located in a state utilizing a judicial foreclosure process.
Deficiency Judgment State		
Deficiency	1 = Deficiency judgment state; 0 = Non-deficiency judgment state	Indicates whether property is located in a state that allows deficiency judgments.
Downpayment Source		
dpa_nonprof	1 = Non-profit gift; 0 = No non-profit gift	Indicates whether downpayment assistance was provided by a non-profit.
Unicon		
flag_unicon	1 = Loan is in the Unicon sample; 0 = Loan is not in the Unicon sample	Indicates whether the loan was sampled from the subset of FHA loans Unicon Corp submitted to credit repositories to obtain retrospective FICO information.
Age		
age	$0 \leq X \leq 120$	Quarterly age of the loans.
Loan Type		
flag_prd_25	1 = 15-year FRM or15-year SR FRM; 0 = Not (15-year FRM or 15-year SR FRM)	Loan product type.
Credit Score		
credit_score	$300 \leq X \leq 850$	Borrower FICO scores range.
credit_score_000	Missing	
credit_score_999	Not Collected	
CLTV		
ltv_current		Current loan-to-value ratio (%) at the claim date. House price is updated by state-level house price indices.

HPA		
hpa2y		Average annual house price appreciation rate during the eight quarters surrounding the claim date.
sigma_parm_a		HPI diffusion volatility parameter *a*
Default Episode Duration		
def_episode1	X = 1	
def_episode2	X = 2	Default Episode Duration (quarterly)
def_episode3	X = 3	
def_episode4	X ≥ 4	
Number of Units		
unit24	1 = The property has more than 1 unit; 0 = The property has only 1 unit	Dummy variables based on number of units
Owner Occupancy		
nowner_occ	1 = Non-owner occupancy; 0 = Owner occupancy	Dummy variables based on owner occupancy
Mortgage Rate Spread		
mspread		Yield curve slope measured as spread between Freddie Mac PMMS mortgage rate and 10-year CMT rate.
Relative Loan Size		
loansize		Relative loan size measured as loan size relative to the average loan size originated in the same state in the same year.

III. Estimation Results

Exhibit E-6 presents the regression coefficients and their standard errors and t-statistics.

Exhibit E-6: Regression Results

Variable	Conv/PFS Selection			Loss Rate Given Conveyance			Loss Rate Given PFS		
	Spline	Coefficient	Chi-Sq Test	Spline	Coefficient	t-Value	Spline	Coefficient	t-Value
Intercept		7.300	1688.50		0.637	37.20		-0.187	-20.31
CLTV spline 1	cap @ 1.3, spline @ 1.0	-3.545	3929.90	spline @ 0.5, 0.9, 1.2	0.304	10.50	spline @ 1.2	0.688	145.89
CLTV spline 2		-2.499	1922.63		1.047	158.73		0.231	45.67
CLTV spline 3					0.387	42.68			
CLTV spline 4					-0.097	-10.50			
Relative Loan Size spline 1	spline @ 100, 180	-0.024	6126.22	spline @ 50, 100, 180	-0.012	-85.79	spline @ 90, 140	-0.002	-44.82
Relative Loan Size spline 2		-0.010	2154.55		-0.005	-205.27		-0.001	-38.28
Relative Loan Size spline 3		-0.008	139.59		-0.002	-63.68		0.000	0.39
Relative Loan Size spline 4					0.000	-1.09			
2-year HPA centered by termination date spline 1	spline @ -0.1, 0.2	-4.917	2238.83	floor @ -0.5, spline @ 0.2	-0.648	-111.54		-0.001	-0.16
2-year HPA centered by termination date spline 2		-0.921	188.80		-0.203	-13.98			
2-year HPA centered by termination date spline 3		-4.859	262.78						
HPA Volatility Sigma a					47.937	38.56		35.546	23.33
Age (by quarter) spline 1		0.000	0.01	spline @ 35, 45	0.010	127.59	cap @ 55, spline @ 15, 30	0.008	46.34
Age (by quarter) spline 2					0.014	54.12		0.009	64.85
Age (by quarter) spline 3					0.015	56.43		0.014	65.63
1-quarter Default Episode Duration Flag					0.111	76.77			
Default Episode Duration spline 1	spline @ 4, 9	0.424	11245.89	spline @ 6, 15	0.016	51.49	spline @ 9	0.024	109.58
Default Episode Duration spline 2		0.140	1510.73		0.008	35.55		0.006	11.45
Default Episode Duration spline 3		0.094	334.36		-0.001	-1.79			
Mortgage Rate Spread								-0.025	-14.01
Prior Mod Flag		-0.141	94.59		0.088	36.88		0.105	56.75
Relative Unemployment Rate					0.045	18.07			
Credit Score spline 1	spline @580, 680	-0.002	60.54		0.000	-37.65		0.000	-15.76
Credit Score spline 2		-0.008	2435.37						
Credit Score splin 3		-0.005	580.96						
Flag for No Credit Score Returned		-0.039	3.54		0.026	17.98		0.014	5.91
Flag for Missing Credit Score		0.194	154.31		0.004	4.32		-0.006	-3.64
Judicial State Flag		-0.590	4419.58		0.090	113.36		0.005	5.35
Deficiency State Flag		-0.711	3366.35		-0.057	-44.21		-0.024	-18.01
UNICON Score Flag					0.031	23.13		-0.027	-16.59
Refinance Flag					0.088	71.86		0.096	84.6
Non-profit Gift Downpayment Assistance Flag					0.054	49.12		0.039	31.31
Number of Units (2-4) Flag		0.035	1.05		0.141	61.85		0.144	41.36
Non-Owner Occupied Flag					-0.042	-10.67		-0.039	-6.14
Fixed 15-year Product Flag					0.205	51.44			
Model Fit Statistic	Somers' D		0.577						
	C		0.788	Adj R-Sq		0.385	Adj R-Sq		0.566

Appendix F

FHA Volume Model

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Appendix F: FHA Volume Model

We have developed and used a FHA mortgage volume model in order to project future FHA loan volumes that are sensitive to alternative economic scenarios. Our FHA volume model specification includes two models. First, we estimate mortgage market dollar volumes separately for purchase and refinance loans at the national level, excluding home equity loans and second liens. Second, we estimate the share of FHA fully-underwritten refinance volume as a percentage of the national refinance volume. Since FY 2012 Review, a FHA SR prepayment transition status was added in the transition and termination models, described in Appendix A, therefore we treated the SR origination volume equals to the SR prepayment counts occurred in one quarter prior and eliminated the SR volume estimation.

In our model, the national purchase volume responds to house prices and prior volumes, while the national refinance volume responds to prior refinance volumes, moving average of national purchase volumes, house prices and mortgage and Treasury interest rates. The FHA fully underwritten refinance volume, stated as a share of the national refinance volume, is a function of GSE and FHA refinance spread.

The FHA purchase volume is derived from the national purchase volume based on an assumed share scheme as shown in Exhibit F-5. The forecasted share starts out at the observed CY2014Q1 purchase share of 16 percent and is reduced to 15 percent from CY2015Q1 and forward. The 15 percent long-term market share is an estimation based on future government policies and the private mortgage market roles. If the alternatives to FHA lending completely rebound to their historical average within the next few years, FHA market shares will be lower than assumed here. The case for at least some continued impairment of the non-FHA market appears warranted given the general economic conditions prevailing at the time of this review.

At the time of the model estimation, we used data over CY 1990Q1 through CY 2013Q1.

I. Volume Model Specification

We use the following notation:

Variables:
V = National Volume ($ millions)
F = FHA Volume ($ millions)
R = Interest Rate
H = National Home Price Index
Q = Quarter Indicator (as 0/1 dummy variables for each quarter)

T = 1 after CY 2006; 0 otherwise
G = Spread of FHA and GSE Refinance Rates

Subscripts:
t = time index (quarterly)
k = index for coefficients or quarters

Superscripts:
P = Purchase Mortgages
R = Refinance Mortgages
S = Streamline Refinance Mortgage (FHA)
1 = 1-year Treasury
10 = 10-year Treasury
m = Mortgage

$\alpha, \beta, \theta, \lambda, \gamma, \varphi$ and ω are coefficients to be estimated.

After some experimentation with forms of the dependent and independent variables, lags and variable inclusions, we estimated by Ordinary Least Squares the set of equations shown below:

$$LnV_t^P = \alpha_0 + \sum_{k=1}^{3} \alpha_k Q_k + \sum_{k=1}^{3} \beta_k LnV_{t-k}^P + \varphi Ln\left(\frac{H_t}{H_{t-4}}\right) + \omega Ln(H_t) \qquad (1)$$

$$LnV_t^R = \alpha_0 + \beta LnV_{t-1}^R + \sum_{k=0}^{4} \gamma_k R_{t-k}^m + \lambda(R_t^{10} - R_t^1) + \varphi Ln\left(\frac{H_t}{H_{t-4}}\right) + \omega Ln\left(\frac{\sum_{k=0}^{3} V_{t-k}^P}{4}\right) \quad (2)$$

$$Ln\frac{F_t^R}{V_t^R} = \alpha_0 + \beta G_t + \theta T \qquad (3)$$

Equation (1) implies that the nation's volume of purchase mortgages is a seasonally adjusted function of its volume in the last three quarters, housing price index (HPI) and the yearly house price appreciation (HPA). Equation (2) says that the nation's volume of new refinance mortgages is a function of its lagged volume, mortgage rates at the current quarter and over the last four quarters, the spread between the 10- and 1-year Treasury rates, the moving average of the national purchase volumes and yearly HPA. The third equation says that the share of FHA's non-SR volume of the nation's refinance mortgages is a function of the spread between the GSE and FHA refinance rates and whether the date is after CY2006. The dependent variable is the share of FHA's volume of fully underwritten refinance mortgages as a percentage of the national refinance volume. As mentioned above, the transition equations include a transition to SR mortgages, so there is no need to have a macro-model projection.

II. Historical Data

When estimating the volume model, we used historical data from public sources as well as the FHA data warehouse as of end of June, 2013. Exhibit F-1 details the data sources.

Exhibit F-1: Sources and Description of Variables

Variables	Source	Description
1-year Treasury rate	Federal Reserve Bank of St. Louis FRED® Economic Data[a]	1-Yr Constant Maturity Securities
10-year Treasury rate	Federal Reserve Bank of St. Louis FRED® Economic Data	10-Yr Constant Maturity Securities
Mortgage rate	Federal Reserve Bank of St. Louis FRED® Economic Data	Mortgage Rates Primary Market: 30-Year Commitment Rate - Fixed Rate, National
GSE & FHA Refinance Spread	Federal Reserve Bank of St. Louis FRED® Economic Data FHA Mortgage Letter	Mortgage Rates Primary Market: 30-Year, Spread between GSE and FHA mortgage interest rate, Mortgage Insurance Premium
House Price Index	FHFA	FHFA Purchase Only Home Price Index (1991Q1 = 100), National
Market originations	MBA[b]	National Mortgage Origination, Purchase and Refinance, 1-4 Family, July 2013
FHA originations	FHA data warehouse	FHA loans separated into purchase, SR, refinance

[a] Federal Reserve Bank of St. Louis FRED® Economic Data, http://research.stlouisfed.org/fred2/
[b] Mortgage Bankers Association, http://www.mbaa.org/ResearchandForecasts/ForecastsandCommentary

III. Regression Results

Exhibits F-2 through F-4 provide the details of the regression results for Equations (1) − (3), respectively. We retained several statistically insignificant coefficients to show more general model specifications and to make the model forecasts more sensitive to macroeconomic forecasts.

Exhibit F-2: Ln(National Purchase Dollar Volume) Regression [Equation (1)]

Variable Name	Coefficient	t-statistic	Pr > | t |
Ln(National Purchase Volume), lagged 1 qtr	0.470	4.28	<.0001
Ln(National Purchase Volume), lagged 2 qtr	0.116	0.97	0.335
Ln(National Purchase Volume), lagged 3 qtr	0.274	2.56	0.012
Ln (Home Price at t / Home Price t-4)	1.459	3.6	0.001
Ln(National Home Price Index at t)	0.050	0.59	0.559
Winter	-0.144	-2.7	0.009
Spring	0.237	3.65	0.001
Summer	0.146	2.53	0.013
Intercept	1.355	2.98	0.004
Number of observations = 90			
Adj R-Sq = 0.925			

Exhibit F-3: Ln(National Refinance Dollar Volume) Regression [Equation (2)]

Variable Name	Coefficient	t-statistic	Pr > | t |
Ln(National Refi Volume), lagged 1 qtr	0.661	8.17	<.0001
Ln(sum(National Purchase Volume, current to lagged 3 qtr)/4)	0.439	3.26	0.002
Mortgage rate at t	-0.574	-7.64	<.0001
Mortgage rate, lagged 1 quarter	-0.263	-2.15	0.035
Mortgage rate, lagged 2 quarters	0.770	6.48	<.0001
Mortgage rate, lagged 3 quarters	-0.302	-2.68	0.009
Mortgage rate, lagged 4 quarters	0.261	3.25	0.002
Spread between 10-Yr and 1-Yr at t	0.012	0.39	0.696
Ln (Home Price at t / Home Price t - 4)	1.010	1.63	0.107
Intercept	-0.668	-0.65	0.518
Number of observations = 92			
Adj R-Sq = 0.9546			

Exhibit F-4: Ln(FHA Fully Underwritten Refinance (FUWR) Volume /National Market Refinance Volume) Regression [Equation (3)]

Variable Name	Coefficient	t-statistic	Pr > | t |
Dummy = 1 if CY=>2007	2.560	2.18	0.032
FHA - GSE Refinance Spread at t	-1.314	-0.51	0.611
Intercept	-4.311	-1.03	0.305
Number of observations = 92 Adj R-Sq = 0.4458			

IV. Model Adjustments

Due to the nature of stochastic simulation, certain paths could cause large deviation of FHA's non-SR volume and project the volume higher than its historical performance maximum, which is 65 percent of the purchase volume, and even exceed the FHA fully-underwritten purchase volume. One adjustment we implemented is that FHA's non-SR volume is capped at 70 percent of predicted FHA fully-underwritten purchase volume through FY 2013Q2 to FY 2020. The cap adjustment can reduce the unreasonable randomness in the forecast.

As described in section I, the dollar volume forecast of the FHA purchase follows Equation 1. But we also applied some assumptions regarding FHA's share of the national purchase market shown in Exhibit F-5 to eliminate the uncertainty of the future national mortgage market policy.

Exhibit F-5: Assumed FHA Purchase Volume Share

Fiscal Years	FHA Purchase Volume Share of National Purchase Volume
2014	16%
2015-2020	15%

FHA's share of the purchase market is assumed to be 16 percent starting from FY2014Q1 and is reduced to 15 percent in the following years and maintain at this level in the future.

Based on Moody's baseline scenario, the predicted product volumes were shown in Appendix C, Exhibit C-1. The refinance volumes decline sharply in response to Moody's forecasted rapid rise in interest rates, resulting in some temporal variability in the product volumes and their relative shares. Note that with this demand model, we have made the volume projections, by type, endogenous, responding to alternative economic scenarios.

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Appendix G

Stochastic Simulation

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Appendix G: Stochastic Simulation

This appendix describes the stochastic processes assumed for the economic variables used in the Monte Carlo simulations of the FHA Actuarial Review 2013. Starting from the 2012 Review, we interpret the expected present value as the present value (PV) of expected cash flows from a wide variety of possible paths of house price appreciation rates (HPA), interest rates and unemployment rates. This interpretation is consistent with the industry best practice for pricing and measuring risks of mortgage portfolios. The concept (in terms on the "Monte Carlo" technique that we use in this Review) is to project a number of equally likely paths of HPA and interest rates, compute the PV of the projected cash flows for each path and, since each path is equally likely, compute the average PV over all the paths as the expected present value.

We selected 100 simulated paths for the Monte Carlo simulations because we observed that the present value of the future cash flows converged to a constant value when we used 100 paths. This converged value is the expected present value of future cash flows. So if we were to randomly draw a number of sets of 100 paths, we infer that the results will be essentially the same expected PV of the future cash flows for each such set. We obtain the economic value of the Fund by adding this expected present value to the capital resources of the Fund. Using more paths would increase the computation time required to conduct simulations with little additional precision. Exhibit G-1 demonstrates the convergence of the Monte Carlo simulation. After about the 75th path the expected PV of future cash flows does not change measurably.

In addition to the standard Monte Carlo simulation approach implemented in the 2012 Review, we also implemented the technique of dynamic simulation to improve simulation efficiency. Details of dynamic simulation are explained later in this appendix. The dynamic simulation approach allowed us to more accurately differentiate the termination probabilities among loans after the fourth quarter in 90-day delinquency.

Exhibit G-1: NPV Convergence in Monte Carlo Simulation
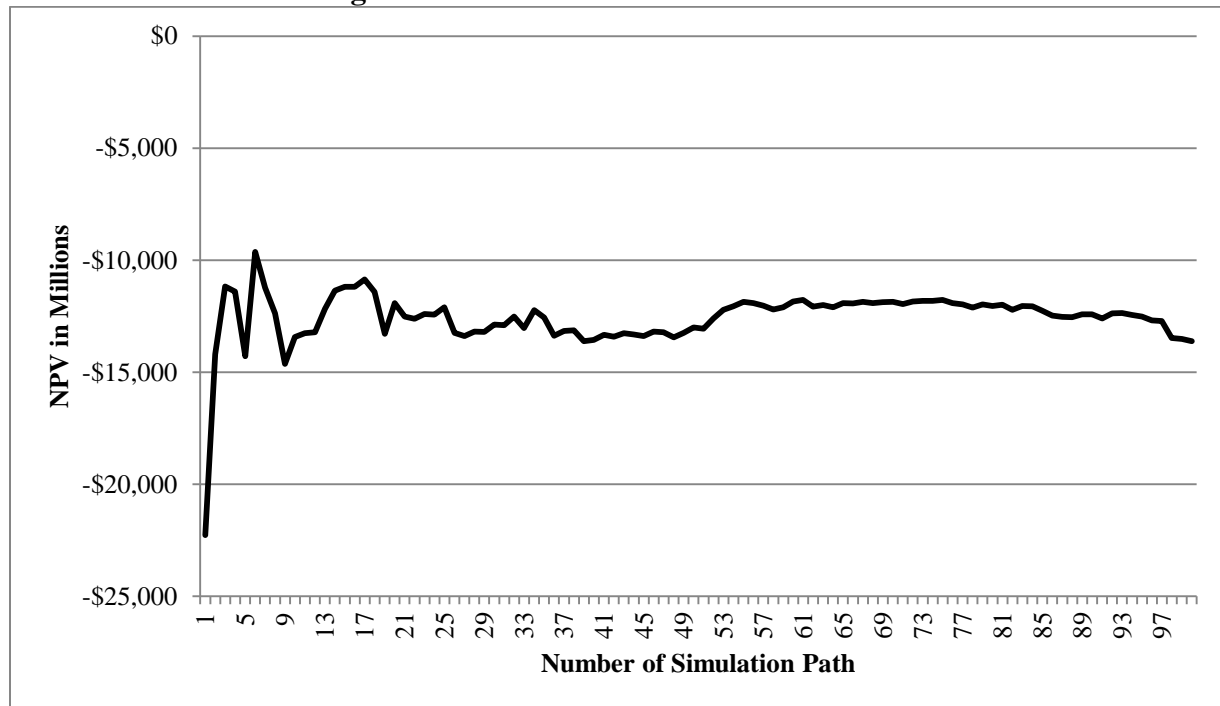
The economic variables modeled herein as stochastic include:
- 1-year Treasury rates,
- 10-year Treasury rates,
- 30-year fixed rate mortgage (FRM) rates,
- FHFA national house price index (HPI), and
- Unemployment rates.

These stochastic variables were modeled to project the "real world" or "physical" measure and hence were estimated using historical data.[46] This approach is appropriate for the Actuarial Review because the simulated rates are designed to approximate the actual future values. Since all transition probability models were estimated using the historically observed interest rate, house price appreciation and unemployment rates, estimating interest rates and other economic variables using the real-world measure, versus risk-neutrals used for security trading purposes, is consistent with this approach.

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[46] For valuing options, so-called "risk-neutral" future paths of interest rates are developed that permit estimation of option values based on observed option prices and the prices of the underlying asset upon which the options are based. These paths need not have any resemblance to historical movements in interest rates.

I. Historical Data

A. Interest Rates

With the high inflation rate caused by the global oil crisis in the late 1970's, interest rates rose to a historically high level in early 1980's. Since then, the Federal government shifted its monetary policy from managing interest rates to managing the money supply. Interest rates generally decreased since this policy shift. Exhibit G-2 shows historical interest rates since 1953. The 1-year Treasury rate (cmt01) was around 2% in 1953 and increased steadily to its peak of 16.32% in 1981 Q1. After that, it followed a decreasing trend and reached an all-time low of 0.11% in 2011 Q4. Also shown are the 10-year Treasury rate (cmt10), the 30-year fixed rate mortgage rate (mrate) and the 1-year LIBOR rate (LIBOR_1y).

Exhibit G-2: Historical Interest Rates (%)
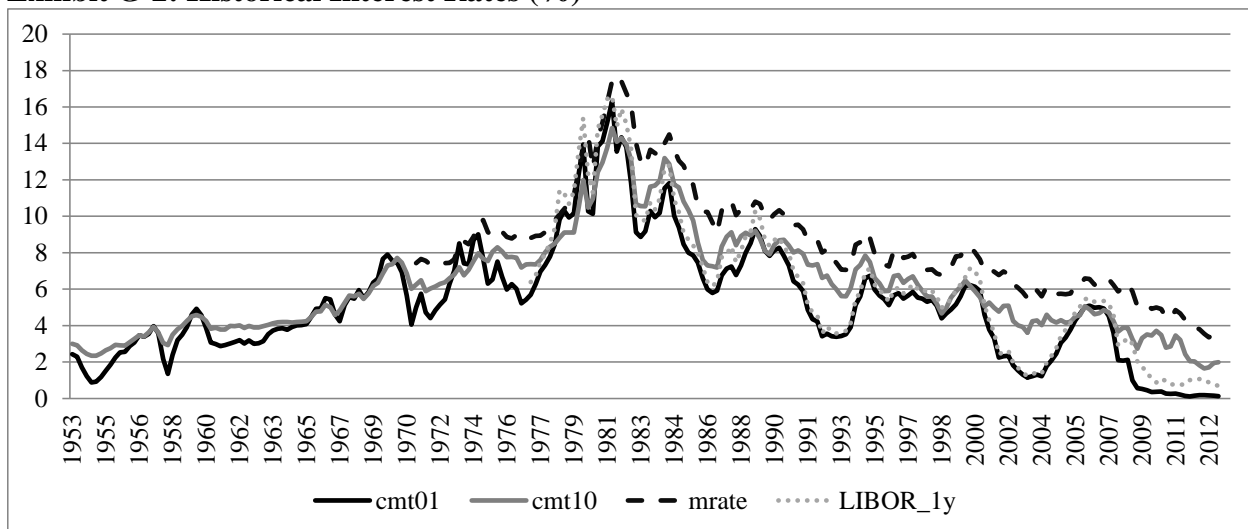
Exhibit G-3 shows historical interest rate spreads, including the spread between the 10-year and the 1-year Treasury rate, the spread between the 30-year mortgage rate and the 10-year Treasury rate, and the spread between the 1-year LIBOR and the 1-year Treasury rate. The spread between the 10-year and 1-year Treasury rates appears to be have long cycles and the spread is not always positive. However, the spread of the mortgage rate over the 10-year Treasury rate and the spread of LIBOR over the 1-year Treasury rate are always positive, reflecting the premium for credit risk.

Exhibit G-3: Historical Interest Rate Spreads (%)
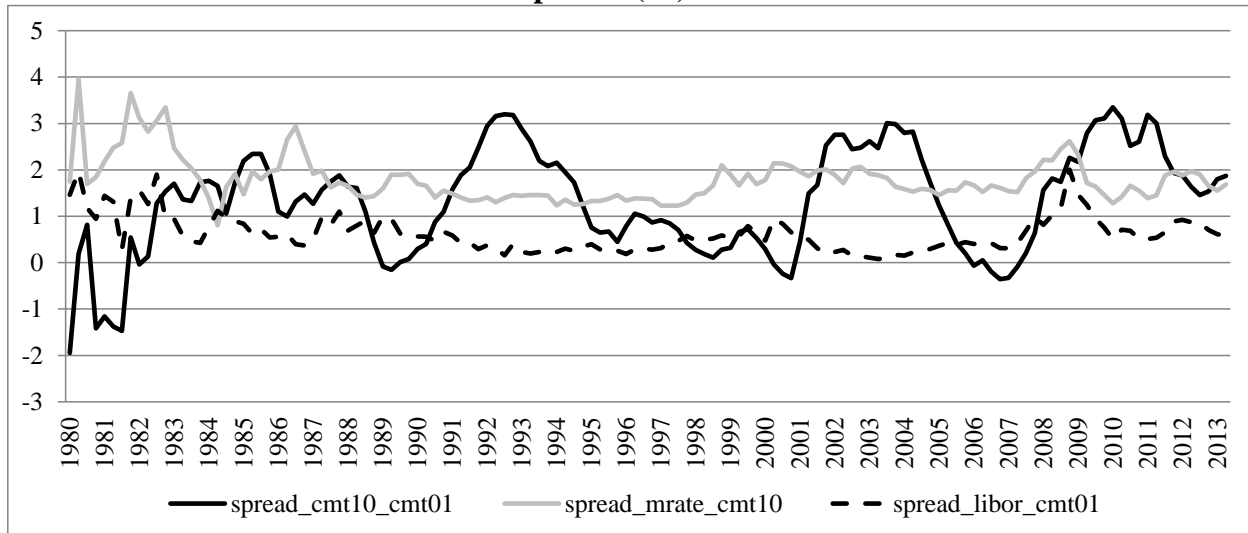
B. House Price Appreciation Rates

The national house price appreciation rate (HPA) is derived from FHFA repeat sales house price indexes (HPIs) of purchase-only (PO) transactions. Previous Reviews used the all-inclusive HPA, which includes refinanced mortgages. The PO Index provides a more reliable measure of housing market conditions, since it is based on repeat sales at market prices and does not use any appraised values.

Since PO HPI index started from 1991, we used the HPI data from 1991 Q1 through 2013 Q2 to build our model. The HPA series being modeled is defined as

$$HPA_t = \ln\left(\frac{HPI_t}{HPI_{t-1}}\right)$$

Exhibit G-4 shows the national HPI and quarterly HPA from 1991 Q1 to 2013 Q2. The long-term average quarterly HPA is around 0.75% (at annual rates).

The PO HPI increased steadily before 2004, and the quarterly appreciation rate was around 1.14%. Then house prices rose sharply starting from around 2004. The average quarterly house price appreciation rate was 1.90% during the subprime mortgage expansion period from 2004 to 2006, and reached its peak of 2.63% in 2005 Q2. After 2006, the average growth rate became negative. Exhibit G-5 shows the average quarterly HPA (at annual rates) by selected historical time periods.

Exhibit G-4: Historical National HPI and HPA
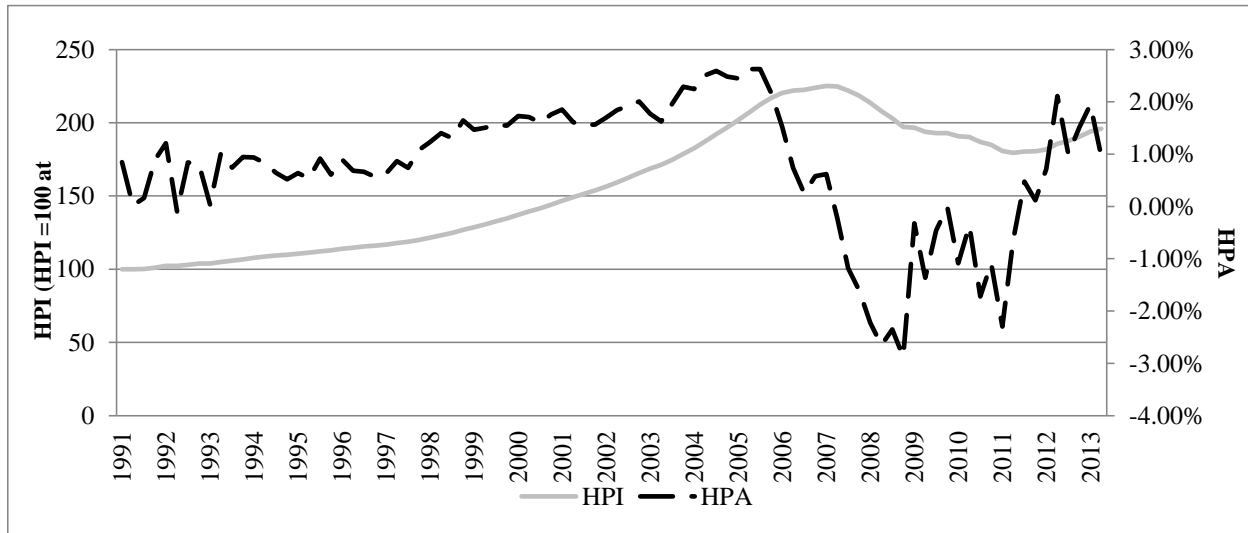
Exhibit G-5: Average Quarterly HPA by Time Span

Period	Average Quarterly HPA
1991 – 2003	1.14%
2004 – 2006	1.90%
2007 – 2010	-1.18%
2011 – 2012	0.59%

II. 1-Year Treasury Rate

In this section, we present selected historical statistics on the one-year Treasury rate, describe the model we used in our simulations, and report the parameter estimates and their standard errors. Exhibit G-6 shows the summary statistics of the historical 1-year Treasury rates for two periods, one from 1953 and the other from 1980.

Exhibit G-6: Statistics for the 1-Year Treasury Rates

Statistics	Since 1980	Since 1953
Mean	5.43%	5.20%
Standard Deviation	3.73%	3.18%
Max	16.32%	16.32%
95- Percentile	13.63%	10.30%
90- Percentile	10.16%	9.18%
50- Percentile	5.24%	5.01%
10- Percentile	0.37%	1.22%
5- Percentile	0.19%	0.35%
Min	0.11%	0.11%

We used a GARCH(1,1) parameterization to model the 1-Year Treasury rate (r_1) and estimated it using data from 1980 Q1 to 2012 Q1. The process takes the following form:

$$r_{1,t} = A + B * r_{1,t-1} + \sigma_t dZ_1 \tag{1}$$

where Z_1 is the independent Wiener random process with distribution N(0,1),

and where the variance (σ) of the residual term follows a GARCH(1,1) process:

$$\sigma_t{}^2 = \beta_0 + \beta_1 \varepsilon_{t-1}^2 + \beta_2 \sigma_{t-1}^2 \tag{2}$$

where ε is the error term, which equals $\sigma_t dZ_1$ from equation (1).

Full information maximum likelihood (FIML) was used to estimate the parameters in equations 1 and 2. The results are presented in Exhibit G-7.

Exhibit G-7: Estimation Results for 1-Year Treasury Rate Model

Parameter	Estimate	Std Dev	t-Value	Prob>t
A	0.0002	Matched with Moody's Forecast		
B	0.993	0.020	0.34	0.735
β_0	3.65E-06	2.13E-06	1.70	0.089
β_1	0.417	0.199	2.10	0.038
β_2	0.549	0.122	4.48	1.67E-05
Adjusted R^2	0.950			

The model based on these parameters is used to simulate FY 2013 Q3 and future 1-year Treasury rates. The "constant" term A is actually a different value during each quarter of the simulation. The values were chosen so that the median value among 100 simulations matches

Moody's July 2013 baseline forecast of the 1-year Treasury rate quarter by quarter. We applied the same procedure for the "constant" terms in the interest rate and HPA equations below.

Note that Moody's July forecast only covers the period until 2043 Q4. After 2043, we repeated Moody's last 4-quarter forecasts for all remaining quarters. All the other interest rates and HPA series are expanded to the year 2100 using the same methodology. A lower bound of 0.01 percent was applied to the simulated future 1-year Treasury rates to avoid negative rates in the simulation.

III. 10-Year Treasury Rate

The 10-year Treasury rate is modeled by adding a stochastic spread term to the 1-year rate. We estimate the dynamics of the spread between the 10-year Treasury rate and the 1-year Treasury rate from the historical data. The spread term is assumed to depend on the one-year rate and the lagged value of the spread term and a random component. The model for the spread is:

$$s_{10,t} = \alpha_{10,t} + \beta_{10} r_{1,t} + \gamma_{10} s_{10,t-1} + \varepsilon_{10,t} \tag{3}$$

where $s_{10,t}$ is the spread between the 10-year and 1-year Treasury rates and $r_{1,t}$ is 1-year Treasury rate. The variance of the residual term follows an ARCH (1) process:

$$\sigma_t{}^2 = \beta_0 + \beta_1 \varepsilon_{t-1}^2 \tag{4}$$

FIML was used to estimate the parameters. The estimated parameters are shown in Exhibit G-8.

Exhibit G-8: Estimation Results for 10-Year Treasury Rate Spread Model

Parameter	Estimate	Std Dev	t-Value	Prob>t
$\alpha_{10,t}$	0.004	Matched with Moody's Forecast		
β_{10}	-0.022	0.017	-1.30	0.197
γ_{10}	0.840	0.048	17.51	3.33E-35
β_0	1.39E-05	3.67E-06	3.77	0.000
β_1	0.530	0.345	1.54	0.127
Adjusted R^2	0.828			

We used the estimated parameters to simulate the spread between the 10-year and 1-year Treasury rates, and added the simulated spread to the simulated 1-year Treasury rate. Then we adjusted the constant term $\alpha_{10,t}$ to calibrate the series such that the median value among 100 simulated paths matched Moody's July 2013 base forecast of the 10-year Treasury rate quarter by quarter (and with the same logic of expanding the forecast series to year 2100). We also set a floor value of 0.01 percent to the simulated 10-year Treasury rates.

IV. Mortgage Rate

We modelled the mortgage rate by first modelling the spread between the mortgage rate and the 10-year Treasury rate and then adding the spread back to the 10-year rate. The process for the spread is assumed to be:

$$s_{m,t} = \alpha_{m,t} + \beta_{1m}r_{1,t} + \beta_{2m}r_{1,t-1} + \beta_{3m}s_{10,t} + \beta_{4m}s_{m,t-1} + \varepsilon_{m,t} \tag{5}$$

where $s_{m,t}$ is the spread between the mortgage rate and the 10-year Treasury rate, $r_{1,t}$ is the 1-year Treasury rate, and $s_{10,t}$ is the spread between the 10-year and 1-year Treasury rates. The variance of the residual term follows a GARCH (1,1) process:

$$\sigma_t{}^2 = \beta_0 + \beta_1\varepsilon_{m,t-1}^2 + \beta_2\sigma_{t-1}^2 \tag{6}$$

FIML was used to estimate the parameters in equations (5) and (6). The estimated parameters are shown in Exhibit G-9.

Exhibit G-9: Estimation Results for the Mortgage to 10-Year Treasury Rate Spread Moel

Parameter	Estimate	Std Dev	t-Value	Prob>t
$\alpha_{m,t}$	0.005	Matched with Moody's Forecast		
β_{1m}	-0.179	0.032	-5.67	1.02E-07
β_{2m}	0.169	0.031	5.47	2.49E-07
β_{3m}	-0.053	0.018	-3.00	0.003
β_{4m}	0.742	0.050	14.70	1.35E-28
β_0	2.35E-07	1.29E-07	1.82	0.071
β_1	0.128	0.064	1.99	0.049
β_2	0.795	0.067	11.93	4.08E-22
Adjusted R^2	0.605			

We used the estimated parameters to simulate the spread between the mortgage rate and the 10-year Treasury rate, and added the simulated spread to the simulated 10-year Treasury rate to obtain the mortgage rate. Then we adjusted the "constant" term $\alpha_{m,t}$ to calibrate the series such that the median value among 100 simulated paths matched Moody's July 2013 base forecast of the mortgage rate quarter by quarter. As with the other interest rates, we also set a floor value at 0.01 percent to the simulated mortgage rate.

V. House Price Appreciation Rate (HPA)

A. National HPA

We specified the national HPA to depend on its own lags, the level of short rates and on various spreads and their lags. After considerable experimentation, the model we adopted was:

$$HPA_t = \mu_t + \beta_1 HPA_{t-1} + \beta_2 HPA_{t-2} + \beta_3 r_{1,t} + \beta_4 r_{1,t-1} + \beta_5 s_{10,t} + \beta_6 s_{10,t-1} + \beta_7 s_{m,t} + \beta_8 s_{m,t-1} + \sigma_{h,t} dZ_h \tag{7}$$

where, $r_{1,t}$ is the 1-year Treasury rate,
$s_{10,t}$ is the spread between the 10-year and 1-year Treasury rates,
$s_{m,t}$ is the spread between mortgage rate and 10-year Treasury rate, and
Z_h is the independent Wiener random process with distribution N(0,1).

The variance of the residual term follows a GARCH (1,1) process:

$$\sigma_{h,t}{}^2 = \gamma_0 + \gamma_1 \varepsilon_{t-1}^2 + \gamma_2 \sigma_{h,t-1}{}^2 \tag{8}$$

The lags and variable inclusions were determined by achieving appropriate coefficient signs and significance, and overall model fit. FIML was used to estimate parameters in equations (7) and (8). The results are shown in Exhibit G-10.

Exhibit G-10: Estimation Results for the National HPA Model

Parameter	Estimate	Std Dev	z-Statistic	Prob>t
μ_t	0.030	Matched with Moody's Forecast		
β_1	0.573	0.103	5.58	0.000
β_2	0.324	0.102	3.17	0.002
β_3	-0.001	0.001	-1.08	0.281
β_4	-0.001	0.001	-1.41	0.157
β_5	-0.002	0.001	-1.64	0.102
β_6	-0.001	0.001	-0.68	0.499
β_7	-0.000	0.002	-0.22	0.828
β_8	-0.001	0.002	-0.66	0.590
γ_0	0.000	0.000	0.51	0.613
γ_1	0.403	0.159	2.53	0.011
γ_2	0.638	0.105	6.10	0.000
Adjusted R^2	0.640			

We used these parameters to simulate future HPAs from 2013 Q3. Also, we calibrated the mean of HPA (μ_t in the equation) by matching the median value across 100 simulated paths to

Moody's July base forecast. Moody's July forecast extends only to year 2043 Q4, so again we repeat the last four quarters for the remaining terms.

B. Geographic dispersion

The MSA-level HPA forecasts were based on Moody's forecast of local and the national HPA forecasts. Specifically, at each time t, there is a dispersion of HPAs between the ith MSA and the national forecast:

$$Disp_{i,t}^{Base} = (HPA_{i,t}^{Base} - HPA_{national,t}^{Base})$$

This dispersion forecast under Moody's base case was preserved for all local house price forecasts under individual future economic paths. That is, for economic path j, the HPA of the ith MSA at time t was computed as:

$$HPA_{i,t}^{j} = (HPA_{national,t}^{j} + DISP_{i,t}^{Base})$$

This approach retains the relative current housing market cycle among different geographic locations and it allows us to capture the geographical concentration of FHA's current endorsement portfolio. This approach is also consistent with Moody's logic in creating local market HPA forecasts relative to the national HPA forecast under alternative economic scenario forecasts. [47] We understand this approach is equivalent to assuming perfect correlation of dispersions among different locations across simulated national HPA paths, which creates a systematic house price decreasing during economic downturns and vice versa during booms. Due to Jensen's Inequality, this tends to generate a more conservative estimate of claim losses of the Fund.

VI. Unemployment Rate

A. National Unemployment Rate

Last year we added the unemployment rate in the transition models and we included it this year as well. In our unemployment rate model, the unemployment rate depends on the prior unemployment rates, house prices, mortgage rates and Treasury rates.

We used quarterly data from CY 1975 to CY 2012 to estimate the national unemployment rate. The model we adopted was:

$$ue_t = \mu_t + \beta_1 ue_{t-1} + \beta_2 ue_{t-2} + \beta_4 r_{1,t} + \beta_5 r_{m,t} + \beta_6 HPA_t + \varepsilon_t \qquad (9)$$

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[47] The dispersion of each MSA remains constant among all alternative Moody's forecast scenarios.

where, $r_{1,t}$ is the 1-year Treasury rate,

$r_{m,t}$ is the 30-year mortgage rate,

HPA_t is the annualized house price growth rate at the national level, and

ue_t is the unemployment rate.

Exhibit G-11: Estimation Results for the National Unemployment Rate Model

Variable	Parameter Estimate	Std Dev	t-Value	Pr > |t|
Intercept	0.1860	0.0956	1.95	0.0537
unemployment rate, lag1	1.5079	0.0650	23.19	<.0001
unemployment rate, lag2	-0.5794	0.0613	-9.45	<.0001
National annual house price growth rate at time t	-1.4975	0.4759	-3.15	0.0020
1-year Treasury rate at time t	-0.0482	0.0201	-2.39	0.0180
30-year mortgage rate at time t	0.0711	0.0233	3.06	0.0027
Durbin-Watson Statistic = 2.020				

From the simulated interest rates and house prices, we applied the parameters shown in Exhibit G-11 to calculate the corresponding national unemployment rate. Based on historical statistics, the national unemployment rate was capped at 20% with a floor at 2%.

B. Geographic dispersion

Following the same logic that we applied to the MSA-level HPA forecasts, we first obtained the dispersion of unemployment rates between the ith MSA level and the national level from Moody's July base-case forecast at each time *t*:

$$Disp_{i,t}^{Base} = (ue_{i,t}^{Base} - ue_{national,t}^{Base})$$

This dispersion forecast was preserved for all local unemployment rate forecasts under each individual future economic path. That is, for economic path *j*, the unemployment rate of the ith MSA at time t was computed as:

$$ue_{i,t}^{j} = (ue_{national,t}^{j} + DISP_{i,t}^{Base})$$

For the simulation, we capped the unemployment rate at local level at 30% with a floor at 1%.

VII. Dynamic Simulation

This year we adopted a dynamic simulation methodology to handle certain path dependencies. Dynamic simulation uses a random number process to assign each loan to a single status at any point in time, depending on the relative probabilities among feasible transitions during that particular time period. In previous year simulated loans were represented as having probabilities of all possible statuses in the future. This is different from the static simulation approach used in previous years, in which each loan will be split into various possible statuses at each point in time in the future.

The use of dynamic simulation improves the speed of the simulation and allows higher flexibility for the transition probabilities to be path-dependent. FY 2012 Review used a series of dummy variables for default duration: 1, 2, 3, and 4-or-more quarters. This approach was adopted to reduce the dimensions of the matrix of transition probabilities to be generated during the forecast involving product and transition types, mortgage age, and duration. Allowing varying default probabilities for more than 4 quarters would have imposed an unmanageable simulation time to achieve convergence. Thus, all loans in default status at duration 4 or higher at the start of a quarter were assigned to the same duration category. This implied that the delinquency duration impact was constant for durations 4 and higher, and the level the function had attained by duration 4 was applied to all higher durations. This year the dynamic simulation approach removes this limitation and allows default duration to increase without bound.

Under the previous static simulation approach, we had to retain all the previous period's transition probabilities to forecast a loan's future performance to capture the path-dependent nature of asymmetric impact of the economic condition prior to a point in time. Under the dynamic simulation approach, a random number was drawn from the uniform distribution over the range [0,1] and use the transition probabilities as cut points. If the random number is within the cutoffs for a given transition, the particular transition was assigned to the loan with a value of 1 to that transition. That is, the loan is assumed to transit to that status. We assign a value of zero to all other transitions, since they were not selected by the random draw.

For example, if the transition probability from current to default is 0.02, and the cut points are, say, 0 and 0.02, and if the random number drawn is 0.68, then we assign a value of zero to this transition, meaning that this transition does not take place. However if the random number drawn was 0.0152, the assigned value is 1, meaning that the transition occurs. We only need to keep the transition record when it happens, because other transitions are known to be represented by zeros. That is, a loan was assigned to one particular simulated status with certainty. In this way, we can reduce the information to be carried forward along each simulation path, thus improving the efficiency of the simulations. This efficiency allows the removal of the default duration limitation that was previously imposed.

Dynamic simulation can decrease the computation time and reduce the information needs to be carried along each simulation path. We can gain a large efficiency advantage using this method

when using a large loan-level dataset. However, the accuracy of the economic value forecast produced by dynamic simulation depends on both the size of the loan population and the number of simulations. A disadvantage is that in order to have precision, a large number of loans need to be tracked. As the MMI Fund forward portfolio is composed of millions of loans, the precision and stability of the results is not a concern. Nevertheless, we adopted the antithetic variates[48] method to improve the convergence efficiency in the dynamic simulation. With our final model, the variation of the economic value of the MMI Fund due to random number process is controlled to be less than $0.05 billion.

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[48] Glasserman, P., (2003), *Monte Carlo Methods in Financial Engineering*, Springer.

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Appendix H

Econometric Results

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Conditional Claim Rates   All Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1983	0.01	0.44	1.47	2.14	3.39	5.08	4.44	3.12	2.50	2.30	2.04	2.06	1.72	1.18	1.08	0.95	0.73	0.47	0.39	0.21	0.23	0.18	0.10	0.08	0.06	0.05	0.03	0.04	0.02	0.05
1984	0.03	0.96	2.78	4.93	7.30	6.28	4.36	3.27	2.88	2.56	2.53	2.18	1.69	1.58	1.20	1.03	0.81	0.54	0.36	0.27	0.18	0.15	0.13	0.09	0.06	0.09	0.07	0.06	0.05	0.06
1985	0.02	0.83	3.24	6.00	5.37	4.02	3.38	3.06	3.06	2.97	2.82	2.01	1.94	1.65	1.16	1.21	0.73	0.55	0.38	0.32	0.21	0.15	0.11	0.16	0.15	0.10	0.12	0.08	0.04	0.03
1986	0.01	0.44	1.71	2.16	2.03	1.85	1.66	1.57	1.77	1.85	1.51	1.47	1.25	1.09	0.97	0.64	0.48	0.43	0.41	0.28	0.19	0.20	0.13	0.17	0.20	0.23	0.15	0.11	0.07	0.02
1987	0.01	0.36	1.03	1.25	1.28	1.28	1.22	1.37	1.38	1.19	1.20	1.06	0.95	0.82	0.48	0.41	0.41	0.38	0.29	0.20	0.16	0.14	0.24	0.23	0.27	0.19	0.16	0.13	0.04	0.02
1988	0.01	0.39	1.13	1.54	1.81	1.85	2.25	2.44	2.03	1.96	1.77	1.62	1.37	0.84	0.70	0.64	0.63	0.44	0.38	0.23	0.28	0.29	0.30	0.33	0.30	0.26	0.19	0.07	0.07	0.06
1989	0.01	0.33	1.09	1.62	1.99	2.67	2.95	2.46	2.36	1.95	1.74	1.54	0.96	0.83	0.73	0.72	0.56	0.47	0.35	0.32	0.36	0.47	0.45	0.43	0.28	0.19	0.09	0.07	0.07	0.04
1990	0.01	0.29	1.08	1.75	2.57	2.87	2.35	2.40	2.06	1.81	1.55	1.01	0.79	0.76	0.71	0.55	0.49	0.46	0.45	0.40	0.61	0.54	0.45	0.40	0.26	0.08	0.06	0.08	0.05	0.04
1991	0.01	0.30	1.16	2.04	2.61	2.31	2.47	2.17	1.86	1.66	1.03	0.86	0.77	0.75	0.61	0.46	0.40	0.46	0.45	0.47	0.58	0.46	0.53	0.31	0.20	0.11	0.14	0.12	0.07	0.05
1992	0.00	0.21	0.77	1.26	1.40	1.76	1.70	1.57	1.35	0.90	0.69	0.62	0.57	0.49	0.41	0.31	0.37	0.39	0.37	0.49	0.46	0.57	0.47	0.23	0.21	0.29	0.24	0.21	0.17	0.17
1993	0.00	0.16	0.60	0.98	1.47	1.43	1.29	1.07	0.65	0.52	0.48	0.49	0.39	0.32	0.27	0.28	0.32	0.45	0.45	0.42	0.63	0.43	0.33	0.36	0.30	0.25	0.18	0.17	0.20	0.14
1994	0.00	0.22	0.74	1.32	1.58	1.48	1.14	0.72	0.59	0.53	0.53	0.44	0.35	0.30	0.27	0.35	0.53	0.48	0.42	0.65	0.56	0.40	0.36	0.37	0.33	0.29	0.29	0.25	0.22	0.17
1995	0.01	0.29	1.36	2.29	2.73	2.41	1.71	1.38	1.62	1.50	1.17	0.96	0.78	0.81	0.89	1.19	1.06	0.85	1.14	0.82	0.59	0.53	0.60	0.56	0.42	0.31	0.32	0.31	0.19	0.19
1996	0.00	0.31	1.35	2.29	2.31	1.67	1.45	1.63	1.61	1.29	1.04	0.86	0.89	0.94	1.21	1.09	1.14	1.39	1.19	0.76	0.68	0.70	0.50	0.46	0.36	0.35	0.29	0.27	0.23	0.18
1997	0.01	0.39	1.61	2.38	1.99	2.01	2.27	2.15	1.80	1.42	1.23	1.26	1.25	1.47	1.32	1.24	1.69	1.42	0.99	0.94	0.89	0.77	0.67	0.56	0.49	0.40	0.40	0.37	0.30	0.22
1998	0.01	0.34	1.15	1.28	1.35	1.65	1.83	1.65	1.40	1.14	1.15	1.23	1.52	1.44	1.37	1.77	1.57	1.04	0.80	0.80	0.59	0.45	0.39	0.33	0.24	0.23	0.20	0.14	0.12	0.08
1999	0.01	0.32	0.86	1.27	1.85	2.16	1.98	1.57	1.30	1.28	1.37	1.69	1.74	1.64	2.19	1.81	1.21	1.00	0.92	0.70	0.50	0.38	0.33	0.23	0.19	0.15	0.14	0.10	0.09	0.06
2000	0.01	0.49	1.99	4.05	4.80	4.07	3.32	2.84	2.89	2.76	3.19	2.83	2.50	3.36	2.82	2.10	1.89	1.75	1.34	0.99	0.78	0.66	0.53	0.41	0.34	0.26	0.25	0.23	0.16	0.12
2001	0.01	0.43	1.83	3.61	3.77	3.25	2.76	2.69	2.58	3.16	3.06	2.76	3.70	3.31	2.36	2.03	1.84	1.30	0.93	0.72	0.60	0.46	0.35	0.27	0.21	0.17	0.10	0.08	0.08	0.04
2002	0.01	0.47	2.08	2.82	2.67	2.41	2.41	2.44	2.99	2.80	2.72	3.89	3.56	2.62	2.24	1.95	1.51	1.12	0.85	0.72	0.57	0.45	0.37	0.31	0.23	0.18	0.16	0.13	0.12	0.07
2003	0.01	0.66	1.57	1.76	1.68	1.80	1.94	2.57	2.34	2.58	3.93	3.78	2.73	2.23	1.99	1.47	1.12	0.88	0.73	0.60	0.47	0.36	0.31	0.24	0.20	0.16	0.15	0.12	0.08	0.06
2004	0.12	0.88	1.44	1.69	2.07	2.23	2.79	2.59	2.82	4.47	4.46	3.30	2.71	2.43	1.88	1.44	1.12	0.93	0.74	0.59	0.49	0.42	0.34	0.27	0.21	0.19	0.14	0.12	0.09	0.07
2005	0.11	0.76	1.81	2.63	3.21	3.56	3.79	5.40	5.34	4.34	3.75	3.42	2.60	1.99	1.54	1.30	1.04	0.82	0.65	0.52	0.43	0.35	0.28	0.22	0.19	0.14	0.13	0.10	0.08	
2006	0.02	0.62	2.21	3.71	5.23	4.61	4.94	6.49	6.20	5.00	4.60	4.29	3.20	2.46	1.91	1.53	1.14	0.89	0.70	0.54	0.41	0.33	0.23	0.18	0.16	0.12	0.09	0.07	0.05	0.03
2007	0.02	0.81	3.18	5.78	4.97	5.94	8.61	8.11	6.77	6.00	5.61	4.35	3.20	2.53	2.07	1.53	1.15	0.89	0.77	0.57	0.42	0.30	0.23	0.20	0.13	0.11	0.08	0.05	0.04	0.03
2008	0.01	0.69	3.42	4.15	5.30	8.14	7.87	6.56	5.86	5.34	4.05	3.06	2.33	1.89	1.48	1.14	0.89	0.67	0.55	0.41	0.32	0.25	0.18	0.14	0.11	0.08	0.06	0.05	0.03	0.02
2009	0.01	0.52	1.35	2.16	4.07	4.39	3.71	3.17	2.84	2.17	1.67	1.32	1.10	0.86	0.68	0.54	0.44	0.36	0.29	0.23	0.19	0.15	0.12	0.10	0.08	0.06	0.05	0.04	0.03	0.03
2010	0.01	0.23	0.72	1.82	2.24	2.00	1.89	1.82	1.49	1.22	1.02	0.89	0.69	0.58	0.46	0.39	0.33	0.26	0.21	0.18	0.15	0.13	0.11	0.08	0.08	0.06	0.05	0.04	0.03	0.03
2011	0.01	0.21	0.83	1.31	1.35	1.34	1.39	1.17	0.97	0.84	0.72	0.59	0.47	0.38	0.32	0.29	0.23	0.20	0.17	0.13	0.12	0.11	0.09	0.09	0.08	0.06	0.06	0.05	0.03	0.03
2012	0.01	0.18	0.69	0.95	1.07	1.10	1.00	0.87	0.75	0.69	0.54	0.44	0.36	0.30	0.24	0.22	0.18	0.15	0.14	0.12	0.10	0.09	0.07	0.07	0.07	0.06	0.04	0.04	0.03	0.02
2013	0.01	0.23	0.75	1.05	1.13	1.07	0.95	0.84	0.81	0.66	0.55	0.44	0.39	0.30	0.26	0.23	0.20	0.16	0.14	0.12	0.10	0.09	0.08	0.08	0.07	0.05	0.05	0.05	0.03	0.03
2014	0.01	0.26	0.99	1.44	1.44	1.35	1.24	1.15	1.05	0.90	0.75	0.60	0.54	0.44	0.33	0.31	0.27	0.23	0.19	0.17	0.14	0.13	0.10	0.08	0.08	0.06	0.05	0.06	0.03	0.02
2015	0.01	0.31	1.35	1.77	1.70	1.61	1.56	1.36	1.31	1.09	0.96	0.79	0.69	0.52	0.40	0.38	0.32	0.28	0.22	0.17	0.14	0.12	0.10	0.09	0.07	0.05	0.04	0.04	0.03	0.02
2016	0.01	0.40	1.47	1.79	1.72	1.74	1.54	1.35	1.27	1.06	0.94	0.78	0.65	0.52	0.39	0.38	0.33	0.27	0.21	0.20	0.14	0.12	0.09	0.09	0.07	0.05	0.04	0.04	0.03	0.01
2017	0.01	0.42	1.35	1.57	1.59	1.51	1.36	1.17	1.13	0.95	0.83	0.65	0.57	0.46	0.35	0.35	0.29	0.23	0.19	0.17	0.13	0.10	0.09	0.09	0.06	0.05	0.03	0.04	0.03	0.01
2018	0.01	0.41	1.27	1.60	1.52	1.48	1.34	1.13	1.13	0.94	0.78	0.65	0.58	0.49	0.38	0.34	0.29	0.24	0.20	0.16	0.13	0.12	0.09	0.09	0.07	0.06	0.04	0.05	0.03	0.02
2019	0.02	0.40	1.37	1.60	1.56	1.49	1.34	1.20	1.16	0.94	0.81	0.68	0.58	0.51	0.37	0.36	0.30	0.25	0.19	0.16	0.13	0.12	0.09	0.09	0.07	0.06	0.04	0.04	0.03	0.02
2020	0.01	0.45	1.39	1.64	1.57	1.54	1.41	1.22	1.13	0.97	0.84	0.71	0.60	0.51	0.38	0.38	0.31	0.25	0.20	0.18	0.15	0.13	0.09	0.10	0.08	0.06	0.04	0.05	0.03	0.02

Conditional Prepayment Rates   All Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1983	0.35	0.84	2.12	18.72	29.25	12.38	9.51	11.35	13.72	22.35	22.65	23.13	9.41	10.71	9.24	10.87	13.43	6.37	5.55	6.38	5.98	5.22	3.70	2.73	2.09	1.70	1.22	1.28	1.39	4.11
1984	0.27	1.49	21.01	29.02	13.51	10.94	11.95	12.67	19.31	20.57	22.01	9.19	10.32	8.97	10.52	11.47	6.26	5.59	6.12	6.09	5.17	4.12	6.42	2.21	2.35	3.70	1.67	2.65	1.77	1.57
1985	0.35	12.10	25.56	11.83	9.64	11.94	14.26	24.53	25.86	25.26	9.52	11.23	9.78	12.19	12.99	7.76	6.88	7.91	7.87	6.57	5.02	9.28	2.79	3.05	6.18	2.29	2.43	1.67	1.07	0.21
1986	0.58	4.04	2.98	3.53	4.95	6.05	15.63	28.29	27.18	8.07	12.31	10.46	17.14	19.07	10.33	12.64	17.03	19.13	15.11	11.03	13.95	6.37	4.99	6.33	3.69	3.94	3.60	2.41	0.30	0.20
1987	0.31	1.12	1.96	3.17	3.75	9.25	21.04	22.44	6.96	10.74	9.31	16.24	19.52	10.43	13.62	19.55	24.60	18.80	13.97	15.85	7.91	6.53	6.88	5.24	5.39	5.06	3.15	0.43	0.25	0.19
1988	0.41	1.67	3.52	5.22	15.68	28.85	27.28	8.21	12.43	10.39	16.22	18.73	10.83	12.99	17.07	19.31	16.16	12.32	15.31	7.08	5.35	5.15	3.77	4.80	3.43	2.63	0.56	0.37	0.25	0.19
1989	0.50	2.23	4.63	16.80	31.66	29.78	8.53	12.86	10.48	16.99	19.42	10.94	13.24	18.43	20.45	17.79	13.45	16.28	7.28	5.29	4.90	3.49	4.73	3.52	2.57	0.60	0.46	0.29	0.22	0.15
1990	0.40	2.14	10.78	33.31	32.19	8.54	13.27	10.55	17.68	20.48	11.00	13.97	20.19	23.05	19.58	14.64	19.92	8.39	6.21	5.91	4.15	4.90	4.13	2.83	0.72	0.59	0.40	0.29	0.26	0.17
1991	0.39	5.99	28.52	31.64	7.88	13.23	10.68	18.67	21.35	11.00	15.43	21.94	26.08	21.68	16.11	19.58	9.33	6.57	6.57	4.18	4.76	3.96	2.84	0.87	0.68	0.47	0.43	0.28	0.23	0.15
1992	0.62	9.29	17.32	6.54	11.59	10.08	19.04	22.55	11.34	17.47	25.04	32.63	25.64	19.12	16.15	12.05	8.74	6.48	5.54	4.94	4.76	3.73	1.09	0.83	0.69	0.57	0.46	0.44	0.33	0.24
1993	1.37	6.64	4.70	8.54	8.13	14.65	18.81	10.73	16.89	25.64	39.44	29.20	21.89	17.35	12.66	9.74	7.83	6.83	5.96	5.79	4.80	1.62	1.10	0.84	0.77	0.62	0.61	0.54	0.37	0.25
1994	0.89	2.92	7.22	7.52	13.46	16.18	9.94	15.79	22.52	36.86	28.10	21.74	17.01	12.82	9.82	7.75	6.56	6.15	6.40	5.13	1.81	1.37	1.02	0.86	0.77	0.69	0.54	0.47	0.34	0.25
1995	1.91	9.86	9.89	21.66	20.88	10.51	18.25	24.97	33.47	28.13	23.20	18.61	14.04	9.05	6.01	5.14	4.51	4.44	4.40	2.10	1.34	1.11	1.08	0.86	0.80	0.65	0.54	0.34	0.27	0.22
1996	0.62	4.26	18.77	20.87	10.01	18.24	25.36	36.35	29.66	24.36	19.00	14.18	9.67	6.79	5.51	4.95	4.99	5.04	2.44	1.63	1.25	1.09	0.96	0.75	0.67	0.58	0.46	0.39	0.32	0.23
1997	0.98	14.96	24.47	11.25	21.87	25.89	34.94	28.89	24.04	19.12	14.32	9.81	6.27	4.85	4.31	4.32	5.22	2.76	1.90	1.49	1.27	1.13	0.95	0.83	0.69	0.55	0.41	0.34	0.29	0.24
1998	2.04	10.68	7.62	16.38	24.43	40.81	32.46	26.39	19.68	14.51	9.98	7.87	6.01	5.32	5.40	6.69	3.20	2.21	1.71	1.43	1.29	1.04	0.92	0.79	0.64	0.50	0.44	0.37	0.29	0.21
1999	0.96	3.53	13.40	22.97	40.01	32.05	26.70	19.56	14.22	9.93	8.14	6.29	5.67	5.91	7.63	3.65	2.49	1.85	1.50	1.37	1.11	0.98	0.84	0.67	0.61	0.46	0.39	0.31	0.29	0.18
2000	0.97	29.20	35.43	38.03	30.22	26.17	20.16	15.38	9.74	6.53	4.71	3.78	4.15	5.55	3.56	2.51	1.89	1.68	1.41	1.12	1.04	0.97	0.78	0.68	0.53	0.44	0.41	0.31	0.24	0.17
2001	5.72	22.50	46.22	34.25	27.77	20.13	14.05	9.77	8.64	5.93	4.93	5.22	7.44	3.78	2.42	1.80	1.59	1.40	1.23	1.05	0.90	0.77	0.71	0.52	0.44	0.39	0.29	0.29	0.23	0.14
2002	4.72	38.17	32.01	27.23	19.79	14.91	10.17	9.36	6.75	5.70	6.29	9.20	4.41	2.86	2.06	1.78	1.61	1.40	1.24	1.08	1.02	0.81	0.68	0.59	0.49	0.42	0.35	0.28	0.22	0.15
2003	11.38	22.13	25.23	18.03	13.13	8.84	9.11	7.26	6.79	8.22	12.47	5.30	3.32	2.60	2.29	1.96	1.73	1.53	1.37	1.16	1.01	0.86	0.76	0.61	0.53	0.51	0.39	0.32	0.27	0.19
2004	7.72	21.13	16.94	12.65	7.87	7.46	6.11	5.80	7.89	12.90	5.43	3.57	2.84	2.64	2.28	1.95	1.77	1.63	1.36	1.14	1.00	0.88	0.75	0.62	0.55	0.45	0.39	0.32	0.26	0.17
2005	7.20	11.80	11.00	7.59	7.29	5.67	5.28	7.64	11.22	3.64	2.36	1.89	1.74	1.57	1.37	1.21	1.10	0.97	0.81	0.73	0.62	0.55	0.44	0.39	0.33	0.28	0.22	0.20	0.12	0.11
2006	1.43	7.74	9.11	12.30	7.54	6.32	8.92	11.59	3.17	1.83	1.46	1.35	1.20	1.05	0.96	0.86	0.78	0.65	0.55	0.48	0.41	0.37	0.28	0.24	0.23	0.17	0.14	0.13	0.09	0.07
2007	1.44	11.39	15.90	8.06	5.88	7.94	10.80	3.31	1.77	1.37	1.26	1.15	1.01	0.91	0.84	0.74	0.64	0.56	0.53	0.44	0.38	0.33	0.26	0.23	0.21	0.14	0.13	0.09	0.08	0.07
2008	2.13	22.52	12.56	8.10	11.42	14.64	4.03	2.19	1.74	1.66	1.50	1.39	1.27	1.11	0.99	0.83	0.75	0.64	0.56	0.47	0.41	0.35	0.28	0.23	0.21	0.17	0.13	0.12	0.10	0.07
2009	6.14	9.06	7.98	15.08	19.03	4.99	3.23	2.94	3.04	2.82	2.54	2.31	2.11	1.83	1.52	1.37	1.21	1.02	0.85	0.73	0.63	0.53	0.44	0.38	0.34	0.28	0.23	0.19	0.16	0.13
2010	1.86	5.31	10.63	15.65	5.54	4.21	3.95	4.17	3.94	3.67	3.35	2.93	2.57	2.12	1.90	1.65	1.40	1.16	1.02	0.87	0.73	0.62	0.52	0.44	0.37	0.32	0.27	0.21	0.18	0.13
2011	0.61	9.00	18.29	8.27	6.17	5.65	5.85	5.45	5.07	4.68	3.90	3.21	2.69	2.39	2.08	1.74	1.45	1.27	1.10	0.90	0.77	0.66	0.55	0.47	0.41	0.36	0.28	0.23	0.19	0.13
2012	1.06	10.99	6.69	5.79	5.56	5.84	5.57	5.18	5.07	4.58	3.62	3.09	2.82	2.47	2.07	1.73	1.52	1.33	1.13	0.96	0.83	0.73	0.63	0.51	0.47	0.38	0.33	0.27	0.23	0.19
2013	1.92	4.97	5.51	5.45	5.85	5.76	5.28	5.12	4.96	4.35	3.53	3.15	2.77	2.36	2.05	1.73	1.52	1.36	1.18	0.97	0.88	0.73	0.65	0.56	0.47	0.40	0.33	0.28	0.23	0.16
2014	1.75	6.98	8.30	9.13	8.52	7.84	7.04	6.67	6.13	5.23	4.48	3.78	3.21	2.50	2.10	1.80	1.53	1.31	1.12	0.97	0.82	0.67	0.61	0.51	0.42	0.35	0.31	0.24	0.20	0.14
2015	1.56	9.31	11.88	10.53	8.97	8.04	7.48	6.92	5.99	5.44	4.66	3.78	3.06	2.34	1.95	1.59	1.33	1.16	0.98	0.80	0.68	0.55	0.49	0.40	0.31	0.27	0.24	0.17	0.13	0.09
2016	1.48	9.48	11.74	10.47	9.03	8.31	7.51	6.31	5.89	5.26	4.52	3.71	3.07	2.31	1.89	1.55	1.26	1.09	0.95	0.78	0.68	0.55	0.48	0.38	0.31	0.26	0.22	0.17	0.12	0.08
2017	1.45	8.73	10.76	9.68	8.82	8.17	7.09	6.44	5.87	5.18	4.42	3.65	3.02	2.25	1.89	1.55	1.25	1.10	0.97	0.83	0.71	0.59	0.49	0.41	0.34	0.27	0.24	0.18	0.13	0.09
2018	1.37	8.31	10.33	10.10	9.45	8.20	7.21	6.73	5.87	5.23	4.36	3.64	3.09	2.31	1.93	1.51	1.29	1.16	1.02	0.83	0.69	0.57	0.51	0.42	0.33	0.28	0.23	0.20	0.14	0.09
2019	1.39	7.97	10.94	10.70	9.06	8.41	7.81	6.84	6.10	5.35	4.42	3.65	2.98	2.27	1.84	1.52	1.28	1.13	1.00	0.81	0.70	0.58	0.51	0.41	0.34	0.29	0.23	0.20	0.15	0.09
2020	1.31	8.86	12.17	10.52	10.05	9.27	7.79	6.93	6.31	5.43	4.42	3.50	2.87	2.18	1.84	1.50	1.26	1.18	0.98	0.81	0.71	0.57	0.48	0.41	0.32	0.27	0.24	0.20	0.14	0.10

Cumulative Claim Rates   **All Mortgages**   **by Credit Subsidy Endorsement Cohort**

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1983	0.01	0.46	1.90	3.93	6.46	9.01	10.85	11.95	12.70	13.28	13.66	13.95	14.12	14.23	14.31	14.38	14.42	14.45	14.47	14.48	14.48	14.49	14.50	14.50	14.50	14.50	14.50	14.50	14.51	14.51
1984	0.03	1.00	3.70	7.34	10.90	13.32	14.70	15.57	16.21	16.64	16.97	17.19	17.33	17.45	17.52	17.58	17.62	17.65	17.66	17.67	17.68	17.68	17.69	17.69	17.69	17.70	17.70	17.70	17.70	17.70
1985	0.02	0.85	3.66	7.35	10.06	11.78	12.99	13.89	14.54	14.98	15.28	15.46	15.62	15.73	15.80	15.85	15.88	15.91	15.92	15.93	15.94	15.94	15.94	15.95	15.95	15.95	15.96	15.96	15.96	15.96
1986	0.01	0.45	2.08	4.03	5.75	7.21	8.41	9.35	10.09	10.63	11.02	11.35	11.59	11.77	11.89	11.95	12.00	12.03	12.06	12.07	12.08	12.09	12.09	12.10	12.10	12.11	12.12	12.12	12.12	12.12
1987	0.01	0.37	1.38	2.57	3.74	4.84	5.77	6.59	7.21	7.70	8.13	8.47	8.72	8.88	8.97	9.03	9.08	9.12	9.14	9.15	9.16	9.17	9.18	9.19	9.20	9.20	9.21	9.21	9.22	9.22
1988	0.01	0.41	1.51	2.95	4.51	5.83	6.94	7.79	8.42	8.93	9.34	9.64	9.84	9.95	10.03	10.09	10.13	10.16	10.18	10.18	10.20	10.21	10.22	10.23	10.24	10.25	10.25	10.25	10.26	10.26
1989	0.01	0.34	1.40	2.88	4.37	5.69	6.67	7.39	7.98	8.40	8.71	8.92	9.03	9.11	9.17	9.22	9.25	9.27	9.28	9.29	9.30	9.32	9.33	9.34	9.35	9.35	9.36	9.36	9.36	9.36
1990	0.01	0.30	1.35	2.85	4.27	5.31	6.06	6.71	7.19	7.53	7.75	7.88	7.96	8.03	8.07	8.10	8.12	8.13	8.15	8.16	8.18	8.19	8.20	8.21	8.21	8.22	8.22	8.22	8.22	8.22
1991	0.01	0.31	1.40	2.73	3.87	4.76	5.57	6.18	6.60	6.88	7.04	7.14	7.21	7.27	7.30	7.32	7.33	7.35	7.36	7.37	7.39	7.40	7.41	7.42	7.42	7.42	7.43	7.43	7.43	7.43
1992	0.00	0.21	0.91	1.83	2.79	3.82	4.71	5.35	5.77	6.01	6.16	6.26	6.32	6.35	6.38	6.40	6.41	6.43	6.44	6.46	6.47	6.49	6.50	6.51	6.52	6.53	6.54	6.54	6.55	6.56
1993	0.00	0.16	0.72	1.57	2.72	3.72	4.48	4.98	5.25	5.42	5.53	5.61	5.64	5.67	5.68	5.70	5.71	5.73	5.75	5.76	5.79	5.80	5.81	5.82	5.83	5.84	5.84	5.85	5.86	5.86
1994	0.00	0.22	0.93	2.09	3.35	4.35	4.98	5.33	5.57	5.73	5.83	5.89	5.92	5.95	5.97	5.99	6.02	6.04	6.06	6.09	6.11	6.13	6.14	6.16	6.17	6.18	6.20	6.21	6.22	6.22
1995	0.01	0.29	1.49	3.28	4.90	5.99	6.66	7.10	7.47	7.70	7.82	7.89	7.94	7.98	8.03	8.08	8.12	8.15	8.19	8.22	8.24	8.26	8.28	8.30	8.32	8.33	8.34	8.35	8.36	8.37
1996	0.00	0.31	1.59	3.33	4.67	5.52	6.11	6.59	6.88	7.04	7.14	7.20	7.25	7.30	7.36	7.42	7.46	7.52	7.57	7.59	7.62	7.64	7.66	7.68	7.69	7.71	7.72	7.73	7.74	7.74
1997	0.01	0.40	1.75	3.23	4.29	5.10	5.76	6.16	6.38	6.51	6.60	6.68	6.75	6.82	6.88	6.94	7.01	7.06	7.10	7.13	7.17	7.20	7.22	7.24	7.26	7.27	7.29	7.30	7.31	7.32
1998	0.01	0.34	1.35	2.37	3.25	4.05	4.55	4.85	5.03	5.15	5.25	5.34	5.44	5.53	5.61	5.71	5.79	5.83	5.87	5.91	5.93	5.95	5.97	5.98	6.00	6.01	6.01	6.02	6.03	6.03
1999	0.01	0.32	1.15	2.19	3.33	4.10	4.56	4.82	4.99	5.12	5.26	5.40	5.54	5.66	5.81	5.92	5.99	6.04	6.09	6.12	6.15	6.17	6.18	6.20	6.21	6.21	6.22	6.22	6.23	6.23
2000	0.01	0.50	1.88	3.65	4.85	5.51	5.89	6.13	6.34	6.51	6.69	6.83	6.95	7.10	7.21	7.29	7.36	7.42	7.47	7.50	7.52	7.55	7.56	7.58	7.59	7.60	7.60	7.61	7.62	7.62
2001	0.01	0.41	1.74	3.10	3.98	4.50	4.83	5.11	5.33	5.58	5.80	5.98	6.20	6.37	6.49	6.58	6.66	6.72	6.76	6.79	6.81	6.83	6.84	6.85	6.86	6.87	6.87	6.88	6.88	6.88
2002	0.01	0.46	1.67	2.75	3.46	3.96	4.37	4.73	5.12	5.45	5.74	6.12	6.42	6.62	6.78	6.91	7.01	7.08	7.13	7.18	7.21	7.24	7.26	7.28	7.29	7.30	7.31	7.32	7.33	7.33
2003	0.01	0.61	1.68	2.55	3.22	3.83	4.42	5.10	5.66	6.22	6.98	7.58	7.97	8.27	8.52	8.70	8.83	8.93	9.01	9.07	9.12	9.16	9.19	9.22	9.24	9.26	9.27	9.28	9.29	9.30
2004	0.12	0.93	1.97	2.95	3.98	4.98	6.10	7.05	8.00	9.32	10.40	11.12	11.67	12.13	12.46	12.71	12.89	13.04	13.15	13.24	13.31	13.37	13.42	13.46	13.49	13.52	13.54	13.56	13.57	13.58
2005	0.11	0.82	2.30	4.16	6.19	8.41	10.22	11.99	14.21	16.03	17.37	18.45	19.38	20.05	20.53	20.90	21.19	21.43	21.61	21.75	21.86	21.95	22.02	22.08	22.13	22.17	22.20	22.23	22.25	22.27
2006	0.02	0.63	2.64	5.61	9.14	11.84	14.42	17.34	19.62	21.28	22.70	23.95	24.82	25.46	25.95	26.32	26.59	26.79	26.95	27.07	27.17	27.24	27.29	27.33	27.37	27.39	27.41	27.43	27.44	27.45
2007	0.02	0.83	3.59	7.65	10.66	13.86	17.84	20.86	23.09	24.90	26.46	27.59	28.37	28.97	29.43	29.77	30.01	30.20	30.36	30.47	30.56	30.62	30.67	30.71	30.73	30.75	30.77	30.78	30.79	30.80
2008	0.01	0.69	3.28	5.90	8.85	12.60	15.40	17.45	19.12	20.52	21.51	22.22	22.73	23.13	23.43	23.66	23.83	23.96	24.07	24.14	24.20	24.25	24.28	24.31	24.33	24.34	24.36	24.37	24.37	24.38
2009	0.01	0.51	1.66	3.32	5.92	8.06	9.70	11.00	12.09	12.88	13.45	13.88	14.22	14.49	14.69	14.85	14.97	15.07	15.15	15.21	15.26	15.30	15.34	15.36	15.38	15.40	15.41	15.43	15.43	15.44
2010	0.01	0.23	0.90	2.40	3.92	5.17	6.28	7.28	8.05	8.64	9.11	9.50	9.79	10.03	10.21	10.36	10.48	10.58	10.66	10.72	10.77	10.82	10.86	10.88	10.91	10.93	10.95	10.97	10.98	10.99
2011	0.01	0.22	0.97	1.93	2.82	3.64	4.42	5.03	5.50	5.88	6.19	6.43	6.61	6.75	6.87	6.97	7.05	7.11	7.17	7.21	7.25	7.29	7.32	7.34	7.37	7.39	7.41	7.42	7.44	7.45
2012	0.01	0.19	0.80	1.57	2.38	3.15	3.80	4.33	4.76	5.12	5.40	5.60	5.77	5.90	6.00	6.09	6.17	6.23	6.28	6.33	6.37	6.40	6.43	6.45	6.48	6.50	6.52	6.54	6.55	6.56
2013	0.01	0.23	0.94	1.85	2.77	3.58	4.24	4.79	5.28	5.66	5.96	6.19	6.39	6.53	6.66	6.76	6.84	6.92	6.97	7.03	7.07	7.11	7.14	7.18	7.21	7.23	7.25	7.27	7.28	7.30
2014	0.01	0.26	1.17	2.36	3.42	4.32	5.06	5.69	6.22	6.63	6.96	7.21	7.42	7.58	7.70	7.81	7.90	7.98	8.04	8.10	8.15	8.19	8.22	8.25	8.27	8.29	8.31	8.33	8.34	8.35
2015	0.01	0.32	1.52	2.88	4.03	5.00	5.85	6.51	7.10	7.56	7.92	8.21	8.44	8.62	8.74	8.86	8.95	9.03	9.10	9.14	9.18	9.22	9.24	9.27	9.29	9.30	9.31	9.33	9.33	9.34
2016	0.01	0.41	1.72	3.09	4.25	5.29	6.12	6.78	7.35	7.79	8.15	8.43	8.66	8.83	8.95	9.07	9.16	9.24	9.30	9.36	9.40	9.43	9.46	9.48	9.50	9.51	9.52	9.54	9.54	9.55
2017	0.01	0.43	1.64	2.88	3.98	4.92	5.68	6.28	6.80	7.21	7.55	7.79	8.00	8.15	8.27	8.38	8.47	8.54	8.60	8.65	8.68	8.71	8.74	8.76	8.78	8.80	8.80	8.82	8.83	8.83
2018	0.01	0.42	1.57	2.84	3.90	4.82	5.57	6.15	6.67	7.08	7.39	7.63	7.84	8.01	8.13	8.24	8.33	8.41	8.47	8.51	8.55	8.58	8.61	8.64	8.66	8.67	8.69	8.70	8.71	8.72
2019	0.02	0.41	1.65	2.92	4.00	4.91	5.66	6.26	6.78	7.18	7.50	7.75	7.95	8.12	8.24	8.36	8.45	8.52	8.58	8.63	8.66	8.70	8.72	8.75	8.77	8.78	8.80	8.81	8.82	8.82
2020	0.01	0.46	1.71	2.97	4.04	4.95	5.70	6.28	6.77	7.16	7.47	7.72	7.92	8.09	8.20	8.31	8.41	8.48	8.53	8.58	8.62	8.65	8.68	8.70	8.73	8.74	8.75	8.77	8.77	8.78

Cumulative Prepayment Rates **All Mortgages** **by Credit Subsidy Endorsement Cohort**

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1983	0.353	1.192	3.287	21.06	43	49.27	53.24	57.33	61.55	67.34	71.76	75.14	76.2	77.28	78.2	79.59	80.41	80.74	81.03	81.36	81.69	81.9	82.04	82.14	82.23	82.34	82.39	82.43	82.48	82.9
1984	0.28	1.77	22.22	43.72	50.33	54.56	58.39	61.81	66.21	69.86	72.83	73.78	74.73	75.48	76.45	77.51	77.82	78.08	78.37	78.65	78.91	79.05	79.26	79.33	79.44	79.61	79.65	79.73	79.79	**79.84**
1985	0.36	12.45	34.65	41.96	46.85	51.99	57.16	64.51	70.11	73.98	75.03	76.12	76.95	77.87	78.79	79.77	80.07	80.39	80.69	80.93	81.11	81.38	81.45	81.53	81.70	81.78	81.83	81.87	**81.90**	**81.90**
1986	0.59	4.62	7.47	10.68	14.93	19.76	31.25	48.38	59.87	62.33	65.69	68.17	71.69	74.89	76.48	78.77	80.36	81.84	82.78	83.37	84.06	84.31	84.50	84.73	84.86	85.02	85.13	**85.20**	**85.21**	**85.22**
1987	0.31	1.43	3.36	6.40	9.84	17.87	34.18	47.67	50.90	55.45	58.94	64.33	69.67	72.02	75.02	78.72	81.76	83.49	84.54	85.57	86.04	86.36	86.68	86.91	87.16	87.43	**87.54**	**87.56**	**87.57**	**87.58**
1988	0.41	2.09	5.52	10.39	24.00	44.65	58.17	61.05	64.93	67.72	71.52	75.11	76.79	78.56	80.66	82.74	83.90	84.64	85.43	85.75	86.01	86.21	86.35	86.53	86.68	**86.78**	**86.80**	**86.81**	**86.82**	**86.82**
1989	0.51	2.73	7.23	22.60	46.23	60.94	63.80	67.61	70.24	73.95	77.38	78.92	80.54	82.48	84.29	85.60	86.30	87.01	87.28	87.48	87.67	87.78	87.93	88.03	**88.10**	**88.12**	**88.13**	**88.14**	**88.14**	**88.15**
1990	0.40	2.54	13.04	41.61	59.49	62.60	66.87	69.74	73.92	77.79	79.42	81.23	83.44	85.44	86.79	87.67	88.51	88.79	88.98	89.17	89.30	89.43	89.54	**89.60**	**89.62**	**89.63**	**89.64**	**89.65**	**89.65**	**89.66**
1991	0.39	6.38	33.07	53.81	57.25	62.41	65.93	71.27	76.09	78.01	80.36	83.14	85.68	87.23	88.18	89.21	89.53	89.74	89.93	90.05	90.19	90.29	**90.36**	**90.38**	**90.39**	**90.40**	**90.41**	**90.42**	**90.42**	**90.43**
1992	0.62	4.88	22.74	38.56	44.41	53.73	64.09	74.96	80.44	83.53	85.33	86.41	87.05	87.48	87.87	88.28	88.50	**88.71**	**88.80**	**88.86**	**88.91**	**88.95**	**88.98**	**89.01**	**89.03**	**89.05**	**89.07**	**89.08**	**89.09**	**89.10**
1993	1.38	7.96	12.32	19.80	26.24	36.71	47.96	53.11	60.21	69.04	79.03	83.48	85.87	87.41	88.54	89.74	90.10	90.40	90.63	90.86	**91.04**	**91.09**	**91.12**	**91.15**	**91.17**	**91.19**	**91.21**	**91.23**	**91.24**	**91.25**
1994	0.90	3.81	10.76	17.44	28.31	39.39	45.02	52.93	62.30	74.05	79.67	82.81	84.78	86.08	87.40	88.44	88.81	89.14	89.46	**89.70**	**89.78**	**89.84**	**89.88**	**89.91**	**89.94**	**89.97**	**89.99**	**90.01**	**90.03**	**90.04**
1995	1.92	11.62	20.37	37.35	49.77	54.55	61.79	69.69	77.48	81.71	84.17	85.66	86.58	87.09	87.49	87.86	88.05	88.22	**88.39**	**88.46**	**88.50**	**88.54**	**88.58**	**88.61**	**88.63**	**88.65**	**88.67**	**88.68**	**88.69**	**88.70**
1996	0.62	4.88	22.74	38.56	44.41	53.73	64.09	74.96	80.44	83.53	85.33	86.41	87.05	87.48	87.87	88.28	88.50	**88.71**	**88.80**	**88.86**	**88.91**	**88.95**	**88.98**	**89.01**	**89.03**	**89.05**	**89.07**	**89.08**	**89.09**	**89.10**
1997	0.99	15.88	36.42	43.41	55.13	65.66	75.92	81.22	84.26	86.06	87.14	87.76	88.13	88.40	88.66	88.96	**89.18**	**89.29**	**89.36**	**89.41**	**89.46**	**89.50**	**89.53**	**89.56**	**89.58**	**89.60**	**89.61**	**89.63**	**89.64**	**89.65**
1998	2.05	12.56	19.24	32.31	48.33	68.17	77.21	82.03	84.62	86.13	87.02	87.65	88.09	88.47	88.87	**89.31**	**89.47**	**89.58**	**89.65**	**89.72**	**89.77**	**89.82**	**89.86**	**89.89**	**89.92**	**89.94**	**89.96**	**89.98**	**89.99**	**90.00**
1999	0.97	4.49	17.29	36.07	60.87	72.37	78.67	81.95	83.84	84.97	85.79	86.38	86.88	87.37	**87.99**	**88.24**	**88.38**	**88.48**	**88.56**	**88.64**	**88.69**	**88.74**	**88.78**	**88.82**	**88.85**	**88.87**	**88.89**	**88.91**	**88.92**	**88.93**
2000	0.97	29.98	54.66	71.24	78.85	83.13	85.43	86.78	87.47	87.88	88.15	88.35	88.56	**88.83**	**88.99**	**89.09**	**89.16**	**89.22**	**89.27**	**89.30**	**89.34**	**89.37**	**89.39**	**89.42**	**89.43**	**89.45**	**89.46**	**89.47**	**89.48**	**89.49**
2001	5.74	27.04	60.69	73.60	80.10	83.31	85.04	86.03	86.81	87.28	87.64	87.99	**88.47**	**88.69**	**88.83**	**88.93**	**89.00**	**89.06**	**89.11**	**89.16**	**89.20**	**89.23**	**89.25**	**89.28**	**89.29**	**89.31**	**89.32**	**89.33**	**89.34**	**89.35**
2002	4.75	41.28	59.99	70.48	75.80	78.91	80.66	82.08	82.98	83.67	84.38	**85.34**	**85.76**	**86.04**	**86.24**	**86.38**	**86.48**	**86.57**	**86.65**	**86.72**	**86.78**	**86.83**	**86.87**	**86.91**	**86.94**	**86.96**	**86.98**	**87.00**	**87.01**	**87.02**
2003	11.45	31.14	48.45	57.48	62.76	65.79	68.58	70.56	72.24	74.10	**76.64**	**77.61**	**78.19**	**78.65**	**79.05**	**79.32**	**79.52**	**79.70**	**79.86**	**79.99**	**80.10**	**80.19**	**80.27**	**80.33**	**80.39**	**80.44**	**80.48**	**80.51**	**80.54**	**80.57**
2004	7.82	27.38	39.58	47.01	50.98	54.36	56.87	59.05	61.76	**65.76**	**67.23**	**68.15**	**68.85**	**69.48**	**70.02**	**70.37**	**70.67**	**70.95**	**71.17**	**71.35**	**71.50**	**71.63**	**71.74**	**71.83**	**71.92**	**71.98**	**72.04**	**72.09**	**72.13**	**72.16**
2005	7.31	18.31	27.26	32.64	37.28	40.51	43.23	46.82	**51.50**	**52.82**	**53.62**	**54.23**	**54.77**	**55.24**	**55.66**	**55.97**	**56.23**	**56.46**	**56.64**	**56.81**	**56.94**	**57.06**	**57.15**	**57.24**	**57.31**	**57.37**	**57.41**	**57.46**	**57.48**	**57.51**
2006	1.44	9.10	17.35	27.23	32.32	36.04	40.72	**45.96**	**47.16**	**47.80**	**48.28**	**48.70**	**49.06**	**49.38**	**49.67**	**49.89**	**50.08**	**50.24**	**50.37**	**50.48**	**50.58**	**50.66**	**50.73**	**50.78**	**50.84**	**50.88**	**50.91**	**50.94**	**50.96**	**50.98**
2007	1.45	12.71	26.52	32.17	35.73	40.02	**45.04**	**46.28**	**46.88**	**47.31**	**47.67**	**47.99**	**48.26**	**48.50**	**48.72**	**48.89**	**49.03**	**49.15**	**49.26**	**49.35**	**49.43**	**49.50**	**49.55**	**49.60**	**49.64**	**49.67**	**49.70**	**49.72**	**49.74**	**49.76**
2008	2.14	24.27	33.72	38.85	45.21	**51.98**	**53.42**	**54.12**	**54.63**	**55.09**	**55.47**	**55.82**	**56.13**	**56.39**	**56.63**	**56.82**	**56.97**	**57.09**	**57.20**	**57.29**	**57.37**	**57.43**	**57.49**	**57.53**	**57.57**	**57.60**	**57.63**	**57.65**	**57.67**	**57.69**
2009	6.17	14.73	21.52	33.22	**45.37**	**47.83**	**49.28**	**50.51**	**51.71**	**52.76**	**53.68**	**54.48**	**55.21**	**55.83**	**56.35**	**56.78**	**57.13**	**57.41**	**57.65**	**57.85**	**58.03**	**58.17**	**58.29**	**58.40**	**58.49**	**58.56**	**58.63**	**58.68**	**58.73**	**58.77**
2010	1.88	7.13	17.06	**29.99**	**33.77**	**36.43**	**38.77**	**41.10**	**43.18**	**45.04**	**46.66**	**48.04**	**49.22**	**50.20**	**51.07**	**51.75**	**52.29**	**52.72**	**53.10**	**53.42**	**53.68**	**53.90**	**54.09**	**54.24**	**54.38**	**54.49**	**54.59**	**54.67**	**54.74**	**54.80**
2011	0.61	9.63	**26.23**	**32.30**	**36.40**	**39.87**	**43.21**	**46.11**	**48.65**	**50.87**	**52.66**	**54.10**	**55.31**	**56.38**	**57.33**	**58.02**	**58.52**	**58.95**	**59.32**	**59.62**	**59.87**	**60.09**	**60.27**	**60.43**	**60.56**	**60.68**	**60.77**	**60.85**	**60.92**	**60.98**
2012	1.07	**12.06**	**17.99**	**22.74**	**26.99**	**31.15**	**34.86**	**38.10**	**41.11**	**43.70**	**45.69**	**47.38**	**48.93**	**50.30**	**51.50**	**52.34**	**52.96**	**53.49**	**53.94**	**54.32**	**54.64**	**54.92**	**55.16**	**55.36**	**55.54**	**55.69**	**55.82**	**55.92**	**56.02**	**56.11**
2013	**1.93**	**6.84**	**11.99**	**16.76**	**21.54**	**25.93**	**29.69**	**33.11**	**36.26**	**38.87**	**40.92**	**42.70**	**44.25**	**45.57**	**46.73**	**47.61**	**48.30**	**48.91**	**49.44**	**49.86**	**50.25**	**50.56**	**50.84**	**51.08**	**51.28**	**51.46**	**51.60**	**51.73**	**51.84**	**51.93**
2014	**1.76**	**8.65**	**16.25**	**23.81**	**30.13**	**35.36**	**39.63**	**43.36**	**46.54**	**49.08**	**51.13**	**52.80**	**54.18**	**55.26**	**56.17**	**56.88**	**57.41**	**57.87**	**58.25**	**58.58**	**58.86**	**59.08**	**59.28**	**59.45**	**59.60**	**59.71**	**59.82**	**59.90**	**59.97**	**60.04**
2015	**1.57**	**10.78**	**21.38**	**29.53**	**35.62**	**40.51**	**44.62**	**48.09**	**50.87**	**53.22**	**55.13**	**56.61**	**57.78**	**58.69**	**59.45**	**60.02**	**60.42**	**60.78**	**61.07**	**61.30**	**61.51**	**61.67**	**61.81**	**61.93**	**62.02**	**62.10**	**62.17**	**62.22**	**62.26**	**62.31**
2016	**1.48**	**10.88**	**21.35**	**29.44**	**35.57**	**40.60**	**44.69**	**47.84**	**50.57**	**52.85**	**54.70**	**56.16**	**57.35**	**58.26**	**59.01**	**59.56**	**59.95**	**60.28**	**60.57**	**60.80**	**61.01**	**61.17**	**61.31**	**61.42**	**61.51**	**61.59**	**61.66**	**61.71**	**61.75**	**61.78**
2017	**1.46**	**10.12**	**19.79**	**27.42**	**33.60**	**38.72**	**42.75**	**46.11**	**48.96**	**51.31**	**53.22**	**54.74**	**55.97**	**56.92**	**57.72**	**58.31**	**58.71**	**59.07**	**59.38**	**59.64**	**59.87**	**60.05**	**60.20**	**60.33**	**60.44**	**60.53**	**60.61**	**60.67**	**60.71**	**60.75**
2018	**1.38**	**9.63**	**18.97**	**27.03**	**33.68**	**38.83**	**42.92**	**46.42**	**49.25**	**51.61**	**53.48**	**54.98**	**56.23**	**57.18**	**57.99**	**58.55**	**58.97**	**59.35**	**59.67**	**59.93**	**60.15**	**60.33**	**60.49**	**60.62**	**60.73**	**60.82**	**60.89**	**60.96**	**61.01**	**61.05**
2019	**1.40**	**9.31**	**19.24**	**27.74**	**34.04**	**39.28**	**43.66**	**47.15**	**50.04**	**52.40**	**54.25**	**55.72**	**56.90**	**57.82**	**58.58**	**59.14**	**59.55**	**59.91**	**60.22**	**60.47**	**60.69**	**60.87**	**61.02**	**61.15**	**61.25**	**61.34**	**61.42**	**61.48**	**61.53**	**61.57**
2020	**1.32**	**10.12**	**21.06**	**29.22**	**36.06**	**41.65**	**45.83**	**49.23**	**52.09**	**54.38**	**56.14**	**57.49**	**58.58**	**59.43**	**60.15**	**60.67**	**61.06**	**61.41**	**61.71**	**61.95**	**62.16**	**62.33**	**62.47**	**62.59**	**62.68**	**62.76**	**62.83**	**62.89**	**62.94**	**62.98**

Conditional Claim Rates   Fixed Rate 30 Year Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1983	0.02	0.46	1.52	2.21	3.54	5.36	4.70	3.32	2.66	2.44	2.15	2.17	1.80	1.22	1.10	0.95	0.73	0.47	0.39	0.21	0.23	0.18	0.10	0.08	0.06	0.05	0.03	0.04	0.02	0.05
1984	0.03	1.00	2.88	5.13	7.62	6.61	4.60	3.47	3.05	2.71	2.67	2.29	1.76	1.64	1.23	1.03	0.81	0.54	0.36	0.27	0.18	0.15	0.13	0.09	0.06	0.09	0.07	0.06	0.05	0.06
1985	0.02	0.88	3.43	6.35	5.73	4.29	3.62	3.29	3.29	3.19	3.05	2.16	2.08	1.76	1.21	1.24	0.73	0.54	0.38	0.32	0.21	0.15	0.11	0.16	0.15	0.10	0.12	0.08	0.04	0.03
1986	0.01	0.48	1.84	2.31	2.15	1.95	1.76	1.66	1.89	1.97	1.61	1.55	1.32	1.14	1.00	0.65	0.50	0.43	0.42	0.28	0.19	0.20	0.14	0.17	0.20	0.24	0.15	0.11	0.07	0.02
1987	0.01	0.36	1.06	1.28	1.30	1.32	1.27	1.45	1.48	1.27	1.28	1.14	1.02	0.87	0.51	0.43	0.43	0.41	0.30	0.20	0.18	0.15	0.25	0.23	0.28	0.19	0.16	0.12	0.03	0.01
1988	0.01	0.37	1.07	1.50	1.78	1.87	2.35	2.58	2.14	2.10	1.88	1.74	1.46	0.90	0.75	0.68	0.67	0.47	0.40	0.25	0.30	0.32	0.32	0.36	0.30	0.25	0.19	0.05	0.03	0.02
1989	0.01	0.31	1.06	1.62	1.98	2.72	3.02	2.50	2.41	2.01	1.79	1.57	0.98	0.85	0.76	0.74	0.58	0.49	0.36	0.32	0.37	0.47	0.46	0.45	0.27	0.18	0.08	0.07	0.06	0.02
1990	0.01	0.28	1.07	1.76	2.62	2.91	2.38	2.45	2.10	1.85	1.58	1.03	0.81	0.79	0.72	0.55	0.49	0.48	0.47	0.40	0.62	0.55	0.46	0.40	0.26	0.08	0.06	0.07	0.03	0.03
1991	0.01	0.31	1.21	2.15	2.78	2.42	2.56	2.21	1.91	1.72	1.08	0.93	0.82	0.80	0.67	0.49	0.43	0.49	0.47	0.48	0.63	0.47	0.54	0.32	0.18	0.09	0.10	0.08	0.03	0.01
1992	0.01	0.22	0.85	1.40	1.43	1.76	1.69	1.61	1.42	1.00	0.78	0.70	0.68	0.61	0.48	0.38	0.46	0.42	0.46	0.60	0.50	0.60	0.45	0.18	0.14	0.12	0.06	0.05	0.03	0.03
1993	0.00	0.15	0.59	0.94	1.31	1.38	1.34	1.17	0.75	0.63	0.59	0.67	0.57	0.47	0.36	0.37	0.39	0.54	0.56	0.52	0.63	0.36	0.22	0.18	0.14	0.09	0.08	0.05	0.03	0.02
1994	0.00	0.18	0.66	1.20	1.53	1.53	1.26	0.84	0.72	0.67	0.74	0.65	0.52	0.44	0.38	0.50	0.61	0.63	0.51	0.67	0.47	0.29	0.22	0.18	0.14	0.08	0.08	0.06	0.03	0.01
1995	0.00	0.26	1.17	1.98	2.38	2.25	1.67	1.32	1.57	1.55	1.28	1.04	0.89	0.89	0.96	1.22	1.11	0.89	1.06	0.73	0.40	0.34	0.30	0.24	0.16	0.12	0.09	0.04	0.03	0.02
1996	0.00	0.28	1.20	1.96	2.09	1.60	1.35	1.54	1.67	1.40	1.11	0.97	0.90	0.98	1.25	1.10	1.18	1.33	1.08	0.60	0.47	0.45	0.30	0.25	0.16	0.13	0.07	0.07	0.04	0.03
1997	0.01	0.37	1.41	2.02	1.69	1.67	1.95	2.14	1.89	1.51	1.28	1.27	1.22	1.47	1.33	1.19	1.59	1.24	0.76	0.69	0.50	0.43	0.35	0.20	0.15	0.11	0.08	0.07	0.05	0.02
1998	0.01	0.30	1.11	1.27	1.37	1.70	1.92	1.78	1.53	1.24	1.22	1.30	1.56	1.51	1.42	1.73	1.49	0.92	0.70	0.65	0.46	0.34	0.27	0.21	0.13	0.11	0.08	0.06	0.05	0.02
1999	0.01	0.35	0.98	1.43	2.09	2.45	2.26	1.79	1.47	1.44	1.49	1.85	1.90	1.73	2.22	1.76	1.17	0.91	0.88	0.66	0.46	0.34	0.27	0.18	0.15	0.10	0.08	0.06	0.05	0.03
2000	0.01	0.49	2.07	4.24	5.19	4.47	3.65	3.03	2.96	2.76	3.27	2.90	2.52	3.38	2.80	1.98	1.74	1.56	1.17	0.81	0.61	0.46	0.37	0.24	0.14	0.13	0.12	0.08	0.05	0.03
2001	0.01	0.50	1.99	3.92	4.10	3.44	2.91	2.79	2.60	3.17	3.06	2.82	3.57	3.05	2.23	1.90	1.74	1.24	0.87	0.66	0.54	0.41	0.29	0.21	0.15	0.13	0.07	0.05	0.04	0.03
2002	0.01	0.52	2.30	3.21	2.98	2.60	2.43	2.43	3.07	2.86	2.79	3.81	3.35	2.52	2.11	1.88	1.39	1.02	0.75	0.58	0.44	0.34	0.24	0.19	0.15	0.10	0.08	0.05	0.05	0.02
2003	0.01	0.77	1.82	2.09	1.93	1.97	2.14	2.83	2.58	2.79	4.02	3.76	2.77	2.30	2.08	1.49	1.14	0.86	0.67	0.51	0.40	0.29	0.21	0.18	0.14	0.10	0.08	0.07	0.04	0.03
2004	0.12	0.96	1.59	1.85	2.19	2.36	3.02	2.83	3.06	4.60	4.65	3.54	2.98	2.69	2.05	1.51	1.16	0.89	0.69	0.52	0.42	0.33	0.25	0.18	0.14	0.12	0.07	0.05	0.05	0.03
2005	0.11	0.74	1.76	2.52	3.10	3.87	3.60	3.84	5.44	5.34	4.29	3.71	3.35	2.52	1.86	1.40	1.14	0.89	0.67	0.50	0.38	0.29	0.23	0.17	0.12	0.10	0.07	0.05	0.04	0.03
2006	0.01	0.56	2.17	3.68	5.24	4.65	4.96	6.57	6.23	5.01	4.59	4.31	3.19	2.43	1.86	1.48	1.11	0.84	0.65	0.49	0.38	0.29	0.20	0.15	0.12	0.09	0.07	0.06	0.04	0.02
2007	0.02	0.79	3.12	5.74	4.92	5.89	8.60	8.00	6.66	5.93	5.56	4.31	3.17	2.49	2.04	1.50	1.12	0.87	0.74	0.54	0.39	0.28	0.21	0.18	0.11	0.10	0.06	0.04	0.04	0.02
2008	0.01	0.66	3.34	4.08	5.24	8.04	7.66	6.32	5.66	5.21	3.96	3.00	2.27	1.84	1.44	1.10	0.84	0.63	0.52	0.38	0.30	0.24	0.16	0.13	0.10	0.07	0.05	0.04	0.02	0.01
2009	0.01	0.44	1.08	1.79	3.32	3.50	2.91	2.62	2.53	1.98	1.54	1.22	1.00	0.78	0.59	0.46	0.37	0.29	0.24	0.18	0.15	0.11	0.09	0.07	0.05	0.04	0.03	0.03	0.02	0.01
2010	0.00	0.13	0.51	1.39	1.79	1.64	1.64	1.67	1.40	1.12	0.92	0.78	0.61	0.50	0.38	0.31	0.26	0.20	0.16	0.13	0.10	0.08	0.07	0.05	0.05	0.04	0.02	0.02	0.01	0.01
2011	0.00	0.11	0.59	1.04	1.11	1.18	1.29	1.12	0.89	0.75	0.63	0.49	0.37	0.30	0.24	0.21	0.17	0.13	0.12	0.09	0.07	0.06	0.05	0.04	0.05	0.03	0.03	0.02	0.02	0.01
2012	0.00	0.14	0.59	0.83	1.02	1.13	1.05	0.90	0.75	0.68	0.51	0.38	0.29	0.23	0.19	0.16	0.13	0.11	0.10	0.08	0.06	0.05	0.04	0.04	0.04	0.04	0.03	0.02	0.01	0.01
2013	0.00	0.16	0.63	1.03	1.19	1.20	1.06	0.92	0.87	0.70	0.56	0.43	0.34	0.26	0.21	0.19	0.15	0.13	0.10	0.09	0.07	0.05	0.05	0.05	0.05	0.02	0.02	0.02	0.01	0.01
2014	0.00	0.20	0.94	1.53	1.58	1.50	1.37	1.24	1.14	0.96	0.81	0.62	0.53	0.42	0.29	0.28	0.23	0.21	0.16	0.14	0.09	0.09	0.07	0.06	0.05	0.04	0.02	0.03	0.02	0.01
2015	0.01	0.31	1.40	1.86	1.79	1.70	1.65	1.42	1.36	1.13	0.99	0.80	0.69	0.52	0.39	0.37	0.31	0.27	0.21	0.16	0.13	0.10	0.09	0.08	0.06	0.05	0.03	0.03	0.02	0.01
2016	0.01	0.41	1.53	1.87	1.80	1.82	1.62	1.41	1.33	1.09	0.97	0.79	0.66	0.52	0.39	0.38	0.32	0.27	0.20	0.19	0.12	0.11	0.08	0.08	0.06	0.04	0.03	0.03	0.03	0.01
2017	0.01	0.43	1.42	1.66	1.69	1.61	1.46	1.24	1.20	1.00	0.88	0.67	0.59	0.47	0.35	0.34	0.28	0.23	0.19	0.17	0.11	0.09	0.08	0.08	0.06	0.04	0.02	0.03	0.02	0.01
2018	0.01	0.41	1.33	1.70	1.64	1.61	1.45	1.22	1.22	1.00	0.83	0.68	0.59	0.50	0.37	0.34	0.29	0.23	0.20	0.15	0.12	0.11	0.08	0.08	0.06	0.05	0.03	0.03	0.03	0.01
2019	0.01	0.39	1.42	1.68	1.64	1.59	1.44	1.27	1.23	0.99	0.85	0.70	0.59	0.52	0.36	0.35	0.29	0.25	0.19	0.16	0.12	0.11	0.08	0.08	0.06	0.05	0.03	0.03	0.03	0.01
2020	0.01	0.44	1.43	1.72	1.65	1.63	1.51	1.28	1.19	1.01	0.88	0.73	0.60	0.51	0.37	0.37	0.31	0.24	0.20	0.17	0.13	0.11	0.08	0.09	0.06	0.05	0.03	0.04	0.02	0.01

Conditional Prepayment Rates   Fixed Rate 30 Year Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1983	0.36	0.83	2.13	19.22	29.74	12.57	9.59	11.44	13.88	22.43	22.75	23.34	9.32	10.62	9.10	10.55	13.42	6.37	5.55	6.38	5.98	5.22	3.70	2.73	2.09	1.70	1.22	1.28	1.39	4.11
1984	0.28	1.50	21.42	29.36	13.75	11.15	12.16	12.80	19.25	20.66	22.28	9.24	10.33	8.90	10.38	11.22	6.26	5.59	6.12	6.10	5.17	4.12	6.43	2.21	2.35	3.70	1.67	2.65	1.77	1.57
1985	0.36	12.26	25.79	12.06	9.86	12.21	14.56	24.77	26.27	25.94	9.72	11.50	9.87	12.35	13.07	7.33	6.84	7.89	7.84	6.53	4.98	9.28	2.79	3.03	6.18	2.23	2.43	1.66	1.05	0.20
1986	0.60	4.03	2.87	3.42	4.85	5.93	15.59	28.61	27.54	8.04	12.37	10.44	17.31	19.27	10.22	12.34	17.06	19.14	15.16	11.03	13.93	6.35	4.94	6.29	3.67	3.91	3.54	2.37	0.29	0.20
1987	0.27	0.94	1.81	3.02	3.61	9.24	21.16	22.48	6.88	10.76	9.25	16.25	19.49	10.27	13.41	19.31	24.43	18.77	14.04	15.81	7.83	6.44	6.78	5.22	5.34	5.00	3.06	0.36	0.22	0.18
1988	0.31	1.32	3.19	4.92	15.82	29.76	28.25	8.30	12.70	10.53	16.61	19.26	10.79	12.73	17.26	19.47	16.48	12.34	15.52	6.94	5.20	4.90	3.63	4.86	3.34	2.56	0.55	0.36	0.24	0.18
1989	0.32	1.85	4.37	16.81	32.16	30.23	8.50	12.93	10.55	17.15	19.70	10.99	13.26	18.48	20.63	17.95	13.53	16.46	7.17	5.18	4.78	3.50	4.72	3.51	2.55	0.60	0.47	0.29	0.20	0.15
1990	0.27	1.63	10.35	33.66	32.57	8.51	13.23	10.50	17.77	20.70	10.99	13.91	20.31	23.17	19.63	14.61	19.93	8.30	6.16	5.91	4.17	4.88	4.11	2.84	0.70	0.58	0.40	0.28	0.25	0.16
1991	0.29	5.14	29.49	33.27	7.88	13.35	10.53	18.92	21.71	10.80	14.86	21.78	26.27	21.84	16.03	19.30	8.94	6.39	6.47	4.21	4.75	3.96	2.85	0.86	0.67	0.42	0.39	0.26	0.19	0.13
1992	0.37	8.11	18.40	6.10	10.82	9.39	18.75	23.09	10.71	16.52	25.18	34.01	27.02	19.83	15.82	11.30	8.23	6.78	5.55	5.07	4.91	3.78	1.01	0.69	0.63	0.44	0.30	0.34	0.24	0.16
1993	0.63	4.14	3.74	7.06	7.24	13.31	17.95	10.17	15.65	25.13	40.45	30.73	23.12	16.90	12.38	9.28	7.91	6.66	6.05	6.09	4.71	1.46	1.08	0.77	0.68	0.51	0.50	0.40	0.26	0.18
1994	0.27	1.91	6.16	6.20	12.27	15.63	9.23	14.52	22.50	38.15	29.29	22.83	16.86	12.34	9.14	7.36	6.40	6.13	6.58	5.21	1.67	1.22	0.92	0.72	0.61	0.53	0.40	0.36	0.24	0.19
1995	2.01	9.46	7.32	17.93	20.17	9.58	16.27	24.68	34.95	28.84	23.36	18.10	13.11	8.66	6.02	5.32	4.93	4.92	4.53	2.10	1.37	1.07	0.99	0.73	0.61	0.55	0.43	0.29	0.22	0.20
1996	0.38	2.75	12.65	17.35	8.59	15.83	24.78	37.26	30.03	24.68	18.65	13.45	9.15	6.69	5.36	5.09	5.34	5.12	2.44	1.63	1.17	1.01	0.85	0.66	0.57	0.49	0.39	0.35	0.27	0.17
1997	0.71	11.17	18.61	7.96	16.23	25.36	36.82	29.82	24.31	18.25	12.88	9.03	6.33	4.96	4.62	4.80	5.53	2.72	1.90	1.45	1.14	1.04	0.82	0.68	0.54	0.43	0.34	0.24	0.23	0.21
1998	0.99	6.21	5.83	13.19	22.47	39.91	31.93	26.05	19.15	13.66	9.48	7.72	5.97	5.23	5.39	6.54	3.08	2.14	1.68	1.36	1.15	0.95	0.83	0.70	0.55	0.45	0.38	0.34	0.26	0.18
1999	0.52	2.79	12.10	22.12	38.92	31.48	26.31	19.08	13.67	9.49	7.99	6.18	5.44	5.67	7.29	3.45	2.37	1.79	1.44	1.28	1.04	0.91	0.78	0.62	0.53	0.44	0.36	0.27	0.25	0.15
2000	0.88	28.79	36.15	39.25	31.02	26.06	18.98	13.52	8.70	6.52	4.68	3.94	4.30	5.27	3.46	2.53	1.83	1.48	1.26	1.01	0.89	0.85	0.68	0.60	0.45	0.36	0.34	0.25	0.19	0.14
2001	5.40	19.79	45.21	33.60	26.83	19.21	13.17	9.35	8.65	5.92	4.90	5.27	7.05	3.52	2.23	1.71	1.49	1.31	1.11	0.92	0.80	0.69	0.64	0.48	0.38	0.34	0.24	0.24	0.20	0.12
2002	3.05	36.00	32.27	26.36	17.93	12.79	9.33	9.50	6.85	5.81	6.50	8.86	3.83	2.47	1.79	1.58	1.37	1.15	1.06	0.88	0.84	0.67	0.57	0.47	0.40	0.33	0.28	0.22	0.17	0.12
2003	6.35	19.33	23.89	16.40	11.77	8.13	8.57	7.01	6.55	8.07	11.75	4.43	2.65	2.17	1.94	1.60	1.43	1.24	1.11	0.94	0.82	0.70	0.61	0.45	0.39	0.38	0.29	0.23	0.19	0.13
2004	5.86	19.70	15.13	10.78	6.99	7.56	6.20	5.92	8.09	12.51	4.46	2.86	2.30	2.13	1.80	1.58	1.41	1.28	1.07	0.89	0.77	0.67	0.55	0.45	0.41	0.33	0.29	0.24	0.19	0.12
2005	6.23	9.75	9.03	6.41	7.41	5.90	5.66	8.23	11.16	2.96	1.90	1.52	1.33	1.16	1.02	0.94	0.83	0.73	0.60	0.55	0.48	0.42	0.32	0.29	0.25	0.20	0.16	0.14	0.09	0.08
2006	1.16	7.29	8.91	12.42	7.67	6.54	9.22	11.48	2.81	1.62	1.27	1.16	1.01	0.88	0.81	0.75	0.69	0.57	0.49	0.42	0.34	0.33	0.25	0.21	0.20	0.15	0.12	0.12	0.08	0.05
2007	1.26	10.93	15.78	8.01	5.92	8.03	10.73	3.15	1.66	1.27	1.14	1.04	0.92	0.82	0.77	0.70	0.59	0.52	0.49	0.41	0.36	0.30	0.24	0.21	0.19	0.12	0.12	0.09	0.07	0.07
2008	2.03	22.34	12.66	8.14	11.59	14.63	3.92	2.09	1.64	1.54	1.37	1.25	1.14	1.01	0.90	0.78	0.71	0.60	0.52	0.43	0.38	0.33	0.26	0.20	0.19	0.16	0.12	0.11	0.09	0.06
2009	6.95	9.23	8.05	15.00	19.54	5.04	3.34	3.03	3.07	2.75	2.47	2.20	1.96	1.68	1.42	1.29	1.14	0.95	0.79	0.67	0.57	0.48	0.39	0.34	0.29	0.24	0.19	0.15	0.13	0.10
2010	1.70	4.94	10.46	15.64	5.46	4.25	3.99	4.10	3.80	3.49	3.16	2.69	2.33	1.95	1.76	1.57	1.32	1.09	0.95	0.81	0.66	0.56	0.48	0.39	0.33	0.28	0.23	0.18	0.15	0.11
2011	0.54	8.40	18.66	8.59	6.63	6.06	6.06	5.47	5.05	4.58	3.63	2.88	2.42	2.18	1.91	1.61	1.33	1.16	1.01	0.81	0.69	0.58	0.47	0.40	0.35	0.31	0.23	0.19	0.15	0.11
2012	1.02	11.19	7.54	6.91	6.76	6.84	6.32	5.85	5.65	4.83	3.49	2.98	2.68	2.34	1.97	1.69	1.50	1.29	1.07	0.89	0.78	0.65	0.57	0.44	0.40	0.31	0.27	0.21	0.17	0.14
2013	1.79	5.58	6.68	7.01	7.04	6.64	6.03	5.80	5.51	4.65	3.68	3.22	2.75	2.20	2.00	1.69	1.48	1.34	1.12	0.89	0.80	0.63	0.55	0.45	0.36	0.32	0.25	0.21	0.16	0.11
2014	1.39	7.23	8.99	9.57	8.74	7.59	6.79	6.45	5.96	5.24	4.31	3.51	2.82	2.13	1.79	1.56	1.32	1.14	0.96	0.81	0.68	0.53	0.48	0.39	0.30	0.26	0.22	0.17	0.14	0.08
2015	1.37	9.32	11.86	10.40	8.79	7.81	7.23	6.67	5.75	5.24	4.41	3.52	2.81	2.13	1.80	1.49	1.27	1.10	0.92	0.75	0.64	0.51	0.45	0.36	0.28	0.25	0.21	0.15	0.12	0.08
2016	1.36	9.44	11.61	10.30	8.85	8.07	7.28	6.16	5.70	5.08	4.32	3.53	2.87	2.12	1.76	1.46	1.20	1.04	0.91	0.75	0.64	0.53	0.46	0.36	0.28	0.24	0.20	0.15	0.11	0.07
2017	1.34	8.69	10.60	9.63	8.79	8.13	7.12	6.40	5.78	5.05	4.28	3.50	2.86	2.06	1.77	1.49	1.22	1.07	0.94	0.79	0.68	0.56	0.46	0.38	0.31	0.25	0.22	0.16	0.12	0.08
2018	1.14	8.21	10.33	10.16	9.56	8.17	7.23	6.71	5.79	5.09	4.18	3.45	2.88	2.12	1.80	1.46	1.26	1.11	0.98	0.78	0.64	0.54	0.47	0.39	0.29	0.25	0.21	0.17	0.12	0.08
2019	1.26	7.94	10.94	10.83	9.16	8.48	7.73	6.78	5.94	5.17	4.21	3.47	2.79	2.08	1.74	1.47	1.24	1.09	0.96	0.77	0.66	0.54	0.48	0.38	0.30	0.26	0.21	0.18	0.13	0.08
2020	1.17	8.79	12.06	10.68	10.13	9.20	7.66	6.84	6.14	5.25	4.21	3.31	2.66	1.97	1.72	1.41	1.20	1.13	0.92	0.76	0.67	0.54	0.45	0.38	0.29	0.24	0.22	0.18	0.12	0.08

Cumulative Claim Rates   Fixed Rate 30 Year Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1983	0.02	0.48	1.98	4.08	6.71	9.38	11.29	12.45	13.24	13.85	14.25	14.55	14.74	14.85	14.94	15.01	15.06	15.08	15.10	15.11	15.12	15.13	15.14	15.14	15.14	15.14	15.14	15.15	15.15	15.15
1984	0.03	1.03	3.84	7.62	11.29	13.79	15.23	16.13	16.79	17.24	17.58	17.81	17.96	18.08	18.16	18.22	18.26	18.29	18.30	18.32	18.32	18.33	18.33	18.34	18.34	18.34	18.34	18.34	18.35	18.35
1985	0.02	0.90	3.87	7.76	10.63	12.44	13.71	14.66	15.34	15.80	16.12	16.31	16.47	16.59	16.66	16.73	16.76	16.78	16.80	16.81	16.82	16.82	16.82	16.83	16.83	16.83	16.84	16.84	16.84	16.84
1986	0.01	0.49	2.24	4.33	6.17	7.72	9.01	10.01	10.81	11.39	11.82	12.18	12.44	12.63	12.76	12.84	12.89	12.92	12.95	12.96	12.97	12.98	12.99	12.99	13.00	13.01	13.01	13.02	13.02	13.02
1987	0.01	0.38	1.42	2.65	3.84	4.99	5.98	6.85	7.53	8.07	8.54	8.91	9.19	9.38	9.48	9.55	9.61	9.65	9.67	9.69	9.70	9.70	9.72	9.73	9.74	9.75	9.75	9.76	9.76	9.76
1988	0.01	0.38	1.43	2.84	4.40	5.76	6.92	7.81	8.46	9.01	9.43	9.75	9.96	10.08	10.16	10.22	10.27	10.30	10.32	10.33	10.34	10.35	10.36	10.37	10.38	10.39	10.40	10.40	10.40	10.40
1989	0.01	0.32	1.35	2.85	4.34	5.69	6.69	7.42	8.02	8.45	8.76	8.98	9.09	9.18	9.24	9.29	9.32	9.34	9.35	9.36	9.38	9.39	9.40	9.42	9.42	9.43	9.43	9.43	9.43	9.43
1990	0.01	0.29	1.34	2.87	4.33	5.39	6.15	6.81	7.30	7.65	7.88	8.01	8.10	8.17	8.21	8.24	8.26	8.28	8.30	8.31	8.32	8.34	8.35	8.36	8.37	8.37	8.37	8.37	8.37	8.37
1991	0.01	0.32	1.46	2.87	4.04	4.95	5.76	6.37	6.79	7.07	7.23	7.34	7.41	7.47	7.50	7.53	7.54	7.56	7.57	7.58	7.60	7.61	7.62	7.63	7.64	7.64	7.64	7.64	7.64	7.64
1992	0.01	0.23	1.01	2.04	3.02	4.07	4.97	5.65	6.10	6.38	6.56	6.68	6.75	6.80	6.83	6.85	6.87	6.89	6.91	6.93	6.95	6.97	6.98	6.99	6.99	7.00	7.00	7.00	7.00	7.00
1993	0.00	0.16	0.72	1.58	2.68	3.74	4.62	5.23	5.58	5.83	6.00	6.11	6.18	6.22	6.25	6.27	6.29	6.32	6.35	6.37	6.40	6.41	6.42	6.43	6.43	6.44	6.44	6.44	6.44	6.44
1994	0.00	0.18	0.83	1.93	3.21	4.32	5.08	5.53	5.86	6.09	6.25	6.35	6.40	6.45	6.48	6.51	6.55	6.59	6.62	6.66	6.68	6.70	6.71	6.72	6.72	6.73	6.73	6.74	6.74	6.74
1995	0.00	0.26	1.30	2.91	4.45	5.58	6.32	6.80	7.22	7.48	7.63	7.72	7.78	7.84	7.89	7.95	8.01	8.05	8.09	8.12	8.14	8.15	8.16	8.17	8.18	8.18	8.19	8.19	8.19	8.19
1996	0.00	0.28	1.45	3.09	4.49	5.45	6.12	6.68	7.06	7.27	7.39	7.48	7.55	7.62	7.70	7.76	7.83	7.90	7.95	7.98	8.00	8.02	8.03	8.04	8.05	8.05	8.06	8.06	8.06	8.06
1997	0.01	0.38	1.62	3.04	4.11	4.98	5.71	6.21	6.50	6.68	6.79	6.89	6.98	7.08	7.16	7.23	7.31	7.38	7.41	7.45	7.47	7.49	7.50	7.51	7.52	7.52	7.53	7.53	7.53	7.53
1998	0.01	0.31	1.34	2.43	3.45	4.40	5.02	5.41	5.64	5.80	5.92	6.04	6.18	6.30	6.40	6.52	6.61	6.67	6.71	6.74	6.77	6.79	6.80	6.81	6.82	6.82	6.83	6.83	6.83	6.84
1999	0.01	0.36	1.31	2.51	3.85	4.77	5.33	5.64	5.85	6.02	6.18	6.35	6.52	6.66	6.83	6.95	7.02	7.08	7.13	7.17	7.20	7.22	7.23	7.24	7.25	7.26	7.26	7.27	7.27	7.27
2000	0.01	0.50	1.95	3.79	5.06	5.75	6.14	6.40	6.60	6.77	6.95	7.10	7.22	7.37	7.48	7.56	7.62	7.67	7.71	7.74	7.76	7.77	7.78	7.79	7.80	7.80	7.80	7.81	7.81	7.81
2001	0.01	0.48	1.99	3.55	4.56	5.15	5.54	5.85	6.10	6.37	6.61	6.81	7.05	7.23	7.35	7.45	7.54	7.60	7.64	7.67	7.70	7.72	7.73	7.74	7.75	7.75	7.76	7.76	7.76	7.76
2002	0.01	0.52	1.93	3.23	4.07	4.65	5.11	5.51	5.96	6.34	6.68	7.09	7.41	7.63	7.81	7.96	8.07	8.15	8.20	8.24	8.27	8.30	8.31	8.33	8.34	8.35	8.35	8.35	8.36	8.36
2003	0.01	0.74	2.11	3.27	4.15	4.92	5.67	6.56	7.29	8.01	8.92	9.65	10.13	10.51	10.84	11.07	11.24	11.36	11.46	11.53	11.58	11.62	11.65	11.67	11.69	11.71	11.72	11.73	11.73	11.74
2004	0.12	1.03	2.21	3.36	4.55	5.71	7.05	8.19	9.32	10.82	12.07	12.94	13.62	14.20	14.63	14.93	15.15	15.31	15.44	15.53	15.61	15.67	15.71	15.74	15.76	15.78	15.80	15.81	15.82	15.82
2005	0.11	0.80	2.28	4.17	6.29	8.65	10.64	12.56	14.95	16.90	18.33	19.50	20.49	21.21	21.71	22.08	22.38	22.60	22.77	22.89	22.98	23.05	23.11	23.15	23.18	23.20	23.22	23.24	23.25	23.26
2006	0.01	0.57	2.56	5.55	9.12	11.87	14.49	17.46	19.76	21.44	22.88	24.15	25.04	25.69	26.17	26.54	26.81	27.01	27.17	27.28	27.37	27.44	27.49	27.52	27.55	27.57	27.59	27.60	27.61	27.62
2007	0.01	0.81	3.54	7.61	10.62	13.83	17.85	20.87	23.10	24.92	26.51	27.65	28.45	29.05	29.53	29.87	30.11	30.30	30.46	30.58	30.66	30.72	30.76	30.80	30.82	30.84	30.86	30.87	30.87	30.88
2008	0.01	0.66	3.19	5.79	8.72	12.44	15.18	17.18	18.82	20.21	21.20	21.91	22.43	22.83	23.14	23.37	23.54	23.67	23.77	23.84	23.90	23.95	23.98	24.00	24.02	24.04	24.05	24.05	24.06	24.06
2009	0.01	0.43	1.34	2.71	4.83	6.55	7.85	8.95	9.95	10.69	11.24	11.65	11.98	12.23	12.41	12.55	12.67	12.75	12.82	12.87	12.92	12.95	12.97	12.99	13.01	13.02	13.03	13.04	13.04	13.05
2010	0.00	0.13	0.61	1.77	3.01	4.06	5.05	6.00	6.75	7.32	7.77	8.13	8.40	8.62	8.78	8.90	9.01	9.09	9.16	9.21	9.25	9.28	9.31	9.33	9.34	9.36	9.37	9.38	9.38	9.39
2011	0.00	0.11	0.65	1.41	2.15	2.87	3.60	4.19	4.63	4.98	5.25	5.46	5.61	5.72	5.81	5.89	5.96	6.00	6.04	6.07	6.10	6.12	6.14	6.16	6.17	6.18	6.19	6.20	6.21	6.21
2012	0.00	0.14	0.67	1.34	2.10	2.88	3.54	4.07	4.48	4.83	5.08	5.25	5.38	5.48	5.56	5.63	5.69	5.73	5.77	5.80	5.83	5.84	5.86	5.87	5.89	5.91	5.92	5.93	5.93	
2013	0.00	0.17	0.76	1.65	2.59	3.46	4.16	4.73	5.23	5.61	5.89	6.10	6.26	6.38	6.47	6.55	6.61	6.66	6.71	6.74	6.77	6.79	6.80	6.82	6.84	6.85	6.86	6.87	6.87	6.88
2014	0.00	0.20	1.07	2.33	3.48	4.47	5.28	5.96	6.54	6.99	7.34	7.60	7.81	7.97	8.08	8.18	8.26	8.33	8.38	8.43	8.46	8.49	8.51	8.53	8.55	8.56	8.57	8.58	8.59	8.59
2015	0.01	0.31	1.56	3.00	4.22	5.25	6.16	6.86	7.49	7.97	8.36	8.66	8.91	9.09	9.22	9.34	9.44	9.52	9.58	9.63	9.67	9.70	9.73	9.75	9.77	9.78	9.79	9.80	9.81	9.81
2016	0.01	0.41	1.78	3.23	4.45	5.56	6.44	7.14	7.75	8.21	8.59	8.89	9.13	9.30	9.43	9.56	9.66	9.74	9.80	9.86	9.90	9.93	9.96	9.98	10.00	10.01	10.02	10.03	10.04	10.04
2017	0.01	0.44	1.71	3.02	4.21	5.22	6.04	6.68	7.24	7.68	8.04	8.30	8.52	8.69	8.81	8.92	9.01	9.09	9.15	9.20	9.23	9.26	9.29	9.31	9.33	9.34	9.35	9.36	9.37	9.37
2018	0.01	0.42	1.62	2.98	4.14	5.14	5.95	6.58	7.15	7.59	7.93	8.19	8.40	8.58	8.71	8.82	8.91	8.99	9.05	9.10	9.13	9.16	9.19	9.21	9.23	9.25	9.25	9.27	9.27	9.28
2019	0.01	0.41	1.70	3.04	4.18	5.16	5.96	6.60	7.16	7.58	7.92	8.18	8.39	8.57	8.69	8.81	8.90	8.98	9.04	9.08	9.12	9.15	9.17	9.20	9.21	9.23	9.24	9.25	9.26	9.26
2020	0.01	0.45	1.73	3.06	4.19	5.16	5.97	6.59	7.11	7.52	7.86	8.12	8.32	8.49	8.61	8.72	8.82	8.89	8.95	8.99	9.03	9.06	9.08	9.11	9.13	9.14	9.15	9.16	9.17	9.17

Cumulative Prepayment Rates   Fixed Rate 30 Year Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1983	0.36	1.20	3.29	21.54	43.69	49.94	53.85	57.84	61.98	67.56	71.81	75.07	76.05	77.03	77.78	78.56	79.43	79.79	80.09	80.44	80.80	81.02	81.17	81.28	81.37	81.50	81.54	81.59	81.64	82.09
1984	0.28	1.77	22.63	44.23	50.85	55.07	58.86	62.18	66.37	69.88	72.76	73.66	74.54	75.22	75.92	76.59	76.92	77.20	77.50	77.81	78.07	78.23	78.45	78.53	78.64	78.82	78.87	78.95	79.01	79.06
1985	0.36	12.60	34.94	42.33	47.25	52.40	57.53	64.67	70.13	73.91	74.91	75.95	76.72	77.57	78.34	78.71	79.03	79.37	79.69	79.94	80.15	80.43	80.51	80.59	80.78	80.86	80.92	80.96	80.99	80.99
1986	0.60	4.61	7.34	10.44	14.58	19.29	30.70	48.01	59.59	61.98	65.29	67.69	71.21	74.38	75.72	77.16	78.89	80.48	81.50	82.14	82.88	83.15	83.35	83.60	83.74	83.92	84.03	84.11	84.12	84.12
1987	0.27	1.21	2.99	5.89	9.19	17.24	33.73	47.30	50.47	55.01	58.44	63.84	69.19	71.42	74.03	77.25	80.52	82.39	83.53	84.64	85.14	85.48	85.82	86.07	86.34	86.61	86.73	86.74	86.75	86.76
1988	0.31	1.63	4.76	9.39	23.30	44.86	58.83	61.68	65.57	68.31	72.10	75.67	77.25	78.89	80.81	82.59	83.78	84.52	85.33	85.65	85.90	86.09	86.23	86.41	86.56	86.66	86.68	86.69	86.70	86.70
1989	0.32	2.17	6.45	21.97	46.20	61.17	63.99	67.79	70.42	74.14	77.58	79.09	80.68	82.59	84.31	85.47	86.19	86.93	87.20	87.39	87.58	87.69	87.84	87.94	88.01	88.03	88.04	88.05	88.06	88.06
1990	0.27	1.90	12.05	41.26	59.47	62.56	66.81	69.66	73.86	77.77	79.38	81.17	83.38	85.37	86.65	87.41	88.27	88.56	88.76	88.95	89.09	89.22	89.33	89.40	89.42	89.43	89.44	89.44	89.45	89.46
1991	0.29	5.44	33.31	55.03	58.36	63.39	66.74	71.96	76.68	78.47	80.64	83.30	85.78	87.27	88.12	88.97	89.29	89.49	89.69	89.81	89.96	90.06	90.13	90.15	90.16	90.17	90.18	90.19	90.19	90.20
1992	0.37	8.49	25.31	29.83	37.23	42.86	52.86	62.63	66.04	70.68	76.48	82.29	85.29	86.88	87.88	88.48	88.87	89.17	89.39	89.59	89.79	89.92	89.95	89.97	89.99	90.00	90.02	90.03	90.04	90.04
1993	0.64	4.76	8.33	14.79	20.87	31.10	42.85	48.22	55.56	65.39	77.11	82.33	85.02	86.52	87.43	88.02	88.48	88.84	89.14	89.43	89.64	89.70	89.74	89.77	89.80	89.82	89.84	89.86	89.87	89.88
1994	0.27	2.19	8.21	13.88	24.23	35.59	41.17	49.02	59.28	72.67	78.93	82.33	84.25	85.41	86.17	86.72	87.16	87.56	87.96	88.25	88.33	88.40	88.44	88.48	88.51	88.54	88.56	88.58	88.59	88.60
1995	2.01	11.30	17.80	32.35	45.44	50.26	57.48	66.45	75.85	80.76	83.52	85.13	86.07	86.61	86.95	87.23	87.47	87.70	87.90	87.98	88.04	88.08	88.12	88.15	88.17	88.19	88.21	88.22	88.23	88.24
1996	0.38	3.13	15.39	29.84	35.63	45.15	57.44	71.09	77.80	81.56	83.65	84.87	85.57	86.04	86.39	86.69	86.99	87.27	87.39	87.46	87.52	87.57	87.60	87.63	87.66	87.68	87.70	87.72	87.73	87.74
1997	0.71	11.85	28.22	33.83	44.13	57.30	71.25	78.15	81.97	84.08	85.28	86.00	86.46	86.79	87.08	87.36	87.66	87.80	87.89	87.96	88.02	88.07	88.10	88.13	88.16	88.18	88.19	88.21	88.22	88.23
1998	0.99	7.17	12.59	24.00	40.60	63.04	73.48	79.11	82.09	83.77	84.77	85.50	86.01	86.42	86.82	87.27	87.47	87.60	87.70	87.77	87.84	87.89	87.94	87.97	88.00	88.03	88.05	88.07	88.08	88.10
1999	0.52	3.31	15.01	33.57	58.56	70.44	76.99	80.38	82.30	83.43	84.29	84.88	85.37	85.83	86.39	86.63	86.78	86.90	86.99	87.06	87.12	87.18	87.22	87.26	87.29	87.31	87.33	87.35	87.37	87.38
2000	0.88	29.50	54.86	71.86	79.44	83.49	85.54	86.67	87.28	87.68	87.94	88.15	88.35	88.59	88.73	88.83	88.90	88.95	88.99	89.03	89.06	89.09	89.11	89.13	89.14	89.15	89.16	89.17	89.18	89.19
2001	5.42	24.22	58.39	71.74	78.40	81.69	83.43	84.47	85.31	85.82	86.21	86.59	87.07	87.27	87.40	87.49	87.57	87.63	87.69	87.73	87.77	87.80	87.83	87.85	87.87	87.89	87.90	87.91	87.92	87.93
2002	3.06	38.12	57.99	68.59	73.67	76.53	78.30	79.89	80.89	81.67	82.45	83.43	83.79	84.01	84.17	84.30	84.41	84.49	84.57	84.64	84.70	84.75	84.79	84.82	84.85	84.87	84.90	84.91	84.92	84.94
2003	6.39	24.58	42.50	51.63	56.96	60.14	63.16	65.36	67.22	69.30	71.99	72.84	73.31	73.68	73.99	74.24	74.45	74.63	74.80	74.93	75.04	75.14	75.22	75.28	75.34	75.39	75.43	75.46	75.49	75.51
2004	5.91	24.52	35.84	42.55	46.36	50.09	52.85	55.24	58.23	62.32	63.53	64.24	64.77	65.24	65.62	65.94	66.22	66.46	66.66	66.83	66.97	67.09	67.19	67.27	67.34	67.40	67.45	67.49	67.53	67.56
2005	6.34	15.51	23.11	27.92	32.99	36.59	39.71	43.84	48.73	49.82	50.46	50.94	51.34	51.67	51.96	52.21	52.43	52.62	52.78	52.91	53.03	53.13	53.21	53.29	53.35	53.40	53.44	53.48	53.50	53.53
2006	1.17	8.40	16.54	26.63	31.85	35.72	40.60	45.79	46.82	47.37	47.77	48.11	48.40	48.64	48.85	49.04	49.21	49.35	49.47	49.57	49.65	49.73	49.79	49.84	49.89	49.93	49.95	49.98	50.01	50.02
2007	1.27	12.09	25.89	31.57	35.19	39.58	44.61	45.80	46.35	46.74	47.07	47.35	47.58	47.78	47.96	48.12	48.26	48.37	48.48	48.57	48.65	48.71	48.76	48.81	48.85	48.87	48.90	48.92	48.94	48.95
2008	2.04	24.01	33.57	38.73	45.21	51.99	53.39	54.05	54.52	54.94	55.28	55.58	55.84	56.06	56.25	56.42	56.57	56.69	56.79	56.88	56.95	57.02	57.07	57.11	57.15	57.18	57.20	57.22	57.24	57.26
2009	6.98	15.62	22.40	33.93	46.38	48.85	50.36	51.64	52.86	53.89	54.78	55.54	56.19	56.74	57.18	57.58	57.93	58.22	58.45	58.65	58.82	58.96	59.08	59.18	59.26	59.33	59.39	59.43	59.48	59.51
2010	1.71	6.59	16.41	29.46	33.24	35.97	38.38	40.72	42.77	44.55	46.08	47.34	48.39	49.25	50.00	50.66	51.21	51.65	52.03	52.35	52.61	52.84	53.02	53.18	53.31	53.42	53.51	53.59	53.65	53.71
2011	0.54	9.35	26.34	32.64	37.04	40.76	44.20	47.08	49.57	51.69	53.28	54.49	55.47	56.33	57.07	57.68	58.17	58.60	58.97	59.26	59.51	59.71	59.88	60.02	60.14	60.26	60.34	60.41	60.47	60.53
2012	1.03	12.20	18.86	24.46	29.52	34.24	38.25	41.70	44.79	47.27	48.96	50.35	51.56	52.59	53.43	54.14	54.76	55.28	55.71	56.06	56.37	56.63	56.85	57.02	57.16	57.27	57.41	57.49	57.56	57.63
2013	1.80	7.31	13.52	19.56	25.14	29.97	34.01	37.63	40.83	43.36	45.25	46.84	48.15	49.17	50.08	50.82	51.47	52.05	52.52	52.90	53.24	53.50	53.73	53.92	54.07	54.20	54.31	54.40	54.48	54.54
2014	1.39	8.56	16.80	24.69	31.11	36.10	40.16	43.71	46.74	49.20	51.10	52.57	53.70	54.53	55.21	55.79	56.28	56.69	57.04	57.33	57.57	57.76	57.92	58.06	58.17	58.26	58.34	58.41	58.46	58.50
2015	1.37	10.61	21.21	29.27	35.25	40.01	44.00	47.36	50.01	52.26	54.03	55.36	56.38	57.12	57.73	58.23	58.65	59.00	59.29	59.53	59.73	59.89	60.04	60.15	60.24	60.31	60.38	60.43	60.47	60.51
2016	1.37	10.73	21.09	29.07	35.10	40.00	43.99	47.07	49.71	51.89	53.62	54.96	56.01	56.75	57.35	57.84	58.23	58.57	58.86	59.10	59.31	59.47	59.62	59.73	59.82	59.90	59.96	60.01	60.05	59.41
2017	1.34	9.97	19.51	27.12	33.29	38.40	42.44	45.77	48.54	50.78	52.57	53.95	55.04	55.79	56.43	56.95	57.37	57.74	58.05	58.32	58.54	58.73	58.88	59.00	59.11	59.19	59.27	59.33	59.37	59.41
2018	1.14	9.31	18.67	26.80	33.54	38.66	42.74	46.21	48.95	51.19	52.92	54.27	55.35	56.12	56.76	57.27	57.70	58.08	58.40	58.66	58.87	59.05	59.21	59.34	59.44	59.52	59.59	59.65	59.70	59.73
2019	1.27	9.15	19.09	27.71	34.07	39.33	43.64	47.08	49.84	52.07	53.77	55.10	56.12	56.86	57.47	57.97	58.39	58.76	59.07	59.32	59.54	59.71	59.87	59.99	60.09	60.17	60.24	60.30	60.35	60.38
2020	1.18	9.92	20.78	29.09	36.00	41.53	45.63	48.97	51.72	53.89	55.52	56.73	57.66	58.34	58.91	59.38	59.77	60.13	60.42	60.66	60.87	61.03	61.17	61.29	61.38	61.45	61.52	61.58	61.62	61.65

Conditional Claim Rates   Fixed Rate 30 Year Streamline Refinance Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1992	0.00	0.24	0.73	1.03	1.07	1.07	0.91	1.01	0.77	0.46	0.31	0.27	0.39	0.18	0.48	0.16	0.03	0.40	0.03	0.34	0.38	0.48	0.35	0.00	0.25	0.28	0.12	0.20	0.05	0.05
1993	0.01	0.20	0.71	1.08	1.55	1.42	1.16	0.88	0.47	0.35	0.29	0.29	0.21	0.11	0.12	0.15	0.17	0.26	0.29	0.22	0.58	0.46	0.39	0.39	0.29	0.24	0.17	0.17	0.14	0.10
1994	0.01	0.32	0.79	1.15	1.27	1.06	0.80	0.51	0.37	0.31	0.29	0.27	0.18	0.16	0.14	0.16	0.40	0.25	0.31	0.49	0.54	0.33	0.34	0.32	0.26	0.21	0.16	0.15	0.06	0.09
1995	0.02	0.42	1.40	2.00	1.83	1.80	1.20	0.83	0.86	0.93	0.66	0.76	0.71	0.08	0.28	0.81	1.11	0.79	1.51	0.82	0.41	0.88	0.18	1.03	0.00	0.00	0.00	0.10	0.00	0.00
1996	0.02	0.50	1.47	1.84	1.63	0.91	0.68	0.71	0.73	0.58	0.73	0.41	0.44	0.40	0.89	0.44	0.62	1.52	1.24	0.92	0.79	0.70	0.34	0.16	0.36	0.29	0.15	0.16	0.14	0.02
1997	0.02	0.63	1.74	2.15	1.46	1.06	1.06	0.99	0.86	0.74	0.66	0.81	0.83	0.88	1.14	0.73	1.32	0.97	1.13	0.51	0.61	0.14	0.23	0.63	0.25	0.00	0.30	0.23	0.11	0.00
1998	0.00	0.22	0.79	0.80	0.71	0.79	1.12	0.92	0.72	0.61	0.59	0.78	1.06	0.99	0.72	1.62	1.67	1.40	0.75	0.81	0.49	0.42	0.33	0.24	0.22	0.22	0.27	0.12	0.10	0.10
1999	0.01	0.25	0.50	0.64	0.80	0.94	0.94	0.75	0.55	0.68	0.73	0.84	0.88	1.03	1.90	1.81	1.13	1.17	0.80	0.62	0.49	0.31	0.35	0.18	0.23	0.22	0.19	0.14	0.08	0.09
2000	0.02	0.36	1.18	1.94	3.19	2.79	1.72	1.63	1.94	1.10	1.38	2.28	1.70	2.92	2.87	2.18	1.14	1.32	1.01	0.82	0.52	0.32	0.13	0.23	0.11	0.00	0.00	0.00	0.00	0.00
2001	0.00	0.20	1.27	2.70	2.91	2.85	2.32	2.44	2.48	3.40	3.30	2.69	5.04	5.33	3.38	2.86	2.34	1.55	1.01	0.79	0.72	0.59	0.51	0.35	0.41	0.25	0.22	0.10	0.11	0.06
2002	0.01	0.41	1.80	2.23	2.02	1.75	1.77	1.90	2.40	2.45	2.27	4.51	4.65	3.03	2.59	1.92	1.63	1.15	0.95	0.84	0.66	0.59	0.49	0.43	0.27	0.25	0.20	0.19	0.12	0.07
2003	0.01	0.56	1.26	1.26	1.21	1.33	1.52	2.11	1.98	2.29	4.01	4.02	2.72	2.04	1.70	1.28	0.93	0.78	0.70	0.65	0.51	0.38	0.42	0.29	0.25	0.22	0.20	0.17	0.12	0.09
2004	0.14	0.84	1.13	1.17	1.38	1.58	2.19	2.14	2.35	4.30	4.18	2.83	2.01	1.66	1.24	0.99	0.79	0.67	0.59	0.51	0.42	0.41	0.33	0.27	0.23	0.22	0.17	0.13	0.10	0.10
2005	0.11	0.66	1.57	2.03	2.48	3.22	3.13	3.41	4.58	4.57	3.58	2.79	2.35	1.59	1.13	0.90	0.80	0.75	0.56	0.42	0.35	0.33	0.29	0.24	0.18	0.14	0.16	0.12	0.08	0.07
2006	0.06	1.04	2.30	3.31	4.54	4.07	4.72	5.85	5.67	4.84	4.15	3.40	2.39	1.81	1.32	1.22	0.79	0.70	0.61	0.57	0.34	0.25	0.18	0.16	0.20	0.19	0.08	0.08	0.07	0.05
2007	0.05	1.11	4.16	6.48	5.87	7.05	9.71	10.73	9.61	8.14	6.78	4.81	3.44	2.77	1.89	1.61	1.27	0.96	0.98	0.79	0.53	0.49	0.37	0.25	0.29	0.30	0.14	0.07	0.11	0.03
2008	0.02	1.33	5.36	5.30	6.60	10.37	11.76	10.87	9.65	7.91	5.75	3.98	2.96	2.31	1.80	1.56	1.37	1.11	0.88	0.64	0.51	0.38	0.30	0.29	0.17	0.16	0.13	0.10	0.12	0.05
2009	0.02	0.84	2.43	3.65	7.06	7.99	7.12	5.59	4.26	2.99	2.19	1.77	1.51	1.19	1.00	0.88	0.71	0.63	0.50	0.41	0.35	0.32	0.23	0.21	0.19	0.15	0.12	0.11	0.07	0.08
2010	0.04	0.79	1.97	4.22	4.74	4.19	3.37	2.70	2.01	1.62	1.40	1.27	0.97	0.84	0.68	0.64	0.52	0.43	0.36	0.32	0.26	0.25	0.21	0.19	0.17	0.13	0.09	0.09	0.07	0.05
2011	0.05	0.69	1.91	2.41	2.26	1.87	1.66	1.27	1.09	0.97	0.85	0.78	0.67	0.53	0.49	0.42	0.34	0.31	0.25	0.19	0.20	0.18	0.17	0.16	0.13	0.11	0.10	0.08	0.05	0.03
2012	0.02	0.32	1.01	1.36	1.28	1.14	0.99	0.85	0.76	0.69	0.61	0.54	0.46	0.40	0.31	0.31	0.26	0.21	0.21	0.18	0.17	0.13	0.11	0.11	0.11	0.10	0.07	0.08	0.05	0.04
2013	0.02	0.32	0.96	1.16	1.12	0.97	0.87	0.77	0.74	0.61	0.56	0.45	0.42	0.35	0.32	0.26	0.24	0.19	0.17	0.17	0.14	0.13	0.12	0.12	0.10	0.08	0.08	0.07	0.05	0.04
2014	0.02	0.37	1.13	1.42	1.31	1.23	1.10	1.06	0.92	0.79	0.68	0.59	0.53	0.46	0.39	0.35	0.34	0.27	0.24	0.23	0.23	0.18	0.15	0.12	0.13	0.11	0.09	0.09	0.06	0.05
2015	0.02	0.44	1.29	1.50	1.40	1.31	1.26	1.15	1.08	0.89	0.80	0.70	0.65	0.50	0.46	0.42	0.37	0.33	0.28	0.27	0.25	0.21	0.16	0.16	0.14	0.13	0.10	0.09	0.07	0.05
2016	0.02	0.49	1.32	1.55	1.41	1.37	1.23	1.10	0.97	0.81	0.71	0.64	0.53	0.45	0.42	0.40	0.39	0.35	0.28	0.30	0.24	0.19	0.18	0.13	0.16	0.14	0.08	0.09	0.06	0.05
2017	0.02	0.50	1.19	1.26	1.15	1.02	0.88	0.76	0.72	0.59	0.50	0.46	0.38	0.36	0.31	0.32	0.26	0.25	0.23	0.20	0.19	0.17	0.12	0.13	0.12	0.11	0.09	0.10	0.07	0.04
2018	0.02	0.51	1.19	1.27	1.10	0.99	0.89	0.77	0.72	0.59	0.53	0.47	0.48	0.42	0.36	0.33	0.30	0.28	0.24	0.20	0.19	0.19	0.13	0.13	0.13	0.12	0.10	0.10	0.06	0.05
2019	0.03	0.54	1.35	1.40	1.30	1.12	0.97	0.97	0.86	0.72	0.62	0.55	0.51	0.48	0.40	0.37	0.33	0.27	0.22	0.21	0.19	0.17	0.15	0.13	0.13	0.11	0.08	0.08	0.07	0.05
2020	0.03	0.63	1.45	1.56	1.36	1.23	1.09	1.04	0.86	0.79	0.68	0.65	0.59	0.50	0.42	0.42	0.38	0.28	0.22	0.28	0.24	0.21	0.14	0.14	0.15	0.12	0.11	0.09	0.06	0.04

Conditional Prepayment Rates   **Fixed Rate 30 Year Streamline Refinance Mortgages**   **by Credit Subsidy Endorsement Cohort**

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1992	2.75	27.01	31.55	7.88	13.31	10.76	21.08	26.33	12.08	16.69	28.60	38.13	24.79	17.62	15.54	8.83	7.49	5.65	7.08	6.46	5.64	4.60	1.99	1.81	0.96	0.87	0.88	0.32	0.27	0.19
1993	2.99	11.95	5.50	8.73	8.02	15.33	20.61	10.73	16.67	27.98	44.97	31.03	21.62	17.79	10.50	8.56	8.07	8.28	6.94	6.47	5.63	1.88	1.12	0.82	0.81	0.61	0.56	0.58	0.38	0.24
1994	1.89	4.12	6.98	7.08	11.46	15.75	9.55	14.17	22.51	41.16	29.99	21.62	16.06	11.06	8.92	8.28	7.82	7.37	7.68	5.90	2.06	1.53	1.12	0.85	0.84	0.74	0.57	0.52	0.34	0.23
1995	2.07	15.49	9.33	22.02	24.34	10.84	18.97	28.55	39.41	30.91	24.90	17.10	12.92	10.10	6.88	4.81	7.51	4.56	5.50	4.02	1.91	1.30	0.85	1.52	0.80	1.38	0.33	0.76	0.10	0.23
1996	2.13	6.08	17.81	22.63	10.22	18.19	29.93	45.95	35.96	27.39	19.61	13.23	9.58	7.88	7.96	5.94	5.61	7.01	2.82	2.05	1.63	1.33	0.97	1.00	0.74	0.60	0.47	0.31	0.41	0.43
1997	3.27	29.93	27.78	9.84	20.18	32.40	44.71	37.85	31.75	23.94	14.14	11.05	6.13	5.19	5.22	5.96	7.09	3.81	3.00	1.45	1.28	1.60	0.46	0.42	0.82	0.88	0.27	0.00	0.24	0.14
1998	4.44	18.01	8.12	17.94	32.35	53.38	42.38	33.17	22.51	15.95	10.77	9.05	6.75	6.30	6.60	8.49	4.51	2.92	2.01	1.79	1.82	1.51	1.31	1.22	0.89	0.50	0.61	0.50	0.37	0.26
1999	2.70	6.05	13.92	25.94	48.93	39.14	31.44	21.84	14.94	10.86	9.03	6.67	6.56	7.20	9.14	4.71	3.04	2.17	1.58	1.67	1.30	1.31	1.01	0.86	0.93	0.57	0.53	0.53	0.47	0.30
2000	3.60	33.27	36.35	44.70	40.69	32.62	24.72	15.56	9.51	7.40	5.76	4.43	3.12	11.01	5.90	3.77	3.18	2.02	2.35	1.74	2.00	1.35	1.00	1.26	0.80	0.73	0.42	0.46	0.79	0.00
2001	7.40	33.68	54.63	40.72	33.19	23.66	15.69	10.61	8.97	5.84	5.14	4.79	9.33	4.69	3.16	2.32	2.08	2.15	1.79	1.55	1.50	1.27	1.18	0.63	0.64	0.69	0.69	0.62	0.46	0.24
2002	10.78	51.13	37.18	30.24	21.00	14.95	9.92	9.85	6.99	6.08	6.46	10.63	5.62	3.72	2.55	2.32	2.20	1.99	1.67	1.52	1.51	1.19	1.00	1.00	0.72	0.70	0.53	0.40	0.35	0.26
2003	19.33	27.32	27.28	18.82	13.10	8.94	10.51	7.93	7.44	8.92	13.78	5.85	3.79	2.90	2.63	2.50	2.20	2.03	1.78	1.55	1.37	1.17	1.04	0.89	0.82	0.74	0.59	0.52	0.44	0.32
2004	11.42	21.98	16.14	11.81	7.59	7.42	6.15	5.98	8.40	14.22	6.31	4.08	3.21	3.04	2.76	2.40	2.24	2.14	1.74	1.50	1.31	1.20	1.06	0.91	0.83	0.67	0.56	0.46	0.39	0.27
2005	9.36	13.10	10.85	6.73	7.11	5.47	4.77	7.43	13.83	6.06	3.66	2.73	2.70	2.47	2.16	1.98	1.85	1.58	1.35	1.23	1.15	0.93	0.82	0.71	0.59	0.54	0.44	0.40	0.24	0.30
2006	3.95	10.96	7.93	10.17	6.27	4.66	7.36	14.56	6.63	3.45	2.94	2.88	2.74	2.38	2.21	1.95	1.52	1.43	1.26	1.18	1.27	0.90	0.78	0.68	0.65	0.45	0.36	0.31	0.23	0.26
2007	4.01	19.60	17.25	7.52	4.83	6.95	13.15	5.80	2.90	2.27	2.67	2.47	1.94	1.83	1.74	1.61	1.51	1.30	1.49	1.05	0.98	0.80	0.79	0.88	0.75	0.48	0.39	0.23	0.25	0.14
2008	4.24	26.29	8.72	5.30	8.33	14.53	4.53	2.32	2.02	2.25	2.13	2.09	1.95	1.79	1.92	1.48	1.28	1.19	1.15	1.18	1.04	0.76	0.76	0.68	0.48	0.48	0.35	0.35	0.27	0.22
2009	3.08	8.25	6.91	15.41	17.14	4.28	2.33	2.14	2.46	2.48	2.26	2.15	2.25	2.10	1.71	1.59	1.46	1.31	1.10	0.98	0.88	0.73	0.66	0.59	0.55	0.45	0.42	0.36	0.29	0.24
2010	2.82	5.70	11.07	14.42	4.19	2.79	2.54	2.97	2.92	2.81	2.72	2.74	2.59	2.14	2.01	1.72	1.58	1.38	1.20	1.08	0.97	0.85	0.65	0.64	0.55	0.49	0.44	0.36	0.33	0.21
2011	0.48	6.79	13.41	4.18	2.98	2.78	3.26	3.24	3.06	3.07	3.00	2.76	2.31	2.13	1.99	1.82	1.54	1.38	1.19	1.05	0.93	0.85	0.74	0.68	0.57	0.50	0.42	0.36	0.29	0.21
2012	0.85	9.08	3.48	2.57	2.53	3.25	3.36	3.20	3.17	3.26	3.00	2.46	2.34	2.17	1.91	1.68	1.49	1.33	1.19	1.05	0.88	0.85	0.72	0.62	0.60	0.53	0.45	0.40	0.34	0.28
2013	1.98	3.79	3.66	3.32	4.29	4.48	4.19	4.09	4.06	3.69	3.05	2.82	2.50	2.33	1.98	1.76	1.55	1.39	1.23	1.04	0.95	0.83	0.74	0.67	0.57	0.49	0.41	0.36	0.32	0.22
2014	2.24	6.37	6.96	8.28	8.16	8.07	7.21	6.75	6.07	4.86	4.34	3.86	3.45	2.84	2.44	2.14	1.86	1.59	1.37	1.22	1.03	0.90	0.81	0.70	0.62	0.50	0.45	0.36	0.29	0.24
2015	3.08	9.81	11.76	11.27	10.48	9.65	9.18	8.34	6.65	5.68	5.10	4.49	3.74	3.12	2.73	2.39	1.96	1.80	1.52	1.27	1.08	1.01	0.86	0.73	0.64	0.51	0.48	0.34	0.30	0.23
2016	2.79	10.61	12.55	11.75	11.42	10.95	9.79	7.10	6.51	5.41	4.70	3.97	3.43	3.18	2.79	2.57	2.11	1.85	1.54	1.26	1.16	0.94	0.79	0.72	0.63	0.52	0.43	0.36	0.30	0.23
2017	2.50	9.25	11.50	9.76	9.33	8.41	6.51	6.21	5.35	4.75	3.92	3.54	3.07	2.74	2.34	1.98	1.48	1.36	1.28	1.14	0.99	0.91	0.75	0.70	0.59	0.47	0.45	0.37	0.29	0.25
2018	2.84	8.94	9.74	9.27	8.99	8.25	6.85	6.40	5.44	5.09	4.32	3.80	3.32	2.68	2.32	1.75	1.53	1.51	1.26	1.14	0.97	0.80	0.71	0.66	0.61	0.49	0.44	0.40	0.30	0.23
2019	2.22	8.13	10.21	9.59	8.64	7.89	8.17	6.81	6.16	5.35	4.45	3.78	3.07	2.64	2.09	1.76	1.55	1.39	1.28	1.06	0.93	0.82	0.71	0.58	0.60	0.52	0.41	0.37	0.29	0.23
2020	2.14	9.30	12.33	9.16	9.70	9.78	8.38	6.89	6.36	5.36	4.41	3.67	3.15	2.70	2.26	2.03	1.65	1.52	1.32	1.15	0.99	0.85	0.72	0.66	0.56	0.50	0.40	0.35	0.29	0.23

Cumulative Claim Rates   Fixed Rate 30 Year Streamline Refinance Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1992	0.00	0.23	0.75	1.24	1.71	2.10	2.40	2.66	2.81	2.88	2.92	2.95	2.97	2.98	3.00	3.00	3.00	3.01	3.01	3.02	3.03	3.03	3.04	3.04	3.05	3.05	3.05	3.05	3.06	3.06
1993	0.01	0.20	0.80	1.67	2.78	3.71	4.33	4.70	4.88	4.99	5.05	5.09	5.10	5.11	5.12	5.12	5.13	5.14	5.15	5.16	5.18	5.19	5.20	5.21	5.22	5.22	5.23	5.23	5.23	5.24
1994	0.01	0.32	1.07	2.06	3.07	3.81	4.26	4.53	4.69	4.79	4.85	4.89	4.91	4.92	4.93	4.94	4.97	4.98	5.00	5.02	5.05	5.06	5.08	5.09	5.10	5.11	5.11	5.12	5.12	5.13
1995	0.02	0.43	1.59	3.06	4.09	4.83	5.26	5.49	5.67	5.78	5.83	5.88	5.91	5.91	5.93	5.95	5.99	6.01	6.05	6.07	6.08	6.10	6.10	6.12	6.12	6.12	6.13	6.13	6.13	6.13
1996	0.02	0.51	1.86	3.22	4.12	4.57	4.84	5.04	5.14	5.19	5.24	5.27	5.29	5.30	5.33	5.35	5.37	5.41	5.45	5.47	5.49	5.50	5.51	5.51	5.52	5.53	5.53	5.54	5.54	5.54
1997	0.02	0.64	1.81	2.82	3.43	3.78	4.01	4.12	4.18	4.22	4.24	4.26	4.29	4.31	4.33	4.35	4.38	4.39	4.41	4.42	4.43	4.43	4.43	4.44	4.44	4.44	4.45	4.45	4.45	4.45
1998	0.00	0.21	0.83	1.40	1.81	2.11	2.31	2.40	2.45	2.48	2.50	2.53	2.57	2.60	2.62	2.66	2.70	2.73	2.74	2.76	2.77	2.78	2.78	2.79	2.79	2.79	2.80	2.80	2.80	2.80
1999	0.01	0.26	0.71	1.21	1.67	1.94	2.10	2.19	2.24	2.29	2.34	2.39	2.43	2.49	2.57	2.65	2.69	2.73	2.76	2.78	2.80	2.81	2.82	2.83	2.83	2.84	2.84	2.85	2.85	2.85
2000	0.02	0.37	1.13	1.91	2.58	2.91	3.04	3.14	3.23	3.27	3.32	3.40	3.46	3.55	3.63	3.68	3.70	3.73	3.75	3.76	3.77	3.78	3.78	3.78	3.78	3.78	3.78	3.78	3.78	3.78
2001	0.00	0.19	0.97	1.69	2.14	2.41	2.58	2.72	2.84	3.00	3.13	3.23	3.40	3.65	3.72	3.77	3.81	3.83	3.84	3.86	3.87	3.88	3.89	3.89	3.90	3.90	3.90	3.91	3.91	3.91
2002	0.01	0.38	1.16	1.74	2.10	2.34	2.54	2.73	2.94	3.14	3.30	3.60	3.86	4.01	4.13	4.22	4.29	4.33	4.37	4.40	4.43	4.45	4.46	4.48	4.49	4.50	4.50	4.51	4.51	4.52
2003	0.01	0.47	1.20	1.72	2.12	2.50	2.89	3.36	3.76	4.17	4.82	5.34	5.67	5.89	6.07	6.20	6.29	6.36	6.42	6.48	6.52	6.55	6.58	6.61	6.63	6.65	6.66	6.67	6.68	6.69
2004	0.14	0.89	1.66	2.32	2.99	3.70	4.58	5.38	6.18	7.48	8.51	9.13	9.54	9.86	10.08	10.26	10.39	10.50	10.59	10.67	10.73	10.79	10.84	10.87	10.91	10.94	10.96	10.98	10.99	11.01
2005	0.11	0.71	1.94	3.33	4.87	6.68	8.29	9.90	11.82	13.38	14.47	15.25	15.87	16.27	16.54	16.75	16.92	17.08	17.20	17.28	17.35	17.41	17.47	17.51	17.54	17.57	17.60	17.62	17.63	17.65
2006	0.06	1.07	3.01	5.53	8.51	10.90	13.41	16.15	18.25	19.82	21.04	21.97	22.59	23.02	23.33	23.60	23.76	23.91	24.03	24.14	24.21	24.25	24.28	24.32	24.35	24.38	24.40	24.41	24.42	24.44
2007	0.05	1.12	4.30	8.19	11.21	14.45	18.29	21.55	23.98	25.78	27.12	27.98	28.55	28.98	29.26	29.49	29.67	29.80	29.92	30.03	30.09	30.15	30.20	30.23	30.26	30.30	30.31	30.32	30.34	30.34
2008	0.02	1.30	5.04	8.20	11.72	16.42	20.41	23.50	25.87	27.59	28.71	29.43	29.92	30.29	30.57	30.80	30.99	31.14	31.26	31.35	31.41	31.46	31.50	31.54	31.56	31.58	31.59	31.61	31.62	31.63
2009	0.02	0.84	3.00	5.93	10.51	14.43	17.49	19.66	21.19	22.19	22.88	23.42	23.85	24.19	24.46	24.69	24.87	25.03	25.15	25.25	25.33	25.41	25.46	25.51	25.56	25.59	25.62	25.65	25.66	25.69
2010	0.04	0.81	2.61	5.97	9.03	11.49	13.33	14.72	15.69	16.44	17.05	17.59	17.98	18.31	18.57	18.80	18.99	19.14	19.27	19.38	19.47	19.55	19.62	19.68	19.74	19.78	19.82	19.85	19.87	19.89
2011	0.05	0.74	2.51	4.40	6.05	7.35	8.45	9.25	9.90	10.46	10.93	11.34	11.69	11.95	12.19	12.39	12.54	12.68	12.80	12.88	12.97	13.05	13.12	13.18	13.24	13.28	13.33	13.36	13.38	13.40
2012	0.02	0.34	1.26	2.43	3.49	4.40	5.15	5.77	6.30	6.76	7.15	7.49	7.76	8.00	8.18	8.35	8.49	8.60	8.71	8.81	8.90	8.97	9.02	9.08	9.14	9.19	9.22	9.26	9.29	9.32
2013	0.02	0.34	1.25	2.29	3.25	4.04	4.70	5.26	5.77	6.17	6.52	6.79	7.04	7.24	7.41	7.55	7.68	7.78	7.87	7.95	8.02	8.08	8.14	8.20	8.25	8.28	8.32	8.36	8.38	8.41
2014	0.02	0.38	1.42	2.60	3.60	4.44	5.13	5.73	6.21	6.59	6.90	7.16	7.38	7.56	7.71	7.83	7.95	8.05	8.13	8.21	8.29	8.35	8.40	8.44	8.48	8.51	8.54	8.57	8.59	8.61
2015	0.02	0.45	1.58	2.71	3.64	4.40	5.05	5.58	6.03	6.38	6.66	6.90	7.10	7.25	7.39	7.51	7.61	7.70	7.77	7.84	7.91	7.96	8.00	8.04	8.07	8.10	8.13	8.15	8.16	8.18
2016	0.02	0.50	1.64	2.80	3.71	4.48	5.08	5.56	5.94	6.24	6.49	6.69	6.86	6.99	7.11	7.22	7.32	7.41	7.48	7.55	7.61	7.66	7.70	7.73	7.77	7.80	7.82	7.84	7.86	7.87
2017	0.02	0.51	1.56	2.53	3.31	3.94	4.42	4.81	5.15	5.42	5.63	5.81	5.96	6.09	6.20	6.31	6.40	6.48	6.55	6.61	6.67	6.72	6.76	6.80	6.84	6.87	6.90	6.93	6.95	6.96
2018	0.02	0.52	1.57	2.57	3.34	3.96	4.47	4.87	5.22	5.49	5.72	5.91	6.09	6.25	6.38	6.49	6.59	6.68	6.76	6.82	6.88	6.93	6.97	7.01	7.05	7.09	7.12	7.15	7.17	7.19
2019	0.03	0.56	1.77	2.88	3.79	4.49	5.05	5.55	5.96	6.28	6.54	6.76	6.95	7.12	7.26	7.38	7.49	7.58	7.65	7.72	7.78	7.83	7.87	7.91	7.95	7.98	8.01	8.03	8.06	8.07
2020	0.03	0.64	1.92	3.11	4.03	4.78	5.36	5.86	6.24	6.56	6.82	7.06	7.26	7.43	7.56	7.69	7.81	7.89	7.96	8.04	8.10	8.16	8.20	8.24	8.28	8.31	8.34	8.37	8.39	8.40

Cumulative Prepayment Rates   Fixed Rate 30 Year Streamline Refinance Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1992	2.756	29.13	51.45	55.23	61.05	65.07	72.03	78.78	81.03	83.75	87.59	91.23	92.68	93.45	94.01	94.28	94.49	94.63	94.81	94.97	95.18	95.27	95.30	95.33	95.35	95.37	95.38	95.39	95.39	95.39
1993	3.00	14.63	19.34	26.35	32.15	42.18	53.38	57.94	64.21	72.90	82.89	86.63	88.42	89.57	90.13	90.54	90.90	91.24	91.50	91.76	91.96	92.01	92.04	92.07	92.09	92.10	92.12	92.13	92.14	92.15
1994	1.90	5.96	12.54	18.69	27.82	38.76	44.27	51.61	61.54	75.51	81.43	84.40	86.12	87.11	87.83	88.44	88.97	89.45	89.90	90.22	90.32	90.39	90.44	90.47	90.51	90.54	90.56	90.58	90.60	90.61
1995	2.08	17.28	24.98	41.21	54.81	59.28	66.13	74.33	82.31	86.03	88.08	89.12	89.76	90.20	90.47	90.64	90.92	91.07	91.25	91.35	91.40	91.43	91.45	91.48	91.50	91.53	91.53	91.55	91.55	91.55
1996	2.14	8.11	24.45	41.17	46.88	55.84	67.74	80.41	85.66	88.19	89.50	90.20	90.64	90.96	91.27	91.47	91.66	91.87	91.95	92.01	92.05	92.08	92.11	92.13	92.15	92.16	92.17	92.18	92.19	92.20
1997	3.28	32.31	50.98	55.64	64.06	74.62	84.32	88.75	91.01	92.16	92.68	93.02	93.19	93.32	93.44	93.58	93.73	93.80	93.86	93.88	93.91	93.93	93.94	93.94	93.95	93.97	93.97	93.97	93.97	93.98
1998	4.46	21.71	28.08	40.90	59.64	80.32	87.79	91.09	92.56	93.36	93.81	94.15	94.37	94.57	94.76	94.99	95.09	95.16	95.20	95.24	95.28	95.31	95.33	95.35	95.37	95.38	95.39	95.40	95.41	95.41
1999	2.71	8.63	21.38	41.67	69.76	80.99	86.37	88.90	90.24	91.07	91.67	92.08	92.45	92.82	93.26	93.46	93.58	93.66	93.72	93.78	93.83	93.87	93.90	93.93	93.96	93.98	93.99	94.01	94.02	94.03
2000	3.61	35.75	59.02	76.89	85.55	89.43	91.33	92.21	92.66	92.96	93.18	93.34	93.44	93.78	93.94	94.03	94.10	94.15	94.20	94.24	94.27	94.30	94.31	94.34	94.35	94.36	94.37	94.38	94.39	94.39
2001	7.42	38.72	72.21	83.17	88.22	90.51	91.62	92.24	92.70	92.96	93.17	93.35	93.67	93.81	93.95	94.00	94.05	94.09	94.12	94.16	94.18	94.20	94.22	94.23	94.24	94.25	94.26	94.27	94.28	
2002	10.83	56.60	72.66	80.61	84.33	86.37	87.50	88.49	89.11	89.59	90.07	90.78	91.10	91.29	91.42	91.52	91.62	91.70	91.77	91.83	91.89	91.93	91.97	92.00	92.03	92.05	92.07	92.08	92.10	92.11
2003	19.43	41.55	57.44	65.26	69.61	72.15	74.84	76.62	78.12	79.75	81.99	82.77	83.23	83.56	83.85	84.10	84.32	84.52	84.69	84.84	84.96	85.06	85.14	85.22	85.28	85.34	85.39	85.43	85.47	85.50
2004	11.60	31.10	42.13	48.80	52.54	55.87	58.38	60.62	63.50	67.85	69.43	70.35	71.03	71.63	72.16	72.60	72.99	73.37	73.66	73.91	74.11	74.29	74.44	74.58	74.70	74.79	74.87	74.94	75.00	75.05
2005	9.48	21.38	29.88	34.50	38.95	42.05	44.52	48.06	53.92	56.03	57.17	57.96	58.71	59.35	59.89	60.38	60.83	61.20	61.51	61.79	62.03	62.22	62.38	62.52	62.63	62.73	62.81	62.88	62.93	62.99
2006	3.97	14.52	21.24	28.98	33.11	35.84	39.81	46.67	49.16	50.31	51.21	52.02	52.75	53.36	53.89	54.35	54.70	55.02	55.31	55.56	55.82	55.99	56.14	56.27	56.40	56.49	56.55	56.60	56.65	56.69
2007	4.03	22.89	36.05	40.55	43.04	46.25	51.45	53.22	53.96	54.46	55.00	55.45	55.78	56.07	56.33	56.57	56.78	56.97	57.17	57.31	57.44	57.54	57.64	57.75	57.84	57.90	57.94	57.97	58.00	58.02
2008	4.25	29.52	35.57	38.73	43.19	49.78	51.32	51.98	52.48	52.98	53.40	53.78	54.11	54.40	54.70	54.93	55.12	55.29	55.45	55.61	55.75	55.84	55.94	56.03	56.09	56.15	56.20	56.24	56.28	56.32
2009	3.09	11.14	17.24	29.64	40.74	42.84	43.84	44.68	45.57	46.40	47.12	47.77	48.43	49.02	49.49	49.91	50.29	50.62	50.90	51.14	51.35	51.53	51.68	51.82	51.95	52.06	52.16	52.25	52.32	52.39
2010	2.84	8.41	18.53	29.94	32.64	34.28	35.67	37.20	38.62	39.92	41.12	42.28	43.33	44.17	44.94	45.58	46.15	46.65	47.07	47.44	47.77	48.06	48.28	48.50	48.68	48.84	48.99	49.11	49.23	49.31
2011	0.49	7.27	19.66	22.93	25.11	27.04	29.20	31.24	33.09	34.85	36.52	37.99	39.18	40.24	41.21	42.08	42.79	43.42	43.96	44.43	44.84	45.21	45.53	45.83	46.07	46.29	46.48	46.64	46.78	46.92
2012	0.86	9.93	13.07	15.29	17.39	19.98	22.55	24.89	27.11	29.31	31.26	32.80	34.21	35.49	36.60	37.54	38.37	39.09	39.73	40.29	40.75	41.20	41.57	41.89	42.20	42.48	42.71	42.92	43.11	43.28
2013	1.99	5.72	9.17	12.15	15.83	19.46	22.68	25.66	28.48	30.92	32.85	34.57	36.05	37.39	38.50	39.47	40.30	41.04	41.68	42.22	42.71	43.13	43.50	43.84	44.13	44.37	44.58	44.77	44.94	45.08
2014	2.25	8.50	14.87	21.81	28.00	33.53	38.01	41.86	45.06	47.43	49.44	51.14	52.58	53.73	54.67	55.48	56.17	56.75	57.23	57.67	58.03	58.33	58.61	58.85	59.06	59.24	59.39	59.51	59.62	59.73
2015	3.10	12.64	22.90	31.44	38.37	43.99	48.75	52.62	55.41	57.61	59.45	60.97	62.17	63.12	63.93	64.62	65.17	65.66	66.07	66.41	66.69	66.95	67.17	67.35	67.52	67.65	67.77	67.86	67.95	68.02
2016	2.81	13.18	24.05	32.81	40.18	46.33	51.14	54.26	56.88	58.90	60.54	61.85	62.93	63.89	64.70	65.43	66.00	66.49	66.89	67.21	67.50	67.74	67.93	68.11	68.27	68.40	68.51	68.60	68.68	68.75
2017	2.51	11.58	21.72	29.22	35.62	40.77	44.39	47.59	50.14	52.27	53.94	55.39	56.59	57.62	58.47	59.16	59.67	60.13	60.55	60.92	61.25	61.54	61.78	62.00	62.20	62.34	62.49	62.61	62.71	62.81
2018	2.86	11.59	20.18	27.46	33.77	38.97	42.89	46.26	48.92	51.25	53.12	54.68	55.99	56.99	57.83	58.44	58.97	59.48	59.90	60.28	60.59	60.85	61.09	61.30	61.49	61.65	61.80	61.93	62.03	62.13
2019	2.23	10.22	19.37	26.95	33.02	38.00	42.71	46.26	49.23	51.61	53.47	54.96	56.12	57.07	57.80	58.40	58.93	59.40	59.82	60.17	60.46	60.73	60.95	61.13	61.32	61.49	61.62	61.74	61.84	61.94
2020	2.16	11.32	22.21	29.18	35.78	41.68	46.17	49.51	52.34	54.56	56.27	57.61	58.70	59.61	60.35	61.00	61.51	61.98	62.38	62.73	63.02	63.26	63.48	63.67	63.83	63.98	64.09	64.20	64.29	64.37

Conditional Claim Rates   Fixed Rate 15 Year Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1998	0.00	0.06	0.26	0.26	0.39	0.37	0.35	0.34	0.32	0.17	0.10	0.16	0.20	0.04	0.10
1999	0.00	0.07	0.22	0.33	0.48	0.43	0.40	0.16	0.20	0.19	0.16	0.06	0.09	0.13	**0.07**
2000	0.00	0.11	0.57	1.22	1.76	0.92	0.87	0.41	0.37	0.50	0.57	0.51	0.00	**0.22**	**0.28**
2001	0.00	0.12	0.54	0.97	0.91	0.92	0.71	0.47	0.80	0.33	0.68	0.23	**0.30**	**0.19**	**0.26**
2002	0.02	0.14	0.49	0.62	0.60	0.35	0.31	0.21	0.39	0.36	0.36	**0.39**	**0.27**	**0.20**	**0.12**
2003	0.01	0.16	0.32	0.32	0.20	0.22	0.42	0.38	0.42	0.46	**0.48**	**0.48**	**0.29**	**0.29**	**0.28**
2004	0.04	0.17	0.26	0.36	0.42	0.45	0.51	0.50	0.64	**0.60**	**0.62**	**0.34**	**0.56**	**0.31**	**0.17**
2005	0.02	0.62	1.67	1.47	1.61	1.59	1.33	0.83	**1.29**	**1.20**	**1.01**	**0.97**	**0.89**	**0.72**	**0.67**
2006	0.05	1.29	2.18	2.70	2.69	1.97	2.22	**2.71**	**2.63**	**1.95**	**2.07**	**1.65**	**1.81**	**1.08**	**0.75**
2007	0.01	0.82	2.24	2.56	2.08	3.25	**3.38**	**3.27**	**2.77**	**2.37**	**2.13**	**1.81**	**1.22**	**0.75**	**0.36**
2008	0.01	0.35	1.26	1.48	1.95	**2.97**	**2.60**	**2.23**	**2.03**	**1.74**	**1.58**	**1.05**	**0.97**	**0.56**	**0.36**
2009	0.01	0.17	0.26	0.56	**0.94**	**0.90**	**0.74**	**0.69**	**0.65**	**0.51**	**0.33**	**0.25**	**0.23**	**0.12**	**0.12**
2010	0.00	0.04	0.15	**0.28**	**0.33**	**0.31**	**0.22**	**0.23**	**0.18**	**0.18**	**0.15**	**0.11**	**0.10**	**0.08**	**0.07**
2011	0.00	0.03	**0.11**	**0.19**	**0.17**	**0.17**	**0.12**	**0.11**	**0.10**	**0.10**	**0.08**	**0.10**	**0.07**	**0.05**	**0.04**
2012	0.00	**0.02**	**0.11**	**0.15**	**0.10**	**0.10**	**0.09**	**0.07**	**0.06**	**0.06**	**0.06**	**0.06**	**0.04**	**0.05**	**0.04**
2013	**0.00**	**0.04**	**0.11**	**0.14**	**0.22**	**0.18**	**0.12**	**0.08**	**0.07**	**0.12**	**0.10**	**0.08**	**0.03**	**0.05**	**0.08**
2014	**0.01**	**0.04**	**0.23**	**0.30**	**0.36**	**0.24**	**0.29**	**0.22**	**0.14**	**0.20**	**0.14**	**0.11**	**0.11**	**0.03**	**0.08**
2015	**0.01**	**0.06**	**0.39**	**0.57**	**0.50**	**0.37**	**0.41**	**0.30**	**0.26**	**0.27**	**0.22**	**0.23**	**0.11**	**0.13**	**0.10**
2016	**0.01**	**0.08**	**0.41**	**0.44**	**0.46**	**0.44**	**0.50**	**0.25**	**0.16**	**0.32**	**0.24**	**0.25**	**0.13**	**0.09**	**0.08**
2017	**0.01**	**0.10**	**0.38**	**0.41**	**0.40**	**0.36**	**0.42**	**0.22**	**0.15**	**0.24**	**0.15**	**0.16**	**0.09**	**0.06**	**0.10**
2018	**0.01**	**0.08**	**0.37**	**0.47**	**0.41**	**0.34**	**0.44**	**0.15**	**0.16**	**0.32**	**0.19**	**0.18**	**0.17**	**0.07**	**0.11**
2019	**0.01**	**0.07**	**0.38**	**0.42**	**0.51**	**0.38**	**0.42**	**0.16**	**0.19**	**0.21**	**0.31**	**0.25**	**0.11**	**0.08**	**0.13**
2020	**0.01**	**0.09**	**0.42**	**0.38**	**0.52**	**0.39**	**0.33**	**0.22**	**0.21**	**0.20**	**0.28**	**0.22**	**0.07**	**0.12**	**0.11**

Conditional Prepayment Rates   **Fixed Rate 15 Year Mortgages**   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1998	1.051	6.037	6.781	11.68	18.91	30.77	21.77	17.8	14.83	12.31	9.852	10.48	9.179	12.97	17.71
1999	0.87	3.51	9.78	17.26	30.00	22.08	17.77	13.92	10.90	9.06	7.95	7.17	9.84	11.48	**18.88**
2000	0.78	18.19	29.05	36.87	25.57	21.09	16.24	10.75	8.31	7.71	6.93	6.64	7.36	**18.98**	**19.70**
2001	2.23	14.52	38.69	29.38	23.61	15.28	12.68	11.30	7.24	8.62	7.40	8.67	**19.31**	**17.61**	**16.24**
2002	2.25	26.90	26.56	20.87	16.68	12.71	10.29	8.07	7.50	7.03	7.63	**16.93**	**17.62**	**17.04**	**15.23**
2003	4.66	15.83	19.08	15.70	12.77	10.29	8.92	8.69	7.95	9.06	**17.69**	**17.46**	**16.06**	**14.48**	**13.70**
2004	4.88	14.68	13.64	11.63	8.74	8.05	7.42	6.80	8.22	**16.34**	**16.04**	**15.51**	**13.73**	**13.75**	**12.14**
2005	5.29	11.32	10.87	9.79	8.18	7.15	7.64	7.60	**12.76**	**11.50**	**11.24**	9.74	9.49	**10.42**	**10.35**
2006	3.70	10.62	11.66	12.42	9.22	7.54	8.08	**11.88**	8.90	7.95	7.93	8.11	7.86	**9.72**	**10.51**
2007	3.57	12.46	16.57	9.97	7.84	7.75	**11.79**	8.22	7.83	7.18	7.15	8.20	8.62	**10.16**	**9.40**
2008	1.51	17.60	13.39	11.63	13.19	**16.22**	8.78	7.68	7.12	7.36	8.37	9.67	10.81	**11.14**	**11.69**
2009	4.41	7.62	12.73	17.46	**20.16**	9.07	7.09	6.63	7.06	8.02	8.84	10.18	11.36	**11.57**	**11.48**
2010	0.92	7.94	15.45	**19.46**	9.40	6.62	6.16	6.61	7.55	8.53	9.19	10.28	11.01	**11.63**	**11.33**
2011	0.94	14.14	**19.41**	10.46	6.65	5.21	5.73	6.55	7.40	8.42	9.44	10.59	11.20	**11.76**	**11.34**
2012	1.59	**11.80**	8.35	6.46	4.74	4.66	5.29	6.03	7.08	8.01	8.76	9.99	11.15	**11.99**	**11.49**
2013	**1.58**	5.84	6.37	5.30	4.96	4.72	5.74	6.19	7.74	8.41	9.34	9.76	10.61	**12.28**	**11.89**
2014	**1.29**	6.24	8.26	8.46	6.65	6.44	6.69	7.45	8.94	9.57	10.44	10.29	10.75	**12.12**	**11.03**
2015	**1.26**	6.78	10.52	10.03	7.81	7.46	7.18	7.90	9.75	10.10	10.97	10.90	11.31	**12.70**	**10.34**
2016	**1.09**	7.05	10.75	10.22	7.60	7.86	7.46	7.79	9.45	10.02	10.61	10.36	11.64	**12.69**	**11.01**
2017	**1.10**	6.81	9.95	9.17	7.28	7.73	7.08	7.41	9.01	9.91	10.61	10.34	10.99	**12.91**	**11.01**
2018	**1.04**	6.80	9.72	10.09	7.87	7.67	7.22	7.61	9.03	9.61	10.34	10.48	11.38	**12.49**	**10.83**
2019	**1.07**	6.87	10.56	10.10	7.72	7.67	7.34	7.57	9.28	9.92	10.78	10.35	11.58	**12.56**	**10.95**
2020	**1.06**	7.27	11.15	10.10	8.64	8.04	7.71	8.34	9.77	10.37	11.10	10.44	11.32	**12.49**	**10.64**

Cumulative Claim Rates   Fixed Rate 15 Year Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1998	0.00	0.06	0.31	0.54	0.84	1.07	1.21	1.32	1.41	1.44	1.46	1.49	1.52	1.53	1.55
1999	0.00	0.08	0.29	0.58	0.92	1.13	1.28	1.33	1.38	1.42	1.46	1.47	1.48	1.50	**1.52**
2000	0.00	0.11	0.58	1.28	1.89	2.13	2.29	2.36	2.41	2.48	2.55	2.60	2.60	**2.63**	**2.65**
2001	0.00	0.12	0.58	1.08	1.40	1.64	1.80	1.89	2.02	2.07	2.17	2.20	**2.24**	**2.26**	**2.28**
2002	0.02	0.16	0.51	0.83	1.07	1.19	1.28	1.33	1.43	1.51	1.58	**1.65**	**1.70**	**1.72**	**1.74**
2003	0.01	0.16	0.42	0.63	0.74	0.84	1.02	1.17	1.32	1.47	**1.61**	**1.72**	**1.78**	**1.83**	**1.88**
2004	0.04	0.21	0.42	0.67	0.93	1.18	1.44	1.68	1.96	**2.21**	**2.41**	**2.50**	**2.63**	**2.69**	**2.72**
2005	0.02	0.62	2.02	3.10	4.14	5.08	5.78	6.19	**6.77**	**7.22**	**7.57**	**7.85**	**8.08**	**8.27**	**8.42**
2006	0.05	1.33	3.22	5.23	6.92	8.01	9.12	**10.34**	**11.34**	**11.99**	**12.61**	**13.07**	**13.53**	**13.78**	**13.94**
2007	0.01	0.83	2.74	4.51	5.76	7.52	**9.14**	**10.47**	**11.45**	**12.21**	**12.84**	**13.33**	**13.63**	**13.79**	**13.89**
2008	0.01	0.36	1.40	2.43	3.61	**5.13**	**6.21**	**7.02**	**7.69**	**8.21**	**8.63**	**8.89**	**9.11**	**9.22**	**9.28**
2009	0.01	0.18	0.42	0.86	**1.46**	**1.91**	**2.24**	**2.52**	**2.78**	**2.96**	**3.07**	**3.14**	**3.21**	**3.24**	**3.27**
2010	0.00	0.04	0.18	**0.40**	**0.61**	**0.79**	**0.90**	**1.02**	**1.10**	**1.18**	**1.24**	**1.28**	**1.31**	**1.33**	**1.35**
2011	0.00	0.03	**0.13**	**0.26**	**0.36**	**0.46**	**0.52**	**0.58**	**0.63**	**0.67**	**0.70**	**0.74**	**0.77**	**0.78**	**0.79**
2012	0.00	**0.02**	**0.12**	**0.23**	**0.31**	**0.38**	**0.43**	**0.48**	**0.51**	**0.55**	**0.58**	**0.61**	**0.62**	**0.64**	**0.65**
2013	**0.00**	**0.04**	**0.14**	**0.26**	**0.44**	**0.58**	**0.66**	**0.72**	**0.76**	**0.83**	**0.89**	**0.93**	**0.94**	**0.97**	**1.00**
2014	**0.01**	**0.04**	**0.26**	**0.52**	**0.80**	**0.97**	**1.17**	**1.31**	**1.39**	**1.50**	**1.56**	**1.60**	**1.64**	**1.66**	**1.68**
2015	**0.01**	**0.07**	**0.43**	**0.91**	**1.28**	**1.53**	**1.79**	**1.96**	**2.10**	**2.22**	**2.31**	**2.40**	**2.44**	**2.49**	**2.51**
2016	**0.01**	**0.09**	**0.48**	**0.84**	**1.18**	**1.48**	**1.79**	**1.93**	**2.01**	**2.16**	**2.26**	**2.35**	**2.40**	**2.43**	**2.46**
2017	**0.01**	**0.12**	**0.47**	**0.81**	**1.12**	**1.37**	**1.63**	**1.76**	**1.84**	**1.96**	**2.02**	**2.08**	**2.11**	**2.14**	**2.17**
2018	**0.01**	**0.09**	**0.43**	**0.83**	**1.14**	**1.37**	**1.65**	**1.74**	**1.83**	**1.97**	**2.06**	**2.12**	**2.19**	**2.21**	**2.24**
2019	**0.01**	**0.08**	**0.44**	**0.79**	**1.17**	**1.43**	**1.68**	**1.77**	**1.87**	**1.97**	**2.10**	**2.19**	**2.23**	**2.25**	**2.28**
2020	**0.01**	**0.10**	**0.49**	**0.80**	**1.18**	**1.44**	**1.64**	**1.76**	**1.86**	**1.94**	**2.05**	**2.12**	**2.14**	**2.17**	**2.20**

Cumulative Prepayment Rates   Fixed Rate 15 Year Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1998	1.07	7.159	13.58	23.87	38.47	57.64	66.86	72.73	76.72	79.62	81.77	83.68	85.2	87.24	91.12
1999	0.88	4.44	13.96	28.99	50.59	61.53	68.33	72.68	75.66	77.95	79.91	81.38	83.28	85.40	89.02
2000	0.79	19.13	42.89	64.10	73.10	78.49	81.71	83.48	84.72	85.87	86.83	87.60	88.41	90.50	92.22
2001	2.27	16.76	49.51	64.41	72.73	76.77	79.59	81.77	83.02	84.41	85.52	86.67	89.13	90.90	92.33
2002	2.30	29.14	48.23	59.13	65.95	70.24	73.27	75.40	77.22	78.85	80.55	83.92	86.72	89.03	90.89
2003	4.76	20.16	35.67	45.90	52.89	57.79	61.63	64.99	67.82	70.79	76.17	80.35	83.54	86.05	88.36
2004	5.01	19.25	30.44	38.65	44.09	48.67	52.53	55.79	59.47	66.25	71.64	76.03	79.34	82.36	84.93
2005	5.46	16.36	25.56	32.82	38.21	42.46	46.61	50.39	56.26	60.75	64.58	67.55	70.20	72.88	75.57
2006	3.76	14.14	24.15	33.34	39.10	43.28	47.32	52.68	56.11	58.88	61.38	63.63	65.70	68.04	70.65
2007	3.62	15.80	29.87	36.69	41.40	45.62	51.34	54.71	57.54	59.91	62.02	64.24	66.39	68.77	71.12
2008	1.53	19.18	30.09	38.20	46.24	54.58	58.23	61.06	63.44	65.69	68.00	70.41	72.87	75.21	77.58
2009	4.50	11.96	23.34	36.96	49.78	54.32	57.53	60.31	63.07	65.99	68.91	71.98	75.11	78.03	80.86
2010	0.94	8.99	23.35	38.55	44.42	48.16	51.42	54.71	58.22	61.91	65.54	69.25	72.86	76.42	79.86
2011	0.96	15.25	32.03	39.27	43.40	46.42	49.59	53.01	56.62	60.47	64.40	68.40	72.26	76.02	79.62
2012	1.63	13.54	20.92	26.15	29.73	33.11	36.77	40.75	45.14	49.78	54.45	59.34	64.33	69.28	74.02
2013	1.61	7.49	13.49	18.13	22.28	26.01	30.37	34.84	40.09	45.38	50.70	55.84	61.02	66.51	72.00
2014	1.31	7.60	15.38	22.64	27.86	32.56	37.14	41.91	47.19	52.37	57.45	62.01	66.38	70.86	75.14
2015	1.28	8.11	17.93	26.26	32.07	37.17	41.70	46.35	51.58	56.51	61.28	65.57	69.61	73.70	77.19
2016	1.11	8.24	18.29	26.75	32.38	37.74	42.41	46.91	51.94	56.79	61.38	65.46	69.62	73.75	77.37
2017	1.12	8.00	17.31	25.00	30.52	35.92	40.49	44.92	49.91	54.92	59.73	64.02	68.16	72.61	76.49
2018	1.06	7.94	17.04	25.50	31.41	36.70	41.28	45.78	50.69	55.49	60.12	64.40	68.60	72.84	76.61
2019	1.09	8.05	17.93	26.32	32.05	37.29	41.90	46.32	51.31	56.15	60.86	64.98	69.18	73.33	77.08
2020	1.08	8.44	18.84	27.13	33.47	38.85	43.56	48.28	53.32	58.17	62.79	66.76	70.66	74.61	78.04

Conditional Claim Rates   **Fixed Rate 15 Year Streamline Refinance Mortgages**   **by Credit Subsidy Endorsement Cohort**

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1992	0.00	0.06	0.11	0.20	0.21	0.16	0.24	0.15	0.10	0.12	0.02	0.01	0.00	0.00	0.00
1993	0.00	0.04	0.10	0.15	0.18	0.14	0.12	0.13	0.08	0.06	0.03	0.02	0.01	0.02	0.02
1994	0.00	0.06	0.20	0.25	0.27	0.22	0.18	0.09	0.09	0.06	0.04	0.05	0.02	0.02	0.02
1995	0.01	0.14	0.44	0.61	0.48	0.39	0.45	0.28	0.20	0.20	0.00	0.21	0.00	0.00	0.02
1996	0.00	0.05	0.15	0.32	0.34	0.32	0.23	0.12	0.23	0.07	0.06	0.03	0.00	0.01	0.00
1997	0.00	0.15	0.20	0.38	0.33	0.19	0.15	0.14	0.23	0.05	0.03	0.00	0.08	0.00	0.00
1998	0.00	0.02	0.14	0.14	0.22	0.11	0.15	0.14	0.03	0.04	0.05	0.07	0.15	0.03	0.04
1999	0.00	0.03	0.08	0.08	0.16	0.13	0.12	0.09	0.07	0.02	0.08	0.14	0.04	0.08	**0.13**
2000	0.00	0.08	0.13	0.30	0.28	0.20	0.20	0.32	0.30	0.43	0.36	0.00	0.09	**0.42**	**0.20**
2001	0.00	0.04	0.10	0.22	0.59	0.33	0.19	0.12	0.30	0.45	0.32	0.18	**0.35**	**0.34**	**0.07**
2002	0.00	0.04	0.22	0.17	0.19	0.13	0.14	0.15	0.11	0.25	0.14	**0.32**	**0.19**	**0.18**	**0.10**
2003	0.00	0.05	0.12	0.16	0.09	0.15	0.14	0.29	0.22	0.21	**0.36**	**0.34**	**0.19**	**0.14**	**0.13**
2004	0.02	0.08	0.17	0.14	0.15	0.23	0.34	0.32	0.30	**0.33**	**0.37**	**0.25**	**0.27**	**0.32**	**0.15**
2005	0.01	0.10	0.12	0.20	0.40	0.47	0.38	0.43	**0.53**	**0.50**	**0.42**	**0.31**	**0.33**	**0.24**	**0.14**
2006	0.00	0.05	0.09	0.47	0.61	0.34	0.71	**0.65**	**0.80**	**0.50**	**0.59**	**0.22**	**0.28**	**0.24**	**0.20**
2007	0.00	0.13	0.28	0.97	0.36	0.37	**2.44**	**2.35**	**1.23**	**0.51**	**1.21**	**0.43**	**0.00**	**0.56**	**1.56**
2008	0.00	0.09	0.59	0.86	1.25	**2.73**	**2.53**	**2.21**	**0.67**	**1.07**	**0.49**	**0.25**	**0.16**	**0.00**	**0.49**
2009	0.00	0.11	0.42	0.78	**2.06**	**2.14**	**1.29**	**1.19**	**0.73**	**0.58**	**0.37**	**0.17**	**0.20**	**0.15**	**0.16**
2010	0.00	0.13	0.45	**1.71**	**1.73**	**1.25**	**0.75**	**0.55**	**0.50**	**0.16**	**0.30**	**0.18**	**0.05**	**0.13**	**0.09**
2011	0.00	0.18	**0.42**	**0.45**	**0.33**	**0.22**	**0.16**	**0.15**	**0.10**	**0.13**	**0.06**	**0.04**	**0.04**	**0.06**	**0.00**
2012	0.00	**0.04**	**0.18**	**0.14**	**0.17**	**0.19**	**0.14**	**0.15**	**0.12**	**0.13**	**0.07**	**0.06**	**0.04**	**0.02**	**0.03**
2013	**0.00**	**0.01**	**0.11**	**0.12**	**0.14**	**0.18**	**0.09**	**0.14**	**0.14**	**0.08**	**0.11**	**0.09**	**0.04**	**0.06**	**0.04**
2014	**0.00**	**0.01**	**0.25**	**0.16**	**0.26**	**0.31**	**0.10**	**0.21**	**0.21**	**0.09**	**0.18**	**0.04**	**0.14**	**0.07**	**0.03**
2015	**0.00**	**0.03**	**0.30**	**0.20**	**0.21**	**0.35**	**0.18**	**0.26**	**0.26**	**0.09**	**0.13**	**0.07**	**0.13**	**0.13**	**0.06**
2016	**0.00**	**0.05**	**0.27**	**0.19**	**0.30**	**0.47**	**0.19**	**0.32**	**0.32**	**0.05**	**0.14**	**0.06**	**0.32**	**0.08**	**0.05**
2017	**0.00**	**0.05**	**0.30**	**0.15**	**0.21**	**0.40**	**0.09**	**0.20**	**0.12**	**0.09**	**0.06**	**0.05**	**0.08**	**0.03**	**0.05**
2018	**0.00**	**0.03**	**0.30**	**0.17**	**0.25**	**0.32**	**0.09**	**0.10**	**0.12**	**0.22**	**0.13**	**0.08**	**0.13**	**0.02**	**0.07**
2019	**0.00**	**0.02**	**0.30**	**0.21**	**0.25**	**0.32**	**0.09**	**0.11**	**0.24**	**0.16**	**0.12**	**0.10**	**0.15**	**0.10**	**0.03**
2020	**0.00**	**0.05**	**0.34**	**0.18**	**0.27**	**0.27**	**0.13**	**0.23**	**0.34**	**0.14**	**0.06**	**0.13**	**0.15**	**0.09**	**0.08**

Conditional Prepayment Rates   **Fixed Rate 15 Year Streamline Refinance Mortgages**   **by Credit Subsidy Endorsement Cohort**

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1992	0.65	9.76	17.93	7.31	11.50	10.12	15.16	17.48	10.81	13.84	20.91	23.73	20.41	19.35	21.88
1993	1.10	6.55	5.65	8.99	9.11	13.12	16.16	10.85	13.53	18.40	25.31	20.29	17.96	19.94	20.02
1994	1.37	3.97	7.05	7.57	10.99	13.69	9.71	12.35	16.30	22.70	19.00	17.12	17.98	17.26	24.90
1995	1.85	9.38	8.28	13.23	17.08	9.91	12.15	18.38	21.98	18.11	14.58	14.08	16.13	13.18	20.29
1996	0.91	4.43	9.75	14.08	9.26	12.58	17.79	26.69	21.80	16.71	16.35	13.54	14.47	17.33	22.51
1997	1.26	9.25	14.45	8.41	11.12	19.16	26.86	21.65	17.61	16.34	13.04	11.60	11.53	15.14	19.60
1998	1.14	7.22	6.36	10.23	16.51	30.18	22.78	16.76	15.51	12.38	12.47	11.43	12.78	15.24	19.61
1999	1.33	4.21	8.43	14.15	26.64	21.04	16.35	14.07	11.22	10.37	9.64	10.25	13.45	15.12	**23.27**
2000	2.20	12.04	17.72	28.52	25.41	17.82	16.33	12.44	9.85	8.91	8.70	7.40	10.03	**22.11**	**16.63**
2001	1.36	13.07	36.66	28.65	21.23	14.10	11.99	10.60	8.21	8.64	8.78	9.39	**21.17**	**20.40**	**18.28**
2002	2.74	24.68	21.48	18.68	13.66	10.83	8.91	8.36	8.08	7.83	8.87	**20.42**	**19.60**	**18.12**	**15.32**
2003	6.23	12.62	15.34	12.62	10.17	8.35	7.83	7.40	8.17	8.86	**18.98**	**18.60**	**17.03**	**16.04**	**15.57**
2004	4.90	11.12	11.03	9.15	7.24	6.33	6.33	6.47	6.94	**17.65**	**18.11**	**16.57**	**15.97**	**16.09**	**14.23**
2005	4.43	8.73	8.56	6.50	5.19	5.63	5.83	6.38	**16.71**	**15.69**	**13.89**	**13.60**	**13.48**	**14.10**	**13.93**
2006	2.84	7.64	7.10	6.94	5.94	4.96	5.84	**18.77**	**16.83**	**12.75**	**11.61**	**12.34**	**13.22**	**14.85**	**14.15**
2007	1.09	8.66	10.98	8.46	5.14	6.75	**19.38**	**13.59**	**9.32**	**10.49**	**12.02**	**12.76**	**14.54**	**13.46**	**14.72**
2008	1.23	8.48	8.06	6.80	10.28	**21.77**	**16.29**	**9.91**	**8.26**	**9.81**	**12.49**	**13.54**	**15.64**	**12.97**	**17.07**
2009	0.86	5.61	9.97	14.39	**21.87**	**11.16**	**7.01**	**6.68**	**7.87**	**9.43**	**10.75**	**11.80**	**14.33**	**14.29**	**14.86**
2010	1.52	8.61	14.76	**18.45**	**9.99**	**6.85**	**6.21**	**7.51**	**9.29**	**10.15**	**10.46**	**12.81**	**14.20**	**14.83**	**14.98**
2011	1.46	33.52	**23.81**	**11.35**	**7.10**	**5.43**	**6.73**	**8.56**	**9.44**	**10.15**	**12.56**	**13.97**	**15.70**	**16.27**	**16.03**
2012	1.61	**14.50**	**8.24**	**5.87**	**5.69**	**6.10**	**7.74**	**8.97**	**10.35**	**12.44**	**12.73**	**14.16**	**16.58**	**17.29**	**17.54**
2013	**4.09**	**9.92**	**7.57**	**6.18**	**6.47**	**8.53**	**7.44**	**9.74**	**11.22**	**12.38**	**13.04**	**13.24**	**16.62**	**17.30**	**16.80**
2014	**4.04**	**11.37**	**10.45**	**10.50**	**9.15**	**10.94**	**10.21**	**12.01**	**12.38**	**13.62**	**13.31**	**13.75**	**17.06**	**17.33**	**17.24**
2015	**3.68**	**12.50**	**15.04**	**13.38**	**10.68**	**12.49**	**12.02**	**13.64**	**12.68**	**14.57**	**14.49**	**13.56**	**18.49**	**16.24**	**18.15**
2016	**2.70**	**12.50**	**15.70**	**14.31**	**11.29**	**12.30**	**13.02**	**12.56**	**12.12**	**14.20**	**13.38**	**13.66**	**17.02**	**17.70**	**18.09**
2017	**2.51**	**11.50**	**14.01**	**11.03**	**9.05**	**9.86**	**9.55**	**10.85**	**11.11**	**12.67**	**13.17**	**13.30**	**17.25**	**17.20**	**16.50**
2018	**3.31**	**10.82**	**12.53**	**10.41**	**10.08**	**10.72**	**9.92**	**11.90**	**11.95**	**12.86**	**14.43**	**14.28**	**16.83**	**17.88**	**16.04**
2019	**2.26**	**9.40**	**12.45**	**11.31**	**9.27**	**10.69**	**10.82**	**12.19**	**12.67**	**14.08**	**13.89**	**14.00**	**16.79**	**17.04**	**16.57**
2020	**2.34**	**10.87**	**15.29**	**11.34**	**9.49**	**12.08**	**11.47**	**12.96**	**12.85**	**14.10**	**13.93**	**13.92**	**17.27**	**17.51**	**16.92**

Cumulative Claim Rates **Fixed Rate 15 Year Streamline Refinance Mortgages** **by Credit Subsidy Endorsement Cohort**

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1992	0.00	0.06	0.16	0.31	0.45	0.54	0.68	0.74	0.78	0.82	0.82	0.83	0.83	0.83	0.83
1993	0.00	0.04	0.14	0.27	0.42	0.52	0.60	0.66	0.70	0.73	0.74	0.74	0.74	0.75	0.75
1994	0.00	0.06	0.26	0.48	0.70	0.86	0.97	1.02	1.07	1.09	1.10	1.11	1.12	1.12	1.12
1995	0.01	0.15	0.55	1.05	1.39	1.61	1.84	1.97	2.05	2.10	2.10	2.14	2.14	2.14	2.15
1996	0.00	0.05	0.19	0.47	0.72	0.94	1.07	1.12	1.20	1.22	1.23	1.24	1.24	1.24	1.24
1997	0.00	0.15	0.33	0.63	0.86	0.97	1.05	1.10	1.17	1.18	1.19	1.19	1.20	1.20	1.20
1998	0.00	0.02	0.15	0.28	0.45	0.52	0.58	0.63	0.64	0.65	0.66	0.67	0.69	0.70	0.71
1999	0.00	0.03	0.11	0.18	0.30	0.37	0.42	0.45	0.47	0.48	0.50	0.53	0.54	0.55	**0.58**
2000	0.00	0.08	0.19	0.40	0.54	0.62	0.68	0.76	0.82	0.91	0.97	0.97	0.99	**1.04**	**1.07**
2001	0.00	0.05	0.13	0.25	0.48	0.57	0.62	0.65	0.71	0.79	0.84	0.87	**0.92**	**0.96**	**0.96**
2002	0.00	0.04	0.20	0.30	0.39	0.44	0.49	0.54	0.57	0.64	0.67	**0.75**	**0.78**	**0.81**	**0.82**
2003	0.00	0.05	0.15	0.26	0.31	0.39	0.46	0.60	0.69	0.77	**0.90**	**1.00**	**1.04**	**1.07**	**1.10**
2004	0.02	0.09	0.24	0.35	0.45	0.60	0.80	0.98	1.14	**1.30**	**1.44**	**1.52**	**1.59**	**1.66**	**1.69**
2005	0.01	0.11	0.21	0.38	0.67	1.01	1.26	1.53	**1.84**	**2.07**	**2.23**	**2.33**	**2.42**	**2.49**	**2.51**
2006	0.00	0.04	0.13	0.52	0.99	1.25	1.73	**2.14**	**2.53**	**2.73**	**2.94**	**3.01**	**3.09**	**3.13**	**3.16**
2007	0.00	0.13	0.38	1.19	1.46	1.71	**3.32**	**4.48**	**4.98**	**5.18**	**5.56**	**5.68**	**5.68**	**5.80**	**5.91**
2008	0.00	0.09	0.63	1.36	2.33	**4.20**	**5.49**	**6.39**	**6.64**	**6.99**	**7.13**	**7.19**	**7.23**	**7.23**	**7.29**
2009	0.00	0.11	0.51	1.18	**2.68**	**3.84**	**4.44**	**4.96**	**5.25**	**5.46**	**5.59**	**5.64**	**5.69**	**5.72**	**5.76**
2010	0.00	0.14	0.56	**1.90**	**2.96**	**3.64**	**4.02**	**4.27**	**4.49**	**4.55**	**4.65**	**4.71**	**4.73**	**4.76**	**4.78**
2011	0.00	0.19	**0.47**	**0.69**	**0.84**	**0.93**	**0.99**	**1.04**	**1.08**	**1.11**	**1.13**	**1.14**	**1.15**	**1.16**	**1.16**
2012	0.00	**0.04**	**0.19**	**0.30**	**0.43**	**0.56**	**0.64**	**0.73**	**0.80**	**0.86**	**0.89**	**0.91**	**0.93**	**0.93**	**0.94**
2013	**0.00**	**0.01**	**0.10**	**0.20**	**0.30**	**0.43**	**0.49**	**0.58**	**0.65**	**0.69**	**0.73**	**0.76**	**0.78**	**0.79**	**0.80**
2014	**0.00**	**0.01**	**0.23**	**0.35**	**0.53**	**0.72**	**0.77**	**0.88**	**0.97**	**1.00**	**1.06**	**1.07**	**1.10**	**1.12**	**1.12**
2015	**0.00**	**0.02**	**0.28**	**0.42**	**0.56**	**0.75**	**0.83**	**0.94**	**1.04**	**1.07**	**1.10**	**1.11**	**1.14**	**1.16**	**1.18**
2016	**0.00**	**0.05**	**0.28**	**0.42**	**0.60**	**0.86**	**0.94**	**1.07**	**1.18**	**1.20**	**1.23**	**1.25**	**1.31**	**1.32**	**1.33**
2017	**0.00**	**0.05**	**0.32**	**0.43**	**0.57**	**0.81**	**0.86**	**0.95**	**1.00**	**1.04**	**1.06**	**1.07**	**1.09**	**1.09**	**1.11**
2018	**0.00**	**0.03**	**0.29**	**0.42**	**0.59**	**0.78**	**0.83**	**0.88**	**0.94**	**1.02**	**1.06**	**1.08**	**1.11**	**1.11**	**1.12**
2019	**0.00**	**0.02**	**0.28**	**0.45**	**0.63**	**0.82**	**0.88**	**0.93**	**1.04**	**1.10**	**1.13**	**1.16**	**1.19**	**1.21**	**1.22**
2020	**0.00**	**0.05**	**0.35**	**0.48**	**0.66**	**0.82**	**0.88**	**0.99**	**1.12**	**1.17**	**1.19**	**1.22**	**1.25**	**1.26**	**1.27**

Cumulative Prepayment Rates   **Fixed Rate 15 Year Streamline Refinance Mortgages**   **by Credit Subsidy Endorsement Cohort**

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1992	0.66	10.58	26.75	32.21	40.13	46.29	54.59	62.63	66.73	71.47	77.64	83.17	86.78	89.55	92.53
1993	1.12	7.71	13.03	20.99	28.34	37.94	48.14	53.89	60.33	67.85	76.40	81.39	84.95	88.23	92.16
1994	1.40	5.39	12.18	18.96	28.02	38.00	44.12	51.18	59.30	68.87	75.04	79.51	83.42	86.64	93.49
1995	1.88	11.25	18.70	29.60	41.67	47.45	53.85	62.22	70.39	75.67	79.26	82.09	84.92	86.94	92.27
1996	0.93	5.40	14.79	26.96	33.82	42.27	52.64	65.44	73.01	77.57	81.35	83.89	86.30	88.86	92.94
1997	1.28	10.58	23.66	30.17	38.06	50.00	63.54	71.42	76.47	80.33	83.12	85.14	87.18	89.32	93.07
1998	1.16	8.42	14.36	23.31	36.18	55.82	66.02	71.80	76.24	79.31	82.08	84.23	86.41	88.71	92.07
1999	1.36	5.60	13.72	26.16	46.25	57.76	64.79	69.87	73.36	76.29	78.85	81.17	84.00	86.81	**91.09**
2000	2.24	14.19	29.58	49.97	62.82	69.50	74.49	77.66	79.85	81.92	83.81	85.04	86.57	**89.91**	**92.10**
2001	1.38	14.53	46.44	62.00	70.18	74.41	77.49	79.88	81.58	83.21	84.87	86.32	**89.40**	**91.66**	**93.40**
2002	2.79	27.30	43.18	53.97	60.34	64.70	67.92	70.70	73.15	75.47	77.94	**82.81**	**86.39**	**89.12**	**91.23**
2003	6.36	18.43	31.19	40.03	46.25	50.84	54.81	58.30	61.87	65.59	**72.65**	**77.93**	**81.89**	**85.10**	**88.07**
2004	5.09	15.86	25.31	32.28	37.30	41.38	45.21	48.93	52.69	**61.58**	**68.65**	**73.93**	**78.26**	**82.12**	**85.25**
2005	4.61	13.10	20.69	25.95	29.88	33.93	37.89	42.03	**52.07**	**59.70**	**65.22**	**69.74**	**73.70**	**77.46**	**80.92**
2006	2.90	10.47	16.93	22.80	27.48	31.14	35.31	**47.77**	**56.52**	**62.07**	**66.16**	**69.91**	**73.50**	**77.11**	**80.57**
2007	1.10	9.81	19.87	26.68	30.47	35.24	**48.01**	**54.88**	**58.81**	**62.86**	**66.80**	**70.49**	**74.15**	**77.21**	**80.18**
2008	1.25	9.79	17.19	22.89	30.88	**45.94**	**54.31**	**58.44**	**61.46**	**64.80**	**68.51**	**72.01**	**75.57**	**78.14**	**81.40**
2009	0.88	6.57	16.04	28.32	**44.18**	**50.25**	**53.59**	**56.50**	**59.67**	**63.18**	**66.78**	**70.29**	**74.10**	**77.46**	**80.67**
2010	1.57	10.22	23.67	**37.98**	**44.12**	**47.85**	**50.97**	**54.48**	**58.51**	**62.51**	**66.19**	**70.22**	**74.19**	**77.95**	**81.61**
2011	1.50	35.00	**50.73**	**56.38**	**59.49**	**61.72**	**64.32**	**67.42**	**70.56**	**73.63**	**77.03**	**80.37**	**83.62**	**86.59**	**89.41**
2012	1.65	**16.29**	**23.33**	**27.92**	**32.13**	**36.38**	**41.45**	**46.88**	**52.59**	**58.73**	**64.25**	**69.64**	**75.11**	**80.00**	**84.54**
2013	**4.16**	**13.80**	**20.43**	**25.41**	**30.33**	**36.40**	**41.26**	**47.17**	**53.33**	**59.39**	**64.94**	**69.86**	**75.28**	**80.10**	**84.52**
2014	**4.11**	**15.18**	**24.21**	**32.27**	**38.57**	**45.39**	**51.08**	**57.09**	**62.51**	**67.78**	**72.18**	**76.18**	**80.52**	**84.24**	**87.81**
2015	**3.74**	**15.98**	**28.83**	**38.46**	**45.12**	**52.07**	**57.94**	**63.76**	**68.40**	**73.08**	**77.03**	**80.24**	**84.10**	**86.89**	**89.99**
2016	**2.76**	**15.16**	**28.69**	**38.99**	**45.97**	**52.67**	**58.90**	**64.10**	**68.48**	**73.02**	**76.68**	**79.97**	**83.55**	**86.69**	**89.76**
2017	**2.55**	**13.95**	**26.22**	**34.45**	**40.47**	**46.43**	**51.69**	**57.09**	**61.98**	**66.99**	**71.49**	**75.48**	**79.98**	**83.81**	**87.38**
2018	**3.38**	**14.06**	**25.03**	**32.93**	**39.80**	**46.34**	**51.77**	**57.66**	**62.83**	**67.78**	**72.54**	**76.62**	**80.80**	**84.53**	**87.84**
2019	**2.30**	**11.68**	**22.89**	**31.72**	**38.12**	**44.81**	**50.88**	**56.98**	**62.52**	**67.92**	**72.46**	**76.43**	**80.62**	**84.21**	**87.70**
2020	**2.39**	**13.22**	**26.71**	**35.12**	**41.37**	**48.56**	**54.54**	**60.54**	**65.68**	**70.60**	**74.76**	**78.36**	**82.29**	**85.61**	**88.81**

Conditional Claim Rates   **Adjustable Rate Mortgages**   **by Credit Subsidy Endorsement Cohort**

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1991	0.02	0.13	0.63	1.04	1.40	1.63	2.25	2.42	1.88	1.58	0.91	0.44	0.45	0.51	0.13	0.15	0.15	0.07	0.24	0.30	0.11	0.29	0.41	0.23	0.52	0.43	0.77	0.68	0.69	0.63
1992	0.00	0.16	0.66	1.10	1.62	2.34	2.36	1.92	1.60	0.84	0.61	0.58	0.36	0.26	0.20	0.11	0.18	0.27	0.21	0.17	0.37	0.48	0.54	0.51	0.50	0.92	1.03	0.82	0.80	0.83
1993	0.00	0.15	0.72	1.38	2.65	2.47	2.19	1.79	1.06	0.74	0.75	0.47	0.28	0.27	0.24	0.23	0.33	0.51	0.31	0.40	0.74	0.68	0.69	1.07	1.14	1.02	0.76	0.81	1.16	0.92
1994	0.00	0.17	0.92	2.15	2.75	2.65	1.98	1.10	0.91	0.93	0.69	0.37	0.37	0.23	0.25	0.31	0.51	0.48	0.35	0.93	0.96	0.97	0.96	1.25	1.26	1.30	1.43	1.27	1.41	1.06
1995	0.01	0.34	1.83	3.20	4.09	3.16	2.04	1.84	2.10	1.57	0.99	0.77	0.49	0.67	0.74	1.12	0.86	0.72	1.45	1.20	1.39	1.29	1.96	1.95	1.69	1.28	1.49	1.71	1.08	1.18
1996	0.00	0.33	1.75	3.78	3.96	2.72	2.79	3.18	2.13	1.37	1.09	0.71	1.23	1.17	1.23	1.42	1.23	1.70	1.77	1.60	1.88	2.30	1.83	1.97	1.70	1.96	1.96	1.77	1.78	1.42
1997	0.01	0.42	2.00	3.30	2.91	3.53	3.88	2.56	1.78	1.38	1.26	1.44	1.51	1.64	1.40	1.51	2.04	2.10	1.83	1.88	2.41	2.24	2.13	2.15	2.11	1.78	1.96	1.88	1.60	1.36
1998	0.01	0.79	2.24	2.49	2.98	3.60	2.65	1.91	1.50	1.31	1.63	1.54	2.10	1.46	1.71	2.39	2.34	2.07	2.18	2.63	2.52	2.01	2.21	2.11	1.92	2.19	2.07	1.70	1.53	1.18
1999	0.00	0.23	0.84	1.99	3.18	2.83	1.77	1.56	1.63	1.35	2.66	2.66	2.19	2.82	3.18	3.25	2.90	3.29	2.72	2.49	2.13	2.12	2.55	2.35	1.89	1.94	2.10	1.58	1.88	1.44
2000	0.01	0.51	1.68	3.26	2.99	2.37	2.00	2.15	2.83	3.42	3.03	2.64	2.63	3.41	3.09	3.08	3.35	3.41	3.02	2.75	2.57	2.81	2.19	2.31	2.77	1.79	1.91	2.18	1.60	1.38
2001	0.00	0.33	1.25	1.87	1.47	2.12	2.05	2.86	3.80	3.73	3.53	3.35	3.44	3.69	2.83	2.99	3.26	2.63	3.21	2.86	3.00	2.12	2.26	2.39	2.07	1.61	0.94	1.99	2.51	0.81
2002	0.00	0.23	1.45	1.85	2.20	2.85	4.61	5.26	5.03	4.58	4.31	4.84	4.23	3.34	3.70	3.03	2.98	2.60	2.34	2.74	2.46	2.31	2.42	2.28	1.94	1.50	1.85	1.67	1.71	1.36
2003	0.01	0.54	1.48	2.13	3.56	5.37	5.76	6.17	4.35	4.73	5.58	5.13	4.26	4.55	3.93	3.77	2.99	2.95	3.45	3.28	2.70	3.05	2.56	2.29	2.02	1.79	2.16	2.04	1.14	1.27
2004	0.08	0.64	1.61	3.05	5.54	6.29	5.82	4.70	4.82	6.82	6.30	4.77	4.58	4.89	4.20	3.85	3.38	3.78	3.48	2.97	2.99	2.86	2.88	3.11	2.12	1.86	1.63	1.85	1.51	1.16
2005	0.09	0.86	2.43	5.06	6.43	6.96	4.98	5.11	8.05	8.49	7.68	7.13	7.21	6.42	6.06	5.53	5.24	4.76	4.41	4.28	3.97	3.33	3.06	2.83	2.71	1.96	2.20	1.91	1.64	
2006	0.02	1.12	3.46	6.96	9.01	7.04	7.05	8.23	9.07	7.21	8.19	7.52	7.22	6.54	6.73	5.29	4.22	4.67	4.28	4.05	3.29	3.41	3.51	2.45	3.04	2.79	2.00	1.65	1.45	1.16
2007	0.00	1.02	4.98	9.73	9.01	8.82	10.22	11.67	9.97	8.63	9.29	8.18	6.88	6.90	6.73	5.45	4.85	3.57	3.96	3.89	4.08	3.65	1.99	3.61	2.68	2.09	2.93	1.87	1.13	1.37
2008	0.01	0.57	4.08	6.77	8.24	11.05	12.27	11.62	10.07	8.98	7.28	6.28	6.04	5.28	5.15	4.27	4.29	3.95	3.85	3.00	2.58	2.45	3.20	1.94	1.72	1.26	1.62	2.20	1.37	1.49
2009	0.09	0.93	2.45	3.25	6.13	7.11	6.77	6.05	5.36	4.91	4.77	4.04	4.05	3.89	3.20	3.69	3.81	3.77	2.06	2.31	2.35	2.34	1.99	1.92	1.87	1.54	1.12	2.33	1.30	1.64
2010	0.01	0.17	0.64	1.96	2.97	2.72	2.88	3.00	2.75	2.70	2.66	2.88	2.57	2.39	2.59	2.33	2.60	2.02	2.10	1.60	1.97	1.89	1.82	1.44	1.27	1.53	1.32	1.13	1.10	1.01
2011	0.00	0.19	0.81	1.85	2.37	2.79	2.92	2.60	2.56	2.56	2.75	2.36	1.90	2.01	1.95	2.15	1.94	2.15	1.87	1.60	1.65	1.64	1.51	1.51	1.65	1.36	1.39	1.47	1.12	0.85
2012	0.00	0.20	0.95	1.89	2.79	3.57	3.28	3.66	4.27	4.10	2.86	2.32	2.71	2.21	1.86	1.67	1.60	2.30	1.86	2.18	1.75	2.44	1.96	2.36	0.65	0.82	0.96	1.75	1.29	0.70
2013	0.00	0.25	0.99	1.02	2.61	2.61	1.80	3.27	5.26	5.41	3.99	2.69	6.34	2.28	1.87	1.99	1.09	5.33	0.56	0.95	0.89	3.93	1.13	3.48	2.42	0.22	1.07	2.68	0.16	0.89
2014	0.00	0.36	2.27	1.90	3.23	3.06	2.26	5.18	5.56	6.74	3.25	3.26	7.05	4.44	3.07	2.87	1.01	1.78	1.33	1.09	2.41	4.82	1.10	2.78	3.16	1.06	1.75	4.43	0.03	1.56
2015	0.00	0.60	3.05	2.23	4.06	3.31	2.77	5.41	7.11	7.93	4.18	3.66	7.61	3.90	4.10	3.57	0.66	1.26	1.22	0.94	3.55	4.26	0.02	3.62	2.07	0.25	4.05	4.58	0.00	0.62
2016	0.00	0.83	2.59	2.17	3.86	4.10	2.34	6.94	6.63	8.44	3.99	4.83	6.23	3.76	2.56	3.97	1.85	1.66	1.34	0.96	3.45	3.65	0.94	2.36	1.40	0.99	4.54	5.12	0.00	0.70
2017	0.00	0.78	2.19	2.10	3.60	4.21	2.67	5.55	6.76	7.80	4.25	4.21	7.37	3.61	4.78	3.54	2.75	1.82	1.92	1.55	3.35	2.96	0.46	4.07	1.79	0.02	3.46	4.54	0.00	1.64
2018	0.00	0.76	2.51	2.21	3.58	3.45	2.32	6.36	6.74	6.95	4.05	3.87	6.54	3.55	4.50	2.69	2.03	1.81	1.77	1.27	1.86	4.71	0.59	3.05	2.44	0.47	3.54	6.25	0.39	0.61
2019	0.02	0.56	2.71	2.48	3.81	4.14	2.27	6.27	6.57	6.94	4.10	5.28	7.62	4.37	3.78	3.02	1.34	1.36	2.74	1.53	1.88	3.13	1.40	4.85	3.24	0.04	2.50	6.07	0.06	0.45
2020	0.00	0.72	2.45	2.65	3.78	3.73	2.82	6.01	5.78	8.21	3.77	3.94	7.52	5.02	5.85	2.90	0.82	1.77	1.44	1.35	3.29	4.05	1.27	4.78	3.46	0.55	2.98	8.61	0.19	0.58

Conditional Prepayment Rates   Adjustable Rate Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1991	0.22	1.99	6.57	8.80	7.04	11.56	11.49	17.19	18.70	12.79	21.88	25.00	26.04	21.58	16.54	21.51	13.95	8.58	7.38	3.72	3.61	2.87	2.82	0.92	0.60	0.81	0.50	0.63	0.87	0.43
1992	0.22	3.13	6.82	7.04	13.15	11.88	19.89	20.21	13.11	21.75	24.31	27.28	22.29	17.47	17.19	14.61	10.65	5.77	4.98	4.03	4.06	3.21	0.99	0.85	0.77	0.96	0.95	0.87	0.68	0.55
1993	0.44	3.41	5.30	12.90	10.96	19.64	20.42	12.82	25.07	27.36	30.10	25.37	20.62	17.50	16.47	10.62	6.37	4.94	3.82	3.00	3.60	1.80	1.01	1.05	0.97	0.98	1.03	1.04	0.85	0.56
1994	0.30	2.47	9.91	11.38	21.39	20.47	12.98	25.53	27.06	31.18	26.72	21.86	19.51	16.64	11.24	5.09	4.39	3.70	3.29	3.26	1.70	1.47	1.06	1.32	1.14	1.11	0.93	0.75	0.72	0.52
1995	1.70	10.18	15.64	31.41	23.17	13.53	25.49	26.49	28.59	26.81	23.78	21.52	17.78	10.29	5.19	3.72	2.47	2.56	3.80	1.90	1.18	1.26	1.40	1.38	1.70	0.96	1.09	0.52	0.59	0.35
1996	0.48	6.04	34.07	32.33	15.78	30.27	27.39	27.69	27.01	23.51	21.50	18.89	11.62	5.40	3.88	2.56	2.79	3.71	2.25	1.45	1.50	1.47	1.62	1.09	1.30	1.17	0.88	0.64	0.61	0.54
1997	0.93	18.35	34.36	18.61	36.91	27.39	27.59	25.72	23.21	21.86	19.14	12.31	5.64	3.92	2.57	1.99	3.95	2.81	1.80	1.56	1.75	1.43	1.51	1.51	1.33	1.02	0.74	0.86	0.59	0.46
1998	2.82	20.60	17.25	36.98	28.94	28.04	27.20	25.13	23.42	22.16	13.73	6.97	3.90	3.08	2.39	5.44	3.05	2.14	1.61	1.80	2.27	1.57	1.60	1.38	1.46	1.11	1.16	0.67	0.71	0.56
1999	0.39	3.97	32.47	31.26	30.32	25.77	27.76	27.01	26.84	17.11	7.17	4.41	2.98	2.63	6.21	3.84	3.31	1.95	2.55	2.31	2.50	1.72	1.91	1.34	1.67	0.71	0.83	0.94	0.64	0.53
2000	1.07	33.05	31.03	29.24	24.68	26.83	26.19	26.33	17.04	6.58	4.52	2.26	2.91	6.07	3.35	1.97	2.13	2.98	2.35	1.89	2.31	2.10	1.76	1.48	1.34	1.09	1.28	0.99	0.78	0.58
2001	4.97	20.07	29.68	26.02	31.56	30.78	30.54	18.06	8.37	4.95	3.15	2.94	5.89	3.15	2.16	2.01	2.58	3.08	2.60	2.95	1.95	1.48	1.50	1.25	1.69	1.41	1.21	1.30	0.73	0.77
2002	2.34	27.54	23.94	31.09	31.82	33.12	19.85	7.22	4.71	2.49	2.38	5.85	3.84	2.08	2.44	2.35	2.85	2.87	2.27	2.21	2.13	1.50	1.48	1.13	1.22	1.09	0.74	0.78	0.66	0.54
2003	8.03	22.25	33.99	35.40	34.77	20.61	7.16	4.09	3.10	2.58	5.47	3.90	2.28	1.94	3.13	3.39	3.05	2.71	2.51	2.23	2.14	1.52	1.15	1.42	1.00	0.97	0.97	0.72	0.36	0.22
2004	6.57	29.81	34.49	34.31	19.57	7.27	4.06	2.14	2.36	6.04	3.91	2.63	2.57	3.41	3.56	3.66	3.37	2.65	2.69	2.21	2.38	1.67	1.55	1.41	0.94	0.98	1.02	0.61	0.71	0.46
2005	9.18	22.06	25.69	19.13	7.01	3.59	1.80	2.00	5.22	2.66	1.86	1.87	2.49	2.68	2.73	2.36	2.41	2.50	2.05	1.88	1.39	1.60	1.10	1.03	1.00	0.78	0.62	0.65	0.33	0.31
2006	2.39	12.77	17.85	14.60	5.50	2.24	2.10	5.11	2.40	1.73	1.65	2.08	2.29	2.25	2.51	2.70	3.25	2.61	1.31	1.84	1.67	1.07	0.95	1.02	1.03	0.58	0.61	0.74	0.60	0.73
2007	1.59	11.62	19.31	12.00	4.39	4.43	5.57	2.14	1.98	1.88	2.30	2.58	3.18	3.04	2.52	2.45	2.82	2.95	1.98	1.63	1.10	1.90	1.11	0.82	1.30	1.49	0.71	0.27	0.63	1.09
2008	0.56	25.24	19.78	13.18	11.44	14.15	3.38	2.41	2.51	3.45	3.67	4.26	4.04	3.68	2.96	2.91	2.79	3.22	2.68	2.29	2.38	1.33	0.90	1.33	1.28	0.63	0.47	0.55	0.34	0.25
2009	12.79	19.92	16.86	12.68	17.42	6.42	4.40	4.71	5.71	7.53	5.98	7.45	5.65	4.27	5.12	5.59	3.67	2.82	3.09	2.42	1.98	2.14	1.74	0.68	1.61	1.17	0.52	0.39	1.03	0.73
2010	2.29	8.07	8.76	19.32	9.69	6.58	6.77	9.09	9.76	9.47	8.86	8.14	7.11	5.79	5.01	4.63	3.91	3.38	3.26	2.89	2.20	1.76	1.65	1.42	1.27	0.92	1.07	0.89	0.61	0.56
2011	1.54	10.18	29.31	16.81	10.67	10.87	13.56	14.27	13.39	11.68	10.12	7.96	6.40	5.91	5.33	4.99	4.54	3.79	3.27	2.58	2.41	1.97	1.79	1.13	0.86	0.91	1.02	0.75	0.60	0.38
2012	3.39	26.16	16.92	13.02	13.36	16.92	18.09	14.74	14.35	11.73	10.55	8.27	7.14	4.86	6.69	5.35	4.60	4.85	4.59	2.40	2.22	2.35	1.79	0.95	0.88	1.06	0.45	0.15	0.52	0.54
2013	5.08	10.65	12.59	10.56	13.00	20.63	16.63	14.81	11.77	10.71	7.07	2.94	10.51	4.25	5.77	2.87	2.03	0.77	4.11	2.93	5.24	0.58	1.63	0.37	3.43	1.89	0.54	0.00	0.85	0.11
2014	2.51	9.55	14.40	16.85	15.84	16.93	16.72	14.78	11.48	7.32	7.49	3.28	11.56	4.04	3.63	3.51	1.64	0.96	2.10	4.56	5.02	0.50	3.78	1.47	2.47	1.53	1.30	0.06	0.00	0.29
2015	2.48	13.25	23.07	19.26	17.26	16.69	17.08	13.20	9.40	6.12	5.45	2.83	11.35	2.47	3.65	4.20	0.98	0.11	3.10	2.31	3.23	0.43	2.58	0.63	1.14	0.78	1.09	0.01	0.00	0.18
2016	2.49	16.21	26.65	21.76	16.26	16.27	17.43	11.20	8.16	7.09	5.03	4.06	11.20	2.54	3.67	1.22	0.28	0.38	2.81	3.22	2.87	0.87	2.74	0.66	1.67	0.35	1.25	0.00	0.00	0.06
2017	2.75	17.74	27.03	21.34	17.85	16.99	13.94	11.78	9.95	5.21	6.60	3.72	11.31	3.73	3.75	3.45	1.31	0.46	2.58	2.01	3.07	0.76	2.11	0.00	1.52	1.58	0.79	0.28	0.33	0.16
2018	2.68	16.20	25.78	22.19	17.04	15.73	14.92	12.20	11.37	5.35	5.49	2.54	10.25	3.04	2.97	1.37	1.48	0.47	4.40	2.23	4.54	0.62	2.81	0.68	0.54	0.39	0.51	0.01	0.00	0.01
2019	2.51	15.48	26.91	22.89	15.98	15.59	16.02	12.62	11.39	7.57	5.58	2.23	10.69	4.15	1.29	1.94	0.75	0.69	3.14	4.04	4.00	1.20	2.59	0.19	1.90	1.50	0.66	0.50	0.00	0.34
2020	2.60	17.50	29.21	21.52	17.98	17.90	16.43	14.02	11.06	6.37	5.83	3.38	9.32	3.90	2.68	1.27	1.92	0.72	2.32	2.60	3.69	0.77	2.64	0.00	1.37	1.16	0.39	0.28	0.00	0.08

Cumulative Claim Rates   Adjustable Rate Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1991	0.02	0.14	0.76	1.70	2.85	4.08	5.54	6.90	7.74	8.31	8.59	8.69	8.77	8.83	8.85	8.86	8.87	8.87	8.89	8.90	8.91	8.92	8.94	8.94	8.97	8.98	9.02	9.05	9.08	9.10
1992	0.00	0.16	0.81	1.79	3.12	4.76	6.18	7.08	7.66	7.92	8.06	8.16	8.21	8.24	8.25	8.26	8.27	8.29	8.30	8.30	8.32	8.34	8.36	8.38	8.40	8.44	8.48	8.51	8.54	8.58
1993	0.00	0.16	0.85	2.10	4.15	5.81	6.95	7.67	8.03	8.22	8.36	8.41	8.44	8.46	8.48	8.49	8.50	8.52	8.54	8.55	8.58	8.60	8.63	8.66	8.70	8.74	8.76	8.79	8.83	8.87
1994	0.00	0.17	1.07	2.94	5.00	6.50	7.36	7.77	8.02	8.20	8.29	8.33	8.35	8.37	8.38	8.39	8.41	8.43	8.45	8.48	8.51	8.55	8.58	8.62	8.66	8.70	8.75	8.79	8.83	8.87
1995	0.01	0.35	1.96	4.29	6.24	7.33	7.91	8.29	8.61	8.77	8.84	8.88	8.90	8.93	8.95	8.98	9.01	9.03	9.06	9.09	9.13	9.16	9.20	9.25	9.28	9.31	9.34	9.38	9.40	9.43
1996	0.00	0.33	1.97	4.23	5.74	6.57	7.14	7.60	7.81	7.90	7.96	7.99	8.03	8.06	8.10	8.13	8.16	8.20	8.24	8.27	8.31	8.36	8.39	8.43	8.46	8.49	8.53	8.56	8.58	8.61
1997	0.01	0.42	2.03	3.72	4.89	5.73	6.38	6.67	6.81	6.89	6.95	7.01	7.05	7.10	7.14	7.18	7.24	7.29	7.33	7.37	7.42	7.47	7.51	7.56	7.60	7.63	7.66	7.70	7.73	7.75
1998	0.01	0.78	2.50	4.03	5.14	6.05	6.51	6.74	6.87	6.96	7.04	7.11	7.19	7.24	7.30	7.38	7.46	7.52	7.58	7.65	7.71	7.76	7.82	7.87	7.91	7.95	8.00	8.03	8.07	8.10
1999	0.00	0.23	1.04	2.31	3.66	4.46	4.81	5.03	5.20	5.29	5.45	5.59	5.70	5.83	5.97	6.10	6.21	6.32	6.41	6.49	6.55	6.61	6.68	6.74	6.79	6.84	6.89	6.92	6.97	7.01
2000	0.01	0.52	1.62	3.07	3.96	4.47	4.77	5.01	5.23	5.44	5.61	5.75	5.88	6.04	6.17	6.29	6.41	6.53	6.63	6.72	6.80	6.88	6.93	6.99	7.06	7.11	7.15	7.21	7.24	7.28
2001	0.00	0.32	1.27	2.25	2.80	3.34	3.68	4.00	4.34	4.64	4.89	5.11	5.33	5.54	5.69	5.84	6.00	6.12	6.26	6.37	6.48	6.56	6.63	6.72	6.78	6.83	6.86	6.93	7.00	7.02
2002	0.00	0.23	1.26	2.24	3.01	3.67	4.35	4.94	5.43	5.83	6.19	6.56	6.85	7.05	7.27	7.44	7.60	7.73	7.84	7.96	8.06	8.16	8.25	8.34	8.41	8.46	8.53	8.59	8.65	8.70
2003	0.01	0.51	1.57	2.54	3.56	4.50	5.24	5.94	6.38	6.83	7.31	7.71	8.01	8.31	8.55	8.76	8.92	9.07	9.23	9.37	9.48	9.61	9.70	9.78	9.86	9.92	9.99	10.06	10.10	10.15
2004	0.08	0.68	1.73	3.00	4.43	5.65	6.62	7.33	8.01	8.90	9.62	10.10	10.53	10.96	11.30	11.58	11.81	12.05	12.26	12.43	12.58	12.72	12.86	13.00	13.10	13.18	13.25	13.33	13.39	13.44
2005	0.09	0.87	2.57	5.12	7.57	9.86	11.33	12.74	14.80	16.68	18.19	19.45	20.61	21.55	22.34	23.01	23.59	24.07	24.49	24.87	25.20	25.50	25.75	25.97	26.17	26.35	26.49	26.64	26.77	26.90
2006	0.02	1.13	4.05	8.67	13.36	16.49	19.34	22.37	25.25	27.28	29.37	31.10	32.59	33.82	34.97	35.79	36.39	37.00	37.52	37.98	38.34	38.70	39.04	39.28	39.55	39.80	39.97	40.11	40.25	40.36
2007	0.00	1.02	5.33	11.70	16.31	20.21	24.14	27.90	30.67	32.78	34.80	36.37	37.55	38.61	39.54	40.23	40.78	41.17	41.55	41.91	42.27	42.58	42.74	43.01	43.22	43.38	43.58	43.71	43.79	43.92
2008	0.01	0.58	3.61	7.43	11.15	15.16	18.47	21.11	23.08	24.61	25.69	26.52	27.24	27.80	28.29	28.67	29.02	29.32	29.59	29.79	29.96	30.10	30.28	30.39	30.49	30.55	30.64	30.75	30.82	30.90
2009	0.09	0.91	2.62	4.44	7.33	9.88	11.98	13.64	14.95	16.01	16.92	17.60	18.20	18.72	19.12	19.54	19.93	20.29	20.47	20.66	20.85	21.03	21.18	21.32	21.45	21.55	21.63	21.80	21.89	22.01
2010	0.10	0.18	0.76	2.37	4.28	5.80	7.26	8.64	9.74	10.69	11.51	12.29	12.91	13.43	13.95	14.38	14.83	15.15	15.47	15.70	15.97	16.22	16.45	16.63	16.79	16.97	17.13	17.26	17.40	17.53
2011	0.00	0.19	0.91	2.05	3.25	4.47	5.56	6.38	7.04	7.60	8.11	8.49	8.77	9.03	9.27	9.52	9.72	9.93	10.11	10.25	10.39	10.52	10.64	10.76	10.88	10.98	11.08	11.19	11.27	11.35
2012	0.00	0.20	0.89	1.99	3.38	4.87	5.95	6.90	7.81	8.51	8.92	9.21	9.51	9.73	9.91	10.05	10.17	10.35	10.47	10.61	10.72	10.86	10.98	11.11	11.14	11.19	11.24	11.33	11.40	11.46
2013	0.00	0.24	1.08	1.84	3.53	4.95	5.71	6.82	8.30	9.55	10.30	10.76	11.78	12.08	12.32	12.54	12.66	13.24	13.30	13.38	13.47	13.79	13.89	14.18	14.36	14.37	14.45	14.63	14.65	14.72
2014	0.00	0.35	2.35	3.75	5.67	7.13	8.00	9.61	11.00	12.38	12.95	13.47	14.48	15.00	15.32	15.62	15.71	15.88	16.00	16.09	16.30	16.66	16.73	16.94	17.15	17.22	17.35	17.62	17.62	17.75
2015	0.00	0.59	3.15	4.54	6.51	7.77	8.62	9.94	11.37	12.68	13.27	13.74	14.63	15.00	15.35	15.65	15.69	15.79	15.88	15.95	16.20	16.48	16.48	16.71	16.83	16.85	17.09	17.35	17.35	17.42
2016	0.00	0.81	2.91	4.16	5.83	7.25	7.89	9.42	10.61	11.91	12.42	12.97	13.63	13.96	14.18	14.48	14.61	14.72	14.82	14.88	15.10	15.32	15.37	15.51	15.59	15.65	15.95	16.20	16.20	16.26
2017	0.00	0.76	2.50	3.67	5.21	6.63	7.33	8.54	9.79	10.96	11.52	12.01	12.80	13.11	13.48	13.74	13.92	14.04	14.17	14.25	14.46	14.62	14.65	14.87	14.96	14.96	15.17	15.39	15.39	15.48
2018	0.00	0.74	2.77	4.05	5.61	6.80	7.44	8.90	10.18	11.24	11.78	12.25	12.99	13.32	13.71	13.93	14.08	14.21	14.35	14.43	14.57	14.87	14.90	15.09	15.22	15.24	15.49	15.82	15.84	15.88
2019	0.02	0.57	2.79	4.21	5.83	7.24	7.86	9.25	10.45	11.48	12.00	12.61	13.42	13.79	14.08	14.31	14.40	14.50	14.68	14.78	14.90	15.08	15.16	15.43	15.59	15.59	15.75	16.02	16.02	16.05
2020	0.00	0.71	2.66	4.09	5.64	6.83	7.53	8.74	9.68	10.78	11.21	11.62	12.35	12.74	13.15	13.35	13.40	13.51	13.59	13.66	13.84	14.04	14.10	14.34	14.49	14.51	14.66	15.01	15.02	15.05

Cumulative Prepayment Rates   Adjustable Rate Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1991	0.22	2.21	8.67	16.68	22.46	31.13	38.62	48.27	56.70	61.28	67.98	73.88	78.46	81.25	82.91	84.71	85.62	86.10	86.48	86.66	86.82	86.95	87.07	87.10	87.13	87.16	87.18	87.21	87.25	87.27
1992	0.22	3.37	9.97	16.29	27.10	35.43	47.39	56.82	61.58	68.32	74.13	79.04	81.92	83.67	85.08	86.07	86.68	86.98	87.22	87.40	87.58	87.72	87.76	87.79	87.83	87.86	87.90	87.94	87.96	87.99
1993	0.45	3.86	8.98	20.65	29.16	42.32	52.96	58.13	66.76	73.69	79.18	82.37	84.30	85.58	86.58	87.11	87.40	87.60	87.76	87.87	88.00	88.07	88.10	88.14	88.17	88.20	88.24	88.27	88.30	88.32
1994	0.30	2.78	12.42	22.30	38.37	50.01	55.69	65.17	72.53	78.65	82.19	84.30	85.75	86.74	87.30	87.52	87.71	87.85	87.98	88.10	88.16	88.21	88.25	88.29	88.33	88.36	88.39	88.42	88.44	88.46
1995	1.71	11.76	25.56	48.40	59.40	64.07	71.40	76.91	81.17	83.93	85.69	86.88	87.64	88.00	88.16	88.27	88.34	88.41	88.51	88.56	88.58	88.61	88.65	88.68	88.72	88.74	88.76	88.77	88.78	88.79
1996	0.49	6.53	38.39	57.73	63.76	73.03	78.64	82.60	85.27	86.91	88.04	88.80	89.18	89.33	89.43	89.50	89.56	89.65	89.70	89.73	89.76	89.79	89.82	89.84	89.87	89.89	89.90	89.91	89.93	89.94
1997	0.93	19.22	46.91	56.45	71.20	77.78	82.36	85.28	87.16	88.49	89.38	89.84	90.02	90.13	90.21	90.26	90.36	90.43	90.48	90.51	90.55	90.58	90.61	90.64	90.66	90.68	90.70	90.71	90.72	90.73
1998	2.84	22.94	36.15	58.93	69.69	76.79	81.49	84.53	86.60	88.05	88.74	89.04	89.19	89.31	89.39	89.58	89.67	89.73	89.78	89.83	89.89	89.92	89.96	90.00	90.03	90.05	90.08	90.09	90.11	90.12
1999	0.39	4.37	35.48	55.40	68.31	75.59	81.17	84.99	87.68	88.91	89.33	89.56	89.71	89.83	90.11	90.26	90.38	90.45	90.54	90.61	90.68	90.73	90.79	90.82	90.86	90.88	90.90	90.92	90.94	90.96
2000	1.07	33.92	54.34	67.29	74.66	80.44	84.42	87.28	88.60	89.01	89.26	89.38	89.53	89.81	89.95	90.03	90.11	90.22	90.30	90.36	90.42	90.49	90.53	90.57	90.61	90.64	90.67	90.69	90.71	90.73
2001	4.99	24.17	46.72	60.34	72.23	79.96	85.09	87.12	87.87	88.26	88.49	88.69	89.06	89.24	89.35	89.45	89.58	89.72	89.83	89.95	90.02	90.07	90.13	90.17	90.22	90.27	90.31	90.34	90.37	90.40
2002	2.35	29.42	46.38	62.78	73.97	81.64	84.57	85.37	85.83	86.05	86.25	86.70	86.96	87.09	87.24	87.37	87.52	87.67	87.77	87.87	87.96	88.03	88.08	88.13	88.17	88.21	88.24	88.27	88.30	88.31
2003	8.09	28.68	52.92	69.12	79.02	82.62	83.55	84.01	84.33	84.57	85.05	85.35	85.51	85.64	85.84	86.03	86.19	86.33	86.45	86.55	86.64	86.70	86.74	86.79	86.83	86.86	86.90	86.92	86.94	86.95
2004	6.65	34.65	57.06	71.26	76.31	77.72	78.40	78.73	79.06	79.86	80.30	80.57	80.81	81.11	81.40	81.67	81.90	82.07	82.23	82.36	82.49	82.57	82.65	82.72	82.76	82.80	82.85	82.88	82.91	82.93
2005	9.33	29.45	47.46	57.04	59.71	60.89	61.42	61.98	63.32	63.90	64.27	64.60	65.01	65.40	65.76	66.05	66.32	66.58	66.77	66.94	67.06	67.19	67.27	67.35	67.42	67.47	67.51	67.56	67.58	67.61
2006	2.41	14.94	29.98	39.65	42.50	43.49	44.33	46.21	46.97	47.45	47.87	48.36	48.83	49.26	49.69	50.12	50.59	50.94	51.10	51.31	51.49	51.60	51.70	51.80	51.91	51.96	52.02	52.09	52.15	52.21
2007	1.60	13.10	29.79	37.60	39.84	41.80	43.93	44.62	45.17	45.63	46.13	46.64	47.19	47.67	48.02	48.33	48.65	48.97	49.17	49.33	49.43	49.59	49.68	49.75	49.85	49.97	50.02	50.04	50.09	50.19
2008	0.57	25.80	40.42	47.83	53.01	58.10	59.01	59.56	60.05	60.64	61.19	61.75	62.23	62.63	62.91	63.17	63.41	63.66	63.86	64.01	64.16	64.24	64.30	64.37	64.44	64.48	64.51	64.54	64.56	64.58
2009	12.87	30.33	41.97	49.07	57.23	59.52	60.88	62.17	63.56	65.20	66.33	67.60	68.44	69.02	69.66	70.31	70.69	70.96	71.24	71.44	71.61	71.77	71.90	71.95	72.06	72.14	72.18	72.20	72.28	72.35
2010	2.32	10.26	18.18	33.99	40.21	43.89	47.33	51.50	55.43	58.76	61.50	63.72	65.45	66.72	67.74	68.60	69.28	69.83	70.33	70.75	71.06	71.30	71.51	71.69	71.85	71.96	72.09	72.19	72.27	72.34
2011	1.56	11.65	37.75	48.14	53.49	58.24	63.35	67.83	71.32	73.87	75.77	77.07	78.01	78.80	79.46	80.04	80.52	80.90	81.21	81.44	81.65	81.81	81.95	82.04	82.11	82.17	82.25	82.30	82.35	82.38
2012	3.42	28.95	41.02	48.64	55.29	62.34	68.31	72.14	75.18	77.20	78.72	79.76	80.55	81.05	81.67	82.13	82.50	82.87	83.19	83.35	83.49	83.63	83.73	83.78	83.83	83.88	83.91	83.91	83.94	83.97
2013	5.14	15.32	26.01	33.75	42.16	53.49	60.47	65.51	68.80	71.29	72.65	73.16	74.88	75.45	76.21	76.55	76.77	76.86	77.27	77.56	78.05	78.10	78.24	78.26	78.53	78.68	78.72	78.72	78.78	78.79
2014	2.53	11.90	24.62	37.01	46.44	54.63	61.10	65.73	68.58	70.09	71.41	71.93	73.67	74.16	74.56	74.92	75.08	75.17	75.37	75.77	76.20	76.23	76.52	76.62	76.79	76.90	76.98	76.98	76.98	77.00
2015	2.50	15.51	34.96	46.96	55.37	61.81	67.08	70.33	72.20	73.22	74.00	74.38	75.76	76.00	76.33	76.69	76.77	76.78	77.01	77.18	77.41	77.44	77.61	77.66	77.73	77.78	77.84	77.84	77.84	77.85
2016	2.51	18.43	40.08	52.57	59.66	65.33	70.17	72.65	74.14	75.24	75.89	76.37	77.60	77.82	78.13	78.23	78.25	78.28	78.49	78.71	78.92	78.97	79.13	79.18	79.27	79.29	79.35	79.35	79.35	79.36
2017	2.76	20.15	41.66	53.66	61.33	67.07	70.78	73.39	75.20	75.99	76.87	77.30	78.53	78.86	79.17	79.44	79.52	79.55	79.73	79.86	80.05	80.10	80.22	80.22	80.30	80.39	80.43	80.45	80.46	80.48
2018	2.70	18.59	39.51	52.41	59.88	65.36	69.59	72.42	74.57	75.40	76.14	76.45	77.65	77.94	78.20	78.32	78.43	78.47	78.80	78.96	79.26	79.30	79.48	79.53	79.56	79.58	79.61	79.61	79.61	79.61
2019	2.53	17.75	39.87	53.09	59.96	65.37	69.82	72.67	74.75	75.88	76.60	76.85	78.01	78.37	78.48	78.63	78.68	78.73	78.95	79.20	79.46	79.53	79.67	79.68	79.78	79.86	79.90	79.93	79.93	79.95
2020	2.61	19.80	43.16	54.90	62.34	68.15	72.31	75.17	76.97	77.84	78.52	78.87	79.78	80.09	80.29	80.37	80.49	80.54	80.68	80.84	81.04	81.08	81.21	81.21	81.28	81.33	81.35	81.36	81.36	81.37

Conditional Claim Rates   Adjustable Rate Streamline Refinance Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1994	0.01	0.55	2.21	3.74	3.38	3.05	1.84	0.89	0.62	0.31	0.25	0.09	0.07	0.00	0.06	0.11	0.45	0.33	0.13	0.51	0.78	0.70	0.45	0.54	0.61	0.76	0.79	0.70	0.62	0.40
1995	0.00	0.60	2.29	2.59	3.91	3.87	1.25	0.98	1.79	0.46	0.32	1.54	0.79	0.53	0.68	0.49	0.68	0.00	0.62	0.00	1.41	1.56	0.67	1.29	1.45	0.77	0.49	1.16	0.65	0.00
1996	0.01	0.44	2.25	4.06	3.13	1.45	1.69	0.66	0.99	1.16	0.82	0.71	0.54	0.26	1.34	0.39	0.29	1.56	1.80	1.78	0.86	1.25	1.48	0.66	1.25	0.66	1.05	0.79	0.00	0.23
1997	0.01	0.42	2.19	3.78	2.90	2.45	2.20	1.25	0.77	0.36	0.77	1.12	0.97	1.29	0.90	1.31	3.78	1.76	2.03	2.69	2.39	0.47	0.20	0.17	0.17	1.17	1.65	0.86	0.50	0.00
1998	0.01	0.34	1.24	1.40	1.61	1.82	1.71	1.32	0.64	0.00	0.56	0.34	1.11	0.64	1.12	3.39	2.11	2.32	0.81	2.25	0.43	1.07	1.59	2.35	0.72	1.43	1.54	1.09	0.68	0.81
1999	0.00	0.14	0.48	0.93	2.40	1.69	1.26	0.54	0.83	0.56	1.11	0.71	2.19	1.69	4.40	2.50	2.81	1.60	2.04	1.36	1.68	1.58	0.68	1.28	0.35	0.58	0.88	0.00	0.53	0.18
2000	0.00	0.39	1.82	4.22	2.67	2.94	1.99	1.75	2.42	1.24	4.38	1.99	2.34	3.44	2.34	3.06	1.68	2.53	1.03	2.24	0.15	1.80	1.12	1.03	0.34	0.88	0.47	0.38	0.54	0.09
2001	0.03	0.19	1.92	2.90	2.07	1.83	1.79	2.94	5.96	4.53	4.02	1.47	5.78	6.22	3.49	3.51	2.71	2.04	1.35	1.92	1.32	1.38	1.67	1.38	1.32	1.14	0.00	0.00	0.10	0.18
2002	0.01	0.40	1.79	2.10	2.49	2.97	4.86	4.80	5.20	3.59	3.73	5.41	5.80	3.61	2.66	2.85	2.51	2.03	1.44	1.43	1.98	0.95	1.55	0.89	0.81	0.87	0.79	0.68	0.76	0.51
2003	0.02	0.81	2.19	2.84	3.27	5.72	5.44	5.63	4.85	4.55	6.50	5.78	3.66	2.76	2.96	2.58	2.53	2.19	1.94	1.46	1.82	1.29	1.05	1.24	1.11	1.20	0.66	0.40	0.17	
2004	0.13	1.26	2.81	3.65	6.20	6.63	5.89	3.87	4.72	7.04	6.47	3.92	3.34	3.01	2.92	2.74	2.16	2.71	1.54	1.82	1.69	1.19	1.54	0.94	1.24	0.78	0.80	0.96	0.77	0.69
2005	0.26	2.04	4.06	5.40	6.76	5.60	4.70	4.49	6.94	5.97	4.98	4.68	4.55	3.92	3.98	3.11	2.70	2.13	2.13	2.02	1.75	1.70	1.16	1.35	1.36	1.04	1.17	0.76	0.59	0.53
2006	0.00	2.49	6.58	7.25	11.84	3.67	5.12	7.41	6.93	5.02	4.86	5.12	5.03	4.71	3.57	4.62	2.66	4.60	4.15	2.14	0.80	1.73	0.00	1.24	0.00	0.82	1.34	0.00	0.00	0.00
2007	0.00	2.34	4.05	11.85	8.38	1.98	13.94	15.11	10.03	5.90	3.11	2.71	2.21	8.26	6.22	3.81	2.67	3.30	5.28	1.58	9.22	7.39	4.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2008	0.00	1.06	6.86	10.02	6.87	17.59	19.58	14.14	15.64	9.58	8.07	7.89	7.22	4.87	5.06	3.09	4.28	5.92	4.61	1.48	1.91	1.77	4.14	1.52	2.76	0.76	1.75	0.00	1.32	0.00
2009	0.04	0.80	3.26	5.75	14.72	14.41	10.44	9.20	7.21	6.44	5.76	4.03	3.39	4.11	5.44	3.10	2.73	2.86	3.14	2.36	2.92	1.71	1.41	1.14	1.46	1.06	1.63	0.58	1.16	0.91
2010	0.12	1.40	3.45	9.58	10.48	7.74	6.50	5.72	4.33	4.12	3.43	4.28	3.52	3.50	3.22	2.40	2.57	2.04	2.05	1.66	1.38	1.67	0.97	0.85	0.95	0.63	0.69	0.85	0.98	0.38
2011	0.03	0.81	3.75	4.66	4.22	3.78	4.05	3.36	3.68	3.56	3.17	3.20	2.51	2.34	2.04	1.60	1.78	1.50	1.42	1.10	1.37	1.12	0.69	0.82	0.77	0.76	0.70	0.38	0.40	0.28
2012	0.06	0.91	2.36	2.49	2.87	2.97	2.81	3.41	4.48	4.82	3.99	4.22	4.05	1.65	1.47	1.74	1.59	1.72	1.03	0.80	0.99	1.10	0.92	0.77	0.30	0.66	1.17	0.00	0.13	0.25
2013	0.00	0.67	1.46	0.59	1.40	2.18	1.33	3.35	6.31	5.36	2.53	2.89	8.36	0.35	2.16	0.87	1.27	0.40	0.00	0.36	0.41	0.68	0.23	0.00	1.97	0.00	0.69	3.94	0.00	0.34
2014	0.00	0.33	2.35	0.86	1.12	2.08	1.85	2.90	6.50	7.11	1.92	3.39	10.81	1.27	1.42	1.51	1.02	0.00	0.45	0.42	1.02	2.80	0.00	0.00	1.58	0.00	0.53	2.98	0.00	0.00
2015	0.00	0.45	2.57	1.55	1.32	1.95	1.54	4.48	6.35	8.28	3.03	2.30	10.45	1.79	1.45	1.29	0.83	0.00	0.12	0.00	0.79	3.63	0.71	1.82	2.83	0.00	0.40	2.98	0.00	0.00
2016	0.00	0.39	2.67	2.32	1.10	2.89	1.48	3.55	6.01	9.19	4.70	1.86	10.71	1.11	2.96	0.46	0.58	0.00	0.23	0.00	0.25	3.66	0.19	0.23	1.57	0.00	0.00	3.52	0.00	0.00
2017	0.00	0.50	2.56	1.16	1.14	2.47	1.12	2.34	4.89	6.05	2.10	2.10	9.34	2.11	4.38	3.87	1.95	0.00	1.26	1.04	5.44	0.51	0.08	0.00	0.69	0.00	0.00	3.49	0.00	0.00
2018	0.00	0.46	2.32	1.73	1.81	3.19	1.16	3.01	6.01	7.34	3.15	2.22	11.73	2.53	4.44	0.80	0.52	0.00	0.93	0.42	1.76	1.32	0.09	0.00	0.44	0.00	0.00	5.67	0.00	0.31
2019	0.00	0.50	2.48	2.02	1.39	3.75	1.42	3.28	8.33	7.22	3.24	3.92	10.15	1.75	4.18	0.80	1.86	0.00	0.38	2.74	2.30	2.21	0.05	0.00	1.10	0.00	0.00	2.56	0.00	0.00
2020	0.00	0.61	3.22	1.92	1.58	3.54	1.48	3.93	6.74	9.20	2.81	3.64	9.48	4.15	2.65	2.01	0.54	0.00	0.55	1.03	2.42	1.31	0.30	0.44	1.55	0.00	0.00	5.31	0.05	0.00

Conditional Prepayment Rates   Adjustable Rate Streamline Refinance Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1994	2.66	6.34	10.75	9.81	15.62	16.12	12.38	20.56	22.88	28.71	23.39	19.60	17.79	15.94	10.58	8.95	4.68	3.87	3.21	3.91	2.17	2.01	1.60	1.35	1.57	1.72	1.51	1.12	0.95	0.55
1995	2.25	18.79	21.06	27.62	18.12	13.60	23.58	27.15	24.42	24.58	20.30	15.95	14.40	9.60	4.73	5.00	2.71	1.45	3.71	2.76	0.41	1.95	3.60	1.56	1.61	2.48	1.08	1.42	0.75	0.80
1996	3.13	22.57	42.04	34.18	15.39	29.26	28.57	30.62	26.90	24.46	21.75	15.68	14.81	6.67	4.54	4.74	2.03	3.76	3.01	1.60	2.67	1.87	1.46	3.30	1.52	1.33	1.38	2.06	0.75	0.07
1997	4.79	40.69	43.35	20.14	35.17	29.37	34.18	31.06	28.59	25.55	22.06	11.76	5.64	3.75	4.21	1.36	4.33	3.21	2.61	3.69	2.67	2.43	2.29	3.02	1.56	1.97	1.27	1.19	1.38	0.45
1998	10.69	42.35	23.04	41.33	35.61	37.34	30.91	29.90	25.54	23.70	15.52	7.60	3.78	3.53	3.80	6.23	3.02	2.45	2.21	3.38	4.01	3.62	1.94	1.99	2.78	2.05	2.35	1.67	0.94	0.99
1999	3.41	10.88	34.24	31.55	33.06	28.58	29.25	28.91	26.08	17.05	9.42	6.94	1.88	2.42	7.11	6.17	3.81	4.38	3.63	5.46	3.82	3.81	3.45	3.69	3.79	2.00	1.07	0.97	1.94	0.65
2000	2.64	23.07	22.00	19.84	23.51	24.87	27.88	27.49	13.98	3.23	3.70	1.69	1.88	7.17	6.17	5.26	3.26	7.78	5.93	3.79	2.74	2.85	1.76	1.44	2.09	2.89	1.34	1.95	1.23	0.00
2001	3.57	33.08	30.59	27.57	33.52	31.98	29.61	16.20	5.83	3.02	1.37	4.02	5.86	4.89	6.04	4.40	4.47	7.16	7.17	6.90	3.71	3.01	2.50	4.41	3.56	1.47	1.09	1.47	1.27	0.37
2002	6.26	35.80	27.90	31.41	32.29	32.01	19.14	7.38	3.52	2.47	2.00	6.00	4.89	4.20	4.02	4.27	5.25	4.73	4.44	4.77	3.93	3.56	2.83	2.78	2.47	2.14	2.09	1.52	1.38	0.57
2003	15.88	29.76	34.12	34.20	34.11	22.26	7.92	4.97	2.45	2.42	7.07	5.53	3.97	4.47	4.40	6.86	6.30	6.40	5.82	4.49	3.32	3.04	2.91	3.20	2.44	3.35	1.88	0.91	1.65	0.68
2004	12.24	31.44	31.21	30.43	18.90	6.58	4.02	2.07	2.34	7.14	6.07	4.92	4.90	6.24	7.25	6.36	6.40	6.69	5.69	4.73	4.50	3.87	3.62	2.99	2.75	2.21	1.97	1.86	1.31	0.77
2005	15.08	25.19	23.60	18.35	5.46	2.90	1.51	2.14	7.39	5.71	4.61	5.02	5.07	6.48	6.35	5.51	5.77	4.92	5.03	4.38	2.73	2.75	2.79	2.34	2.07	1.80	1.51	1.60	0.61	0.73
2006	6.86	16.67	17.55	11.48	4.00	1.03	1.59	7.63	3.70	2.05	3.10	5.09	5.24	7.94	10.16	4.62	7.67	4.18	1.09	1.51	4.67	0.72	2.63	4.17	2.49	1.50	0.00	0.00	0.57	1.02
2007	7.09	19.43	20.91	9.35	3.98	3.46	8.71	1.01	1.60	0.76	3.64	1.88	0.74	2.26	3.19	4.03	1.16	1.97	4.69	5.92	1.91	3.57	0.00	0.00	0.00	0.00	0.00	2.59	0.00	0.00
2008	3.34	29.70	9.24	5.09	5.29	7.14	3.20	1.49	1.99	2.27	2.72	5.16	5.33	3.42	5.46	5.24	2.37	2.67	3.86	2.16	3.58	3.66	1.94	2.42	2.74	0.50	1.74	0.61	1.26	1.51
2009	2.62	11.35	8.91	4.82	7.39	4.06	3.77	4.30	5.46	8.68	6.70	8.48	7.88	7.45	7.05	6.16	4.51	4.28	2.58	2.25	3.09	2.76	2.91	1.87	2.08	2.89	2.49	1.07	1.63	0.40
2010	4.24	11.33	5.43	8.94	5.72	5.81	6.32	8.08	9.80	11.04	11.04	9.70	9.49	7.18	7.32	6.80	6.41	5.13	5.08	3.90	3.86	2.56	2.46	1.94	2.51	1.59	2.37	1.27	1.05	1.21
2011	0.84	8.40	15.40	8.62	7.86	9.30	11.99	13.93	13.53	14.55	13.78	11.84	10.88	8.85	8.68	6.82	6.59	6.27	6.32	5.48	4.85	3.69	4.20	2.91	2.53	1.86	1.28	1.57	1.17	0.83
2012	1.99	16.67	11.72	9.28	10.65	15.32	18.15	15.03	16.46	16.72	13.55	11.11	10.20	7.54	10.58	7.58	8.86	8.39	7.08	6.64	8.23	6.04	5.50	2.54	2.30	0.89	0.55	0.40	0.17	0.42
2013	4.92	13.32	17.66	13.62	23.68	20.37	18.70	16.24	15.19	13.22	6.68	16.49	7.69	9.29	7.42	2.93	1.02	3.86	3.86	14.50	0.77	3.46	0.77	14.57	0.45	3.43	0.45	0.00	0.16	
2014	5.08	15.97	21.05	20.75	18.24	22.95	24.18	20.59	15.95	8.91	12.26	7.26	17.38	4.84	11.05	8.07	2.50	2.18	3.23	3.94	13.16	1.19	4.70	3.39	8.22	1.07	3.50	0.00	0.00	0.00
2015	5.50	20.48	31.50	24.63	21.20	23.77	26.49	19.11	14.51	8.79	11.61	8.24	17.31	3.12	10.71	11.02	1.82	3.09	5.15	2.28	12.20	1.60	5.88	1.44	9.98	0.53	2.94	0.00	0.00	0.00
2016	6.12	23.56	34.48	27.51	22.88	26.57	25.74	15.14	13.55	8.37	9.55	7.79	19.39	3.42	11.42	13.75	2.88	2.83	2.32	3.32	16.50	1.58	5.68	0.19	5.34	0.00	3.53	0.96	0.00	0.00
2017	6.32	24.49	35.10	27.39	21.79	22.58	20.70	15.89	12.86	8.11	11.01	8.62	16.20	5.91	9.57	10.46	2.55	5.00	8.65	8.80	16.00	1.86	5.17	0.35	6.02	0.15	3.26	1.46	0.00	0.00
2018	6.54	21.62	32.50	25.89	21.24	24.79	22.69	17.06	13.54	9.79	11.35	7.02	18.43	2.13	9.53	7.11	3.65	1.77	6.94	4.34	10.56	0.07	7.21	1.19	4.67	1.68	1.01	0.19	0.00	0.00
2019	5.69	21.27	33.52	26.25	20.70	24.25	25.77	17.83	13.20	9.89	9.71	6.24	16.74	2.66	10.44	10.22	1.83	1.35	2.16	1.14	15.76	2.58	11.36	0.35	7.71	1.32	4.35	0.00	0.00	0.00
2020	5.59	23.15	34.06	26.20	21.67	25.30	24.19	18.51	11.97	10.20	10.05	5.17	22.28	5.83	12.80	6.96	1.00	1.66	2.20	4.12	11.23	2.57	8.00	0.86	5.07	0.00	4.34	0.00	0.00	0.05

Cumulative Claim Rates   Adjustable Rate Streamline Refinance Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1994	0.01	0.546	2.553	5.509	7.815	9.501	10.32	10.66	10.84	10.92	10.96	10.97	10.97	10.97	10.98	10.98	11.01	11.03	11.03	11.06	11.09	11.12	11.14	11.17	11.19	11.23	11.26	11.29	11.31	11.34
1995	0.00	0.59	2.40	3.96	5.61	6.88	7.22	7.41	7.68	7.73	7.75	7.85	7.89	7.91	7.94	7.96	7.98	7.98	8.00	8.00	8.05	8.10	8.11	8.15	8.19	8.22	8.23	8.26	8.28	8.28
1996	0.01	0.44	2.12	3.81	4.61	4.91	5.15	5.22	5.29	5.34	5.37	5.39	5.41	5.41	5.44	5.44	5.45	5.47	5.50	5.53	5.54	5.56	5.58	5.59	5.60	5.61	5.62	5.63	5.63	5.63
1997	0.01	0.41	1.64	2.80	3.47	3.82	4.03	4.11	4.14	4.15	4.17	4.19	4.20	4.22	4.23	4.25	4.29	4.31	4.33	4.36	4.38	4.39	4.39	4.39	4.39	4.40	4.42	4.42	4.43	4.43
1998	0.01	0.31	0.95	1.49	1.84	2.10	2.24	2.31	2.34	2.34	2.35	2.36	2.37	2.38	2.40	2.45	2.48	2.51	2.52	2.54	2.55	2.56	2.58	2.60	2.61	2.62	2.63	2.64	2.65	2.66
1999	0.00	0.14	0.55	1.07	1.98	2.40	2.61	2.67	2.74	2.78	2.83	2.86	2.95	3.02	3.19	3.27	3.35	3.40	3.45	3.49	3.53	3.56	3.58	3.60	3.61	3.62	3.64	3.64	3.65	3.65
2000	0.00	0.38	1.74	4.15	5.31	6.24	6.70	6.98	7.25	7.36	7.76	7.92	8.11	8.38	8.54	8.73	8.82	8.96	9.01	9.11	9.12	9.19	9.24	9.28	9.29	9.32	9.34	9.35	9.37	9.39
2001	0.03	0.22	1.46	2.72	3.35	3.70	3.93	4.19	4.61	4.89	5.12	5.20	5.50	5.78	5.92	6.05	6.14	6.21	6.24	6.29	6.32	6.35	6.39	6.42	6.44	6.46	6.46	6.46	6.47	6.47
2002	0.01	0.38	1.45	2.33	3.03	3.56	4.13	4.56	4.97	5.23	5.48	5.82	6.15	6.33	6.45	6.57	6.67	6.75	6.80	6.84	6.90	6.93	6.97	7.00	7.02	7.04	7.06	7.07	7.09	7.11
2003	0.02	0.70	1.98	3.03	3.79	4.63	5.20	5.71	6.10	6.44	6.90	7.24	7.44	7.58	7.71	7.82	7.92	7.98	8.05	8.11	8.15	8.20	8.23	8.26	8.29	8.31	8.34	8.35	8.36	8.37
2004	0.13	1.24	2.90	4.31	5.89	7.15	8.13	8.71	9.37	10.30	11.02	11.40	11.70	11.95	12.16	12.34	12.48	12.62	12.70	12.79	12.86	12.91	12.97	13.00	13.04	13.07	13.10	13.13	13.16	13.18
2005	0.26	2.00	4.50	6.90	9.20	10.87	12.15	13.30	14.97	16.18	17.08	17.84	18.51	19.03	19.50	19.83	20.09	20.28	20.45	20.61	20.74	20.85	20.93	21.01	21.09	21.15	21.22	21.27	21.31	21.34
2006	0.00	2.34	7.30	11.46	16.98	18.41	20.33	22.93	24.97	26.29	27.49	28.63	29.65	30.50	31.06	31.69	32.01	32.51	32.93	33.14	33.22	33.37	33.37	33.45	33.45	33.52	33.61	33.61	33.61	33.61
2007	0.00	2.20	5.16	11.65	15.28	16.03	21.01	25.15	27.46	28.67	29.25	29.74	30.11	31.47	32.36	32.85	33.17	33.57	34.11	34.26	35.14	35.70	36.09	36.09	36.09	36.09	36.09	36.09	36.09	36.09
2008	0.00	1.03	5.65	11.32	14.61	22.03	28.19	31.61	34.81	36.41	37.61	38.65	39.48	39.97	40.43	40.68	41.01	41.42	41.71	41.79	41.90	41.99	42.19	42.27	42.40	42.43	42.51	42.51	42.57	42.57
2009	0.04	0.83	3.64	7.99	17.96	25.52	29.98	33.34	35.62	37.40	38.74	39.56	40.16	40.82	41.57	41.94	42.25	42.54	42.83	43.05	43.30	43.43	43.54	43.62	43.73	43.80	43.92	43.96	44.04	44.11
2010	0.12	1.47	4.38	11.75	18.27	22.30	25.23	27.48	28.94	30.13	30.97	31.86	32.50	33.04	33.49	33.78	34.07	34.28	34.47	34.63	34.74	34.87	34.94	35.01	35.08	35.12	35.17	35.23	35.31	35.34
2011	0.04	0.84	4.26	7.66	10.34	12.44	14.39	15.75	16.98	17.96	18.68	19.28	19.68	20.00	20.25	20.42	20.60	20.73	20.85	20.94	21.04	21.11	21.16	21.21	21.26	21.30	21.34	21.36	21.39	21.42
2012	0.06	0.96	2.88	4.62	6.39	7.96	9.18	10.34	11.59	12.64	13.33	13.93	14.41	14.58	14.71	14.85	14.97	15.08	15.14	15.19	15.24	15.29	15.33	15.36	15.37	15.39	15.44	15.44	15.44	15.46
2013	0.00	0.65	1.86	2.25	3.05	4.08	4.54	5.45	6.80	7.67	8.00	8.31	9.14	9.16	9.31	9.36	9.43	9.45	9.45	9.46	9.48	9.51	9.52	9.52	9.58	9.58	9.61	9.72	9.72	9.74
2014	0.00	0.31	2.19	2.72	3.25	4.05	4.58	5.20	6.25	7.14	7.34	7.65	8.51	8.58	8.66	8.73	8.77	8.77	8.79	8.81	8.85	8.93	8.93	8.93	8.98	8.98	9.00	9.07	9.07	9.07
2015	0.00	0.43	2.36	3.12	3.60	4.15	4.47	5.14	5.87	6.61	6.83	6.98	7.56	7.63	7.69	7.73	7.75	7.75	7.76	7.76	7.77	7.85	7.87	7.91	7.97	7.97	7.98	8.03	8.03	8.03
2016	0.00	0.37	2.29	3.32	3.67	4.35	4.60	5.03	5.63	6.35	6.65	6.76	7.29	7.33	7.42	7.43	7.44	7.44	7.45	7.45	7.45	7.51	7.52	7.52	7.55	7.55	7.55	7.60	7.60	7.60
2017	0.00	0.47	2.28	2.79	3.14	3.74	3.94	4.27	4.84	5.40	5.57	5.73	6.32	6.41	6.58	6.71	6.76	6.76	6.79	6.81	6.92	6.93	6.93	6.93	6.95	6.95	6.95	7.00	7.00	7.00
2018	0.03	0.44	2.13	2.95	3.57	4.41	4.62	5.05	5.74	6.42	6.65	6.81	7.49	7.59	7.76	7.78	7.80	7.80	7.82	7.83	7.87	7.90	7.90	7.90	7.91	7.91	7.91	8.02	8.02	8.03
2019	0.00	0.48	2.32	3.27	3.74	4.73	5.00	5.44	6.34	6.95	7.17	7.41	7.95	8.02	8.17	8.20	8.25	8.25	8.26	8.32	8.38	8.42	8.42	8.42	8.44	8.44	8.44	8.48	8.48	8.48
2020	0.00	0.58	2.91	3.77	4.28	5.16	5.42	5.93	6.61	7.36	7.54	7.75	8.24	8.38	8.46	8.52	8.53	8.53	8.55	8.57	8.61	8.64	8.65	8.65	8.68	8.68	8.68	8.76	8.76	8.76

Cumulative Prepayment Rates   **Adjustable Rate Streamline Refinance Mortgages**   **by Credit Subsidy Endorsement Cohort**

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1994	2.68	8.88	18.66	26.43	37.11	46.03	51.57	59.45	66.34	72.94	76.75	79.20	80.97	82.27	83.03	83.60	83.86	84.06	84.22	84.41	84.51	84.61	84.68	84.74	84.80	84.88	84.94	84.99	85.03	85.07
1995	2.25	20.68	37.30	53.99	61.64	66.11	72.51	78.04	81.62	84.28	85.93	86.94	87.69	88.13	88.32	88.53	88.63	88.68	88.81	88.90	88.91	88.97	89.08	89.12	89.17	89.24	89.27	89.31	89.33	89.35
1996	3.14	25.10	56.51	70.70	74.64	80.74	84.86	87.94	89.80	91.01	91.81	92.26	92.61	92.74	92.83	92.92	92.95	93.01	93.06	93.08	93.12	93.15	93.17	93.21	93.23	93.25	93.26	93.29	93.30	93.30
1997	4.82	43.72	67.99	74.13	82.27	86.48	89.82	91.74	92.94	93.69	94.17	94.37	94.45	94.50	94.56	94.57	94.63	94.66	94.69	94.73	94.75	94.77	94.79	94.82	94.83	94.85	94.86	94.87	94.88	94.88
1998	10.74	48.68	60.48	76.48	84.36	89.54	92.14	93.83	94.82	95.50	95.84	95.98	96.05	96.10	96.16	96.26	96.30	96.33	96.35	96.39	96.44	96.48	96.49	96.51	96.54	96.56	96.58	96.60	96.60	96.61
1999	3.43	13.99	43.54	61.25	73.79	80.76	85.73	89.12	91.27	92.30	92.77	93.08	93.16	93.25	93.53	93.74	93.85	93.98	94.07	94.21	94.30	94.39	94.46	94.53	94.61	94.64	94.66	94.68	94.72	94.73
2000	2.65	25.21	41.63	52.93	63.09	71.01	77.39	81.79	83.37	83.68	84.01	84.15	84.30	84.86	85.28	85.61	85.80	86.23	86.52	86.69	86.81	86.93	87.00	87.05	87.13	87.24	87.30	87.36	87.41	87.41
2001	3.58	35.61	55.35	67.34	77.45	83.62	87.39	88.80	89.21	89.40	89.48	89.70	90.01	90.24	90.49	90.65	90.80	91.02	91.22	91.40	91.49	91.56	91.61	91.70	91.77	91.80	91.82	91.84	91.87	91.88
2002	6.30	40.03	56.77	69.99	78.98	84.77	87.01	87.67	87.95	88.12	88.26	88.64	88.92	89.13	89.31	89.50	89.71	89.88	90.03	90.19	90.31	90.41	90.49	90.56	90.62	90.68	90.73	90.77	90.80	90.82
2003	15.99	41.15	61.12	73.81	81.74	84.97	85.80	86.25	86.45	86.64	87.14	87.47	87.69	87.91	88.11	88.41	88.65	88.81	89.00	89.14	89.23	89.31	89.39	89.46	89.52	89.60	89.64	89.66	89.70	89.72
2004	12.42	40.10	58.50	70.31	75.12	76.38	77.05	77.36	77.69	78.63	79.31	79.79	80.23	80.74	81.28	81.70	82.09	82.46	82.74	82.96	83.16	83.32	83.46	83.57	83.67	83.74	83.81	83.88	83.92	83.96
2005	15.31	36.69	51.24	59.38	61.23	62.10	62.51	63.06	64.84	66.00	66.84	67.65	68.40	69.26	70.02	70.60	71.16	71.60	72.02	72.35	72.55	72.74	72.92	73.07	73.20	73.31	73.40	73.49	73.53	73.58
2006	6.91	22.49	35.73	42.29	44.14	44.55	45.15	47.82	48.91	49.46	50.22	51.37	52.43	53.86	55.46	56.12	57.06	57.52	57.62	57.77	58.19	58.26	58.51	58.84	59.04	59.16	59.16	59.16	59.22	59.32
2007	7.14	25.30	45.64	45.64	47.36	48.67	51.77	52.05	52.42	52.57	53.27	53.61	53.74	54.10	54.57	55.12	55.27	55.52	56.06	56.64	56.81	57.11	57.11	57.11	57.11	57.11	57.11	57.32	57.32	57.32
2008	3.36	32.20	38.39	41.25	43.79	46.79	47.79	48.15	48.56	48.94	49.34	50.01	50.63	50.97	51.48	51.92	52.09	52.28	52.53	52.66	52.86	53.07	53.17	53.29	53.41	53.43	53.50	53.54	53.59	53.66
2009	2.63	13.76	21.40	25.05	30.04	32.17	33.78	35.36	37.08	39.48	41.05	42.78	44.20	45.38	46.37	47.13	47.62	48.06	48.30	48.51	48.77	49.00	49.23	49.37	49.52	49.73	49.90	49.98	50.09	50.12
2010	4.28	15.16	19.73	26.57	30.12	33.15	35.99	39.15	42.44	45.63	48.33	50.36	52.06	53.19	54.21	55.06	55.79	56.32	56.80	57.15	57.48	57.68	57.87	58.02	58.19	58.31	58.48	58.56	58.64	58.73
2011	0.85	9.23	23.19	29.49	34.48	39.67	45.46	51.10	55.62	59.64	62.76	64.98	66.72	67.94	69.01	69.75	70.41	70.99	71.52	71.96	72.31	72.56	72.84	73.03	73.18	73.29	73.36	73.45	73.53	73.57
2012	2.01	18.49	27.99	34.46	41.00	49.13	56.98	62.10	66.68	70.35	72.67	74.24	75.46	76.23	77.22	77.84	78.50	79.07	79.49	79.85	80.27	80.55	80.78	80.88	80.97	81.00	81.02	81.04	81.05	81.07
2013	4.95	17.70	32.21	41.25	50.08	61.28	68.42	73.52	76.96	79.46	81.18	81.91	83.53	84.09	84.74	85.19	85.35	85.41	85.76	85.95	86.65	86.80	86.97	87.00	87.51	87.53	87.62	87.63	87.63	87.64
2014	5.10	20.35	37.15	49.82	58.52	67.38	74.37	78.75	81.33	82.44	83.75	84.40	85.80	86.09	86.68	87.07	87.18	87.27	87.41	87.56	88.07	88.11	88.25	88.37	88.61	88.64	88.72	88.72	88.72	88.72
2015	5.52	24.99	48.60	60.75	68.44	75.15	80.69	83.55	85.21	86.00	86.87	87.40	88.39	88.52	88.94	89.32	89.38	89.47	89.61	89.68	90.00	90.04	90.17	90.20	90.39	90.40	90.45	90.45	90.45	90.45
2016	6.15	28.43	53.11	65.46	72.64	78.99	83.32	85.17	86.51	87.17	87.80	88.24	89.23	89.35	89.74	90.14	90.21	90.28	90.33	90.41	90.78	90.81	90.91	90.91	90.99	90.99	91.05	91.06	91.06	91.06
2017	6.35	29.47	54.22	66.23	73.03	78.49	82.24	84.46	85.95	86.70	87.61	88.20	89.21	89.48	89.90	90.27	90.35	90.50	90.74	90.95	91.31	91.35	91.43	91.44	91.54	91.54	91.60	91.62	91.62	91.62
2018	6.57	26.93	50.69	63.00	70.28	76.85	81.16	83.61	85.16	86.07	86.93	87.39	88.49	88.57	88.96	89.19	89.30	89.35	89.55	89.66	89.94	89.94	90.11	90.14	90.23	90.27	90.29	90.29	90.29	90.29
2019	5.71	25.92	50.74	63.14	70.13	76.55	81.42	83.87	85.30	86.14	86.82	87.20	88.12	88.22	88.63	88.97	89.02	89.05	89.11	89.14	89.56	89.61	89.85	89.85	89.98	90.01	90.08	90.08	90.08	90.08
2020	5.61	27.64	52.22	64.06	71.07	77.37	81.65	84.07	85.29	86.13	86.80	87.10	88.27	88.47	88.89	89.07	89.10	89.14	89.19	89.30	89.54	89.59	89.73	89.75	89.83	89.83	89.90	89.90	89.90	89.90

Loss Rates **All Mortgages** by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1983	36.54	48.44	46.85	46.84	49.69	50.34	48.48	47.06	47.52	48.14	46.40	47.54	49.32	53.61	57.66	54.37	55.51	60.51	63.30	57.02	65.09	61.03	87.58	109.30	135.88	175.49	166.75	259.14	322.08	307.96
1984	46.96	48.27	47.86	49.43	51.08	50.85	50.14	50.05	52.11	51.57	52.92	53.36	60.05	71.55	68.67	67.04	66.55	60.66	82.76	56.69	72.30	61.13	133.93	151.31	165.93	208.87	208.44	182.85	292.75	281.82
1985	45.41	48.24	50.03	50.05	49.13	48.65	49.13	48.29	47.75	49.16	50.21	51.70	58.07	57.63	68.84	55.38	57.99	69.46	60.03	68.53	63.86	103.75	105.61	126.54	140.10	194.05	88.49	161.88	167.10	133.05
1986	45.17	50.36	49.75	47.73	46.19	44.80	44.45	42.52	41.68	41.51	41.43	42.16	42.57	43.77	41.68	43.84	48.40	48.68	49.33	63.35	63.81	73.61	119.20	102.83	93.90	110.24	127.49	128.46	117.16	123.00
1987	46.56	47.98	45.91	44.72	44.63	43.63	41.87	40.72	40.23	40.48	41.38	41.32	43.93	42.25	42.04	47.09	49.20	48.90	57.78	71.15	90.60	99.60	104.92	110.64	116.57	135.11	105.20	114.43	125.18	127.27
1988	43.25	43.92	44.00	43.58	44.08	43.81	44.27	45.42	45.27	45.68	47.10	48.58	47.90	48.45	50.17	46.79	53.92	62.24	66.55	95.68	109.95	110.45	110.89	105.68	115.38	109.48	117.39	121.73	129.32	131.06
1989	50.82	45.72	43.11	44.57	45.11	45.77	47.38	47.86	48.06	49.20	50.82	49.02	47.32	46.89	49.02	53.93	61.50	77.79	101.78	128.66	109.25	108.78	115.40	117.28	108.90	112.17	115.63	117.35	127.99	135.01
1990	43.33	43.94	43.38	44.78	47.13	48.74	50.55	51.26	51.72	51.91	50.45	48.95	52.51	52.79	53.32	57.93	71.24	95.46	116.78	99.04	108.15	115.86	112.91	99.77	111.12	118.70	123.83	124.42	129.16	131.43
1991	45.28	41.87	42.78	45.63	48.29	49.63	52.33	52.20	51.68	47.00	47.82	44.08	45.11	47.98	60.99	78.54	93.79	116.60	103.72	96.28	103.86	103.53	91.74	109.22	110.56	120.05	119.98	127.26	128.49	131.28
1992	43.86	41.34	41.73	43.41	45.15	47.85	47.87	47.65	43.99	40.04	36.82	33.36	43.15	47.80	61.93	81.89	100.06	87.69	87.56	91.15	88.00	95.34	101.41	102.81	111.49	116.58	116.97	124.27	128.78	131.14
1993	35.46	37.16	40.01	40.71	44.37	44.12	41.93	38.68	33.89	31.75	33.45	38.73	43.58	59.04	72.19	87.72	85.49	75.79	84.52	80.41	81.74	96.15	102.46	103.86	109.93	114.92	119.79	124.98	129.23	130.36
1994	30.10	37.42	39.87	41.82	42.12	40.01	36.68	31.77	30.72	32.09	34.68	46.47	53.20	69.73	90.87	74.63	76.34	80.16	87.06	84.35	89.01	95.79	99.42	104.23	107.49	112.87	118.65	120.96	128.67	131.74
1995	38.20	38.09	39.84	40.65	40.54	39.24	35.21	34.13	36.78	37.40	43.10	50.05	78.95	83.70	81.34	79.45	79.46	84.91	80.77	89.01	95.79	99.42	104.23	107.49	112.87	118.65	120.96	128.67	131.74	135.57
1996	31.69	38.15	38.14	37.51	36.07	33.68	31.85	33.99	35.45	41.00	52.51	65.87	79.60	84.40	75.70	83.46	82.52	78.62	84.82	88.85	94.32	99.81	103.60	107.08	111.86	115.53	119.84	123.71	127.51	133.28
1997	25.75	36.87	35.48	34.53	32.77	32.18	32.99	36.92	40.43	49.64	65.79	81.31	81.03	80.10	80.48	84.79	76.18	82.74	86.24	88.99	96.40	100.30	104.61	107.26	111.22	115.89	119.90	125.84	129.35	136.53
1998	27.94	35.11	31.66	30.43	30.37	30.96	33.35	37.17	46.95	63.86	76.16	78.47	71.79	75.84	85.31	73.28	77.70	80.33	84.93	91.19	95.30	100.10	103.58	106.85	110.87	118.03	119.99	126.62	131.06	136.24
1999	28.05	31.18	29.65	29.25	29.91	32.71	36.75	43.96	60.81	72.79	74.15	69.06	75.57	79.66	70.52	74.84	77.87	80.70	86.13	90.06	95.17	99.85	101.33	105.10	111.31	114.38	119.42	125.85	128.69	134.22
2000	25.78	30.30	30.00	33.36	35.61	39.29	47.74	60.41	76.34	78.10	75.16	80.31	86.02	72.69	76.42	77.91	80.19	85.01	89.63	92.80	96.69	99.58	103.60	108.84	111.89	118.75	121.25	128.29	131.97	137.51
2001	28.20	29.73	33.11	36.03	38.61	45.54	58.58	70.76	73.76	70.99	76.52	80.40	68.71	73.60	75.28	77.36	81.01	84.75	88.73	92.04	95.66	99.68	104.43	107.66	112.75	118.84	123.06	128.21	132.43	141.56
2002	24.88	31.54	35.35	37.66	42.87	53.44	64.80	68.42	66.81	69.49	77.17	66.49	70.14	71.84	73.58	77.06	80.22	83.95	86.93	90.06	93.36	98.93	101.54	106.83	112.17	116.60	120.35	127.36	130.71	135.08
2003	29.46	35.31	35.43	40.56	50.17	60.35	63.97	62.06	64.94	71.81	63.72	66.81	68.43	69.91	73.00	76.03	78.70	81.88	84.43	88.49	92.61	97.64	101.59	107.95	111.12	115.43	122.13	126.44	129.32	135.84
2004	31.96	33.37	38.56	48.13	57.73	62.17	59.96	64.53	69.99	62.53	65.54	66.60	67.91	71.14	73.35	76.07	78.47	80.47	84.71	88.85	92.61	97.16	102.02	106.38	112.34	115.61	122.49	127.10	130.22	136.72
2005	33.18	38.06	47.71	58.51	62.64	61.17	65.08	70.66	62.65	65.07	66.14	67.02	69.57	71.67	73.35	74.89	76.21	79.27	83.05	86.23	90.33	94.56	99.14	104.94	108.41	113.58	117.11	122.59	126.51	131.91
2006	38.21	44.30	56.30	62.07	61.55	65.86	71.55	64.33	67.53	68.59	69.38	72.01	73.58	75.79	76.87	77.89	79.35	82.29	85.26	88.36	93.01	95.83	98.73	104.48	108.77	113.48	118.79	121.25	127.84	131.71
2007	33.23	52.63	60.13	60.01	64.79	71.88	64.26	67.72	68.92	69.80	71.85	73.23	75.34	77.21	78.19	80.08	82.94	84.10	87.26	90.12	94.63	98.58	103.02	106.02	113.17	115.16	118.65	125.81	129.76	135.49
2008	41.87	53.44	52.76	58.26	63.67	58.89	63.11	64.69	64.41	65.62	67.60	69.65	71.17	72.86	74.73	77.56	78.63	82.21	85.73	90.79	94.08	98.08	102.48	106.37	110.27	115.85	120.19	125.48	131.40	132.56
2009	40.70	43.93	49.85	53.42	50.06	54.82	56.51	55.72	55.64	56.58	58.32	59.98	62.32	65.01	68.92	70.62	74.62	78.62	82.89	86.08	90.46	95.09	99.04	105.04	108.79	112.78	117.67	123.29	127.51	138.01
2010	35.25	43.79	44.97	43.09	46.47	47.56	46.83	47.28	47.75	48.96	50.93	53.51	56.11	60.28	62.18	66.05	69.75	74.46	78.01	81.90	87.30	91.64	94.79	101.79	105.27	109.27	114.73	119.32	124.03	128.80
2011	35.11	38.79	36.92	39.26	40.52	40.37	41.43	42.24	43.67	45.25	48.07	50.92	55.38	58.09	61.92	66.30	70.47	73.59	78.47	82.60	86.82	90.74	95.24	99.64	104.72	110.71	114.89	119.62	127.51	132.71
2012	37.01	33.30	33.96	35.76	35.78	37.01	38.02	39.30	40.24	41.36	44.99	48.81	51.73	54.63	59.78	63.89	67.94	72.41	75.62	79.25	84.00	88.79	93.46	98.29	102.74	105.55	112.52	116.72	123.06	128.94
2013	32.37	32.00	33.49	34.60	36.08	37.61	38.70	39.71	40.40	42.07	46.45	47.78	51.21	55.96	60.94	63.91	68.31	71.19	75.82	80.67	84.74	89.14	95.45	98.15	103.16	108.82	113.16	118.66	123.51	129.22
2014	29.35	30.30	32.11	34.82	36.50	38.38	39.45	40.23	41.22	44.22	46.04	48.94	52.75	57.29	62.29	65.44	68.86	72.32	77.70	80.89	86.77	93.01	95.25	99.44	104.13	109.01	115.19	118.54	123.87	129.00
2015	30.69	30.24	33.16	35.91	37.94	38.82	39.36	40.62	42.23	43.09	46.00	49.41	53.14	57.22	62.43	64.69	67.60	72.21	77.44	80.92	85.59	89.88	94.39	98.25	103.53	104.39	114.83	116.85	123.90	125.73
2016	31.41	31.55	33.76	36.22	37.76	38.39	39.25	41.08	41.12	42.78	45.26	49.32	52.71	58.00	62.58	64.59	68.50	72.88	78.63	80.81	86.52	90.19	94.46	97.39	103.54	105.41	113.49	116.06	121.15	128.01
2017	32.61	31.65	33.58	35.38	36.38	37.19	38.84	38.97	39.72	42.31	45.49	48.66	53.25	57.31	62.56	65.19	68.28	72.29	77.92	81.02	84.05	91.09	95.47	99.05	102.83	104.21	114.90	115.52	123.19	129.99
2018	31.18	31.75	32.97	34.41	35.62	37.56	37.17	38.49	40.59	42.58	45.89	48.62	53.30	56.91	62.37	65.06	68.81	72.83	76.89	81.56	84.58	89.65	94.36	98.48	103.39	104.74	114.93	116.93	122.18	127.57
2019	31.59	31.19	32.30	34.24	36.23	36.32	36.99	38.71	40.89	42.51	46.70	49.41	53.32	58.47	62.71	65.60	68.91	72.28	77.42	80.57	85.33	90.71	95.59	99.28	103.55	108.71	113.71	117.27	123.69	128.69
2020	31.04	31.15	32.37	34.49	35.18	35.63	37.19	39.30	40.90	43.33	46.88	49.95	54.85	59.24	63.29	66.21	69.00	72.57	77.90	81.78	85.67	90.80	94.70	99.62	103.10	107.32	114.51	120.31	124.05	129.53

Loss Rates   Fixed Rate 30 Year Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1983	35.83	48.53	46.83	46.69	49.59	50.24	48.40	47.00	47.50	48.25	46.46	47.41	49.32	53.51	57.32	54.38	55.51	60.51	63.30	57.02	65.09	61.03	87.58	109.30	135.88	175.49	166.75	259.14	322.08	307.96
1984	47.19	48.32	47.92	49.33	50.85	50.82	50.03	49.86	52.07	51.48	52.69	53.18	59.49	71.44	68.19	66.46	66.55	60.66	82.76	56.69	72.30	61.13	133.93	151.31	165.93	208.87	208.44	182.85	292.75	281.82
1985	45.36	48.30	49.97	50.01	49.08	48.55	48.96	48.09	47.51	48.89	49.91	51.51	57.48	56.97	63.59	54.71	57.97	69.81	60.03	68.53	61.84	104.51	105.61	126.54	140.10	194.05	88.49	161.88	167.10	133.05
1986	45.13	50.51	49.78	47.64	46.16	44.72	44.39	42.49	41.67	41.32	41.33	41.98	42.57	43.75	41.35	43.94	48.45	48.81	49.14	65.30	65.10	73.61	119.20	102.62	95.95	110.67	129.51	128.76	116.75	121.13
1987	46.38	48.14	45.67	44.75	44.78	43.74	41.95	40.92	40.37	40.89	41.44	41.58	44.61	43.22	42.37	47.32	50.47	50.64	56.47	72.79	88.50	101.17	108.72	114.15	116.83	140.86	104.52	113.40	123.39	131.49
1988	45.68	44.14	43.72	43.78	43.83	43.50	44.02	44.88	45.25	45.25	47.18	49.04	48.06	48.73	50.74	46.66	53.73	62.31	66.29	98.71	110.56	110.16	115.28	106.37	121.74	109.82	116.59	121.72	132.34	134.31
1989	52.97	46.09	43.18	44.48	44.94	45.31	46.88	47.46	47.66	48.79	50.73	48.88	47.82	47.03	47.71	54.13	61.47	77.79	102.27	132.31	108.66	110.11	115.27	115.63	110.34	112.46	115.63	117.69	124.95	138.26
1990	45.77	44.19	43.24	44.61	46.92	48.34	50.21	51.04	51.28	52.09	50.20	49.20	52.43	52.72	53.51	57.88	71.64	96.06	116.78	99.03	109.19	117.47	112.40	100.26	111.34	118.36	123.64	125.48	132.12	133.51
1991	44.42	41.91	42.93	45.56	48.02	49.68	52.50	51.81	51.92	47.43	48.77	43.60	45.77	49.74	59.60	78.30	95.46	117.76	103.94	94.36	102.99	105.80	90.16	109.48	113.85	122.42	118.72	129.61	134.01	131.53
1992	46.95	40.96	42.25	43.55	45.93	48.43	48.47	49.26	44.77	40.88	39.35	33.57	44.37	51.23	64.51	84.82	102.06	86.81	85.30	90.86	92.10	95.74	101.10	102.69	114.89	117.05	121.95	128.74	137.12	130.67
1993	37.34	36.69	38.82	39.69	42.90	42.66	41.44	39.05	35.15	32.54	34.80	39.94	43.97	58.30	72.44	90.02	85.56	79.07	82.00	80.65	79.63	96.74	103.63	103.52	111.39	116.45	124.08	129.35	130.60	125.63
1994	36.05	37.34	38.23	39.84	40.93	40.63	37.84	33.72	32.50	32.80	35.98	47.79	56.79	70.16	88.62	75.84	77.57	84.29	87.07	94.35	98.12	101.87	108.46	114.42	116.21	124.84	131.08	143.67		
1995	33.03	37.52	38.66	40.27	41.69	40.96	36.54	36.18	37.39	37.94	43.36	50.68	78.02	84.42	80.39	79.15	79.30	86.19	81.24	88.76	96.89	99.47	104.95	110.77	114.51	120.47	123.21	128.89	131.62	142.21
1996	35.83	36.23	37.66	39.06	37.29	35.06	33.44	34.84	35.68	42.03	53.25	65.67	80.21	84.66	78.39	83.24	83.00	79.01	84.67	89.27	95.37	102.13	104.90	107.25	113.55	116.38	125.46	121.84	134.71	135.45
1997	23.84	35.87	36.54	36.48	34.70	34.15	34.54	37.48	40.67	51.08	66.32	81.21	81.22	80.00	79.98	86.23	75.89	83.01	86.80	89.82	97.89	100.10	105.79	108.09	110.49	116.23	122.67	127.97	129.18	134.52
1998	27.97	35.85	33.22	31.59	31.35	31.40	33.53	38.03	46.90	65.20	78.02	79.41	71.86	75.28	85.66	73.09	77.84	80.19	85.01	91.13	95.65	100.14	103.88	106.66	108.58	116.78	123.77	130.16	138.86	
1999	29.99	32.47	30.34	29.95	30.40	33.07	37.10	44.23	60.97	73.99	74.93	69.04	76.05	80.43	70.90	75.29	78.19	80.83	86.47	90.48	95.63	100.45	101.90	106.45	112.25	113.82	120.45	125.97	129.34	133.78
2000	26.82	30.47	30.24	33.55	35.89	39.76	48.67	61.63	77.89	80.27	76.51	80.77	86.73	73.34	77.17	79.44	81.72	86.39	90.66	94.44	98.40	100.89	105.56	111.74	115.25	120.13	121.32	129.24	136.37	139.43
2001	28.48	30.15	33.56	36.74	39.23	46.23	58.92	70.86	74.33	70.81	77.07	80.61	68.41	73.56	75.22	77.37	81.19	85.10	88.94	92.06	95.57	100.07	105.21	107.74	114.59	118.51	123.64	131.12	133.81	141.46
2002	28.72	32.44	36.32	38.90	44.19	54.47	65.25	69.34	66.74	78.06	66.42	70.53	72.10	74.10	77.63	80.96	84.27	87.27	91.06	94.26	100.18	102.87	108.09	113.01	116.16	121.86	126.62	129.21	139.72	
2003	34.15	37.64	37.18	42.40	51.56	60.97	64.42	62.75	65.24	72.01	63.69	67.27	69.20	70.76	73.93	76.90	79.55	82.34	84.58	89.42	93.03	98.48	102.12	107.82	112.36	115.05	122.00	126.28	127.62	136.65
2004	33.78	35.04	39.89	48.99	58.48	62.31	60.15	64.89	70.11	63.36	66.57	67.58	69.06	72.43	74.39	77.02	78.90	80.85	85.41	89.44	93.33	96.90	102.31	106.76	111.61	114.18	121.31	125.70	129.46	134.30
2005	35.15	39.57	47.94	58.49	62.61	60.93	64.93	70.75	63.09	65.80	66.83	67.91	70.54	72.71	74.38	75.95	77.04	80.16	84.23	87.54	91.29	95.28	100.30	105.22	109.28	113.08	119.20	122.96	125.56	130.60
2006	41.45	44.41	56.00	61.89	61.35	65.73	71.42	64.52	67.93	68.94	69.74	72.39	74.00	76.36	77.33	78.53	79.73	82.58	85.65	88.58	93.40	96.52	98.52	105.15	109.35	113.79	118.59	121.11	128.95	132.56
2007	32.88	52.21	59.93	59.81	64.52	71.71	64.16	67.67	68.84	69.73	71.81	73.22	75.45	77.12	78.34	80.23	82.94	84.28	87.31	89.91	94.48	98.60	102.72	106.34	113.16	114.62	119.48	125.10	128.21	135.37
2008	42.49	53.14	52.32	57.68	63.10	58.31	62.56	64.19	63.86	65.26	67.35	69.35	70.90	72.71	74.54	77.45	78.37	81.90	85.66	90.74	93.65	98.01	102.17	106.54	110.30	115.14	120.30	124.99	130.88	137.15
2009	40.14	42.03	47.37	50.66	46.63	50.90	52.04	51.55	52.34	53.74	55.78	57.73	59.95	62.76	66.52	68.10	72.13	76.46	80.92	83.79	88.11	93.08	97.76	102.78	105.83	110.20	114.19	121.31	127.26	127.28
2010	28.85	37.13	40.03	39.02	42.34	43.26	43.29	44.56	45.32	46.62	48.64	51.02	53.83	57.69	59.55	63.75	67.59	72.17	75.59	80.36	86.04	89.25	92.70	100.04	102.94	107.37	113.51	115.86	119.52	126.86
2011	26.81	31.91	32.29	34.90	36.07	36.83	38.31	39.53	40.96	42.13	45.15	48.15	52.40	55.13	58.61	63.47	67.92	70.91	75.94	80.35	85.40	88.48	91.46	96.38	101.15	107.64	111.53	114.94	122.87	125.48
2012	32.80	28.60	29.38	31.20	31.91	34.02	35.20	36.23	37.09	38.27	41.82	45.32	48.15	52.33	56.75	61.77	65.32	69.84	74.22	77.46	82.51	86.79	89.45	96.14	102.22	102.63	109.25	116.15	122.53	125.15
2013	27.29	27.93	29.82	31.69	33.84	35.59	36.71	37.48	38.13	39.82	43.53	44.26	48.55	53.28	58.31	60.72	65.13	66.77	72.76	77.19	81.55	86.26	91.84	93.46	98.09	103.90	110.40	112.95	118.08	127.68
2014	30.96	28.50	30.35	33.58	35.38	37.27	37.93	38.72	39.56	42.38	44.06	46.41	50.25	55.26	59.84	62.19	65.53	69.54	75.74	78.11	84.50	86.30	91.92	95.72	101.55	102.03	111.08	113.26	120.14	126.57
2015	31.91	29.93	32.77	35.66	37.63	38.59	39.07	40.17	41.79	42.54	45.40	48.76	52.58	56.63	61.84	63.84	66.66	71.64	76.98	79.95	84.56	89.28	93.54	97.19	102.27	102.17	111.48	115.18	123.19	124.82
2016	32.46	31.33	33.48	36.01	37.45	38.15	39.02	40.84	40.93	42.48	45.99	48.95	52.42	57.75	62.30	64.02	68.20	72.59	78.55	80.22	86.05	89.46	93.80	96.59	102.97	103.55	110.47	114.50	120.41	127.93
2017	33.22	31.46	33.36	35.23	36.19	37.03	38.69	38.72	39.65	42.16	45.33	48.31	53.12	57.19	62.48	64.83	67.85	71.94	77.75	80.95	84.10	90.86	94.92	98.01	101.86	102.96	113.85	114.22	123.24	131.68
2018	32.55	31.51	32.69	34.19	35.47	37.51	36.98	38.18	40.57	42.47	45.66	48.26	53.07	56.65	62.10	64.45	67.92	72.99	76.35	81.15	83.66	88.85	93.27	97.14	102.41	102.96	112.56	114.16	121.85	126.88
2019	32.34	30.84	31.86	33.81	35.78	35.98	36.62	38.28	40.68	42.33	46.31	48.86	52.79	58.19	62.20	65.22	68.33	71.68	77.10	79.90	84.74	89.79	94.86	98.68	102.59	107.55	112.02	115.97	124.71	127.86
2020	31.23	30.60	31.72	33.76	34.76	35.31	36.83	38.73	40.44	42.90	46.28	49.12	54.09	58.77	62.50	65.31	68.40	72.14	77.39	81.32	84.93	90.16	94.44	99.39	102.01	106.37	113.31	119.02	123.40	128.36

Loss Rates	Fixed Rate 30 Year Streamline Refinance Mortgages										by Credit Subsidy Endorsement Cohort																			
Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1992	19.48	42.35	36.06	39.50	41.08	43.44	44.17	43.54	46.30	33.69	30.22	43.29	49.66	41.22	68.93	52.88	97.31	93.84	167.63	110.42	69.22	96.42	99.31	0.00	107.38	121.60	118.00	122.32	137.98	135.03
1993	32.14	36.99	40.45	42.54	47.22	47.20	43.33	37.76	32.77	30.58	34.88	39.12	38.24	62.83	63.84	75.34	96.73	54.62	80.82	88.60	86.34	93.36	103.42	104.14	109.95	113.59	116.36	122.04	128.51	127.40
1994	27.69	36.60	41.43	44.88	45.59	42.11	37.47	29.77	29.02	30.83	29.93	40.60	40.94	69.51	83.15	73.20	73.26	59.54	90.54	79.51	93.44	96.52	104.84	108.48	113.02	117.58	120.72	124.24	128.06	126.75
1995	25.65	38.29	43.16	42.31	44.19	34.51	32.79	28.29	35.04	49.78	67.98	29.74	77.89	147.63	87.54	89.66	75.94	73.14	85.41	95.26	97.03	96.40	123.69	90.74	0.00	0.00	0.00	153.01	0.00	0.00
1996	29.28	40.47	39.54	37.37	33.29	27.50	29.56	30.55	26.32	34.25	55.95	65.76	69.93	104.65	67.40	52.45	64.34	78.45	81.35	91.81	95.98	105.26	109.53	108.09	114.95	119.20	113.14	139.39	127.67	158.66
1997	32.05	35.85	35.58	31.85	25.79	25.53	22.33	30.80	42.84	28.82	101.14	78.44	63.97	49.67	67.10	111.63	76.70	88.20	88.73	97.74	95.50	124.75	109.71	111.62	119.14	0.00	117.06	125.14	121.83	0.00
1998	20.63	30.38	24.81	23.58	23.13	26.30	29.27	32.07	45.04	56.69	62.30	69.83	70.66	75.33	77.41	72.13	78.58	81.23	85.72	92.99	97.70	97.74	101.74	106.99	112.25	114.72	120.11	130.92	137.72	138.92
1999	23.29	24.00	24.51	23.58	26.01	29.43	32.69	43.13	62.44	60.61	70.73	70.24	64.43	74.15	68.96	73.12	78.48	83.60	87.02	89.53	94.11	100.63	100.38	106.37	110.69	116.46	123.04	124.80	124.24	139.55
2000	11.99	24.01	24.92	29.38	29.04	30.83	40.04	41.42	85.54	102.91	62.19	76.91	118.31	77.91	76.87	76.06	82.60	86.41	89.96	91.55	91.70	105.18	105.00	109.62	128.07	0.00	0.00	0.00	0.00	0.00
2001	17.67	25.74	29.53	30.44	33.24	40.33	55.73	71.01	72.59	72.92	74.16	79.35	71.38	74.60	76.42	78.86	80.64	84.25	88.82	93.40	97.31	100.29	104.95	108.93	109.17	120.76	116.89	127.12	134.33	142.70
2002	16.84	28.73	31.57	33.16	37.13	51.55	63.84	66.97	66.42	71.63	74.31	67.60	70.21	72.25	73.65	76.60	80.41	83.93	89.43	91.37	93.96	98.37	103.19	107.46	111.51	117.54	121.18	128.92	134.19	146.08
2003	21.74	30.60	31.84	36.52	46.75	60.21	62.02	59.56	62.84	70.44	63.61	66.17	67.01	68.19	71.01	74.28	76.66	80.87	84.67	87.38	92.40	96.03	101.21	107.24	110.08	116.01	121.95	126.36	130.47	133.32
2004	29.89	30.36	36.02	46.12	56.53	61.13	58.66	62.96	67.82	60.24	63.43	64.19	64.82	67.52	70.42	73.76	77.99	80.09	83.87	88.21	91.30	97.45	101.22	106.23	112.43	116.55	123.45	127.01	131.26	139.06
2005	26.52	34.14	45.89	58.90	62.70	61.21	64.28	67.39	59.89	61.70	64.47	65.40	68.74	70.01	72.11	74.77	77.34	79.41	83.48	88.13	91.93	97.82	99.79	105.57	112.73	114.02	118.86	123.15	128.47	135.43
2006	31.09	40.72	58.47	61.71	63.56	67.58	72.08	62.13	63.79	65.65	67.71	69.90	71.88	71.35	78.07	76.96	78.87	84.13	86.86	88.53	95.23	99.57	108.62	103.64	111.71	120.16	118.52	124.72	129.44	146.74
2007	33.96	51.58	58.33	65.32	71.53	66.03	69.42	69.69	72.21	72.90	76.17	76.41	77.69	83.33	80.63	83.25	85.87	85.06	89.96	97.71	100.17	105.98	106.73	108.07	117.13	121.17	125.99	129.85	136.78	140.28
2008	38.24	56.61	58.33	65.32	71.53	66.03	69.42	71.13	72.15	72.38	73.38	76.54	77.65	78.46	81.56	83.35	84.58	88.82	89.80	95.36	100.88	103.59	106.76	108.91	114.32	123.13	128.24	136.57	136.48	138.74
2009	43.13	47.78	53.81	58.33	55.94	61.42	64.00	64.07	64.25	65.04	66.38	66.96	69.52	71.71	75.47	76.69	80.90	83.59	87.67	90.85	94.99	97.84	102.37	109.07	112.04	116.54	121.30	125.91	132.61	131.87
2010	38.00	50.34	52.26	49.77	54.98	57.47	57.34	57.94	58.29	59.47	60.09	62.81	65.02	69.06	70.43	73.04	77.02	80.81	83.45	86.18	91.18	96.93	99.64	103.93	109.05	113.46	118.53	121.25	124.77	128.51
2011	36.60	44.17	42.72	46.64	48.85	48.94	50.14	50.77	50.86	52.94	55.18	55.79	59.93	62.52	65.46	69.76	73.14	76.45	79.85	84.38	87.68	91.52	98.12	101.63	106.85	111.69	114.67	123.20	127.53	133.22
2012	38.07	38.13	39.73	41.92	42.41	42.85	43.71	45.00	45.66	46.24	49.12	52.61	54.89	56.68	62.75	65.36	69.78	74.02	76.13	79.93	84.80	89.53	94.68	98.47	102.55	106.60	111.85	115.41	122.83	129.30
2013	34.19	34.64	36.50	37.73	38.72	40.49	41.33	42.37	43.33	44.87	49.55	51.06	53.48	57.92	62.53	66.20	70.31	74.01	77.82	82.54	86.15	90.58	96.82	99.93	105.34	110.08	113.30	119.99	124.96	129.93
2014	28.72	31.62	34.27	36.51	38.05	40.12	41.91	42.41	44.20	47.42	49.35	52.58	56.76	59.91	64.94	69.22	72.30	75.55	79.59	83.51	87.65	93.06	97.43	102.35	105.29	112.37	116.45	121.49	125.78	130.12
2015	27.42	30.48	33.62	35.86	37.78	39.72	40.92	43.16	46.34	48.68	50.84	54.55	58.46	61.93	66.61	71.20	74.88	76.57	80.59	85.43	88.11	92.59	99.34	101.91	107.31	112.16	116.30	121.58	126.74	129.37
2016	27.22	31.07	33.16	35.93	37.25	38.87	40.13	41.41	43.44	45.48	49.23	52.61	57.23	61.54	65.44	70.33	71.53	75.95	79.15	84.03	87.68	95.35	98.43	101.76	105.47	112.10	117.57	124.01	126.93	130.38
2017	30.18	30.90	32.36	34.15	35.62	36.46	37.97	38.53	39.67	43.36	46.65	50.29	55.77	57.96	62.93	67.70	71.39	74.88	77.53	82.14	83.15	91.75	98.50	103.68	105.84	108.71	113.53	120.71	123.01	126.73
2018	26.68	31.93	32.70	34.35	34.66	36.07	37.19	38.04	39.67	43.02	46.49	50.03	54.80	58.77	63.39	68.23	72.76	71.53	78.51	83.45	86.65	92.79	98.69	105.29	105.83	109.44	116.28	120.09	122.84	129.33
2019	28.89	31.90	33.47	35.81	37.58	37.82	39.17	39.64	41.77	43.90	48.73	52.17	56.71	60.34	65.56	68.20	71.77	75.95	78.32	83.87	87.16	94.29	98.18	102.23	105.98	112.80	114.37	120.15	125.38	131.31
2020	30.29	32.41	34.61	37.92	36.25	37.09	38.84	41.72	43.94	47.19	50.22	54.29	59.10	62.58	67.84	71.21	72.38	74.97	80.76	84.22	88.19	93.59	96.42	100.00	104.97	109.96	115.44	122.79	126.35	134.46

Loss Rates   **Fixed Rate 15 Year Mortgages**   **by Credit Subsidy Endorsement Cohort**

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1998	0.00	40.98	41.52	41.53	44.26	51.65	40.94	48.19	48.54	56.63	59.21	97.98	158.63	115.59	1995.75
1999	0.00	31.03	39.06	37.95	41.44	50.08	61.62	117.72	89.39	81.40	109.45	158.59	123.20	73.73	**86.25**
2000	0.00	28.57	41.08	37.47	53.16	57.41	72.70	68.57	97.45	158.23	115.41	145.74	0.00	**109.54**	**89.58**
2001	0.00	36.71	42.71	46.99	49.88	61.37	83.09	68.11	62.48	54.10	113.01	195.02	**59.81**	**85.85**	**81.76**
2002	3.76	43.18	40.83	46.58	42.35	61.88	83.99	87.74	87.78	98.22	100.56	**84.22**	**65.43**	**76.55**	**77.40**
2003	73.56	44.91	40.41	46.84	60.75	69.52	74.03	79.40	79.88	126.11	**74.00**	**57.32**	**73.09**	**70.54**	**65.04**
2004	28.46	36.39	51.89	55.92	60.94	72.15	66.20	72.46	78.96	**45.22**	**57.19**	**67.40**	**67.92**	**77.76**	**73.98**
2005	18.25	43.80	46.45	56.77	62.49	57.73	71.88	91.53	**61.15**	**53.90**	**58.87**	**65.13**	**65.21**	**70.99**	**77.76**
2006	39.55	51.61	59.90	68.21	64.16	69.73	84.46	**52.06**	**56.62**	**60.54**	**60.31**	**66.94**	**66.53**	**75.49**	**69.00**
2007	56.44	52.39	66.16	62.00	70.52	87.85	**69.26**	**65.09**	**62.07**	**66.01**	**62.26**	**69.36**	**69.06**	**72.35**	**78.66**
2008	48.04	52.10	54.28	62.62	72.58	**62.28**	**63.38**	**61.37**	**57.76**	**60.65**	**62.81**	**68.44**	**70.78**	**73.82**	**82.49**
2009	51.27	43.88	54.01	59.43	**56.45**	**56.13**	**55.95**	**53.16**	**55.49**	**57.74**	**62.60**	**66.48**	**68.78**	**77.40**	**77.65**
2010	0.00	46.72	45.89	**47.23**	**50.62**	**48.92**	**48.27**	**51.35**	**51.68**	**52.92**	**55.64**	**63.44**	**64.85**	**68.23**	**71.26**
2011	38.31	49.70	**43.68**	**50.90**	**46.14**	**46.86**	**47.38**	**45.06**	**48.66**	**53.70**	**55.33**	**60.04**	**63.83**	**68.02**	**71.95**
2012	64.69	**35.21**	**45.62**	**44.01**	**42.66**	**44.61**	**38.91**	**44.99**	**46.36**	**45.25**	**54.24**	**47.64**	**66.27**	**66.49**	**71.85**
2013	**55.70**	**40.73**	**46.75**	**43.50**	**47.80**	**54.66**	**44.01**	**48.70**	**44.21**	**54.69**	**53.15**	**52.95**	**64.44**	**62.10**	**76.43**
2014	**33.75**	**48.04**	**49.14**	**48.67**	**54.50**	**56.39**	**48.55**	**54.46**	**54.03**	**52.58**	**50.71**	**63.50**	**61.30**	**81.60**	**68.60**
2015	**32.92**	**52.27**	**56.58**	**50.11**	**58.34**	**52.80**	**47.62**	**51.69**	**48.54**	**48.93**	**57.18**	**58.36**	**62.94**	**68.78**	**66.12**
2016	**30.13**	**54.16**	**57.06**	**52.80**	**60.73**	**55.23**	**48.55**	**53.21**	**52.40**	**58.72**	**52.28**	**62.28**	**72.86**	**71.99**	**60.28**
2017	**30.79**	**50.61**	**56.76**	**53.97**	**54.14**	**53.53**	**49.08**	**56.28**	**52.49**	**47.17**	**53.05**	**63.57**	**79.72**	**62.76**	**65.34**
2018	**33.40**	**50.61**	**53.93**	**49.13**	**53.08**	**55.94**	**46.74**	**56.03**	**51.17**	**51.82**	**54.16**	**64.12**	**58.63**	**64.96**	**68.29**
2019	**32.60**	**50.48**	**50.60**	**48.58**	**52.08**	**51.00**	**43.79**	**56.06**	**48.68**	**47.38**	**54.87**	**59.36**	**54.48**	**62.73**	**67.08**
2020	**32.70**	**50.96**	**50.92**	**51.54**	**51.30**	**48.99**	**45.64**	**55.79**	**49.96**	**45.88**	**56.99**	**62.40**	**75.20**	**74.12**	**67.77**

Loss Rates   **Fixed Rate 15 Year Streamline Refinance Mortgages**   **by Credit Subsidy Endorsement Cohort**

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1992	0	41.088	34.521	45.869	34.171	49.914	61.984	48.144	85.199	105.38	181.35	193.84	0	0	0.00
1993	0.00	32.44	42.30	34.44	38.14	49.19	52.57	53.36	39.37	65.30	47.05	36.84	41.43	56.06	611.02
1994	54.59	36.77	38.41	41.33	47.99	51.23	52.70	50.52	60.41	40.40	72.46	112.12	214.76	168.94	187.68
1995	133.47	39.58	40.35	42.16	38.94	48.39	42.18	70.87	39.13	81.04	0.00	159.19	0.00	0.00	770.18
1996	0.00	41.10	55.34	37.81	55.18	35.23	32.31	31.59	71.85	120.27	124.46	191.85	0.00	775.83	0.00
1997	0.00	34.03	49.63	49.84	62.06	52.94	63.11	90.91	24.23	81.46	86.76	0.00	96.95	0.00	0.00
1998	0.00	23.13	30.97	29.41	45.62	42.60	38.81	49.07	164.79	139.28	96.76	127.82	108.72	339.24	291.83
1999	0.00	34.50	30.75	24.01	37.73	37.21	34.93	49.15	81.04	81.64	83.44	112.96	126.89	244.31	83.00
2000	0.00	16.17	41.32	21.59	27.01	60.86	86.36	91.37	123.65	105.68	142.54	0.00	255.99	389.34	71.41
2001	0.00	27.58	41.56	40.90	44.73	50.39	59.81	150.12	127.18	104.75	101.96	93.13	76.15	81.82	90.82
2002	0.00	36.79	35.22	40.35	43.71	59.32	69.61	72.65	100.97	67.90	127.90	62.10	64.67	73.73	87.54
2003	0.00	34.83	31.89	42.45	65.36	67.60	92.02	71.49	77.43	78.02	65.87	61.78	73.29	72.69	79.73
2004	32.92	39.02	37.14	48.87	61.16	66.57	71.62	64.39	81.01	58.20	56.91	66.91	71.45	74.59	77.70
2005	36.67	35.37	52.24	64.39	59.63	59.71	74.80	82.86	49.11	57.68	54.33	58.96	64.46	70.76	72.79
2006	0.00	42.04	64.60	55.95	68.66	65.74	93.01	56.63	51.54	51.79	52.33	58.38	66.03	63.36	66.93
2007	0.00	42.88	60.86	41.10	93.13	61.63	56.06	52.78	55.36	49.28	57.04	60.86	0.00	75.04	70.81
2008	0.00	41.35	72.67	52.28	71.75	61.31	61.33	53.40	70.65	59.22	63.00	78.48	67.25	0.00	65.75
2009	0.00	43.43	53.26	61.57	59.15	61.94	54.86	50.20	54.13	57.99	59.58	57.53	68.68	74.41	79.37
2010	57.34	55.11	55.88	54.62	57.52	58.16	52.36	50.73	55.51	55.29	59.80	65.18	70.14	74.82	84.45
2011	0.00	45.13	48.59	53.70	50.95	56.46	53.15	43.80	56.98	47.77	55.67	63.64	62.49	85.08	0.00
2012	0.00	54.24	48.33	47.81	46.62	45.45	44.83	44.14	48.17	50.70	65.27	65.55	78.37	71.86	72.35
2013	0.00	48.64	45.92	50.01	46.98	43.30	51.88	45.41	54.35	53.54	54.64	66.17	67.10	74.97	66.19
2014	0.00	50.64	38.14	49.58	43.90	48.88	53.47	40.72	42.87	58.16	58.70	59.37	73.17	70.37	73.96
2015	0.00	42.73	38.95	50.37	47.50	47.79	51.14	42.14	50.25	65.28	68.31	59.71	81.18	67.15	76.10
2016	30.60	39.86	40.36	51.04	44.40	45.82	48.36	36.05	45.62	63.77	69.87	76.17	75.64	78.58	83.40
2017	27.56	34.46	37.96	48.20	44.84	45.63	52.37	42.07	47.74	62.55	71.30	67.88	71.22	73.35	81.92
2018	25.34	39.23	36.47	42.45	46.46	43.58	55.29	44.49	47.81	50.03	71.82	64.94	65.39	63.11	70.48
2019	0.00	45.90	35.68	45.85	43.11	44.71	51.61	46.71	46.73	55.42	65.44	64.09	58.47	70.61	69.89
2020	0.00	36.58	37.63	52.95	42.71	45.76	48.88	47.22	45.17	53.35	68.70	66.24	73.59	81.04	68.67

Loss Rates   Adjustable Rate Mortgages   by Credit Subsidy Endorsement Cohort

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1991	68.45	35.47	42.52	48.00	46.70	45.91	48.40	53.47	47.54	41.11	34.70	46.54	32.64	21.24	75.81	106.86	54.15	112.81	93.04	129.24	170.37	50.42	117.83	107.53	95.35	113.34	122.31	123.30	125.30	131.20
1992	31.09	41.93	42.08	43.39	42.95	46.74	46.19	43.58	41.20	36.41	25.02	30.66	33.01	21.29	31.93	71.29	82.40	86.40	101.34	81.82	74.28	92.90	103.41	103.74	108.44	115.97	115.97	122.84	127.44	131.12
1993	39.02	38.38	40.46	39.20	43.22	42.79	40.77	37.11	30.29	26.78	25.62	27.00	45.32	55.90	69.41	88.70	69.12	83.44	120.84	72.67	80.77	97.74	100.34	104.42	109.45	115.48	119.35	125.02	129.38	131.31
1994	26.75	38.23	39.41	40.34	39.79	36.10	32.29	27.96	26.07	30.95	29.71	42.32	38.82	62.65	115.62	70.23	77.37	83.11	90.02	82.36	89.38	95.58	101.13	105.23	108.75	114.48	118.34	121.50	127.97	131.54
1995	41.77	38.73	41.35	40.97	38.34	35.34	31.63	28.55	35.25	34.09	40.04	47.36	83.99	76.38	87.68	78.98	79.76	79.87	78.93	89.17	94.67	99.27	103.56	106.57	112.31	117.80	120.36	128.58	131.69	134.87
1996	38.99	41.06	38.58	34.87	33.96	31.03	27.89	31.90	35.13	35.71	46.25	66.04	78.92	78.09	63.43	89.64	83.91	78.32	86.92	87.27	92.41	96.46	101.27	106.85	110.64	114.87	118.40	123.51	126.20	132.83
1997	26.53	38.43	34.32	32.10	30.35	29.49	30.49	35.43	39.38	45.18	62.48	82.04	81.45	81.67	81.63	79.88	76.50	81.82	85.35	87.46	95.12	100.27	103.65	106.76	111.30	115.49	119.43	125.38	129.28	136.67
1998	29.63	36.09	30.31	29.98	29.72	30.60	34.42	32.20	48.78	53.80	67.36	75.45	70.79	83.52	77.30	76.01	75.76	80.71	84.15	90.55	93.82	100.64	103.33	107.97	113.06	119.60	120.57	127.84	131.29	134.69
1999	0.00	30.61	27.90	27.84	27.16	28.99	33.78	35.41	51.11	61.56	65.33	66.77	79.40	72.72	65.20	71.84	72.54	74.83	81.33	86.91	93.88	96.18	99.22	100.49	108.39	114.24	115.95	126.13	129.49	133.64
2000	20.74	29.83	28.25	32.39	32.82	35.88	39.05	50.99	64.21	62.99	63.48	76.04	78.12	64.58	70.82	70.59	72.83	79.22	85.77	87.78	92.73	97.42	100.15	105.22	109.70	117.49	120.86	127.81	130.41	136.95
2001	0.00	27.88	32.53	33.05	37.58	41.09	53.30	64.82	66.80	68.68	70.53	72.32	63.22	66.92	71.81	70.98	78.89	78.28	86.54	90.69	94.01	93.75	100.47	107.59	109.90	119.18	129.78	123.61	130.09	140.98
2002	17.95	28.28	32.95	31.25	38.77	47.10	61.17	63.50	67.33	70.65	72.78	64.54	67.33	68.66	69.46	72.31	75.99	81.97	83.11	84.96	89.73	96.27	97.57	104.22	110.88	116.52	118.75	127.00	130.17	131.71
2003	20.11	33.83	32.03	37.29	48.20	55.58	65.93	64.29	69.46	76.79	68.85	67.04	66.85	67.46	69.70	74.91	76.76	81.09	82.67	87.72	91.09	98.46	100.80	110.30	110.50	116.63	122.06	125.46	129.75	139.20
2004	29.65	31.90	36.21	46.64	56.48	63.56	62.54	65.79	75.25	66.21	65.35	65.14	65.66	67.85	71.84	74.01	76.10	79.34	82.40	87.53	91.65	97.05	101.79	105.82	113.39	117.04	121.34	128.54	129.98	134.99
2005	33.18	36.24	47.94	57.98	63.02	62.76	69.12	73.82	63.71	64.60	63.76	63.43	64.96	67.16	69.16	70.52	72.55	75.87	79.45	82.40	87.81	91.71	96.20	104.34	105.78	113.00	114.48	121.19	126.34	131.24
2006	27.18	46.36	58.80	65.60	63.16	65.94	72.12	64.95	65.13	64.98	64.34	65.25	67.02	69.29	69.50	68.24	74.09	77.53	80.46	86.65	88.35	90.01	97.35	101.29	105.71	110.28	120.43	120.94	124.30	126.80
2007	0.00	50.73	57.86	60.23	65.25	71.00	63.16	64.67	63.71	64.98	64.11	67.30	65.62	71.01	69.69	70.12	73.03	76.07	82.45	86.34	90.39	93.25	104.44	101.85	110.58	114.96	112.39	128.15	134.63	135.23
2008	12.12	48.83	46.26	56.54	57.79	55.78	59.39	58.95	57.33	57.68	58.65	62.10	65.44	65.39	67.25	68.12	73.50	77.37	80.63	84.23	93.28	92.25	101.90	101.13	104.22	116.85	113.93	123.22	130.69	120.84
2009	32.91	37.95	48.72	49.02	48.61	51.16	52.22	49.82	48.30	50.76	52.14	54.12	56.30	60.16	63.16	68.48	69.50	73.97	79.23	84.31	92.08	98.88	90.67	102.96	113.66	109.84	121.62	123.10	129.48	128.70
2010	26.29	32.92	37.42	39.98	43.06	43.46	43.22	42.76	44.47	43.79	48.07	50.68	52.92	58.51	61.27	64.11	67.84	73.63	79.27	79.89	84.56	90.11	93.99	102.59	105.53	108.02	112.44	122.61	127.10	129.68
2011	0.00	28.49	34.13	36.05	39.26	38.35	40.04	40.86	42.43	45.20	46.92	50.92	55.92	58.62	64.15	66.39	71.64	74.46	81.70	85.59	87.50	91.80	97.72	101.82	108.44	114.84	118.86	120.53	131.13	136.92
2012	50.17	36.75	31.46	35.47	35.55	38.32	39.71	40.97	42.30	42.59	48.13	53.90	54.29	55.68	60.92	66.31	71.07	73.54	79.68	85.77	81.80	92.82	101.23	103.55	116.85	118.58	132.07	127.07	125.44	141.09
2013	0.00	29.89	38.00	39.24	40.82	32.83	40.04	46.16	36.85	40.93	46.43	52.98	50.22	62.97	70.18	70.90	65.35	76.49	80.27	88.61	100.71	81.73	103.95	104.30	118.25	132.39	124.82	121.61	144.26	120.72
2014	0.00	31.51	33.23	42.84	41.19	39.46	49.31	47.94	40.83	47.72	48.17	49.39	47.26	62.28	64.05	66.81	70.35	84.81	86.99	80.33	105.25	89.74	118.28	99.75	107.56	130.04	123.45	116.67	149.34	127.20
2015	0.00	33.31	35.62	43.90	42.94	38.28	48.47	48.93	42.99	43.31	55.78	57.17	51.28	61.32	65.12	67.93	81.74	76.57	79.74	105.87	99.26	89.89	103.23	103.32	110.05	134.55	133.68	118.07	0.00	121.74
2016	0.00	35.66	36.82	44.45	46.14	41.42	47.38	51.57	41.39	42.09	53.11	55.53	48.77	55.64	67.84	72.28	72.33	72.19	81.27	115.90	95.45	92.84	100.19	108.27	111.68	122.04	126.50	116.93	0.00	121.10
2017	0.00	35.21	37.64	41.52	42.51	42.49	53.08	52.34	40.62	44.06	50.97	61.62	48.05	61.29	65.01	69.50	78.10	77.82	95.66	72.29	83.88	94.07	116.34	104.73	113.21	118.58	126.92	112.42	0.00	125.45
2018	0.00	33.83	36.43	41.22	41.67	39.78	48.93	55.87	44.21	40.57	56.20	57.98	53.82	56.45	67.48	76.66	80.19	80.12	97.24	84.44	103.45	88.94	107.44	92.39	109.28	119.62	129.68	115.37	130.45	122.15
2019	36.49	31.25	35.58	44.09	42.42	39.36	49.24	54.93	44.76	40.75	51.87	57.16	55.12	58.59	64.08	62.34	80.76	74.12	86.52	80.40	92.39	94.30	98.86	98.79	107.90	139.95	132.67	118.18	157.69	119.68
2020	0.00	33.84	36.20	45.18	40.30	35.77	53.10	51.13	45.42	39.57	59.37	62.18	57.34	54.41	63.35	73.99	70.68	76.63	84.09	70.07	87.22	88.51	84.93	102.19	113.79	119.26	124.87	121.60	118.13	114.05

Loss Rates   **Adjustable Rate Streamline Refinance Mortgages**   by Credit Subsidy Endorsement Cohort

Book\Po	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1994	31.33	41.28	43.72	48.53	48.15	43.42	37.03	27.94	20.18	19.15	66.00	61.49	118.80	0.00	97.82	54.21	70.67	86.66	36.02	84.78	86.28	92.29	98.27	104.03	106.93	110.70	118.85	122.29	121.75	125.17
1995	0.00	41.86	37.36	45.63	34.17	40.82	17.82	2.75	13.94	35.99	39.96	14.53	88.56	140.07	47.46	155.09	129.43	0.00	76.93	0.00	87.48	108.26	103.67	111.81	105.92	120.12	112.46	123.20	135.82	0.00
1996	0.31	35.54	37.14	36.00	27.44	23.05	20.17	34.11	52.92	22.41	46.59	46.05	43.76	185.43	48.43	40.60	95.79	48.56	75.80	86.33	93.26	90.02	113.83	109.25	105.91	114.54	126.04	125.85	0.00	123.70
1997	28.26	38.57	31.10	29.55	26.07	18.23	26.09	27.72	48.73	29.03	34.89	60.51	70.88	86.86	141.90	69.95	85.03	87.62	81.98	92.55	97.72	111.66	136.49	123.94	141.54	131.15	119.06	130.87	146.26	0.00
1998	28.73	26.03	27.47	23.37	16.84	25.17	32.24	28.18	20.39	0.00	31.72	-35.01	55.66	52.03	110.52	73.42	78.92	76.76	89.51	93.42	95.01	100.52	104.99	96.91	111.58	116.81	108.51	127.04	118.87	138.23
1999	0.00	26.87	25.04	21.07	24.22	32.72	29.89	37.08	76.79	87.67	49.68	31.20	94.66	77.09	75.17	71.54	77.37	77.06	83.91	87.34	86.89	93.79	108.47	103.20	115.25	115.66	116.41	0.00	117.28	103.39
2000	0.00	31.84	25.06	26.11	33.67	26.56	31.08	59.15	64.01	40.90	73.65	75.11	79.60	90.31	75.00	68.43	90.66	86.68	94.20	99.82	101.36	96.24	97.10	112.70	122.58	119.36	139.41	129.24	120.02	129.30
2001	25.08	28.48	33.99	33.46	30.99	42.31	58.24	70.96	61.54	64.40	57.41	94.24	61.82	73.66	69.94	74.06	78.17	87.42	82.53	84.89	97.45	106.24	90.46	95.86	107.75	114.76	0.00	0.00	163.63	145.03
2002	11.76	25.60	30.02	30.88	37.10	49.12	66.45	66.12	66.65	69.82	71.99	65.21	66.10	68.78	69.55	75.23	73.13	82.81	80.14	87.51	92.40	93.45	100.98	105.01	112.94	117.92	118.28	129.60	135.36	134.22
2003	23.52	30.11	30.90	32.44	45.72	56.70	62.86	61.81	70.83	69.68	59.57	62.61	64.66	68.18	70.65	70.80	78.67	81.81	82.85	83.34	90.22	95.64	100.77	108.82	107.11	110.74	124.74	134.49	131.39	131.91
2004	27.39	29.58	35.61	46.72	55.05	61.45	58.66	66.31	74.71	61.85	62.91	65.59	65.26	69.37	69.41	74.15	77.96	79.27	85.22	87.68	92.99	99.54	104.26	106.37	113.97	117.83	129.42	127.71	130.91	142.25
2005	28.27	32.29	48.45	59.65	62.01	62.65	59.02	73.87	59.74	61.73	62.65	61.31	63.17	67.86	71.59	73.52	74.65	80.18	80.95	85.33	89.95	98.98	106.54	104.94	112.69	122.87	116.47	132.97	132.06	141.09
2006	0.00	45.32	52.51	59.71	59.20	65.52	70.51	62.79	66.98	71.27	65.42	71.25	71.65	70.77	70.43	75.17	66.36	84.03	78.88	79.76	102.38	87.55	0.00	97.95	0.00	116.38	99.22	0.00	0.00	0.00
2007	0.00	56.29	80.86	67.90	69.21	65.84	64.66	64.98	68.70	62.41	76.02	73.96	77.91	77.11	72.52	80.90	88.11	87.70	82.35	90.50	116.27	92.66	107.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2008	0.00	46.07	61.57	72.77	77.99	73.20	72.51	69.20	67.12	65.87	71.19	72.48	71.56	66.30	74.73	76.41	80.21	80.76	85.16	98.31	90.21	101.29	108.42	101.69	127.49	102.46	118.14	0.00	118.19	0.00
2009	43.03	50.54	55.21	59.67	57.41	61.64	62.11	62.19	61.70	59.49	63.32	68.39	66.90	72.63	74.80	75.38	84.73	80.82	80.91	93.01	95.17	102.50	96.49	102.17	111.21	117.31	117.13	116.42	129.76	134.72
2010	41.14	46.27	51.52	53.60	56.36	58.61	57.18	56.85	58.14	59.58	64.44	64.79	68.03	75.39	75.21	78.55	77.56	86.21	86.14	92.02	100.10	100.11	103.19	107.38	110.17	119.46	124.24	123.95	131.16	142.85
2011	44.82	41.48	41.73	45.81	47.76	47.43	49.29	49.72	52.38	52.57	55.98	60.50	67.10	69.62	76.51	84.74	82.75	82.15	90.98	89.05	92.68	103.90	104.70	105.45	109.08	109.75	120.06	128.09	137.62	136.84
2012	37.13	35.12	43.12	42.96	42.63	45.18	47.41	51.42	47.32	52.38	55.65	58.74	66.20	68.19	76.68	81.38	85.85	92.41	95.57	93.41	102.26	92.67	114.15	117.56	103.06	120.71	132.90	0.00	138.76	139.18
2013	0.00	34.51	33.99	51.15	40.00	37.32	50.62	48.91	42.35	41.41	50.07	64.07	52.72	91.16	73.96	89.41	82.67	105.53	0.00	92.34	104.84	114.00	115.56	0.00	117.53	0.00	144.42	130.92	0.00	138.01
2014	0.00	33.24	26.15	40.30	38.94	38.49	49.59	50.53	43.53	42.77	62.50	65.43	53.05	73.33	78.16	95.98	88.60	0.00	88.28	100.06	99.48	93.20	0.00	117.85	0.00	145.82	136.88	0.00	0.00	0.00
2015	0.00	35.66	28.11	32.17	40.11	39.85	54.75	49.41	45.61	41.40	57.83	70.86	58.05	78.12	70.06	90.25	72.22	0.00	106.30	0.00	83.92	96.79	116.95	121.85	119.85	0.00	134.98	127.90	0.00	0.00
2016	0.00	37.13	28.65	33.75	38.84	35.81	56.18	49.35	44.76	40.07	55.13	70.49	55.42	113.39	63.06	88.05	74.44	0.00	117.55	0.00	107.66	85.02	116.59	125.81	120.04	0.00	0.00	130.66	0.00	0.00
2017	0.00	43.00	31.89	35.55	37.03	33.35	52.49	52.72	41.27	45.91	52.42	62.94	48.23	71.95	59.90	90.30	74.37	0.00	90.48	113.37	103.20	99.77	116.12	0.00	116.31	0.00	0.00	132.28	0.00	0.00
2018	0.00	36.17	33.42	34.09	32.57	35.21	48.34	65.40	43.63	42.15	61.88	69.32	52.73	65.42	68.47	97.21	80.71	0.00	83.79	101.80	104.89	100.95	122.03	0.00	128.70	0.00	0.00	129.75	0.00	133.92
2019	0.00	41.14	33.36	37.68	40.37	30.67	48.46	59.95	46.59	45.97	64.74	67.55	61.26	66.60	66.81	80.39	95.49	0.00	83.31	91.51	97.67	93.92	115.70	0.00	113.61	0.00	0.00	131.96	0.00	0.00
2020	0.00	42.71	33.81	39.53	42.87	33.63	56.33	51.23	44.86	45.36	68.79	77.76	63.39	66.23	66.42	82.24	68.36	0.00	108.26	84.88	106.97	116.11	123.24	119.51	110.57	0.00	0.00	140.43	176.92	0.00

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