Actuarial Review of the Federal Housing Administration Mutual Mortgage Insurance Fund Forward Loans for Fiscal Year 2016

November 15, 2016

Prepared for

U.S. Department of Housing and Urban Development

By

Integrated Financial Engineering, Inc.

ffe

Integrated
Financial Engineering

IFE Group, 51 Monroe Street, Suite 1100, Rockville, MD 20850, U.S.A

Phone: (301) 309-6560
Fax: (301) 309-6562
info@ifegroup.com

November 15, 2016

The Honorable Golding, Edward
Principal Deputy Assistant Secretary for Housing – Federal Housing Commissioner
U.S. Department of Housing and Urban Development
451 Seventh Street, SW, Room 9100
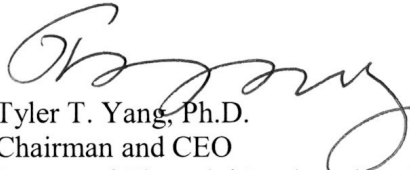Washington, DC 20410

Dear Dr. Golding:

IFE Group has completed and, along with this letter, is submitting the fiscal year 2016 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 2016 was *positive* $35.27 billion and the unamortized insurance in force was $1,188.57 billion. We project that at the end of fiscal year 2023 the Fund's economic value will be $102.15 billion and the unamortized insurance in force will be $1,655.99 billion. Our sensitivity analysis indicates that there is approximately a 99 percent probability that the FY 2016 economic value would be positive.

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 sources 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 2016

I have reviewed the "Actuarial Review of the Federal Housing Administration Mutual Mortgage Insurance Fund, Forward Loans, for Fiscal Year 2016". 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., FCIA
Fellow of the Canadian Institute of Actuaries
November 15, 2016

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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. Enacted on July 30, 2008, 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 IFE Group's independent analysis for fiscal year (FY) 2016.

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, and

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

We use a stochastic method to estimate the net present value of expected future cash flows. In the FY 2011 and previous Reviews, the net present value of the cash flows was computed using a single, deterministic path of house prices and interest rates. Starting with the FY 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.

Based on our stochastic simulation analysis, we estimate that the economic value of the Fund as of the end of FY 2016 is *positive* $35.27 billion. This represents an $18.23 billion improvement from the *positive* $17.04 billion economic value estimated in the FY 2015 Review. Because the HECM portfolio is excluded from this analysis, we do not report the capital ratio of the entire Fund.

We project that there is approximately a 99 percent probability that the FY 2016 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 2023. The FY 2016 economic value under the worst path in the Monte Carlo simulation is *negative* $9.37 billion and under a modified Moody's protracted slump scenario it is *negative* $36.12 billion.

A. Status of the Fund

Exhibit ES-1 reports the estimates of the Fund's current and future economic values 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 2016 through 2023 ($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
2016	35,272	1,188,573	1,076,650	13,198	228,855	
2017	46,647	1,248,134	1,124,507	10,825	213,939	549
2018	54,128	1,314,123	1,172,859	6,365	158,208	1,117
2019	62,059	1,383,557	1,222,076	6,342	155,550	1,590
2020	71,562	1,454,746	1,272,306	7,512	173,677	1,991
2021	81,471	1,524,104	1,319,682	7,494	176,009	2,415
2022	91,599	1,591,501	1,364,637	7,273	183,599	2,854
2023	102,151	1,655,990	1,407,520	7,247	193,012	3,305

[a] All values are as of the end of each fiscal year. The economic value for FYs 2016 through 2023 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, 2016, 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.

The capital resources of the Fund at the end of FY 2016 are $31.32 billion. We simulated the capital resources over the next seven years using 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 a 5 percent chance that the capital resources may fall below $30.4 billion during the next seven years.

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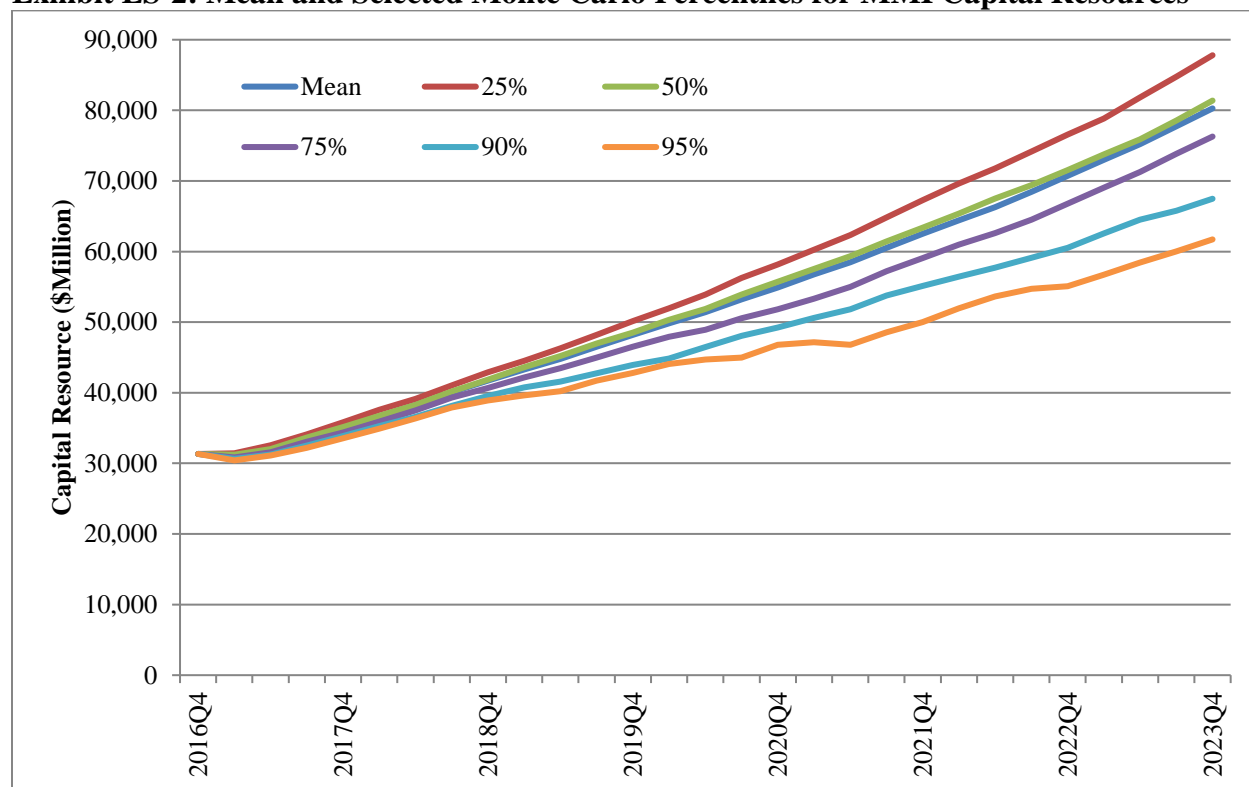
B. Sources of Change in the Status of the Fund

Change in Economic Value from FY 2015 to FY 2016

We estimate that the economic value of the Fund is *positive* $35.27 billion as of the end of FY 2016, which represents an increase of $18.23 billion compared to the FY 2015 economic value of *positive* $17.04 billion. Meanwhile, there has been a $38.12 billion increase in the estimated unamortized IIF from the FY 2015 value of $1,150.45 billion, to $1,188.57 billion.

Current Estimate of FY 2016 Economic Value Compared with the Estimate Presented in the FY 2015 Actuarial Review

Our current estimate of the FY 2016 economic value is $10.11 billion higher than the economic value projected for FY 2016 in the FY 2015 Actuarial Review. Our current estimate of the FY 2022 economic value is $91.60 billion, which is $16.99 billion higher than estimated in the FY 2015 Actuarial Review. The FY 2016 differences are attributed to the following changes, with the magnitude of the incremental changes in the estimated FY 2016 economic value shown in parentheses for each source:

- Updating the estimated origination volume of the FY 2015 and FY 2016 books of business (+$3.51 billion)
- Updating the discount factors published by OMB (-$0.16 billion)
- Updating actual performance in FY 2015-FY 2016 (+$2.96 billion)
- Updating capital resources at the end of FY 2016 (+$7.33 billion)
- Updating the econometric models (+$3.79 billion)
- Adjusting third party sales loss rate projection (-$0.19 billion)
- Updating the economic scenario forecast (-$6.22 billion)
- Adjusting delayed claims (-$0.46 billion)
- Adjusting the November 2015 and September 2016 Note Sale transactions (-$0.44 billion)

In summary, the estimated FY 2016 economic value of the Fund increased and is $10.11 billion higher than as estimated last year.

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 March 31, 2016 provided by HUD. We supplemented that with various updates up to August 2016. 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 and stochastic paths generated by Monte Carlo simulation algorithms. Our modeling approach is based on our experience and research in this field and on the relevant literature. However, it is not the only way to build such models. We recognize that other capable modelers may use different assumptions and models and thus obtain different estimates.

C. Impact of Economic Forecasts

The economic value of the Fund and its pattern of accumulation to FY 2023 depend on many factors. One of the most important set of factors is the prevailing economic conditions over the next 37 years, and most critically during the first 10 years of that time period. We capture 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
- 10-year Treasury rates
- 1-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 derived from Monte Carlo simulations centered on Moody's Analytics quarterly forecasts for interest rates and MSA-level house price appreciation and unemployment rates, which Moody's Analytics forecasted along with other macroeconomic and regional variables, as of July 2016.

We also estimated the economic value of the Fund under eight additional economic scenarios. The first five of these come from a ranking of the FY 2016 economic values produced by the 100 simulation paths from the highest FY 2016 economic value to the lowest. The sixth scenario corresponds to Moody's Protracted Slump Scenario. The seventh is Moody's baseline forecast applied as a deterministic scenario. The last path is the low interest rate path, where we keep the current low interest rate for two years and recover to Moody's baseline forecast in another two years.

- 10th Best Path in Simulation
- 25th Best Path in Simulation
- 25th Worst Path in Simulation
- 10th Worst Path in Simulation
- Worst Path in Simulation
- Moody's Protracted Slump Scenario
- Moody's Baseline Forecast as a Deterministic Scenario
- The Low Interest Rate Scenario

These eight scenarios do not represent the full range of possible experience, but they represent considerable 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 approximately an 80 percent chance that the FY 2016 economic value is in the range of *positive* $26 billion and *positive* $45 billion. From the worst path in the simulation, we infer that there is approximately a 99 percent probability that the

FY 2016 economic value will be better than *negative* $9 billion. Under a modified Moody's protracted slump scenario, the FY 2016 economic value would be *negative* $36.12 billion. Also from our simulated scenarios, we infer that there is approximately a 99 percent chance the FY 2016 economic value will 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
2016	35,272	44,590	40,461	31,863	25,834	-9,375
2023	102,151	79,788	108,485	127,926	86,376	-11,245

Fiscal Year	Moody's Protracted Slump	Moody's Baseline	Low Interest Rate
2016	-36,116	39,349	31,565
2023	17,080	112,072	113,735

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 these non-profit-assisted loans had not been endorsed, the economic value of the Fund would have improved by $16.50 billion, resulting in an economic value of $51.78 billion in FY 2016.

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 2016. One of the programs that was 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 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 the 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 of financial soundness, (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 MMI 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 MMI 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 MMI 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 MMI Fund, which subsequently included HECMs.

To further strengthen the capital position of the MMI 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 MMI 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 prior Reviews, we have assumed continuation of the current HUD policy that no distributive shares will be paid, and we continue to make that assumption in this FY 2016 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. 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 loss rates that FHA was experiencing on ARMs. 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 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 (LTVs). This rule was further tightened in 2010.[2] Starting October 4, 2010, borrowers with credit scores below 500 were no longer eligible for FHA insurance, and the maximum loan-to-value ratio for borrowers with credit scores between 500 and 579 was limited to 90 percent. In 2011, FHA removed eligibility for loans on investor property.[3] In 2012, FHA modified documentation requirements for self-employed borrowers. Starting from April 1, 2012, profit-loss and balance sheets of 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.

For manually underwritten loans assigned on or after April 21, 2014, HUD clarified a series of maximum qualifying ratios for different lowest minimum decision credit scores and acceptable compensating factors.[5] It also revised the compensating factors that must be cited to exceed FHA's standard qualifying ratios for manually underwritten loans.

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, using a scorecard custom-estimated for FHA endorsed loans. FHA also made a substantial number of revisions to its credit policies and reduced documentation requirements for loans assessed by Loan Prospector. This was the first time that FHA incorporated an automated

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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.
[5] Mortgagee Letter 2014-02, January 21, 2014: Manual Underwriting.

underwriting system (AUS) in its insurance endorsement process. Fannie Mae's Desktop Underwriter and PMI Mortgage Services' Automated Underwriting Risk Analysis (AURA) were approved to underwrite FHA mortgages in 1999, followed soon thereafter by Countrywide Funding Corporation's Countrywide Loan-Underwriting Expert System (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. A new guidance issued in February 2011 prohibits the use of the TOTAL scorecard on streamline refinance transactions.[6]

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.[7]

On August 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.[8] The annual insurance premium was further increased by another 25 basis points for all loans starting April 18, 2011.[9] 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.[10] For loans exceeding $625,500, 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 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.

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[6] Mortgagee Letter 2011-11, February 14, 2011: FHA Refinance Transactions.
[7] Mortgagee Letter 2010-02, January 21, 2010: Increase in Upfront Premiums for FHA Mortgage Insurance.
[8] Mortgagee Letter 2010-28, September 1, 2010: Changes to FHA Mortgage Insurance Premiums.
[9] Mortgagee Letter 2011-10, February 14, 2011: Annual Mortgage Insurance Premium Changes and Guidance on Case Numbers.
[10] Mortgage Letter 2012-04, March 6, 2012: Single Family Mortgage Insurance: Annual and Up-Front Mortgage Insurance Premium-Changes.

Under Public Law 111-229 (1)(b), FHA adjusted its annual MIP rates effective from April 1, 2013.[11] 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 these loans if their case number is assigned on or after June 3, 2013. In addition, the new duration of the annual MIP for loans with an LTV up to 90 percent is 11 years, and it is for the life of the loan for LTVs greater than 90 percent. Effective on January 26, 2015, FHA reduced the annual premium rates by 50 bps for loans with terms greater than 15 years, with the exception of streamline refinance loans if the original FHA loan was endorsed on or before May 31, 2009.[12]

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)[13] 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.[14]

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 $417,000. Effective January 1, 2009, and per HERA the FHA mortgage limit for any given area

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[11] 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.
[12] Mortgagee Letter 2015-01, January 9, 2015: Reduction of Federal Housing Administration (FHA) annual Mortgage Insurance Premium (MIP) rates and Temporary Case Cancellation Authority.
[13] The GSEs are Fannie Mae, Freddie Mac, and the Federal Home Loan Banks.
[14] Mortgagee Letter 2008-06, March 6, 2008, Temporary Loan Limit Increase for FHA.

was set at 115 percent of the area median house price, with a ceiling of 150 percent of the GSE conforming loan limit, or $625,500.[15]

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.[16] 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.[17] 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, FHA's national loan limit was reduced to $625,500, which was the same as the GSE's national limit.[18] The FHA national loan limit for loans endorsed after November 18th, 2011 reverted to $729,750, while Fannie Mae's and Freddie Mac's conforming loan limit remained at $625,500.[19] The FHA national loan limit was reduced to $625,500 starting on January 1, 2014 and remained at the same level as GSE's national limit.[20]

6. Concentration of Loans with Downpayment Assistance

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.[21] 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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[15] Mortgagee Letter 2008-36, November 7, 2008, 2009 FHA Maximum Mortgage Limits.

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

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

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

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

[20] Mortgagee Letter 2013-43, December 6, 2013: Federal Housing Administration Maximum Loan Limits Effective January 1, 2014 through December 31, 2014;
Mortgagee Letter 2014-25, December 5, 2014: Federal Housing Administration Maximum Loan Limits Effective January 1, 2015 through December 31, 2015

[21] 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.[22] 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. In April 2014, HUD provided a guidance to clarify whether government-assisted nonprofit organizations' secondary financing programs require HUD approval on the Nonprofit Organization Roster.[23]

7. Foreclosure Avoidance and Loss Mitigation Programs

One of the consequences of the recent 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,[24] 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 obligations even when the proceeds may be less than the amount owed.[25] This approach attempts to reduce the total credit costs to FHA by avoiding the costs of the foreclosure-REO process.

In 1996, 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.[26] This approach proved to be an effective way of keeping financially stressed borrowers in their homes and reducing FHA's default claim 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, The Helping Families Save Their Homes Act of 2009 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 help FHA borrowers already in

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

[23] Morgagee Letter 2014-08, April 29, 2014, Guidance on Nonprofits Assisting Government Entities in Providing Secondary Financing in Conjunction with FHA-Insured Mortgages.

[24] The regulations for the PFS Program are codified in 24 CFR 203.370.

[25] Mortgagee Letter 2008-43, December 24, 2008, Utilizing the PFS Loss Mitigation Option.

[26] 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.

default or at "imminent" risk of default with opportunities to reduce payments by loan modification with principal deferment. Starting from 2009, FHA has aggressively engaged in loan modification programs, including rate reduction, term extension and principal forgiveness, in addition to traditional repayment plans. The post modification data have been included in the loan status transition model to capture the future behavior of modified loans.

On March 26, 2010, HUD and the Department of the Treasury announced enhancements to the existing Making Home Affordable (MHA) program and FHA refinance program that attempted to give a greater number of responsible borrowers the opportunity to remain in their homes.[27] These enhancements were designed to maintain homeownership by allowing borrowers who owe more on their conventional mortgages than the value of their homes to refinance into an affordable FHA 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.[28] Loans with certain high-risk characteristics are required to complete a three-month or longer trial period before a permanent standard modification and/or partial claim can be granted.

On November 16, 2012, FHA announced revisions to loss mitigation home retention options.[29] The home retention option waterfall was streamlined into a new 3-tier incentive structure: Special Forbearance, Loan Modification, and HAMP. The Special Forbearance option was restricted to cases where mortgagors were unemployed. The revision also eliminated some requirements for HAMP and expanded the option of HAMP to include Modification and Partial Claim, and at the same time increased the limit of Partial Claim amounts. In 2013, FHA further updated some of the revisions to provide guidance on assessing loss mitigation options.[30] The number of HAMP cases quadrupled in FY 2013 and more than doubled in FY 2014. The number of Partial Claims cases also doubled in FY 2013 and doubled again in FY 2014.[31] The model for this Actuarial Review for FY 2016 applies adjustments to claim and loss mitigation costs to reflect these changes.

In the August 25, 2016 press release for ML 2016-14, HUD announced new procedures to strengthen the process mortgage servicers use to help struggling families avoid foreclosure and remain in their homes. "FHA is streamlining its loss mitigation protocols that servicers must use when evaluating and deploying 'home retention options', foreclosure alternatives that allow

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[27] Mortgagee Letter 2010-23, August 6, 2010, FHA Refinance of Borrowers in Negative Equity Positions.
[28] Mortgagee Letter 2011-28, August 15, 2011, Trial Payment Plan for Loan Modifications and Partial Claims under Federal Housing Administration's Loss Mitigation Program.
[29] Mortgagee Letter 2012-22, November 16,2012, Revisions to FHA's Loss Mitigation Home Retention Options
[30] Mortgagee Letter 2013-32, September 20, 2013, Update to FHA's Loss Mitigation Home Retention Options
[31] Annual Report to Congress Regarding the Financial Status of the FHA Mutual Mortgage Insurance Fund Fiscal Year 2013; Annual Report to Congress Regarding the Financial Status of the FHA Mutual Mortgage Insurance Fund Fiscal Year 2014

delinquent borrowers to retain their home." "These changes will reduce the number of steps that a servicer and borrower must take to resolve a delinquency and enter into a loss mitigation home retention product." In the ML, Loan Modification as a standalone option was eliminated and combined into HAMP.

In 2013, FHA also extended its PFS eligibility for delinquent loans. Compared to the previous guideline in ML 2008-43,[32] the new PFS guideline in ML 2013-23[33] has less restrictive eligibility criteria for PFS approval regarding non-owner occupied homes. In the previous ML 2008-43, the subject properties must not have been rental homes for more than 18 months prior to PFS acceptance. In ML 2013-23, all non-owner-occupied homes with more than 90 days in delinquency and borrower credit score less than 620 are qualified for streamlined PFS. Also the maximum consideration toward successful PFS was increased from $1,000 to $3,000 to give borrowers more incentive to use this program. In 2014, the updated PFS guideline in ML 2014-15[34] required a minimum marketing period of 15-calendar days for all PFS transactions. It also clarified that non-arms-length transactions are permitted only if they are necessary to comply with the state law.

In November 2011, FHA started a pilot program 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 onto the implementation of the TPS program. In 2014, to encourage TPSs, HUD reimburses lenders for third-party service fees that incurred for an amount that does not exceed 5 percent of a property's net sales price. Also, bidding instructions have changed to "align net expected recoveries in REO with the appraised value of the property to provide at minimum break-even bidding prices for FHA's interest in the property,"[35] in order to improve TPS efficiency. HUD further requires servicers to "use the Commissioner's Adjusted Fair Market Value (i.e., which will be made available to mortgagees) for all foreclosure sales and post-foreclosure sales efforts associated with defaulted FHA-insured mortgages" when the qualification criteria are all met.[36] These policy initiatives have resulted in additional TPS claims, which reduced loss severity by avoiding the additional carrying and disposition costs in otherwise identical REO claims.

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

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

[34] Mortgagee Letter 2014-15, July 10, 2014, Updated Requirements for Pre-Foreclosure Sales (PFS) and Deeds in Lieu (DIL) of Foreclosure.

[35] U.S. Department of Housing and Urban Development, December 13, 2013, Annual Report to Congress Regarding the Financial Status of the FHA Mutual Mortgage Insurance Fund Fiscal Year 2013.

[36] Mortgagee Letter 2014-24, November 16, 2014, Increasing Opportunities for Use of FHA's Claims Without Conveyance of Title (CWCOT).

In a June 8, 2012 press release,[37] HUD announced the Distressed Asset Securitization Program. "Under the program, FHA-insured notes are sold competitively at a market-determined price generally below the outstanding principal balance. Once the note is purchased, foreclosure is delayed for a minimum of six additional months as the borrower gets direct help from their servicer to find an affordable solution to avoid foreclosure."

As this Review was produced, HUD had completed three settlements of single-family non-performing loans in FY 2013, seven settlements in FY 2014, one settlement in FY 2015, and two settlements in FY 2016.[38]

C. Current and Future Market Environment

1. Interest Rates

Since the recent housing recession and national financial crisis, the Fed has taken active monetary policies to reduce market interest rates. Consequently, the 1-year Treasury rate has fallen to a historically low level: from 2.20 percent in August 2008 to 0.10 percent in July 2014, which then rose slightly to 0.31 in July 2015 and then increased to 0.49 in July 2016. Similarly, the 10-year Treasury yield also declined from 3.53 percent in August 2009 to 1.67 percent in July 2016. The average conventional 30-year fixed-rate mortgage commitment rate posted by Freddie Mac declined from 5.18 percent in August 2009 to 3.50 percent in July 2016. These realized 2016 rates are lower than those projected in last year's Review.

Moody's July 2016 economic forecast projected that future mortgage rates will steadily rise to 5.81 percent by calendar year (CY) 2019, and then gradually increase to a long-term stable level at 6.22 percent by CY 2033. Compared to last year's Moody's forecast, the mortgage rates would be starting at a lower level, rising by a similar speed and then stabilize at a lower level. The 1-year Treasury rate was projected to rise quickly to about 3.61 percent in CY 2020, and then rise to 3.63 percent in CY 2023 and stay at that level thereafter. The 10-year Treasury rate was projected to rise to 4.04 percent by CY 2018, and later settle to a long term level at 4.35 percent. Moody's July 2016 forecasted rates for the 1-year Treasury rate has similar long-term levels as those in July 2015 forecast, but lower starting points. The 10-year Treasury rate and the mortgage rate have much lower starting points, and are projected to have lower long term levels than those in the July 2015 forecast.

Exhibit I-1 shows Moody's base-case forecasts of the 10-year Treasury rate used this year and in last year's Review. As mentioned, the realized 10-year Treasury rates during the last year turned out to be declining instead of rising as was forecasted last year. However, Federal Reserve officials intended an interest rate increase before the end of the calendar year, and the economy

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[37] HUD Press Release No. 12-096, June 8, 2012, HUD to Expand Sale Of Troubled Mortgages Through Program Designed to Help Borrowers Avoid Costly, Lengthy Foreclosures.
[38] http://portal.hud.gov/hudportal/HUD?src=/program_offices/housing/comp/asset/hsgloan

shows signs of picking up. Therefore, the capital market expects that interest rates may steadily rise in the next few years, converging to the long-term targets.

Exhibit I-1: 10-Year Treasury Rate Forecasts for FY 2015 and FY 2016 Reviews
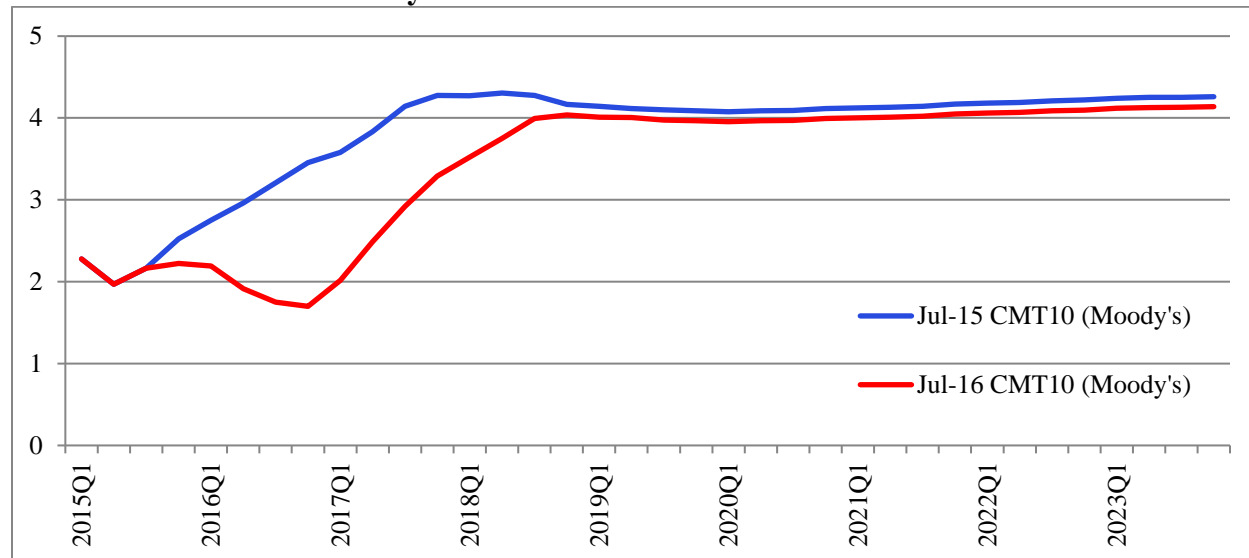
2. House Price Growth Rates

The Federal Housing Finance Agency (FHFA) published the Purchase-Only (PO) House Price Index for 75 MSAs for the first time in 2013. In 2015 the PO HPI for 100 MSAs was published. 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 direct and reliable measure of housing market conditions. The PO HPI has been adopted for the Actuarial Reviews since FY 2013.

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 as an alternative simulation scenario in Section V.

Exhibit I-2 presents the July 2016 Moody's baseline national house price growth rate forecast as compared to the one used in the FY 2015 Review. According to the FHFA-published HPI, the 4-quarter growth rate is 5.67 percent through the first quarter of CY 2016, which is similar to the one Moody's forecasted last year. The growth rate is forecasted to be a bit higher than last year's forecast throughout the next two years. After that, the house price growth rate fluctuates around a long-run average annual rate of around 3.40 percent, which is also higher than the level in last year's forecast.

Exhibit I-2: House Price Appreciation Forecasts for FY 2015 and FY 2016 Reviews
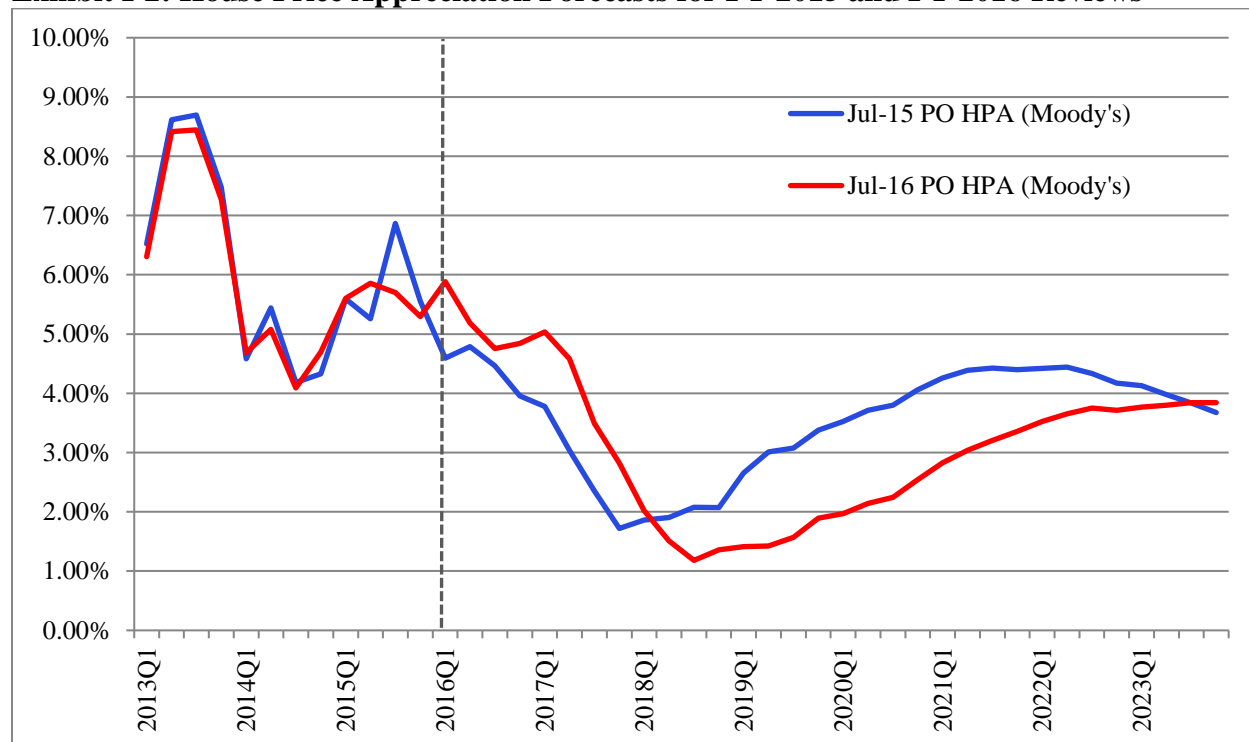
3. Mortgage Demand

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). As a result of 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. Origination volume during FY 2009 reached a record high of $330 billion, up from $176 billion in FY 2008. The FHA endorsement volume has remained high since then. The FY 2013 volume was $235 billion, which is only lower than FY 2009 and FY 2010, due to the record low mortgage interest rate. The FY 2015 volume was $216 billion. The estimate for the FY 2016 Volume is $229 billion,[39] as mortgage interest rates remain at an almost historical low level.

The forecast of future FHA endorsement volumes depends critically on what the future holds for conventional mortgage lenders, private mortgage insurers, 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

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[39]Based on FHA data warehouse as of the end of June 2016.

the role of other mortgage market institutions, we determine the FHA market share to settle to around 15 percent of the total single-family mortgage market based on FHA projection.

Moody's July 2016 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 $158 billion in FY 2018 and $156 billion in FY 2019. We then expect FHA endorsement volume to increase by 5.5% every year to more than $190 billion for FY 2023, 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 2015 Actuarial Review – presents the Fund's estimated economic value and insurance-in-force for FY 2016 through FY 2023. This section also provides a reconciliation and explanation of the major differences between the FY 2015 and FY 2016 Reviews.

Section III. Current Status of the MMI Fund – presents the estimated economic value and IIF for the Fund at the end of FY 2016 and provides an analysis of the performance of the FY 1987 through FY 2016 books of business.

Section IV. Characteristics of the Fiscal Year 2016 Insurance Portfolio – describes the FY 2016 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 analysis 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 default, 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, and interest 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 2015 Actuarial Review

This section presents the economic value and insurance-in-force of the Fund[40] as of the end of FY 2016 and provides a discussion of how the estimated economic value in this year's Review compares with that in the FY 2015 Review.

A. The FY 2016 Actuarial Review

The FY 2016 Actuarial Review estimates the economic value of the Fund as of the end of FY 2016 (September 30, 2016) and projects the status of the Fund through FY 2023. 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 conduct this Review by analyzing the historical loan performance using data provided by FHA, developing econometric models and estimating their parameters, and generating multiple paths around economic forecasts provided by Moody's. Econometric models are used to project the future cash flows of the Fund and their present value is combined with the Fund's capital resources to derive the economic value of the Fund.

The econometric models are similar in many respects to those of the FY 2015 Review, but with updated data and some changes in variable specifications. The estimation of the loan status transition models utilizes loan-level data on the Fund's experience as recorded by HUD since FY 1996, extending through the second quarter of FY 2016. 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 2016, the Fund is projected to have an estimated economic value of **$35.27 billion**, an unamortized insurance-in-force of **$1,188.57 billion** and an amortized insurance-in-force of **$1,076.65 billion**.

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

- The FY 2016 book of business is estimated to contribute **$13.20 billion** in present value to the economic value of the Fund.

Our current baseline projections indicate that the Fund's economic value will increase in the future, rising by an average of 16.41 percent per year through FY 2023. With the reduced insurance premium schedule, the continuation of a relatively high FHA market share and a strong housing market recovery, the unamortized IIF is expected to increase by an average rate of 4.85 percent per year through FY 2023. The economic value is estimated 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 2023. In summary, the economic value is projected to steadily increase over the next 7 years to reach $102.15 billion by the end of FY 2023.

Exhibit II-1: Projected Fund Performance for FY 2016 to FY 2023 ($ 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
2016	35,272	1,188,573	1,076,650	13,198	228,855	
2017	46,647	1,248,134	1,124,507	10,825	213,939	549
2018	54,128	1,314,123	1,172,859	6,365	158,208	1,117
2019	62,059	1,383,557	1,222,076	6,342	155,550	1,590
2020	71,562	1,454,746	1,272,306	7,512	173,677	1,991
2021	81,471	1,524,104	1,319,682	7,494	176,009	2,415
2022	91,599	1,591,501	1,364,637	7,273	183,599	2,854
2023	102,151	1,655,990	1,407,520	7,247	193,012	3,305

[a] All values are as of the end of each fiscal year. The economic value for FY 2016 through FY 2023 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 year's capital resources, plus the economic value of the new book of business.
[b] Estimated based on the data extract as of June 30, 2016 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 shows the derivation of our estimate of the Fund's current economic value from the $17.04 billion at the end of FY 2015 as shown in the FY 2015 Review. The total capital resource as reported in FHA's audited financial statement is $31.32 billion at the end of FY 2016. The present value of future cash flows of current books of business is estimated to be $3.95 billion.

Consequently, as of the end of FY 2016, the Fund is estimated to have an economic value of $35.27 billion.

Exhibit II-2: Estimates of Fund Economic Value as of the End of FY 2016 ($ Millions)

Item	End of FY 2015[b]	End of FY 2016
Capital Resources	$ 21,230	$ 31,324[a]
PV of Future Cash Flows on Outstanding Business	(4,186)	3,948
Economic Value	$ 17,044	$ 35,272
Unamortized Insurance-In-Force	1,150,452	1,188,573
Amortized Insurance-In-Force	1,046,224	1,076,650

[a] Source: Audited Financial Statements for FY 2016.
[b] From the FY 2015 Actuarial Review.

As seen in Exhibit II-2, the estimated FY 2016 economic value of the Fund increased by $18.23 billion from the level estimated in FY 2015, from $17.04 billion to $35.27 billion. The unamortized IIF increased by 3.31 percent – from $1,150.45 billion to $1,188.57 billion. The change in the estimated economic value represents the net impact of several significant factors, which are described in detail next.

C. Sources of Change from the FY 2015 Review to the FY 2016 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 2016 and FY 2022. Separating out the specific impacts can be done only up to a certain degree of accuracy, because it depends on the order in which the decomposition is done. The interdependency among the various components of the analysis prevents us from identifying and analyzing these as purely independent effects. With this caveat, this section presents an approximate decomposition of differences in the FY 2016 and FY 2022 economic values from those presented in the FY 2015 Review, by source of change.

1. Change in Economic Value from FY 2015 to FY 2016

The FY 2015 Review estimated the economic value of the Fund as of the end of FY 2015 to be $17.04 billion, and the projected FY 2022 economic value to be $74.60 billion. In this Review, we estimate the end-of-FY 2016 economic value for the Fund to be $35.27 billion, which represents an increase of $18.23 billion from the FY 2015 economic value reported in the

FY 2015 Review. This is a significant increase in the estimated economic value of the Fund. Accompanying this increase in economic value is an increase in the unamortized IIF of 3.31 percent.

2. Current Estimate of FY 2016 Economic Value Compared with the Estimate Presented in the FY 2015 Actuarial Review

The FY 2015 Review projected that the FY 2016 investment earnings on Fund balances and the present value of the FY 2016 book of business would add $0.19 billion and $7.93 billion, respectively, to the economic value of the Fund, resulting in a projected FY 2016 economic value of $25.16 billion. As shown in Exhibit II-2, with the updated financial statements and data extract we now observe the change in capital resources in FY 2016 to be $10.09 billion, thus the end-of-FY 2016 capital resources is $31.32 billion. Combining the capital resources with the estimated present value of future cash flows of the outstanding portfolio of $3.95 billion, this year's estimate of the FY 2016 economic value is $35.27 billion. Thus, this year's estimate of the FY 2016 economic value is $10.11 billion higher than the economic value of $25.16 billion projected for FY 2016 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 economic value of the Fund as of the end of FYs 2016 and 2022 from the FY 2015 Review as compared to the FY 2016 Review. The overall net change in economic value, reflecting several offsetting factors, is positive for both FY 2016 and FY 2022.

Exhibit II-3: Changes in Fund Estimated Economic Value Between FYs 2015 and 2016 ($ Millions)

	Change in FY 2016 Economic Value	FY 2016 Economic Value[a]	Change in FY 2022 Economic Value	FY 2022 Economic Value[b]
FY 2015 Economic Value Presented in the FY 2015 Review		17,044		
FY 2016 Economic Value Presented in the FY 2015 Review, Excluding the FY 2016 Book of Business:	190	17,234		
Plus: Forecasted Economic Value of FY 2016 Book of Business Presented in the FY 2015 Review	7,930			
Equals: Economic Value Presented in the FY 2015 Actuarial Review		**25,164**		**74,605**
Plus: a. Update Origination Volume for FY 2015 and FY 2016	3,505	28,669	4,200	78,805
Plus: a1. Update Volume Forecast of FY 2017 and Later Books of Business	0	28,669	-2,125	76,681
Plus: b. Update FY 2016 Discount Factors	-155	28,514	-826	75,854
Plus: c. Update Actual Performance in FY 2015 - FY 2016	2,955	31,469	13,280	89,135
Plus: d. Update Capital Resource at End of FY 2016	7,328	38,797	8,662	97,797
Plus: e. Update Econometric Models	3,791	42,588	6,073	103,870
Plus: f. Update Third Party Sale Adjustment	-191	42,397	-382	103,488
Plus: g. Update Economic Scenario Forecast	-6,217	36,179	-10,816	92,671
Plus: h. Adjustment for Inventory of Delayed Claims	-464	35,716	-548	92,123
Plus: i. Adjustment for 2016 Note Sale Transactions	-444	35,272	-525	91,599
Equals: Estimate of Economic Value	**10,108**	**35,272**	**16,994**	**91,599**

[a] Shows the progression of economic values as of the end of FY 2016 as incremental changes are made.
[b] FY 2022 is the latest year in which the economic value can be directly compared between the FY 2015 and FY 2016 Reviews.

3. Decomposition of the Differences in Economic Value of the Current Review versus the FY 2015 Review

We now present a step-by-step analysis of the differences between the FY 2015 and FY 2016 Reviews, shown in Exhibit II-3.

a. Update Origination Volume of FY 2015 and FY 2016

The first component of change depicted in Exhibit II-3 relates to the updated origination volume and composition for the FY 2015 and FY 2016 books of business. As a result of the lower than projected market interest rate, the actual realized origination volume of the FY 2015 book and updated estimate of the FY 2016 book based on August 2016 data are higher than what was projected in last year's Review. The greater realized volume caused an increase of $3.50 billion in the estimated FY 2016 economic value and an increase in the FY 2022 economic value by $4.20 billion. The high projected volume for the books of business is mainly due to the low mortgage rates in FY 2016.

a1. Update Volume Forecast of FY 2017 and Later Books of Business

The second element of change in Exhibit II-3 is the change in the forecasted FHA endorsement volume for FY 2017 and later books of business. This step has no impact on the estimated FY 2016 economic value, but the smaller volume of future books of business decreases the estimated FY 2022 economic value by $2.13 billion.

b. Update FY 2016 Discount Factors

The OMB discount factors are used to discount the projected cash flows to their present values. The OMB FY 2017 discount factors are slightly higher than the discount factors used in last year's Review. The higher discount factors increase the magnitude of the present value of positive cash flows and the absolute size of the present value of negative cash flows. The existing portfolio consists of older books with negative NPVs, and recent books with positive NPVs, which essentially offset each other. Updating the discount factors caused the estimated FY 2016 economic value to decrease by $0.16 million and the estimated FY 2022 economic value to decrease by $0.83 million .

c. Update Actual Performance of FY 2015 to FY 2016

The actual performance of the Fund realized during FY 2015 to FY 2016 period affects the economic value of the Fund through the realized ending capital resources, and the status of the outstanding portfolio, which would affect the net present value of the future cash flows. The net effect of these two factors is an increase of $2.96 billion in the FY 2016 economic value. The major source of change is the experienced claims lower than projected in the 2015 Review. The update also affects our projection of future mortgage portfolios as we simulate future loan originations based on the most recent years' experience, and it results in an increase of $13.28 billion in FY 2022 economic value.

d. Update Capital Resource at End of FY 2016

The actual audited capital resource will depend on factors other than the realized experience of Forward loans. By updating the capital resource, an increase of $7.33 billion in economic value is reflected. It also results in an increase of $8.66 billion in FY 2022 economic value.

e. Update Econometric Models

In FY 2016, we continued to refine the econometric models to better capture the termination behavior of loans in the Fund. We re-estimated the models using updated data and revised variable specifications. We applied adjustments to claim and modified cure probability and loss mitigation costs. For details about these model updates and refinements, refer to Appendices A, B and E.

These model changes led to an increase in estimated economic value in FY 2016 of $3.79 billion, and an increase in the estimated economic value of $6.07 billion in FY 2022.

f. Update Third Party Sale Adjustment

For this year's Review, we keep the same assumption of the share of Third Party Sale (TPS) at the current level of 25 percent. With one more year of data, we updated the TPS loss rate haircut compared to REO sales to 18.72 percent in FY 2016 Review. The lower haircut results in slightly higher loss rates, and thus a *negative* $0.19 billion change in the FY 2016 economic value, and a *negative* $0.38 billion change in the FY 2022 economic value.

g. Update Economic Scenario Forecast

For this decomposition step, we updated the forecasts for the purchase-only HPI, and the interest and unemployment rates from Moody's July 2015 forecast to those of July 2016. The HPA during the past year was close to the forecast in FY 2015, while the future forecast is very different: the future HPA forecasted by Moody's July 2016 is much lower during FY 2018 to FY 2023, and reverts to last year's level by about 2030. The updated HPA forecast has a negative effect on the projected economic value. On the other hand, interest rates turned out to be lower

than the projections used in the FY 2015 Review, and the long-term level is also lowered in Moody's forecast this year. This leads to higher prepayment and claim rates, both resulting in lower economic value. The net impact of these two changes is a decrease of $6.22 billion in the estimated FY 2016 economic value and a decrease of $10.82 billion in the estimated FY 2022 economic value.

h. Adjustment for Inventory of Delayed Claims

As of the end of FY 2016, there was a large inventory of loans deep into the foreclosure process, or even with completed auction sales, that had no claims filed when this Review was prepared. These loans in the foreclosure process should have already been claimed under normal market operations. However, they continue to remain in the Fund as non-performing loans with no losses yet recorded. We project that the industry will accelerate the claim-filing process to quickly eliminate this excess foreclosure inventory. To reflect this effect, we identified 26,655 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 FY 2016 Q4. This state-level estimation is based on all loans that terminated between fiscal quarters 2006 Q1 through 2016 Q1.[41] Please refer to Appendix B for details of the claim speed estimation. This adjustment resulted in a $0.46 billion decrease in the FY 2016 economic value and a $0.55 billion decrease in the FY 2022 economic value.

i. Adjustment for November 2015 and September 2016 Note Sale Transactions

As of the end of FY 2016, there were more than 19,000 loans identified in two sets of note sales in the near period,[42] some of which have not filed claims at the time this Review was prepared. We have implemented a note sale override schedule to account for the note sale transactions. There are altogether 7,743 loans that need to be overridden with realized loss severity numbers. Based on the data available to date, the loss rate of the November 2015 deal is 63.33 percent, which is slightly higher than average REO loss severity rate. There are additional 11,579 loans identified to have been released for sale in the September note sale. Based on the experience of recent note sales, our model projected 70% of the loans, or 8,025 cases, will be settled in the next quarter FY 2017 Q1, as the September 2016 note sales are not settled yet by the end of FY 2016. These note sales cause the FY 2016 economic value to decrease by $0.44 billion and the FY 2022 economic value to decrease by $0.52 billion.

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[41] Data source: FHA default episode datasets.
[42] http://portal.hud.gov/hudportal/HUD?src=/program_offices/housing/comp/asset/hsgloan

Section III: Current Status of the MMI Fund[43]

As of the end of FY 2016, the Fund has an estimated economic value of $35.27 billion. The estimated economic value at the end of FY 2015 was $17.04 billion. The current estimated economic value is $18.23 billion higher than what it was at the end of FY 2015 and $10.11 billion higher than the $25.16 billion economic value projected for FY 2016 in the FY 2015 Review. At the same time, the unamortized IIF of the Fund increased 3.31 percent, from $1,150.45 billion in FY 2015 to $1,188.57 billion in FY 2016, which is about $6 million more than what was estimated in last year's Review.

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 2016 and the projected future performance of new books of business through FY 2023. This section describes the components of the Fund's economic value and how they are expected to change through FY 2023.

A. The Current Economic Value of the Fund

According to the 2008 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 as of the end of FY 2016 plus the present value of expected future cash flows of the existing loan portfolio as estimated by our financial models. We project the cash flows based on a Monte Carlo simulation of 100 possible future economic scenarios that are centered on Moody's July 2016 baseline economic forecasts. Our estimate is computed as the average economic value from each of these 100 simulated paths. Individual modeling components used in this Monte Carlo simulation analysis are presented in Appendices A to G of this report.

The present value of expected future cash flows is calculated based on a set of financial models 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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[43] The MMI Fund in this Review refers to the 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 defined by subtracting total liabilities from total assets and are reported in the year-end financial statements of the Fund. Exhibit III-1 indicates that the Fund's audited capital resources at the end of FY 2015 is $21.23 billion. The capital resources of the Fund as of the end of FY 2016 are estimated to be $31.32 billion.

Exhibit III-1: Estimate of Fund Economic Value as of the End of FY 2016 ($ Millions)

Item	End of FY 2015[b]	End of FY 2016
Capital Resources	$ 21,230	$ 31,324[a]
PV of Future Cash Flows on Outstanding Business	(4,186)	3,948
Economic Value	$ 17,044	$ 35,272
Unamortized Insurance-In-Force	1,150,452	1,188,573
Amortized Insurance-In-Force	1,046,224	1,076,650

[a] Source: Audited Financial Statements for FY 2016.
[b] From the FY 2015 Actuarial Review.

2. Present Value of Future Cash Flows in FY 2016 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 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 1987 through the FY 2016 books of business that are estimated to have survived to the end of FY 2016. The present values are computed from the projected cash flows occurring during FY 2017 and future years. They are computed by taking their average over a set of simulated economic scenarios. This exhibit is 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 2016. From Exhibit III-2, the total present value of these future cash flows is $3.95 billion. Compared to the corresponding figure estimated in the FY 2015 Review, the total present value increased by $8.13 billion.

The sharply negative house price growth rates from 2007 to 2011 suggest that mortgages originated during the years from 2005 through 2010 are likely to face higher claim rates. 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* $3.84 billion and *negative* $4.83 billion, respectively. However, at the end of the housing recession, house prices bottomed out and turned slightly positive, giving the FY 2012 through FY 2016 books a positive initial start, and their present values are positive, even excluding the upfront premiums.

Exhibit III-2: Present Value of Future Cash Flows by Origination Fiscal Year & Mortgage Type as of the End of FY 2016 ($ Millions)

Fiscal Year	FRM 30	FRM 15	ARM	SR 30	SR 15	SR ARM	Total
1987	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0
1989	-1	0	0	0	0	0	-1
1990	-1	0	0	0	0	0	-2
1991	-2	0	0	0	0	0	-2
1992	-3	0	-1	0	0	0	-5
1993	0	0	-2	-2	0	0	-3
1994	0	0	-4	-4	0	0	-8
1995	0	0	-6	0	0	0	-6
1996	-4	0	-9	-1	0	0	-14
1997	-10	0	-17	-1	0	0	-28
1998	-14	0	-14	-5	0	0	-34
1999	-34	0	-8	-12	0	-1	-54
2000	-61	0	-24	-2	0	-1	-88
2001	-178	0	-10	-24	0	-1	-214
2002	-270	0	-41	-51	0	-8	-370
2003	-341	0	-28	-142	0	-7	-518
2004	-731	0	-90	-240	0	-29	-1,090
2005	-910	-1	-227	-149	0	-30	-1,318
2006	-943	-1	-68	-60	0	-3	-1,075
2007	-1,449	-3	-48	-90	0	-2	-1,592
2008	-3,346	-11	-89	-384	-1	-13	-3,844
2009	-2,830	-14	-72	-1,849	-5	-62	-4,833
2010	-1,782	-14	-232	-813	-4	-133	-2,978
2011	82	-13	-133	-252	-2	-72	-389
2012	1,120	-13	-39	18	-4	-28	1,055
2013	2,885	9	-8	456	-1	-7	3,335
2014	3,245	32	-4	16	2	-3	3,289
2015	5,248	52	-14	1,218	4	-7	6,500
2016[a]	6,814	59	-20	1,371	11	0	8,237
Total[b]	6,484	81	-1,207	-1,003	-1	-405	3,948

[a] Based on projected volume as of August 2016 and FHA's origination composition forecasts.
[b] Numbers may not add up due to rounding.

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, and the unamortized IIF and the amortized IIF as of the end of FY 2016.

As can be inferred from Exhibit III-3, the FY 2013 through FY 2016 books of business constitute 13.3, 6.4, 15.9 and 20.2 percent of the Fund's total end-of-FY 2016 amortized IIF, respectively. Given the relative robust quality of these books and the recovery of the housing market, the economic value of the fund is expected to improve steadily over the next several years.

The endorsement volume of the FY 2016 book turned out to be higher than was projected in the 2015 Review, as market mortgage rates remained at a historically low level throughout FY 2016. The most recent books, FYs 2013 through 2016, have a better credit quality composition than the traditional composition of FHA loans, and have experienced or are expected to experience a robust housing market since their origination. As a result, the FYs 2013 through 2016 books of business are projected to generate a positive $3.33, $3.29, $6.50, and $8.24 billion of present values of future cash flows to the Fund, respectively, as shown in Exhibit III-2. This contrasts to the large negative present values of the FY 2004 to FY 2011 books. As these newer cohorts become the dominant component of the outstanding portfolio, the financial strength of the Fund is expected to continue to improve over the next several years.

Exhibit III-3: Endorsements and Insurance-in-Force as of End of FY 2016 ($ Millions)

Book of Business[a]	Mortgage Endorsements	Unamortized Insurance-in-Force[b]	Amortized Insurance-in-Force[b]
1987	70,230	1,300	59
1988	37,432	902	119
1989	39,764	824	177
1990	47,127	830	235
1991	44,067	804	277
1992	45,093	1,092	409
1993	73,799	1,830	762
1994	79,693	2,585	1,159
1995	41,534	1,163	603
1996	61,697	1,871	1,039
1997	65,469	2,051	1,207
1998	88,593	3,440	2,137
1999	110,066	5,103	3,319
2000	86,805	2,777	1,946
2001	119,891	4,848	3,511
2002	128,893	8,149	5,787
2003	106,180	12,358	8,661
2004	118,732	21,082	15,086
2005	76,287	17,898	13,707
2006	50,139	11,552	9,390
2007	57,672	12,825	10,853
2008	176,113	35,163	30,325
2009	329,910	91,578	79,283
2010	295,406	115,118	100,899
2011	214,237	90,821	80,312
2012	217,905	115,744	103,907
2013	235,519	155,827	143,472
2014	135,917	72,415	68,854
2015	215,568	176,220	171,207
2016[c]	228,855	220,405	217,947
Total[d]	3,598,592	1,188,573	1,076,650

[a] End of year insurance-in-force

[b] Based on June 30, 2016 data extract from HUD and the performance of outstanding loans projected by the econometric models for the fiscal year 2016

[c] Based on HUD's August 2016 projections.

[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 2017 through FY 2023 based on: (a) fully-underwritten mortgage volume and streamline refinance mortgage volume as projected by our econometric models, (b) FHA's forecast of the compositions of future endorsements, (c) our stochastic economic forecasts that are centered on Moody's July 2016 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 future book of business are first projected, and then by adding these to the projected end-of-period capital resources, the total economic value of the Fund in each year of the forecast period is estimated.

The cash flows associated with future books discounted to the end of each corresponding future fiscal year are presented in Exhibit III-4.

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

Fiscal Year	FRM 30	FRM 15	ARM	SR 30	SR 15	SR ARM	Total
2017	9,330	87	-12	1,226	16	13	10,659
2018	5,876	57	-4	185	3	3	6,120
2019	5,592	58	-5	272	3	5	5,924
2020	6,160	63	-3	566	4	9	6,800
2021	5,922	63	-5	569	4	9	6,562
2022	5,489	58	-7	598	4	10	6,153
2023	5,124	55	-7	728	6	11	5,917

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

C. Projected Future Capital Resources

In this section we present the projection of potential changes of future capital resources based on our 100 Monte Carlo simulation paths. All the paths start from the estimated $31.32 billion of capital resources at the end of FY 2016. Going forward, the capital resources were updated with investment returns and future net cash flows from insurance, including upfront premiums, annual premiums, premium refunds, loss mitigation costs, and net claim losses. Exhibit III-5 displays the quarterly levels of the capital resources under a wide range of possible economic scenarios, according to selected percentiles of our 100-path Monte Carlo simulation. The mean of the capital resources reaches its lowest point of $31.15 billion in FY 2017 Q1 and recovers after that. The capital resources are expected to recover to the end-of-FY 2016 level in FY 2017 Q2. At the 95th worst percentile, the capital resources drop to $30.42 billion; and they are projected to grow back to the end-of-FY 2016 level in two quarters, and rise to $61.71 billion by the end of FY 2023, which implies that there is an approximately 5 percent chance that capital resources may drop below $30.4 billion over the next seven years.

Exhibit III-5: Mean and Selected Percentile Projections of the Fund's Capital Resources ($Millions)
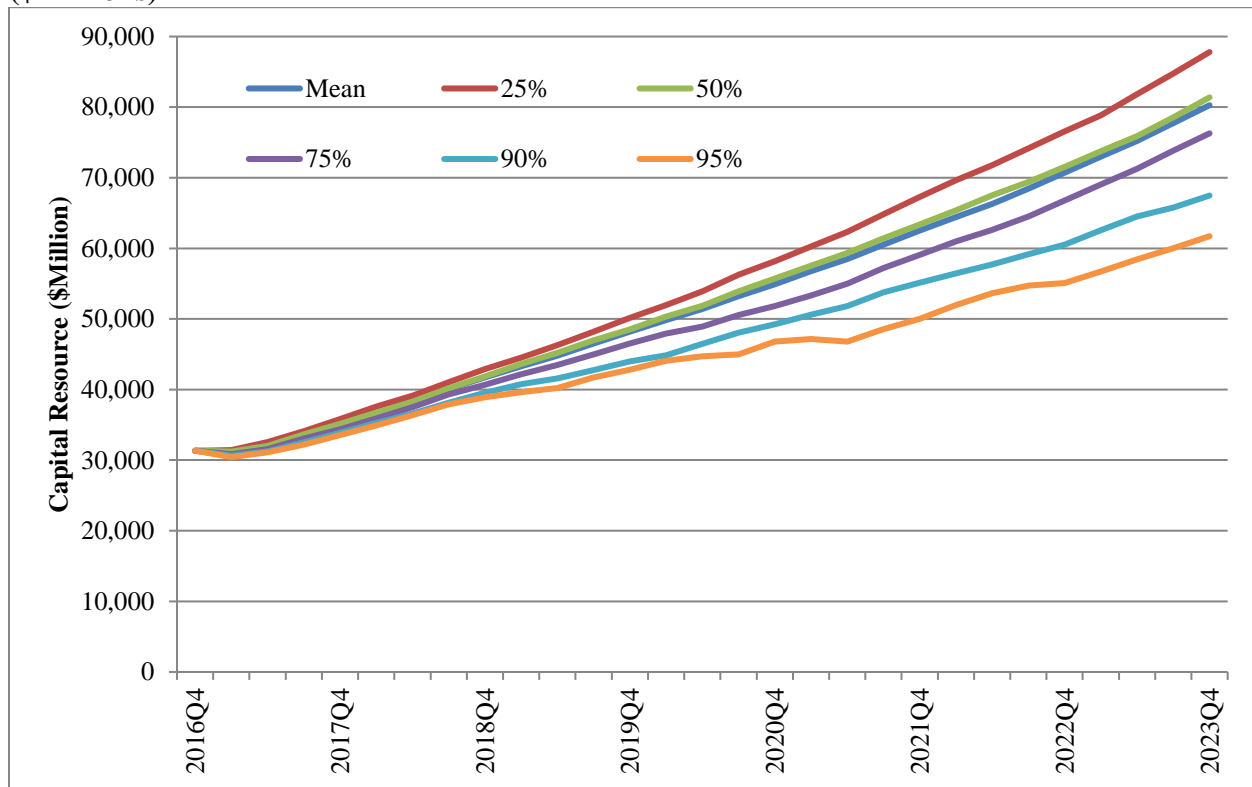
Section IV: Characteristics of the Fiscal Year 2016 Insurance Portfolio

This section analyzes the characteristics of the loan portfolio insured by the Fund at the end of FY 2016.[44] 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 2016 book with previous books in order to gain insights into how the FY 2016 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, 2016, the characteristics for the FY 2016 book reflect only loans originated in the first three quarters of FY 2016 – between October 1, 2015 and June 30, 2016.

We also examine FHA's business concentration profile to identify indicators that could have significance for the FY 2016 Actuarial Review.

A. Volume and Share of Mortgage Originations

FHA projects to endorse $229 billion in single-family forward mortgages in FY 2016, bringing the Fund's total unamortized IIF to $1,188.57 billion. Exhibit IV-1 shows FHA's origination count and volume. The count dropped significantly from FY 2003 to FY 2007, increased dramatically through FY 2010, 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 housing bubble burst. The capital impairment of the private mortgage insurance companies also contributed to FHA's rising volume after the burst. As the private mortgage insurance industry faced severe capital constraints, the GSEs had been unable to purchase or guarantee loans with less than a 20 percent down payment. FHA became the primary source of high LTV loans after FY 2008. Some of the private mortgage insurance companies finally were able to recover underwriting policies during the past four years.

The volumes show a similar pattern, for the same reasons cited above, but the post-bubble volumes were much higher than in the early 2000s. The loan size limits were increased to the levels of the GSEs, making more loans eligible for FHA insurance. The private mortgage insurers and non-conforming lenders faced capital constraints, making FHA the only feasible channel for high LTV loans.

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

Exhibit IV-1: Total Count and Volume of FHA-Insured Originations

Fiscal Year	Count of Originations			Volume of Originations ($Billions)		
	New purchase	Fully underwritten refinance	Streamline	New purchase	Fully underwritten refinance	Streamline
1985	399,951	10	670	24.06	0.00	0.03
1986	908,119	19	21,035	56.44	0.00	1.31
1987	981,104	15	145,857	61.02	0.00	9.21
1988	584,240	1	31,589	35.51	0.00	1.92
1989	615,741	5	18,895	38.64	0.00	1.13
1990	689,968	146	25,645	45.54	0.01	1.58
1991	614,050	545	28,961	42.17	0.04	1.86
1992	540,239	2,834	94,090	38.42	0.21	6.47
1993	572,145	16,006	402,892	43.23	1.17	29.40
1994	601,220	13,358	445,322	47.90	0.93	30.86
1995	489,898	5,317	26,052	39.31	0.41	1.81
1996	606,820	29,334	91,931	51.76	2.41	7.53
1997	662,562	30,344	47,321	58.48	2.63	4.36
1998	708,798	56,193	190,526	64.51	5.17	18.91
1999	812,784	70,480	238,499	79.95	6.94	23.18
2000	771,329	35,839	25,947	80.53	3.77	2.51
2001	783,123	69,395	208,255	86.50	8.04	25.35
2002	735,909	82,608	283,132	85.59	10.09	33.22
2003	595,535	97,836	550,200	72.67	12.63	65.29
2004	480,742	67,898	222,481	59.45	9.00	24.45
2005	326,346	43,038	106,084	39.95	5.92	11.85
2006	283,355	71,060	32,214	35.93	10.52	3.68
2007	265,607	123,187	21,266	35.65	18.96	3.06
2008	607,728	379,241	64,136	98.87	66.52	10.73
2009	990,227	504,398	334,807	170.68	92.33	66.90
2010	1,097,282	341,066	213,854	189.65	61.98	43.77
2011	768,264	237,715	173,798	132.76	44.06	37.41
2012	744,674	179,239	286,012	126.36	32.26	59.28
2013	690,605	128,524	500,526	122.92	23.71	88.89
2014	598,085	76,619	115,162	106.36	13.26	16.29
2015	758,402	130,062	237,918	141.41	24.82	49.33
2016[a]	610,542	121,390	144,664	117.97	23.25	27.69

Source: FHA data warehouse, June 30, 2016 extract.
[a] Based on partial year data.

Exhibit IV-2 shows FHA's origination volume and market share in home purchase mortgages from FY 1995 through FY 2016.

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

Fiscal Year	Number of Home Sales (Thousands)			Volume of Home Sales ($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	4,879	15.04	124	1,097	11.30
2013	702	5,489	12.79	125	1,354	9.23
2014	595	5,335	11.15	106	1,384	7.66
2015	753	5,722	13.16	140	1,551	9.03
2016[c]	398	2,512	15.84	77	683	11.27

Sources: FHA Share of Home Purchase Activity Report for cohorts before 2011[45] and Quarterly Report to Congress on FHA Single-Family Mutual Mortgage Insurance Fund Programs for 2012-2016 cohorts.[46] 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 2016 numbers are through March 2016.

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 next several years and by FY 2008, FHA's market share was back to the 1990's levels. FHA's share by loan 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 lower level similar to the FYs 1995-2002: the partial-year data shows that the FHA share in FY 2016 by loan count is 15.84 percent and the share by dollar volume is 11.27 percent.

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 2011 through FY 2016. The states are ordered based on the dollar volume endorsed during FY 2016.

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

State[a]	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
California	17.47	18.90	17.00	16.34	18.96	17.35
Texas	5.99	6.57	7.19	8.88	7.25	7.56
Florida	4.27	4.14	4.83	6.05	5.97	6.79
New York	4.58	4.21	3.93	3.97	3.51	3.64
Georgia	2.77	2.79	3.14	3.39	3.25	3.62
Maryland	3.63	3.50	3.46	3.09	3.57	3.56
Arizona	2.56	2.46	2.85	3.51	3.72	3.48
Virginia	4.12	3.92	3.79	3.38	3.58	3.42
New Jersey	3.86	3.83	3.55	3.07	3.47	3.38
Colorado	3.06	3.11	3.27	3.21	3.39	3.27

Source: FHA data warehouse, June 30, 2016 extract.
[a] States are ranked according to their share of FY 2016 origination volume in the Fund.

The percentage share of FHA loans originated in California changed from 18.96 percent in FY 2015 to 17.35 percent in FY 2016. Currently, loans in California comprise the largest percentage of all FHA loans in dollar volume.

Historical house prices in the local housing markets are reflected in our econometric models through the variables measuring local and national house 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 a dollar-weighted average share of approximately 72.72 percent of the business over the FYs 1986-2016. The share of total mortgages represented by 30-year FRMs began to change in the early 1990s when FHA started insuring adjustable-rate mortgages (ARMs) and streamline-refinancing mortgages (SRs). For the next few years, ARM and SR mortgages gradually assumed a larger share of annual loan originations and the 30-year FRM share decreased. FYs 1993, 1994 and 2003 recorded the lowest shares of 30-year FRMs. An opposite trend 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 in FY 2009 through FY 2013 dropped to an average level of 71.24 percent. For FY 2014 the volume of 30-year FRM increased to 82.59 percent, in FY 2015 dropped down to 74.19 percent, and in FY 2016 increased again to 81.48 percent.

The ARM share of the portfolio, including streamline refinance ARMs, 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, and then has stayed low thereafter. ARMs account for only 0.73 percent of the endorsements in FY 2016. The 15-year FRMs have increased from 1.22 percent in FY 2007 to 6.34 percent in FY 2012 but have declined in the last four years and are at 1.47 percent in FY 2016. The 15-year SR continues to be a 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 transition models, which are estimated separately for each of the six 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
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	2.86	13.43	0.36	1.03
2011	72.64	5.68	4.22	15.03	0.63	1.81
2012	65.05	6.34	1.40	25.08	1.17	0.96
2013	58.56	3.07	0.57	36.46	0.95	0.38
2014	82.59	2.49	2.92	10.93	0.39	0.67
2015	74.19	1.65	1.28	22.25	0.18	0.45
2016[a]	81.48	1.47	0.66	16.08	0.23	0.07

Source: FHA data warehouse, June 30, 2016 extract.
[a] Based on partial year data.

D. Initial Loan-to-Value Ratio 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 the complement 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 1986 through FY 2016.

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 had LTVs greater than or equal to 97 percent. This concentration in the highest risk category gradually declined during the next few 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 through FY 2016, this concentration continued to decline and is 1.51 percent in FY 2016. Since FY 2010, over 60 percent of mortgages have LTV ratios between 95 to 97 percent.

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. 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 to capture potential behavioral differences among borrowers who self-select into different original LTV categories. For streamline refinance loans, we use the original LTV of the prior fully underwritten mortgage, updated for the 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%
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	29.14	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	64.08	4.49
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	0.01	4.73	10.66	9.68	71.76	3.16
2014	0.01	4.97	10.32	9.30	73.44	1.96
2015	0.01	5.94	11.97	9.37	70.92	1.78
2016[a]	0.02	6.87	13.08	8.71	69.81	1.51

Source: FHA data warehouse, June 30, 2016 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 for 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 45.06 percent of the FY 2016 loans have credit scores above 680. Loans with credit scores below 600 are only 2.13 percent of the loans originated in FY 2016, which is substantially lower than in the FY 2007 book, where 37.08 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
1997[a]	2.45	0.19	1.39	2.54	4.15	3.95	5.60	79.73
1998[a]	1.91	0.24	1.83	3.16	5.19	4.67	5.52	77.47
1999[a]	1.81	0.22	1.82	3.29	5.37	4.64	4.99	77.86
2000[a]	1.98	0.33	2.43	3.45	4.97	3.98	4.01	78.85
2001[a]	1.46	0.27	2.12	3.29	4.61	3.76	3.92	80.58
2002[a]	1.42	0.31	2.31	3.56	5.07	4.19	4.57	78.58
2003[a]	1.56	0.32	2.68	4.26	6.14	5.15	5.63	74.27
2004[b]	1.43	0.51	4.92	8.61	12.56	10.41	11.70	49.86
2005	5.07	0.93	9.32	16.94	24.55	20.23	22.97	0.00
2006	4.80	0.91	8.67	16.52	24.35	20.67	24.07	0.00
2007	4.68	1.43	11.60	19.37	24.76	18.78	19.39	0.00
2008	2.43	0.80	7.09	14.72	24.60	22.38	27.98	0.00
2009	1.09	0.05	1.19	5.59	19.32	25.29	47.47	0.00
2010	1.09	0.01	0.19	1.04	14.30	26.57	56.79	0.00
2011	0.87	0.00	0.08	0.59	10.01	29.02	59.43	0.00
2012	0.50	0.00	0.11	0.62	9.52	32.27	56.97	0.00
2013	0.37	0.00	0.10	0.50	7.28	37.59	54.16	0.00
2014	0.27	0.00	0.10	1.09	12.03	41.88	44.63	0.00
2015	0.19	0.00	0.12	1.65	15.28	38.48	44.28	0.00
2016[c]	0.14	0.00	0.12	1.87	15.98	36.83	45.06	0.00

[a] Credit score data are obtained from the previous FHA special data collection project. Early-default 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.
[c] Based on partial year data.

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 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 probability 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 similar-quality homes in the area, the house price volatility of these houses tends to be relatively low in comparison to the house price volatility of extremely low- and high-priced houses. With the increased FHA loan size limit, FHA started endorsements of higher-priced houses after FY 2008.

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 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 12.13 percent in FY 2016. On the other hand, the share in lowest loan size category also increased from 6.96 percent in FY 2008 to 8.78 percent in FY 2016. The increase in both the highest and lowest loan size categories demonstrate the penetration of FHA products into high-balance loans and the resurgence of the low-balance loan.

Our econometric models account for the differences both in the propensity to default and in their loss severity.

Exhibit IV-7: Percentage of Origination Count 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
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	19.70	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	22.68	24.32	18.10	10.67	13.62
2013	10.13	22.23	24.99	18.48	10.74	13.43
2014	9.39	21.95	25.59	19.10	11.16	12.82
2015	8.85	21.23	26.09	19.72	11.58	12.52
2016[a]	8.78	20.72	26.30	20.06	12.02	12.13

Source: FHA data warehouse, June 30, 2016 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 1997. Average contract rates in FY 2013 were 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 in the next two years, the prepayment rates of the recent originations are likely to remain low. As these loans will have longer durations, as reflected in our econometric models, more insurance premium income will be generated, thus tending to improve the economic value of these recent books with historically low contract rates.

Also, a mortgage with a contract rate lower than the market rate tends to experience a lower probability of default because the borrower has the incentive to keep the below-market rate mortgage longer even when experiencing some negative equity. 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. This also tends to improve the economic value.

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
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	5.59	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	3.62	3.15	2.99	3.71	3.36	2.89	3.63
2014	4.30	3.72	3.32	4.52	3.90	3.39	4.29
2015	4.03	3.47	3.26	3.99	3.70	3.36	4.00
2016[a]	3.97	3.45	3.27	3.95	3.58	3.37	3.95

Source: FHA data warehouse, June 30, 2016 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 2003. Secondary loans provided by governments were included in the category of downpayment assistance and typically these were local government units.

Starting in FY 2003, there was a rapid increase in the share of loans with gift letters from non-profit, religious, or community institutions. Home sellers contributed a large share of these funds to the non-profit organizations, which subsequently provided gift to the buyers of the same properties to fulfill the downpayment requirements. This concentration increased dramatically to almost 25 percent in the FY 2005 through FY 2007 books of business. HERA effectively terminated seller-financed downpayment assistance effective October 1, 2008, because of the high losses associated with these loans. The share of loans with this type of assistance declined to negligible amounts after FY 2008.

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

Origination Fiscal Year	No Gift	Relative	Non-profit, Religious, or Community	Government	Employer
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	84.20	14.57	0.17	0.99	0.06
2013	86.16	12.69	0.11	0.97	0.06
2014	77.58	20.35	0.33	1.62	0.12
2015	78.27	18.37	0.80	2.43	0.13
2016[b]	76.61	19.07	1.09	3.00	0.23

Source: FHA data warehouse, June 30, 2016 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 2002 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. The discrepancy in claim rates disappeared after the seller-financed downpayment assistance was ruled out by HERA. 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
2003	7.02	9.68	22.13	19.09	12.84
2004	9.48	11.68	24.20	18.21	14.95
2005	13.84	16.32	28.72	22.84	20.55
2006	17.68	19.92	30.48	22.92	27.37
2007	20.21	21.34	32.64	25.32	25.24
2008	16.93	15.55	25.10	21.67	17.14
2009	9.81	8.38	18.30	12.99	10.77
2010	5.04	4.80	5.96	6.41	5.60
2011	2.50	2.32	2.29	3.07	1.98
2012	1.19	1.13	1.36	1.64	1.29
2013	0.66	0.55	0.74	0.75	0.36
2014	0.28	0.27	0.19	0.25	0.61
2015	0.02	0.02	0.02	0.02	0.14
2016[a]	0.00	0.00	0.00	0.00	0.00

Source: FHA data warehouse, June 30, 2016 extract.
[a] Based on partial year data.

Among the different downpayment assistance sources, loans with gifts from non-profit organizations have the highest cumulative claim rates prior to FY 2010. GAO reported that the downpayment assistance loans had been misused by many non-profit organizations, with the assistance being funded by home sellers.[47] 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.

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

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 over FY 2001 through FY 2008, they generated 31.62 percent of the negative economic value of these books of business.

Exhibit IV-11: Present Value of Cash Flows since Endorsement, by Downpayment Assistance Source as of the End of FY 2016 ($Millions)[a]

Origination Fiscal Year	No Gift	Relative	Non-profit, Religious, or Community	Government	Employer	Total
2001	-536	-153	-351	-78	0	-1,118
2002	-618	-109	-642	-99	0	-1,468
2003	-648	-143	-869	-125	0	-1,785
2004	-1,813	-346	-1,788	-232	0	-4,178
2005	-2,766	-603	-2,671	-516	0	-6,555
2006	-3,247	-587	-2,152	-638	0	-6,624
2007	-5,357	-641	-2,829	-729	0	-9,556
2008	-13,838	-1,029	-4,696	-735	0	-20,298
2009	-10,527	-424	-685	-322	0	-11,958
2010	1,265	473	-10	-144	0	1,583
2011	5,804	1,114	8	206	0	7,132
2012	8,859	1,638	11	408	0	10,916
2013	11,228	2,058	10	471	0	13,767
2014	6,147	1,879	24	458	0	8,507
2015	10,142	2,306	58	232	0	12,739
2016	10,355	2,490	77	277	0	13,198
Total	14,449	7,924	-16,504	-1,567	0	4,302

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

These costly non-profit downpayment 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* $16.50 billion to the economic value of the MMI Fund as of the end of FY 2016.

We estimated that these loans accounted for $22.38 billion of the amortized IIF as of the end of FY 2016. Therefore, if these loans had been excluded from the Fund, the revised economic value and the amortized IIF of the Fund would have been $51.78 billion and $1,054.27 billion, respectively. On the positive side, following the elimination of this type of high-risk loan by

HERA in 2008, the performance of recent and future books of business have improved over what would have been the case if these loans had still been underwritten in significant amounts. Since FY 2009, the proportion of loans funded by non-profit organizations has been below one percent of the total loan endorsements.

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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 compare the baseline economic value from the Monte Carlo simulation with eight alternative scenarios. The baseline economic value is the mean of the economic values of the Fund from the 100 simulated paths. Each of the eight alternative scenario estimates the performance of the Fund using the future interest, unemployment and house price appreciation rates simulated as a deterministic path.

The eight alternative scenarios are

- 10th Best Path in Simulation, the path that resulted in the 10th highest FY 2016 economic value in the Monte Carlo simulation.
- 25th Best Path in Simulation, the path that resulted in the 25th highest FY 2016 economic value in the Monte Carlo simulation.
- 25th Worst Path in Simulation, the path that resulted in the 25th lowest FY 2016 economic value in the Monte Carlo simulation.
- 10th Worst Path in Simulation, the path that resulted in the 10th lowest FY 2016 economic value in the Monte Carlo simulation.
- The Worst Path in Simulation, the path that resulted in the lowest FY 2016 economic value in the Monte Carlo simulation.
- Moody's Protracted Slump Scenario, the most stressful alternative scenario forecasted by Moody's Analytics in July 2016.
- Moody's July 2016 baseline forecast as a deterministic scenario.
- The low interest rate scenario, the path that keeps the current low interest rate for two years and recovers to Moody's baseline forecast in another two years.

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 2016 is positive \$35.27 billion, and the projected economic value for FY 2023 is positive \$102.15 billion. These projections constitute the baseline, against which the projections from the alternative scenarios are compared. The economic values and IIFs of the Fund for FY 2016 through FY 2023 under the eight alternative scenarios are presented in Exhibits V-2 to V-9. 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 HPA, 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
2016	35,272	1,188,573	1,076,650	13,198	228,855	
2017	46,647	1,248,134	1,124,507	10,825	213,939	549
2018	54,128	1,314,123	1,172,859	6,365	158,208	1,117
2019	62,059	1,383,557	1,222,076	6,342	155,550	1,590
2020	71,562	1,454,746	1,272,306	7,512	173,677	1,991
2021	81,471	1,524,104	1,319,682	7,494	176,009	2,415
2022	91,599	1,591,501	1,364,637	7,273	183,599	2,854
2023	102,151	1,655,990	1,407,520	7,247	193,012	3,305

A. Selected Scenarios from Monte Carlo Simulation

The Monte Carlo simulation approach provides 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, claims and loss rates. In addition to the estimation of the expected economic value of the MMI Fund, the simulation also provides the economic values associated with each one of the 100 possible future economic paths. The distribution of economic values based on these scenarios allows 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 selected from the 100 simulated paths. Exhibit V-2 is based on the path that produced the 10th best FY 2016 economic value. Under this path, the economic value of the Fund is $44.59 billion at the end of FY 2016. This is $9.32 billion higher than that of the mean across the 100 paths. The high economic value in this path resulted from a rapid increase in the mortgage rate after FY 2016. This creates low prepayment rates in the near future, which allows FHA to continue to receive monthly insurance premium cash inflows for a longer period of time. There are 9 other paths with the FY 2016 economic value of the Fund higher than $44.59 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
2016	44,590	1,180,531	1,069,628	15,202	228,845	
2017	53,019	1,252,741	1,125,731	7,735	158,458	694
2018	57,365	1,332,490	1,186,219	3,076	148,473	1,269
2019	61,091	1,413,398	1,246,105	2,041	149,612	1,685
2020	63,614	1,496,513	1,305,298	563	133,584	1,960
2021	67,300	1,571,589	1,355,739	1,539	145,547	2,147
2022	72,593	1,683,040	1,443,265	2,935	217,008	2,358
2023	79,788	1,739,705	1,478,342	4,576	236,699	2,619

Exhibit V-3 demonstrates that under the 25th best simulation path, the economic value of the fund at the end of FY 2016 is $40.46 billion, which is $5.19 billion higher than the baseline. The FY 2023 economic value is $108.49 billion, which is $6.33 billion higher than the baseline. This path features higher mortgage rates than Moody's base forecast before FY 2020. The higher mortgage rates will lead to less prepayment and hence premiums are received for a longer period of time. On the other hand, the house price level remains below Moody's baseline forecast for a long period of time. The lower or even negative house price appreciation will lead to more defaults and hence more claim losses. It turns out that the interest rate effect is stronger than the house price effect and the net effect is an economic value above the baseline case for FY 2016.

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
2016	40,461	1,199,424	1,086,317	12,624	213,066	
2017	44,941	1,273,758	1,142,984	3,850	147,131	630
2018	50,486	1,343,112	1,193,124	4,469	139,582	1,076
2019	56,605	1,410,306	1,240,280	4,636	157,929	1,483
2020	65,347	1,480,238	1,290,154	6,927	192,227	1,816
2021	73,782	1,559,262	1,347,944	6,229	203,720	2,206
2022	90,048	1,617,159	1,390,665	13,681	336,819	2,585
2023	108,485	1,667,201	1,428,988	15,187	348,627	3,249

Exhibit V-4 shows that the FY 2016 economic value under the 25th worst simulation path is $31.86 billion. The FY 2016 economic value is $3.41 billion below the baseline but the FY 2023 economic value is $25.78 billion above the baseline. This path is characterized by a low interest rate level prior to FY 2024. Prepayments are projected to be high and hence premium income is low. On the other hand, the house price appreciation in this path is similar with the baseline before FY 2018, and becomes lower than the baseline until FY 2020. As a result, defaults are high and claim losses are high. From FY 2021 to FY 2026, the house price appreciation is higher than the baseline. With the higher prepayment rates up to FY 2019, there are many fewer loans left in the FY 2016 portfolio to benefit from the low claim losses due to the higher house price appreciation after FY 2020. This result in a worse performance of current books of business, but it creates a much larger future endorsement volume and profitability: the FY 2023 economic value is positive $127.93 billion. The opposite impacts between the FY 2016 and FY 2023 along this path demonstrates that a path with less favorable short term economic environment may produce more favorable economic conditions for future portfolios: a negative short term impact in the short term economic value could coexist with a positive impact in the long term economic value along the same simulated path.

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
2016	31,863	1,202,676	1,088,681	11,202	212,795	
2017	43,274	1,241,313	1,117,027	10,915	213,495	496
2018	59,136	1,287,040	1,152,249	14,826	230,982	1,036
2019	73,695	1,351,935	1,200,457	12,822	187,918	1,737
2020	84,741	1,408,581	1,235,922	8,682	143,992	2,364
2021	97,640	1,473,612	1,278,948	10,039	156,232	2,860
2022	113,783	1,551,714	1,336,156	12,723	207,690	3,421
2023	127,926	1,627,589	1,389,353	10,037	172,229	4,106

Exhibit V-5 shows the 10th lowest economic value for the FY 2016 economic value among the 100 simulated paths. Under this more pessimistic path, the economic value of the Fund is $25.83 billion at the end of FY 2016, which is $9.44 billion lower than the baseline economic value. This path features a low mortgage rate environment prior to FY 2019. Prepayments are high and premium income is low. On the other hand, the house price level in this path stays similar to Moody's baseline up to FY 2018. After FY 2018, the house price appreciation is much lower than Moody's baseline until FY 2025, and even becomes negative from FY 2018 to FY 2020. As a result, defaults are high and claim losses are high. FY 2023 economic value on this path is $86.38 billion, which is $15.77 billion lower than the baseline FY 2023 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
2016	25,834	1,187,178	1,075,006	12,597	227,951	
2017	37,930	1,242,760	1,119,940	11,693	227,594	402
2018	45,684	1,297,879	1,157,790	6,846	152,225	908
2019	50,810	1,360,574	1,198,305	3,785	119,266	1,342
2020	56,516	1,418,857	1,233,096	4,076	120,157	1,630
2021	63,463	1,472,414	1,262,502	5,039	126,067	1,908
2022	77,268	1,548,698	1,317,685	11,582	212,146	2,223
2023	86,376	1,610,400	1,356,298	6,320	155,553	2,788

Exhibit V-6 shows the worst result from our Monte Carlo simulation. Under this scenario, the economic value of the Fund is *negative* $9.38 billion at the end of FY 2016. This is a depression-level scenario, where house prices drop at an average annual rate of 4 percent from FY 2018 to FY 2021, and remains below the baseline up to FY 2039. The interest rates are similar to Moody's baseline projection. The deep depressed house price level leads to high claim losses, which makes this the lowest economic value projected among the 100 paths.

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
2016	-9,375	1,189,478	1,078,237	4,021	235,852	
2017	-9,641	1,251,237	1,127,754	-120	207,669	-146
2018	-14,333	1,314,306	1,171,248	-4,461	129,076	-231
2019	-16,555	1,366,080	1,199,941	-1,802	98,541	-421
2020	-17,107	1,400,115	1,210,349	-21	86,485	-531
2021	-16,778	1,432,636	1,218,137	906	83,662	-577
2022	-14,366	1,475,214	1,237,264	3,000	118,174	-588
2023	-11,245	1,512,839	1,250,838	3,639	108,709	-518

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 falls significantly for two years and then 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 same adjustment as previous years, where the house price growth rate of this scenario converge to the long-run growth rates of Moody's baseline scenario, instead of the index itself converging to the long-term level. This adjustment avoids having the stress scenarios show optimistic growth after the initial stress period. Under the adjusted scenario, the house price decreases more than 10 percent in two years; at the same time, the mortgage rates drop to 2.6 percent in FY 2018, and gradually increase to baseline scenario level 20 years later. Both of these two economic variables represent more severe economic conditions up to FY 2021, compared to the worst simulation path.

Exhibit V-7 shows that the FY 2016 economic value is *negative* $36.12 billion under this most pessimistic alternative scenario published by Moody's in July 2016, which is $71.39 billion

lower than the stochastic baseline. Under this scenario, the FY 2023 economic value is $17.08 billion which is $85.07 billion lower than the stochastic baseline.

Exhibit V–7: Fund Performance: Protracted Slump ($ 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
2016	-36,116	1,209,870	1,094,888	-233	208,390	
2017	-29,294	1,271,128	1,141,082	7,384	187,318	-562
2018	-18,193	1,295,227	1,151,848	11,802	185,336	-701
2019	-10,832	1,307,085	1,146,367	7,896	120,451	-534
2020	-4,758	1,328,815	1,146,858	6,421	96,566	-347
2021	1,608	1,363,989	1,159,119	6,527	101,371	-161
2022	8,859	1,409,532	1,181,483	7,194	114,465	56
2023	17,080	1,464,342	1,213,912	7,901	129,017	320

C. Moody's July 2016 Forecast as a Deterministic Scenario

Exhibit V-8 presents the estimated economic value of the Fund based on Moody's baseline forecast as a deterministic scenario. The FY 2016 and FY 2023 economic values are $39.35 billion and $112.07 billion, respectively. The FY 2016 economic value under this deterministic scenario is $4.08 billion higher than the FY 2016 economic value under our stochastic baseline, and the FY 2023 economic value under this deterministic scenario is $9.92 billion higher than the FY 2023 economic value under the stochastic baseline.

Exhibit V–8: Fund Performance: Moody's Baseline Forecast ($ 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
2016	39,349	1,187,524	1,075,625	14,498	225,998	
2017	52,067	1,240,205	1,116,507	12,105	197,106	613
2018	60,954	1,307,524	1,165,841	7,640	148,547	1,247
2019	69,651	1,376,867	1,214,492	6,907	139,605	1,790
2020	79,306	1,444,778	1,260,586	7,421	143,080	2,234
2021	89,704	1,510,168	1,303,460	7,721	147,049	2,677
2022	100,633	1,573,820	1,344,138	7,786	150,736	3,143
2023	112,072	1,634,132	1,382,095	7,808	154,248	3,631

D. Low Interest Rate Scenario

Exhibit V-9 presents the estimated economic value of the Fund based on the low interest rate scenario. The FY 2016 economic value is $31.57 billion, which is $3.70 billion lower than the mean economic value from the Monte Carlo simulation. The FY 2023 economic value is $113.73 billion, which is $11.58 billion higher than the baseline Monte Carlo result. The lower interest rates will result in higher prepayments, reducing the premium income for current books; while the volume of future endorsements will increase and the economic value will eventually be higher than the baseline.

Exhibit V–9: Fund Performance: Low Interest Rate Forecast ($ 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
2016	31,565	1,188,860	1,076,788	12,712	224,211	
2017	46,204	1,238,505	1,117,278	14,147	233,806	492
2018	60,879	1,298,679	1,164,352	13,569	207,203	1,106
2019	72,244	1,361,633	1,207,901	9,577	151,648	1,788
2020	81,671	1,424,948	1,248,468	7,109	131,704	2,318
2021	91,641	1,488,091	1,288,003	7,214	135,234	2,757
2022	102,369	1,553,667	1,329,665	7,517	144,054	3,210
2023	113,735	1,617,932	1,370,726	7,672	150,677	3,694

E. Summary of Alternative Scenarios

Exhibit V-10 shows the Fund's projected economic values from the baseline Monte Carlo simulation and those of the eight 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, Moody's protracted slump scenario, Moody's baseline forecast as a deterministic scenario and the low interest rate scenario.

Inferring from the 25th best and worst paths, the Fund's FY 2016 economic value has approximately a 50 percent probability of being in the range of $32 billion to $40 billion. From the 10th best path and 10th worst path, the Monte Carlo simulation results indicate that there is an 80 percent chance that the economic value of the Fund being between $26 billion and $45 billion. Further, among the 100 simulated paths, there is 1 path that yields negative economic values as of the end of FY 2016. As a result, we conclude that there is approximately a 1 percent chance that the FY 2016 economic value of the Fund may be negative.

Exhibit V-10: 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
2016	35,272	44,590	40,461	31,863	25,834	-9,375
2017	46,647	53,019	44,941	43,274	37,930	-9,641
2018	54,128	57,365	50,486	59,136	45,684	-14,333
2019	62,059	61,091	56,605	73,695	50,810	-16,555
2020	71,562	63,614	65,347	84,741	56,516	-17,107
2021	81,471	67,300	73,782	97,640	63,463	-16,778
2022	91,599	72,593	90,048	113,783	77,268	-14,366
2023	102,151	79,788	108,485	127,926	86,376	-11,245

Fiscal Year	Moody's Protracted Slump	Moody's Baseline	Low Interest Rate
2016	-36,116	39,349	31,565
2017	-29,294	52,067	46,204
2018	-18,193	60,954	60,879
2019	-10,832	69,651	72,244
2020	-4,758	79,306	81,671
2021	1,608	89,704	91,641
2022	8,859	100,633	102,369
2023	17,080	112,072	113,735

F. Sensitivity Tests for Economic Variables

The above scenario analyses were conducted to examine the distribution of the economic value of the Fund with different possible combinations of the interest rate and house price movements in the future. It is also useful to understand the marginal impact of each single economic factor on the economic value. Below, we show the sensitivity of the FY 2016 economic value of the Fund respect to the change of a single economic factor at a time. This sensitivity test is conducted for three sets of economic variables:

- National House Price Appreciation (HPA)
- Interest rates, including:
    - 10-year constant maturity Treasury rate
    - 1-year constant maturity Treasury rate
    - Commitment rate on 30-year fixed-rate mortgages
- Discount Rate

The marginal impact is measured by the change of the FY 2016 economic value from the deterministic base scenario result (Exhibit V-8). These simulations change each of these variables one at a time in that deterministic baseline scenario. The changes are parallel shifts in the path of each variable in the deterministic base scenario, where all three interest rates are all shifted together and at the same magnitudes, but are kept from going negative.

Exhibit V-11 reports the sensitivity of the economic value with respect to changes in the HPA forecast. Specifically, we applied a parallel shift to the annualized house price appreciation rates (HPA) from the base scenario up and down by 20, 50, 100 and 200 basis points. The results show a concave shape, indicating the asymmetric impact of positive vs. negative changes in future HPA. An adverse house price trend would harm the economic value of the fund more than a favorable house price trend of the same magnitude would benefit it. For example, a 100 basis points decline in HPA will incur an economic value change of *negative* $5.89 billion, while a 100 basis points rise in HPA will result in economic value increase of $4.34 billion. This is due to the limit on upside potential, which after claims become minimal is limited by the fixed-rate premium income; and conversely the relatively unlimited losses when HPA goes negative.

Exhibit V-11 also reports the sensitivity of the economic value with respect to change in future interest rates. Specifically, we applied parallel shift to the 1-year Treasury rate, 10-year Treasury rate and the mortgage rate series up and down from the base scenario by 20, 50, 100 and 200 basis points, but kept these interest rates from turning negative. The curve showed a positive slope, indicating that the economic value of the Fund is positively related to the future interest rate. Higher future interest rates benefit the Fund in two ways. First, higher future interest rate means lower refinance incentive for existing borrowers. Thus, there would be fewer prepayments, which lead to a longer stream of annual insurance premium revenue. Second, high future interest rates imply that the mortgage payments of existing borrowers would be lower than that of a new mortgage with the market interest rate. The below-market mortgage payment

serves as an incentive for borrowers to keep their mortgages longer and thus is a disincentive to default in order to continue to benefit from their below-market payments. A 100 basis points fall in interest rates will incur an economic value change of *negative* $8.22 billion, and a positive 100 basis points change in interest rates will result in an economic value increase of $7.06 billion.

Finally, Exhibit V-11 reports the sensitivity of the economic value with respect to the discount rate. From the FY 2017 OMB discount factors, we first transform the discount factors into future spot rates, which is the implied yield curve from the discount factors. We apply a parallel shift to the implied yield curve in the base scenario up and down by 20, 50, 100 and 200 basis points, but kept the discount rates from turning negative. The curve indicates that changes in discount rates associated with the implied yield curve generally have a negative linear effect with slight convexity on the economic value of the fund. A negative 100 basis points change in discount rates associated with the implied yield curve will produce an economic value change of *positive* $1.16 billion, and a positive 100 basis points change in discount rates associated with the implied yield curve will result in reduced economic value of *negative* $0.99 billion.

These sensitivity analyses show that economic value of Forward portfolios would be significantly affected by changes in interest rates and House Price Appreciation, while a change in discount rates has much smaller impact.

Exhibit V–11: Sensitivity Test for Economic Variables
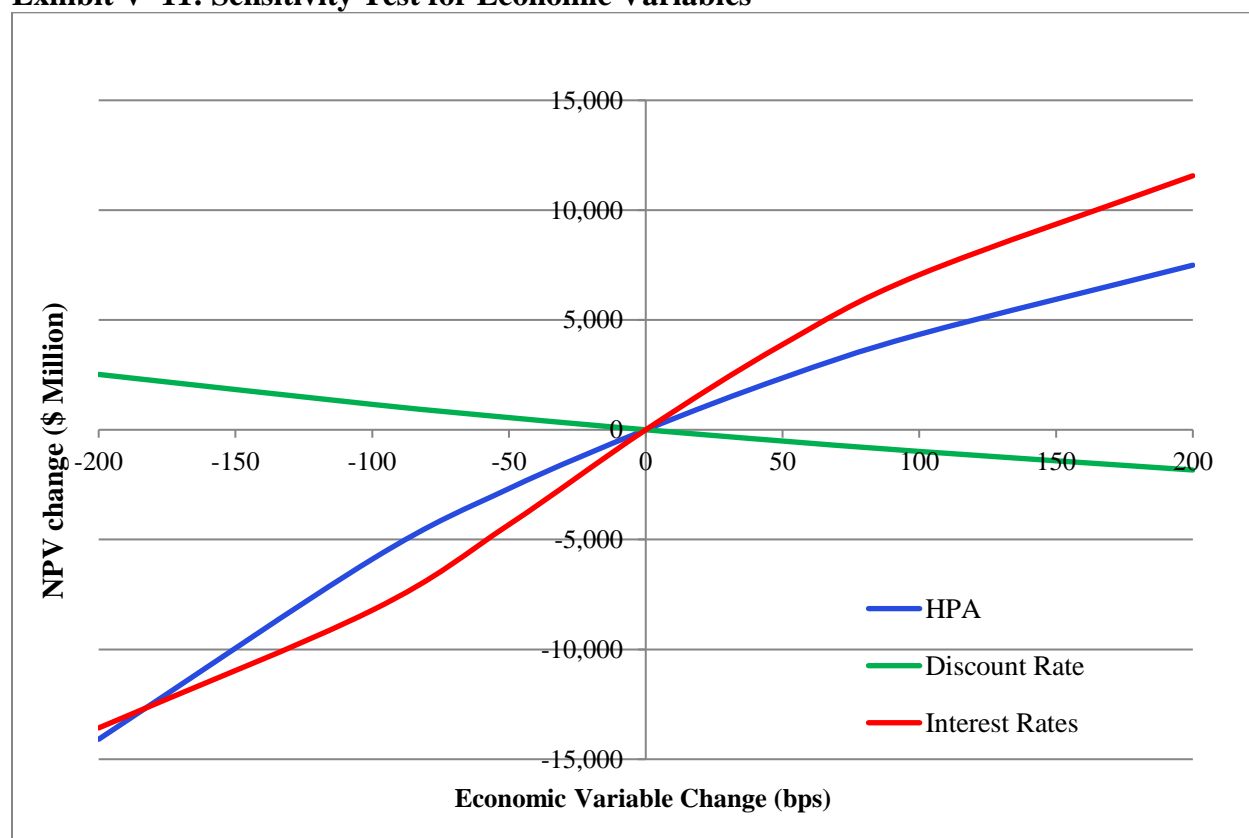
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Section VI: Summary of Methodology

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 incidences of claim and prepayment terminations for FHA forward loans in the mutual mortgage insurance portfolio, in order to project 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 loss-mitigation techniques means claim costs are incurred and cessation of mortgage insurance premium revenues, 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 additional transition stage since the FY 2009 Actuarial Review is the transition from current to 90-day or more delinquent, which we call default. Since the FY 2012 Review, cures from default were separated into cures by modification, and "self" cures with no modification or with "light" modifications. Since the FY 2013 Review, 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 since the FY 2013 Review 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 procedure since the FY 2013 Review, we tracked the transition from current to prepayment that is 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. Accuracy is enhanced because we capture the original, fully underwritten loan's LTV and hence original house price, and original credit score, since streamline refinances do not require appraisals or collecting credit scores.

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

For a loan in default status at the beginning of a particular time period, it may be prepaid (streamline refinance is not allowed if delinquent), be claimed, be cured, or remain in default. Since the FY 2013 Review, cures are treated separately into two types: cures by modification and self-cures. This becomes five transitions for a loan in default, and only four equations need to be estimated.

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

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 must 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 relationships.

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 status 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.

Since the FY 2012 Review, 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, refinance incentive and borrower credit scores. An important benefit of the spline specification over a categorical variable approach is that it allows changing marginal effects over the range of values of the variable while avoiding sudden jumps in the marginal effects. For qualitative or categorical variables, such as season, judicial states and number of units, we necessarily adopted the dummy variable specification.

Following same approach as in the FY 2013 Review, for a loan that is current, the default duration variable takes the form of a linear spline specification instead of the prior categorical variables. 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 for the details.

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 end of the second quarter of FY 2016 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 terminations by claim or prepayment. The data warehouse also maintains a record of loans entering and exiting default status. See Appendix A for the details of classifying mortgages over time according to their default status.

C. Estimation Sample

The entire population of loan-level data from the FHA single-family data warehouse was extracted for the FY 2016 analysis. This produced a population of around 32 million single-family loans originated between FY 1975 through the second quarter of FY 2016. Among these loans, historical status transition records during FY 1996 and later years were available and were used to estimate the loan status transition models. Our model estimation dataset did not include pre-1996 cohorts and performance due to the limited availability of reliable 90-day default episode data and a major change in FHA underwriting policies in FY 1996. The resulting dataset, with more than 20 million loan records and their performance records up to FY 2016 Q2, was used to generate loan-level transition event histories until the end of the observed data period.

Estimation and forecasting were completed 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 binomial logit transition probabilities.

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:

Exhibit VI-1: Sampling Scheme for Various Product Types

Product Number	Product Type	Sampling Scheme
Product 1	FRM30	1) Clean periods of clean loans[48]: 1% 2) Clean periods of non-clean loans[49]: 10% 3) Non-clean periods of non-clean loans[50]: 100%
Product 2	FRM15	100% for all loans
Product 3	ARM	100% for all loans
Product 4	FRM30_SR	1) Clean periods of clean loans: 6.25% 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

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

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

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

D. Cash Flow Model

After we projected the future default, claim and prepayment rates using the econometric models, we 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, (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 to discount future cash flows to determine their present value as of the end of FY 2016.

Starting with the FY 2013 Review, we also implemented a foreclosure backlog adjustment to estimate the speed of processing 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 26,655 loans (versus 31,380 loans in FY 2015 Review) on the books at the end of the observation period, that had already held a foreclosure auction prior to January 1, 2015, or completed the foreclosure prior to July 1, 2015, but had not yet been claimed by July 31, 2016. State-level econometric analyses were performed to estimate the conditional termination speed. The resulting cumulative probability functions were used to simulate the timing of the claims of this extra foreclosure inventory; Appendix B provides the technical details.

HUD executed a note sale in November 2015 and launched another one in September 2016. From the loan-level data provided by HUD, we recorded the termination of 7,743 loans from FY 2016 Q1 to FY 2016 Q4 and assigned observed loss rates for loans settled in the November 2015 note sale. For the September 2016 sale, we projected the termination of 8,025 loans in FY 2017 Q1 and assigned average loss rates of recent sales at 63 percent of the loans' unpaid balance, as the September 2016 note sales were not yet settled by the end of FY 2016. The adjustment is intended to improve the accuracy of the composition of the existing portfolio entering the simulation model.

E. Loss Severity Rate Model

FHA incurs a loss from a mortgage claim event. This loss amount depends on many 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 separated into real-estate-owned (REO) and third party sales (TPS). We correspondingly developed sub-models: an FC/PFS selection model, which predicts the probability that a claim will be disposed of as FC/REO or PFS, and separate loss severity rate

models for REO and PFS cases. Based on the trend of the TPS share of total FC loans over the recent four years, we derived assumptions for future TPS shares and loss rates. The effective loss rate is the weighted average of the three separate loss severity rates. The loss severity models capture 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 REO and PFS loss severity rate models. Details of these models are provided in Appendix E.

F. Volume Forecast Model

We updated the model for projecting future FHA endorsement volumes. The modeling approach 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 target purchase share of the national purchase volume and the estimated national purchase mortgage volume. Following the FY 2013 Review, we include the FHA refinance effective interest spread in the FHA refinance share model. Appendix F provides the technical details.

The projected volumes vary according to alternative scenarios of interest rates and home prices in our Monte Carlo simulations. For example, higher interest rates would depress refinancing volume. FHA's streamline refinance volume and loan characteristics are endogenously generated from the current-to-streamline refinance transition equations. As a result, the future streamline origination volume and compositions are fully consistent with the projection of loans in the existing portfolio terminated through streamline refinance loans.

G. Monte Carlo Simulation

In the FY 2011 and prior Reviews we calculated the present value (PV) of future cash flows based on a single, deterministic path. Since the FY 2012 Review, we estimated the economic value of the Fund using a stochastic, Monte Carlo approach. The Monte Carlo approach uses multiple economic paths, where a "path" is a set of economic variables whose values are projected into the future. The following are the economic variables that "drive" our behavioral equations, *i.e.*, they are the critical economic explanatory variables in our transition, loss severity and volume models:

- 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 July 2016 baseline forecast as the median level for each variable and each time period in the simulations. We then constructed the random paths by applying historically estimated dispersion behavior surrounding this Moody's baseline forecast. The degree of dispersion is determined by the variances we estimated for each of these 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 level. Appendix G explains how we generate these multiple random paths.

Under the Monte Carlo framework, each of the paths is assumed to be equally likely to occur. Once the present values are computed for individual paths, they are averaged to derive the expected present value of the future cash flows. In the literature, this approach is considered the preferred way to compute fair market values under uncertainty about future paths of the critical driver variables. In particular, this approach accounts for nonlinearities in the way the present values respond to alternative paths, especially in that recession-type paths create more losses than boom-type paths can recoup in increased premium revenue.

In FY 2013, the Monte Carlo simulation framework was enhanced to use dynamic simulation, or simulated incidence. Dynamic simulation provides a method of reducing the memory requirement. Under this approach we use 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 include more path-dependent variables in the model estimation, which had been infeasible in the past.

The antithetic variates method has also been adopted in combination with the implementation of the dynamic simulation approach. Dynamic simulation can greatly increase simulation flexibility, but it can be subject to material estimation error unless we use a very large number of simulation runs. Antithetic variates significantly reduce the simulation standard error and thus improve the convergence of the result; i.e., it reduces the computation time to achieve a given level of accuracy. By combining these two methods, we are able to simultaneously improve simulation flexibility and retain accuracy.

Since the FY 2014 Review, we implemented a full dynamic simulation process to capture the life cycle of streamline refinance loans. In this algorithm, we generate all the future streamline refinance originations from the simulated streamline refinance outcome from all previous vintages, both historical books and the future books before each specific future origination quarter. In this way we can more accurately capture not only the previous vintage of the newly originated streamline refinance loans, but also their characteristic distributions. Further, we can calculate the mortgage insurance premium (MIP) for streamline loans more accurately, at the loan level, instead of depending on the average characteristics at the cohort level as was the case in previous Reviews.

Simulated stochastic 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 the computations. Further details of the Monte Carlo simulation algorithms can be found in Appendix G.

Section VII: Qualifications and Limitations

The actuarial models used in this Review 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 estimated using 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 20 years. The estimated models are used together with assumptions about future loan endorsements 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 Analytics, 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.

During 2006-2012, most housing markets in the country experienced a severe house price decline. Such extreme conditions have occurred prior to 2006, 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. This nation-wide great recession experience has had significant impact to our projection of the volatility of the future economic environment. The model used in this Review takes alternative projected house price growth rates 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.

Three of the critical economic variables used in making these projections are future house prices and future interest and unemployment rates. We have developed stochastic models to project the future distribution of house prices and interest and unemployment rates using Monte Carlo simulation. Our stochastic models have been calibrated so that they are centered on Moody's July 2016 base-case economic forecasts. The estimated results, then, 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 and unemployment rates. This dependence is captured mostly by the central core of

the distribution which is anchored on Moody's baseline projections. Our estimation of the economic value of the Fund is the result of averaging the economic values that come from 100 independent and stochastic economic paths of house prices and interest and unemployment rates. This estimate will be higher or lower if we had used a different forecast as the median scenario that was more or less favorable than Moody's base case.

Mortgage interest rates have been at historically low levels since CY 2012. In the past four years, Moody's has projected the interest rates to rise to their long term expectations immediately in the future, which continually turned out to be much higher than realized interest rates. In this year's Review, in order to address this observation, we incorporate a low interest rate scenario, which assumes the interest rates will stay at low levels for two years before rising to their long-term expectations.

In order to gain insights into the possible magnitude of the impacts, we conducted sensitivity analysis to examine how the Fund's economic value may change with these macroeconomic factors. Specifically, we investigated the changes in economic value by applying parallel shifts to the National House Price Index (HPI), the discount rates from OMB and interest rates including the 1-year Treasury rate, the 10-year Treasury rate, and the 30-year fixed-rate mortgage rate. The benchmark for these sensitivity tests is the deterministic base case, using the July 2016 forecast from Moody's Analytics.

Alternative deterministic scenarios are also conducted to estimate the combined sensitivity of the Fund's performance with respect to the projected path of house prices and interest rates. The estimates of extreme behavior and in particular the range of possible outcomes depend on our stochastic models and the procedures we used.

B. Basic Data Inputs

The econometric analysis in this Review uses a data extract from FHA's data warehouse as of March 31, 2016. The volume and composition of the existing portfolio are based on FHA data as of June 30, 2016. The future trends of economic conditions are based on July 2016 forecasts by Moody's Analytics. Future endorsement compositions are modeled based on HUD's projections as of August 2016. While we have reviewed the integrity and consistency of these data and projections and believe them 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 Group's analysis of the MMI Fund, excluding loans insured under the Home Equity Conversion Mortgage (HECM) Program. The HECM program was moved into the MMI Fund starting FY 2009, and 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 $35.27 billion and unamortized IIF of $1,188.57 billion as of the end of FY 2016. We project that the economic value will steadily increase after FY 2016 at an average of $9.55 billion per year to $102.15 billion by the end of FY 2023. This is equivalent to an average annual rate of increase of 16.41 percent over the next 7 years. Also, the unamortized IIF will also increase, at an average annual rate of 4.85 percent to the end of FY 2023. The much faster rate of increase in economic value than in the IIF indicates that the financial strength of the Fund will continue to improve over the next 7 years.

The estimate of the FY 2016 economic value is $10.11 billion higher than projected in last year's Review, mainly due to the higher endorsement volume in FY 2016 and lower realized and forecasted interest rates, which is also associated with better-than-expected performance in the past year. The estimated FY 2022 economic value is higher than projected in last year's Review by $16.99 billion, due primarily to better performance of projected future books of loans.

As the market mortgage rates remain at historically low levels, Moody's Analytics revised its rates forecast downward both in the near term and also for the long term. The house price forecast is also revised downward in the near future. However, as the quality of endorsed loans kept improving since the crisis, the economic value of the Fund has grown steadily and is expected to increase to $102.15 billion by the end of FY 2023.

The credit quality of recent endorsements under the Fund has shown significant improvement relative to the average credit quality of historical books. Due to capital constraints that arose during the recession, most private mortgage insurance companies in the U.S. have tightened their underwriting standards considerably. This left the FHA as the primary source of housing finance for borrowers with higher LTVs. Although private mortgage insurance companies have resumed their activities during the last three years, we still observe a robust credit profile of the FY 2016 book of business in terms of LTVs and credit scores. HUD forecasts that the credit quality of future books will gradually return to the compositions experienced in the mid-1990s, before the expansion of the subprime market. The improved credit-risk profile compared to historical levels significantly improves the projected performance of the Fund.

On August 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. Effective January 26, 2015, however, the annual insurance premium rate was reduced by 50 basis points for loans with terms greater than 15 years, with the exception of streamline refinance loans if the original FHA loan was endorsed on or before May 31, 2009. FHA also terminated the policy of automatic cancelation of annual insurance premiums for loans endorsed after FY 2013 when their LTV amortized to 78 percent. The increased annual premiums, the cancelation of the automatic stop of annual premiums improved the financial strength of the FYs 2013-2014 endorsement books. For the FY 2015 and FY 2016 books, although the annual insurance premium rate was reduced by 50 basis points, the larger endorsement volume and better mortgage quality contributed to the increase in economic value over the estimate in the FY 2015 Review.

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. This continues to help maintain the credit quality of the FHA portfolio. The significance of eliminating this seller financed non-profit organization downpayment assistance program is highlighted by our estimate that if non-profit-assisted loans had always been excluded, the economic value of the Fund would have been $51.78 billion in FY 2016, instead of the economic value of $35.27 billion estimated in this report.

Appendix A

Econometric Analysis of

Mortgage Status

Transitions and Terminations

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 2016 Review. The models follow those implemented in FY 2015. We continue to apply our model enhancement of FY 2015 regarding future streamline refinance loan originations. With the status transition models, we are able to generate future streamline refinance loans based on the specific loans that are estimated to terminate by streamline refinancing for each quarter in the future. In essence, this makes future streamline refinance volumes endogenous.

Section I of this Appendix summarizes the model specification and estimation issues arising from the analysis of FHA mortgage status transitions and the subsequent ultimate claim and prepayment rates. We also discuss issues related to the measurement of borrower default episodes and prepayment and claim terminations. In AR 2016, we continue to apply the same multinomial logistic probability framework used to model competing risks as applied last year. 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 separate binomial logit estimates. Section II describes the details of the streamline refinance simulation. Section III describes the explanatory variables for estimation. The econometric estimates of the binomial logistic model coefficients are presented in Section IV.

I. Model Specification and Estimation

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 cannot also be prepaid or claimed during the same quarter. This new transition state was possible after FHA combined multiple data sources, allowing for the use of historical data on new, 90-day default episodes that have occurred on all endorsed mortgages since FY 1990 Q1. The date from 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 by cure or the loan terminates through claim or prepayment. Under this approach, loans that enter a policy quarter as 90-or-more days 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.

Exhibit A-1 summarizes the status transitions and the loss severity model components that we have modeled for the FY 2016 Review. Tracking loans with and without prior default episodes or prior loan modification as separate loan status categories enhances the path dependency of the analysis, that is, subsequent behavior depends on whether they were previously in default or were modified. Loans in current status (C) at the beginning of a quarter can continue in their current status, default and cure in the same quarter (CX), transition to default status (D) at the start of the next quarter, or terminate as a prepayment to an FHA streamline refinance product (SR) or as a prepayment (PRE) for any reason other than SR.

The transition from current into SR rather than into a non-FHA prepayment allows feedback into an ongoing portfolio where these 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 computation of the value of the current portfolio.

All loans that had been in 90-day delinquency status during the prior periods are flagged with an "X" and assigned to a separate current status. "CX" means the loan is in current status but had defaulted before. This also applies when a loan goes into and out of a 90-day delinquency during 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.

Starting in the FY 2013 Review, a prior loan modification flag is included to identify the cure type. Once a loan is modified, the prior modification flag is permanently activated to distinguish between self-cured and mod-cured. This approach models the transition to these cure types to better identify and model the mix of cure types. The transition equation to project future transitions for these loans is differentiated by using the flag as an explanatory variable in the equations.

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. The flags are kept on for the remaining terms of these loans to distinguish their transition probabilities from otherwise identical un-flagged loans. Similarly, DX has different transition probabilities from D, for purposes of modeling the transitions to the next quarter. Minimizing the number of transitions is very important for the efficiency of model estimation, especially in the simulations of future performance, and the use of flags is an efficient technique that preserves the path dependency.

Exhibit A-1: Loan Status Transitions Framework
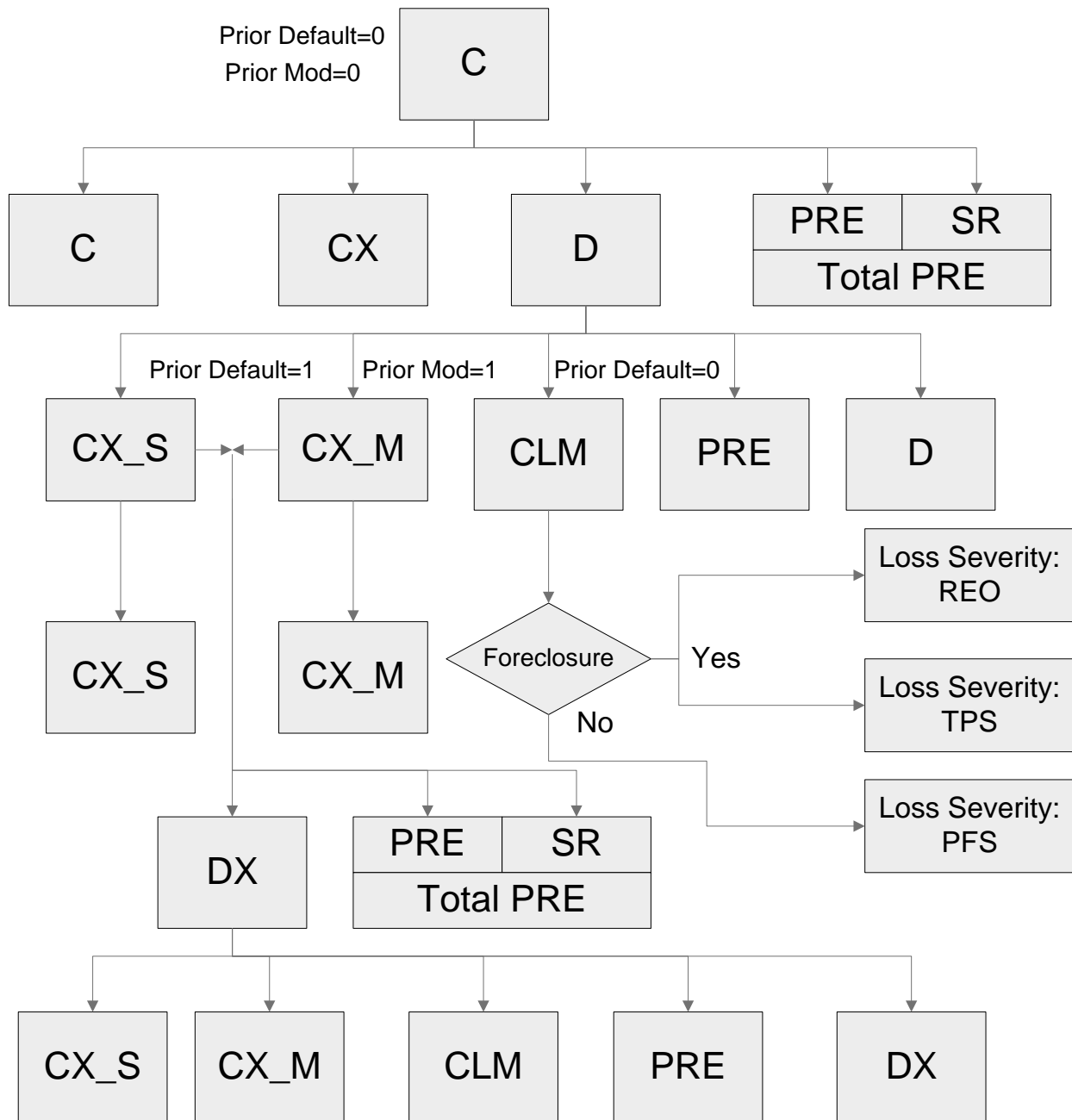
In summary, from the current status, there are five possible transitions: CUR_CUR, CUR_CX (a loan that goes 90-day delinquent within a quarter but is less than 90-day delinquent at the beginning of the next quarter; typically this is a self-cure, because modifications normally take longer to execute), CUR_D, CUR_PRE and CUR_SR. Note that the underline 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. We do not estimate the CUR_CUR transition probability, inferring it instead from the other four transitions. 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 (flags) that account for prior default episodes and prior loan modifications. In other words, we do not expand the state space to keep track of the complete dataset of prior default episodes, yet account 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), having a prior episode of default.

Similarly, there are five possible transitions from a default status: D_D, D_CLM, D_PRE, D_CX_S and D_CX_M, with the latter two reflecting self-cure and modified-cure. The D_SR transition is not allowed, because loans in default status cannot be streamline refinanced, by policy. Since the sum of the transition probabilities must sum to unity, we do not estimate the D_D transition, but infer its probability from the other four transitions. And as above, we use 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") as a claim, as in Example 1, or ends as a prepayment, as in Example 3. The end of a default episode is denoted "end_dt" when it cures, as in Example 2. A default episode can also be "censored" if it does not end at the end of the sample observation period, as in Example 4. Note that these examples also illustrate the notion of default duration ("dur"), which is an explanatory variable in the transition equations. Example 5 illustrates the situation of a loan going into a 90-day episode within a quarter but 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 if a loan is 60-day delinquent prior to the quarter, goes to 90- or even 120-day delinquent in the first months of the quarter, but with sufficient arrearages being paid in the last month of the quarter so that in the next quarter it starts off at less than 90-day delinquent.

Exhibit A-2: Examples of Loan Transition Types

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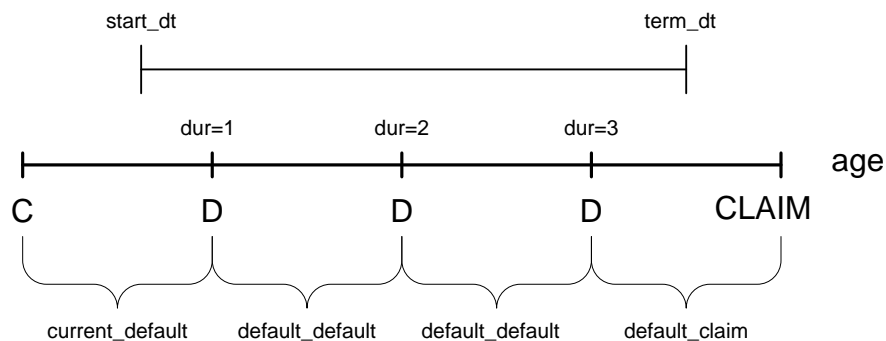
Example 2 : current-to-default / default-to-current
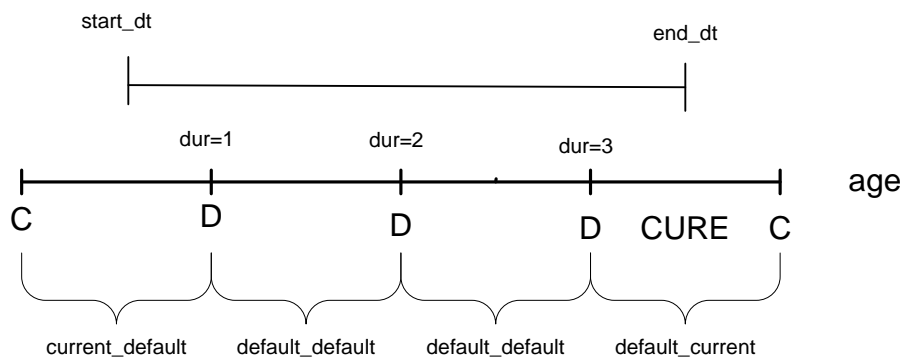
Example 3: current-to-default / default-to-prepay
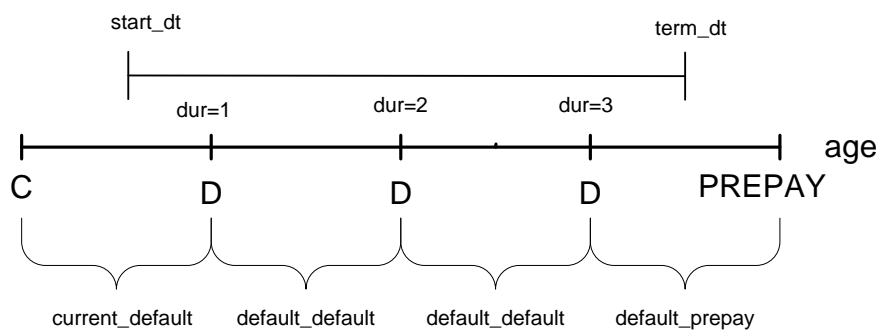
Example 4: current-to-default / censored
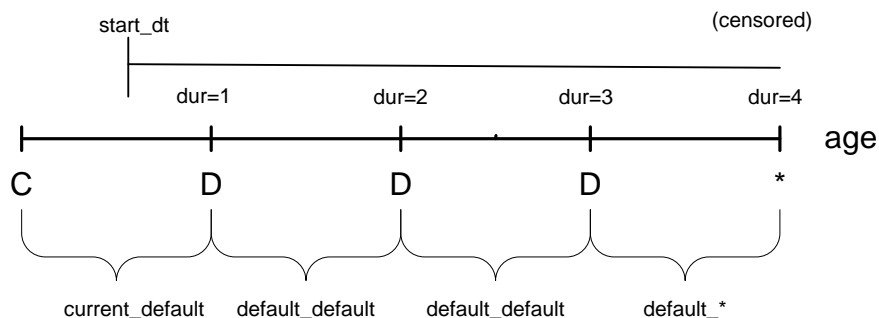
Example 5: current-to-current
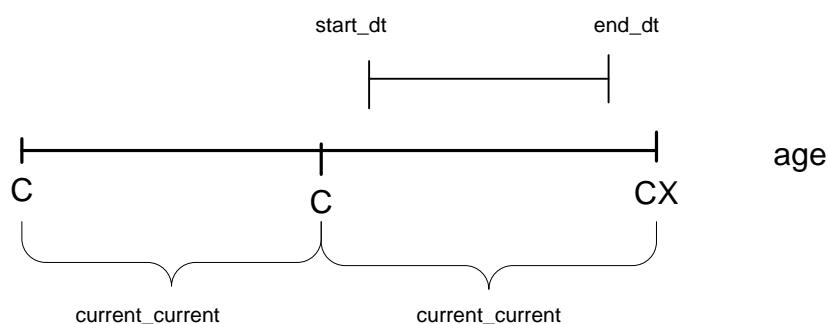
B. Specification of Multinomial Logistic Models

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 that are current at the start of the quarter, the competing risks are prepayment, a transition to default status, or remaining current, as was shown above in the first layer of transitions in Exhibit A-1. 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 remaining 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, streamline refinance, default, blemished current, or remaining current; as well as 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, t to $t+1$, for loans starting in a "clean" current status in 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 the respective equations:

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

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

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

$$\pi^{DEF}_{CUR\_M}(t) = \frac{e^{\alpha^{DEF}_{CUR\_M} + X^{DEF}_{CUR\_M}(t)\beta^{DEF}_{CUR\_M}}}{1 + e^{\alpha^{DEF}_{CLM} + X^{DEF}_{CLM}(t)\beta^{DEF}_{CLM}} + e^{\alpha^{DEF}_{PRE} + X^{DEF}_{PRE}(t)\beta^{DEF}_{PRE}} + e^{\alpha^{DEF}_{CUR\_S} + X^{DEF}_{CUR\_S}(t)\beta^{DEF}_{CUR\_S}} + e^{\alpha^{DEF}_{CUR\_M} + X^{DEF}_{CUR\_M}(t)\beta^{DEF}_{CUR\_M}}} \quad (2d)$$

$$\pi^{DEF}_{DEF}(t) = \frac{1}{1 + e^{\alpha^{DEF}_{CLM} + X^{DEF}_{CLM}(t)\beta^{DEF}_{CLM}} + e^{\alpha^{DEF}_{PRE} + X^{DEF}_{PRE}(t)\beta^{DEF}_{PRE}} + e^{\alpha^{DEF}_{CUR\_S} + X^{DEF}_{CUR\_S}(t)\beta^{DEF}_{CUR\_S}} + e^{\alpha^{DEF}_{CUR\_M} + X^{DEF}_{CUR\_M}(t)\beta^{DEF}_{CUR\_M}}} \quad (2e)$$

The constant terms α^i_f and coefficient vectors β^i_f are the parameters to be estimated for the multinomial logistic model, where 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), 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 use $X^i_f(t)$ to denote 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 $X^i_f(t)$ 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 $X^i_f(t)$ 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 2016 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 $X^i_f(t)$ 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's existence following the last default episode (cx_time).

We distinguish the current-to-current status transition into three possible ending statuses depending on whether the loan experienced: (1) both prior default episodes and loan modifications (CX_M), (2) prior default episodes but not loan modifications (CX_S) and (3) none of the above (C). 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.

Starting with the FY 2013 Review, we expanded the possible ending statuses for cures to include two possible cure types: 1) self-cure or non-mod foreclosure alternative (CUR_S), and 2) modification cure (CUR_M); for 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 a current status related to the loan modification flag:

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

C. Computation of Multinomial Logit Probabilities from Binomial Logit Parameters

As in prior 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. 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:

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

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

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

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

The upper-case Π indicates the binomial logistic probability and distinguishes 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) are used to derive the corresponding multinomial logistic (MNL) probabilities.

HUD provided realized loss mitigation cases and cash flows data up to the end of June, 2016. Both the count and amount of loss mitigation costs increased substantially during the past two years following the policy updates of home retention options. Coinciding with this, the number of claim events dropped significantly during the same period. Using quarterly aggregated claims data in FY 2016, we estimate that the new loss mitigation policy is likely to modify 25.70% of the loans that otherwise would have transited from in-default to claim during a particular quarter. According to HUD management, the main loss mitigation policy for the future will be to actively use HAMP as the tool to avoid foreclosures and REOs. This vision is validated by the multiple changes related to loan modification, HAMP, and the general loss mitigation procedures published in Mortgagee Letters during the past three years. However, due to the lack of adequate historical data, the impact of this policy regime shift cannot be estimated by the econometric models. In order to capture the significant impact of this policy change, we apply a 25.7 percent haircut to the model estimated probability of transition from default to claim, and assign the reduced claim probability to the probability of default to cure-by-modification. Due to the significantly higher loan modification probabilities, especially with partial claims, the cost of loss mitigation is adjusted upward accordingly. The specific loss mitigation cost adjustment method is presented in Appendix B.

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 March 31, 2016.

E. Data Samples

There are approximately 33.16 million single-family loans originated between the first quarter of FY 1975 and the second quarter of FY 2016. 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. We also use 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 is supported by the literature, which is summarized here.

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

We used loans originated from FY 1996 through FY 2015 Q4 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 reached claim, full prepayment, or maturation.

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

Starting from the FY 2013 Review, for FRM30 and FRM30_SR, we used a two-stage process to implement choice-based sampling.

For example, the two-stage sampling process of FRM30 follows:

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 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 illustrating the ultimate sampling probability for loan-quarter combinations. The corresponding weight is the reciprocal of the sampling rate applied on each of observations.

Sampling Rate	Good Loan	Bad Loan
Good Quarter	1%	10%
Bad Quarter	N/A	100%

The sampling rate scheme used for each product to produce the estimation dataset is summarized in Exhibit A-3.

Exhibit A-3: Choice-Based Sampling Scheme

Product Number	Product Type	Sampling Scheme
Product 1	FRM30	1) Clean periods of clean loans[51]: 1% 2) Clean periods of non-clean loans[52]: 10% 3) Non-clean periods of non-clean loans[53]: 100%
Product 2	FRM15	100% for all loans
Product 3	ARM	100% for all loans
Product 4	FRM30_SR	1) Clean periods of clean loans: 6.25% 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

Sample Period for Transition Models

In order to limit the impact of policy actions, such as the foreclosure moratorium and mass modification programs taken by government agencies, lenders/servicers and other mortgage market participants, which are likely to under-estimate the true default-to-claim transition, we cut off the default-to-claim transition data at FY 2009 Q3 from the estimation dataset. For the rest of the transitions, such as default-to-prepay, default-to-self cure, default to medication and all current transitions, we use the observations up to FY 2015 Q4 for estimation. Also due to default data quality concerns,[54] we exclude observations from FY 2006 Q2 through FY 2007 Q3 in the estimation of all the default transitions.

II. Streamline Refinance Dynamic Algorithm

A dynamic simulation of the streamline refinance loan originations allows us to simulate endogenously the future streamline refinance loans on a quarterly basis. Exhibit A-4 illustrates the dynamic simulation process.

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

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

[53] "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.

[54] FHA changed the default dataset recording system during FY 2006, rendering part of the default data unreliable.

Exhibit A-4: Streamline Refinance Dynamic Simulation
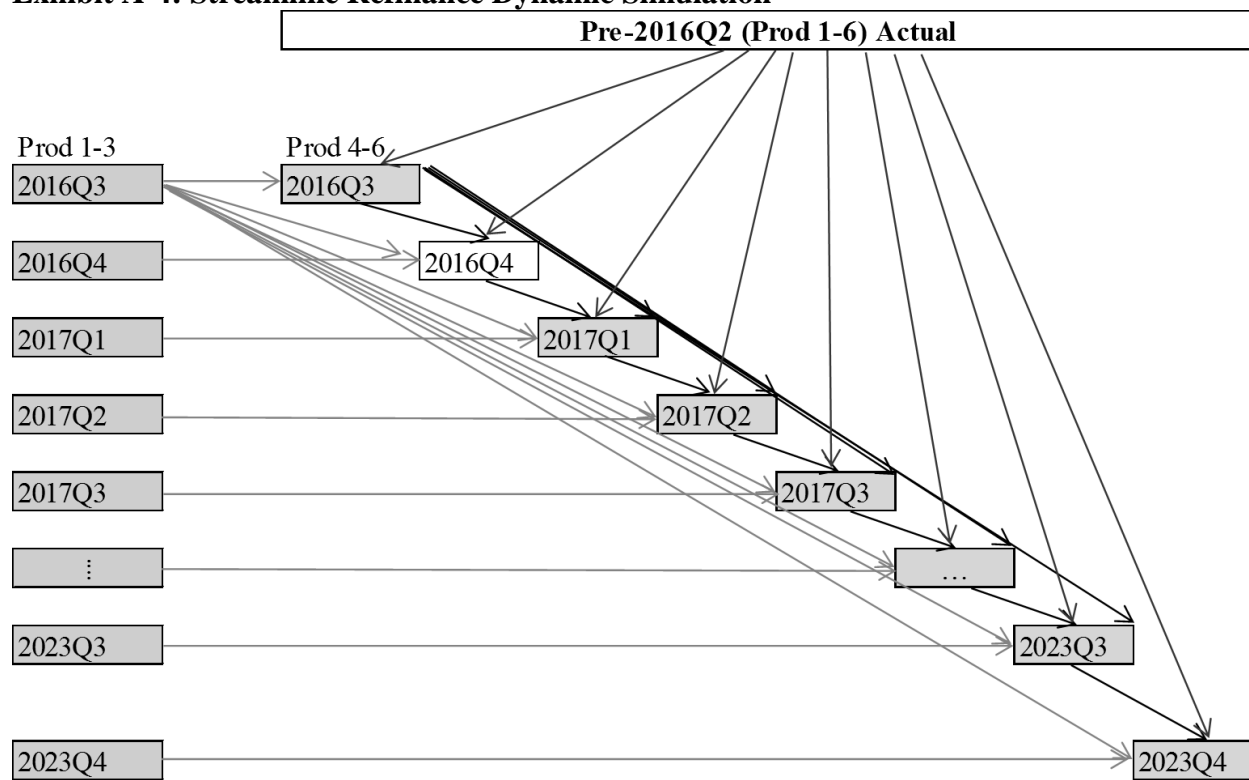
Below is the 4-step procedure for simulating future originations of streamline refinance loans. Please refer to Section I-E for the definition of each product, but products 1-3 are for-purchase mortgages and products 4-6 are the streamline refinance loans.

1. Simulate SR loans originated from existing books and generate initial input files for products 4 to 6 for FY 2016 Q3 – FY 2023 Q4. This is represented as the horizontal bar at the top of the exhibit and the arrows to the quarter for which the streamline refinances are predicted to be originated from the current book of business.

2. Simulate SR loans originated from future books of products 1 to 3 in future years. Add these SR loans into the origination files of products 4 to 6 for FY 2016 Q3 – FY 2023 Q4. Simulated SR loans would appear in the same quarter as previous fully underwritten loans terminated by prepayment. This is depicted in the exhibit as the left-hand column and the arrows to the respective quarters.

3. Simulate using products 4 to 6 of the first forecast quarter (FY 2016 Q3), and update origination files of products 4 to 6 for the second (FY 2016 Q4) and subsequent forecast quarters.

4. Recursively apply step 3 until the origination files of products 4-6 are obtained, until reaching FY 2023 Q4. These are represented by the arrows along the diagonal.

With the implementation of this dynamic simulation, which tracks the transitions of specific loans, we are able to trace back the information of the previous prepaid loan from which the streamline refinanced loan was originated. This information indicates whether the previous loan was fully underwritten or a streamline-refinance loan, as well as the endorsement date of each previous loan. This information enables us to accommodate the premium structures outlined in Mortgagee Letter 2012-4, which requires applying different upfront and annual MIPs to streamline refinance loans depending on whether they are refinancing FHA loans endorsed before May 31, 2009. This information also allows us to attach the original fully underwritten data, such as credit score and LTV, to the subsequent streamline refinanced loan, in order to help predict the subsequent transitions of the refinanced loan.

Following the change introduced last year, we continue to use a quarterly basis for dynamic simulation, as it is more accurate than an annual basis. The historical data suggests that the average length of time between the termination date of a previous loan and the origination date of the subsequent new loan is around 15 days, so the streamline refinance volume is assumed to be contemporaneous within the quarter with the termination of the respective refinanced loan.

III. 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 ratio (LTV), 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 down payment assistance;

- Dynamic variables based entirely on loan information, including mortgage age, duration of default episode, whether a loan has had a prior default episode and 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, and percentage of monthly payment reduction resulting from loan modifications;

- 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, the number of prior quarters the prepayment option was in the money, the cumulative number of quarters that a loan has been "underwater", and the current loan-to-value ratio (CLTV);

- 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 may be combined, as in the case of adjustable-rate mortgages 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-5.1 through A-5.6 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. We employ categorical (dummy) variables for those variables that are binary, such as the indicator of prior default episodes. For continuous variables such as refinance incentive, the burnout factor and the yield curve slope, linear forms were used when they seemed reasonable and improved statistical fit compared to a categorical form, and linear spline forms were used to reflect nonlinearities where necessary. 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; another example is the credit burnout quarters, because at some point, the borrower is sufficiently underwater and incremental "underwaterness" does not matter.

Additional details of some explanatory variables are now discussed.

First-Time Buyer

The first-time buyer dummy variable indicates whether the borrower was a first-time homebuyer. This is an important variable since the default and prepayment behavior of a first-time homebuyer can be quite different from that of a non-first-time buyer.

Purchase-Only HPI

Starting in the FY 2013 Review, we use the Purchase-Only (PO) Home Price Index (HPI) to replace the all-transaction HPI which was used in previous Reviews. The PO series for a large number of local markets were not available from FHFA for Reviews before 2013. The PO Index is based on actual sales transaction prices and does not use any appraised values. As such, it provides a more reliable measure of housing market conditions.

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 in its 20th quarter, the prior loan modification indicator is equal to 1 and remains 1 starting from the 21st quarter. In the loss severity model, a duration variable is also used to measure the number of quarters since last loan modification.

Loan Modification Payment Change

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 better afford. Therefore, the percentage decrease in the monthly payment resulting from a loan modification reduces the degree of the borrower's likelihood of defaulting, claiming and prepaying the modified loan.

Since the financial crisis and the crash of the U.S. housing market, loan modifications have been widely used to reduce foreclosures. At the beginning of the financial crisis, most loan modifications were in the form of forbearance, resulting ultimately 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 has become insignificant since 2010. Since forbearance is not expected to be a major modification type in the future, we floor the percentage of monthly payment change to zero so that the monthly payment change resulting from forbearance will not impact model estimation and its forecasts.

The details of the loan modification payment change are not retrievable for some of the modified loans. In such cases, we created an indicator that identifies when this information is missing.

Number of Quarters Since the End of the Last Default Episode

Following the change in the FY 2013 Review, we replaced the prior default episode indicator by the number of quarters since the end of the latest default episode (CX_TIME) for transitions from the current status. The reason is that we believe the duration since the latest default episode will affect future transitions. In particular, a loan that was recently cured from a default episode may have a higher probability of re-defaulting compared with a loan that 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.

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 episode. 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 the longer the time since the last default episode.

Mortgage Premium (Refinance Incentive)

In Reviews prior to 2013, the refinance incentive was proxied by the relative spread between the mortgage contract interest rate and the current market mortgage rate. Starting in the FY 2013 Review, 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 refinance 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 an FHA mortgage, by definition. For all other transitions we use the payment from a market mortgage, assumed to be a GSE mortgage.

Also, we add 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 the extant FHA loan.

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 calculate 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 1994-2008 period, 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 this 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 the 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 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 percent). 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 the probability of negative equity variable (PNEQ) used in prior Reviews. In general, ARM transitions are more difficult to predict than FRM's.

CLTV was used as a continuous variable for transitions to cure (both self and modifications), except for FRM30, and also for ARM SR in the default-to-prepay transition. 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 current-to-default and default-to-claim (all such transitions except for ARM, FRM SR and ARM SR, where the transitions from current to default were 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:

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

$$cltv2 = \begin{cases} 0 & \text{if } cltv \leq k_1 \\ cltv - k_1 & \text{if } k_1 < cltv \leq k_2 \\ k_2 - k_1 & \text{if } cltv > k_2 \end{cases} \tag{13}$$

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

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:

$$\text{CLTV Function} = \beta_1 \cdot cltv1 + \beta_2 \cdot cltv2 + \beta_3 \cdot cltv3 \tag{14}$$

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 value of β_3 to zero in our estimation.

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. 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.

House Price Volatility

The home price volatility is a measurement of uncertainty with regard to the dispersion of individual house price appreciation rates around the market average represented by the local-level HPI. The parameters used in our model are estimated by FHFA applying the three-stage weighted-repeat-sales methodology advanced by Case-Shiller (1987, 1989). Except in the case of streamline refinances, a borrower needs to meet underwriting standards in order to qualify for a new refinance loan. Holding everything else constant, when there is high dispersion of individual house price growth rates within a location, there is a higher chance that a particular house price may not be sufficient to meet the LTV requirement of the new loan. As a result, the probability of prepayment tends to be lower when the local home price volatility is higher.

House Price Appreciation

The house price enters the model via two variables, each of which has a different interpretation. House 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 house 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):

$$HPA2Y(t,i) = \frac{HPI(t+4,i)}{HPI(t-4,i)}. \tag{15}$$

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). This 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. Empirical results show that 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 2016 Q2, we applied relative loan size assumptions consistent with the loans originated during FY 2014 Q3 to FY 2016 Q2.

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, etc. A high SATO loan is generally riskier, 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.

$$SATO = C - R. \tag{16}$$

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, in percentage points. 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 or otherwise ineligible for a standard refinance, such as having loss of income or poor credit scores. However, at some point, the effect may be reversed, showing a marginally 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 65.1 percent. Therefore, we are assuming that once a loan has the value of the burnout factor larger than 65.1 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 loan 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 rental income, combined with idiosyncratic risk of the properties, tends to increase the default risk for these loans and reduce the prepayment propensity.

Mortgage Age Functions

The age of the mortgage since origination was modeled in linear spline form, similar to the CLTV variable above, some of which are also capped as are some of the CLTV variables. 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 age variables age1 to age4.

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 in linear forms as a result of the testing.

Default Durations

We changed the specification for default durations since the FY 2013 Review and maintained the same procedure this year. Prior to FY 2013, 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. Since the FY 2013 Review, 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. The duration of default, for each default episode, is measured as the number of quarters that a loan has been in 90-day delinquency. A derivative variable used in some equations is an indicator of whether the duration

is greater than 20 quarters. In the loss severity model, a dummy variable indicating the first quarter since 90-day delinquency is also used.

Judicial State Indicators

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):

$$pmt\_shock(t) = \left\{ 100 * \frac{PMT(t) - PMT(0)}{PMT(0)} \right\}. \tag{17}$$

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 these equations, although it is predictive in the default-to-claim equation. In addition, we found it useful for the ARM prepayment transitions, and in the transitions to cures.

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:

$$C(t) = max\{ min[\, Index(t-S) + Margin,$$
$$C(t-1) + A(t) \cdot Period\_UpCap, C(0) + Life\_UpCap\,], \qquad (18)$$
$$C(t-1) - A(t) \cdot Period\_DownCap(t), max(C(0) - Life\_DownCap, Life\_Min)\}$$

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.

Current 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

FHA single-family program experienced a significant increase in the use of downpayment assistance from relatives, non-profit organizations, and government programs during the early 2000's. We 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 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. We 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 2016, and since estimation is now based on data for loans endorsed during FY 1996 to FY 2016, 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.

FHA Score Indicator

As mentioned above, the borrower's FICO scores could be collected directly by FHA or through the choice-based sample collection by Unicon. An FHA score indicator is included to capture the difference of the source of borrower's credit scores. If the score was directly collected by FHA during the underwriting of the loan, the FHA Score Indicator equals to one, otherwise, the variable is set to zero.

Variables for Streamline Refinance Mortgages

The current Review follows the same logic used in the prior Reviews 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 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 generally less when an appraisal is required; and the other transition probabilities are generally 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.

IV. Logistic Model Estimation Results

Exhibit A-5 (parts A-5.1 to A-5.6) 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-5.1 Product 1 (FRM30) Binomial Logit Model Coefficient Estimates

Description	Name	Values	Current to Default Spline	est_16	Current to CurrentX Spline	est_16	Current to Prepay Spline	est_16	Current to SR Spline	est_16	Default to Claim Spline	est_16	Default to Prepay Spline	est_16	Default to Mod. Cure Spline	est_16	Default to Self Cure Spline	est_16
Mortgage age function	age1	Spline function knot values shown next to the corresponding coefficient estimates	2	1.4128	2	1.6933	4	0.5875	2	1.0810	8	0.1480	8	-0.0407	6	0.3658	8	0.0307
	age2		5	0.1535	7	0.1326	10	0.0074	5	-0.0459	>8	0.0185	24	-0.0435	>6	0.0022	>8	0.0015
	age3		>5	-0.0038	>7	-0.0313	20	-0.0273	10	-0.1422			>24	-0.0658				
	age4						50	-0.0633	>10	-0.0420								
	age5						>50	-0.0360										
Burnout factor. Cumulative amount of quarterly positive refinance incentives	burnout1	Spline function	9	0.0075	65	0.0131	65	-0.0069	65	-0.0017								
	burnout2		65.1	-0.0055	>65.1	0.0000	>65.1	0.0000	>65.1	0.0000								
	burnout3		>65.1	0.0000														
Credit burnout factor. Prior cumulative number of quarters the loan is underwater	c_burnout1	Spline function	6	0.0059					14	0.0247								
	c_burnout2		14	-0.0191					>14	0.0000								
	c_burnout3		>14	0.0000														
Credit score	credit_score1	Spline function	600	-0.0023	600	-0.0040	660	0.0012	660	0.0021	660	0.0020	660	0.0001	600	0.0002	600	0.0009
	credit_score2		660	-0.0086	>600	-0.0156	740	0.0045	>660	0.0023	>660	0.0041	>660	0.0034	>600	-0.0022	>600	-0.0019
	credit_score3		>660	-0.0125			>740	0.0008										
Missing credit score	credit_score_000	X=0/1		-0.1598		-0.4714		0.0389		-0.1944		0.3046		0.1344		-0.1529		-0.1396
No credit score returned	credit_score_999	X=0/1		-0.5659		-0.3936		0.2409		0.3116		-0.6997		0.3522		-0.0455		0.0543
Unemployment rate change in last two quarters	delta_ue1	Spline function	0	0.1019														
	delta_ue2		>0	0.1594														
Downpayment assistant types	dpa_govt	X=0/1		0.1821		0.3406		-0.1329		-0.4786		0.0022		-0.2335		-0.0310		0.0039
	dpa_nonprof	X=0/1		0.2982		0.3842		-0.1026		0.1999		0.2566		-0.2823		0.0774		-0.1062
	dpa_relative	X=0/1		0.1167		0.1711		0.0670		-0.0321								
Missing front-end ratio	dti000	X=0/1		-0.0461		-0.0838		-0.0400		-0.1844								-0.0210
Duration of default episodes	dur_def_episode_1	Spline function									2	0.0542	6	-0.1485	3	0.2586	10	-0.1595
	dur_def_episode_2										4.5	0.2970	12	-0.0310	10	-0.1590	20	0.0054
	dur_def_episode_3										12	-0.0597	20	0.0693	20	-0.1235	>20	0.0000
	dur_def_episode_4										>12	0.0000	>20	0.0000	>20	0.0000		
Indicator of duration of default episodes > 20	dur_def_epd_dum	X=0/1										0.1660						
FHA credit score indicator	fha_score	X=0/1		-0.2991				-0.6170		0.0024		-0.7860				0.2340		0.1984
Indicator of first time buyer	frst_tm_by	X=0/1						-0.0796										
House price appreciation local level	hpa2y	linear function				0.0041												
	hpa2y_n	linear function		-0.0101				0.0131		0.0206						-0.0045		
House price appreciation national level	hpa2y_usa	linear function		-0.0052										0.0334		-0.0231		0.0101
Judicial state	judicial	X=0/1				-0.1823						-0.2333		-0.2704		-0.1734		-0.1522
Number of living units	liv_units_2	X=0/1						-0.1431		-0.3212				0.1605		-0.3270		
	liv_units_34	X=0/1		0.0778				-0.1638		-0.2976				0.2109		-0.6651		
Relative loan size	loansize	linear function		0.0004								-0.0028						
	loansize1	Spline function			50	0.0040	100	0.0113	50	0.0766			40	-0.0139	120	0.0048		
	loansize2				>50	-0.0016	180	0.0048	100	0.0251			110	0.0070	>120	0.0000		
	loansize3						>180	0.0008	140	0.0099			120	-0.0011				
	loansize4								>140	0.0024			>120	0.0000				-0.0009
LTV	ltv100	X=0/1		-0.0145				0.3301		0.0062		0.2139		0.5298		0.0458		0.1180
	ltv95	X=0/1		0.0520				0.2251		0.0750		0.1923		0.3806		-0.0028		0.0405
Current LTV	ltv_current1	Spline function	1	1.3635			0.7	-3.2086	1.1	1.5032	0.6	6.1627	0.6	-6.2983	0.6	1.7137	1	-0.7267
	ltv_current2		1.3	1.1745			>0.7	-5.9387	1.8	-0.9699	1	2.2669	>0.6	-8.5921	>0.6	-0.9694	>1	-1.6770
	ltv_current3		1.8	0.8218					>1.8	0.0000	>1.0	0.0000		0.0000		0.0000		
	ltv_current4		>1.8	0.0000														

The following table presents the estimated coefficients for the eight transition equations. Each spline segment is shown as "knot: coefficient".

Description	Variable	Function	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Spread of mortgage rate to 10-year CMT rate	mspread	linear function	-0.0244		0.6291	-0.3642			-0.8677	0.1757
Indicator of prior default	prior_default	X=0/1	-0.3177		-0.1761				0.0334	-0.0085
Front-end ratio	ratio_tmp_tei	linear function			0.0155					
	ratio_tmp_tei1	Spline function	28: 0.0281			28: -0.0112	30: 0.0215		30: 0.0167	
	ratio_tmp_tei2		35: 0.0160			>28: -0.0028	>30: -0.0028		>30: 0.0036	
	ratio_tmp_tei3		>35: 0.0040							
Refinance loan	refinance	X=0/1		0.3116						
Relative unemployment rate	rel_ue_p	linear function		0.2710	-0.3870				-0.6342	
Spread at origination	satol	Spline function	0: -0.0734			0: 0.1067			0: 0.4602	
	sato2	Spline function	>0: 0.3470			>0: 0.0000			>0: 0.0313	
Season of year	season_fall	X=0/1	0.2970	0.1336	-0.4880	-0.0050	0.1150		-0.2718	-0.1254
	season_spring	X=0/1	-0.0793	0.2325	-0.7232	-0.0160	0.1973		0.5188	-0.3436
	season_summer	X=0/1	0.1705	0.2389	-0.6168	0.0802	0.2048		0.5886	-0.5757
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	0.0310		0.0853	0.1759			-0.2558	-0.0384
FHA refinance incentive	FHA_refi_ince_PMT1	Spline function		-2: 0.0857						
	FHA_refi_ince_PMT2			13: 0.2543						
	FHA_refi_ince_PMT3			>13: 0.0588						
GSE refinance incentive	GSE_refl_ince_PMT	linear function								
	GSE_refl_ince_PMT1		0: 0.0104		0: 0.0054					<2: 0.0000
	GSE_refl_ince_PMT2	Spline function	25: 0.0249		13: 0.0692					2: -0.0159
	GSE_refl_ince_PMT3		>25: -0.0089		24: 0.0428					
	GSE_refl_ince_PMT4				>24: -0.0349					
Number of quarters since end of last default episode	cx_time1		1: 2.2083		1: -0.6521					1: -2.3425
	cx_time2	Spline function	10: -0.1048		10: 0.0268					5: 0.3185
	cx_time3		25: -0.0334		25: 0.0031					15: 0.0611
	cx_time4		>25: 0.0009		>25: 0.0089					>15: 0.0082
Prior loan modification	prior_mod	linear function	0.1520		-1.0251	-0.6828			-0.4744	-0.2967
Percentage monthly payment reduction of loan modification	mod_pay_pct_rdct	linear function	-3.5819		-0.8216	-4.8381		-5.6208		
	mod_pay_pct_rdct1		0.16: -0.7185							
	mod_pay_pct_rdct2	Spline function	0.36: 2.0398							
	mod_pay_pct_rdct3		>0.36							
Missing of percentage monthly payment reduction of loan modification	mis_mod_pay_pct_rdct	X=0/1	-0.2169			0.6404		0.6473		
Intercept Term	constant		-8.0224	-7.8181	-4.8954	-17.7809	-7.3232	1.4897	-4.4270	-1.1693
Estimation Sample Count	N	Total	24,360,008	5,363,805	21,438,903	20,970,239	3,503,951	12,862,263	13,465,305	13,959,456
Gini Coefficient			(0.126)	0.227	0.606	0.783	0.383	0.709	0.370	0.361
Log Likelihood (model)	-2*LOG(L1)		33,170,378	3,538,463	44,481,048	22,825,785	2,014,206	1,395,812	4,328,627	6,993,572
Log Likelihood (constant)	-2*LOG(L0)		38,219,467	3,733,299	49,642,458	28,017,618	2,137,325	1,725,677	4,557,674	7,393,341
Degrees of Freedom	d.f.		51	22	46	46	29	28	32	27
Chi-Square Statistic	Chi-square	-2*(Log(L0)-Log(L1))	5,049,089	194,835	5,161,409	5,191,834	123,119	329,865	229,047	399,769

Exhibit A-5.2 Product 2 (FRM15) Binomial Logit Model Coefficient Estimates

Description	Variable Name	Values	Current to Default Spline	est_16	Current to CurrentX Spline	est_16	Current to Prepay Spline	est_16	Current to SR Spline	est_16	Default to Claim Spline	est_16	Default to Prepay Spline	est_16	Default to Mod. Cure Spline	est_16	Default to Self Cure Spline	est_16
Mortgage age function	age1		2	1.3929	2	1.8327	4	0.5161	2	1.2233	8	0.2017	8	0.0109	6	0.4498	8	0.0355
	age2	Spline function knot values shown next to the corresponding coefficient estimates	6	0.1593	10	0.0746	10	0.0523	5	0.0283	>8	0.0294	20	-0.0682	>6	-0.0076	>8	-0.0115
	age3		12	0.0134	>10	-0.0266	20	-0.0449	10	-0.1484			>20	0.0195				
	age4		24	-0.0033			>20	0.0161	>10	-0.1081								
	age5		>24	0.0278														
Credit burnout factor. Prior cumulative number of quarters the loan is underwater	c_burnout1	Spline function	6	-0.0294														
	c_burnout2		14	-0.0243														
	c_burnout3		>14	0.0000														
Credit score	credit_score	linear function				-0.0128		0.0013				0.0015				-0.0013		-0.0008
	credit_score1	Spline function	600	-0.0035					660	0.0000								
	credit_score2		>600	-0.0131					>660	0.0026								
Missing credit score	credit_score_000	X=0/1		-0.4134		-0.6170		0.0837		-0.5161		0.0558		0.3247		-0.2436		-0.0402
No credit score returned	credit_score_999	X=0/1		-0.5674		-0.3615		0.1753		0.2996		-0.5665		0.5895		-0.1776		0.0971
Unemployment rate change in last two quarters	delta_ue	linear function		0.2176								0.1199		-0.5280		0.1854		-0.1102
Downpayment assistant types	dpa_govt	X=0/1		0.6021		0.6932		-0.3275		1.0090		0.2336		-0.7134		-0.0632		-0.1945
	dpa_nonprof	X=0/1		0.2049		0.4366		0.0423										
	dpa_relative	X=0/1																
Missing front-end ratio	dti000	X=0/1		-0.2037		-0.3834		-0.1209		-0.6564								-0.0297
Duration of default episodes	dur_def_episode_1	Spline function									5	0.2405	12	-0.1191	3	0.2502	10	-0.1575
	dur_def_episode_2										20	-0.0538	20	0.0501	12	-0.1591	>10	0.0000
	dur_def_episode_3										>20	0.0000	>20	0.0000	>12	0.0000		
Indicator of duration of default episodes > 20	dur_def_ept_dum	X=0/1										1.0111						
FHA credit score indicator	fha_score	X=0/1		0.0116				-0.2384		1.2077		-0.7343						
House price appreciation local level	hpa2y	linear function				0.0020												
	hpa2y_n	linear function		-0.0086												0.0038		
House price appreciation national level	hpa2y_usa	linear function						0.0233		0.0342				0.0381		-0.0253		0.0070
Judicial state	judicial	X=0/1										-0.3789		-0.1261		-0.1126		-0.1552
Number of living units	liv_units_2	X=0/1						-0.2017		-0.2438				0.1033		-0.0983		
	liv_units_34	X=0/1						-0.2507		-0.3725				0.3194		-0.5369		
Relative loan size	loansize	linear function		-0.0012				0.0050				-0.0040		0.0018		0.0036		
	loansize1	Spline function							100	0.0313								
	loansize2									140	0.0128								
	loansize3									>140	0.0035								
LTV	ltv100	X=0/1		0.0304				0.0637		-0.0860		0.4442		0.2059				0.0704
	ltv95	X=0/1		0.0251				0.0520		-0.0093		0.2790		-0.0131				0.0413
Current LTV	ltv_current	linear function																
	ltv_current1	Spline function	1	1.9985			0.4	0.0000			0.9	3.9602	0.4	0.0000				-1.5080
	ltv_current2		1.2	0.6365			0.9	-1.7369			>0.9	0.0000	0.9	-4.5414		-0.2177		
	ltv_current3		>1.2	0.0000			>0.9	0.0000					>0.9	0.0000				

Description	Variable	Functional form	Knot	M1	M2	M3	M4	M5	M6	M7	M8
Spread of mortgage rate to 10-year CMT rate	mspread	linear function				0.1279	0.8298	-0.2881	-0.2668	-0.8145	0.1278
Indicator of prior default	prior_default	X=0/1						-0.2649			-0.0080
Front-end ratio	ratio_tmp_tei	linear function		0.0021	0.0163	-0.0037	0.0205				
Refinance loan	refinance	X=0/1					0.5495				
Relative unemployment rate	rel_ue_p	linear function			0.4148					-0.7120	-0.2850
Spread at origination	sato	linear function		0.1978						0.0338	
Season of year	season_fall	X=0/1		0.2566	-0.3646	0.1087	-0.0436	-0.0444	0.0753	-0.0756	-0.1610
	season_spring	X=0/1		-0.0744	-0.5923	0.1624	0.1356	0.0113	-0.0061	0.5621	-0.2402
	season_summer	X=0/1		0.1209	-0.4568	0.1792	-0.1871	0.0299	0.0972	0.6585	-0.4395
Cross section house price volatility	sigma_parm_a	linear function				-0.0324					
Yield curve slope measured as difference of 10 year CMT to 1 year CMT rates	yeslope	linear function		0.0254		0.0711	0.3739	-0.2599			
FHA refinance incentive	FHA_refi_ince_PMT1	Spline function	-2				0.2800				
	FHA_refi_ince_PMT2		10				0.1778				
	FHA_refi_ince_PMT3		>10				-0.2478				
GSE refinance incentive	GSE_refi_ince_PMT				0.0152			-0.0138	-0.0340	-0.0236	-0.0147
	GSE_refi_ince_PMT1	Spline function	5 / -7	0.0926		0.1601					
	GSE_refi_ince_PMT2		>5 / 15	0.0241		0.0353					
	GSE_refi_ince_PMT3		>15			-0.1385					
Number of quarters since end of last default episode	cx_time1	Spline function	1	2.5862		-0.4747	-1.9112				
	cx_time2		10 / 10 / 5	-0.1162		0.0048	0.2352				
	cx_time3		25 / 25 / 15	-0.0343		-0.0036	0.0476				
	cx_time4		>25 / >25 / >15	-0.0143		0.0640	0.0774				
Prior loan modification	prior_mod	X=0/1		-0.2772	-0.8012	-0.08012	-1.1428				-0.3190
Intercept Term	constant	Total		-7.4767	-3.2146	-5.8089	-13.5351	-6.6653	-2.9934	-3.6064	
Estimation Sample Count	N			8,993,276	8,667,495	9,160,665	8,985,857	34,062	172,070	180,241	190,274
Gini Coefficient	Gini Coefficient			0.679	0.146	0.384	0.703	0.749	0.343	0.341	0.4587
Log Likelihood (model)	-2*LOG(L1)			535,637	69,472	1,965,984	476,287	15,778	27,628	61,503	112,456
Log Likelihood (constant)	-2*LOG(L0)			644,505	74,717	2,074,454	567,084	16,986	30,918	64,275	118,399
Degrees of Freedom	df.			35	16	33	36	23	23	23	22
Chi-Square Statistic	Chi-square	-2*(Log(L0)-Log(L1))		108,868	5,246	108,470	90,798	1,208	3,290	2,772	5,943

Exhibit A-5.3 Product 3 (ARM) Binomial Logit Model Coefficient Estimates

Description	Name	Values	Current to Default Spline	Current to Default est_16	Current to CurrentX Spline	Current to CurrentX est_16	Current to Prepay Spline	Current to Prepay est_16	Current to SR Spline	Current to SR est_16	Default to Claim Spline	Default to Claim est_16	Default to Prepay Spline	Default to Prepay est_16	Default to Mod. Cure Spline	Default to Mod. Cure est_16	Default to Self Cure Spline	Default to Self Cure est_16
Mortgage age function	age	linear function														-0.0081		-0.0006
	age1	Spline function knot values shown next to the corresponding coefficient estimates	2	1.3029	2	1.7780	4	0.5699	2	1.2147	4	0.1507	30	-0.0431				
	age2		6	0.1263	6	0.1469	10	0.0194	5	0.2293	12	0.0867	>30	-0.0659				
	age3		20	-0.0041	12	0.0445	20	-0.0651	10	-0.1264	>12	0.0216						
	age4		>20	0.0107	>12	-0.0273	>20	-0.0616	>10	-0.1277								
Credit burnout factor. Prior cumulative number of quarters the loan is underwater	c_burnout1	Spline function	6	0.0051														
	c_burnout2		14	-0.0376														
	c_burnout3		>14	0.0000														
Credit score	credit_score	linear function				-0.0115		0.0023		0.0005		0.0024		0.0013		-0.0008		-0.0008
	credit_score1	Spline function	600	-0.0025														
	credit_score2		>600	-0.0094														
Missing credit score	credit_score_000	X=0/1		-0.0636		-0.1736		0.0380		-0.0886		0.3430		0.0810		-0.1692		-0.1268
No credit score returned	credit_score_999	X=0/1		-0.7291		-0.4654		0.2008		0.1253		-0.7515		0.2870		0.0219		0.1008
Unemployment rate change in last two quarters	delta_ue	linear function		0.0518														
Downpayment assistant types	dpa_govt	X=0/1		0.1880		0.3489		-0.1076		-0.0420		0.1826		-0.2508		-0.0345		-0.0457
	dpa_nonprof	X=0/1		0.2391		0.3064		-0.0370		0.1500		0.2529		-0.2469		0.0886		-0.0365
	dpa_relative	X=0/1		0.1290		0.1456		0.0014		-0.1562								
Missing front-end ratio	dti000	X=0/1		0.0673		-0.0162		-0.1092		-0.0319								0.0042
Duration of default episodes	dur_def_episode_1	Spline function									5	0.1844	8	-0.1348	3	0.3402	10	-0.1833
	dur_def_episode_2										20	-0.0325	20	0.0189	12	-0.1652	20	0.0522
	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_epd_dum	X=0/1										0.3332						
Current mortgage rate level	cy_rate	linear function		0.1163				-0.1825		-0.1154								
FHA credit score indicator	fha_score	X=0/1		-0.1705				-0.4497		-0.4026		-0.6234				0.2480		0.1007
Indicator of first time buyer	frst_tm_by	X=0/1						-0.0896										
House price appreciation local level	hpa2y	linear function				0.0071										-0.0069		
	hpa2y_n	linear function																
	hpa2y_n1	Spline function	-20	0.0051														
	hpa2y_n2		>-20	-0.0150														
House price appreciation national level	hpa2y_usa	linear function						0.0137						0.0356		-0.0363		0.0125
Judicial state	judicial	X=0/1						-0.1717		-0.3327		-0.0970		-0.2515		-0.1310		-0.2102
Number of living units	liv_units_2	X=0/1						-0.2488		-0.2112				0.0048		-0.3696		
	liv_units_34	X=0/1		0.3117										-0.0461		-0.8367		
Relative loan size	loansize	linear function										-0.0028		0.0034		0.0028		-0.0006
	loansize1	Spline function	120	-0.0022			130	0.0069	100	0.0187								
	loansize2		>120	0.0022			>130	-0.0004	>100	0.0016								
LTV	ltv100	X=0/1		0.0810				0.2302		0.2924		0.1635		0.2472		0.0482		-0.0084
	ltv95	X=0/1		0.0687				0.1797		0.2640		0.1589		0.1989		-0.0230		0.0049
Current LTV	ltv_current	linear function																
	ltv_current1	Spline function	1	1.5053			0.6	-2.8893			0.8	4.2416	0.6	-5.9992		-0.7766		-1.2901
	ltv_current2		1.4	1.0836			>0.6	-5.4248			1	0.7141	>0.6	-8.3995				
	ltv_current3		>1.4	0.9853							>1.0	0.0000		0.0000				

Description	Variable	Function	Threshold	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Spread of mortgage rate to 10-year CMT rate	mspread	linear function		0.1480		0.0890	0.6016	-0.1777		-0.6568	
ARM payment shock	pmt_shock	linear function						-0.0029			
	pmt_shock1	Spline function	0			-0.0021	-0.0555		0.0022	-0.0086	0.0075
	pmt_shock2		>0			0.0091	-0.0116		0.0080	-0.0021	0.0002
Indicator of prior default	prior_default	X=0/1						-0.3666	-0.2506	0.2377	0.1470
Front-end ratio	ratio_tmp_tei	linear function		0.0178	0.0080	-0.0069	0.0141				
Refinance loan	refinance	X=0/1					0.1244				-0.0090
Relative unemployment rate	rel_ue_p	linear function			0.2029					-0.3971	
Spread at origination	satio	linear function		0.1495						-0.1077	
Season of year	season_fall	X=0/1		0.2260	-0.4502	0.0984	-0.1236	0.0098	0.1783	-0.4355	0.1500
	season_spring	X=0/1		-0.1087	-0.5793	0.2461	0.0625	0.0306	0.2363	0.4882	-0.2277
	season_summer	X=0/1		0.1031	-0.4958	0.1696	-0.1860	0.0322	0.2831	0.4915	-0.4005
Cross section house price volatility	sigma_parm_a	linear function				-0.0169					
Yield curve slope measured as difference of 10 year CMT to 1 year CMT rates	yeslope	linear function			0.1127	0.0291	0.1325	-0.2433			-0.0275
FHA refinance incentive	FHA_refi_ince_PMT	linear function					0.1071				
GSE refinance incentive	GSE_refi_ince_PMT	linear function				0.0233				-0.0013	-0.0033
	GSE_refi_ince_PMT1	Spline function	6		0.0122						
	GSE_refi_ince_PMT2		>6		0.0222						
Number of quarters since end of last default episode	cx_time1	Spline function	1		2.4350	-0.6789	-2.1127				
	cx_time2		10		-0.1306	0.0490	0.3969				
	cx_time3		25		-0.0355	0.0097	0.0635				
	cx_time4		>25		-0.0071	-0.0093	0.0722				
Prior loan modification	prior_mod	X=0/1			0.0881	-0.2895	-0.1850	-0.0733			-0.4073
Intercept Term	constant			-2.9547	-7.4312	-3.6404	-9.0869	-7.1477	0.2790	-1.8781	0.1958
Estimation Sample Count	N	Total		13,493,271	12,181,610	13,763,327	13,464,091	29,667	559,433	582,097	613,194
Gini Coefficient				0.576	0.285	0.505	0.623	0.385	0.666	0.402	0.366
Log Likelihood (model)	-2*LOG(LL)			2,141,178	266,439	3,976,281	1,932,083	166,334	108,691	174,448	339,309
Log Likelihood (constant)	-2*LOG(L0)			2,462,030	277,981	4,404,983	2,224,912	177,355	130,181	185,364	359,871
Degrees of Freedom	d.f.			41	17	38	35	26	24	28	26
Chi-Square Statistic	Chi-square	-2*(Log(L0)-Log(LL))		320,654	11,542	428,702	292,830	11,020	21,490	10,915	20,562

Exhibit A-5.4 Product 4 (FRM30 SR) Binomial Logit Model Coefficient Estimates

Description	Name	Values	Current to Default Spline	Current to Default est_16	Current to CurrentX Spline	Current to CurrentX est_16	Current to Prepay Spline	Current to Prepay est_16	Current to SR Spline	Current to SR est_16	Default to Claim Spline	Default to Claim est_16	Default to Prepay Spline	Default to Prepay est_16	Default to Mod Cure Spline	Default to Mod Cure est_16	Default to Self Cure Spline	Default to Self Cure est_16
Mortgage age function	age	linear function		1.4409		1.7561		1.0547		1.0065				-0.0558				0.0001
	age1	Spline function knot values shown next to the corresponding coefficient estimates	2	0.1601	2	0.1522	2	0.1223	2	-0.1042	8	0.0765			6	0.2596		
	age2		5	-0.0101	6	-0.0482	6	-0.0049	10	-0.0155	>8	0.0209			12	0.0419		
	age3		10	-0.0025	18		18	-0.0631	>10						>12	0.0000		
	age4		50	-0.0025	36		36	-0.0330										
	age5		>50	0.0000	>36		>36											
Loan with appraisal value	appraisal_req	X=0/1		-0.0541		0.1109		0.2233		-0.3678		-0.1037		0.2737		-0.1103		0.0031
Burnout factor. Cumulative amount of quarterly positive refinance incentives	burnout1	Spline function	65.1		65.1	0.0228	65.1	-0.0055										
	burnout2		>65.1		>65.1	0.0000	>65.1	0.0000										
Credit burnout factor. Prior cumulative number of quarters the loan is underwater	c_burnout1	Spline function	6	-0.0053														
	c_burnout2		14	-0.0184														
	c_burnout3		>14	0.0000														
Credit score	credit_score	linear function		-0.0057		-0.0099		0.0020		0.0010		0.0035		0.0017		-0.0017		-0.0016
Missing credit score	credit_score_000	X=0/1		-0.0432		-0.1211		-0.1698		-0.3432		0.2039		-0.5461		-0.0442		-0.0111
No credit score returned	credit_score_999	X=0/1		-0.3229		-0.0993		0.2815		0.2019		-0.5712		0.3601		0.0005		0.0304
Unemployment rate change in last two quarters	delta_ue	linear function		0.1444														
Downpayment assistant types	dpa_govt	X=0/1		0.2075		0.2592		0.0093		0.0186		0.0927		-0.2071		0.0653		-0.0180
	dpa_nonprof	X=0/1		0.2547		0.2805		-0.0275		0.0438		0.1918		-0.2313		0.0533		-0.0605
	dpa_relative	X=0/1		0.0915		0.2148		0.1798		-0.0463								
Missing front-end ratio	dti000	X=0/1		0.1838		0.1835		-0.0352		0.4462								-0.0737
Duration of default episodes	dur_def_episode_1	Spline function									2	-0.0937	12	-0.0944	3	0.2083	10	-0.1314
	dur_def_episode_2										4.5	0.3586	20	0.0964	12	-0.1748	20	-0.0041
	dur_def_episode_3										12	-0.0886	>20	0.0000	>12	0.0000	>20	0.0000
	dur_def_episode_4										>12	0.0000						
FHA credit score indicator	fha_score	X=0/1		-0.1354				-0.2413		0.1855		-0.7803				0.2164		0.0801
House price appreciation local level	hpa2y_n	linear function														-0.0061		
	hpa2y_n1	Spline function	-20	0.0000														
	hpa2y_n2		>-20	-0.0278														
House price appreciation national level	hpa2y_usa	linear function						0.0301		0.0441				0.0449		-0.0192		0.0121
Judicial state	judicial	X=0/1										-0.2487		-0.3055		-0.1691		-0.1670
Number of living units	liv_units_2	X=0/1								-0.2131						-0.3387		
	liv_units_34	X=0/1								-0.1593						-0.6239		
Relative loan size	loansize	linear function		0.0010								-0.0035		0.0051		0.0032		0.0001
	loansize1	Spline function					120	0.0108	60	0.0398								
	loansize2						>120	0.0029	120	0.0155								
	loansize3								150	0.0063								
	loansize4								>150	0.0000								
LTV	ltv100	X=0/1		-0.1437				0.4239		0.0230		-0.0680		0.4531		0.0145		0.1193
	ltv95	X=0/1		0.0195				0.1091		0.1242		-0.0919		0.0561		-0.0193		0.0275
Current LTV	ltv_current	linear function																
	ltv_current1	Spline function	1.2	1.9180			0.6	-2.0823	0.8	3.1942	1.0	5.1227	0.4	0.0000		-0.6866		-1.6169
	ltv_current2		>1.2	0.9279			>0.6	-5.2266	1.0	2.3447	>1.0	0.0000	>0.4	-7.9669				
	ltv_current3								>1	0.0000								

Description	Variable	Functional form	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Spread of mortgage rate to 10-year CMT rate	nspread	linear function			-0.0152	0.8783	-0.5059	-0.2485	-0.9668	0.2311
Indicator of prior default	prior_default	X=0/1								
Prior product	prior_prod_2	X=0/1	0.1038	0.1906	0.0742	0.0028	-0.3962	-0.2068	0.0609	0.0137
	prior_prod_3	X=0/1	-0.0704	-0.2496	0.0255	0.0733	-0.0146	0.1748	-0.1164	0.0141
	prior_prod_4	X=0/1	0.0314	0.1091	0.1035	0.4215	0.0742	-0.0957	-0.1061	-0.0620
	prior_prod_5	X=0/1	0.0130	-0.1316	0.0761	0.4507	0.0527	0.2019	0.0675	-0.0861
	prior_prod_6	X=0/1	0.1132	0.1416	0.1807	0.6343	-0.1679	-0.0442	-0.0347	-0.0933
Front-end ratio	ratio_tmp_tei	linear function	0.0082	0.0078	-0.0027	0.0092	0.1715		-0.0157	-0.0032
Relative unemployment rate	rel_ue_p	linear function	0.1163	0.2007					-0.4911	
Spread at origination	satio	linear function							0.0675	
Season of year	season_fall	X=0/1	0.2437	-0.3839	0.1658	0.0697	0.0184	0.1214	-0.1733	-0.0750
	season_spring	X=0/1	-0.1062	-0.6314	0.2630	0.0921	-0.0737	0.1758	0.5307	-0.3507
	season_summer	X=0/1	0.1090	-0.5460	0.2817	0.0210	0.0686	0.1891	0.6548	-0.5691
Cross section house price volatility	sigma_parm_a	linear function			-0.0293					
Yield curve slope measured as difference of 10 year CMT to 1 year CMT rates	ycslope	linear function	0.0503		0.0721	0.2782	-0.2341			-0.0243
FHA refinance incentive	FHA_refi_ince_PMT1	Spline function				0.2544 (8)				
	FHA_refi_ince_PMT2					0.0482 (20)				
	FHA_refi_ince_PMT3					-0.0888 (>20)				
GSE refinance incentive	GSE_refi_ince_PMT			0.0126	0.0372		-0.0080	-0.0067	-0.0113	
	GSE_refi_ince_PMT1	Spline function	0.0000 (-10)							0.0000 (<2)
	GSE_refi_ince_PMT2		0.0485 (0)							-0.0151 (2)
	GSE_refi_ince_PMT3		0.0289 (25)							
	GSE_refi_ince_PMT4		-0.0445 (>25)							
Number of quarters since end of last default episode	cx_time1	Spline function	2.1010 (1)		-0.5283 (1)	-2.3738 (1)				
	cx_time2		-0.0845 (10)		0.0250 (10)	0.3573 (5)				
	cx_time3		-0.0404 (25)		0.0014 (25)	0.0656 (15)				
	cx_time4		0.0000 (>25)		0.0050 (>25)	-0.0002 (>15)				
Prior loan modification	prior_mod	X=0/1	0.1083		-0.6700	-1.0490	-0.0761			-0.2609
Percentage monthly payment reduction of loan modification	mod_pay_pct_rdct	linear function	-2.0759							
Missing of percentage monthly payment reduction of loan modification	mis_mod_pay_pct_rdct	X=0/1	-0.1611							
Intercept Term	constant		-6.2315	-4.5933	-6.9505	-16.0877	-6.3355	-2.6488	-2.0042	0.6586
Estimation Sample Count	N	Total	6,096,909	3,332,523	5,851,104	5,693,909	356,763	1,901,090	1,995,391	2,047,870
Gini Coefficient			0.186	0.436	0.614	0.751	0.408	0.765	0.350	0.351
Log Likelihood (model)	-2*LOG(L1)		5,020,129	529,148	8,471,631	4,288,220	203,215	184,854	689,358	972,119
Log Likelihood (constant)	-2*LOG(L0)		5,711,530	556,825	9,530,338	5,251,600	218,099	239,813	721,944	1,024,379
Degrees of Freedom	d.f.		42	23	42	43	30	25	33	30
Chi-Square Statistic	Chi-square	-2*(Log(L0)-Log(L1))	691,402	27,677	1,058,707	963,379	14,885	54,959	32,586	52,260

Exhibit A-5.5 Product 5 (FRM15 SR) Binomial Logit Model Coefficient Estimates

Description	Name	Values	Current to Default		Current to CurrentX		Current to Prepay		Current to SR		Default to Claim		Default to Prepay		Default to Mod. Cure		Default to Self Cure	
			Spline	est_16	Spline	est_16	Spline	est_16	Spline	est_16	Spline	est_16	Spline	est_16	Spline	est_16	Spline	est_16
Mortgage age function	age	linear function												0.0049				-0.0219
	age1	Spline function knot values shown next to the corresponding coefficient estimates	2	1.1531	6	0.2874	2	1.1128	2	1.4289	6	0.2873			6	0.2521		
	age2		6	0.1075	>6	-0.0244	10	0.1003	10	-0.0027	>6	0.0476			>6	-0.0127		
	age3		20	-0.0023			20	-0.0480	20	-0.1747								
	age4		>20	0.0091			>20	0.0078	>20	-0.0937								
Loan with appraisal value	appraisal_req	X=0/1		-0.0135		0.0832		0.1866		-0.3902		-0.1647		0.0304		0.1445		0.1586
Credit burnout factor. Prior cumulative number of quarters the loan is underwater	c_burnout1	Spline function	6	0.0212														
	c_burnout2		14	-0.0412														
	c_burnout3		>14	0.0000														
Credit score	credit_score	linear function				-0.0122		0.0003		0.0019		0.0049		0.0023		-0.0026		-0.0008
	credit_score1	Spline function	600	-0.0027														
	credit_score2		>600	-0.0110														
Missing credit score	credit_score_000	X=0/1		-0.2092		-0.6153		-0.3809		-1.6053		-0.0670		-0.5845		0.0734		-0.1763
No credit score returned	credit_score_999	X=0/1		-0.4974		-0.6377		0.0533		0.3414		-0.0791		0.0758		-0.0821		-0.0414
Unemployment rate change in last two quarters	delta_ue	linear function		0.1600														
Downpayment assistant types	dpa_govt	X=0/1		0.2100		0.0155		0.0045		0.4848		0.6554		-0.6807		0.1721		0.0710
	dpa_nonprof	X=0/1		0.2548		0.0425		0.1371		0.1466		0.6698		-0.1376		-0.0710		-0.2199
	dpa_relative	X=0/1		0.1666		0.2900		0.1088		0.1016								
Missing front-end ratio	dti000	X=0/1		0.1920		0.1330		-0.0917		-0.4702								0.0561
Duration of default episodes	dur_def_episode_1	Spline function									5	0.2775	7	-0.1696	3	0.2043	10	-0.1633
	dur_def_episode_2										20	-0.0419	20	-0.0022	12	-0.1482	20	0.0207
	dur_def_episode_3										>20	0.0000	>20	0.0000	>12	0.0000	>20	0.0000
FHA credit score indicator	fha_score	X=0/1		-0.0226				-0.0515		1.8905								
House price appreciation local level	hpa2y	linear function				0.0059										0.0024		
	hpa2y_n	linear function		-0.0063														
House price appreciation national level	hpa2y_usa	linear function						0.0256		0.0503				0.0352		-0.0235		0.0076
Judicial state	judicial	X=0/1										0.0703		-0.3023		-0.1387		
Number of living units	liv_units_2	X=0/1						-0.1124		-0.3418				0.0050		-0.1387		
	liv_units_34	X=0/1						-0.2989		-0.6190				0.4319		-0.1724		-1.3306
Relative loan size	loansize	linear function		0.0001				0.0041		0.0116		-0.0077		-0.0002		0.0028		0.0009
LTV	ltv100	X=0/1		-0.0474				0.0881		0.0931		0.0537		-0.2543		0.1157		0.0946
	ltv95	X=0/1		0.0431				0.0451		0.0423		0.0049		-0.0817		0.1701		0.0282
Current LTV	ltv_current	linear function														-0.4137		-2.0465
	ltv_current1		1	1.4933			0.8	-1.8747										
	ltv_current2	Spline function	1.1	4.4675			>0.8	-2.2913			0.8	6.2735	0.4	-4.2179				
	ltv_current3		>1.1	0.0000				0.0000			>0.8	0.0000	>0.4					

Description	Variable	Function	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Spread of mortgage rate to 10-year CMT rate	mspread	linear function	0.1163		1.3766	-0.1617	-0.4387		-0.7412	0.1389
Indicator of prior default	prior_default	X=0/1		-0.2005					-0.0157	
Prior product	prior_prod_2	X=0/1	0.0666	-0.2918	0.8160	0.0417	-0.2904	0.2981	0.0286	-0.0963
	prior_prod_3	X=0/1	-0.1664	-0.4245	0.5740	0.1201	-0.5067	0.2352	-0.0421	-0.1775
	prior_prod_4	X=0/1	-0.0468	0.3133	0.6464	0.0696	-0.1955	0.1990	0.1072	-0.2204
	prior_prod_5	X=0/1	-0.0091	-0.5933	0.2827	0.2888	-0.2705	0.2728	0.0602	-0.1274
	prior_prod_6	X=0/1	0.0062	0.0112	0.0084			-0.0036	-0.8901	0.0469
Front-end ratio	ratio_fmp_tei	linear function	0.3804	-0.2707	0.0467	-0.0266	0.0719			-0.0057
Relative unemployment rate	rel_ue_p	linear function	0.2515	-0.4966	0.1160	0.0074	0.1336		-0.5347	-0.2956
Season of year	season_fall	X=0/1	-0.1257	-0.4944	0.1017	0.0513	0.1442		-0.1753	-0.1012
	season_spring	X=0/1	0.0499						0.4562	-0.1966
	season_summer	X=0/1							0.5514	-0.3671
Cross section house price volatility	sigma_parm_a	linear function		-0.0160						
Yield curve slope measured as difference of 10 year CMT to 1 year CMT rates	yeslope	linear function	0.0207	0.0605		0.3759	-0.2839			-0.0103
FHA refinance incentive	FHA_refl_ince_PMT1	Spline function				0.3026 [-2]				
	FHA_refl_ince_PMT2					0.2241 [8]				
	FHA_refl_ince_PMT3					-0.0773 [>8]				
GSE refinance incentive	GSE_refl_ince_PMT								-0.0112	-0.0007
	GSE_refl_ince_PMT1	Spline function	0.0425 [0]		0.0926 [-7]					
	GSE_refl_ince_PMT2		0.0311 [25]		0.0212 [>7]					
	GSE_refl_ince_PMT3		0.0000 [>25]							
Number of quarters since end of last default episode	cx_time1	Spline function	3.2776 [1]		-0.1849 [1]	-0.7377 [1]				
	cx_time2		-0.1354 [10]		-0.0169 [10]	0.1392 [5]				
	cx_time3		-0.0489 [25]		-0.0083 [25]	0.0676 [15]				
	cx_time4		-0.0302 [>25]		0.0447 [>25]	-0.0388 [>15]				
Prior loan modification	prior_mod	X=0/1	-0.0527		-0.8135	-0.7890				-0.3557
Intercept Term	constant		-7.5012	-1.1667	-5.8584	-13.7548	-10.4669	-3.8705	-1.8829	1.0555
Estimation Sample Count	N	Total	5,668,266	5,446,529	5,791,820	5,670,750	19,765	72,913	75,766	83,199
Gini Coefficient	Gini Coefficient		0.586	0.059	0.340	0.748	0.494	0.417	0.321	0.335
Log Likelihood (model)	-2*LOG(L1)		297,356	49,675	1,340,725	148,839	5,903	19,679	26,555	60,997
Log Likelihood (constant)	-2*LOG(L0)		346,951	51,368	1,399,124	187,470	6,518	21,011	27,611	64,272
Degrees of Freedom	d.f.		41	20	40	40	26	26	31	29
Chi-Square Statistic	Chi-square	-2*(Log(L0)-Log(L1))	49,595	1,693	58,399	38,631	615	1,333	1,056	3,274

Exhibit A-5.6 Product 6 (ARM SR) Binomial Logit Model Coefficient Estimates

Description	Name	Values	Current to Default		Current to CurrentX		Current to Prepay		Current to SR		Default to Claim		Default to Prepay		Default to Mod. Cure		Default to Self Cure	
			Spline	est_16	Spline	est_16	Spline	est_16	Spline	est_16	Spline	est_16	Spline	est_16	Spline	est_16	Spline	est_16
Mortgage age function	age1	Spline function knot values shown next to the corresponding coefficient estimates	2	1.3472	2	1.9412	6	0.2118	2	1.2056	8	0.1054	6	-0.0444	5	0.3070	12	0.0104
	age2		6	0.1116	8	0.0502	12	-0.0470	5	-0.0439	>8	0.0255	>6	-0.0572	>5	-0.0075	>12	0.0003
	age3		20	-0.0078	>8	-0.0409	>12	-0.0548	10	-0.1975								
	age4		>20	0.0049					>10	-0.0813								
Loan with appraisal value	appraisal_req	X=0/1		0.0395		0.2515		0.1881		-0.2131		-0.3141		0.2170		-0.0629		0.0553
Credit burnout factor. Prior cumulative number of quarters the loan is underwater	c_burnout1	Spline function	6	-0.0069														
	c_burnout2		14	-0.0348														
	c_burnout3		>14	0.0000														
Credit score	credit_score	linear function				-0.0094		0.0019		0.0002		0.0035		0.0007		-0.0011		-0.0016
	credit_score1	Spline function	600	-0.0025														
	credit_score2		>600	-0.0074														
Missing credit score	credit_score_000	X=0/1		-0.3143		-0.1701		-0.0747		-0.0679		0.0864		-0.1887		-0.0369		0.1648
No credit score returned	credit_score_999	X=0/1		-0.3783		-0.2048		0.1895		0.0669		-0.3969		0.1923		-0.0765		0.1557
Unemployment rate change in last two quarters	delta_ue	linear function		0.0914														
Downpayment assistant types	dpa_govt	X=0/1		0.1957		0.4311		0.0934		0.1484		0.2434		-0.0133		0.1339		0.0144
	dpa_nonprof	X=0/1		0.2836		0.3042		0.0372		0.1381		0.2435		-0.1736		0.0372		-0.0987
	dpa_relative	X=0/1		0.0931		0.2024		0.1316		-0.1501								
Missing front-end ratio	dti000	X=0/1		0.2139		0.3977		-0.1008		0.3299								-0.1211
Duration of default episodes	dur_def_episode_1	Spline function									4	0.2282	12	-0.0853	3	0.2277	10	-0.1388
	dur_def_episode_2										20	-0.0097	20	0.0367	20	-0.1239	20	0.0227
	dur_def_episode_3										>20	0.0000	>20	0.0000	>20	0.0000	>20	0.0000
Current mortgage rate level	ey_rate	linear function						-0.0304		0.0722		-0.3924						
FHA credit score indicator	fha_score	X=0/1		0.0521				-0.0178		-0.2330				0.1135				
House price appreciation local level	hpa2y	linear function				0.0048												
	hpa2y_n	linear function		-0.0143														
House price appreciation national level	hpa2y_usa	linear function						0.0227						0.0424		-0.0229		0.0134
Judicial state	judicial	X=0/1										-0.3152		-0.1874		-0.1546		-0.2202
Number of living units	liv_units_2	X=0/1						-0.1600		-0.1180				0.2106		-0.5068		
	liv_units_34	X=0/1						-0.4503		-0.0968				-0.3073		-0.6393		
Relative loan size	loansize	linear function						0.0083				-0.0005		0.0049		0.0025		
	loansize1	Spline function							120	0.0155								
	loansize2								>120	0.0017								
LTV	ltv00	X=0/1		-0.1719				0.4144		0.2253		-0.2445		0.4492				0.1645
	ltv95	X=0/1		-0.0050				0.1395		0.1395		-0.4724		0.5506				0.0698
Current LTV	ltv_current	linear function								0.2341								
	ltv_current1	Spline function	1	1.9988							0.6	8.3526		-8.2987		-0.8220		-1.8191
	ltv_current2		1.2	2.0034			0.6	-2.2159			0.9	3.0549						
	ltv_current3		>1.2	0.9052			>0.6	-5.6778			>0.9	0.0000						

Description	Variable	Function	Knot	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Spread of mortgage rate to 10-year CMT rate	msspread	linear function			-0.2185	0.3685	-0.1339			-0.8390	
ARM payment shock	pmt_shock1				0.0023	-0.0814			0.0057	0.0061	0.0134
	pmt_shock2	Spline function	0 / >0		0.0063	-0.0055			0.0166	0.0081	0.0032
Indicator of prior default	**prior_default**	X=0/1				-0.1840	-0.4088	-0.3047	-0.2913		0.1572
Prior product	prior_prod_2	X=0/1		0.0143	-0.0787	0.1164	0.4045	0.2096	-0.5954		-0.2500
	prior_prod_3	X=0/1		-0.0580	0.1164	-0.0486	0.1152	-0.0486	0.0163		-0.0214
	prior_prod_4	X=0/1		0.0743	0.1496	0.0749	0.0388	0.0749	0.0522		-0.0356
	prior_prod_5	X=0/1		-1.1158	0.0365	0.0955	-10.0766	0.0955	-0.6203		-0.1389
	prior_prod_6	X=0/1		0.1221	0.2632	0.1145	0.0815	0.1145	0.0147		-0.0643
Front-end ratio	ratio_tmp_tei	linear function		0.0083	0.0077	-0.0040	0.0034				-0.0040
Relative unemployment rate	rel_ue_p	linear function		0.1131					0.0861	-0.4763	
Spread at origination	**sato**	linear function		0.0372	-0.2846	-0.1557	0.0484	0.0200	0.0859	-0.2505	0.0616
Season of year	**season_fall**	X=0/1		0.2205	-0.2846	0.1696	-0.1557	0.0484	0.0859	-0.2505	0.0616
	season_spring	X=0/1		-0.1290	-0.5727	0.2758	0.0002	0.0200	0.1467	0.5232	-0.2681
	season_summer	X=0/1		0.0801	-0.4408	0.2875	-0.1333	0.1345	0.2250	0.5952	-0.5130
Cross section house price volatility	sigma_prm_a	linear function				-0.0245					
Yield curve slope measured as difference of 10 year CMT to 1 year CMT rate	ycslope	linear function		0.1018	-0.0223	0.1315	-0.3278				-0.0030
FHA refinance incentive	**FHA_refi_ince_PMT**	linear function				0.0915					
GSE refinance incentive	**GSE_refi_ince_PMT**	linear function		0.0139	0.0001		-0.0036	0.0094		-0.0065	-0.0066
	GSE_refi_ince_PMT1	Spline function	-7			0.0061					
	GSE_refi_ince_PMT2		15			0.0193					
	GSE_refi_ince_PMT3		>15			0.0184					
Number of quarters since end of last default episode	cx_time1	Spline function	1	2.0633		-0.5426	-1.6915				
	cx_time2		10 / 5	-0.1055		0.0414	0.3384				
	cx_time3		25 / 15	-0.0358		-0.0039	0.0249				
	cx_time4		>25 / >15	0.0000		-0.0004	0.0650				
Prior loan modification	prior_mod	X=0/1		0.0882		-0.4676	-0.5053			0.2232	-0.3099
Intercept Term	constant			-7.4914	-4.6214	-3.6452	-8.5385	-9.5194	1.3379	-2.2893	0.3802
Estimation Sample Count	N	Total		2,392,275	2,166,884	2,445,197	23,855,980	47,334	132,281	138,141	142,730
Gini Coefficient	Gini Coefficient			0.548	0.466	0.509	0.592	0.402	0.733	0.346	0.359
Log Likelihood (model)	-2*LOG(L1)			389,910	50,748	7,588,661	338,637	30,125	17,593	44,196	68,958
Log Likelihood (constant)	-2*LOG(L0)			437,581	53,428	814,656	386,298	32,402	22,183	44,199	72,878
Degrees of Freedom	d.f.			41	23	43	40	29	30	32	32
Chi-Square Statistic	Chi-square	-2*(Log(L0)-Log(L1))		47,673	2,680	78,824	47,661	2,276	4,591	2,002	3,920

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Appendix B

Cash Flow Analysis

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 incidences, and severity and cash flow items associated with each type of outcome. This Appendix describes the components of these cash flow calculations.

The evaluation of the Fund's economic value at a point in time (*e.g.*, end-of-year FY 2016) requires the addition of the value of net assets and 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 2017 through FY 2023) requires the same type of calculation but also requires specification of the size and composition of the future endorsements for the respective future 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, loan term, interest rate and credit burnouts, 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 (Appendix A) and then generated respective cash flows for individual loans.

We estimated an econometric model of loss severity rates (Appendix E). The loss rate model distinguishes between pre-foreclosure sales, conveyance, and third-party sales. We estimated future FHA mortgage volumes for purchase, refinance and streamline refinance mortgages that vary with alternative house price, unemployment rate 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's basket of zero discount factors as published in the President's 2017 Budget. 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	√	
Interest Income	√	
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 will 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. Also note that net present values of future cash flows are simulated for multiple possible future paths the economy may take. The average of the net present values over the multiple paths becomes the expected net present value of these projected cash flows (Appendix G).

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.

- **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 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 1-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 cover all costs associated with mortgage loans insured by the Fund, under a normal or expected economic environment. 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.

- 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 April 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. To align this change with fiscal quarters, we started applying this policy change on October 1, 2010.

- 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. To align this change with fiscal quarters, we started applying this policy change on April 1, 2011.

- 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. To align this change with fiscal quarters, we started applying this policy change on April 1, 2012.

- 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. Also effective June 11, 2012, for all single family forward streamline refinance loans which are refinancing existing FHA loans that were endorsed on or before May 31, 2009, the upfront premium decreased 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. To align this change with fiscal quarters, we started applying this policy change on July 1, 2012.

- 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 payment period for annual premiums for loans with case numbers assigned on or after June 3, 2013 and with an LTV up to 90 percent was 11 years, and the annual premium applied for the life of the loan for LTVs greater than 90 percent. To align this change with fiscal quarters, we started applying these policy changes on July 1, 2013.

- Effective January 26, 2015, the annual premium rates for loans with a term greater than 15 years have been reduced by 50 basis points. To align this change with fiscal quarters, we started applying these policy changes on January 1, 2015.

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

Origination Date	30yr Loans, Fixed or Adjustable Rate (%)	15yr Loans, Fixed or Adjustable Rate (%)
9/1/83 to 6/30/91	3.80	2.40
7/1/91 to 9/30/92	3.80	2.00
10/1/92 to 4/16/94	3.00	2.00
4/17/94 to 9/30/96	2.25	2.00
10/1/96 to 9/21/97	2.25/2.00[a]	2.00
9/22/97 to 12/31/00	2.25/2.00/1.75[a]	2.00
1/1/01 to 9/30/08	1.50	1.50
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	1.00	1.00
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 to 1/25/15	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	
1/26/15 and later	0.80% if LTV ≤ 95% & base loan amount ≤ $625,500 0.85% if LTV > 95% & base loan amount ≤ $625,500 1.00% if LTV≤ 95% & base loan amount > $625,500 1.05% 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%

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 4/8/12	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
4/9/12 to 3/31/13	1.75%	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	1.75%	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]	1.75% [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, until loan balance reaches 78% of original property value, minimum of 5 years [b]	1.75% [b]	0.45% if LTV≤ 90% & base loan amount ≤ $625,500 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 to 1/25/15 [b]	1.75% [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]	1.75% [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]
1/26/15 and later [b]	1.75% [b]	0.80% if LTV≤ 95% & base loan amount ≤ $625,500 0.85% if LTV > 95% & base loan amount ≤ $625,500 1.00% if LTV ≤ 95% & base loan amount > $625,500 1.05% if LTV > 95% & base loan amount > $625,500, If LTV≤ 90%, 11 years; if LTV> 90%, life of loan [b]	1.75% [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 (if the prior loan was endorsed before May 31,2009)	0.01%	0.55% until loan balance reaches 78% of original property value, minimum of 5 years	0.01%	0.55% until loan balance reaches 78% of original property value

[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).

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 allows a premium finance program to those qualified for mortgage insurance, so that the upfront premium does not add to the borrower's equity burden 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 96.5 percent.

3. Annual Premium

The annual premium is calculated as follows:

Quarterly Payment of Annual Premium =
*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 a particular mortgage loan is prepaid or claimed.

The annual 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. Traditionally, 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

$$Claim\ Loss_t = UPB_t *\ Loss\ Rate_t$$

For this review, we applied a dynamic simulation approach that tracks loan transitions to default, claim and prepayment that reflect the probabilities of the various transitions (see Appendix A). The UPB_t is the amount of the unpaid balance of the loan at the beginning of time *t* for loans that terminate at time *t* with a claim.

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 from property sale and expense incurred in property acquisition, holding and sales. This amount is divided by the unpaid principal balance at the time of claim. The portfolio-level loss rate is predicted as the weighted average loss rates among conveyance, pre-foreclosure sales, and the implemented policy of third party sales, where the weights reflect the probability that a claim is associated with the individual types of claims. For additional details, see Appendix E.

C. Loss Mitigation Expenses

HUD initiated a loss mitigation program in 1996 in an effort to provide opportunities for borrowers in financial difficulties 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. In 2009, FHA started the HAMP program as a new loss mitigation option, and the program represented increasing percentages of loss mitigation assistance through the years. In 2016, Loan Modification as a standalone option was eliminated and combined into HAMP.

The loss mitigation program includes Forbearance and HAMP, which has Loan Modification and Partial Claim options. A Special Forbearance is a written repayment agreement between the mortgagee, acting on behalf of FHA, and the borrower that contains a plan to reinstate a loan. A Loan Modification modifies the contractual terms of the mortgage permanently, such as lowering the interest rate, or increasing the loan term. 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 payable to FHA of the amount advanced.

Loan mitigation cases increased significantly from FY 2007 to FY 2015, the latest fiscal year with reliable finalized cash flows. There were 86,527 loss mitigation claims in FY 2007 which increased to 195,707 cases in FY 2015. The amount FHA paid in these cases after all adjustments

and curtailments was $158.57 million in FY 2007, which increased to $2.74 billion in FY 2015. Loss mitigation payments made by FHA include administrative fees and costs of title searches, recording fees and subordinated mortgage note amounts.

Exhibit B-5: Claims and Loss Mitigation Costs
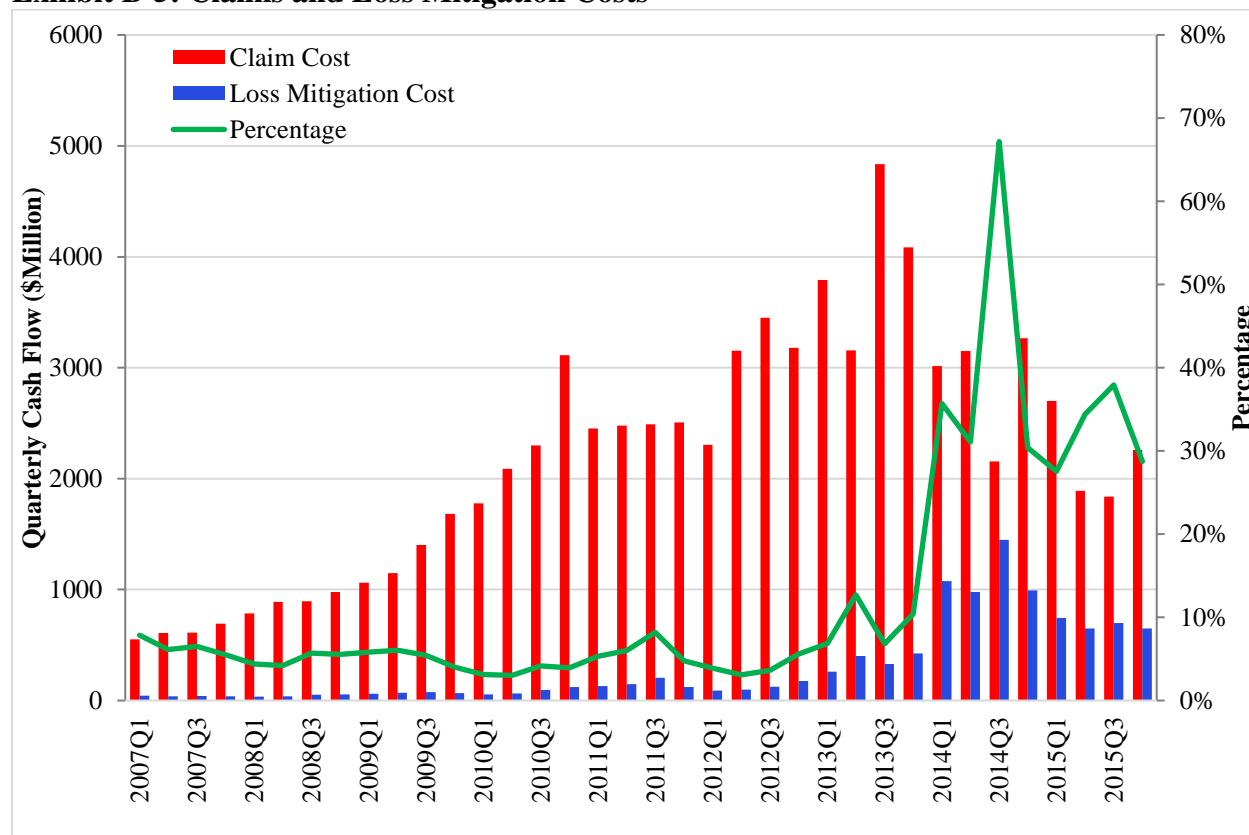
Exhibit B-5 shows the aggregated loss mitigation payments and total claim costs from FY 2007 to FY 2015. Loss mitigation costs had stayed at approximately 6.6 percent of the total claim cost prior to FY 2013. This ratio increased sharply to 67 percent in FY 2014, and then gradually stabilized during FY 2015. In the absent of enough historical data, we choose to assume that future loss mitigation costs will be approximately 32.49 percent, the average level during FY 2015, of the total claim payments during the same policy quarter. At the same time, the reduced claim losses are reflected in the model as a reduction in claim transition probability, as specified in Appendix A. Continued close scrutiny of the performance during the next several years is necessary to better understand the impact of this newly implemented policy.

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* Refund Rate

For this review, we applied a dynamic simulation approach that tracks loan transitions to default, claim and prepayment that reflect the probabilities of the various transitions (see Appendix A). Refund payments at each quarter are calculated based on the number of loans prepaid in that quarter.

In the past, borrowers always 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.

The upfront premium refund rate schedules for different endorsement dates are presented in Exhibit B-6.

Exhibit B-6: 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				
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 net cash flows plus the current capital resources.

A. Discount Factors

The discount factors applied in computing the present value of cash flows are the quarterly Federal credit subsidy present value conversion factors published by the Office of Management and Budget (OMB). The credit subsidy discount factors for the 2017 President's Budget reflect the most recent Treasury yield curve, which captures the Federal government's cost of capital in raising funds. These factors reflect the capital market's expectation of the consolidated interest risk of U.S. Treasury securities. The discount factors are shown in Exhibit B-7. For example, a cash flow occurring at the end of FY 2017 is multiplied by 0.9847 to convert it into a present value for year-end FY 2016. Our simulations aggregated each future year's cash flows, which are treated as being received at the end of the year. The discount factors used in this Review are slightly higher than the corresponding discount factors in last year's Review.

Exhibit B-7: OMB Discount Factors

Year that Cash Flow Occurs	Discount Factor	Year that Cash Flow Occurs	Discount Factor	Year that Cash Flow Occurs	Discount Factor
2017	0.9847	2028	0.6837	2039	0.4441
2018	0.9616	2029	0.6590	2040	0.4261
2019	0.9342	2030	0.6348	2041	0.4086
2020	0.9052	2031	0.6111	2042	0.3917
2021	0.8756	2032	0.5881	2043	0.3754
2022	0.8460	2033	0.5657	2044	0.3597
2023	0.8165	2034	0.5438	2045	0.3446
2024	0.7880	2035	0.5226	2046	0.3300
2025	0.7608	2036	0.5021	2047	0.3160
2026	0.7346	2037	0.4821	2048	0.3026
2027	0.7089	2038	0.4628	2049	0.2898

B. Calculating the Economic Value

The economic value of the Fund as of the end of FY 2016 was calculated first by determining the present value of the future cash flows for all surviving loans as of September 30, 2016. This figure was then added to the capital resources of the Fund, estimated as of the same date.

For each fiscal year beyond 2016, 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 Return on the Beginning Economic Value + Economic Value of the New Book of Business

The return on investment of the beginning economic value for each of the future fiscal years is assumed to equal the 1-year Treasury forward rates implied by the most recent Federal credit subsidy discount factors. Specifically, these rates are shown in Exhibit B-8.

Exhibit B-8: Interest Rate Earned by the Fund

Fiscal Year	Interest Rate (%)
2017	1.56%
2018	2.39%
2019	2.94%
2020	3.21%
2021	3.38%
2022	3.50%
2023	3.61%

V. Cash Flow Overrides

This section describes the on-top adjustments we have made to account for episodic loan sales and for the effect of delayed claim filings.

A. Asset Sales Override

FHA began selling distressed single-family loans through the *Distressed Asset Stabilization Program*, and has been aggressively pursuing this alternative disposition approach since 2012.[55] It has sold more than 108,000 single family loans up to July, 2016.[56] Most recently, HUD sold

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[55] Distressed Asset Stabilization Program Announcement, July18, 2012
 http://portal.hud.gov/hudportal/HUD?src=/press/press_releases_media_advisories/2012/HUDNo.12-116
[56] HUD internal loss severity report, July 2014.

7,743 loans under this program and settled in FY 2016 Q1 and Q2, and another 11,579 loans are scheduled to be settled in a September 2016 deal. The average loss severity rate of all settled note sales during FY 2016 is 63.33 percent. For the September deal, we assume 70 percent, or 8,025 loans will be settled in FY 2017 Q1.

B. Foreclosed Loans and Delayed Claim Override

After the U.S. mortgage market meltdown, the number of outstanding delinquent loan inventory increased dramatically. Starting in 2008, lenders that did not follow appropriate procedures to foreclose mortgages had been subsequently penalized. Since then many lenders took extra precautions in the foreclosure procedures to avoid the risk of not being paid by the mortgage insurers. As of June 30, 2016, there were 118,624 loans that had begun the foreclosure process, or had completed the foreclosure process but claims had not yet been filed. For this year's Review, we identified 26,655 loans in default that have completed foreclosure for more than 4 quarters but have not yet been filed as claims as of end of July 2016. We assume claims of losses for these loans will arrive starting in FY 2016 Q4.

We adjusted the termination process for loans that have completed foreclosure but have not yet been claimed. We assumed that all these loans will eventually become claims. The model described below was used to estimate the timing of the claim filing of these loans.

First, we used data from all loans defaulted and terminated between FY 2006 Q1 and FY 2016 Q1 to estimate the foreclosure-to-claim duration. Specifically, we assume the claim likelihood follows an exponential distribution after the date that the auction is held or foreclosure is completed. The time lag from auction to claim and the time lag from foreclosure completion to claim are calibrated to the exponential density functions in the following form:

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

where *x* denotes either the auction-to-claim lag or the foreclosure-to-claim lag, θ and σ are the expected lag and the standard deviation of the lag, respectively.

The distributions of auction-to-claim, or foreclosure-to-claim were each estimated at the state level. The estimated parameters are shown in Exhibit B-9:

Exhibit B-9: Parameters for Foreclosure Backlog

State or Territory Code	θ for Auction to Claim	σ for Auction to Claim	θ for Foreclosure Completion to Claim	σ for Foreclosure Completion to Claim
AK	-0.0023	1.7545	-0.0009	0.6981
AL	-0.0001	1.7660	0.0000	0.6696
AR	-0.0002	1.7441	-0.0001	0.7861
AZ	-0.0001	1.2934	0.0000	0.8093
CA	-0.0001	1.9340	-0.0001	0.9824
CO	-0.0001	1.4246	0.0000	0.2469
CT	-0.0009	2.8644	-0.0002	0.9013
DC	-0.0463	3.7500	-0.0027	0.2414
DE	-0.0029	2.8524	-0.0012	1.0105
FL	-0.0001	2.1659	0.0000	0.8510
GA	0.0000	1.6763	0.0000	0.5651
GU	0.0000	1.9580	0.0000	0.6236
HI	-0.0839	3.1892	-0.0286	1.0286
IA	-0.0003	1.7548	-0.0001	0.7012
ID	-0.0003	1.3020	-0.0001	0.4830
IL	-0.0001	2.5332	0.0000	0.0803
IN	-0.0001	1.4554	0.0000	0.4959
KS	-0.0003	2.6195	0.0000	0.1337
KY	-0.0002	2.1379	0.0000	0.1011
LA	-0.0003	1.9836	-0.0001	0.6235
MA	-0.0017	3.2379	-0.0007	1.4145
MD	-0.0005	3.6334	0.0000	0.1246
ME	-0.0032	2.4617	-0.0003	0.2549
MI	-0.0001	3.2331	0.0000	1.2795
MN	-0.0004	3.6177	-0.0001	1.3461
MO	-0.0001	1.6030	0.0000	0.6441
MS	-0.0002	1.5094	-0.0001	0.6794
MT	-0.0015	1.7460	-0.0006	0.7065
NC	-0.0001	1.4803	0.0000	0.2678
ND	-0.0054	1.6162	-0.0011	0.3207
NE	-0.0005	1.5926	-0.0002	0.5096
NH	-0.0021	2.4683	-0.0007	0.8148
NJ	-0.0008	2.7719	0.0000	0.0825
NM	-0.0007	2.3942	-0.0002	0.6520
NV	-0.0002	1.5966	-0.0002	0.9779
NY	-0.0005	2.3860	-0.0001	0.3453
OH	-0.0001	2.5255	0.0000	0.7030
OK	-0.0001	1.5667	0.0000	0.1152
OR	-0.0006	2.1876	-0.0002	0.7152
PA	-0.0002	2.6255	-0.0001	0.7879
PR	-0.0021	2.9507	-0.0004	0.5207
RI	-0.0034	3.1747	-0.0014	1.3499
SC	-0.0002	1.4246	0.0000	0.2489
SD	-0.0034	2.9621	-0.0005	0.4214
TN	-0.0001	1.4296	0.0000	0.1750
TX	0.0000	1.2064	0.0000	0.6515
US	0.0000	1.9580	0.0000	0.6236
UT	-0.0002	1.2693	-0.0001	0.5750
VA	-0.0001	1.6761	0.0000	0.1815
VI	0.0000	1.9580	0.0000	0.6236
VT	-0.0195	2.8699	-0.0036	0.5000
WA	-0.0002	1.7449	-0.0001	0.7365
WI	-0.0002	2.1962	-0.0001	0.7863
WV	-0.0011	2.2070	-0.0003	0.5402
WY	-0.0016	2.3638	-0.0002	0.2952

After modeling the two time lags, we used the following rule to simulate loans that need adjustment, which would accelerate their terminations. Any loans which had auctions held prior to January 1st, 2015 or foreclosure completed prior to July 1st, 2015 were assumed to be claimed following this accelerated termination process.

For each loan, we simulated its termination lag time in quarters from FY 2016 Q4 using the corresponding estimated exponential distribution. Exhibit B-10 summarizes the simulated termination outcome.

Exhibit B-10: Special Treatment for Foreclosure Backlog

Termination Lag	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	6,185	23.20	6,185	23.20
1	7,711	28.93	13,896	52.13
2	4,458	16.72	18,354	68.86
3	2,845	10.67	21,199	79.53
4	1,837	6.89	23,036	86.42
5	1,185	4.45	24,221	90.87
6	793	2.98	25,014	93.84
7	477	1.79	25,491	95.63
8	369	1.38	25,860	97.02
9 to 32	795	2.98	26,655	100.00

Appendix C

Data for Loan Performance Simulations

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 requires 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-current, current-to-default (default is 90+ days delinquent), current-to-current_X (default and cure within same quarter), current-to-streamline refinance, current-to-prepay, default-to-default, 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 end of FY 2016 Q2, 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 projecting future economic values, we forecasted the loan performance of future FHA books originated through FY 2023. The dollar endorsement volumes for FY 2016 through FY 2023 are projected 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 projected volumes are allocated among the three loan-product types (only for fully underwritten loans) following their distribution in the most recent endorsements over FY 2015 Q3 through FY 2016 Q2. 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 for-purchase and fully underwritten refinance mortgages. Also, we assumed stable proportions of product types for fully underwritten mortgages over FY 2016 through FY 2023 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
FY 2016	$139,768	$36,807	$52,423	$228,998
FY 2017	$141,405	$41,668	$31,179	$214,252
FY 2018	$135,003	$13,886	$9,514	$158,403
FY 2019	$125,818	$16,374	$13,523	$155,715
FY 2020	$121,303	$27,828	$24,149	$173,279
FY 2021	$120,727	$30,044	$25,425	$176,196
FY 2022	$122,542	$31,533	$29,516	$183,592
FY 2023	$125,445	$32,786	$34,916	$193,147

Period	FHA Purchase Share	FHA Fully Underwritten Refi Share	FHA Streamline Refi Share
FY 2016	66.00%	19.45%	14.55%
FY 2017	85.23%	8.77%	6.01%
FY 2018	80.80%	10.52%	8.68%
FY 2019	70.00%	16.06%	13.94%
FY 2020	68.52%	17.05%	14.43%
FY 2021	66.75%	17.18%	16.08%
FY 2022	64.95%	16.97%	18.08%
FY 2023	66.00%	19.45%	14.55%

Exhibit C-2: Projected Composition of FICO-LTV For Purchase Mortgages

Loan-to-Value Ratio	Term	Projected Composition of FY 2016 - 2023 Purchase Loans							
		FICO Score Range							
		Missing	300-499	500-579	580-619	620-659	660-679	680-719	720-850
X ≤ 90	30 Yr	0.00%	0.00%	0.00%	0.40%	1.60%	1.10%	2.40%	1.00%
	15 Yr	0.00%	0.00%	0.00%	0.90%	4.00%	6.80%	21.70%	7.40%
90 < X ≤ 95	30 Yr	0.00%	0.00%	0.00%	0.60%	3.40%	2.30%	4.10%	2.60%
	15 Yr	0.00%	0.00%	0.20%	0.30%	2.80%	2.70%	8.10%	3.40%
95 < X	30 Yr	0.00%	0.00%	0.00%	3.40%	25.40%	15.40%	22.10%	14.20%
	15 Yr	0.00%	0.00%	0.00%	0.80%	9.00%	7.30%	15.10%	9.50%

Exhibit C-3: Projected Composition of Fully Underwritten Refinance Loans

Loan-to-Value Ratio	Term	Projected Composition of FY 2016 - 2023 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%	0.80%	2.90%	10.60%	6.70%	10.20%	6.10%
	15 Yr	0.00%	0.00%	0.40%	3.90%	17.40%	12.50%	26.70%	15.30%
90 < X ≤ 95	30 Yr	0.00%	0.00%	0.20%	1.10%	5.20%	3.90%	7.10%	5.80%
	15 Yr	0.00%	0.00%	0.00%	0.20%	2.20%	2.00%	3.70%	4.30%
95 < X	30 Yr	0.00%	0.00%	0.10%	1.10%	10.40%	8.10%	12.50%	7.20%
	15 Yr	0.00%	0.00%	0.00%	0.30%	1.70%	1.70%	3.40%	4.30%

Exhibit C-4: Product Type Distribution of Fully Underwritten Mortgages for FY 2016 Q3-FY 2023 Q4

Product Type	Proportion
Fixed-Rate 30 Year Mortgages	97.04%
Fixed-Rate 15 Year Mortgages	1.78%
Adjustable Rate Mortgages	1.18%

The development of 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 2015 and the first two quarters of FY 2016. While this basic approach imposes the assumption that future detailed loan characteristics occur with the same distribution as the recent FHA endorsements, several adjustments are made to ensure

consistency with future economic conditions and volume forecasts. In particular, the starting mortgage coupon rates for all products are modified to reflect forecasted market conditions at the time of origination of these projected future cohorts. This is achieved by adjusting the loan-level coupons up or down by the same percentage change as occurred for the average market mortgage rate.

As described in Appendix A, we implemented a full dynamic simulation method for streamline refinance (SR) loan originations. As all SR loan originations are generated endogenously from the previous cohorts according to our transition models to streamline refinance, it is not necessary to make exogenous adjustments for SR loan originations.

II. Future Economic Forecasts

Moody's Analytics serves as our source for the quarterly economic forecasts 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 updated loan to value ratio, it is important to take into account both sources of uncertainty. We adopt the Yang et al. (2011) methodology to incorporate these two sources of dispersion of future house price indexes at each location.[57]

Local purchase-only HPI is published by FHFA. In assigning metropolitan area indices, we first used the Metropolitan Statistical Area (MSA) index if the index exists for the loan's Federal Information Processing Standards (FIPS) state-county code. If the MSA index does not exist, we used the corresponding State HPI if that index is available. In case neither the MSA nor the State level index is available, we applied the corresponding Census Regional HPIs. We applied national level HPI if no local level of index is unavailable.

As described in Appendix A, the indices are used in conjunction with estimates of house price diffusion parameters to compute cross-sectional volatility at each loan age for individual 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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[57] 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.

Appendix D

Economic Forecasts

Appendix D: Economic Forecasts

To measure the Fund's resilience against potential future losses on current and future portfolios, the economic value of the Fund was estimated under a Monte Carlo simulation framework and also for eight alternative deterministic economic scenarios. Our Monte Carlo paths are centered on Moody's base forecast in the sense that our values are equally likely to lie above the Moody's forecast as they are to lie below them. For this calibration we used the July 2016 forecast of the U.S. economy published by Moody's Analytics. For purposes of our Review, the components of Moody's forecast include:

- FHFA Purchase-Only Home Price Index (HPI) at the MSA, state, Census Region and national levels

- 1-year constant maturity Treasury rate

- 10-year constant maturity Treasury rate

- Commitment rate on 30-year fixed-rate mortgages

- Unemployment rates at the MSA, state, and Census division levels

A summary of a portion of these time series data used in the baseline simulation is presented in Exhibit D-1. We used a quarterly frequency and local HPI and unemployment rate in deriving the economic value of the MMI Fund and in alternative scenarios. The quarterly economic factors forecasted by Moody's are available from FY 2016 through FY 2046.

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**
2016	232.40	3.60	0.55	1.84	4.89
2017	242.18	4.47	0.75	3.06	4.65
2018	246.59	5.54	1.87	3.95	4.43
2019	250.36	5.80	3.23	3.98	4.50
2020	255.82	5.81	3.58	3.98	4.78
2021	263.58	5.84	3.59	4.03	5.04
2022	273.24	5.90	3.63	4.09	5.06
2023	283.82	5.96	3.63	4.14	4.93
2024	294.93	6.01	3.64	4.18	4.84
2025	306.03	6.04	3.64	4.21	4.76
2026	316.62	6.08	3.64	4.24	4.69

[a] Source: Moody's Analytics July 2016 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, eight alternative scenarios were used. The eight scenarios are:

- Moody's July 2016 Baseline Deterministic Scenario

- Moody's Protracted Slump Scenario

- 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

- Low Rate Scenario

The details of constructing different stochastic simulation paths are presented in Appendix G. The scenarios were based on modified versions of the July 2016 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 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 for the protracted slump scenario is FY 2019 Q3. This modification ensures that the HPA rate in a pessimistic scenario never exceeds that of the baseline scenario. However, it also causes the modified scenario to be even more stressful than the original Moody's protracted slump scenario.

The market has experienced low interest and mortgage rates in recent years after the recession. In order to assess the fund performance in a possible low interest rate market, this FY 2016 Review adds a low rate scenario. The low rate scenario assumes that interest rates remains at their current low levels for two years and then gradually rise up to the long term projection of Moody's forecast in another two years.

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 for which HPI differs from the baseline case. Note that the low rate scenario shares the same HPI projection as the Moody's Baseline scenario.

Exhibit D-2: Paths of the Future National House Price Index in Different Scenarios
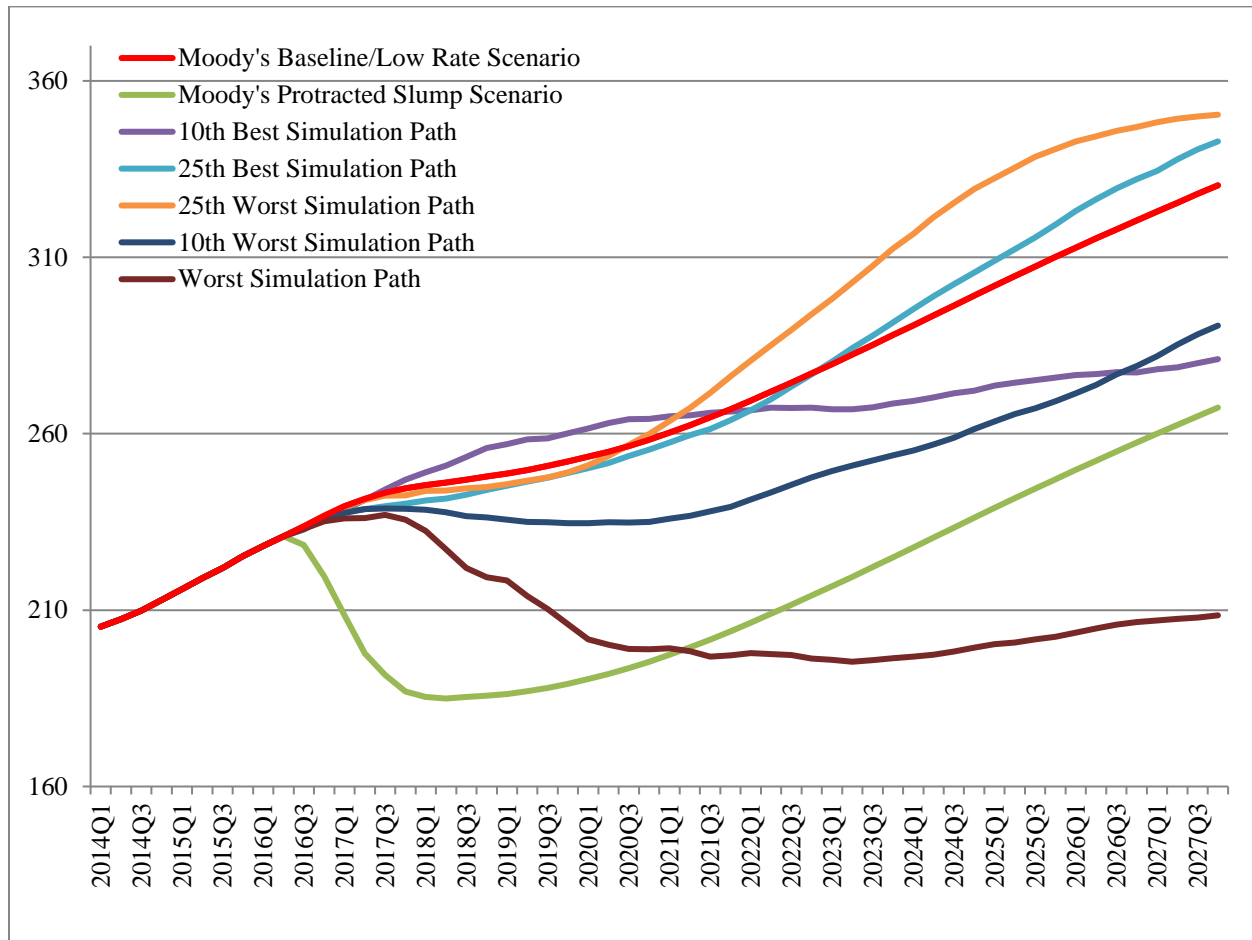
Exhibits D-3 shows the forecasted mortgage rate of 30-year fixed-rate mortgages in the eight alternative scenarios up to FY 2027. Moody's forecast shows that the mortgage rates will rise to 5.80 percent in FY 2019 Q2 and stay around 6.0 percent after that. The low rate scenario represents a continuation of the rate in recent years, and assumes that the interest rates stay at current level for two years before rising linearly to the long-term average forecasted by Moody's.

Exhibit D-3: Paths of the Future Mortgage Rate (%) in Different Scenarios
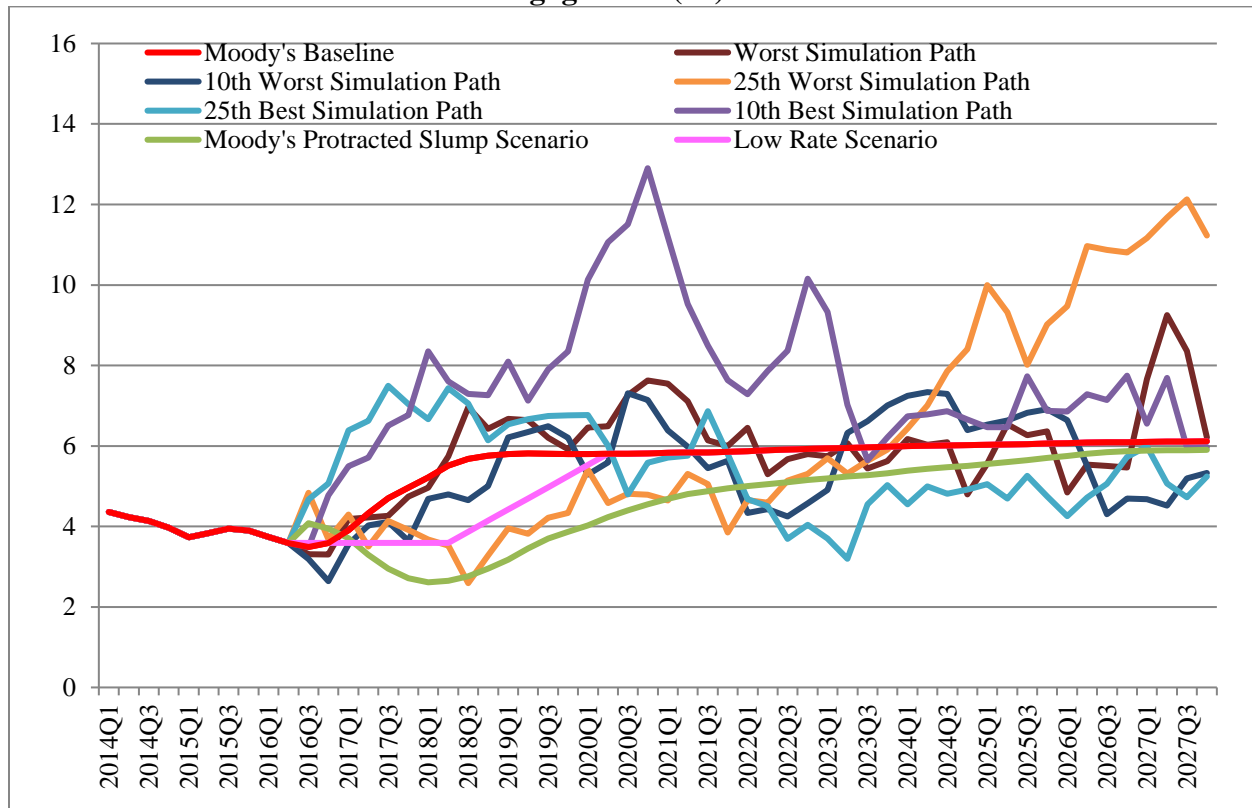
Exhibit D-4 shows the forecasted unemployment rate under different scenarios. Moody's Protracted Slump scenario depicts a recession where the unemployment rate can rise up to 10 percent in 2018.

Exhibit D-4: Paths of the Future National Unemployment Rate in Different Scenarios
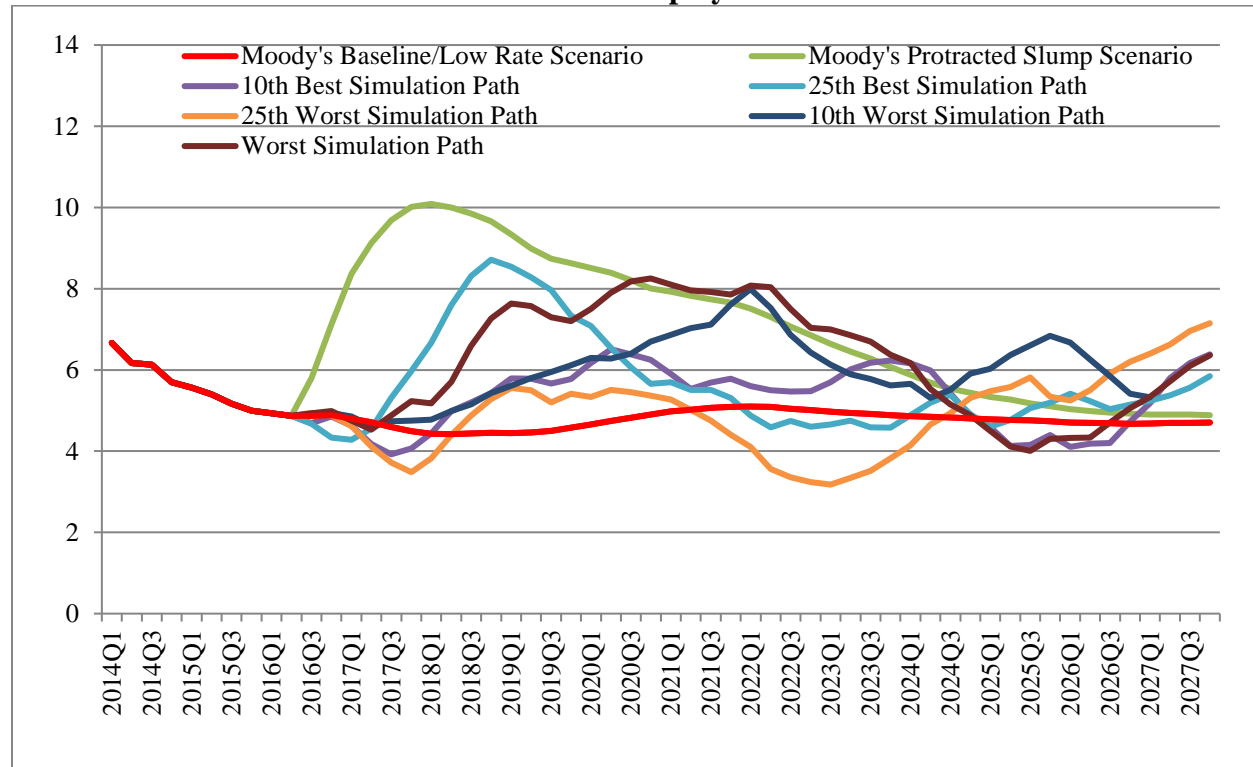
Appendix E

Loss Severity Model

Appendix E: Loss Severity Model

This Appendix describes the loss severity model used in the FY 2016 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."[58] This Review projects the loss rate by modeling the probability of the type of claim used along with modeling the loss rate for each type of claim. Section I summarizes the model specifications and estimation approaches. Section II describes the explanatory variables used in these models. Section III presents the estimation results.

I. Model Specifications 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, the underlying house 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 the 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 cannot recoup from this process:

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

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

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. Open Foreclosure refers to the loans that have begun the foreclosure process, but have not yet completed the foreclosure process. 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.

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 lender. The loss amount of a pre-foreclosure sale case is reported as the acquisition cost to FHA.

There was a significant volume of note (non-performing loan) sales from FY 2003 through FY 2006, with no or few notes sales until after FY 2012, and the percentage of note sales rose above 26 percent in FY 2014 (see Exhibit E-1). In these cases, the expenses of foreclosure procedures and subsequent house sales are avoided by FHA. Note Sales are discretionary and highly unpredictable. For forecasting purposes, we use a note sale override to incorporate recent and imminent note sale transactions. We do not model them as a continuing program. For those loan sales we do recognize, we use the recent actual loss severity rates as indicated in Appendix B.

FHA changed its servicing guide in 2013 to allow foreclosure without conveyance. This consists of a third-party-sale (TPS) during the foreclosure auction. A third party, instead of FHA, acquires the property directly from the foreclosure auction. This process allows FHA to avoid the process and expenses of property disposition after conveyance including any associated holding costs. We model this procedure by determining the percentage a foreclosure ends in either a conveyance or a TPS.

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	94.87	0.11	0.00	5.02
2000	0.00	95.06	0.09	0.00	4.85
2001	0.01	95.02	0.01	0.00	4.97
2002	0.00	94.33	0.00	0.00	5.66
2003	0.00	86.74	8.34	0.00	4.92
2004	0.00	85.57	8.41	0.00	6.02
2005	0.02	83.28	9.79	0.00	6.91
2006	0.04	89.33	2.83	0.00	7.80
2007	2.68	90.32	0.00	0.00	7.00
2008	3.87	89.46	0.00	0.10	6.57
2009	1.36	88.84	0.00	0.01	9.79
2010	1.11	83.53	0.31	0.00	15.05
2011	0.84	75.65	1.16	0.02	22.32
2012	0.96	70.56	1.31	3.54	23.63
2013	1.74	55.76	17.36	6.72	18.41
2014	2.81	41.63	26.64	14.80	14.12
2015	4.51	52.88	15.88	16.10	10.63
2016	4.65	59.09	11.75	16.92	7.59

Exhibit E-2 presents the average loss severity rates for the combined Foreclosure (REO and TPS) and Pre-foreclosure sale claims by termination fiscal year over the FYs 1991-2016. The loss rate has increased from FY 2000, reaching a record level of 61.99 percent in FY 2009. As discussed below, the loss rate for FY 2016 is biased downward due to significant disposition and reporting time lags.

Exhibit E-2: Historical Loss Rates

Termination Year	Loss Rate	Termination Year	Loss Rate	Termination Year	Loss Rate
1991	44.06%	2001	32.71%	2011	59.22%
1992	44.03%	2002	31.13%	2012	61.98%
1993	43.12%	2003	32.38%	2013	55.90%
1994	43.84%	2004	35.33%	2014	53.35%
1995	44.17%	2005	37.43%	2015	52.71%
1996	43.83%	2006	42.34%	2016	29.89%
1997	44.15%	2007	51.44%		
1998	43.12%	2008	60.33%		
1999	40.54%	2009	61.99%		
2000	36.60%	2010	57.25%		

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 lengthen the time period of the foreclosure process and this varies by state. Repair expenses may be a function of the financial condition of the borrowers, which we proxy by their credit scores. 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 cost 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 has been lengthened and foreclosure claims have been delayed, while the pre-foreclosure sales process has remained relatively stable. Since FY 2009, the pre-foreclosure sales share has increased significantly. Moreover, the proceeds recovered from conveyance and pre-foreclosure sales differ significantly. To achieve 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 foreclosure. The following flowchart (Exhibit E-3) describes the major components of the FY 2016 Review loss severity model.

Exhibit E-3: Choice-Based Loss Severity Model
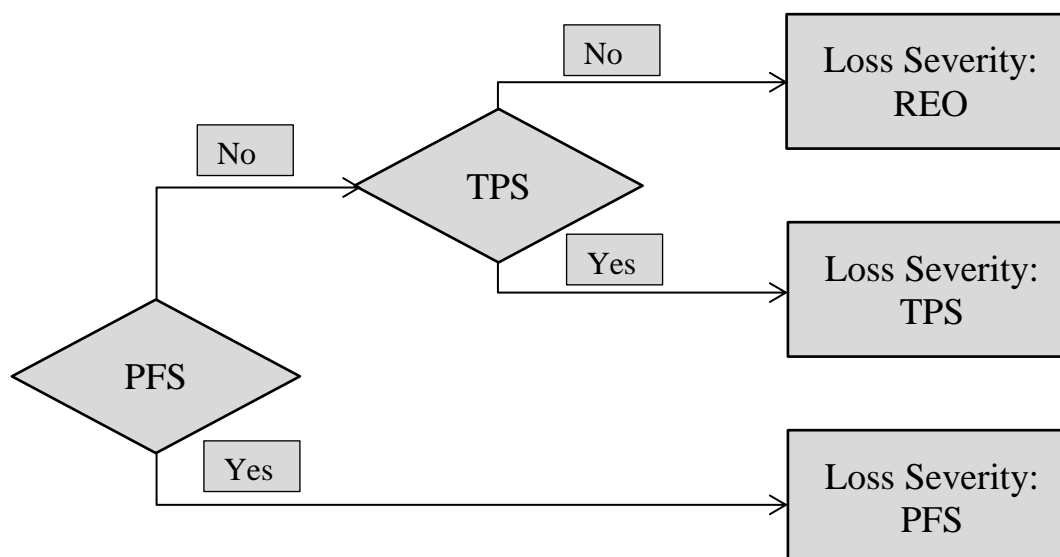
First, we estimate the probability that a claim is settled by the foreclosure process versus the pre-foreclosure sale (PFS) process. The foreclosure outcome is further split into conveyance (REO) and Third Party Sale (TPS). The difference of these two outcomes depends on whether foreclosed loans are sold to third-parties through auctions. A property would be conveyed to FHA if it fails to sell the property to a third-party in the auction, becoming REP.

To model the first-stage choice event, we used a standard binomial logit model to estimate the probability that a property would be settled as pre-foreclosure sale. The functional form is given by the following logit equation.

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

where x_i denotes that the outcome of the claim i is PFS;
π is the probability of being a PFS;
X_{ki} is the value of explanatory variable k for claim i;
the sum is over k;
and e_i is the error term.

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

$$Probability\ of\ \text{PFS} = \frac{e^{\beta_0 + \sum\beta_k X_{ki}}}{1 + e^{\beta_0 + \sum\beta_k X_{ki}}},$$

$$Probablity\ of\ Foreclosure = 1 - Probablity\ of\ PFS.$$

In the second-stage choice event, the probability of foreclosure is split into REO and TPS, where the TPS probability is assumed to be a long-term average (*TPS_Perm_Ratio)*:

$$Probablity\ of\ TPS = Probablity\ of\ Foreclosure * (TPS\_Perm\_Ratio).$$

As the average TPS share accounted for about 25 percent of the foreclosures from FY 2013 Q4 through FY 2016 Q2, we set the TPS ratio at 25 percent.

And the REO probability is

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

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 REO or PFS. That is, there are three loss rate models. The loss rate is not necessarily bounded between zero and one. For example, the REO loss rate 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 square (OLS) regression to estimate the parameters of the REO and PFS loss rate models. Conditional on whether the claim is a PFS or an REO, the specifications of the regression models are:

$$LossRate_{REO}(X_i | i \in REO) = f(X_i) + \varepsilon_{REO,i}$$

$$LossRate_{PFS}(X_i | i \in PFS) = g(X_i) + \varepsilon_{PFS,i}$$

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 the ε's are the error terms.

As shown in Exhibit E-1, TPS activity was almost non-existent prior to FY 2014. Thus we exclude all TPS cases from the loss rate model estimation.

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 from the following model:

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

In the FY 2015 Review, we used 21.1% as the TPS loss rate haircut. For the FY 2016 Review, we calculated the TPS loss rate haircut by comparing the dollar-weighted historical average REO and TPS loss rates. The TPS loss rate haircut for this FY 2016 Review is 18.7%.

Thus, the estimated loss rate in the Fund is the expected value of loss rates of different claim types.

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

where the probabilities of foreclosure and PFS are predicted from the loss selection model, the probability of REO vs. TPS follows the assumption described above, and *LossRate_{REO}* and *LossRate_{PFS}* are predicted from the two conditional loss rate models above respectively.

B. Estimation Sample

The sample used to estimate the loss severity model for the FY 2016 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 2016. The FHA loss mitigation program was initiated in 1996 and fully implemented in 2002. For the PFS/foreclosure selection model, our analysis uses the sample with origination years from FY 1990 Q1 to FY 2014 Q4 and termination years from FY 2006 through FY 2015 Q4. We also include accelerated claims and claims without conveyance (TPS) as foreclosure sales, given that we apply a haircut to the loss rate of the TPSs from that of the REOs. The final sample used for the selection estimation includes 925,708 loans claimed over these past years. Exhibit E-4 shows the impact of the various sample exclusions for the choice model and the PFS and REO loss rate models.

Many claims associated with foreclosures in FY 2015 Q2 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 2015 Q2 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 2015 Q2, while the PFS loss rate model used the sample with termination years from FY 2000 through FY 2015 Q4. 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 estimation of the REO and PFS loss rate models included 898,565 and 149,516 loans, respectively.

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

	Loan Count
Original Total Claims or Open Foreclosure	**1,957,096**
Drop cases with UPB = 0 or loan age < 0	176,635
Drop cases with missing LTV data	228,330
Observations Surviving First Round of Exclusions	**1,552,131**
Drop if other miscellaneous data quality issues	747
Observations Eligible for Severity Models	**1,551,384**
Observations Eligible for Selection Model (FY 2006 Q1 – FY 2015 Q4, all the open foreclosure, conveyance, accelerated claims, non-conveyance claims without conveyance of title, pre-foreclosure cases)	925,708
Observations Eligible for Conveyance Loss Rate Model (FY 2000 Q1 – FY 2015 Q2, all conveyance cases)	898,565
Observations Eligible for PFS Loss Rate Model (FY 2000 Q1 – FY 2015 Q4, all pre-foreclosure cases)	149,516

II. Explanatory Variables

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

- Fixed initial loan characteristics, including mortgage product type;

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

- Fixed property characteristics, including number of units;

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

- Dynamic variables based entirely on loan information, including mortgage age, scheduled amortization of the loan balance, relative loan size, current loan-to-value, default episode duration, and modification age (defined as the duration between the last modification date and loan termination date);
- Dynamic variables derived by combining loan information with economic time series such as house price appreciation rates (e.g., as it influences the REO sales price) and interest rates (e.g., as used to indicate the refinance incentive).

Most explanatory variables used in the loss severity model are the same as those used in the loan status transition models. Please refer to Appendix A for the definition of these variables. For a

number of the splines, we capped the open-ended interval at a zero incremental slope, identified by the specified cap or there being no associated t-statistic.

A deficiency judgment state indicator was created especially for the loss severity model. Some states allow lenders to go after the personal property of the 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 to the borrowers (deficiency flag by state) is expected to increase the probability of PFS; and reduce losses, all else equal.

III. Estimation Results

Exhibit E-5 presents the regression coefficients and the corresponding Chi-square and t-statistics.

Exhibit E-5: Regression Results

Description	name	value	Foreclosure/PFS Selection			Loss Rate Given Conveyance			Loss Rate Given PFS		
			Spline	Coefficient	Chi-Sq	Spline	Coefficient	t-value	Spline	Coefficient	t-Value
Intercept				**-5.3325**	1200.79		**0.5534**	44.38		**-0.1805**	-23.09
Current LTV	ltv_current1	spline function	1	**2.3942**	3911.63	0.5	**0.4606**	22.09	1.2	**0.6859**	178.27
	ltv_current2		>1.0	**2.1149**	1918.84	0.9	**1.0358**	267.26	>1.2	**0.2769**	53.71
	ltv_current3		cap @1.3			1.1	**0.6721**	111.58			
	ltv_current4					>1.1	**0.0000**				
Relative Loan Size	loansize1	spline function	100	**0.0228**	8744.01	50	**-0.0103**	-103.20	90	**-0.0026**	-56.66
	loansize2		180	**0.0091**	2707.23	100	**-0.0052**	-269.59	140	**-0.0013**	-50.69
	loansize3		>180	**0.0055**	145.86	180	**-0.0017**	-87.86	>140	**0.0000**	
	loansize4					>180	**0.0009**	8.43			
House price appreciation local level	hpa2y_1	spline function	-0.2	**5.9956**	1503.85	0.2	**-0.5695**	-168.96	0.1	**-0.0126**	-2.24
	hpa2y_2		0.1	**1.1812**	544.67	>0.2	**-0.3769**	-33.70	>0.1	**0.0000**	
	hpa2y_3		>0.1	**3.1700**	2447.21						
Cross Section House Price Volatility	sigma_parm_a	linear function					**22.9160**	23.21		**17.8715**	12.43
Loan age	age1	spline function	20	**-0.0122**	218.95	35	**0.0096**	231.44	15	**0.0077**	47.22
	age2		>20	**0.0027**	19.69	50	**0.0168**	137.65	30	**0.0064**	55.66
	age3					>50	**0.0122**	68.82	>30	**0.0157**	97.09
									cap @55		
Flag for First Quarter Default Episode	def_episode	x=0/1					**0.1146**	96.38			
Default Episode Duration	def_epi_dur1	spline function	4	**-0.3863**	12829.61	6	**0.0181**	77.85	6	**0.0241**	89.30
	def_epi_dur2		9	**-0.1493**	3218.81	18	**0.0101**	83.42	20	**0.0192**	86.26
	def_epi_dur3		>9	**-0.0582**	747.49	>18	**-0.0002**	-0.45	>20	**0.0118**	7.34
Modification Age Dummy	mod1	1 if mod_age=1		**-3.0826**	130.66						
	mod2	1 if mod_age=2		**-1.4728**	287.79						
	mod3	1 if mod_age>=3		**-0.1535**	236.30						
Modification Age	mod_age1	spline function				1	**0.0408**	26.02	1	**0.0883**	30.12
	mod_age2					20	**0.0059**	39.46	16	**0.0010**	3.24
	mod_age3					>20	**0.0000**		>16	**0.0000**	
Relative Unemployment Rate	rel_ue	linear function					**0.0441**	34.43			
Credit Score	credit_score1	spline function	580	**0.0023**	81.40					**-0.0001**	-17.25
	credit_score2		680	**0.0066**	2665.29	680	**-0.0004**	-49.76			
	credit_score3		>680	**0.0042**	616.75	>680	**-0.0001**	-4.31			
Flag for No Credit Score Returned	credit_score000	x=0/1		**0.1214**	50.30		**0.0219**	19.18		**0.0130**	6.17
Flag for Missing Credit Score	credit_score999	x=0/1		**-0.3098**	538.06		**-0.0035**	-4.54		**-0.0086**	-5.12
Judicial State Flag	judicial	x=0/1		**0.4539**	3925.12		**0.0928**	156.45		**0.0085**	9.17
Deficiency State Flag	deficiency	x=0/1		**0.6883**	4730.34		**-0.0656**	-68.66		**-0.0307**	-24.88
UNICON Score Flag	unicon_score	x=0/1					**0.0255**	30.53		**-0.0210**	-14.11
Refinance Flag	judicial	x=0/1					**0.1164**	148.49		**0.1020**	100.29
Non-profit Gift Downpayment Assistance Flag	non_profit_downpay	x=0/1					**0.0508**	67.40		**0.0379**	32.32
Number of Units (2-4) Flag	flag_24	x=0/1					**0.1566**	80.70		**0.1669**	52.99
Fixed 15-year Product Flag	prod_25	x=0/1					**0.2419**	85.85			
Model Fit Statistics			Somer's D	**0.5500**		Adj. R2	**0.4813**		Adj. R2	**0.5550**	
			c	**0.7750**							

Appendix F

FHA Volume Model

Appendix F: FHA Volume Model

This Appendix describes our model for projecting future FHA endorsement volumes. The model is used to project future FHA loan volumes that are sensitive to alternative economic scenarios. Our FHA volume model specification includes two sub-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. The future streamline refinance originations are endogenously simulated by the results of the FHA SR transition equations, on a quarterly basis. Therefore, the SR origination volume equals the SR counts occurring during the same quarter if previous loans are fully-underwritten loans or during the immediate preceding quarter if previous loans are SR loans.

In our model, the national purchase volume responds to house prices and prior volumes, while the national refinance volume responds to prior refinance volumes, the 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 also dependent on the GSE and FHA refinance spread.

The FHA purchase volume is derived from the national purchase volume based on an assumed share scheme as provided by FHA. The forecasted share of 15 percent is assumed for the period from FY 2016 Q3 to FY 2023 Q4. The 15 percent long-term market share is an estimate based on future government policies and private mortgage market roles. If alternatives to FHA lending completely rebound to their historical average within the next few years, the FHA market share may be overestimated.

For model estimation, we use data from FY 1990 Q2 through FY 2016 Q1.

I. Volume Model Specification

We use the following notation:

Variables:
V^P = National purchase mortgage volume ($ millions)
V^R = National refinance mortgage volume ($ millions)
F^P = FHA purchase mortgage volume ($ millions)
F^R = FHA refinance mortgage volume ($ millions)
R^m = Commitment rate on 30-year fixed-rate mortgages
R^1 = 1-year constant maturity Treasury rate
R^{10} = 10-year constant maturity Treasury rate

H = FHFA national purchase-only home price index
Q = Seasonality indicator (as 0/1 dummy variables for each quarter of a year)
T = 1 after FY 2006; 0 otherwise
G = Spread of FHA and GSE refinance interest rates

Subscripts:
t = time index (quarterly)
k = index for calendar quarters 1, 2 and 3

α, β, θ, λ, γ, φ and ω are coefficients to be estimated.

We estimate the set of equations shown below by ordinary least squares (OLS):

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

$$LnV_t^R = \alpha_0 + \beta LnV_{t-1}^R + \sum_{j=0}^4 \gamma_j R_{t-j}^m + \lambda(R_t^{10} - R_t^1) + \varphi Ln\left(\frac{H_t}{H_{t-4}}\right) + \omega Ln\left(\frac{\sum_{j=0}^3 V_{t-j}^P}{4}\right) \tag{2}$$

$$Ln\frac{F_t^R}{V_t^R} = \alpha_0 + \beta G_t + \theta T \tag{3}$$

Equation (1) implies that the nation's volume of purchase mortgages is a seasonally adjusted function of its volume in the past three quarters and the annual house price appreciation rate (HPA). Equation (2) indicates 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 suggests that the share of FHA's non-SR refinance volume as a percentage of the nation's refinance mortgages is a function of the spread between the effective GSE and FHA refinance interest rates and whether the date is after FY 2006. As mentioned above, the transition equations include an endogenous transition to SR mortgages, so there is no need to have an additional model to project the volume of those mortgages.

II. Historical Data

When estimating the volume model, we use historical data from public sources as well as from the FHA data warehouse as of the end of June, 2016. Exhibit F-1 details the data sources. For model estimation in this year's Review, we use data from FY 1990 Q2 through FY 2016 Q1.

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 (1991 Q1 = 100), National
Market originations	MBA[b]	National Mortgage Origination, separated into Purchase and Refinance, 1-4 Family, February 2016
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 regression results for Equations (1) – (3), respectively. We do not exclude several variables that had statistically insignificant coefficients to retain a more general model specification and to make the model forecasts sensitive to changes in 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	0.474	4.679	<.0001
Ln(National Purchase Volume), lagged 2 qtr	0.112	1.006	0.317
Ln(National Purchase Volume), lagged 3 qtr	0.294	3.032	0.003
Ln (Home Price at t / Home Price at t-4)	1.357	4.354	0.000
Winter	-0.151	-2.975	0.004
Spring	0.248	4.031	0.000
Summer	0.158	2.904	0.005
Intercept	1.361	3.326	0.001
Number of observations = 101			
Adj R-Sq = 0.9210			
Durbin-Watson = 1.924			

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	0.783	12.90	<.0001
Ln((lag 1 to 4 National Purchase Volume)/4)	0.284	2.33	0.0218
Mortgage rate at t	-0.581	-8.00	<.0001
Mortgage rate, lagged 1 quarter	-0.189	-1.66	0.0996
Mortgage rate, lagged 2 quarters	0.797	7.17	<.0001
Mortgage rate, lagged 3 quarters	-0.323	-3.03	0.0032
Mortgage rate, lagged 4 quarters	0.238	3.16	0.0021
Spread between 10-Yr and 1-Yr	-0.020	-0.71	0.4781
Ln (Home Price at t / Home Price t - 4)	0.717	1.26	0.2119
Intercept	-0.539	-0.53	0.5992
Number of observations =101			
Adj R-Sq = 0.9427			
Durbin-Watson = 2.417			

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 FY>2006	2.588	9.56	<.0001
FHA - GSE Refinance Spread	-1.328	-2.56	0.0119
Intercept	-4.297	-8.44	<.0001
Number of observations = 104			
Adj R-Sq = 0.4802			
Durbin-Watson = 0.180			

IV. Model Adjustments

Due to the nature of stochastic simulation, certain paths could cause a large deviation of FHA's non-SR volume and project a share higher than its highest historical performance range, which is 65 percent of the purchase volume, and even exceed the FHA fully-underwritten purchase volume. Accordingly, an adjustment we implemented is to cap FHA's non-SR volume at 70 percent of the predicted FHA fully-underwritten purchase volume over the forecast period FY 2016 Q3 through FY 2023.

As described in Section I, the dollar volume forecast of the FHA for-purchase mortgages follows Equation (1). We also adopted the FHA projection that its share of the purchase market will be 15 percent throughout the forecast period from FY 2016 Q3 through FY 2023.

Based on Moody's baseline scenario, the predicted product volumes are shown in Appendix C, Exhibit C-1. The refinance volume is projected to 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, the volume projection is endogenous, responding to alternative economic scenarios.

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Appendix G

Stochastic Models

Appendix G: Stochastic Models

This Appendix describes the stochastic models used for generating the economic variables used in the Monte Carlo simulations of the FY 2016 FHA Forward Actuarial Review. Starting from the FY 2012 Review, we computed the present value of expected cash flows as the average of present values for the 100 possible paths of house price appreciation (HPA) and unemployment and interest rates.

The concept of Monte Carlo simulation approach that we use in this Review is to project a number of equally likely future paths of HPA and unemployment and interest rates; and compute the net present value (NPV) of the projected cash flows for each path. Since each path is equally likely to occur, the mean of the NPV among all simulated paths is the estimate of the expected value of the Fund NPV. By increasing the number of simulations, the average NPV among the paths will gradually converge to a constant level, which is the unbiased estimate of the expected present value of the MMI Forward Fund.

The economic variables modeled herein as stochastic for computing expected present values include:

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

These stochastic variables were modeled to project the "actuarial" or "real-world" distributions and hence were estimated using historical data.[59] This approach is appropriate for the Actuarial Review because the simulated rates are designed to approximate the actual future values. Since all status transition probability models were estimated using the historically observed interest and unemployment rates and house price appreciation rates, using the interest rates and other economic variables in the actuarial measure, versus risk-neutral measures typically used for security trading purposes, makes the entire model internally consistent.

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[59] For valuing options, so-called "risk-neutral" future paths of the endogenous 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 do not have any resemblance to historical movements in interest and house price appreciation rates and are not suitable for the purpose of the actuarial review.

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. Then the Federal Reserve shifted its monetary policy from managing interest rates to managing the money supply, at least until inflation, and consequently interest rates, receded. Exhibit G-1 shows historical interest rates since CY 1970. The 1-year Treasury rate (cmt01) was around 5% in CY 1970 and increased steadily to its peak of 16.31% in CY 1981 Q3. After that, it followed a decreasing trend and reached an all-time low of 0.10% in CY 2014 Q2. Also shown are the 10-year Treasury rate (cmt10) and the 30-year fixed rate mortgage rate (mrate).

Exhibit G-1: Historical Interest Rates (%)
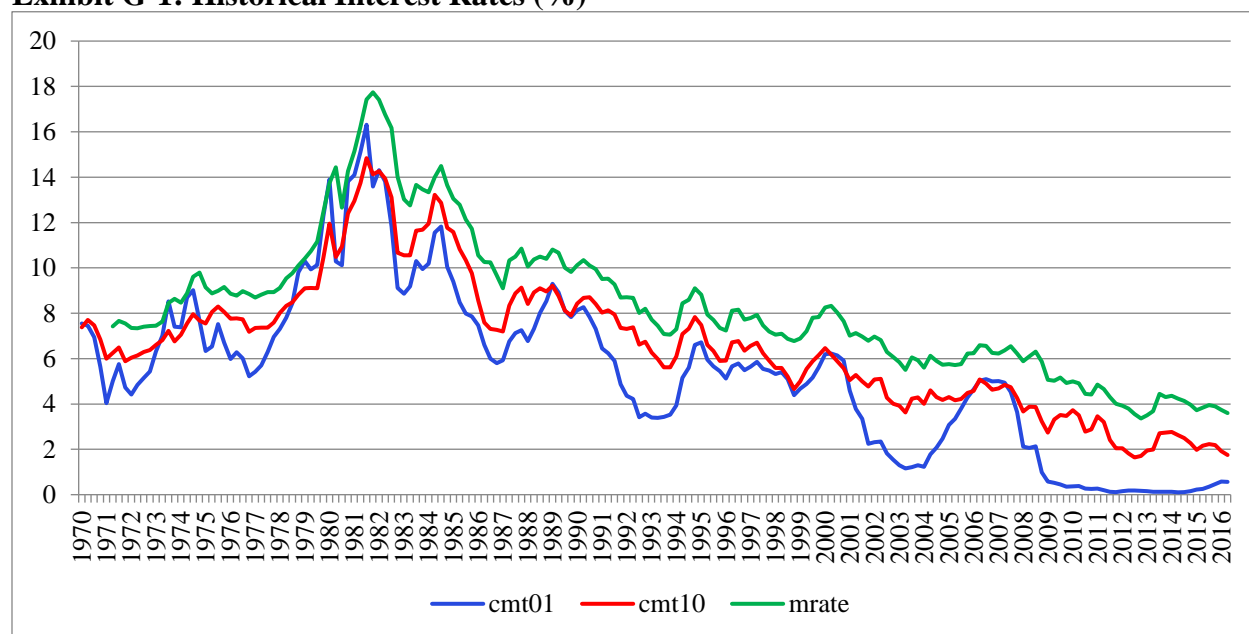
Exhibit G-2 shows historical interest rate spreads, including the spread between 10-year and 1-year Treasury rates and the spread between the 30-year mortgage rate and the 10-year Treasury rate. The spread between the 10-year and 1-year Treasury rates appears to have long cycles and the spread is not always positive. However, the spread of the mortgage rate over the 10-year Treasury rate is always positive, reflecting the premium for credit risk.

Exhibit G-2: Historical Interest Rate Spreads (%)
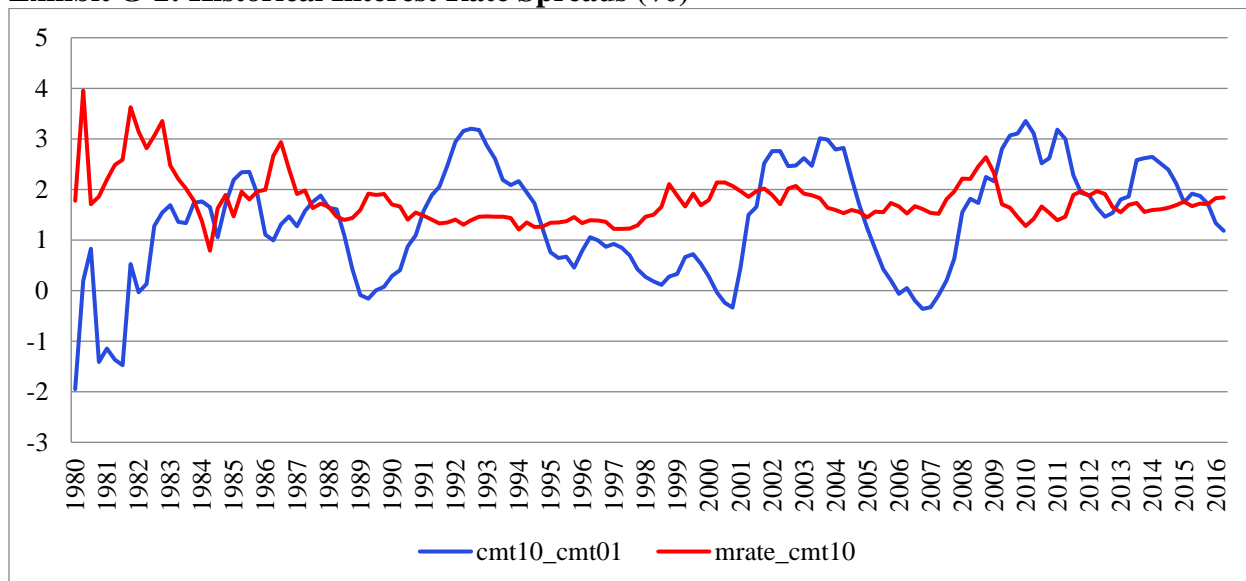
B. House Price Appreciation Rates

The national house price appreciation rate (HPA) is derived from the FHFA repeat sales house price indexes (HPIs) of purchase-only (PO) transactions. The PO HPI provides a reliable measure of housing market conditions, since it is based on repeat sales at market prices and does not use any appraised values.

Exhibit G-3 shows the national HPI and quarterly HPA from CY 1991 Q1 to CY 2016 Q2. The long-term average quarterly HPA is around 0.83% (3.30% annual rate).

The HPI increased steadily before 2004, and the quarterly appreciation rate was around 1.14%. Then house prices rose sharply starting in 2004. The average quarterly house price appreciation rate was 1.88% during the subprime mortgage expansion period from 2004 to 2006, and reached its peak of 2.59% in CY 2005 Q2. After 2006, the average growth rate of house price became negative. Exhibit G-4 shows the quarterly HPA by selected historical time periods.

Exhibit G-3: Historical National HPI and Quarterly HPA
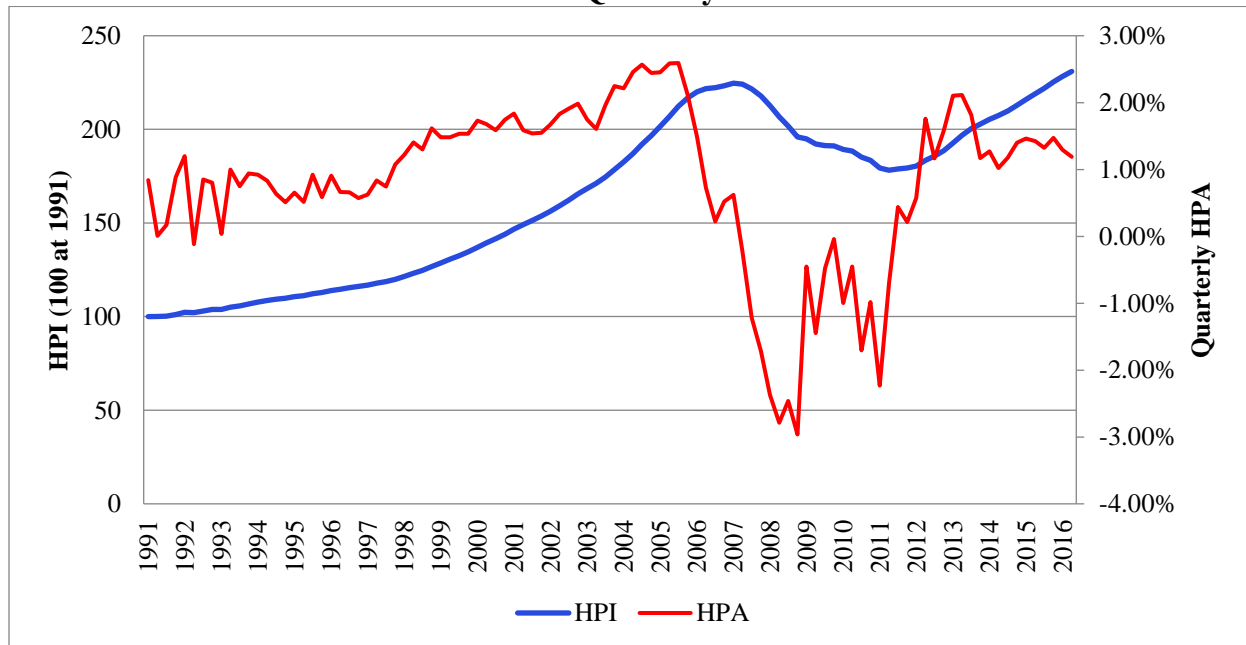
Exhibit G-4: Average Quarterly HPA by Time Span

Period	Average Quarterly HPA
1991 – 2003	1.13%
2004 – 2006	1.87%
2007 – 2010	-1.23%
2011 – 2015	1.03%

II. 1-Year Treasury Rate

In this section, we present some historical statistics on the 1-year Treasury rate, and then describe the estimation model for the stochastic process, and finally report the parameter estimates and their standard errors. Exhibit G-5 shows the summary statistics of the historical 1-year Treasury rates for two periods, one from 1962 and the other from 1980.

Exhibit G-5: Statistics for the 1-Year Treasury Rates

Statistics	Since 1980	Since 1962
Mean	5.00%	5.32%
Standard Deviation	3.85%	3.37%
Max	16.31%	16.31%
95- Percentile	13.15%	11.60%
90- Percentile	10.14%	9.52%
50- Percentile	5.39%	5.41%
10- Percentile	0.21%	0.36%
5- Percentile	0.14%	0.17%
Min	0.10%	0.10%

We used a GARCH(1,1) parameterization to model the 1-Year Treasury rate (r_1) and estimated it using data from CY 1980 Q1 to CY 2016 Q1.[60] 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 an independent Wiener random process with distribution N(0,1),

and where the variance (σ) of the residual term follows a GARCH(1,1) process:

$$\sigma_t{}^2 = \beta_0 + \beta_1 \varepsilon_{t-1}^2 + \beta_2 \sigma_{t-1}^2 + \gamma_1 r_{1,t-1} \tag{2}$$

where ε is the error term, which equals $\sigma_t dZ_1$ from equation (1).

The Full Information Maximum Likelihood (FIML) method was used to estimate the parameters in equations (1) and (2). The results are presented in Exhibit G-6.

Exhibit G-6: Estimation Results for 1-Year Treasury Rate Model

Parameter	Estimate	Std Dev	t-value	prob>t
A	1.60E-04	0.000119	1.34	0.1816
B	0.971893	0.0113	85.87	<.0001
β_0	-2.71E-07	9.42E-08	-2.88	0.0046
β_1	0.362551	0.1632	2.22	0.0279
β_2	0.346784	0.1007	3.44	0.0008
γ_1	0.000259	0.000084	3.08	0.0025
Adj. R^2	0.962			

The model based on these parameters is used to simulate the 1-year Treasury rates for the forecast period starting in FY 2016 Q3. When the simulation is implemented, the "constant" term

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[60] An example of using a GARCH model for fixed-income analysis includes Heston and Nandi (2003).

A is further calibrated to different time-dependent values to match Moody's baseline forecast in each forecasted quarter. The values were chosen so that the median value among 100 simulations used to compute the values of the endogenous variables in our models matches Moody's July 2016 baseline forecast of the 1-year Treasury rate quarter by quarter. We applied the same procedure for the "constant" terms in the interest rate, unemployment rate and HPA equations below.

Note that Moody's July forecast only covers the period until CY 2046 Q4. After 2046, we repeated Moody's last quarter forecasts for all remaining quarters. All the other interest and unemployment 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 10-year Treasury rate and 1-year Treasury rate from the historical data. The spread term is assumed to depend on the 1-year rate, 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 at time *t* and $r_{1,t}$ is 1-year Treasury rate at time *t*. The variance of the residual term is assumed to follow 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-7.

Exhibit G-7: Estimation Results for 10-Year Treasury Rate Spread Model

Parameter	Estimate	Std Dev	t-value	prob>t
α_{10}[61]	0.003	0.001	2.51	0.013
β_{10}	-0.017	0.013	-1.34	0.181
γ_{10}	0.845	0.043	19.45	<.0001
β_0	1.20E-05	2.56E-06	4.8	<.0001
β_1	0.580	0.267	2.17	0.031
Adj. R^2	0.835			

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 2016 base forecast of the 10-year Treasury rates quarter by quarter. We also set a floor value at 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-8.

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[61] The intercept term is calibrated each time period so that the median simulated spread matches Moody's baseline forecast.

Exhibit G-8: Estimation Results for the Mortgage to 10-Year Treasury Rate Spread Model

Parameter	Estimate	Std Dev	t-value	prob>t
$\alpha_m{}^{62}$	0.006	0.001	5.75	<.0001
β_{1m}	-0.183	0.031	-5.96	<.0001
β_{2m}	0.172	0.030	5.70	<.0001
β_{3m}	-0.056	0.017	-3.37	0.001
β_{4m}	0.728	0.050	14.62	<.0001
β_0	1.81E-07	1.06E-07	1.71	0.090
β_1	0.148	0.073	2.04	0.044
β_2	0.784	0.067	11.76	<.0001
Adj. R^2	0.629			

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 2016 base forecast of the mortgage rate quarter by quarter. We overrode the simulated spread between the mortgage rate and 10-year Treasury rate to be positive.

V. House Price Appreciation Rate (HPA)

A. National HPA

We specified the national HPA to depend on its own lags, seasonal dummy variables, the level of short rates and on various spreads and their lags. The model takes the following form:

$$HPA_t = \mu_t + \beta_1 HPA_{t-1} + \beta_2 HPA_{t-2} + \beta_3 r_{1,t} + \beta_4 r_{1,t-1} + \beta_5 s_{10,t} + \beta_6 s_{10,t-1} + \beta_7 s_{m,t} + \beta_8 s_{m,t-1} + \sigma_{h,t} dZ_h \tag{7}$$

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:

$$\sigma_{h,t}{}^2 = \gamma_0 + \gamma_1 \varepsilon_{t-1}^2 + \gamma_2 \sigma_{h,t-1}{}^2 \tag{8}$$

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[62] The intercept term is calibrated each time period so that the median simulated spread matches Moody's baseline forecast.

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-9.

Exhibit G-9: Estimation Results for the National HPA Model

Parameter	Estimate	Std Dev	t-value	prob>t
μ[63]	0.001	0.002	0.73	0.4642
β_1	0.632	0.084	7.50	<.0001
β_2	0.244	0.082	2.96	0.004
β_3	-0.092	0.067	-1.37	0.174
β_4	0.077	0.067	1.16	0.249
β_5	-0.145	0.088	-1.65	0.101
β_6	0.133	0.087	1.53	0.129
β_7	-0.069	0.136	-0.51	0.610
β_8	0.152	0.125	1.22	0.224
γ_0	3.56E-07	3.57E-07	1.00	0.321
γ_1	0.406	0.113	3.61	0.000
γ_2	0.630	0.073	8.68	<.0001
Adj. R^2	0.686			

We used these parameters to simulate future HPAs from FY 2016 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 CY 2046 Q4, so 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:

$$HPA_{i,t}^{j} = (HPA_{national,t}^{j} + DISP_{i,t}^{Base})$$

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[63] The intercept term is calibrated each time period so that the median simulated spread matches Moody's baseline forecast.

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. [64] We understand this approach is equivalent to assuming perfect correlation of dispersions among different locations across simulated national HPA paths, which creates systematic house price decreases 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

In our unemployment rate model, the unemployment rate depends on the prior unemployment rate, house prices, mortgage rates and Treasury rates.

We used quarterly data from CY 1975 to CY 2016 Q1 to estimate the national unemployment rate. The model we adopted was:

$$ue_t = \mu_t + \beta_1 ue_{t-1} + \beta_2 ue_{t-2} + \beta_3 r_{1,t} + \beta_4 r_{m,t} + \beta_5 HPA_t + \varepsilon_t \tag{9}$$

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-10: Estimation Results for the National Unemployment Rate Model

Parameter	Estimate	Std Dev	t-value	prob>t
μ	0.182	0.092	1.98	0.050
β_1	1.496	0.063	23.78	<.0001
β_2	-0.568	0.059	-9.58	<.0001
β_3	-0.048	0.019	-2.45	0.016
β_4	0.072	0.023	3.14	0.002
β_5	-1.570	0.454	-3.46	0.001
Adj. R^2	0.981			

From the simulated interest rates and house prices, we applied the parameters shown in Exhibit G-10 to calculate the corresponding national unemployment rate. Based on historical statistics, the national unemployment rate was capped at 20% with a floor at 2%.

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[64] The dispersion of each MSA remains constant among all alternative Moody's forecast scenarios.

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 the local level at 30% with a floor at 1%.

VII. Dynamic Simulation

Starting in the FY 2013 Review, we use 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. Previously, simulated loans were represented as having probabilities of all possible statuses in the future.

The use of dynamic simulation improves the speed of the simulation and allows greater flexibility for the transition probabilities to be path-dependent. The FY 2012 Review used a limited set 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. The dynamic simulation approach removes this limitation and allows default duration to increase without bound. In other words, the behavioral accuracy is increased without significant increases in the simulation computation time.

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], using 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 point is 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 is 0.0152, the assigned value is 1, meaning that the transition to default 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. Importantly, this efficiency allows a freer and hence more accurate specification of the default duration, compared to the limitation that was previously imposed.

Dynamic simulation decreases 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 precision 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 sample of 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[65] method to improve the convergence efficiency in the dynamic simulation.

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[65] Glasserman, P., (2003), *Monte Carlo Methods in Financial Engineering*, Springer.

Appendix H

Econometric Results

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
1986	0.01	0.44	1.71	2.17	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	0.20	0.20	0.14	0.17	0.20	0.24	0.15	0.13	0.08	0.07
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	0.18	0.11	0.14	0.09
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	0.30	0.30	0.33	0.30	0.28	0.18	0.18	0.16	0.19
1989	0.01	0.33	1.09	1.62	1.99	2.67	2.95	2.46	2.35	1.95	1.74	1.54	0.96	0.83	0.74	0.72	0.56	0.47	0.35	0.32	0.36	0.47	0.45	0.43	0.35	0.22	0.23	0.29	0.24	0.06
1990	0.01	0.29	1.08	1.75	2.57	2.87	2.35	2.40	2.06	1.82	1.55	1.01	0.79	0.76	0.71	0.55	0.49	0.47	0.46	0.40	0.62	0.55	0.46	0.53	0.30	0.32	0.37	0.33	0.12	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	0.59	0.46	0.55	0.37	0.38	0.43	0.44	0.09	0.06	0.06
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	0.52	0.39	0.45	0.47	0.50	0.20	0.17	0.20	0.13
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	0.43	0.60	0.44	0.53	0.45	0.51	0.20	0.19	0.18	0.14	0.09
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	0.36	0.53	0.48	0.42	0.60	0.50	0.51	0.53	0.58	0.25	0.20	0.26	0.19	0.22	0.19
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	0.79	0.81	0.89	1.19	1.06	0.87	1.08	0.86	1.02	1.22	0.84	0.39	0.39	0.34	0.28	0.28	0.26	0.21
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	1.10	1.17	1.25	1.05	1.21	1.15	0.94	0.46	0.45	0.39	0.33	0.28	0.30	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	1.27	1.25	1.47	1.32	1.26	1.48	1.31	1.34	1.33	1.29	0.57	0.57	0.63	0.48	0.39	0.41	0.36	0.32	0.33
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	1.40	1.65	1.38	1.46	1.37	1.16	0.53	0.50	0.44	0.36	0.29	0.25	0.24	0.21	0.16	0.11
1999	0.01	0.32	0.86	1.27	1.85	2.16	1.98	1.57	1.30	1.28	1.38	1.69	1.74	1.69	1.89	1.59	1.57	1.62	1.23	0.57	0.54	0.47	0.36	0.25	0.24	0.16	0.17	0.11	0.09	0.10
2000	0.01	0.49	1.99	4.05	4.80	4.08	3.32	2.84	2.89	2.76	3.19	2.84	2.58	2.91	2.33	2.43	2.41	2.02	1.00	0.99	0.89	0.74	0.64	0.43	0.44	0.35	0.31	0.23	0.26	0.14
2001	0.01	0.43	1.83	3.61	3.77	3.25	2.76	2.69	2.59	3.16	3.07	2.84	3.09	2.46	2.48	2.36	2.03	0.94	0.96	0.73	0.53	0.40	0.37	0.20	0.25	0.22	0.13	0.11	0.08	0.07
2002	0.01	0.47	2.08	2.82	2.67	2.41	2.41	2.44	2.99	2.80	2.78	3.18	2.54	2.46	2.47	1.94	1.15	0.97	0.83	0.59	0.51	0.41	0.28	0.33	0.26	0.18	0.18	0.13	0.17	0.11
2003	0.01	0.66	1.57	1.76	1.68	1.80	1.94	2.57	2.34	2.65	3.17	2.64	2.24	2.27	1.95	1.01	0.97	0.82	0.69	0.50	0.39	0.25	0.29	0.22	0.16	0.17	0.13	0.11	0.09	0.07
2004	0.12	0.88	1.44	1.69	2.07	2.23	2.79	2.59	2.88	3.47	3.03	2.49	2.54	2.32	1.27	1.19	1.01	0.82	0.62	0.55	0.41	0.34	0.31	0.22	0.24	0.17	0.20	0.12	0.12	0.07
2005	0.11	0.76	1.81	2.63	3.21	3.91	3.56	3.84	4.69	4.14	3.60	3.52	2.99	1.72	1.55	1.32	1.02	0.84	0.68	0.55	0.52	0.43	0.34	0.33	0.23	0.26	0.21	0.17	0.13	0.09
2006	0.02	0.62	2.21	3.71	5.23	4.61	5.00	6.36	5.65	4.84	4.81	3.91	2.11	1.82	1.61	1.13	0.85	0.70	0.53	0.44	0.37	0.26	0.27	0.18	0.16	0.16	0.10	0.08	0.07	0.06
2007	0.02	0.81	3.18	5.78	4.98	6.02	9.11	7.53	6.08	6.25	5.25	2.78	2.46	2.10	1.53	1.19	0.91	0.67	0.56	0.43	0.39	0.29	0.24	0.20	0.14	0.12	0.09	0.07	0.05	0.04
2008	0.01	0.69	3.43	4.15	5.41	8.82	7.80	6.17	5.97	5.14	2.60	2.36	1.97	1.43	1.11	0.78	0.60	0.49	0.41	0.32	0.30	0.20	0.18	0.15	0.12	0.10	0.07	0.06	0.06	0.04
2009	0.01	0.52	1.35	2.18	3.95	4.03	3.18	3.13	2.88	1.66	1.40	1.18	0.85	0.63	0.49	0.34	0.32	0.28	0.21	0.19	0.15	0.13	0.10	0.09	0.08	0.07	0.07	0.05	0.03	0.02
2010	0.01	0.23	0.72	1.55	1.78	1.60	1.67	1.72	1.05	0.99	0.87	0.64	0.53	0.41	0.29	0.29	0.24	0.21	0.19	0.14	0.14	0.11	0.09	0.08	0.08	0.08	0.06	0.05	0.04	0.03
2011	0.01	0.21	0.66	0.86	0.89	1.08	1.21	0.87	0.84	0.75	0.54	0.45	0.35	0.29	0.23	0.21	0.19	0.17	0.14	0.14	0.13	0.11	0.10	0.08	0.08	0.07	0.06	0.05	0.05	0.03
2012	0.01	0.15	0.34	0.46	0.70	0.91	0.68	0.68	0.64	0.47	0.37	0.28	0.24	0.20	0.19	0.14	0.15	0.11	0.12	0.09	0.10	0.07	0.07	0.06	0.05	0.06	0.05	0.04	0.03	0.03
2013	0.01	0.10	0.27	0.57	0.78	0.61	0.62	0.58	0.49	0.38	0.29	0.23	0.22	0.18	0.17	0.15	0.13	0.12	0.11	0.10	0.10	0.07	0.07	0.06	0.05	0.05	0.05	0.03	0.03	0.02
2014	0.00	0.09	0.68	1.31	1.01	1.13	1.05	0.91	0.75	0.64	0.52	0.48	0.45	0.34	0.34	0.28	0.27	0.23	0.21	0.16	0.16	0.14	0.11	0.11	0.09	0.09	0.07	0.06	0.06	0.04
2015	0.00	0.14	0.73	0.85	0.92	0.94	0.82	0.69	0.60	0.52	0.46	0.40	0.36	0.32	0.26	0.27	0.22	0.20	0.17	0.13	0.14	0.13	0.08	0.07	0.08	0.07	0.06	0.04	0.04	0.03
2016	0.01	0.20	0.65	0.90	0.93	0.82	0.75	0.64	0.59	0.52	0.46	0.38	0.35	0.28	0.29	0.26	0.24	0.20	0.17	0.16	0.14	0.11	0.08	0.07	0.06	0.08	0.05	0.03	0.03	0.02
2017	0.01	0.23	0.96	1.25	1.08	1.00	0.94	0.82	0.77	0.69	0.58	0.55	0.45	0.42	0.38	0.33	0.33	0.25	0.24	0.20	0.16	0.13	0.10	0.10	0.07	0.07	0.04	0.03	0.03	0.02
2018	0.01	0.37	1.28	1.52	1.42	1.28	1.18	1.12	1.01	0.86	0.83	0.64	0.72	0.56	0.50	0.49	0.42	0.35	0.34	0.26	0.21	0.19	0.17	0.14	0.11	0.07	0.05	0.04	0.03	0.02
2019	0.01	0.40	1.19	1.46	1.34	1.18	1.22	1.09	0.95	0.91	0.71	0.72	0.65	0.57	0.54	0.50	0.44	0.38	0.30	0.27	0.23	0.18	0.14	0.13	0.10	0.07	0.05	0.04	0.02	0.02
2020	0.01	0.29	1.05	1.29	1.18	1.12	1.10	0.97	0.91	0.79	0.82	0.63	0.61	0.55	0.57	0.50	0.45	0.38	0.30	0.27	0.24	0.18	0.14	0.13	0.12	0.08	0.05	0.04	0.03	0.02
2021	0.01	0.29	1.04	1.21	1.24	1.14	1.04	1.07	0.83	0.94	0.76	0.71	0.66	0.56	0.56	0.54	0.43	0.37	0.34	0.28	0.23	0.21	0.18	0.15	0.11	0.09	0.06	0.04	0.04	0.02
2022	0.01	0.28	0.96	1.27	1.25	1.17	1.26	1.05	1.06	0.92	0.92	0.81	0.70	0.69	0.65	0.56	0.44	0.38	0.35	0.28	0.26	0.19	0.18	0.16	0.12	0.09	0.06	0.05	0.03	0.02
2023	0.01	0.27	1.01	1.30	1.27	1.29	1.13	1.23	1.03	0.99	0.97	0.86	0.81	0.71	0.59	0.49	0.46	0.38	0.33	0.30	0.24	0.19	0.15	0.15	0.13	0.12	0.07	0.05	0.03	0.01

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
1986	0.58	4.05	2.98	3.53	4.95	6.05	15.64	28.30	27.20	8.08	12.32	10.47	17.16	19.11	10.36	12.67	17.08	19.21	15.20	11.10	14.05	6.43	5.04	6.40	3.74	3.99	3.66	3.99	4.77	8.48
1987	0.30	1.12	1.96	3.17	3.75	9.25	21.05	22.45	6.97	10.75	9.32	16.25	19.54	10.44	13.63	19.57	24.64	18.84	14.01	15.91	7.94	6.56	6.92	5.27	5.43	5.13	5.30	5.82	6.58	5.25
1988	0.41	1.67	3.52	5.22	15.68	28.84	27.28	8.21	12.43	10.40	16.23	18.74	10.84	13.00	17.08	19.35	16.19	12.36	15.35	7.13	5.38	5.19	3.81	4.83	3.49	4.11	4.37	4.28	3.56	0.77
1989	0.50	2.23	4.63	16.80	31.66	29.78	8.54	12.86	10.49	17.00	19.44	10.95	13.25	18.45	20.48	17.83	13.49	16.35	7.32	5.32	4.94	3.53	4.78	3.58	4.05	4.23	4.20	3.33	1.04	0.72
1990	0.40	2.14	10.78	33.31	32.19	8.54	13.27	10.55	17.69	20.49	11.01	13.98	20.21	23.08	19.62	14.67	19.97	8.42	6.24	5.95	4.18	4.93	4.18	4.36	4.94	4.83	3.60	1.28	1.11	0.57
1991	0.39	5.99	28.52	31.64	7.88	13.23	10.68	18.67	21.36	11.01	15.43	21.96	26.11	21.72	16.14	19.64	9.39	6.60	6.61	4.22	4.79	4.01	4.31	4.57	4.64	3.39	1.48	1.19	0.78	0.44
1992	0.61	9.29	17.32	6.54	11.59	10.08	19.05	22.55	11.34	17.47	25.04	32.64	25.66	19.14	16.19	12.11	8.79	6.50	5.59	4.98	4.82	5.50	5.31	5.72	4.12	1.65	1.27	0.93	0.68	0.58
1993	1.37	6.64	4.70	8.54	8.13	14.65	18.82	10.73	16.89	25.65	39.45	29.21	21.91	17.37	12.69	9.76	7.86	6.85	5.99	5.85	6.63	6.27	6.60	4.90	2.28	1.58	1.16	1.01	0.85	0.85
1994	0.89	2.92	7.22	7.52	13.46	16.19	9.94	15.79	22.53	36.86	28.11	21.75	17.03	12.84	9.84	7.77	6.58	6.18	6.44	6.98	6.55	6.44	5.17	2.36	1.78	1.40	1.30	0.95	0.84	0.70
1995	1.91	9.86	9.89	21.66	20.87	10.51	18.25	24.97	33.47	28.13	23.19	18.61	14.05	9.07	6.02	5.16	4.60	4.49	5.15	4.74	4.98	4.51	2.95	1.93	1.33	1.48	1.22	1.13	0.83	0.91
1996	0.62	4.26	18.77	20.87	10.01	18.24	25.36	36.36	29.66	24.36	19.01	14.19	9.69	6.80	5.53	5.01	5.03	5.88	5.36	5.38	4.74	3.08	2.22	1.51	1.51	1.50	1.24	1.00	0.85	0.78
1997	0.98	14.96	24.47	11.25	21.87	25.89	34.94	28.89	24.04	19.13	14.33	9.82	6.28	4.86	4.34	4.35	5.24	4.92	4.99	4.59	3.20	2.19	1.82	1.61	1.41	1.13	1.12	0.89	0.83	0.78
1998	2.04	10.69	7.63	16.38	24.43	40.82	32.46	26.40	19.70	14.53	9.99	7.89	6.02	5.34	5.44	7.15	5.71	5.81	5.43	3.80	2.67	1.94	1.77	1.54	1.45	1.17	1.25	0.86	0.95	0.82
1999	0.96	3.53	13.40	22.97	40.01	32.06	26.71	19.57	14.23	9.94	8.15	6.30	5.69	5.94	8.03	6.31	6.40	5.83	3.88	2.84	1.95	1.76	1.46	1.40	1.28	1.16	1.07	0.98	0.86	0.70
2000	0.97	29.20	35.43	38.03	30.22	26.17	20.16	15.39	9.76	6.54	4.72	3.79	4.18	5.32	4.76	4.98	4.84	3.65	2.77	2.05	1.62	1.75	1.33	1.41	1.17	0.88	0.95	0.75	0.60	0.51
2001	5.72	22.50	46.22	34.25	27.78	20.13	14.06	9.78	8.65	5.94	4.94	5.24	7.58	5.80	5.66	5.25	3.83	2.79	1.84	1.51	1.36	1.31	1.23	1.08	0.93	0.83	0.76	0.72	0.59	0.51
2002	4.72	38.17	32.01	27.24	19.79	14.91	10.17	9.37	6.76	5.71	6.31	9.49	6.96	6.61	6.02	4.16	2.67	1.85	1.66	1.54	1.45	1.29	1.19	1.13	1.05	0.90	0.76	0.71	0.61	0.45
2003	11.38	22.13	25.24	18.03	13.13	8.84	9.11	7.26	6.80	8.26	13.36	8.35	8.16	7.41	4.59	2.83	1.93	1.87	1.66	1.49	1.44	1.41	1.26	1.18	1.07	1.01	0.80	0.78	0.69	0.48
2004	7.71	21.13	16.94	12.65	7.87	7.46	6.11	5.80	7.92	13.49	8.07	8.12	7.59	4.86	2.88	2.11	1.93	1.85	1.72	1.58	1.52	1.39	1.23	1.12	1.00	0.92	0.79	0.75	0.65	0.46
2005	7.19	11.80	11.00	7.59	7.29	5.68	5.28	7.66	13.54	7.96	7.98	6.35	3.19	1.73	1.19	1.15	1.14	0.97	0.91	0.84	0.81	0.73	0.64	0.63	0.48	0.48	0.45	0.40	0.36	0.28
2006	1.43	7.74	9.11	12.30	7.54	6.33	8.94	14.87	8.79	8.64	6.64	3.26	1.50	1.04	0.88	0.81	0.73	0.72	0.66	0.59	0.58	0.55	0.50	0.49	0.43	0.32	0.37	0.32	0.25	0.25
2007	1.44	11.39	15.90	8.07	5.88	7.95	13.44	8.68	8.17	6.57	3.74	1.70	1.02	0.93	0.87	0.67	0.73	0.64	0.60	0.59	0.47	0.50	0.42	0.40	0.33	0.25	0.32	0.25	0.25	0.21
2008	2.13	22.53	12.56	8.10	11.44	17.73	10.49	9.25	7.79	4.57	2.26	1.44	1.11	0.95	0.82	0.79	0.76	0.72	0.71	0.57	0.56	0.50	0.42	0.44	0.37	0.35	0.31	0.29	0.26	0.22
2009	6.14	9.06	7.98	15.10	21.69	10.85	14.21	12.66	7.27	3.59	2.39	1.88	1.63	1.47	1.37	1.36	1.25	1.14	0.99	0.93	0.86	0.79	0.70	0.67	0.62	0.57	0.53	0.49	0.44	0.36
2010	1.86	5.32	10.64	17.25	10.62	17.04	15.73	9.77	4.98	3.36	2.83	2.30	1.98	1.77	1.68	1.64	1.44	1.24	1.23	1.07	0.97	0.87	0.82	0.77	0.71	0.65	0.61	0.53	0.51	0.42
2011	0.61	9.01	16.41	11.46	17.59	19.11	14.23	7.42	5.03	4.33	3.62	2.92	2.52	2.37	2.14	1.87	1.64	1.56	1.43	1.29	1.17	1.08	1.01	0.94	0.85	0.75	0.74	0.71	0.57	0.49
2012	1.07	9.93	10.10	16.64	18.42	15.54	8.18	5.74	5.04	4.26	3.56	3.21	2.92	2.57	2.26	2.00	1.89	1.66	1.62	1.47	1.38	1.27	1.20	1.08	1.03	0.98	0.92	0.84	0.76	0.65
2013	1.10	5.79	14.39	15.84	14.17	8.21	5.71	5.10	4.45	3.69	3.39	3.21	2.84	2.56	2.22	2.19	1.95	1.81	1.62	1.54	1.47	1.40	1.33	1.20	1.22	1.14	1.04	0.99	0.95	0.74
2014	2.08	28.62	22.59	15.99	8.60	6.42	5.91	5.20	4.56	4.24	3.92	3.47	2.86	2.36	2.34	2.17	2.04	1.70	1.70	1.56	1.46	1.43	1.33	1.20	1.24	1.17	1.17	1.14	1.04	0.86
2015	3.74	14.76	12.39	6.79	5.61	5.87	5.31	4.80	4.42	4.18	3.88	3.21	2.50	2.48	2.28	2.12	1.83	1.80	1.75	1.58	1.50	1.36	1.29	1.24	1.21	1.19	1.13	1.04	0.97	0.87
2016	3.65	9.02	5.74	5.11	5.63	5.63	5.27	4.85	4.52	4.12	3.40	2.83	2.51	2.20	2.09	1.88	1.69	1.61	1.53	1.47	1.35	1.29	1.23	1.11	1.18	1.12	1.11	1.01	0.94	0.73
2017	2.67	5.91	5.89	6.39	6.47	6.42	6.26	5.89	5.11	4.52	3.42	3.14	2.50	2.26	2.00	1.88	1.66	1.53	1.53	1.36	1.22	1.26	1.20	1.14	1.19	1.10	0.95	0.94	0.90	0.68
2018	2.42	8.13	9.92	8.66	8.29	8.17	7.43	6.73	5.83	4.41	3.94	3.19	2.73	2.20	2.07	1.96	1.71	1.58	1.50	1.41	1.28	1.32	1.34	1.12	0.99	1.00	0.89	0.84	0.77	0.65
2019	2.71	11.55	10.86	9.67	9.55	9.47	8.89	7.32	5.67	4.91	4.00	3.34	2.65	2.45	2.25	2.01	1.89	1.72	1.65	1.46	1.38	1.34	1.39	1.13	1.05	1.05	0.91	0.83	0.77	0.65
2020	2.88	10.31	11.23	10.83	10.68	10.17	8.74	6.76	6.04	4.91	4.09	3.28	2.70	2.50	2.20	2.17	1.90	1.70	1.66	1.55	1.43	1.42	1.34	1.08	1.09	1.00	0.96	0.87	0.81	0.62
2021	2.98	11.73	12.23	11.18	11.00	10.04	7.91	7.18	5.82	4.86	3.85	3.35	2.83	2.39	2.25	2.13	1.91	1.65	1.69	1.58	1.40	1.29	1.29	1.17	1.10	0.97	0.97	0.80	0.85	0.62
2022	3.16	12.15	13.13	12.16	11.44	9.22	8.50	7.11	6.00	4.88	4.03	3.42	2.84	2.41	2.23	2.07	1.77	1.70	1.66	1.60	1.37	1.37	1.26	1.12	1.04	0.93	0.95	0.79	0.75	0.56
2023	3.27	13.74	13.97	12.40	10.25	9.78	8.43	7.07	5.92	5.05	4.09	3.56	2.98	2.65	2.26	2.12	2.00	1.78	1.79	1.56	1.51	1.49	1.24	1.15	1.05	0.97	0.97	0.82	0.80	0.60

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
1986	0.01	0.45	2.08	4.03	5.76	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	10.08	10.13	10.15	10.17	10.18	10.19	10.21	10.22	10.23	10.24	10.25	10.25	10.26	10.26	10.27
1989	0.01	0.34	1.40	2.89	4.37	5.69	6.67	7.39	7.98	8.40	8.70	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	9.37	9.37	9.37
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	8.17	8.19	8.20	8.21	8.22	8.22	8.23	8.24	8.24	8.24
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	7.43	7.43	7.44	7.44	7.45	7.45
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	6.53	6.54	6.54	6.55	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	5.78	5.80	5.81	5.83	5.84	5.84	5.85	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	6.19	6.19	6.20	6.21
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	8.25	8.29	8.32	8.33	8.34	8.35	8.36	8.37	8.38	8.39
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	7.47	7.52	7.56	7.60	7.64	7.67	7.68	7.69	7.71	7.72	7.72	7.73	7.74	7.75
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	7.00	7.05	7.10	7.14	7.18	7.20	7.22	7.24	7.25	7.27	7.28	7.29	7.30	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	5.70	5.77	5.84	5.89	5.94	5.96	5.98	6.00	6.01	6.02	6.03	6.04	6.05	6.05	6.06
1999	0.01	0.32	1.15	2.19	3.33	4.10	4.56	4.82	4.99	5.13	5.26	5.40	5.54	5.67	5.79	5.89	5.97	6.05	6.11	6.14	6.16	6.18	6.19	6.20	6.21	6.22	6.23	6.23	6.24	6.24
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	7.08	7.18	7.27	7.35	7.42	7.45	7.48	7.50	7.52	7.54	7.55	7.57	7.58	7.59	7.59	7.60	7.61
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	6.17	6.30	6.42	6.52	6.60	6.64	6.67	6.70	6.72	6.73	6.74	6.75	6.76	6.77	6.77	6.78	6.78	6.78
2002	0.01	0.46	1.67	2.75	3.46	3.96	4.37	4.73	5.12	5.45	5.75	6.06	6.27	6.45	6.62	6.74	6.81	6.86	6.91	6.94	6.96	6.98	7.00	7.02	7.03	7.04	7.05	7.05	7.06	7.07
2003	0.01	0.61	1.68	2.55	3.22	3.83	4.42	5.10	5.66	6.24	6.85	7.27	7.58	7.87	8.08	8.19	8.28	8.36	8.42	8.47	8.50	8.53	8.55	8.57	8.58	8.60	8.61	8.62	8.63	8.63
2004	0.12	0.93	1.97	2.95	3.98	4.98	6.10	7.05	8.01	9.04	9.78	10.32	10.81	11.20	11.40	11.58	11.72	11.84	11.92	11.99	12.04	12.09	12.13	12.15	12.18	12.20	12.23	12.24	12.26	12.27
2005	0.11	0.82	2.30	4.16	6.19	8.41	10.23	12.01	13.93	15.31	16.36	17.27	17.96	18.34	18.66	18.93	19.13	19.29	19.42	19.53	19.62	19.70	19.76	19.82	19.86	19.91	19.95	19.98	20.01	20.03
2006	0.02	0.63	2.64	5.62	9.14	11.84	14.46	17.31	19.30	20.76	22.01	22.90	23.35	23.72	24.04	24.26	24.42	24.55	24.65	24.73	24.80	24.84	24.89	24.93	24.96	24.98	25.00	25.02	25.03	25.04
2007	0.02	0.83	3.59	7.65	10.66	13.90	18.11	20.80	22.62	24.21	25.38	25.94	26.42	26.81	27.09	27.30	27.45	27.57	27.66	27.73	27.80	27.84	27.88	27.92	27.94	27.96	27.97	27.99	28.00	28.00
2008	0.01	0.69	3.28	5.91	8.91	12.98	15.61	17.30	18.69	19.71	20.18	20.59	20.91	21.14	21.31	21.43	21.52	21.59	21.65	21.70	21.74	21.77	21.79	21.81	21.83	21.85	21.86	21.86	21.87	21.88
2009	0.01	0.51	1.66	3.34	5.86	7.76	9.04	10.07	10.87	11.28	11.61	11.88	12.06	12.20	12.30	12.37	12.43	12.49	12.53	12.57	12.59	12.62	12.64	12.65	12.67	12.68	12.69	12.70	12.71	12.71
2010	0.01	0.23	0.91	2.19	3.38	4.31	5.10	5.77	6.13	6.45	6.72	6.91	7.06	7.18	7.26	7.33	7.39	7.45	7.49	7.53	7.56	7.59	7.61	7.63	7.65	7.67	7.68	7.69	7.70	7.71
2011	0.01	0.22	0.82	1.47	2.05	2.62	3.13	3.44	3.72	3.94	4.10	4.22	4.32	4.39	4.45	4.50	4.54	4.58	4.61	4.65	4.67	4.70	4.72	4.73	4.75	4.76	4.78	4.79	4.80	4.81
2012	0.01	0.15	0.46	0.82	1.28	1.76	2.06	2.33	2.57	2.73	2.85	2.94	3.02	3.07	3.13	3.16	3.20	3.23	3.26	3.28	3.31	3.32	3.34	3.36	3.37	3.38	3.39	3.40	3.41	3.42
2013	0.01	0.11	0.36	0.81	1.33	1.67	1.99	2.27	2.49	2.65	2.76	2.86	2.94	3.00	3.06	3.11	3.16	3.20	3.23	3.26	3.29	3.32	3.33	3.35	3.37	3.38	3.40	3.41	3.41	3.42
2014	0.00	0.09	0.57	1.27	1.72	2.17	2.55	2.86	3.10	3.29	3.44	3.57	3.69	3.78	3.86	3.93	3.99	4.04	4.09	4.12	4.16	4.19	4.21	4.23	4.25	4.27	4.28	4.29	4.30	4.31
2015	0.00	0.14	0.74	1.34	1.94	2.52	2.99	3.36	3.66	3.91	4.12	4.29	4.44	4.57	4.68	4.78	4.86	4.94	5.00	5.04	5.09	5.14	5.16	5.19	5.21	5.23	5.25	5.27	5.28	5.29
2016	0.01	0.20	0.77	1.51	2.23	2.82	3.33	3.73	4.08	4.37	4.62	4.82	4.99	5.12	5.26	5.38	5.49	5.58	5.65	5.72	5.78	5.82	5.85	5.88	5.91	5.94	5.96	5.97	5.98	5.99
2017	0.01	0.24	1.12	2.18	3.03	3.76	4.38	4.89	5.33	5.71	6.00	6.27	6.48	6.67	6.84	6.97	7.11	7.21	7.31	7.39	7.45	7.50	7.53	7.57	7.59	7.62	7.63	7.64	7.65	7.66
2018	0.01	0.37	1.52	2.72	3.73	4.55	5.23	5.82	6.31	6.70	7.06	7.32	7.59	7.80	7.98	8.16	8.30	8.42	8.53	8.61	8.68	8.73	8.79	8.83	8.86	8.88	8.89	8.91	8.92	8.92
2019	0.01	0.41	1.43	2.53	3.42	4.12	4.77	5.28	5.69	6.06	6.33	6.59	6.81	7.00	7.17	7.33	7.46	7.57	7.66	7.73	7.79	7.84	7.88	7.91	7.94	7.96	7.97	7.98	7.99	7.99
2020	0.01	0.30	1.21	2.20	2.98	3.64	4.21	4.67	5.06	5.37	5.68	5.90	6.11	6.29	6.47	6.62	6.75	6.86	6.94	7.01	7.07	7.12	7.16	7.19	7.22	7.24	7.25	7.26	7.27	7.27
2021	0.01	0.29	1.18	2.08	2.88	3.52	4.04	4.53	4.88	5.24	5.51	5.76	5.97	6.15	6.32	6.48	6.60	6.70	6.79	6.87	6.93	6.98	7.02	7.06	7.08	7.10	7.12	7.13	7.14	7.14
2022	0.01	0.28	1.09	2.02	2.80	3.45	4.06	4.52	4.95	5.29	5.61	5.88	6.10	6.30	6.49	6.64	6.76	6.86	6.95	7.02	7.08	7.12	7.17	7.20	7.23	7.25	7.26	7.28	7.28	7.29
2023	0.01	0.27	1.12	2.04	2.81	3.50	4.04	4.57	4.97	5.33	5.66	5.93	6.17	6.38	6.54	6.67	6.79	6.89	6.97	7.04	7.09	7.14	7.17	7.20	7.23	7.26	7.27	7.28	7.29	7.29

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
1986	0.583	4.623	7.467	10.68	14.93	19.77	31.26	48.39	59.88	62.34	65.71	68.18	71.71	74.91	76.51	78.79	80.39	81.87	82.81	83.4	84.09	84.34	84.52	84.75	84.88	85.05	85.16	85.28	85.43	85.94
1987	0.30	1.43	3.36	6.39	9.84	17.87	34.18	47.68	50.91	55.46	58.95	64.34	69.69	72.03	75.04	78.73	81.78	83.51	84.56	85.59	86.06	86.38	86.70	86.93	87.18	87.46	87.65	87.85	88.08	88.25
1988	0.41	2.08	5.52	10.38	24.00	44.65	58.16	61.04	64.93	67.72	71.53	75.11	76.79	78.56	80.66	82.75	83.91	84.65	85.44	85.77	86.02	86.22	86.37	86.55	86.70	86.87	87.02	87.16	87.26	87.28
1989	0.50	2.73	7.22	22.60	46.22	60.94	63.80	67.61	70.24	73.96	77.39	78.92	80.55	82.49	84.30	85.61	86.31	87.02	87.29	87.49	87.68	87.80	87.94	88.05	88.17	88.32	88.42	88.50	88.53	88.55
1990	0.40	2.54	13.04	41.61	59.49	62.60	66.87	69.74	73.92	77.80	79.43	81.23	83.44	85.44	86.80	87.68	88.52	88.80	88.99	89.18	89.31	89.44	89.55	89.65	89.78	89.90	89.97	90.00	90.02	90.03
1991	0.39	6.37	33.07	53.81	57.25	62.41	65.93	71.27	76.10	78.02	80.36	83.14	85.69	87.24	88.19	89.22	89.54	89.75	89.94	90.06	90.21	90.30	90.40	90.51	90.61	90.69	90.71	90.74	90.75	90.76
1992	0.62	9.89	25.48	30.32	38.22	44.21	54.15	63.44	67.01	71.80	77.37	82.75	85.58	87.16	88.30	89.19	89.59	89.85	90.07	90.25	90.44	90.62	90.77	90.94	91.05	91.09	91.12	91.14	91.16	91.18
1993	1.38	7.96	12.31	19.80	26.24	36.72	47.96	53.11	60.22	69.05	79.03	83.48	85.87	87.41	88.55	89.75	90.11	90.40	90.64	90.87	91.16	91.36	91.55	91.68	91.74	91.78	91.81	91.83	91.86	91.88
1994	0.90	3.81	10.76	17.44	28.31	39.39	45.02	52.93	62.31	74.06	79.68	82.81	84.79	86.08	87.41	88.44	88.82	89.15	89.47	89.83	90.16	90.41	90.60	90.68	90.73	90.78	90.82	90.85	90.88	90.91
1995	1.92	11.62	20.37	37.35	49.77	54.55	61.78	69.68	77.47	81.71	84.17	85.66	86.58	87.09	87.49	87.86	88.06	88.23	88.42	88.60	88.77	88.91	89.04	89.12	89.15	89.18	89.21	89.23
1996	0.62	4.88	22.74	38.56	44.41	53.73	64.09	74.97	80.45	83.54	85.34	86.42	87.06	87.48	87.88	88.29	88.51	88.75	88.96	89.16	89.32	89.42	89.48	89.53	89.57	89.61	89.65	89.68	89.70	89.73
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	88.97	89.19	89.38	89.56	89.72	89.82	89.88	89.94	89.99	90.03	90.06	90.09	90.12	90.14	90.17
1998	2.05	12.56	19.24	32.31	48.33	68.17	77.21	82.04	84.63	86.14	87.03	87.66	88.10	88.48	88.88	89.43	89.72	89.98	90.22	90.37	90.47	90.54	90.60	90.65	90.70	90.74	90.79	90.82	90.85	90.88
1999	0.97	4.49	17.29	36.07	60.87	72.38	78.67	81.96	83.85	84.97	85.80	86.38	86.89	87.38	88.06	88.64	89.00	89.30	89.48	89.61	89.70	89.77	89.83	89.89	89.94	89.99	90.03	90.07	90.11	90.14
2000	0.97	29.98	54.66	71.24	78.85	83.13	85.43	86.78	87.48	87.89	88.16	88.36	88.57	88.82	89.05	89.27	89.44	89.56	89.65	89.71	89.76	89.80	89.84	89.88	89.91	89.94	89.96	89.98	90.00	90.01
2001	5.74	27.04	60.70	73.60	80.10	83.32	85.04	86.04	86.81	87.29	87.65	88.00	88.47	88.80	89.11	89.38	89.53	89.64	89.71	89.77	89.81	89.86	89.90	89.94	89.97	90.00	90.02	90.05	90.07	90.09
2002	4.75	41.28	60.00	70.48	75.80	78.91	80.67	82.08	82.98	83.68	84.38	85.34	85.96	86.52	87.01	87.29	87.44	87.55	87.64	87.73	87.80	87.87	87.93	87.99	88.04	88.08	88.12	88.15	88.19	88.21
2003	11.45	31.15	48.45	57.48	62.76	65.79	68.59	70.57	72.25	74.11	76.76	78.17	79.42	80.50	81.15	81.48	81.68	81.86	82.02	82.16	82.29	82.42	82.53	82.63	82.72	82.81	82.88	82.94	83.01	83.06
2004	7.82	27.38	39.58	47.01	50.98	54.36	56.88	59.05	61.77	65.88	67.95	69.81	71.44	72.46	73.07	73.41	73.70	73.97	74.21	74.43	74.63	74.81	74.97	75.11	75.23	75.35	75.45	75.54	75.63	75.70
2005	7.31	18.31	27.27	32.65	37.29	40.52	43.24	46.84	52.43	55.15	57.55	59.26	60.08	60.53	60.85	61.11	61.34	61.54	61.72	61.88	62.03	62.16	62.28	62.39	62.48	62.57	62.65	62.72	62.79	62.85
2006	1.44	9.10	17.35	27.24	32.32	36.05	40.74	47.44	50.56	53.19	54.95	55.73	56.09	56.34	56.56	56.73	56.87	57.01	57.14	57.24	57.35	57.45	57.54	57.63	57.71	57.77	57.83	57.89	57.94	58.00
2007	1.45	12.71	26.52	32.18	35.74	40.04	46.27	49.39	51.84	53.55	54.40	54.76	54.98	55.17	55.35	55.48	55.61	55.72	55.82	55.92	56.00	56.08	56.15	56.22	56.27	56.31	56.37	56.41	56.46	56.50
2008	2.14	24.27	33.72	38.85	45.22	53.41	56.96	59.52	61.35	62.28	62.71	62.97	63.18	63.35	63.51	63.65	63.76	63.87	63.97	64.06	64.14	64.21	64.27	64.33	64.39	64.44	64.48	64.52	64.56	64.60
2009	6.17	14.73	21.52	33.23	47.07	52.23	57.96	62.17	64.22	65.15	65.74	66.20	66.60	66.96	67.30	67.60	67.85	68.08	68.28	68.46	68.62	68.78	68.91	69.04	69.16	69.26	69.36	69.46	69.55	69.63
2010	1.88	7.14	17.08	31.33	38.45	48.44	55.93	59.77	61.53	62.67	63.60	64.35	65.00	65.58	66.13	66.60	66.97	67.29	67.60	67.87	68.12	68.33	68.53	68.72	68.89	69.05	69.20	69.34	69.47	69.60
2011	0.62	9.64	24.54	33.17	44.76	54.98	61.05	63.74	65.44	66.84	67.98	68.90	69.69	70.44	71.12	71.62	72.01	72.37	72.70	73.00	73.26	73.49	73.72	73.92	74.11	74.28	74.44	74.60	74.74	74.88
2012	1.08	11.01	20.08	33.40	45.60	53.88	57.53	59.89	61.85	63.47	64.80	65.99	67.09	68.07	68.95	69.60	70.10	70.53	70.95	71.32	71.67	71.98	72.27	72.53	72.78	73.02	73.24	73.44	73.63	73.82
2013	1.11	6.90	20.36	33.02	42.46	47.10	50.05	52.53	54.60	56.25	57.73	59.11	60.31	61.40	62.35	63.16	63.82	64.41	64.94	65.44	65.90	66.33	66.74	67.10	67.47	67.81	68.12	68.42	68.72	68.98
2014	2.10	30.32	46.15	54.72	58.54	61.11	63.31	65.12	66.62	67.95	69.13	70.14	70.96	71.63	72.28	72.82	73.30	73.69	74.07	74.42	74.73	75.04	75.32	75.57	75.83	76.07	76.31	76.55	76.77	76.99
2015	3.78	18.11	28.30	33.16	36.86	40.49	43.56	46.16	48.43	50.48	52.30	53.76	54.86	55.94	56.91	57.76	58.45	59.12	59.76	60.33	60.87	61.34	61.79	62.21	62.63	63.03	63.41	63.77	64.12	64.48
2016	3.68	12.43	17.48	21.70	26.06	30.13	33.71	36.80	39.53	41.91	43.79	45.31	46.62	47.75	48.81	49.71	50.48	51.20	51.88	52.52	53.10	53.64	54.16	54.62	55.11	55.58	56.03	56.46	56.88	57.24
2017	2.69	8.48	13.89	19.34	24.45	29.13	33.36	37.06	40.06	42.57	44.38	45.98	47.22	48.31	49.27	50.13	50.85	51.51	52.15	52.72	53.21	53.72	54.20	54.66	55.14	55.58	55.96	56.35	56.73	57.07
2018	2.43	10.40	19.29	26.17	32.09	37.35	41.69	45.29	48.18	50.22	51.95	53.30	54.41	55.29	56.10	56.83	57.44	57.99	58.51	58.98	59.41	59.84	60.28	60.64	60.96	61.28	61.57	61.85	62.13	62.39
2019	2.73	14.01	23.34	30.65	37.06	42.73	47.49	51.01	53.52	55.57	57.13	58.38	59.35	60.21	60.99	61.65	62.25	62.78	63.27	63.71	64.11	64.50	64.90	65.22	65.51	65.81	66.07	66.31	66.55	66.77
2020	2.90	12.95	22.73	30.99	38.16	44.17	48.76	51.97	54.62	56.63	58.22	59.44	60.41	61.29	62.04	62.74	63.33	63.84	64.33	64.79	65.20	65.60	65.97	66.27	66.57	66.85	67.12	67.37	67.60	67.82
2021	3.00	14.43	24.89	33.19	40.33	46.06	50.08	53.41	55.88	57.82	59.27	60.48	61.47	62.28	63.03	63.69	64.26	64.75	65.24	65.69	66.08	66.44	66.79	67.11	67.40	67.66	67.93	68.15	68.40	68.61
2022	3.17	14.99	26.15	35.02	42.24	47.33	51.54	54.72	57.18	59.06	60.52	61.71	62.65	63.43	64.14	64.75	65.26	65.74	66.21	66.64	67.01	67.37	67.70	67.99	68.25	68.49	68.75	68.96	69.17	69.35
2023	3.28	16.63	28.27	37.05	43.31	48.60	52.66	55.73	58.10	59.98	61.42	62.61	63.57	64.38	65.07	65.69	66.25	66.73	67.22	67.62	68.01	68.39	68.70	68.99	69.26	69.50	69.75	69.96	70.18	70.38

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
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	0.43	0.28	0.20	0.20	0.14	0.17	0.20	0.24	0.15	0.13	0.09	0.07
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	0.44	0.41	0.30	0.20	0.18	0.15	0.25	0.23	0.28	0.20	0.19	0.12	0.14	**0.10**
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	0.33	0.36	0.30	0.28	0.16	0.18	**0.16**	**0.18**
1989	0.01	0.31	1.06	1.62	1.98	2.72	3.02	2.50	2.41	2.01	1.79	1.58	0.98	0.85	0.76	0.74	0.58	0.49	0.37	0.33	0.37	0.47	0.46	0.45	0.34	0.22	0.23	**0.30**	**0.24**	**0.06**
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	0.56	0.49	0.48	0.47	0.40	0.62	0.55	0.47	0.54	0.30	0.33	**0.38**	**0.33**	**0.12**	**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	0.49	0.64	0.47	0.58	0.39	0.41	**0.44**	**0.45**	**0.10**	**0.04**	**0.03**
1992	0.01	0.22	0.85	1.40	1.43	1.76	1.69	1.61	1.41	1.00	0.79	0.70	0.68	0.61	0.49	0.39	0.46	0.42	0.46	0.60	0.50	0.61	0.40	0.52	**0.45**	**0.57**	**0.18**	**0.09**	**0.10**	**0.04**
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	0.53	0.74	0.57	0.71	**0.51**	**0.55**	**0.21**	**0.12**	**0.12**	**0.06**	**0.01**
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	0.52	0.74	0.59	0.64	**0.65**	**0.64**	**0.25**	**0.11**	**0.13**	**0.10**	**0.07**	**0.05**
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	0.88	0.96	1.22	1.11	0.92	1.08	0.86	1.06	**1.16**	**0.77**	**0.29**	**0.21**	**0.15**	**0.09**	**0.05**	**0.04**	**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	1.20	1.23	1.05	1.24	**1.10**	**0.90**	**0.40**	**0.34**	**0.19**	**0.18**	**0.12**	**0.07**	**0.06**	**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	1.20	1.49	1.27	1.33	**1.30**	**1.25**	**0.46**	**0.40**	**0.42**	**0.24**	**0.10**	**0.13**	**0.08**	**0.06**	**0.05**
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	1.57	1.52	1.45	1.69	1.39	1.49	**1.39**	**1.16**	**0.46**	**0.42**	**0.32**	**0.26**	**0.18**	**0.15**	**0.12**	**0.10**	**0.06**	**0.04**
1999	0.01	0.35	0.98	1.43	2.09	2.45	2.26	1.79	1.47	1.44	1.49	1.86	1.91	1.78	1.96	1.64	1.63	**1.71**	**1.27**	**0.57**	**0.52**	**0.46**	**0.33**	**0.21**	**0.19**	**0.12**	**0.13**	**0.08**	**0.06**	**0.05**
2000	0.01	0.49	2.07	4.24	5.19	4.47	3.65	3.03	2.97	2.76	3.27	2.91	2.61	2.90	2.36	2.56	**2.46**	**2.05**	**0.92**	**0.86**	**0.74**	**0.57**	**0.48**	**0.30**	**0.25**	**0.15**	**0.14**	**0.07**	**0.09**	**0.02**
2001	0.01	0.50	1.99	3.92	4.10	3.44	2.91	2.79	2.60	3.17	3.07	2.90	3.11	2.46	2.53	**2.37**	**2.04**	**0.94**	**0.94**	**0.69**	**0.50**	**0.37**	**0.32**	**0.16**	**0.21**	**0.18**	**0.10**	**0.08**	**0.05**	**0.04**
2002	0.01	0.52	2.30	3.21	2.98	2.60	2.43	2.43	3.07	2.86	2.85	3.25	2.65	2.60	**2.62**	**1.99**	**1.12**	**0.94**	**0.72**	**0.47**	**0.42**	**0.32**	**0.20**	**0.26**	**0.18**	**0.10**	**0.09**	**0.07**	**0.07**	**0.03**
2003	0.01	0.77	1.82	2.09	1.93	1.97	2.14	2.83	2.58	2.87	3.49	2.94	2.52	**2.59**	**2.06**	**1.02**	**0.95**	**0.83**	**0.68**	**0.45**	**0.38**	**0.21**	**0.23**	**0.19**	**0.13**	**0.14**	**0.10**	**0.07**	**0.05**	**0.04**
2004	0.12	0.96	1.59	1.85	2.20	2.35	3.01	2.83	3.12	3.84	3.43	2.87	**2.99**	**2.65**	**1.37**	**1.22**	**1.02**	**0.82**	**0.61**	**0.50**	**0.36**	**0.28**	**0.24**	**0.16**	**0.16**	**0.10**	**0.14**	**0.07**	**0.08**	**0.03**
2005	0.11	0.74	1.76	2.52	3.10	3.87	3.60	3.89	4.85	4.39	3.84	**3.78**	**3.14**	**1.72**	**1.43**	**1.15**	**0.86**	**0.68**	**0.49**	**0.37**	**0.32**	**0.27**	**0.17**	**0.16**	**0.10**	**0.12**	**0.10**	**0.06**	**0.04**	**0.03**
2006	0.01	0.56	2.17	3.68	5.24	4.65	5.02	6.49	5.82	5.04	**4.96**	**4.05**	**2.12**	**1.80**	**1.57**	**1.07**	**0.77**	**0.64**	**0.45**	**0.36**	**0.31**	**0.19**	**0.20**	**0.11**	**0.10**	**0.12**	**0.06**	**0.05**	**0.04**	**0.03**
2007	0.02	0.79	3.12	5.74	4.92	5.97	9.12	7.60	6.17	**6.32**	**5.24**	**2.74**	**2.41**	**2.03**	**1.48**	**1.14**	**0.87**	**0.62**	**0.50**	**0.37**	**0.36**	**0.24**	**0.20**	**0.17**	**0.10**	**0.10**	**0.08**	**0.06**	**0.04**	**0.03**
2008	0.01	0.66	3.34	4.09	5.36	8.76	7.73	6.18	**5.93**	**5.02**	**2.50**	**2.27**	**1.89**	**1.36**	**1.06**	**0.74**	**0.55**	**0.46**	**0.36**	**0.29**	**0.26**	**0.17**	**0.15**	**0.13**	**0.09**	**0.09**	**0.05**	**0.05**	**0.04**	**0.03**
2009	0.01	0.44	1.08	1.81	3.36	3.47	2.80	**2.72**	**2.42**	**1.37**	**1.18**	**1.00**	**0.73**	**0.54**	**0.41**	**0.28**	**0.26**	**0.23**	**0.17**	**0.15**	**0.12**	**0.10**	**0.08**	**0.06**	**0.05**	**0.06**	**0.04**	**0.04**	**0.02**	**0.01**
2010	0.00	0.13	0.51	1.18	1.47	1.39	**1.47**	**1.54**	**0.92**	**0.89**	**0.76**	**0.56**	**0.44**	**0.33**	**0.23**	**0.23**	**0.18**	**0.17**	**0.14**	**0.09**	**0.10**	**0.08**	**0.07**	**0.05**	**0.05**	**0.05**	**0.04**	**0.03**	**0.02**	**0.01**
2011	0.00	0.11	0.41	0.68	0.76	**0.98**	**1.13**	**0.80**	**0.76**	**0.70**	**0.47**	**0.40**	**0.29**	**0.24**	**0.17**	**0.16**	**0.14**	**0.13**	**0.11**	**0.10**	**0.08**	**0.07**	**0.06**	**0.05**	**0.05**	**0.05**	**0.04**	**0.03**	**0.03**	**0.02**
2012	0.00	0.07	0.26	0.38	**0.67**	**0.91**	**0.69**	**0.71**	**0.67**	**0.47**	**0.35**	**0.28**	**0.22**	**0.17**	**0.15**	**0.12**	**0.12**	**0.10**	**0.10**	**0.06**	**0.07**	**0.06**	**0.06**	**0.05**	**0.04**	**0.05**	**0.03**	**0.03**	**0.03**	**0.02**
2013	0.00	0.06	0.20	**0.58**	**0.82**	**0.65**	**0.69**	**0.66**	**0.56**	**0.43**	**0.32**	**0.24**	**0.23**	**0.18**	**0.17**	**0.14**	**0.12**	**0.11**	**0.11**	**0.09**	**0.09**	**0.07**	**0.05**	**0.06**	**0.05**	**0.05**	**0.04**	**0.04**	**0.02**	**0.02**
2014	0.00	0.08	**0.72**	**1.41**	**1.05**	**1.20**	**1.12**	**0.97**	**0.81**	**0.69**	**0.55**	**0.51**	**0.47**	**0.35**	**0.35**	**0.28**	**0.27**	**0.23**	**0.21**	**0.15**	**0.16**	**0.14**	**0.10**	**0.10**	**0.09**	**0.08**	**0.06**	**0.06**	**0.05**	**0.04**
2015	0.00	**0.14**	**0.71**	**0.85**	**0.93**	**0.99**	**0.87**	**0.75**	**0.65**	**0.58**	**0.48**	**0.44**	**0.38**	**0.34**	**0.26**	**0.27**	**0.22**	**0.20**	**0.17**	**0.13**	**0.15**	**0.13**	**0.08**	**0.07**	**0.07**	**0.07**	**0.06**	**0.04**	**0.04**	**0.02**
2016	**0.01**	**0.20**	**0.63**	**0.93**	**0.93**	**0.88**	**0.81**	**0.70**	**0.61**	**0.55**	**0.50**	**0.39**	**0.37**	**0.29**	**0.28**	**0.25**	**0.25**	**0.21**	**0.16**	**0.15**	**0.15**	**0.11**	**0.08**	**0.08**	**0.07**	**0.06**	**0.04**	**0.04**	**0.02**	**0.02**
2017	**0.01**	**0.21**	**0.93**	**1.28**	**1.13**	**1.07**	**0.99**	**0.87**	**0.80**	**0.72**	**0.62**	**0.59**	**0.47**	**0.42**	**0.37**	**0.32**	**0.33**	**0.26**	**0.23**	**0.20**	**0.16**	**0.12**	**0.10**	**0.11**	**0.07**	**0.05**	**0.04**	**0.03**	**0.02**	**0.02**
2018	**0.01**	**0.33**	**1.25**	**1.53**	**1.44**	**1.31**	**1.18**	**1.11**	**1.01**	**0.85**	**0.83**	**0.65**	**0.71**	**0.55**	**0.48**	**0.48**	**0.42**	**0.35**	**0.33**	**0.25**	**0.20**	**0.18**	**0.16**	**0.13**	**0.10**	**0.07**	**0.05**	**0.03**	**0.03**	**0.02**
2019	**0.01**	**0.36**	**1.14**	**1.46**	**1.34**	**1.18**	**1.22**	**1.08**	**0.94**	**0.90**	**0.70**	**0.73**	**0.64**	**0.55**	**0.52**	**0.49**	**0.45**	**0.37**	**0.29**	**0.25**	**0.22**	**0.18**	**0.13**	**0.12**	**0.10**	**0.06**	**0.05**	**0.03**	**0.02**	**0.02**
2020	**0.01**	**0.29**	**1.01**	**1.29**	**1.16**	**1.12**	**1.11**	**0.97**	**0.88**	**0.77**	**0.80**	**0.64**	**0.61**	**0.53**	**0.52**	**0.45**	**0.42**	**0.34**	**0.26**	**0.25**	**0.21**	**0.16**	**0.13**	**0.11**	**0.10**	**0.05**	**0.04**	**0.04**	**0.03**	**0.02**
2021	**0.01**	**0.29**	**0.99**	**1.19**	**1.22**	**1.13**	**1.04**	**1.06**	**0.83**	**0.91**	**0.76**	**0.70**	**0.64**	**0.55**	**0.53**	**0.51**	**0.41**	**0.33**	**0.30**	**0.26**	**0.21**	**0.19**	**0.17**	**0.13**	**0.09**	**0.07**	**0.05**	**0.03**	**0.03**	**0.02**
2022	**0.01**	**0.28**	**0.92**	**1.26**	**1.23**	**1.15**	**1.25**	**1.04**	**1.03**	**0.90**	**0.90**	**0.80**	**0.68**	**0.68**	**0.62**	**0.54**	**0.44**	**0.36**	**0.31**	**0.25**	**0.23**	**0.17**	**0.17**	**0.15**	**0.10**	**0.06**	**0.06**	**0.04**	**0.03**	**0.02**
2023	**0.01**	**0.27**	**1.00**	**1.30**	**1.24**	**1.29**	**1.14**	**1.24**	**1.02**	**0.98**	**0.94**	**0.86**	**0.80**	**0.70**	**0.57**	**0.48**	**0.45**	**0.37**	**0.31**	**0.28**	**0.22**	**0.19**	**0.15**	**0.14**	**0.11**	**0.09**	**0.06**	**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
1986	0.59	4.03	2.87	3.42	4.85	5.93	15.60	28.62	27.56	8.05	12.38	10.45	17.34	19.31	10.26	12.37	17.11	19.21	15.24	11.10	14.02	6.40	4.98	6.35	3.72	3.96	3.59	3.92	4.67	8.45
1987	0.26	0.94	1.81	3.02	3.61	9.24	21.16	22.49	6.88	10.76	9.26	16.26	19.51	10.29	13.42	19.33	24.48	18.82	14.08	15.87	7.87	6.48	6.82	5.26	5.38	5.07	5.25	5.79	6.66	5.27
1988	0.30	1.32	3.19	4.92	15.81	29.75	28.25	8.30	12.70	10.53	16.62	19.26	10.80	12.74	17.28	19.50	16.51	12.37	15.57	6.99	5.24	4.94	3.66	4.90	3.41	4.05	4.35	4.15	3.47	0.76
1989	0.32	1.85	4.37	16.81	32.16	30.23	8.50	12.94	10.55	17.16	19.71	10.99	13.27	18.50	20.66	17.98	13.57	16.53	7.22	5.22	4.81	3.55	4.77	3.57	4.04	4.24	4.17	3.35	1.04	0.74
1990	0.26	1.63	10.35	33.66	32.57	8.51	13.23	10.51	17.78	20.72	11.00	13.92	20.32	23.19	19.67	14.64	19.98	8.33	6.20	5.95	4.20	4.91	4.17	4.35	4.95	4.84	3.65	1.30	1.09	0.58
1991	0.29	5.14	29.49	33.27	7.88	13.35	10.54	18.93	21.72	10.81	14.87	21.80	26.29	21.88	16.07	19.35	8.99	6.41	6.50	4.25	4.78	4.01	4.32	4.64	4.67	3.42	1.54	1.26	0.80	0.45
1992	0.36	8.11	18.40	6.10	10.82	9.39	18.75	23.09	10.72	16.52	25.18	34.02	27.03	19.85	15.86	11.36	8.29	6.81	5.61	5.13	4.99	5.70	5.48	5.63	4.22	1.84	1.46	0.99	0.74	0.62
1993	0.63	4.14	3.74	7.06	7.24	13.31	17.95	10.17	15.65	25.14	40.45	30.74	23.13	16.91	12.40	9.29	7.92	6.67	6.09	6.14	6.92	6.42	7.07	5.11	2.60	1.92	1.43	0.95	0.88	0.98
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	16.88	12.37	9.17	7.38	6.42	6.17	6.61	7.40	6.88	6.52	5.13	2.59	1.96	1.57	1.33	1.03	0.88	0.81
1995	2.01	9.45	7.32	17.93	20.16	9.58	16.26	24.67	34.94	28.83	23.35	18.10	13.12	8.68	6.02	5.35	5.05	4.97	5.36	5.01	5.17	4.79	3.30	2.17	1.39	1.60	1.28	1.23	0.87	0.94
1996	0.38	2.75	12.65	17.35	8.59	15.83	24.78	37.26	30.03	24.68	18.66	13.46	9.17	6.70	5.37	5.15	5.38	6.24	5.51	5.61	4.90	3.31	2.44	1.61	1.58	1.52	1.26	1.03	0.87	0.84
1997	0.71	11.17	18.61	7.96	16.23	25.36	36.82	29.82	24.31	18.25	12.89	9.04	6.34	4.98	4.66	4.81	5.79	5.19	5.30	4.76	3.49	2.40	1.97	1.67	1.39	1.16	1.15	0.94	0.89	0.82
1998	0.99	6.21	5.83	13.19	22.47	39.91	31.93	26.06	19.16	13.67	9.49	7.73	5.99	5.26	5.42	7.18	5.72	5.83	5.46	3.85	2.76	1.99	1.71	1.54	1.46	1.20	1.30	0.87	0.97	0.85
1999	0.52	2.79	12.10	22.12	38.92	31.49	26.31	19.08	13.69	9.50	7.99	6.19	5.46	5.69	5.99	6.25	5.73	3.92	2.89	1.96	1.74	1.41	1.35	1.24	1.13	1.09	1.00	0.89	0.72	
2000	0.88	28.79	36.15	39.25	31.02	26.06	18.99	13.54	8.72	6.53	4.70	3.96	4.33	5.43	4.73	4.93	4.67	3.60	2.81	1.97	1.53	1.64	1.27	1.34	1.12	0.86	0.92	0.78	0.58	0.52
2001	5.40	19.79	45.21	33.60	26.83	19.22	13.17	9.36	8.66	5.93	4.91	5.29	7.54	5.67	5.55	5.11	3.72	2.74	1.75	1.44	1.26	1.18	1.17	1.00	0.87	0.78	0.72	0.73	0.60	0.51
2002	3.05	36.00	32.27	26.36	17.93	12.79	9.33	9.51	6.85	5.82	6.53	9.75	6.83	6.36	5.46	3.85	2.45	1.66	1.45	1.36	1.26	1.13	1.06	1.04	0.96	0.87	0.71	0.71	0.57	0.45
2003	6.35	19.33	23.89	16.40	11.77	8.13	8.57	7.01	6.55	8.10	13.37	8.06	7.83	6.30	3.66	2.30	1.55	1.44	1.32	1.17	1.12	1.14	1.00	0.97	0.92	0.87	0.71	0.66	0.63	0.41
2004	5.86	19.70	15.13	10.78	7.41	7.56	6.20	5.92	8.12	14.09	8.16	8.07	6.59	3.74	2.15	1.56	1.41	1.37	1.29	1.22	1.15	1.11	0.98	0.98	0.90	0.83	0.68	0.65	0.54	0.42
2005	6.23	9.75	9.03	6.42	7.41	5.91	5.67	8.25	14.63	8.37	8.22	6.05	2.63	1.31	0.86	0.84	0.85	0.70	0.68	0.67	0.63	0.61	0.54	0.58	0.40	0.45	0.41	0.35	0.33	0.25
2006	1.16	7.29	8.91	12.42	7.68	6.54	9.24	15.32	9.01	8.79	6.58	3.03	1.32	0.87	0.71	0.68	0.64	0.63	0.57	0.53	0.53	0.50	0.46	0.46	0.40	0.31	0.34	0.29	0.23	0.24
2007	1.26	10.93	15.78	8.02	5.92	8.05	13.67	8.78	8.23	6.56	3.67	1.61	0.91	0.83	0.78	0.61	0.66	0.57	0.57	0.54	0.45	0.48	0.39	0.39	0.31	0.25	0.31	0.24	0.24	0.21
2008	2.03	22.34	12.66	8.14	11.61	18.07	10.65	9.40	7.81	4.50	2.14	1.30	0.98	0.84	0.72	0.73	0.71	0.66	0.67	0.54	0.54	0.48	0.40	0.42	0.36	0.33	0.30	0.27	0.25	0.22
2009	6.94	9.23	8.04	15.01	22.53	11.60	14.81	13.05	7.45	3.57	2.31	1.67	1.38	1.24	1.17	1.19	1.11	1.01	0.90	0.85	0.79	0.74	0.64	0.61	0.56	0.51	0.48	0.44	0.41	0.32
2010	1.70	4.94	10.47	17.33	10.73	17.22	15.80	9.70	4.84	3.13	2.49	1.90	1.60	1.44	1.42	1.43	1.29	1.15	1.17	0.99	0.90	0.81	0.76	0.72	0.67	0.62	0.58	0.50	0.46	0.39
2011	0.54	8.82	16.17	11.17	17.21	19.17	14.53	7.38	4.72	3.87	3.02	2.21	1.84	1.83	1.70	1.56	1.43	1.38	1.28	1.11	1.05	0.95	0.91	0.84	0.75	0.65	0.67	0.62	0.51	0.41
2012	1.03	9.00	9.69	16.24	19.00	16.70	8.81	5.97	4.97	3.88	2.98	2.50	2.21	2.01	1.81	1.76	1.64	1.48	1.43	1.27	1.25	1.10	1.02	0.93	0.86	0.80	0.78	0.68	0.62	0.51
2013	0.79	5.43	15.85	16.84	14.99	9.04	6.33	5.39	4.60	3.56	3.14	2.75	2.33	2.13	1.95	1.94	1.80	1.59	1.49	1.39	1.31	1.26	1.16	1.04	1.05	1.01	0.94	0.88	0.82	0.67
2014	2.05	31.09	23.41	16.09	8.61	6.38	5.76	5.01	4.37	4.07	3.75	3.27	2.68	2.26	2.30	2.14	2.05	1.72	1.71	1.58	1.45	1.45	1.33	1.19	1.25	1.21	1.20	1.18	1.08	0.90
2015	4.21	14.40	11.72	6.51	5.40	5.55	4.99	4.49	4.21	3.96	3.64	2.93	2.28	2.26	2.10	1.96	1.70	1.68	1.62	1.44	1.39	1.25	1.19	1.12	1.10	1.09	1.06	0.97	0.88	0.82
2016	3.48	8.13	5.10	4.68	4.99	5.16	4.83	4.50	4.26	3.91	3.33	2.68	2.44	2.15	2.01	1.83	1.68	1.59	1.53	1.44	1.32	1.25	1.18	1.09	1.11	1.07	1.04	0.95	0.91	0.78
2017	2.12	5.15	5.42	5.97	6.06	6.13	6.04	5.66	4.94	4.43	3.38	3.12	2.49	2.30	1.95	1.89	1.71	1.58	1.54	1.39	1.21	1.21	1.13	1.06	0.94	0.95	0.86	0.73		
2018	2.12	7.59	9.59	8.29	7.97	7.91	7.28	6.59	5.66	4.38	3.86	3.10	2.66	2.17	2.00	1.93	1.70	1.59	1.48	1.40	1.27	1.29	1.23	1.11	0.98	0.98	0.90	0.85	0.76	0.67
2019	2.38	10.75	10.11	8.96	8.94	9.07	8.70	7.14	5.40	4.84	3.89	3.23	2.54	2.40	2.20	1.93	1.85	1.70	1.57	1.45	1.37	1.31	1.29	1.10	1.01	1.02	0.91	0.82	0.72	0.66
2020	2.28	8.73	10.14	9.97	9.95	9.82	8.40	6.38	5.75	4.78	3.98	3.07	2.56	2.38	2.07	2.04	1.80	1.69	1.58	1.54	1.40	1.37	1.26	1.03	1.03	0.97	0.92	0.85	0.74	0.65
2021	2.08	10.15	11.06	10.16	10.24	9.53	7.52	6.92	5.58	4.74	3.76	3.19	2.73	2.28	2.13	2.01	1.87	1.62	1.62	1.55	1.37	1.26	1.25	1.11	1.03	0.93	0.95	0.78	0.79	0.65
2022	2.19	10.16	11.75	11.07	10.45	8.71	8.14	6.81	5.73	4.67	3.85	3.20	2.68	2.30	2.18	1.98	1.73	1.67	1.56	1.55	1.33	1.34	1.22	1.08	0.97	0.90	0.92	0.76	0.69	0.59
2023	2.08	11.62	12.53	11.14	9.15	9.18	7.96	6.73	5.62	4.79	3.90	3.30	2.84	2.53	2.15	1.98	1.90	1.72	1.70	1.50	1.46	1.41	1.20	1.08	0.99	0.95	0.93	0.81	0.73	0.63

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
1986	0.01	0.49	2.24	4.34	6.17	7.72	9.01	10.02	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	1.43	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	9.77
1988	0.01	0.38	1.43	2.84	4.40	5.76	6.92	7.81	8.46	9.00	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	10.41	10.41
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	9.43	9.43	9.44	9.44	9.45	9.45
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	8.38	8.38	8.39	8.39	8.39
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	7.65	7.66	7.66	7.66	7.66
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	7.00	7.01	7.02	7.03	7.03	7.03	7.04
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	6.42	6.45	6.47	6.48	6.49	6.49	6.50	6.50	6.50
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	6.69	6.72	6.75	6.78	6.78	6.79	6.79	6.80	6.80	6.80
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	8.10	8.13	8.17	8.21	8.23	8.24	8.25	8.26	8.26	8.26	8.26	8.26
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	7.89	7.94	8.00	8.04	8.08	8.10	8.11	8.11	8.12	8.13	8.13	8.13	8.13
1997	0.01	0.38	1.62	3.04	4.11	4.98	5.71	6.20	6.50	6.67	6.79	6.89	6.98	7.08	7.16	7.23	7.31	7.37	7.44	7.49	7.54	7.56	7.58	7.59	7.60	7.61	7.61	7.61	7.62	7.62
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	6.60	6.69	6.76	6.82	6.84	6.86	6.88	6.89	6.89	6.90	6.91	6.91	6.91	6.92
1999	0.01	0.36	1.31	2.51	3.85	4.77	5.33	5.65	5.85	6.02	6.18	6.36	6.52	6.67	6.81	6.93	7.03	7.13	7.19	7.22	7.25	7.27	7.28	7.29	7.30	7.31	7.31	7.32	7.32	7.32
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	7.35	7.45	7.54	7.63	7.69	7.72	7.75	7.77	7.78	7.80	7.81	7.81	7.82	7.82	7.82	7.82	7.82
2001	0.01	0.48	1.99	3.55	4.56	5.15	5.54	5.85	6.10	6.37	6.61	6.82	7.03	7.17	7.31	7.43	7.52	7.56	7.60	7.63	7.65	7.66	7.67	7.68	7.69	7.69	7.70	7.70	7.70	7.70
2002	0.01	0.52	1.93	3.23	4.07	4.65	5.11	5.51	5.96	6.34	6.69	7.04	7.29	7.51	7.72	7.86	7.94	8.00	8.04	8.07	8.09	8.11	8.13	8.14	8.15	8.16	8.16	8.17	8.17	8.17
2003	0.01	0.74	2.11	3.27	4.15	4.92	5.67	6.56	7.29	8.02	8.82	9.38	9.80	10.19	10.47	10.60	10.72	10.82	10.90	10.96	11.00	11.02	11.05	11.07	11.09	11.10	11.11	11.12	11.13	11.13
2004	0.12	1.03	2.21	3.36	4.55	5.71	7.05	8.19	9.34	10.59	11.51	12.18	12.81	13.31	13.55	13.76	13.93	14.06	14.16	14.23	14.29	14.33	14.37	14.39	14.41	14.43	14.45	14.46	14.47	14.48
2005	0.11	0.80	2.28	4.17	6.29	8.65	10.64	12.58	14.71	16.26	17.43	18.45	19.21	19.60	19.92	20.17	20.35	20.49	20.59	20.67	20.73	20.79	20.82	20.85	20.88	20.90	20.92	20.93	20.94	20.95
2006	0.01	0.57	2.56	5.55	9.12	11.88	14.52	17.45	19.50	21.00	22.28	23.20	23.65	24.02	24.33	24.54	24.69	24.81	24.89	24.96	25.02	25.05	25.09	25.11	25.13	25.15	25.16	25.17	25.18	25.18
2007	0.02	0.81	3.54	7.61	10.62	13.87	18.14	20.88	22.74	24.37	25.54	26.10	26.56	26.95	27.22	27.42	27.58	27.68	27.77	27.83	27.89	27.93	27.97	27.99	28.01	28.03	28.04	28.05	28.06	28.07
2008	0.01	0.66	3.19	5.79	8.78	12.84	15.45	17.15	18.52	19.52	19.98	20.37	20.68	20.90	21.07	21.18	21.26	21.33	21.39	21.43	21.47	21.49	21.52	21.53	21.55	21.56	21.57	21.57	21.58	21.59
2009	0.01	0.43	1.34	2.73	4.86	6.50	7.61	8.51	9.18	9.52	9.80	10.02	10.19	10.30	10.39	10.45	10.50	10.55	10.58	10.61	10.64	10.66	10.67	10.69	10.70	10.71	10.72	10.72	10.73	10.73
2010	0.00	0.13	0.61	1.60	2.60	3.43	4.14	4.76	5.08	5.38	5.62	5.80	5.93	6.03	6.10	6.16	6.21	6.26	6.30	6.32	6.35	6.37	6.39	6.40	6.42	6.43	6.44	6.45	6.45	6.46
2011	0.00	0.11	0.49	1.00	1.51	2.05	2.54	2.83	3.09	3.31	3.46	3.57	3.65	3.72	3.77	3.81	3.85	3.89	3.92	3.94	3.96	3.98	3.99	4.00	4.02	4.03	4.04	4.05	4.05	4.06
2012	0.00	0.07	0.31	0.61	1.07	1.56	1.87	2.16	2.41	2.58	2.70	2.79	2.86	2.92	2.96	3.00	3.03	3.06	3.09	3.11	3.13	3.14	3.16	3.17	3.18	3.20	3.20	3.21	3.22	3.23
2013	0.00	0.06	0.25	0.71	1.24	1.60	1.94	2.24	2.48	2.66	2.78	2.87	2.96	3.02	3.08	3.13	3.17	3.21	3.24	3.27	3.30	3.32	3.33	3.35	3.37	3.38	3.40	3.41	3.41	3.42
2014	0.00	0.08	0.57	1.29	1.73	2.19	2.59	2.90	3.15	3.35	3.51	3.64	3.76	3.85	3.93	4.00	4.06	4.11	4.16	4.19	4.23	4.26	4.28	4.30	4.32	4.33	4.34	4.36	4.37	4.37
2015	0.00	0.14	0.72	1.34	1.96	2.58	3.08	3.49	3.83	4.12	4.34	4.54	4.71	4.85	4.96	5.07	5.16	5.24	5.30	5.35	5.40	5.45	5.48	5.50	5.53	5.55	5.57	5.59	5.60	5.61
2016	0.01	0.20	0.76	1.54	2.28	2.93	3.50	3.96	4.34	4.67	4.95	5.16	5.35	5.50	5.64	5.76	5.88	5.98	6.05	6.12	6.18	6.23	6.26	6.30	6.32	6.35	6.37	6.38	6.39	6.41
2017	0.01	0.22	1.08	2.20	3.11	3.91	4.59	5.15	5.63	6.04	6.37	6.67	6.89	7.10	7.27	7.41	7.56	7.67	7.76	7.85	7.91	7.96	8.00	8.04	8.07	8.09	8.10	8.12	8.13	8.13
2018	0.01	0.33	1.46	2.70	3.74	4.60	5.30	5.91	6.41	6.81	7.18	7.45	7.74	7.95	8.13	8.31	8.46	8.58	8.69	8.77	8.84	8.90	8.95	8.99	9.02	9.04	9.06	9.07	9.08	9.08
2019	0.01	0.37	1.36	2.49	3.41	4.14	4.81	5.35	5.78	6.16	6.45	6.72	6.96	7.15	7.33	7.49	7.63	7.75	7.84	7.91	7.98	8.03	8.06	8.10	8.12	8.14	8.15	8.16	8.17	8.18
2020	0.01	0.29	1.19	2.21	3.02	3.72	4.33	4.82	5.22	5.55	5.88	6.12	6.35	6.53	6.71	6.86	7.00	7.10	7.18	7.26	7.32	7.37	7.41	7.44	7.47	7.48	7.49	7.50	7.51	7.52
2021	0.01	0.29	1.16	2.08	2.91	3.59	4.15	4.67	5.05	5.43	5.73	6.00	6.22	6.41	6.59	6.76	6.89	6.99	7.08	7.15	7.21	7.27	7.32	7.35	7.38	7.40	7.41	7.42	7.43	7.44
2022	0.01	0.28	1.09	2.06	2.88	3.56	4.22	4.72	5.17	5.54	5.89	6.18	6.42	6.65	6.84	7.01	7.14	7.25	7.34	7.41	7.47	7.52	7.56	7.60	7.63	7.64	7.66	7.67	7.68	7.68
2023	0.01	0.28	1.14	2.11	2.92	3.67	4.26	4.84	5.28	5.67	6.02	6.33	6.60	6.82	7.00	7.15	7.28	7.38	7.47	7.54	7.60	7.65	7.69	7.72	7.75	7.78	7.79	7.80	7.81	7.81

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
1986	0.59	4.61	7.34	10.44	14.58	19.30	30.70	48.02	59.61	62.00	65.31	67.71	71.23	74.40	75.74	77.18	78.91	80.51	81.53	82.17	82.91	83.18	83.38	83.63	83.77	83.95	84.06	84.19	84.34	84.90
1987	0.26	1.20	2.98	5.88	9.19	17.24	33.73	47.30	50.47	55.01	58.45	63.86	69.20	71.44	74.04	77.26	80.53	82.41	83.55	84.66	85.16	85.50	85.85	86.10	86.36	86.64	86.85	87.07	87.33	87.51
1988	0.30	1.63	4.76	9.38	23.29	44.85	58.82	61.68	65.56	68.31	72.10	75.68	77.26	78.90	80.82	82.60	83.79	84.54	85.34	85.67	85.92	86.11	86.25	86.43	86.58	86.76	86.90	87.04	87.14	87.16
1989	0.32	2.17	6.44	21.97	46.20	61.16	63.99	67.79	70.42	74.14	77.58	79.09	80.69	82.60	84.31	85.48	86.20	86.94	87.21	87.41	87.59	87.71	87.86	87.96	88.09	88.23	88.34	88.42	88.45	88.47
1990	0.27	1.90	12.05	41.26	59.47	62.56	66.81	69.66	73.86	77.78	79.39	81.17	83.39	85.38	86.66	87.41	88.28	88.57	88.77	88.96	89.10	89.23	89.34	89.45	89.58	89.71	89.78	89.81	89.83	89.84
1991	0.29	5.44	33.31	55.03	58.36	63.39	66.74	71.96	76.68	78.48	80.64	83.30	85.78	87.28	88.13	88.98	89.30	89.50	89.70	89.82	89.97	90.07	90.17	90.28	90.39	90.47	90.50	90.52	90.54	90.55
1992	0.36	8.48	25.30	29.82	37.22	42.85	52.85	62.62	66.04	70.68	76.48	82.29	85.29	86.88	87.89	88.49	88.88	89.18	89.40	89.61	89.81	90.00	90.17	90.34	90.45	90.50	90.54	90.57	90.59	90.61
1993	0.64	4.76	8.33	14.79	20.87	31.10	42.85	48.22	55.56	65.39	77.12	82.34	85.03	86.53	87.43	88.03	88.49	88.85	89.15	89.44	89.76	90.01	90.27	90.44	90.53	90.59	90.63	90.66	90.69	90.73
1994	0.27	2.19	8.21	13.88	24.24	35.59	41.17	49.02	59.29	72.67	78.93	82.33	84.25	85.42	86.17	86.73	87.17	87.57	87.97	88.39	88.76	89.07	89.29	89.40	89.48	89.54	89.59	89.63	89.67	89.71
1995	2.01	11.30	17.79	32.35	45.43	50.25	57.47	66.44	75.84	80.75	83.51	85.12	86.07	86.61	86.95	87.23	87.48	87.71	87.95	88.16	88.37	88.54	88.65	88.72	88.77	88.82	88.86	88.90	88.92	88.96
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	85.58	86.04	86.39	86.70	87.00	87.33	87.60	87.87	88.08	88.21	88.30	88.36	88.42	88.48	88.52	88.56	88.60	88.63
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	87.68	87.95	88.20	88.42	88.56	88.66	88.73	88.80	88.85	88.89	88.94	88.97	89.01	89.05
1998	0.99	7.17	12.59	24.01	40.60	63.04	73.48	79.11	82.09	83.78	84.78	85.50	86.02	86.43	86.83	87.33	87.69	88.03	88.32	88.51	88.64	88.74	88.81	88.88	88.95	89.00	89.06	89.10	89.14	89.19
1999	0.52	2.31	15.01	33.57	58.56	70.44	77.00	80.39	82.31	83.44	84.29	84.89	85.38	85.84	86.44	86.85	87.25	87.58	87.80	87.94	88.04	88.13	88.19	88.26	88.31	88.37	88.42	88.47	88.51	88.55
2000	0.89	29.50	54.86	71.86	79.44	83.49	85.54	86.67	87.28	87.68	87.95	88.15	88.36	88.61	88.80	88.99	89.15	89.27	89.36	89.42	89.46	89.51	89.54	89.58	89.61	89.63	89.66	89.68	89.70	89.71
2001	5.42	24.23	58.39	71.75	78.40	81.69	83.43	84.47	85.31	85.83	86.22	86.60	87.10	87.44	87.74	88.00	88.17	88.29	88.37	88.43	88.48	88.53	88.57	88.61	88.64	88.67	88.70	88.73	88.75	88.78
2002	3.06	38.12	57.99	68.60	73.67	76.53	78.30	79.89	80.90	81.67	82.46	83.53	84.18	84.73	85.16	85.44	85.61	85.72	85.81	85.90	85.97	86.04	86.11	86.17	86.23	86.28	86.32	86.36	86.40	86.43
2003	6.39	24.58	42.50	51.63	56.97	60.14	63.16	65.37	67.22	69.31	72.37	73.90	75.23	76.18	76.69	76.99	77.18	77.36	77.52	77.66	77.79	77.92	78.04	78.15	78.25	78.35	78.43	78.51	78.58	78.64
2004	5.91	24.52	35.83	42.55	46.35	50.09	52.85	55.24	58.24	62.85	65.03	66.95	68.34	69.05	69.44	69.71	69.95	70.18	70.39	70.59	70.77	70.93	71.08	71.23	71.37	71.49	71.60	71.70	71.79	71.87
2005	6.34	15.51	23.11	27.92	32.99	36.60	39.72	43.85	50.28	53.23	55.77	57.40	58.04	58.35	58.54	58.73	58.91	59.06	59.21	59.35	59.48	59.60	59.71	59.83	59.91	60.00	60.09	60.16	60.23	60.30
2006	1.17	8.41	16.54	26.63	31.86	35.73	40.62	47.54	50.72	53.36	55.07	55.76	56.04	56.21	56.36	56.49	56.61	56.73	56.84	56.94	57.04	57.13	57.22	57.30	57.38	57.43	57.50	57.56	57.60	57.66
2007	1.27	12.09	25.89	31.57	35.19	39.59	46.00	49.17	51.66	53.35	54.18	54.51	54.69	54.84	54.99	55.10	55.22	55.32	55.42	55.51	55.59	55.67	55.74	55.80	55.85	55.90	55.95	55.99	56.04	56.08
2008	2.04	24.01	33.57	38.74	45.23	53.59	57.19	59.79	61.60	62.50	62.89	63.12	63.28	63.42	63.53	63.65	63.76	63.86	63.96	64.04	64.12	64.19	64.25	64.31	64.37	64.42	64.46	64.50	64.54	64.58
2009	6.98	15.62	22.39	33.94	48.30	53.78	59.71	64.01	66.07	66.97	67.52	67.90	68.21	68.48	68.74	68.99	69.23	69.44	69.62	69.80	69.96	70.11	70.23	70.36	70.47	70.57	70.67	70.76	70.85	70.92
2010	1.71	6.60	16.43	30.90	38.20	48.48	56.14	60.02	61.74	62.79	63.59	64.18	64.67	65.10	65.52	65.94	66.30	66.62	66.95	67.22	67.47	67.69	67.89	68.08	68.26	68.43	68.59	68.73	68.86	68.99
2011	0.55	9.37	24.08	32.56	44.08	54.60	60.94	63.65	65.25	66.49	67.41	68.06	68.59	69.11	69.58	70.01	70.39	70.76	71.09	71.38	71.64	71.88	72.11	72.32	72.51	72.68	72.85	73.01	73.15	73.28
2012	1.04	10.02	18.81	32.06	44.97	54.06	58.00	60.42	62.30	63.68	64.70	65.53	66.24	66.88	67.43	67.97	68.45	68.89	69.30	69.66	70.01	70.32	70.60	70.86	71.09	71.31	71.53	71.72	71.90	72.07
2013	0.80	6.23	21.18	34.52	44.30	49.27	52.41	54.90	56.89	58.35	59.59	60.64	61.50	62.27	62.96	63.63	64.24	64.77	65.26	65.71	66.13	66.53	66.90	67.22	67.54	67.85	68.14	68.42	68.68	68.92
2014	2.07	32.73	48.57	56.80	60.44	62.87	64.90	66.55	67.89	69.09	70.14	71.01	71.70	72.26	72.82	73.33	73.80	74.19	74.57	74.92	75.23	75.54	75.82	76.07	76.33	76.58	76.83	77.08	77.32	77.55
2015	4.25	18.17	27.80	32.49	36.09	39.56	42.48	44.95	47.14	49.11	50.84	52.17	53.17	54.14	55.01	55.81	56.50	57.16	57.79	58.33	58.86	59.32	59.76	60.17	60.57	60.96	61.35	61.71	62.06	62.42
2016	3.51	11.42	15.97	19.90	23.85	27.70	31.09	34.06	36.74	39.07	40.97	42.44	43.74	44.85	45.87	46.78	47.59	48.35	49.07	49.74	50.34	50.90	51.43	51.91	52.40	52.88	53.34	53.78	54.21	54.63
2017	2.13	7.20	12.24	17.44	22.34	26.93	31.13	34.79	37.78	40.31	42.14	43.77	45.02	46.14	47.07	47.95	48.73	49.44	50.12	50.72	51.24	51.75	52.23	52.69	53.16	53.61	54.00	54.41	54.79	55.18
2018	2.13	9.60	18.27	24.94	30.73	35.93	40.28	43.89	46.76	48.83	50.56	51.89	52.98	53.85	54.62	55.36	55.99	56.56	57.10	57.59	58.03	58.48	58.90	59.27	59.60	59.93	60.24	60.53	60.81	61.10
2019	2.40	12.94	21.74	28.66	34.85	40.49	45.34	48.93	51.43	53.52	55.11	56.37	57.32	58.19	58.97	59.63	60.25	60.80	61.31	61.77	62.20	62.61	63.00	63.34	63.65	63.96	64.24	64.50	64.74	64.98
2020	2.29	10.86	19.90	27.80	34.80	40.93	45.61	48.84	51.53	53.62	55.26	56.47	57.44	58.31	59.05	59.76	60.37	60.93	61.45	61.95	62.40	62.83	63.22	63.53	63.85	64.15	64.43	64.70	64.95	65.19
2021	2.09	12.09	21.82	29.68	36.71	42.50	46.59	50.03	52.58	54.61	56.13	57.36	58.37	59.19	59.93	60.61	61.23	61.75	62.27	62.77	63.19	63.58	63.96	64.29	64.60	64.88	65.17	65.41	65.67	65.91
2022	2.20	12.20	22.52	31.01	38.04	43.22	47.58	50.88	53.45	55.39	56.91	58.11	59.08	59.88	60.61	61.26	61.82	62.35	62.84	63.32	63.72	64.12	64.48	64.80	65.08	65.35	65.62	65.86	66.08	66.30
2023	2.09	13.53	24.37	32.70	38.70	44.09	48.28	51.49	53.96	55.92	57.43	58.64	59.63	60.48	61.18	61.82	62.42	62.96	63.48	63.92	64.35	64.76	65.11	65.42	65.71	65.98	66.25	66.49	66.72	66.95

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
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	0.29	0.82	1.13	0.80	0.83	0.65	0.86	0.41	0.80	0.23	0.00	0.24	0.00	0.30	0.24	0.28
1996	0.02	0.50	1.47	1.84	1.63	0.91	0.68	0.72	0.73	0.58	0.73	0.41	0.45	0.40	0.89	0.44	0.62	1.04	0.67	0.61	1.20	0.58	0.34	0.24	0.66	0.20	0.12	0.08	0.16	0.00
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	1.15	0.73	0.67	0.54	0.43	0.82	1.26	1.54	1.28	0.00	0.74	0.00	0.00	0.14	0.00	0.19
1998	0.00	0.22	0.79	0.80	0.71	0.79	1.12	0.92	0.72	0.61	0.59	0.79	1.07	0.99	0.72	1.18	1.15	1.18	0.80	1.07	0.57	0.58	0.41	0.26	0.07	0.03	0.21	0.08	0.09	0.09
1999	0.01	0.25	0.50	0.64	0.80	0.94	0.94	0.75	0.55	0.69	0.73	0.84	0.88	1.08	1.32	1.20	1.03	0.99	0.92	0.43	0.46	0.33	0.34	0.20	0.22	0.16	0.07	0.03	0.05	0.07
2000	0.02	0.36	1.18	1.94	3.19	2.79	1.72	1.63	1.95	1.11	1.39	2.28	1.71	2.46	1.74	0.92	2.57	2.71	1.67	0.50	0.15	1.16	0.40	0.30	0.00	0.53	0.40	0.00	0.00	0.00
2001	0.00	0.20	1.27	2.70	2.91	2.85	2.33	2.44	2.49	3.41	3.31	2.77	3.23	2.62	2.42	2.35	2.10	0.90	0.86	0.81	0.46	0.37	0.41	0.17	0.24	0.13	0.13	0.08	0.06	0.07
2002	0.01	0.41	1.80	2.24	2.02	1.75	1.78	1.90	2.40	2.46	2.33	2.86	2.14	2.03	1.91	1.71	1.21	0.83	0.89	0.65	0.46	0.32	0.33	0.26	0.15	0.13	0.09	0.11	0.21	0.07
2003	0.01	0.56	1.26	1.26	1.21	1.33	1.52	2.11	1.98	2.35	2.72	2.23	1.87	1.72	1.76	0.96	0.95	0.63	0.56	0.50	0.28	0.24	0.30	0.19	0.14	0.15	0.11	0.10	0.07	0.05
2004	0.14	0.84	1.13	1.17	1.38	1.58	2.19	2.14	2.40	2.84	2.47	1.96	1.73	1.70	0.97	0.93	0.76	0.60	0.47	0.37	0.30	0.21	0.23	0.17	0.19	0.14	0.16	0.07	0.08	0.05
2005	0.11	0.66	1.57	2.03	2.48	3.22	3.13	3.48	4.00	3.22	2.82	2.56	2.28	1.26	1.17	0.91	0.74	0.49	0.51	0.42	0.37	0.24	0.27	0.14	0.16	0.19	0.15	0.10	0.09	0.03
2006	0.06	1.04	2.30	3.31	4.54	4.07	4.82	5.68	4.58	3.51	3.81	2.67	1.69	1.38	1.18	0.75	1.05	0.61	0.32	0.35	0.19	0.42	0.16	0.39	0.27	0.15	0.08	0.05	0.03	0.04
2007	0.05	1.11	4.16	6.48	5.87	7.15	10.14	7.80	5.75	5.92	6.07	3.68	2.96	2.72	1.85	1.28	0.94	0.72	0.61	0.94	0.28	0.40	0.37	0.24	0.26	0.16	0.06	0.10	0.21	0.09
2008	0.02	1.33	5.37	5.30	6.73	11.03	9.70	7.22	7.87	7.86	4.35	3.72	3.10	2.13	1.65	0.98	0.89	0.65	0.73	0.52	0.65	0.34	0.33	0.24	0.16	0.07	0.19	0.09	0.04	0.05
2009	0.02	0.84	2.44	3.69	6.44	6.37	4.79	4.82	4.76	2.82	2.22	1.84	1.26	0.94	0.74	0.50	0.54	0.44	0.33	0.33	0.22	0.20	0.16	0.15	0.15	0.07	0.14	0.06	0.03	0.04
2010	0.04	0.79	1.98	3.79	3.65	2.94	2.89	2.98	1.82	1.42	1.28	0.93	0.79	0.59	0.45	0.41	0.37	0.28	0.26	0.21	0.21	0.16	0.12	0.13	0.09	0.08	0.09	0.05	0.05	0.03
2011	0.05	0.69	1.84	1.77	1.52	1.58	1.74	1.22	1.08	0.87	0.70	0.51	0.46	0.37	0.33	0.28	0.23	0.20	0.15	0.17	0.19	0.16	0.12	0.10	0.09	0.05	0.07	0.08	0.05	0.03
2012	0.02	0.35	0.58	0.75	0.89	1.10	0.78	0.68	0.62	0.49	0.42	0.26	0.27	0.25	0.26	0.18	0.20	0.13	0.12	0.14	0.13	0.08	0.08	0.08	0.07	0.06	0.07	0.04	0.04	0.05
2013	0.02	0.19	0.40	0.59	0.78	0.60	0.56	0.50	0.40	0.32	0.25	0.22	0.18	0.18	0.16	0.15	0.15	0.13	0.11	0.11	0.11	0.08	0.08	0.06	0.05	0.04	0.05	0.02	0.03	0.03
2014	0.01	0.20	0.63	1.00	0.90	0.80	0.72	0.66	0.46	0.35	0.31	0.26	0.29	0.23	0.23	0.18	0.20	0.17	0.16	0.13	0.10	0.08	0.09	0.09	0.06	0.06	0.10	0.03	0.03	0.03
2015	0.00	0.15	0.81	0.86	0.84	0.76	0.64	0.48	0.39	0.33	0.37	0.23	0.28	0.20	0.23	0.21	0.21	0.18	0.15	0.10	0.11	0.09	0.07	0.06	0.07	0.06	0.06	0.04	0.03	0.04
2016	0.01	0.21	0.74	0.80	0.92	0.61	0.52	0.41	0.49	0.38	0.30	0.33	0.24	0.25	0.30	0.29	0.20	0.15	0.21	0.14	0.12	0.10	0.06	0.04	0.04	0.15	0.07	0.02	0.03	0.01
2017	0.01	0.37	1.18	1.06	0.72	0.49	0.50	0.38	0.55	0.39	0.25	0.17	0.31	0.32	0.34	0.29	0.34	0.13	0.27	0.09	0.12	0.11	0.02	0.04	0.04	0.18	0.02	0.01	0.03	0.00
2018	0.05	1.10	1.85	1.21	0.95	0.66	0.98	1.44	0.77	1.08	0.61	0.24	0.88	0.83	0.66	0.83	0.31	0.30	0.44	0.30	0.56	0.25	0.21	0.27	0.19	0.22	0.04	0.01	0.08	0.00
2019	0.03	0.89	1.81	1.47	1.38	1.06	1.19	1.21	1.03	1.05	0.73	0.49	0.67	0.84	0.85	0.48	0.26	0.44	0.51	0.54	0.42	0.14	0.15	0.26	0.12	0.23	0.09	0.07	0.05	0.00
2020	0.00	0.33	1.40	1.37	1.37	1.15	0.96	0.94	1.15	0.94	1.00	0.52	0.58	0.81	1.15	0.91	0.76	0.88	0.80	0.45	0.48	0.35	0.26	0.29	0.29	0.35	0.09	0.08	0.03	0.00
2021	0.00	0.31	1.43	1.41	1.45	1.20	0.96	1.09	0.74	1.10	0.74	0.75	0.81	0.65	0.79	0.88	0.58	0.75	0.82	0.50	0.33	0.31	0.19	0.27	0.30	0.31	0.09	0.04	0.07	0.01
2022	0.00	0.25	1.23	1.38	1.40	1.28	1.40	1.08	1.27	1.15	1.03	0.84	0.86	0.65	1.01	0.69	0.47	0.47	0.74	0.46	0.54	0.37	0.28	0.31	0.29	0.37	0.08	0.10	0.03	0.00
2023	0.00	0.28	1.11	1.34	1.41	1.33	1.13	1.20	1.09	1.08	1.21	0.87	0.81	0.73	0.72	0.58	0.49	0.45	0.48	0.44	0.31	0.20	0.11	0.24	0.24	0.29	0.13	0.09	0.06	0.00

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
1995	2.06	15.49	9.33	22.02	24.35	10.84	18.97	28.59	39.53	31.03	25.01	17.20	13.17	10.20	6.96	4.87	7.64	4.99	4.49	6.28	6.98	4.25	2.08	1.08	1.66	1.83	0.80	1.00	0.17	0.79
1996	2.13	6.08	17.81	22.63	10.22	18.20	29.93	45.98	36.01	27.41	19.65	13.26	9.61	7.91	7.99	5.96	5.72	8.00	6.82	6.14	4.96	2.81	1.79	0.89	1.22	1.45	1.29	0.74	1.08	0.91
1997	3.27	29.93	27.78	9.84	20.19	32.41	44.73	37.88	31.86	24.01	14.19	11.10	6.16	5.22	5.25	6.40	7.43	6.76	6.88	4.87	3.39	2.69	1.29	0.34	1.67	1.27	0.89	0.00	0.24	0.82
1998	4.45	18.02	8.13	17.94	32.36	53.40	42.42	33.22	22.58	16.02	10.82	9.09	6.78	6.35	6.70	8.54	7.22	7.29	6.54	4.43	2.73	1.95	2.41	1.49	1.35	1.08	0.91	0.79	0.82	0.73
1999	2.70	6.05	13.92	25.94	48.94	39.16	31.47	21.87	14.97	10.88	9.06	6.69	6.59	7.28	9.29	8.02	7.77	6.86	3.70	2.54	1.96	1.73	1.57	1.67	1.51	1.26	0.82	0.84	0.75	0.63
2000	3.60	33.28	36.36	44.71	40.71	32.65	24.75	15.59	9.53	7.42	5.77	4.45	3.13	6.05	6.02	5.53	4.57	5.67	2.28	2.47	1.64	2.82	1.05	1.94	1.47	0.73	1.50	0.26	1.42	0.50
2001	7.40	33.69	54.63	40.73	33.20	23.69	15.70	10.62	8.99	5.86	5.13	4.80	8.41	6.04	5.80	6.00	4.59	3.12	2.28	1.71	1.81	2.15	1.64	1.62	1.30	1.15	1.08	0.59	0.57	0.50
2002	10.78	51.14	37.18	30.24	21.01	14.96	9.93	9.85	7.00	6.09	6.48	10.15	7.96	7.18	8.01	5.45	3.63	2.39	2.24	2.02	2.11	1.69	1.51	1.47	1.48	0.96	1.01	0.77	0.88	0.50
2003	19.33	27.32	27.28	18.82	13.10	8.94	10.51	7.93	7.45	8.96	14.45	9.04	8.62	9.19	6.19	3.96	2.60	2.64	2.30	2.12	2.08	2.02	1.85	1.65	1.42	1.36	0.99	1.08	0.85	0.67
2004	11.39	21.99	16.14	11.81	7.59	7.42	6.16	5.99	8.44	14.24	8.31	8.35	9.12	6.46	4.11	3.06	2.70	2.60	2.39	2.20	2.22	1.95	1.79	1.44	1.20	1.10	1.07	1.03	0.92	0.60
2005	9.35	13.10	10.85	6.73	7.11	5.47	4.78	7.45	13.35	7.76	7.97	7.16	4.59	2.57	1.86	1.73	1.71	1.49	1.48	1.18	1.35	1.09	0.93	0.74	0.72	0.52	0.57	0.67	0.53	0.45
2006	3.95	10.96	7.93	10.17	6.28	4.66	7.37	13.30	8.15	8.30	7.53	4.50	2.49	1.66	2.02	1.72	1.50	1.43	1.68	1.03	1.10	1.12	0.88	0.81	0.82	0.50	0.78	0.71	0.49	0.40
2007	4.01	19.61	17.25	7.53	4.83	6.97	11.11	8.03	7.97	6.51	3.92	1.95	1.72	2.11	1.82	1.33	1.82	1.75	1.16	1.33	0.67	0.96	1.01	0.54	0.66	0.31	0.68	0.44	0.43	0.29
2008	4.24	26.30	8.73	5.30	8.35	13.46	8.95	7.38	6.63	3.91	2.09	1.64	1.49	1.46	1.52	1.39	1.26	1.36	1.18	0.96	0.85	0.77	0.85	0.61	0.56	0.59	0.59	0.42	0.31	
2009	3.08	8.25	6.91	15.41	18.88	7.93	12.38	11.33	6.06	2.96	2.04	2.00	2.02	1.93	1.88	1.91	1.73	1.62	1.31	1.23	1.13	0.98	0.95	0.96	0.88	0.79	0.72	0.73	0.58	0.55
2010	2.82	5.70	11.09	16.50	8.26	16.75	15.97	8.83	4.05	2.75	2.58	2.64	2.47	2.41	2.40	2.43	2.05	1.64	1.52	1.43	1.38	1.18	1.17	1.09	1.01	0.92	0.82	0.78	0.84	0.62
2011	0.49	6.80	15.29	10.02	18.70	18.87	12.42	6.09	4.03	3.66	3.64	3.45	3.49	3.31	3.23	2.94	2.38	2.18	2.02	2.10	1.75	1.70	1.49	1.48	1.41	1.32	1.14	1.22	1.02	1.06
2012	0.85	11.18	10.43	18.48	17.99	13.72	6.62	4.67	4.22	3.90	3.54	3.61	3.50	3.16	2.97	2.52	2.52	2.10	2.10	1.98	1.75	1.73	1.71	1.50	1.51	1.50	1.31	1.30	1.16	1.05
2013	1.54	6.15	12.22	14.32	13.13	7.13	4.74	4.44	3.87	3.42	3.30	3.41	3.19	2.92	2.47	2.54	2.15	2.11	1.80	1.75	1.62	1.58	1.45	1.49	1.35	1.20	1.17	1.17	0.87	
2014	1.34	11.65	15.57	13.58	7.65	5.47	5.04	4.46	3.97	3.57	3.42	3.37	2.86	2.27	2.17	2.20	1.91	1.58	1.65	1.40	1.44	1.27	1.32	1.30	1.16	0.98	1.02	0.98	0.84	0.68
2015	1.88	15.01	13.56	7.14	5.83	6.46	5.87	5.33	4.69	4.51	4.29	3.81	3.02	3.09	2.82	2.64	2.28	2.21	2.20	2.10	1.90	1.79	1.70	1.70	1.64	1.58	1.43	1.33	1.33	1.12
2016	4.10	11.42	7.43	6.10	7.46	6.98	6.59	5.82	5.13	4.60	3.35	3.13	2.54	2.24	2.31	2.04	1.73	1.68	1.52	1.58	1.50	1.45	1.42	1.20	1.49	1.34	1.40	1.24	1.10	0.51
2017	5.76	10.07	8.09	8.24	8.64	8.05	7.44	7.07	5.86	4.66	3.22	2.88	2.23	1.74	2.18	1.79	1.27	1.08	1.50	1.14	1.23	1.56	1.69	1.39	1.70	1.40	1.05	0.91	1.24	0.19
2018	7.01	15.91	13.66	14.05	13.87	13.20	9.87	8.83	8.50	3.86	4.87	4.12	3.35	2.09	3.26	2.66	1.95	1.23	1.90	1.57	1.53	2.21	4.31	1.56	1.42	1.47	0.85	0.68	1.30	0.13
2019	5.89	19.33	18.51	18.10	17.97	15.39	11.74	10.10	9.79	5.39	4.89	4.57	4.01	2.84	2.99	3.57	2.91	2.22	3.36	1.75	1.65	1.93	3.63	1.72	1.77	1.72	1.05	0.86	1.72	0.33
2020	6.17	19.37	18.10	16.83	16.53	13.38	11.76	10.08	8.62	5.75	4.59	4.82	3.75	3.42	3.47	3.65	3.07	1.85	2.62	1.66	1.73	1.93	2.33	1.70	1.73	1.35	1.46	1.08	1.69	0.27
2021	7.75	20.90	19.83	18.54	17.46	14.88	11.69	9.72	7.92	5.44	4.20	4.46	3.39	3.24	3.46	3.52	2.33	2.09	2.49	1.99	1.73	1.67	1.82	1.87	1.87	1.45	1.23	1.11	1.57	0.26
2022	7.53	22.27	21.23	19.54	19.09	13.65	11.83	9.77	8.26	6.39	5.19	5.12	4.01	3.25	2.65	3.01	2.24	2.00	2.68	2.13	1.71	1.70	1.81	1.45	1.78	1.27	1.24	1.04	1.44	0.23
2023	8.03	23.32	21.40	19.77	17.77	14.29	11.99	9.68	8.03	6.84	5.23	5.37	3.86	3.47	3.17	3.45	2.96	2.38	2.75	2.15	2.03	2.20	1.70	1.83	1.65	1.19	1.36	0.92	1.56	0.29

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
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	6.03	6.05	6.07	6.08	6.09	6.10	6.10	6.10	6.10	6.11	6.11	6.11
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	5.40	5.42	5.43	5.46	5.47	5.48	5.48	5.50	5.50	5.50	5.50	5.51	5.51
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	4.36	4.37	4.38	4.39	4.41	4.43	4.44	4.44	4.45	4.45	4.45	4.45	4.45	4.46
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	2.65	2.67	2.70	2.71	2.73	2.74	2.75	2.76	2.76	2.76	2.76	2.77	2.77	2.77	2.77
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	2.55	2.60	2.64	2.67	2.70	2.71	2.73	2.73	2.74	2.75	2.75	2.76	2.76	2.76	2.76	2.76
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	3.54	3.59	3.61	3.67	3.73	3.76	3.77	3.77	3.79	3.80	3.80	3.80	3.81	3.82	3.82	3.82	3.82
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	3.34	3.42	3.49	3.55	3.60	3.62	3.63	3.65	3.66	3.66	3.67	3.67	3.68	3.68	3.68	3.69	3.69	3.69
2002	0.01	0.38	1.16	1.74	2.10	2.34	2.54	2.73	2.94	3.14	3.31	3.50	3.62	3.72	3.81	3.88	3.93	3.96	3.99	4.01	4.03	4.04	4.05	4.06	4.06	4.07	4.07	4.07	4.08	4.08
2003	0.01	0.47	1.20	1.72	2.12	2.50	2.89	3.36	3.76	4.18	4.62	4.92	5.14	5.32	5.48	5.56	5.64	5.69	5.73	5.76	5.78	5.80	5.82	5.83	5.84	5.85	5.85	5.86	5.87	5.87
2004	0.14	0.89	1.66	2.32	2.99	3.70	4.58	5.38	6.19	7.05	7.67	8.11	8.45	8.75	8.91	9.05	9.16	9.24	9.30	9.35	9.39	9.41	9.44	9.46	9.48	9.50	9.51	9.52	9.53	9.54
2005	0.11	0.71	1.94	3.33	4.87	6.68	8.29	9.93	11.61	12.71	13.58	14.27	14.83	15.12	15.37	15.56	15.71	15.81	15.90	15.98	16.04	16.09	16.13	16.16	16.18	16.21	16.23	16.25	16.26	16.27
2006	0.06	1.07	3.02	5.53	8.51	10.90	13.46	16.11	17.84	18.99	20.09	20.77	21.16	21.47	21.72	21.88	22.10	22.21	22.27	22.34	22.37	22.45	22.47	22.54	22.58	22.61	22.62	22.63	22.63	22.64
2007	0.05	1.12	4.30	8.19	11.21	14.49	18.49	20.91	22.41	23.73	24.92	25.57	26.06	26.49	26.76	26.94	27.08	27.17	27.25	27.38	27.41	27.46	27.51	27.54	27.57	27.58	27.59	27.60	27.63	27.64
2008	0.02	1.30	5.04	8.20	11.79	16.78	20.09	22.08	23.94	25.53	26.30	26.92	27.40	27.72	27.96	28.09	28.22	28.30	28.40	28.46	28.54	28.58	28.62	28.65	28.67	28.68	28.70	28.71	28.72	28.73
2009	0.02	0.84	3.00	5.96	10.13	13.21	15.19	16.84	18.20	18.92	19.46	19.88	20.16	20.36	20.51	20.61	20.72	20.80	20.87	20.93	20.97	21.00	21.03	21.06	21.09	21.10	21.13	21.14	21.14	21.15
2010	0.04	0.81	2.63	5.64	7.94	9.58	10.87	11.95	12.53	12.95	13.32	13.58	13.79	13.94	14.05	14.15	14.24	14.30	14.36	14.41	14.45	14.49	14.51	14.54	14.56	14.57	14.59	14.60	14.61	14.62
2011	0.05	0.75	2.46	3.81	4.84	5.69	6.43	6.87	7.24	7.52	7.73	7.88	8.01	8.11	8.20	8.27	8.32	8.37	8.40	8.44	8.49	8.52	8.55	8.57	8.59	8.60	8.61	8.63	8.64	8.65
2012	0.02	0.38	0.88	1.47	2.03	2.60	2.94	3.21	3.45	3.63	3.77	3.86	3.95	4.02	4.10	4.15	4.21	4.25	4.28	4.31	4.35	4.37	4.39	4.41	4.43	4.44	4.46	4.47	4.48	4.49
2013	0.02	0.21	0.58	1.05	1.58	1.94	2.24	2.50	2.70	2.85	2.97	3.06	3.14	3.21	3.27	3.33	3.38	3.43	3.47	3.51	3.54	3.57	3.60	3.62	3.63	3.65	3.66	3.67	3.68	3.69
2014	0.01	0.21	0.76	1.49	2.05	2.50	2.89	3.22	3.44	3.59	3.73	3.84	3.96	4.04	4.13	4.20	4.27	4.33	4.39	4.43	4.46	4.49	4.52	4.55	4.57	4.58	4.61	4.62	4.63	4.64
2015	0.00	0.15	0.83	1.44	1.99	2.46	2.82	3.08	3.27	3.43	3.60	3.70	3.81	3.89	3.98	4.06	4.14	4.20	4.25	4.29	4.33	4.36	4.38	4.40	4.42	4.44	4.45	4.47	4.48	4.49
2016	0.01	0.21	0.84	1.46	2.13	2.54	2.86	3.09	3.35	3.54	3.68	3.84	3.94	4.05	4.18	4.29	4.38	4.43	4.52	4.57	4.61	4.65	4.67	4.69	4.70	4.76	4.78	4.79	4.80	4.80
2017	0.01	0.36	1.36	2.17	2.67	2.98	3.26	3.47	3.73	3.91	4.01	4.08	4.21	4.33	4.47	4.57	4.69	4.74	4.83	4.86	4.91	4.94	4.95	4.96	4.98	5.04	5.04	5.05	5.06	5.06
2018	0.05	1.07	2.51	3.29	3.81	4.12	4.51	5.03	5.27	5.58	5.74	5.80	6.01	6.20	6.35	6.52	6.59	6.64	6.73	6.78	6.87	6.91	6.94	6.97	6.99	7.02	7.03	7.03	7.04	7.04
2019	0.03	0.86	2.23	3.11	3.77	4.18	4.55	4.89	5.14	5.37	5.52	5.61	5.73	5.87	6.01	6.09	6.13	6.19	6.26	6.33	6.38	6.40	6.41	6.43	6.45	6.47	6.48	6.49	6.49	6.49
2020	0.00	0.32	1.37	2.20	2.88	3.34	3.68	3.96	4.26	4.48	4.69	4.80	4.91	5.05	5.25	5.40	5.51	5.64	5.75	5.81	5.87	5.91	5.93	5.97	5.99	6.04	6.04	6.05	6.06	6.06
2021	0.00	0.29	1.33	2.14	2.80	3.24	3.54	3.83	4.00	4.24	4.39	4.53	4.67	4.78	4.90	5.04	5.13	5.23	5.34	5.40	5.44	5.48	5.50	5.52	5.55	5.58	5.59	5.60	5.61	5.61
2022	0.00	0.23	1.12	1.88	2.50	2.94	3.35	3.62	3.91	4.14	4.33	4.47	4.60	4.70	4.85	4.94	5.00	5.06	5.15	5.20	5.26	5.30	5.33	5.36	5.38	5.42	5.43	5.44	5.44	5.44
2023	0.00	0.26	1.04	1.77	2.37	2.83	3.16	3.46	3.70	3.92	4.15	4.29	4.42	4.53	4.64	4.72	4.79	4.84	4.90	4.95	4.99	5.01	5.02	5.04	5.07	5.10	5.11	5.12	5.13	5.13

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
1995	2.07	17.27	24.97	41.20	54.81	59.28	66.13	74.34	82.34	86.07	88.12	89.15	89.81	90.24	90.51	90.69	90.97	91.13	91.29	91.59	91.89	91.97	92.02	92.03	92.06	92.10	92.11	92.13	92.13	92.15
1996	2.14	8.11	24.45	41.17	46.89	55.85	67.75	80.43	85.68	88.20	89.51	90.21	90.65	90.98	91.28	91.49	91.68	91.92	92.12	92.31	92.47	92.53	92.57	92.58	92.61	92.64	92.66	92.67	92.69	92.72
1997	3.28	32.32	50.98	55.64	64.07	74.63	84.33	88.76	91.03	92.18	92.69	93.03	93.20	93.33	93.46	93.60	93.75	93.90	94.04	94.12	94.16	94.20	94.21	94.22	94.24	94.25	94.26	94.26	94.27	94.28
1998	4.46	21.73	28.10	40.91	59.66	80.33	87.81	91.10	92.57	93.38	93.83	94.17	94.39	94.59	94.78	95.00	95.18	95.34	95.47	95.55	95.60	95.63	95.67	95.69	95.71	95.73	95.74	95.75	95.77	95.78
1999	2.71	8.63	21.38	41.67	69.77	80.99	86.38	88.91	90.25	91.08	91.69	92.09	92.46	92.84	93.28	93.62	93.93	94.17	94.29	94.37	94.43	94.48	94.52	94.56	94.61	94.64	94.66	94.68	94.70	94.72
2000	3.61	35.76	59.03	76.90	85.56	89.44	91.34	92.22	92.66	92.97	93.19	93.35	93.45	93.64	93.81	93.96	94.07	94.20	94.25	94.31	94.33	94.38	94.40	94.44	94.46	94.47	94.50	94.50	94.52	94.53
2001	7.42	38.72	72.22	83.18	88.22	90.51	91.63	92.25	92.70	92.97	93.18	93.36	93.65	93.83	93.99	94.15	94.25	94.32	94.37	94.41	94.44	94.48	94.51	94.54	94.56	94.58	94.60	94.61	94.63	94.64
2002	10.84	56.61	72.66	80.61	84.34	86.38	87.50	88.49	89.11	89.60	90.08	90.75	91.22	91.59	91.97	92.21	92.35	92.45	92.53	92.60	92.68	92.73	92.78	92.83	92.87	92.90	92.93	92.95	92.98	93.00
2003	19.44	41.55	57.45	65.27	69.61	72.16	74.84	76.62	78.13	79.77	82.10	83.31	84.34	85.32	85.91	86.26	86.48	86.70	86.88	87.05	87.20	87.34	87.46	87.57	87.67	87.75	87.82	87.88	87.94	87.99
2004	11.60	31.10	42.13	48.81	52.55	55.88	58.38	60.62	63.52	67.87	69.97	71.86	73.71	74.88	75.57	76.06	76.48	76.87	77.22	77.53	77.82	78.06	78.28	78.46	78.61	78.73	78.85	78.97	79.08	79.16
2005	9.48	21.39	29.89	34.50	38.96	42.05	44.52	48.08	53.71	56.42	58.90	60.89	62.04	62.65	63.07	63.46	63.83	64.15	64.47	64.71	64.97	65.17	65.33	65.47	65.60	65.69	65.78	65.89	65.97	66.06
2006	3.97	14.52	21.24	28.98	33.11	35.85	39.81	46.07	49.17	51.93	54.13	55.30	55.91	56.30	56.76	57.14	57.47	57.78	58.13	58.33	58.53	58.74	58.90	59.05	59.19	59.28	59.40	59.51	59.60	59.68
2007	4.03	22.89	36.06	40.57	43.06	46.27	50.66	53.15	55.24	56.71	57.48	57.83	58.12	58.46	58.75	58.94	59.20	59.45	59.61	59.79	59.88	60.00	60.13	60.19	60.28	60.31	60.40	60.45	60.51	60.56
2008	4.25	29.52	35.58	38.74	43.21	49.31	52.37	54.42	55.99	56.78	57.16	57.43	57.67	57.89	58.11	58.31	58.49	58.68	58.83	58.96	59.07	59.18	59.27	59.38	59.46	59.53	59.60	59.67	59.73	59.78
2009	3.09	11.14	17.24	29.65	41.88	45.71	50.85	54.72	56.46	57.21	57.71	58.17	58.62	59.04	59.43	59.82	60.16	60.48	60.73	60.97	61.18	61.36	61.53	61.70	61.86	62.01	62.13	62.27	62.38	62.50
2010	2.85	8.42	18.55	31.62	36.84	46.16	53.28	56.46	57.76	58.58	59.32	60.06	60.72	61.34	61.94	62.54	63.02	63.41	63.75	64.08	64.38	64.64	64.89	65.13	65.34	65.54	65.71	65.88	66.07	66.23
2011	0.49	7.29	21.42	29.12	41.77	51.93	57.23	59.46	60.83	62.02	63.14	64.16	65.15	66.06	66.90	67.65	68.24	68.76	69.24	69.72	70.12	70.50	70.82	71.15	71.45	71.73	71.98	72.24	72.48	72.78
2012	0.86	12.04	21.26	35.78	47.18	54.20	57.09	58.97	60.59	62.00	63.24	64.45	65.58	66.56	67.45	68.18	68.89	69.47	70.04	70.57	71.02	71.47	71.90	72.27	72.65	73.01	73.33	73.65	73.94	74.23
2013	1.56	7.67	19.02	30.64	39.68	43.91	46.50	48.80	50.72	52.33	53.83	55.33	56.68	57.88	58.86	59.85	60.66	61.45	62.11	62.73	63.33	63.88	64.41	64.89	65.38	65.81	66.20	66.58	66.97	67.31
2014	1.35	12.92	26.55	36.49	41.28	44.41	47.11	49.37	51.27	52.91	54.42	55.85	57.02	57.93	58.77	59.61	60.33	60.92	61.53	62.03	62.53	62.97	63.40	63.84	64.21	64.51	64.81	65.11	65.38	65.62
2015	1.90	16.75	28.09	33.20	37.05	41.02	44.37	47.22	49.58	51.73	53.67	55.32	56.58	57.82	58.92	59.92	60.76	61.56	62.33	63.06	63.70	64.28	64.83	65.37	65.89	66.38	66.81	67.22	67.64	68.03
2016	4.13	15.15	21.48	26.26	31.69	36.35	40.41	43.74	46.49	48.82	50.43	51.89	53.03	54.01	55.00	55.85	56.56	57.23	57.84	58.45	59.03	59.58	60.11	60.55	61.10	61.58	62.07	62.53	62.95	63.17
2017	5.80	15.33	22.18	28.51	34.53	39.61	43.90	47.64	50.52	52.66	54.06	55.27	56.18	56.87	57.72	58.39	58.86	59.26	59.81	60.23	60.67	61.22	61.79	62.28	62.87	63.36	63.72	64.04	64.47	64.57
2018	7.04	21.87	32.42	41.59	49.26	55.47	59.47	62.65	65.39	66.52	67.87	68.95	69.80	70.30	71.06	71.67	72.10	72.36	72.76	73.08	73.38	73.83	74.66	74.94	75.22	75.51	75.66	75.80	76.07	76.12
2019	5.91	24.17	38.09	48.95	57.60	63.55	67.36	70.21	72.64	73.84	74.85	75.74	76.48	76.98	77.49	78.08	78.54	78.88	79.37	79.62	79.86	80.13	80.63	80.86	81.09	81.31	81.45	81.57	81.80	81.86
2020	6.19	24.42	38.09	48.32	56.51	61.96	66.06	69.14	71.47	72.88	73.93	74.97	75.72	76.39	77.04	77.68	78.19	78.49	78.89	79.15	79.40	79.69	80.02	80.25	80.49	80.67	80.88	81.05	81.29	81.34
2021	7.78	27.11	41.53	52.14	60.13	65.67	69.32	71.97	73.89	75.10	75.96	76.84	77.46	78.04	78.63	79.20	79.56	79.87	80.24	80.52	80.77	81.00	81.24	81.49	81.74	81.92	82.09	82.24	82.45	82.49
2022	7.55	28.20	43.42	54.28	62.66	67.42	70.93	73.44	75.33	76.66	77.64	78.55	79.21	79.73	80.13	80.57	80.88	81.16	81.52	81.80	82.01	82.22	82.44	82.61	82.82	82.97	83.13	83.26	83.43	83.46
2023	8.06	29.56	44.61	55.38	63.00	67.96	71.46	73.92	75.73	77.13	78.11	79.05	79.68	80.23	80.71	81.21	81.62	81.94	82.31	82.58	82.83	83.10	83.30	83.52	83.72	83.87	84.04	84.15	84.33	84.37

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
2001	0.00	0.12	0.54	0.97	0.91	0.92	0.72	0.48	0.80	0.33	0.68	0.26	0.22	0.29	0.31
2002	0.02	0.14	0.49	0.62	0.60	0.35	0.31	0.21	0.39	0.36	0.36	0.41	0.22	0.39	**0.19**
2003	0.01	0.16	0.32	0.32	0.20	0.22	0.42	0.38	0.42	0.46	0.61	0.33	0.39	**0.49**	**0.23**
2004	0.04	0.17	0.26	0.36	0.42	0.45	0.51	0.50	0.65	0.57	0.89	0.56	**0.38**	**0.50**	**0.28**
2005	0.02	0.62	1.67	1.47	1.61	1.59	1.33	0.87	1.48	1.30	1.07	**0.71**	**0.98**	**0.51**	**0.35**
2006	0.05	1.29	2.19	2.69	2.69	1.98	2.26	2.83	2.27	2.23	**1.83**	**1.20**	**0.70**	**0.93**	**0.66**
2007	0.01	0.82	2.24	2.56	2.08	3.41	4.39	3.13	2.15	**2.31**	**1.97**	**0.70**	**1.24**	**0.90**	**0.76**
2008	0.01	0.35	1.26	1.48	1.97	3.47	2.68	2.31	**1.67**	**1.33**	**0.99**	**0.85**	**0.76**	**0.65**	**0.44**
2009	0.01	0.17	0.26	0.57	1.23	1.14	1.13	**0.77**	**0.49**	**0.34**	**0.34**	**0.44**	**0.27**	**0.21**	**0.16**
2010	0.00	0.04	0.15	0.36	0.40	0.46	**0.31**	**0.23**	**0.13**	**0.19**	**0.17**	**0.16**	**0.10**	**0.08**	**0.07**
2011	0.00	0.03	0.14	0.20	0.24	**0.20**	**0.13**	**0.12**	**0.14**	**0.15**	**0.09**	**0.09**	**0.07**	**0.03**	**0.07**
2012	0.00	0.03	0.07	0.08	**0.11**	**0.09**	**0.07**	**0.05**	**0.07**	**0.04**	**0.06**	**0.04**	**0.04**	**0.04**	**0.03**
2013	0.00	0.01	0.05	**0.10**	**0.09**	**0.08**	**0.08**	**0.08**	**0.05**	**0.04**	**0.05**	**0.04**	**0.05**	**0.05**	**0.04**
2014	0.00	0.03	**0.11**	**0.21**	**0.21**	**0.16**	**0.16**	**0.12**	**0.13**	**0.11**	**0.09**	**0.12**	**0.14**	**0.07**	**0.05**
2015	0.00	**0.04**	**0.12**	**0.18**	**0.17**	**0.15**	**0.09**	**0.10**	**0.10**	**0.10**	**0.08**	**0.06**	**0.09**	**0.08**	**0.07**
2016	**0.00**	**0.05**	**0.13**	**0.12**	**0.19**	**0.10**	**0.11**	**0.12**	**0.09**	**0.05**	**0.07**	**0.07**	**0.08**	**0.07**	**0.16**
2017	**0.01**	**0.08**	**0.24**	**0.27**	**0.28**	**0.27**	**0.36**	**0.27**	**0.21**	**0.18**	**0.13**	**0.26**	**0.12**	**0.13**	**0.04**
2018	**0.03**	**0.14**	**0.43**	**0.52**	**0.55**	**0.43**	**0.23**	**0.28**	**0.41**	**0.19**	**0.26**	**0.07**	**0.09**	**0.17**	**0.16**
2019	**0.00**	**0.14**	**0.32**	**0.38**	**0.24**	**0.31**	**0.30**	**0.29**	**0.16**	**0.15**	**0.13**	**0.16**	**0.27**	**0.08**	**0.13**
2020	**0.00**	**0.09**	**0.27**	**0.33**	**0.30**	**0.23**	**0.24**	**0.20**	**0.23**	**0.19**	**0.19**	**0.06**	**0.26**	**0.14**	**0.10**
2021	**0.00**	**0.08**	**0.17**	**0.41**	**0.26**	**0.23**	**0.38**	**0.20**	**0.12**	**0.30**	**0.17**	**0.16**	**0.15**	**0.13**	**0.14**
2022	**0.00**	**0.15**	**0.23**	**0.36**	**0.24**	**0.54**	**0.28**	**0.24**	**0.33**	**0.20**	**0.36**	**0.25**	**0.13**	**0.14**	**0.09**
2023	**0.02**	**0.05**	**0.42**	**0.39**	**0.47**	**0.49**	**0.29**	**0.29**	**0.24**	**0.25**	**0.36**	**0.22**	**0.10**	**0.38**	**0.10**

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
2001	2.24	14.52	38.70	29.39	23.63	15.30	12.73	11.34	7.25	8.69	7.42	8.75	10.10	13.40	18.04
2002	2.29	26.91	26.60	20.89	16.72	12.75	10.33	8.10	7.53	7.05	7.75	10.16	9.51	12.77	**16.62**
2003	4.68	15.86	19.10	15.72	12.78	10.31	8.94	8.70	7.98	9.17	10.21	9.67	11.45	**16.79**	**14.58**
2004	4.87	14.71	13.65	11.67	8.75	8.06	7.45	6.82	8.24	9.78	8.71	9.13	**14.80**	**16.64**	**13.15**
2005	5.27	11.33	10.87	9.80	8.19	7.16	7.64	7.73	9.16	8.39	8.29	**12.41**	**12.11**	**10.91**	**8.13**
2006	3.70	10.62	11.66	12.46	9.25	7.55	8.09	9.93	7.12	7.45	**9.78**	**10.49**	**9.55**	**9.95**	**9.41**
2007	3.59	12.48	16.61	9.98	7.85	7.83	9.93	9.16	7.80	**9.68**	**11.20**	**9.66**	**9.30**	**8.48**	**8.10**
2008	1.51	17.61	13.39	11.64	13.28	15.56	10.72	9.55	**10.67**	**10.56**	**10.38**	**8.97**	**9.12**	**10.09**	**10.06**
2009	4.41	7.62	12.74	17.50	21.18	12.59	12.41	**12.66**	**12.03**	**10.72**	**9.71**	**10.50**	**11.34**	**11.87**	**11.46**
2010	0.92	7.95	15.46	20.00	11.85	13.06	**12.90**	**11.52**	**10.05**	**9.63**	**10.26**	**11.34**	**12.12**	**12.70**	**11.86**
2011	0.94	14.15	19.27	11.60	14.18	**12.93**	**10.60**	**8.64**	**8.41**	**9.31**	**10.12**	**11.47**	**12.37**	**13.11**	**12.06**
2012	1.61	10.83	9.14	11.35	**11.58**	**9.03**	**6.45**	**5.85**	**7.08**	**8.57**	**9.77**	**11.04**	**12.10**	**12.92**	**12.13**
2013	1.12	5.43	9.78	**11.59**	**9.08**	**4.94**	**4.44**	**5.67**	**6.83**	**8.04**	**9.22**	**10.91**	**11.88**	**12.54**	**12.24**
2014	3.30	16.82	**16.97**	**13.44**	**7.18**	**5.74**	**6.72**	**7.97**	**8.74**	**10.36**	**10.96**	**11.75**	**11.77**	**12.20**	**11.08**
2015	2.71	**13.10**	**12.51**	**7.08**	**5.29**	**5.42**	**6.49**	**7.36**	**8.34**	**9.63**	**10.92**	**11.19**	**10.96**	**11.75**	**11.75**
2016	**3.46**	**8.72**	**5.75**	**4.98**	**5.18**	**5.06**	**5.64**	**6.99**	**8.47**	**9.59**	**10.13**	**10.40**	**10.82**	**12.01**	**11.86**
2017	**1.87**	**5.52**	**5.87**	**6.49**	**6.40**	**5.78**	**6.88**	**9.00**	**9.11**	**10.61**	**11.16**	**10.78**	**11.41**	**11.52**	**12.08**
2018	**1.55**	**6.80**	**9.25**	**9.04**	**8.17**	**6.75**	**8.45**	**9.48**	**11.09**	**9.99**	**10.57**	**11.24**	**12.87**	**14.32**	**13.83**
2019	**1.64**	**8.06**	**10.26**	**10.24**	**8.61**	**8.37**	**8.55**	**8.89**	**9.64**	**10.71**	**11.52**	**11.15**	**12.17**	**11.76**	**11.96**
2020	**1.45**	**7.63**	**9.38**	**10.56**	**9.17**	**7.29**	**8.46**	**8.57**	**8.87**	**10.80**	**10.86**	**13.57**	**12.42**	**13.79**	**12.18**
2021	**1.78**	**8.49**	**10.72**	**10.66**	**8.51**	**7.65**	**8.14**	**7.80**	**9.16**	**11.07**	**11.56**	**13.09**	**12.24**	**14.12**	**10.97**
2022	**1.67**	**9.00**	**11.63**	**10.96**	**8.43**	**7.56**	**7.43**	**8.31**	**9.67**	**11.41**	**12.35**	**13.60**	**12.98**	**13.35**	**11.99**
2023	**1.54**	**9.61**	**11.35**	**11.27**	**8.02**	**7.34**	**8.41**	**9.05**	**10.23**	**10.44**	**12.67**	**13.55**	**13.72**	**13.00**	**13.36**

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
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	2.23	2.26	2.30
2002	0.02	0.16	0.51	0.83	1.07	1.19	1.28	1.33	1.43	1.51	1.58	1.66	1.70	1.76	**1.79**
2003	0.01	0.16	0.42	0.63	0.74	0.84	1.02	1.17	1.32	1.47	1.65	1.73	1.83	**1.94**	1.99
2004	0.04	0.21	0.42	0.67	0.93	1.18	1.44	1.68	1.97	2.20	2.52	2.70	**2.81**	2.94	3.02
2005	0.02	0.62	2.02	3.10	4.14	5.08	5.78	6.21	6.87	7.38	7.76	**8.00**	8.28	8.42	8.51
2006	0.05	1.33	3.23	5.23	6.92	8.01	9.14	10.41	11.32	12.11	**12.70**	13.03	13.20	13.41	13.57
2007	0.01	0.83	2.74	4.51	5.76	7.61	9.71	10.99	11.77	**12.52**	13.08	13.25	13.53	13.71	13.86
2008	0.01	0.36	1.40	2.43	3.62	5.40	6.51	7.33	**7.86**	8.22	8.46	8.64	8.79	8.91	8.99
2009	0.01	0.18	0.42	0.86	1.65	2.21	2.69	**2.97**	3.13	3.22	3.30	3.40	3.46	3.50	3.53
2010	0.00	0.04	0.18	0.47	0.71	0.96	**1.11**	1.20	1.25	1.31	1.36	1.40	1.42	1.44	1.45
2011	0.00	0.03	0.15	0.29	0.44	**0.54**	0.60	0.65	0.70	0.75	0.78	0.80	0.82	0.83	0.84
2012	0.00	0.03	0.09	0.16	**0.24**	0.29	0.33	0.36	0.40	0.42	0.44	0.46	0.47	0.48	0.49
2013	0.00	0.01	0.06	**0.15**	0.22	0.27	0.32	0.37	0.40	0.42	0.44	0.46	0.49	0.50	0.52
2014	0.00	0.03	**0.12**	0.26	0.38	0.47	0.55	0.61	0.67	0.71	0.74	0.78	0.82	0.84	0.85
2015	0.00	**0.04**	0.14	0.28	0.39	0.49	0.55	0.60	0.66	0.71	0.74	0.77	0.80	0.83	0.85
2016	**0.00**	0.05	0.16	0.26	0.42	0.50	0.58	0.66	0.72	0.75	0.79	0.82	0.85	0.88	0.94
2017	**0.01**	**0.10**	**0.32**	**0.56**	**0.79**	**0.98**	**1.24**	**1.42**	**1.55**	**1.65**	**1.71**	**1.83**	**1.88**	**1.92**	**1.94**
2018	**0.03**	**0.17**	**0.58**	**1.02**	**1.42**	**1.72**	**1.87**	**2.03**	**2.25**	**2.34**	**2.44**	**2.47**	**2.50**	**2.56**	**2.60**
2019	**0.00**	**0.14**	**0.43**	**0.75**	**0.92**	**1.13**	**1.31**	**1.47**	**1.55**	**1.62**	**1.67**	**1.72**	**1.81**	**1.83**	**1.88**
2020	**0.00**	**0.10**	**0.34**	**0.62**	**0.84**	**0.99**	**1.14**	**1.25**	**1.37**	**1.46**	**1.54**	**1.56**	**1.65**	**1.69**	**1.74**
2021	**0.00**	**0.08**	**0.23**	**0.56**	**0.74**	**0.90**	**1.12**	**1.23**	**1.30**	**1.44**	**1.51**	**1.56**	**1.61**	**1.65**	**1.68**
2022	**0.00**	**0.15**	**0.36**	**0.65**	**0.81**	**1.15**	**1.32**	**1.44**	**1.60**	**1.69**	**1.83**	**1.92**	**1.96**	**2.00**	**2.02**
2023	**0.02**	**0.07**	**0.45**	**0.76**	**1.09**	**1.40**	**1.57**	**1.72**	**1.83**	**1.94**	**2.07**	**2.14**	**2.18**	**2.27**	**2.29**

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
2001	2.28	16.77	49.52	64.43	72.75	76.79	79.62	81.80	83.06	84.45	85.56	86.72	87.96	89.49	91.91
2002	2.34	29.18	48.29	59.19	66.01	70.31	73.35	75.47	77.29	78.92	80.64	82.61	84.32	86.47	89.11
2003	4.78	20.20	35.72	45.96	52.94	57.84	61.68	65.05	67.88	70.88	73.98	76.54	79.35	83.15	86.21
2004	5.03	19.29	30.49	38.72	44.16	48.74	52.61	55.87	59.55	63.65	66.93	70.02	74.70	79.25	82.52
2005	5.46	16.38	25.58	32.84	38.24	42.48	46.63	50.48	54.64	58.21	61.31	65.52	69.14	72.14	74.37
2006	3.76	14.14	24.15	33.36	39.15	43.33	47.37	51.82	54.64	57.38	60.66	63.67	66.10	68.52	70.85
2007	3.65	15.85	29.94	36.76	41.47	45.73	50.51	54.30	57.12	60.35	63.54	65.96	68.10	69.93	71.66
2008	1.53	19.20	30.11	38.23	46.32	54.33	58.77	62.22	65.63	68.56	71.12	73.08	74.91	76.83	78.68
2009	4.50	11.96	23.35	37.00	50.47	56.68	61.95	66.60	70.42	73.41	75.82	78.17	80.46	82.66	84.73
2010	0.94	9.00	23.38	39.01	46.38	53.50	59.57	64.28	67.90	71.05	74.07	77.07	79.97	82.74	85.27
2011	0.97	15.26	31.92	40.00	48.70	55.47	60.29	63.80	66.94	70.13	73.27	76.49	79.60	82.60	85.30
2012	1.65	12.57	20.76	30.00	38.33	44.03	47.76	50.94	54.57	58.68	62.95	67.33	71.67	75.87	79.79
2013	1.14	6.67	16.02	26.00	32.85	36.25	39.19	42.77	46.86	51.37	56.12	61.25	66.33	71.29	76.08
2014	3.38	20.01	33.90	42.96	47.14	50.25	53.69	57.50	61.36	65.52	69.48	73.27	76.67	79.90	82.81
2015	2.79	15.88	26.61	31.91	35.60	39.19	43.25	47.58	52.13	56.96	61.91	66.41	70.44	74.41	78.36
2016	3.55	12.17	17.34	21.58	25.74	29.60	33.72	38.52	43.95	49.59	55.01	59.98	64.74	69.62	74.40
2017	1.91	7.45	12.97	18.71	24.00	28.45	33.44	39.53	45.15	51.06	56.65	61.46	66.12	70.53	75.13
2018	1.58	8.43	17.05	24.65	30.85	35.56	41.03	46.64	52.55	57.30	61.84	66.16	70.66	75.18	79.43
2019	1.67	9.77	19.21	27.61	33.93	39.54	44.79	49.76	54.69	59.64	64.38	68.44	72.50	76.06	79.73
2020	1.48	9.18	17.86	26.68	33.50	38.41	43.71	48.63	53.27	58.42	63.06	68.25	72.44	76.65	80.23
2021	1.81	10.35	20.13	28.81	34.96	40.03	44.99	49.36	54.08	59.28	64.08	68.89	72.93	77.12	80.40
2022	1.70	10.76	21.32	30.09	36.08	40.98	45.41	50.00	54.89	60.11	65.14	69.94	73.95	77.68	81.11
2023	1.56	11.25	21.51	30.49	36.12	40.85	45.86	50.81	55.86	60.53	65.56	70.31	74.46	78.01	81.53

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
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	0.02
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	0.11
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	0.51	0.00
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	0.29	0.15	0.02
2002	0.00	0.04	0.22	0.17	0.19	0.13	0.14	0.15	0.11	0.25	0.14	0.21	0.16	0.10	**0.19**
2003	0.00	0.05	0.12	0.16	0.09	0.15	0.14	0.29	0.22	0.22	0.37	0.34	0.21	**0.22**	**0.16**
2004	0.02	0.08	0.17	0.14	0.15	0.23	0.34	0.32	0.30	0.29	0.31	0.21	**0.25**	**0.20**	**0.11**
2005	0.01	0.10	0.12	0.20	0.40	0.47	0.38	0.43	0.40	0.38	0.39	**0.32**	**0.27**	**0.20**	**0.16**
2006	0.00	0.05	0.09	0.47	0.61	0.34	0.71	0.54	0.55	0.45	**0.22**	**0.30**	**0.12**	**0.17**	**0.12**
2007	0.00	0.13	0.28	0.97	0.36	0.37	1.23	0.75	0.50	**0.82**	**1.27**	**0.33**	**0.70**	**0.00**	**0.33**
2008	0.00	0.09	0.59	0.86	1.25	2.12	1.88	0.84	**0.77**	**1.51**	**0.33**	**0.54**	**0.48**	**0.21**	**0.19**
2009	0.00	0.11	0.42	0.78	1.25	1.22	1.12	**1.19**	**0.75**	**0.35**	**0.67**	**0.47**	**0.36**	**0.24**	**0.14**
2010	0.00	0.13	0.45	0.98	1.26	0.79	**0.92**	**0.68**	**0.36**	**0.39**	**0.34**	**0.27**	**0.16**	**0.20**	**0.15**
2011	0.00	0.18	0.33	0.36	0.45	**0.71**	**0.33**	**0.28**	**0.15**	**0.09**	**0.07**	**0.29**	**0.21**	**0.00**	**0.03**
2012	0.00	0.04	0.09	0.12	**0.20**	**0.13**	**0.13**	**0.21**	**0.08**	**0.09**	**0.10**	**0.13**	**0.04**	**0.05**	**0.06**
2013	0.00	0.01	0.06	**0.12**	**0.09**	**0.11**	**0.09**	**0.14**	**0.11**	**0.10**	**0.09**	**0.11**	**0.15**	**0.12**	**0.09**
2014	0.00	0.03	**0.06**	**0.20**	**0.19**	**0.17**	**0.08**	**0.14**	**0.09**	**0.11**	**0.06**	**0.04**	**0.22**	**0.26**	**0.15**
2015	0.00	**0.01**	**0.21**	**0.08**	**0.26**	**0.21**	**0.17**	**0.15**	**0.08**	**0.10**	**0.02**	**0.15**	**0.19**	**0.20**	**0.10**
2016	**0.00**	**0.03**	**0.04**	**0.10**	**0.08**	**0.19**	**0.08**	**0.11**	**0.05**	**0.10**	**0.11**	**0.12**	**0.09**	**0.32**	**0.10**
2017	**0.00**	**0.07**	**0.04**	**0.07**	**0.07**	**0.17**	**0.05**	**0.05**	**0.07**	**0.23**	**0.19**	**0.13**	**0.01**	**0.07**	**0.03**
2018	**0.00**	**0.01**	**0.06**	**0.71**	**0.70**	**0.52**	**0.09**	**0.01**	**0.12**	**0.11**	**0.01**	**0.00**	**0.05**	**0.00**	**0.00**
2019	**0.04**	**0.01**	**0.06**	**0.73**	**0.38**	**0.99**	**0.00**	**0.06**	**0.05**	**0.64**	**0.02**	**0.09**	**0.00**	**0.00**	**0.00**
2020	**0.00**	**0.02**	**0.19**	**0.69**	**0.87**	**0.62**	**0.04**	**0.04**	**0.16**	**0.13**	**0.00**	**0.98**	**0.81**	**0.16**	**0.00**
2021	**0.00**	**0.04**	**0.28**	**0.83**	**0.57**	**0.20**	**0.12**	**0.16**	**0.03**	**0.31**	**0.11**	**0.71**	**0.71**	**0.20**	**0.12**
2022	**0.02**	**0.07**	**0.58**	**0.82**	**0.54**	**0.48**	**0.42**	**0.38**	**0.18**	**0.16**	**0.04**	**0.98**	**0.01**	**0.32**	**0.01**
2023	**0.00**	**0.08**	**0.54**	**0.59**	**0.42**	**0.93**	**0.54**	**0.73**	**0.47**	**0.27**	**0.22**	**1.08**	**0.17**	**0.36**	**0.34**

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
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	20.33
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	26.85	21.64	17.61	16.33	13.08	11.60	11.53	15.14	19.58
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	19.62
1999	1.33	4.21	8.43	14.15	26.64	21.04	16.35	14.08	11.23	10.37	9.64	10.28	13.46	15.19	22.49
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	16.64	25.53
2001	1.35	13.06	36.67	28.65	21.25	14.08	11.99	10.60	8.21	8.74	8.79	9.48	12.01	13.74	19.07
2002	2.74	24.68	21.49	18.70	13.67	10.84	8.91	8.36	8.10	7.85	8.94	10.85	13.01	16.91	**18.41**
2003	6.24	12.64	15.35	12.64	10.19	8.36	7.85	7.40	8.18	8.92	10.67	11.23	13.70	**17.55**	**16.31**
2004	4.88	11.13	11.03	9.16	7.25	6.34	6.34	6.48	6.97	9.06	9.12	10.42	**15.89**	**17.41**	**13.40**
2005	4.42	8.73	8.56	6.50	5.19	5.63	5.83	6.44	7.97	7.99	8.69	**11.95**	**11.99**	**11.01**	**9.35**
2006	2.84	7.64	7.10	6.94	5.94	4.96	5.84	8.28	6.65	7.87	**8.78**	**10.08**	**10.75**	**9.59**	**9.43**
2007	1.09	8.66	10.98	8.46	5.14	6.75	7.17	6.43	5.59	**9.85**	**10.69**	**12.30**	**11.41**	**11.67**	**8.43**
2008	1.29	8.48	8.06	6.73	10.28	12.63	8.80	7.74	**8.48**	**8.93**	**8.37**	**9.32**	**9.21**	**10.67**	**9.19**
2009	0.86	5.61	9.99	14.41	16.16	8.97	10.04	**10.03**	**9.97**	**8.33**	**8.95**	**9.71**	**11.13**	**11.79**	**11.90**
2010	1.52	8.61	14.77	15.24	9.60	11.75	**10.12**	**9.54**	**7.52**	**7.97**	**8.98**	**10.80**	**12.11**	**13.87**	**12.26**
2011	1.46	33.52	23.79	13.71	14.40	**13.86**	**11.04**	**9.48**	**8.95**	**10.14**	**11.03**	**14.66**	**16.57**	**17.73**	**15.62**
2012	1.60	13.50	12.58	13.31	**12.89**	**10.81**	**7.83**	**7.71**	**9.18**	**10.69**	**12.91**	**14.38**	**16.58**	**17.15**	**14.98**
2013	1.14	4.88	8.45	**11.89**	**10.98**	**6.57**	**6.11**	**7.41**	**8.89**	**9.87**	**11.30**	**13.09**	**13.28**	**14.36**	**13.08**
2014	2.00	8.17	**15.26**	**13.15**	**7.77**	**6.17**	**6.89**	**7.80**	**7.90**	**9.73**	**10.69**	**11.16**	**11.94**	**12.87**	**11.54**
2015	1.50	**14.74**	**13.36**	**7.25**	**5.48**	**6.44**	**6.98**	**7.85**	**7.50**	**9.65**	**9.38**	**12.70**	**11.77**	**12.62**	**13.78**
2016	**3.51**	**13.24**	**8.65**	**8.15**	**8.52**	**7.66**	**8.34**	**10.21**	**11.75**	**13.16**	**13.52**	**14.36**	**15.12**	**15.86**	**15.87**
2017	**7.98**	**13.46**	**11.26**	**11.66**	**10.77**	**10.74**	**11.21**	**13.78**	**15.53**	**15.62**	**15.49**	**16.74**	**16.13**	**19.43**	**19.40**
2018	**12.54**	**29.13**	**22.01**	**18.17**	**15.93**	**15.82**	**13.20**	**14.65**	**15.26**	**14.33**	**11.96**	**16.68**	**18.76**	**18.91**	**17.53**
2019	**15.82**	**41.85**	**30.94**	**24.00**	**17.71**	**18.24**	**18.10**	**15.63**	**18.74**	**15.96**	**18.88**	**18.49**	**15.89**	**15.87**	**24.93**
2020	**15.52**	**41.56**	**32.92**	**24.08**	**19.79**	**16.47**	**16.54**	**19.41**	**16.13**	**16.91**	**14.57**	**25.84**	**21.14**	**16.30**	**19.48**
2021	**16.31**	**43.97**	**30.86**	**24.80**	**19.41**	**15.17**	**18.77**	**18.01**	**13.83**	**16.57**	**17.21**	**20.74**	**21.19**	**18.53**	**19.22**
2022	**17.93**	**46.18**	**34.39**	**23.67**	**19.87**	**16.93**	**13.53**	**16.68**	**13.42**	**13.12**	**18.65**	**18.24**	**19.36**	**20.70**	**21.39**
2023	**19.70**	**47.29**	**33.78**	**25.01**	**16.94**	**15.21**	**15.57**	**14.37**	**19.16**	**16.56**	**14.29**	**19.08**	**18.52**	**20.20**	**27.83**

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
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	1.21
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	0.57
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	1.05	1.05
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	0.91	0.93	0.93
2002	0.00	0.04	0.20	0.30	0.39	0.44	0.49	0.54	0.57	0.64	0.67	0.72	0.75	0.77	**0.81**
2003	0.00	0.05	0.15	0.26	0.31	0.39	0.46	0.60	0.69	0.78	0.91	1.02	1.08	**1.13**	**1.17**
2004	0.02	0.09	0.24	0.35	0.45	0.60	0.80	0.98	1.14	1.28	1.41	1.49	**1.58**	**1.64**	**1.67**
2005	0.01	0.11	0.21	0.38	0.67	1.01	1.26	1.53	1.76	1.96	2.14	**2.28**	**2.38**	**2.44**	**2.50**
2006	0.00	0.04	0.13	0.52	0.99	1.25	1.73	2.07	2.38	2.61	**2.71**	**2.84**	**2.88**	**2.94**	**3.01**
2007	0.00	0.13	0.38	1.19	1.46	1.71	2.51	3.03	3.30	**3.73**	**4.30**	**4.43**	**4.68**	**4.68**	**4.78**
2008	0.00	0.09	0.63	1.36	2.33	3.78	4.87	5.30	**5.67**	**6.32**	**6.44**	**6.62**	**6.77**	**6.85**	**6.90**
2009	0.00	0.11	0.51	1.18	2.08	2.80	3.40	**3.97**	**4.28**	**4.41**	**4.65**	**4.79**	**4.90**	**4.96**	**4.99**
2010	0.00	0.14	0.56	1.32	2.13	2.58	**3.05**	**3.35**	**3.49**	**3.64**	**3.76**	**3.85**	**3.90**	**3.95**	**4.00**
2011	0.00	0.19	0.41	0.59	0.78	**1.04**	**1.14**	**1.22**	**1.26**	**1.28**	**1.29**	**1.34**	**1.38**	**1.38**	**1.38**
2012	0.00	0.04	0.12	0.20	**0.33**	**0.41**	**0.47**	**0.57**	**0.60**	**0.64**	**0.67**	**0.71**	**0.72**	**0.73**	**0.75**
2013	0.00	0.01	0.07	**0.18**	**0.25**	**0.33**	**0.38**	**0.46**	**0.52**	**0.57**	**0.61**	**0.65**	**0.70**	**0.74**	**0.76**
2014	0.00	0.03	**0.08**	**0.23**	**0.36**	**0.46**	**0.51**	**0.59**	**0.63**	**0.68**	**0.70**	**0.72**	**0.78**	**0.86**	**0.90**
2015	0.00	**0.01**	**0.20**	**0.25**	**0.43**	**0.57**	**0.68**	**0.76**	**0.80**	**0.84**	**0.85**	**0.91**	**0.97**	**1.03**	**1.05**
2016	**0.00**	**0.03**	**0.07**	**0.14**	**0.20**	**0.32**	**0.37**	**0.43**	**0.46**	**0.50**	**0.54**	**0.58**	**0.61**	**0.68**	**0.70**
2017	**0.00**	**0.07**	**0.10**	**0.15**	**0.19**	**0.28**	**0.31**	**0.33**	**0.35**	**0.42**	**0.47**	**0.50**	**0.50**	**0.51**	**0.52**
2018	**0.00**	**0.01**	**0.05**	**0.37**	**0.62**	**0.79**	**0.81**	**0.81**	**0.84**	**0.85**	**0.85**	**0.85**	**0.86**	**0.86**	**0.86**
2019	**0.04**	**0.05**	**0.08**	**0.31**	**0.40**	**0.59**	**0.59**	**0.59**	**0.60**	**0.66**	**0.66**	**0.66**	**0.66**	**0.66**	**0.66**
2020	**0.00**	**0.02**	**0.11**	**0.32**	**0.52**	**0.63**	**0.63**	**0.64**	**0.65**	**0.66**	**0.66**	**0.71**	**0.74**	**0.74**	**0.74**
2021	**0.00**	**0.03**	**0.16**	**0.40**	**0.53**	**0.56**	**0.58**	**0.60**	**0.60**	**0.63**	**0.63**	**0.67**	**0.70**	**0.71**	**0.71**
2022	**0.02**	**0.08**	**0.32**	**0.54**	**0.64**	**0.71**	**0.76**	**0.80**	**0.82**	**0.83**	**0.83**	**0.88**	**0.88**	**0.89**	**0.89**
2023	**0.00**	**0.06**	**0.28**	**0.43**	**0.50**	**0.64**	**0.71**	**0.79**	**0.83**	**0.85**	**0.86**	**0.90**	**0.91**	**0.92**	**0.93**

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
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	92.30
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	10.57	23.66	30.16	38.05	49.99	63.53	71.41	76.46	80.32	83.12	85.14	87.18	89.32	93.06
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	92.08
1999	1.36	5.60	13.72	26.16	46.26	57.76	64.79	69.87	73.36	76.29	78.85	81.18	84.01	86.83	92.26
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	89.04	94.91
2001	1.37	14.52	46.43	62.00	70.19	74.41	77.49	79.88	81.58	83.23	84.89	86.35	88.06	89.82	92.32
2002	2.79	27.30	43.19	53.99	60.37	64.72	67.94	70.72	73.18	75.50	77.98	80.50	83.26	86.47	**89.68**
2003	6.37	18.45	31.23	40.07	46.29	50.88	54.86	58.35	61.92	65.66	69.78	73.37	77.36	**81.89**	**85.70**
2004	5.10	15.88	25.33	32.30	37.32	41.41	45.25	48.96	52.74	57.78	62.03	66.26	**72.20**	**77.76**	**81.71**
2005	4.61	13.11	20.69	25.96	29.89	33.93	37.90	42.08	46.97	52.24	57.57	**62.92**	**67.68**	**71.66**	**75.08**
2006	2.90	10.47	16.93	22.80	27.48	31.14	35.31	40.93	45.17	50.96	**56.26**	**60.69**	**64.94**	**68.48**	**72.19**
2007	1.10	9.81	19.87	26.68	30.47	35.24	39.97	43.90	47.21	**52.49**	**57.40**	**62.41**	**66.39**	**70.22**	**73.50**
2008	1.31	9.84	17.25	22.89	30.88	39.59	44.75	48.82	**52.91**	**56.83**	**60.06**	**63.36**	**66.35**	**69.61**	**72.46**
2009	0.88	6.57	16.06	28.36	40.01	45.36	50.73	**55.50**	**59.71**	**62.87**	**65.99**	**69.04**	**72.26**	**75.38**	**78.42**
2010	1.57	10.22	23.68	35.46	41.70	48.52	**53.64**	**57.93**	**60.96**	**63.99**	**67.07**	**70.51**	**73.99**	**77.59**	**80.79**
2011	1.50	35.00	50.69	57.53	63.72	**68.78**	**72.22**	**74.84**	**77.08**	**79.40**	**81.68**	**84.41**	**87.04**	**89.52**	**91.52**
2012	1.65	15.27	26.18	36.26	**44.70**	**50.81**	**54.76**	**58.38**	**62.33**	**66.53**	**71.07**	**75.52**	**79.93**	**83.81**	**87.05**
2013	1.17	6.13	14.28	**24.78**	**33.23**	**37.74**	**41.67**	**46.18**	**51.18**	**56.26**	**61.50**	**66.93**	**71.76**	**76.44**	**80.52**
2014	2.05	10.26	**24.35**	**34.49**	**39.70**	**43.54**	**47.59**	**51.82**	**55.82**	**60.36**	**64.84**	**69.02**	**73.10**	**76.96**	**80.53**
2015	1.54	**16.47**	**27.84**	**33.18**	**36.92**	**41.11**	**45.36**	**49.81**	**53.75**	**58.45**	**62.54**	**67.50**	**71.73**	**75.81**	**80.08**
2016	**3.58**	**16.56**	**23.92**	**30.26**	**36.33**	**41.35**	**46.40**	**52.07**	**57.90**	**63.70**	**68.87**	**73.63**	**77.94**	**81.94**	**85.61**
2017	**8.14**	**20.66**	**29.76**	**38.10**	**44.90**	**50.95**	**56.58**	**62.73**	**68.73**	**73.83**	**78.08**	**81.93**	**85.01**	**88.38**	**91.40**
2018	**12.88**	**38.45**	**51.84**	**60.47**	**66.60**	**71.64**	**78.59**	**81.66**	**84.07**	**85.82**	**87.90**	**89.86**	**91.63**	**93.22**	
2019	**16.18**	**51.36**	**66.08**	**73.89**	**78.26**	**81.90**	**84.77**	**86.75**	**88.90**	**90.36**	**91.73**	**92.90**	**93.70**	**94.52**	**95.47**
2020	**15.92**	**50.95**	**66.54**	**74.07**	**78.71**	**81.77**	**84.33**	**86.81**	**88.49**	**89.98**	**91.06**	**92.61**	**93.61**	**94.19**	**94.94**
2021	**16.60**	**53.23**	**67.01**	**74.54**	**78.92**	**81.66**	**84.47**	**86.69**	**88.14**	**89.59**	**90.82**	**92.10**	**93.10**	**93.84**	**94.49**
2022	**18.26**	**55.53**	**69.82**	**76.13**	**80.10**	**82.80**	**84.60**	**86.50**	**87.78**	**88.87**	**90.19**	**91.30**	**92.25**	**93.10**	**93.84**
2023	**19.99**	**57.47**	**70.83**	**77.19**	**80.36**	**82.73**	**84.77**	**86.37**	**88.13**	**89.41**	**90.34**	**91.33**	**92.15**	**92.90**	**93.71**

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
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	0.69	0.46	0.43	0.60	0.77	0.61	0.69	1.04	0.88	1.08	1.11
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	1.12	0.88	0.92	1.57	1.14	0.85	1.23	1.16	1.12	1.33	1.28	1.12
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	1.24	1.45	1.21	1.36	1.46	1.33	0.88	1.24	1.49	1.33	1.38	1.82	1.38	1.25
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	1.55	1.53	1.54	1.45	1.50	1.47	0.90	1.18	1.50	1.43	1.64	1.62	1.58	1.45	1.55
1998	0.01	0.79	2.25	2.49	2.98	3.60	2.65	1.92	1.50	1.31	1.64	1.54	2.11	1.46	1.79	1.93	1.39	1.47	1.84	1.37	1.38	1.47	1.97	1.70	1.93	1.85	1.90	2.00	1.66	1.46
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	2.91	2.53	1.77	2.00	1.61	1.29	1.21	1.61	1.61	1.75	1.72	2.19	1.62	1.91	1.79	1.24	1.83
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	2.72	3.19	2.36	1.61	2.12	1.80	1.61	2.26	2.36	2.30	2.27	1.82	2.47	2.54	2.11	2.01	2.29	1.65
2001	0.00	0.33	1.25	1.87	1.47	2.12	2.05	2.87	3.81	3.74	3.54	3.36	3.16	2.38	1.42	2.10	1.33	1.33	2.29	2.28	2.30	2.04	2.71	1.76	2.39	2.76	1.79	2.16	1.84	1.83
2002	0.00	0.23	1.45	1.85	2.20	2.85	4.61	5.26	5.03	4.58	4.34	4.48	2.88	2.45	2.48	2.01	1.70	1.80	2.47	2.46	2.29	2.15	1.79	2.15	2.27	1.97	2.45	1.58	2.21	1.92
2003	0.01	0.54	1.48	2.13	3.56	5.37	5.76	6.17	4.35	4.80	4.68	3.15	2.41	2.73	2.88	1.80	2.30	3.26	2.87	2.46	2.84	1.83	2.70	2.50	2.12	2.36	2.14	2.65	2.24	1.79
2004	0.08	0.64	1.61	3.05	5.54	6.29	5.82	4.70	4.86	5.08	3.55	2.55	3.14	2.77	2.26	3.03	2.96	2.83	2.12	3.47	2.75	3.18	2.77	2.56	2.90	2.58	2.45	2.05	1.79	1.45
2005	0.09	0.86	2.43	5.06	6.43	6.97	4.98	5.12	5.60	4.73	3.80	3.78	3.64	3.01	3.90	4.28	3.68	3.83	3.80	3.69	3.97	3.59	3.34	3.84	2.84	3.16	2.49	2.83	2.24	1.75
2006	0.02	1.12	3.46	6.96	9.02	7.05	7.12	6.15	5.09	3.93	4.37	3.88	3.35	3.99	4.10	4.39	3.51	3.34	4.66	4.54	3.74	3.83	4.74	3.84	3.37	2.70	2.54	1.97	1.74	2.39
2007	0.00	1.02	4.98	9.73	9.01	8.92	8.60	5.38	4.02	5.80	5.60	4.14	4.81	5.97	4.13	4.87	4.93	5.06	6.01	4.15	4.89	6.08	3.73	3.96	4.00	3.13	2.47	2.60	1.18	1.64
2008	0.01	0.57	4.08	6.78	8.40	9.85	10.10	6.21	5.94	5.35	3.87	4.44	3.62	3.89	3.66	3.95	4.35	3.10	3.88	3.33	3.57	2.55	3.51	2.73	3.24	2.52	1.92	2.61	2.06	1.61
2009	0.09	0.93	2.46	3.31	4.79	5.63	3.67	3.93	4.44	2.29	3.14	2.75	3.27	2.97	2.24	2.59	2.25	3.23	2.23	2.57	2.41	2.52	2.27	2.53	2.68	2.24	2.17	1.93	1.65	1.22
2010	0.01	0.17	0.65	1.37	1.90	1.53	2.06	2.27	1.66	2.17	2.13	2.11	2.13	2.29	1.84	2.37	2.10	1.80	2.48	2.25	2.22	1.81	1.78	1.75	2.20	1.81	1.70	1.46	1.24	1.15
2011	0.00	0.19	0.56	0.79	0.87	1.43	1.59	1.51	1.88	1.71	2.02	1.82	1.78	1.69	1.79	1.78	1.99	1.94	1.28	1.96	2.12	2.29	2.27	1.58	1.38	1.73	1.55	1.16	1.41	1.25
2012	0.00	0.13	0.44	0.54	1.35	1.86	1.44	2.17	2.15	2.40	2.63	2.21	2.39	2.58	1.97	2.14	2.24	2.09	2.57	2.01	2.73	2.37	3.27	1.86	1.54	1.61	1.38	2.05	0.90	0.73
2013	0.00	0.02	0.16	0.62	1.24	1.49	1.90	1.83	2.28	2.03	2.19	2.64	2.93	1.94	2.80	2.81	2.51	2.31	2.23	2.30	2.60	1.08	2.15	2.12	3.44	2.20	1.94	1.09	1.65	1.90
2014	0.00	0.06	0.59	1.20	1.43	1.99	2.26	2.29	2.89	2.85	3.26	3.23	2.48	2.18	3.36	2.80	3.25	2.74	2.82	3.47	2.99	2.55	2.08	2.19	1.72	1.26	2.07	1.32	2.51	0.88
2015	0.00	0.16	0.64	1.14	2.23	2.82	2.55	2.11	2.60	2.33	2.44	3.10	2.62	3.07	3.23	2.68	2.21	1.38	2.39	2.58	2.91	1.91	2.90	2.87	2.89	1.69	1.54	0.76	1.30	0.87
2016	0.00	0.19	1.04	2.22	2.42	2.45	2.64	2.60	2.66	3.16	2.50	3.63	4.11	2.22	3.46	2.84	2.93	2.88	2.22	3.59	2.25	2.61	3.89	2.81	1.20	1.50	0.97	1.59	0.97	1.12
2017	0.00	0.16	1.52	2.41	3.03	4.12	3.47	3.23	3.50	3.95	3.31	3.44	3.73	4.55	3.72	4.15	2.41	4.06	2.67	2.98	2.61	3.23	3.11	0.95	2.13	1.51	1.29	1.68	1.30	0.72
2018	0.00	0.46	1.73	2.89	3.22	3.07	3.53	3.32	3.74	3.87	4.46	1.99	3.16	2.79	4.04	2.17	2.58	1.98	3.37	4.45	1.95	1.58	4.58	2.29	2.27	1.87	3.11	1.79	1.10	1.18
2019	0.00	0.64	2.00	2.72	3.46	3.84	3.32	3.13	4.42	2.99	4.06	3.53	4.58	6.03	3.78	3.93	3.57	2.07	2.49	2.70	2.45	3.23	3.97	2.03	2.12	1.67	2.54	1.98	1.06	2.95
2020	0.04	0.51	1.71	2.08	2.66	3.60	4.15	3.82	3.73	4.30	5.93	3.35	4.19	3.89	2.75	4.75	3.88	3.87	2.68	4.27	1.84	2.30	2.25	2.96	2.09	2.26	2.04	1.07	0.78	1.11
2021	0.00	0.42	1.77	2.67	3.51	4.16	3.50	4.97	3.73	5.73	3.52	4.04	4.78	3.59	5.17	3.49	3.31	3.27	3.15	2.62	4.33	2.23	1.96	1.86	1.50	2.60	1.28	1.35	0.84	1.84
2022	0.00	0.38	1.82	2.56	3.93	4.48	3.29	3.63	4.88	4.13	5.76	4.44	3.63	4.26	3.97	1.64	2.99	4.28	2.93	3.71	3.05	2.96	1.81	1.51	2.49	3.95	1.68	1.62	1.26	1.22
2023	0.04	0.41	1.43	2.41	3.96	4.33	2.79	4.17	4.88	4.88	4.57	3.26	4.13	2.97	3.79	2.70	4.24	1.96	3.16	2.91	3.22	1.66	2.45	2.07	2.73	1.87	2.85	1.56	1.04	1.78

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
1994	0.30	2.47	9.91	11.38	21.39	20.47	12.99	25.53	27.07	31.19	26.73	21.87	19.52	16.66	11.25	5.10	4.40	3.71	3.30	3.79	4.25	4.94	3.81	1.34	1.07	1.02	0.98	0.70	0.69	0.45
1995	1.70	10.18	15.65	31.41	23.18	13.53	25.49	26.50	28.60	26.82	23.80	21.54	17.80	10.30	5.19	3.74	2.48	2.57	3.64	3.59	4.06	3.40	1.63	1.03	1.04	0.92	0.96	0.69	0.71	0.78
1996	0.48	6.04	34.08	32.33	15.79	30.28	27.40	27.70	27.03	23.53	21.52	18.92	11.64	5.41	3.91	2.57	2.79	2.99	3.95	3.75	3.68	1.92	1.14	1.17	1.25	1.43	1.07	0.86	0.63	0.36
1997	0.93	18.35	34.36	18.62	36.92	27.39	27.59	25.73	23.22	21.88	19.16	12.32	5.64	3.93	2.57	2.04	3.10	3.84	3.81	4.00	2.14	1.38	1.29	1.44	1.45	1.05	0.97	0.80	0.65	0.58
1998	2.82	20.61	17.25	36.98	28.95	28.05	27.21	25.14	23.44	22.17	13.77	6.99	3.91	3.08	2.40	3.49	3.96	3.85	4.03	2.70	1.44	1.42	1.74	1.72	1.38	0.92	1.07	0.74	0.71	0.47
1999	0.39	3.97	32.47	31.26	30.32	25.77	27.76	27.01	26.84	17.11	7.17	4.44	2.98	2.63	4.54	4.13	5.47	4.72	3.59	2.34	1.96	2.43	2.12	1.59	1.47	1.50	1.03	1.08	0.52	0.30
2000	1.07	33.05	31.03	29.24	24.69	26.83	26.21	26.33	17.04	6.58	4.53	2.26	2.91	4.01	4.42	5.08	6.29	3.97	2.61	2.67	2.44	2.64	1.88	1.95	1.53	1.05	1.27	0.46	0.69	0.47
2001	4.97	20.07	29.69	26.02	31.57	30.79	30.63	18.09	8.43	4.97	3.16	3.06	4.03	6.39	5.68	5.51	4.37	3.33	2.27	2.81	2.88	2.09	1.78	1.63	1.06	0.98	0.60	0.62	0.43	0.33
2002	2.34	27.54	23.94	31.09	31.82	33.12	19.85	7.22	4.72	2.53	2.38	4.88	4.74	6.10	6.90	4.81	3.12	2.89	2.99	2.55	2.02	2.30	2.24	1.77	1.26	1.02	0.74	0.53	0.60	0.30
2003	8.03	22.25	34.00	35.40	34.77	20.62	7.19	4.10	3.14	2.59	4.89	4.44	5.95	6.63	5.36	2.99	3.90	4.03	3.41	2.79	2.86	1.79	2.13	1.58	1.01	0.84	0.82	0.57	0.42	0.27
2004	6.57	29.81	34.49	34.31	19.57	7.30	4.06	2.14	2.38	4.19	5.28	6.49	7.31	5.88	3.59	3.37	4.18	3.85	3.55	3.09	2.80	2.33	1.76	1.23	1.34	1.16	0.76	0.82	0.64	0.38
2005	9.16	22.07	25.69	19.13	7.01	3.59	1.80	2.01	4.58	4.54	5.57	6.30	3.91	2.60	2.36	2.76	2.75	2.44	2.21	1.97	1.67	1.22	0.89	0.90	0.87	0.65	0.83	0.39	0.59	0.35
2006	2.39	12.77	17.85	14.62	5.50	2.24	2.13	5.16	3.62	4.82	4.52	4.06	1.96	2.91	2.31	2.89	2.23	1.96	1.60	1.87	1.52	1.18	1.02	1.05	0.73	0.35	0.89	0.50	0.41	0.11
2007	1.59	11.62	19.31	12.00	4.39	4.43	7.12	3.30	5.16	4.85	3.00	1.69	2.52	1.87	3.19	2.74	2.27	2.93	1.82	1.97	1.25	1.32	1.17	0.61	0.58	0.44	0.89	0.24	0.00	
2008	0.56	25.24	19.78	13.18	11.47	16.32	6.66	6.89	8.35	6.14	3.62	4.09	4.09	3.09	3.46	2.98	2.96	2.88	2.01	1.34	1.46	0.64	0.96	0.79	0.43	0.63	0.41	0.45	0.47	0.18
2009	12.81	19.92	16.89	12.69	18.56	11.30	10.81	11.78	9.87	6.76	5.46	6.57	5.29	4.89	5.00	4.36	3.59	3.42	2.78	2.30	1.58	1.76	0.92	0.95	1.03	0.55	0.41	0.17	0.47	0.23
2010	2.29	8.08	8.76	17.96	17.54	19.02	17.50	14.76	8.52	7.82	9.12	8.50	7.88	7.04	6.02	5.39	4.14	3.03	2.38	2.38	1.85	1.96	1.41	1.13	0.99	0.57	0.73	0.70	0.52	0.33
2011	1.54	10.16	20.45	19.62	23.43	26.59	20.82	11.98	11.57	11.74	10.77	10.20	9.38	7.79	7.08	5.12	3.95	3.93	2.79	2.49	1.78	1.79	1.53	1.43	0.84	0.75	0.83	0.67	0.31	0.42
2012	3.41	19.21	20.30	23.59	30.18	24.78	14.70	14.28	15.63	13.44	10.71	10.75	10.13	7.27	5.92	4.97	4.35	4.56	3.03	2.63	2.43	2.15	1.19	0.82	0.92	0.46	0.52	0.44	0.35	0.20
2013	2.93	15.22	26.39	34.80	29.84	15.49	15.96	17.85	16.81	15.54	11.14	10.00	9.21	7.35	4.14	4.57	3.14	3.40	3.25	1.27	2.04	1.63	1.74	1.00	0.16	0.38	0.92	0.36	0.12	0.16
2014	4.02	33.75	38.22	30.74	16.97	16.10	19.30	18.77	16.20	14.27	13.71	10.81	10.43	6.38	5.98	4.66	3.45	3.24	2.57	2.63	2.29	1.87	1.57	1.13	1.80	0.80	0.43	0.98	0.58	0.19
2015	9.03	28.41	27.44	16.43	16.66	19.13	20.11	17.26	15.65	12.63	12.17	10.77	6.95	6.65	5.02	4.80	3.42	2.68	3.26	2.03	1.80	1.53	0.76	1.91	1.27	1.58	0.71	0.59	0.81	0.36
2016	5.70	18.59	14.13	17.13	19.91	19.23	17.56	16.54	14.20	11.96	9.69	7.63	6.34	6.34	6.21	3.83	3.12	2.66	3.25	3.48	2.30	0.90	0.65	1.87	1.09	0.47	1.16	0.28	0.63	0.34
2017	2.59	10.03	16.06	20.39	18.29	17.02	14.73	13.48	11.55	10.52	6.22	6.28	6.31	5.81	6.02	4.01	3.19	2.33	1.65	3.29	2.50	1.27	2.03	1.16	0.19	0.78	0.40	0.33	0.82	1.92
2018	2.12	14.58	24.08	21.88	17.24	16.22	13.66	14.46	10.26	8.17	7.77	7.92	5.41	3.97	4.83	3.31	3.13	2.84	3.63	1.42	1.13	1.38	0.70	1.08	0.70	0.55	0.85	0.20	0.67	0.11
2019	2.92	20.00	24.01	21.50	20.69	20.07	15.49	12.98	10.65	7.80	7.55	5.93	5.68	5.52	2.57	3.36	2.88	3.43	1.53	1.48	1.36	0.16	0.48	2.86	1.24	0.74	1.43	1.27	0.84	0.38
2020	2.96	16.77	25.33	24.01	21.22	17.33	15.43	12.49	10.11	8.54	9.11	5.25	6.50	4.45	3.48	3.18	3.23	2.06	2.32	2.27	1.04	0.82	0.99	1.00	2.38	1.27	0.12	0.17	0.78	0.24
2021	2.37	18.29	24.91	24.92	20.04	17.49	11.89	11.49	10.67	8.44	5.12	7.16	6.66	4.63	2.33	4.33	2.29	3.24	2.44	1.80	1.66	1.44	1.91	2.22	0.20	0.32	0.61	0.49	0.21	0.73
2022	2.50	18.76	26.33	23.73	20.62	14.31	11.97	11.06	8.89	7.09	6.34	6.57	4.95	4.39	2.74	3.70	1.65	2.78	3.93	1.59	1.55	0.69	0.51	1.93	0.58	1.20	0.02	0.32	0.14	
2023	2.55	19.13	26.99	24.29	15.63	16.18	12.77	10.81	9.39	8.86	6.61	5.44	5.06	5.16	1.94	2.44	2.61	2.41	2.17	1.79	1.45	2.15	1.35	1.05	0.41	0.15	0.65	0.54	0.10	1.26

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
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	8.47	8.49	8.50	8.52	8.54	8.56	8.58	8.61	8.64	8.67	8.71
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	9.08	9.10	9.13	9.16	9.18	9.20	9.23	9.25	9.28	9.31	9.34
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	8.19	8.22	8.25	8.28	8.30	8.32	8.34	8.37	8.39	8.42	8.45	8.47	8.49
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	7.22	7.26	7.30	7.33	7.36	7.38	7.40	7.43	7.46	7.49	7.52	7.55	7.57	7.61
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	7.31	7.37	7.41	7.46	7.51	7.55	7.58	7.62	7.67	7.71	7.75	7.79	7.84	7.88	7.92	7.96
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	5.94	6.02	6.09	6.15	6.19	6.23	6.28	6.33	6.38	6.42	6.48	6.53	6.57	6.62	6.65	6.70
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	6.03	6.13	6.20	6.28	6.34	6.39	6.46	6.53	6.59	6.66	6.70	6.76	6.82	6.87	6.92	6.98	7.02
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	5.31	5.45	5.53	5.63	5.69	5.75	5.84	5.93	6.02	6.09	6.18	6.24	6.31	6.40	6.45	6.52	6.58	6.64
2002	0.00	0.23	1.26	2.24	3.01	3.67	4.35	4.94	5.43	5.83	6.19	6.53	6.73	6.89	7.03	7.14	7.22	7.31	7.42	7.52	7.61	7.69	7.76	7.84	7.91	7.98	8.06	8.11	8.18	8.25
2003	0.01	0.51	1.57	2.54	3.56	4.50	5.24	5.94	6.38	6.83	7.24	7.49	7.66	7.84	8.02	8.12	8.24	8.40	8.53	8.63	8.75	8.82	8.92	9.01	9.08	9.16	9.23	9.31	9.38	9.44
2004	0.08	0.68	1.73	3.00	4.43	5.65	6.62	7.33	8.01	8.68	9.10	9.37	9.68	9.92	10.10	10.33	10.54	10.72	10.85	11.05	11.20	11.36	11.49	11.61	11.74	11.85	11.95	12.04	12.11	12.18
2005	0.09	0.87	2.57	5.12	7.57	9.86	11.33	12.74	14.17	15.25	16.04	16.76	17.37	17.84	18.42	19.01	19.48	19.94	20.37	20.76	21.15	21.49	21.79	22.12	22.35	22.60	22.80	23.01	23.19	23.35
2006	0.02	1.13	4.05	8.67	13.36	16.49	19.37	21.62	23.28	24.44	25.63	26.59	27.35	28.20	29.02	29.84	30.44	30.99	31.70	32.36	32.86	33.35	33.93	34.36	34.73	35.02	35.28	35.49	35.68	35.97
2007	0.00	1.02	5.33	11.70	16.31	20.26	23.56	25.29	26.47	28.03	29.36	30.26	31.25	32.38	33.10	33.89	34.62	35.32	36.09	36.57	37.10	37.73	38.08	38.44	38.79	39.05	39.25	39.46	39.56	39.69
2008	0.01	0.58	3.61	7.44	11.23	14.79	17.47	18.84	19.99	20.86	21.42	22.02	22.46	22.90	23.29	23.67	24.07	24.33	24.63	24.88	25.13	25.30	25.52	25.69	25.89	26.04	26.14	26.29	26.42	26.52
2009	0.09	0.91	2.62	4.47	6.73	8.75	9.84	10.84	11.78	12.20	12.73	13.14	13.59	13.96	14.22	14.50	14.73	15.03	15.23	15.44	15.63	15.82	15.99	16.17	16.35	16.50	16.65	16.78	16.89	16.97
2010	0.01	0.18	0.76	1.89	3.14	3.95	4.82	5.58	6.04	6.59	7.07	7.49	7.87	8.23	8.50	8.81	9.07	9.28	9.55	9.78	10.00	10.17	10.34	10.49	10.68	10.84	10.98	11.11	11.21	11.33
2011	0.00	0.19	0.69	1.25	1.73	2.34	2.81	3.16	3.54	3.84	4.14	4.38	4.59	4.76	4.92	5.07	5.23	5.37	5.46	5.59	5.72	5.86	5.99	6.08	6.15	6.25	6.33	6.40	6.47	6.55
2012	0.00	0.13	0.47	0.81	1.45	2.04	2.38	2.80	3.15	3.47	3.77	3.98	4.18	4.38	4.51	4.64	4.76	4.87	5.00	5.09	5.21	5.31	5.44	5.52	5.57	5.63	5.69	5.77	5.81	5.84
2013	0.00	0.02	0.16	0.54	1.02	1.42	1.84	2.17	2.51	2.74	2.95	3.18	3.39	3.52	3.68	3.83	3.95	4.06	4.16	4.26	4.36	4.41	4.49	4.56	4.69	4.76	4.83	4.87	4.92	4.99
2014	0.00	0.05	0.43	0.90	1.28	1.70	2.10	2.41	2.72	2.97	3.21	3.40	3.53	3.62	3.76	3.86	3.97	4.06	4.14	4.24	4.32	4.38	4.43	4.48	4.52	4.55	4.60	4.63	4.68	4.70
2015	0.00	0.15	0.57	1.10	1.95	2.83	3.45	3.84	4.23	4.52	4.78	5.05	5.25	5.46	5.66	5.81	5.93	6.00	6.11	6.23	6.35	6.43	6.55	6.65	6.76	6.82	6.87	6.90	6.94	6.99
2016	0.00	0.18	0.98	2.43	3.60	4.60	5.43	6.09	6.63	7.17	7.52	7.98	8.44	8.66	8.98	9.21	9.44	9.65	9.80	10.03	10.17	10.31	10.53	10.68	10.74	10.82	10.87	10.96	11.01	11.08
2017	0.00	0.16	1.50	3.24	4.93	6.72	7.91	8.82	9.63	10.41	10.97	11.49	12.01	12.58	12.98	13.39	13.61	13.95	14.16	14.40	14.58	14.81	15.02	15.07	15.21	15.30	15.38	15.48	15.56	15.62
2018	0.00	0.46	1.90	3.68	5.17	6.30	7.35	8.16	8.91	9.57	10.24	10.51	10.89	11.19	11.59	11.79	12.00	12.17	12.42	12.76	12.90	13.00	13.30	13.45	13.59	13.71	13.87	13.97	14.05	14.12
2019	0.00	0.63	2.18	3.72	5.21	6.46	7.28	7.91	8.64	9.07	9.58	9.97	10.42	10.97	11.27	11.56	11.80	11.93	12.08	12.24	12.37	12.55	12.76	12.87	12.97	13.04	13.16	13.25	13.31	13.48
2020	0.04	0.54	1.92	3.14	4.29	5.46	6.53	7.32	7.96	8.60	9.36	9.72	10.14	10.48	10.71	11.07	11.34	11.59	11.76	12.00	12.10	12.23	12.34	12.50	12.61	12.72	12.82	12.87	12.91	12.95
2021	0.00	0.42	1.83	3.38	4.86	6.19	7.06	8.10	8.76	9.61	10.06	10.54	11.03	11.35	11.80	12.07	12.31	12.53	12.73	12.89	13.13	13.25	13.36	13.45	13.52	13.64	13.71	13.77	13.81	13.89
2022	0.00	0.37	1.81	3.26	4.89	6.29	7.12	7.88	8.77	9.42	10.21	10.74	11.13	11.56	11.91	12.05	12.28	12.60	12.81	13.05	13.23	13.41	13.52	13.60	13.74	13.95	14.03	14.12	14.19	14.26
2023	0.04	0.45	1.57	2.92	4.53	5.95	6.67	7.58	8.48	9.25	9.87	10.27	10.73	11.03	11.38	11.62	11.96	12.11	12.34	12.54	12.75	12.85	13.01	13.12	13.29	13.39	13.54	13.62	13.68	13.77

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
1994	0.30	2.78	12.42	22.30	38.37	50.01	55.70	65.18	72.54	78.65	82.20	84.30	85.76	86.75	87.31	87.53	87.71	87.86	87.98	88.13	88.27	88.44	88.56	88.60	88.63	88.67	88.69	88.72	88.74	88.75
1995	1.71	11.76	25.56	48.40	59.40	64.07	71.40	76.91	81.17	83.94	85.69	86.88	87.64	88.00	88.16	88.27	88.34	88.41	88.51	88.60	88.70	88.77	88.81	88.83	88.85	88.87	88.89	88.91	88.92	88.94
1996	0.49	6.53	38.40	57.73	63.76	73.03	78.65	82.61	85.28	86.92	88.04	88.81	89.18	89.33	89.44	89.50	89.57	89.64	89.73	89.81	89.88	89.92	89.94	89.96	89.98	90.01	90.03	90.04	90.05	90.06
1997	0.93	19.22	46.91	56.45	71.21	77.78	82.36	85.28	87.17	88.49	89.39	89.84	90.02	90.14	90.21	90.27	90.35	90.44	90.53	90.62	90.67	90.69	90.72	90.75	90.78	90.80	90.81	90.83	90.84	90.85
1998	2.84	22.95	36.16	58.94	69.70	76.80	81.50	84.54	86.60	88.06	88.75	89.05	89.20	89.31	89.40	89.52	89.64	89.76	89.87	89.95	89.98	90.02	90.06	90.10	90.13	90.16	90.18	90.20	90.21	90.22
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	90.03	90.21	90.42	90.59	90.71	90.78	90.84	90.91	90.97	91.02	91.06	91.09	91.12	91.15	91.16	91.17
2000	1.07	33.92	54.34	67.29	74.66	80.44	84.42	87.28	88.60	89.01	89.27	89.38	89.53	89.72	89.91	90.12	90.35	90.49	90.57	90.66	90.73	90.80	90.85	90.90	90.94	90.97	91.00	91.01	91.03	91.04
2001	4.99	24.17	46.72	60.35	72.24	79.97	85.11	87.14	87.90	88.28	88.51	88.72	88.97	89.34	89.64	89.91	90.11	90.26	90.35	90.46	90.56	90.64	90.70	90.75	90.78	90.82	90.83	90.85	90.87	90.88
2002	2.35	29.42	46.38	62.78	73.98	81.64	84.57	85.37	85.84	86.06	86.26	86.63	86.96	87.35	87.76	88.01	88.17	88.30	88.44	88.55	88.63	88.72	88.80	88.87	88.91	88.94	88.97	88.99	89.00	89.02
2003	8.10	28.69	52.92	69.12	79.02	82.63	83.56	84.02	84.34	84.58	85.01	85.36	85.80	86.24	86.56	86.73	86.93	87.13	87.29	87.41	87.52	87.59	87.67	87.73	87.76	87.79	87.82	87.84	87.85	87.86
2004	6.66	34.65	57.06	71.26	76.32	77.73	78.41	78.74	79.07	79.62	80.25	80.95	81.67	82.19	82.48	82.73	83.03	83.28	83.50	83.68	83.83	83.95	84.03	84.09	84.15	84.20	84.24	84.27	84.30	84.32
2005	9.33	29.45	47.46	57.04	59.71	60.89	61.43	61.98	63.15	64.20	65.36	66.55	67.21	67.62	67.97	68.35	68.71	69.00	69.25	69.46	69.63	69.75	69.83	69.91	69.99	70.04	70.11	70.14	70.18	70.22
2006	2.41	14.94	29.98	39.66	42.51	43.50	44.35	46.24	47.42	48.85	50.08	51.07	51.52	52.14	52.60	53.14	53.53	53.85	54.10	54.37	54.58	54.74	54.87	54.99	55.07	55.11	55.21	55.26	55.30	55.32
2007	1.60	13.10	29.79	37.60	39.84	41.80	44.53	45.59	47.12	48.41	49.13	49.50	50.02	50.37	50.93	51.38	51.72	52.13	52.36	52.60	52.74	52.88	52.99	53.10	53.15	53.21	53.24	53.32	53.34	53.34
2008	0.57	25.80	40.42	47.83	53.01	58.88	60.65	62.17	63.78	64.78	65.31	65.86	66.36	66.71	67.08	67.37	67.64	67.88	68.04	68.14	68.25	68.29	68.36	68.41	68.43	68.47	68.49	68.52	68.55	68.56
2009	12.89	30.35	42.01	49.11	57.80	61.84	65.05	68.05	70.15	71.38	72.29	73.28	74.01	74.62	75.20	75.66	76.02	76.34	76.58	76.78	76.91	77.04	77.10	77.17	77.24	77.28	77.31	77.32	77.35	77.37
2010	2.32	10.27	18.19	32.89	44.44	54.51	61.86	66.82	69.20	71.15	73.20	74.90	76.30	77.43	78.30	79.02	79.54	79.89	80.16	80.41	80.60	80.79	80.92	81.02	81.11	81.16	81.23	81.29	81.33	81.37
2011	1.55	11.63	29.81	43.57	56.62	67.80	74.07	76.87	79.20	81.24	82.87	84.21	85.29	86.09	86.75	87.18	87.50	87.79	87.99	88.15	88.27	88.38	88.47	88.56	88.60	88.65	88.69	88.73	88.75	88.78
2012	3.45	22.18	38.09	52.72	66.88	74.79	78.23	81.02	83.57	85.37	86.58	87.63	88.49	89.03	89.43	89.73	89.98	90.23	90.38	90.51	90.62	90.71	90.76	90.79	90.83	90.84	90.87	90.88	90.90	90.91
2013	2.96	17.89	39.73	60.84	72.44	76.59	80.13	83.38	85.83	87.66	88.74	89.58	90.26	90.73	90.97	91.22	91.38	91.54	91.69	91.75	91.83	91.90	91.97	92.01	92.01	92.03	92.06	92.07	92.08	92.08
2014	4.06	36.72	61.09	72.99	77.46	80.91	84.29	86.87	88.62	89.87	90.86	91.51	92.05	92.34	92.58	92.76	92.88	92.98	93.06	93.13	93.20	93.25	93.28	93.31	93.35	93.37	93.38	93.40	93.42	93.42
2015	9.13	35.21	53.06	60.74	67.14	73.10	77.97	81.20	83.57	85.12	86.40	87.36	87.90	88.36	88.68	88.95	89.14	89.27	89.43	89.52	89.61	89.67	89.70	89.77	89.82	89.88	89.90	89.92	89.95	89.97
2016	5.76	23.45	34.33	45.50	55.95	63.78	69.38	73.59	76.51	78.55	79.95	80.92	81.63	82.19	82.77	83.09	83.34	83.53	83.76	84.00	84.14	84.20	84.23	84.34	84.40	84.42	84.48	84.49	84.53	84.55
2017	2.61	12.46	26.59	41.34	51.55	59.01	64.10	67.91	70.63	72.74	73.80	74.77	75.65	76.39	77.06	77.47	77.77	77.98	78.11	78.37	78.56	78.65	78.79	78.87	78.88	78.93	78.96	78.98	79.03	79.14
2018	2.14	16.52	36.61	50.14	58.15	64.14	68.22	71.79	73.87	75.30	76.50	77.57	78.23	78.68	79.17	79.49	79.77	80.01	80.31	80.41	80.49	80.59	80.64	80.71	80.75	80.78	80.83	80.85	80.90	80.91
2019	2.94	22.49	41.05	53.33	62.27	68.85	72.72	75.35	77.16	78.29	79.27	79.95	80.53	81.05	81.26	81.52	81.73	81.96	82.05	82.14	82.22	82.23	82.26	82.42	82.48	82.52	82.58	82.64	82.67	82.69
2020	2.98	19.37	39.76	53.85	63.04	68.75	72.77	75.40	77.18	78.47	79.67	80.26	80.92	81.33	81.63	81.88	82.11	82.25	82.41	82.54	82.60	82.64	82.70	82.75	82.87	82.93	82.94	82.95	82.98	82.99
2021	2.39	20.39	40.23	54.76	63.21	68.86	71.86	74.32	76.22	77.51	78.18	79.02	79.74	80.17	80.38	80.73	80.90	81.13	81.28	81.40	81.50	81.58	81.68	81.80	81.81	81.82	81.86	81.88	81.89	81.94
2022	2.52	20.96	41.79	55.26	63.89	68.40	71.47	73.88	75.53	76.66	77.57	78.39	78.94	79.39	79.64	79.97	80.10	80.32	80.60	80.71	80.86	80.89	81.00	81.04	81.10	81.10	81.12	81.14	81.14	81.14
2023	2.56	21.34	42.57	56.23	62.68	68.06	71.42	73.82	75.59	77.02	77.95	78.63	79.20	79.74	79.92	80.14	80.36	80.56	80.73	80.86	80.96	81.11	81.20	81.26	81.29	81.30	81.34	81.37	81.38	81.46

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
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	0.91	1.31	1.04	0.47	1.22	0.96	0.71	0.00	0.24	0.00	0.40	0.00	0.16	0.00	0.00	0.36
1998	0.01	0.34	1.24	1.40	1.61	1.82	1.71	1.32	0.64	0.00	0.57	0.35	1.12	0.65	1.13	0.20	2.50	1.02	1.54	0.38	0.00	0.17	0.39	0.64	0.82	0.18	0.51	0.25	0.00	0.00
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	2.20	1.70	3.93	1.18	1.45	0.96	0.97	0.56	0.39	0.18	0.48	0.43	0.12	0.36	0.16	0.34	0.00	0.20
2000	0.00	0.39	1.82	4.22	2.67	2.94	1.99	1.75	2.42	1.24	4.38	2.00	2.35	2.75	1.31	2.47	1.09	1.04	0.41	0.38	0.97	0.88	0.21	0.59	0.45	0.24	0.56	0.63	0.10	0.00
2001	0.03	0.19	1.92	2.90	2.07	1.83	1.79	2.94	5.94	4.51	4.00	1.46	4.14	3.19	1.80	2.68	1.12	0.38	0.68	0.42	0.60	0.23	0.58	1.32	0.00	0.64	0.21	0.61	0.21	0.00
2002	0.01	0.40	1.79	2.10	2.49	2.97	4.86	4.80	5.20	3.60	3.73	3.90	3.06	2.19	1.63	1.33	0.84	1.27	1.08	0.96	0.81	0.92	0.53	0.36	0.42	0.33	0.16	0.23	0.28	0.05
2003	0.02	0.81	2.19	2.84	3.27	5.73	5.45	5.64	4.86	4.66	4.64	3.14	1.52	1.57	1.31	0.61	0.69	1.30	0.94	0.79	0.93	0.49	0.54	0.40	0.19	0.32	0.19	0.11	0.22	0.17
2004	0.13	1.26	2.81	3.65	6.20	6.63	5.89	3.87	4.73	4.59	2.76	2.09	2.27	1.91	1.38	1.49	1.32	1.03	1.24	0.72	0.73	0.66	0.98	0.57	0.64	0.31	0.35	0.27	0.14	0.21
2005	0.26	2.04	4.06	5.40	6.77	5.61	4.70	4.51	4.97	3.22	2.71	2.99	2.34	1.85	1.86	1.73	1.65	1.24	1.53	0.75	0.95	0.93	0.64	0.41	0.28	0.41	0.37	0.11	0.21	0.16
2006	0.00	2.49	6.58	7.25	11.84	3.67	5.48	3.46	3.66	1.76	4.14	2.56	2.25	1.87	3.23	4.93	2.61	1.47	0.00	1.32	1.29	0.00	0.56	0.00	0.55	0.00	0.82	0.00	0.00	0.46
2007	0.00	2.34	4.05	11.85	8.38	1.98	12.65	1.31	5.32	5.96	8.52	7.37	6.96	2.81	2.59	1.74	0.00	3.49	1.05	0.00	0.00	0.00	1.10	2.43	0.00	0.00	0.00	0.00	0.00	0.00
2008	0.00	1.06	6.86	10.02	7.02	13.97	17.48	8.69	8.53	8.70	5.00	5.92	7.21	4.55	4.18	4.85	0.76	2.12	2.07	1.25	1.71	0.69	0.00	1.10	0.19	0.00	0.55	0.35	0.00	1.66
2009	0.04	0.80	3.26	5.75	9.78	8.60	5.51	7.49	6.10	4.77	4.37	4.64	3.96	3.04	2.60	1.56	2.77	1.96	0.66	1.64	0.80	1.53	0.50	0.57	0.31	0.46	0.07	0.33	0.08	0.43
2010	0.12	1.40	3.45	6.18	7.13	5.35	5.68	4.24	3.34	3.70	3.58	2.74	2.62	2.07	1.91	1.72	1.68	1.43	1.05	1.17	0.72	0.73	0.83	0.36	0.26	0.14	0.28	0.25	0.18	0.11
2011	0.03	0.81	2.55	2.78	2.85	2.99	2.86	2.41	2.88	2.46	1.99	1.54	1.71	1.35	1.48	1.27	0.63	0.80	0.96	0.46	0.91	0.37	0.65	0.35	0.37	0.20	0.19	0.34	0.05	0.21
2012	0.06	0.90	1.45	1.21	2.04	2.42	1.75	2.44	2.69	2.46	2.23	2.14	1.49	1.36	1.09	1.28	1.36	0.66	0.92	0.47	0.61	0.56	1.49	0.53	0.13	0.31	0.11	0.12	0.10	0.00
2013	0.11	0.34	0.60	1.38	1.50	1.72	2.21	2.31	2.80	1.98	1.57	2.03	1.83	1.15	1.60	1.20	0.45	0.94	0.83	0.26	0.38	0.30	0.34	1.03	0.14	0.29	0.00	0.00	0.00	0.00
2014	0.00	0.20	0.86	1.59	2.01	2.50	2.19	2.45	1.48	3.15	2.81	1.64	1.42	2.04	0.58	0.84	0.59	0.38	1.06	0.39	0.45	0.38	0.00	0.98	0.40	0.43	1.41	0.00	0.00	0.00
2015	0.00	0.23	1.47	1.88	3.10	2.86	2.39	3.30	2.03	2.76	2.52	1.20	1.15	1.85	1.45	1.60	1.84	1.69	1.56	0.65	1.73	2.38	0.14	0.32	0.26	1.12	0.72	0.29	0.00	0.00
2016	0.03	0.21	1.07	2.00	1.94	2.17	1.52	1.41	1.48	1.58	1.15	0.92	0.93	1.37	2.63	2.04	2.14	3.16	1.54	0.74	0.83	0.92	0.14	0.80	0.45	0.16	1.49	0.00	0.34	0.00
2017	0.01	0.35	1.59	2.10	1.94	2.30	1.89	1.85	1.45	1.81	1.37	2.37	1.48	1.43	0.64	0.56	1.38	2.05	0.65	0.44	1.20	0.00	0.37	0.49	0.00	0.71	0.45	0.00	0.00	0.00
2018	0.00	0.35	1.82	3.72	2.96	2.64	2.10	1.43	1.11	0.84	2.61	5.27	0.91	1.53	0.00	0.00	2.73	2.39	1.91	1.82	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	0.01	0.55	1.52	2.67	2.22	2.05	3.44	2.48	1.80	4.59	1.55	1.74	1.99	1.13	0.15	2.69	0.64	0.00	3.16	0.54	0.00	0.00	1.28	0.03	0.00	0.00	0.00	0.00	0.00	0.00
2020	0.03	0.30	1.68	3.18	2.76	3.35	2.64	2.96	0.92	1.08	1.68	2.45	0.15	0.73	1.92	1.92	1.31	2.17	2.23	0.41	2.58	0.96	0.92	0.00	0.00	1.10	1.27	0.00	0.00	0.00
2021	0.01	0.56	1.98	2.34	2.49	3.27	2.47	3.50	2.68	3.32	1.41	2.88	2.66	3.29	3.90	1.50	2.48	1.64	1.17	0.50	0.00	0.67	0.40	0.00	0.00	0.03	0.59	0.00	0.00	0.00
2022	0.01	0.56	2.45	3.27	3.13	1.49	2.37	2.66	1.11	1.10	0.61	1.68	3.68	1.64	2.93	0.17	0.77	1.27	1.76	0.27	0.92	0.33	0.00	0.61	0.97	0.00	0.02	0.00	0.00	0.00
2023	0.02	0.49	2.00	3.05	2.47	2.48	4.51	3.48	2.72	4.37	0.92	1.28	2.75	2.33	2.85	0.26	0.66	0.37	0.74	0.92	0.34	2.80	0.91	0.22	0.00	1.39	0.00	0.00	0.00	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
1997	4.79	40.68	43.36	20.14	35.17	29.37	34.18	31.06	28.75	25.61	22.13	11.80	5.67	3.76	4.23	1.37	2.62	2.99	2.20	2.75	0.99	1.03	1.82	3.49	1.54	0.52	2.20	0.27	0.11	1.11
1998	10.69	42.38	23.05	41.34	35.64	37.40	30.99	30.01	25.68	23.88	15.68	7.69	3.83	3.58	3.85	5.99	3.52	5.28	4.15	1.59	3.29	1.55	2.28	1.33	1.48	1.07	0.57	1.03	1.48	0.38
1999	3.41	10.88	34.24	31.55	33.06	28.58	29.25	28.91	26.08	17.25	9.44	6.96	1.89	2.43	3.13	5.56	3.95	3.64	2.21	3.32	1.39	2.38	2.80	2.70	1.73	2.00	1.92	1.22	0.25	0.16
2000	2.64	23.07	22.00	19.84	23.51	24.87	27.88	27.49	13.98	3.23	4.04	1.69	1.89	3.95	3.70	3.80	4.19	2.44	2.06	1.99	1.72	1.74	1.78	2.74	1.95	1.25	0.40	0.79	0.56	0.77
2001	3.56	33.08	30.57	27.56	33.50	31.96	29.57	16.06	5.81	3.00	1.37	4.00	2.55	4.98	6.80	4.77	3.23	1.90	3.92	3.54	3.14	2.73	1.66	2.00	2.00	2.97	1.66	2.21	0.50	0.42
2002	6.26	35.80	27.91	31.42	32.30	32.02	19.14	7.39	3.52	2.47	2.00	3.91	4.60	6.24	5.72	4.92	3.37	2.97	3.03	3.09	3.42	3.08	2.34	1.60	1.48	1.33	1.53	1.01	0.64	0.70
2003	15.89	29.77	34.14	34.22	34.14	22.29	7.93	5.03	2.47	2.50	5.16	5.28	5.87	6.40	4.35	3.15	3.51	4.27	3.62	3.32	3.17	2.31	1.79	2.12	1.84	1.27	1.90	1.24	0.71	0.72
2004	12.21	31.44	31.21	30.44	18.90	6.59	4.02	2.07	2.34	4.09	4.52	5.85	6.81	5.63	3.48	3.89	4.55	4.38	3.88	3.21	2.80	2.25	2.01	1.69	1.78	1.29	1.06	0.80	1.00	0.48
2005	15.05	25.20	23.60	18.35	5.48	2.90	1.51	2.16	3.97	4.41	6.60	6.66	5.18	4.11	3.46	3.90	3.78	3.69	2.66	2.57	2.38	2.01	2.13	1.33	1.57	1.20	0.69	0.76	0.42	0.31
2006	6.86	16.67	17.55	11.48	4.00	1.03	1.59	3.93	7.12	8.16	7.41	6.27	4.78	5.10	2.61	3.20	0.54	4.61	1.35	1.62	1.09	1.62	1.62	0.86	0.60	1.26	1.59	0.26	0.25	
2007	7.09	19.43	20.91	9.35	3.98	3.46	6.77	2.73	6.24	4.66	1.55	6.52	0.87	2.45	4.45	4.61	7.94	3.38	0.82	6.07	2.25	4.38	2.01	1.60	0.00	7.83	0.00	0.00	1.81	
2008	3.34	29.70	9.24	5.09	5.29	7.58	3.81	4.14	6.62	4.17	3.45	3.80	4.80	6.93	4.60	3.48	4.89	1.71	2.55	1.33	3.34	0.81	1.32	0.94	0.00	1.38	1.67	2.32	0.00	0.98
2009	2.62	11.37	8.94	4.82	7.93	5.25	7.10	8.85	7.87	5.93	5.01	6.35	6.37	5.94	5.97	4.78	4.92	4.22	4.17	3.24	2.16	1.52	1.62	2.08	1.33	0.86	0.87	0.61	0.82	0.65
2010	4.24	11.33	5.44	10.01	9.34	12.93	12.37	10.05	7.47	6.83	8.14	8.16	7.41	7.36	6.30	5.90	4.48	3.22	3.21	3.23	2.03	2.31	1.50	1.63	1.31	1.10	1.25	0.73	0.64	0.73
2011	0.84	8.42	16.87	16.98	22.05	22.06	16.69	11.29	10.86	12.32	12.58	12.96	10.57	8.92	7.57	6.38	5.50	5.16	4.41	2.97	2.94	2.28	2.46	1.67	1.78	1.48	1.00	0.73	0.82	0.62
2012	1.98	17.49	21.74	26.52	26.04	20.56	14.48	13.30	16.20	15.56	14.90	12.08	11.62	9.43	7.24	5.66	6.26	5.07	2.99	3.66	2.75	2.43	2.08	1.71	1.86	1.04	1.03	0.41	1.17	0.85
2013	3.63	15.03	21.59	28.98	28.46	18.66	19.95	19.92	21.92	16.69	14.32	12.02	9.45	7.63	8.05	5.70	5.13	5.63	4.35	4.06	1.80	2.32	4.71	2.10	2.74	1.56	0.60	1.67	0.53	0.85
2014	4.09	35.33	35.37	27.64	18.32	18.88	21.29	20.56	19.59	17.66	15.18	10.31	9.64	8.56	7.16	5.76	7.55	4.68	3.16	4.75	5.32	2.56	3.03	1.01	3.88	0.82	1.81	0.54	0.11	0.40
2015	7.71	31.04	33.12	22.60	21.53	24.12	24.44	23.79	19.76	16.82	11.17	14.41	9.36	8.98	3.60	10.08	6.52	0.94	2.65	1.29	1.53	1.65	0.00	3.23	0.27	0.57	1.59	0.00	1.72	0.45
2016	7.59	24.47	26.19	25.53	27.12	27.31	25.53	23.28	18.75	14.49	14.35	12.27	8.22	5.47	7.03	5.87	6.02	2.49	4.30	2.09	2.35	1.28	1.68	0.70	1.43	0.83	0.45	0.57	0.85	1.00
2017	13.42	24.74	27.58	27.97	28.80	30.41	24.31	19.58	17.10	13.45	11.46	12.78	11.00	5.88	4.49	5.63	5.81	2.35	3.77	2.62	2.40	0.73	1.70	3.92	0.53	0.33	0.00	0.90	2.35	0.42
2018	13.07	32.24	34.75	30.13	28.37	31.22	27.66	20.35	15.16	8.12	13.55	10.22	7.00	5.87	0.37	2.44	2.48	0.40	4.19	1.51	10.06	8.86	0.20	3.39	5.72	1.40	0.97	0.00	0.59	0.00
2019	17.15	39.74	37.39	30.14	29.24	32.02	23.46	18.56	14.06	13.23	12.84	11.61	13.90	8.38	4.45	3.08	4.13	2.69	3.91	1.34	2.05	4.12	2.06	0.36	1.11	1.04	0.00	0.41	1.36	0.00
2020	21.12	44.83	37.75	31.39	30.05	25.42	21.06	17.85	12.73	9.41	16.92	10.24	7.87	10.44	5.48	3.04	5.09	4.85	0.62	0.78	2.05	0.54	2.87	5.41	0.38	2.12	4.80	0.00	0.73	0.13
2021	29.54	47.86	38.82	32.26	30.61	25.44	19.16	17.11	10.10	14.54	11.65	10.81	6.52	9.40	7.14	2.98	0.31	0.75	0.20	1.57	1.40	4.34	1.53	0.64	0.43	0.33	1.11	2.16	0.44	0.51
2022	33.26	54.72	39.89	30.94	27.21	21.97	21.01	14.93	15.35	17.14	14.43	10.55	6.18	2.86	2.38	4.97	2.45	1.34	3.97	0.98	7.02	0.71	1.99	0.46	1.06	0.31	0.39	0.68	0.94	0.41
2023	33.40	53.86	40.28	29.60	25.61	25.27	21.25	16.46	13.19	12.61	11.96	10.81	5.76	4.81	3.55	4.47	4.65	2.19	1.53	0.54	0.50	2.15	1.98	1.15	1.44	3.05	0.00	2.98	0.19	0.01

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
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	4.26	4.27	4.28	4.29	4.30	4.30	4.30	4.30	4.30	4.30	4.31	4.31	4.31	4.31
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	2.40	2.44	2.45	2.47	2.47	2.47	2.48	2.48	2.49	2.49	2.50	2.50	2.50	2.50	2.50
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	3.17	3.21	3.26	3.29	3.31	3.33	3.34	3.35	3.36	3.37	3.37	3.38	3.39	3.39	3.39	3.40
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	8.32	8.42	8.58	8.65	8.71	8.74	8.76	8.81	8.86	8.87	8.90	8.92	8.93	8.96	8.99	9.00	9.00
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	5.42	5.57	5.65	5.76	5.80	5.82	5.84	5.86	5.88	5.88	5.90	5.94	5.94	5.96	5.96	5.98	5.98	5.98
2002	0.01	0.38	1.45	2.33	3.03	3.56	4.13	4.56	4.97	5.23	5.48	5.73	5.90	6.02	6.10	6.16	6.20	6.25	6.29	6.33	6.36	6.39	6.41	6.42	6.43	6.44	6.45	6.45	6.46	6.47
2003	0.02	0.70	1.98	3.03	3.79	4.63	5.20	5.71	6.10	6.45	6.77	6.97	7.05	7.14	7.20	7.23	7.26	7.32	7.35	7.38	7.42	7.44	7.45	7.47	7.47	7.48	7.49	7.49	7.50	7.51
2004	0.13	1.24	2.90	4.31	5.89	7.15	8.13	8.71	9.37	9.97	10.30	10.53	10.76	10.94	11.06	11.18	11.28	11.35	11.44	11.48	11.53	11.57	11.63	11.66	11.69	11.71	11.73	11.74	11.75	11.76
2005	0.26	2.00	4.50	6.90	9.20	10.87	12.15	13.31	14.49	15.19	15.74	16.28	16.66	16.95	17.21	17.44	17.65	17.80	17.97	18.05	18.15	18.25	18.31	18.35	18.37	18.41	18.45	18.46	18.48	18.50
2006	0.00	2.34	7.30	11.46	16.98	18.41	20.46	21.66	22.83	23.34	24.40	24.98	25.46	25.82	26.40	27.23	27.63	27.85	27.85	28.03	28.20	28.20	28.27	28.34	28.34	28.43	28.43	28.43	28.43	28.51
2007	0.00	2.20	5.16	11.65	15.28	16.03	20.55	20.92	22.38	23.84	25.69	27.13	28.30	28.74	29.11	29.34	29.34	29.74	29.86	29.86	29.86	29.86	29.95	30.17	30.17	30.17	30.17	30.17	30.17	30.17
2008	0.00	1.03	5.65	11.32	14.68	20.56	26.30	28.54	30.46	32.10	32.93	33.82	34.81	35.35	35.79	36.25	36.32	36.49	36.65	36.75	36.87	36.92	36.92	37.00	37.02	37.02	37.05	37.07	37.07	37.17
2009	0.04	0.83	3.64	7.99	14.60	19.37	22.00	25.13	27.25	28.68	29.84	30.97	31.81	32.40	32.85	33.10	33.51	33.78	33.87	34.07	34.16	34.33	34.38	34.45	34.48	34.53	34.54	34.57	34.58	34.63
2010	0.12	1.47	4.38	9.12	13.69	16.56	19.04	20.55	21.57	22.58	23.45	24.04	24.54	24.89	25.19	25.43	25.65	25.83	25.95	26.08	26.16	26.24	26.32	26.35	26.38	26.39	26.42	26.44	26.47	26.48
2011	0.04	0.84	3.15	5.18	6.84	8.15	9.08	9.72	10.37	10.84	11.17	11.39	11.60	11.74	11.88	11.99	12.04	12.10	12.17	12.20	12.25	12.28	12.31	12.34	12.36	12.37	12.38	12.40	12.40	12.42
2012	0.06	0.95	2.12	2.87	3.78	4.54	4.97	5.47	5.94	6.28	6.53	6.73	6.85	6.95	7.02	7.09	7.16	7.19	7.24	7.26	7.28	7.31	7.37	7.39	7.39	7.40	7.41	7.41	7.42	7.42
2013	0.11	0.44	0.93	1.81	2.48	3.01	3.54	3.98	4.39	4.61	4.75	4.90	5.02	5.09	5.17	5.23	5.25	5.29	5.32	5.33	5.34	5.35	5.36	5.39	5.40	5.41	5.41	5.41	5.41	5.41
2014	0.00	0.20	0.74	1.36	1.92	2.47	2.85	3.18	3.33	3.58	3.76	3.84	3.91	3.99	4.01	4.04	4.06	4.07	4.09	4.10	4.11	4.12	4.12	4.14	4.15	4.16	4.19	4.19	4.19	4.19
2015	0.00	0.22	1.15	1.94	2.90	3.57	3.98	4.39	4.57	4.77	4.91	4.97	5.02	5.09	5.13	5.18	5.23	5.27	5.31	5.33	5.36	5.42	5.42	5.43	5.43	5.46	5.47	5.48	5.48	5.48
2016	0.03	0.23	0.98	2.00	2.70	3.27	3.54	3.73	3.87	4.00	4.08	4.13	4.17	4.23	4.34	4.42	4.49	4.59	4.63	4.65	4.67	4.70	4.70	4.72	4.73	4.74	4.77	4.77	4.78	4.78
2017	0.01	0.32	1.35	2.32	2.94	3.44	3.72	3.93	4.05	4.18	4.26	4.38	4.44	4.50	4.52	4.54	4.58	4.64	4.65	4.67	4.70	4.70	4.70	4.72	4.72	4.73	4.74	4.74	4.74	4.74
2018	0.00	0.31	1.37	2.74	3.46	3.90	4.14	4.25	4.31	4.35	4.47	4.67	4.70	4.75	4.75	4.75	4.82	4.88	4.93	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97
2019	0.01	0.46	1.20	2.00	2.44	2.72	3.03	3.19	3.28	3.48	3.53	3.58	3.64	3.66	3.71	3.72	3.72	3.74	3.79	3.80	3.80	3.80	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82
2020	0.03	0.26	0.96	1.76	2.21	2.58	2.78	2.95	2.99	3.04	3.10	3.17	3.18	3.19	3.23	3.27	3.29	3.33	3.37	3.37	3.41	3.42	3.43	3.43	3.43	3.43	3.45	3.46	3.46	3.46
2021	0.01	0.38	1.04	1.50	1.83	2.11	2.26	2.43	2.53	2.64	2.67	2.74	2.79	2.85	2.91	2.93	2.96	2.98	2.99	3.00	3.00	3.01	3.01	3.01	3.01	3.01	3.02	3.02	3.02	3.02
2022	0.01	0.34	0.98	1.47	1.78	1.88	2.00	2.11	2.14	2.17	2.19	2.22	2.28	2.30	2.34	2.34	2.35	2.37	2.39	2.39	2.40	2.40	2.40	2.41	2.42	2.42	2.42	2.42	2.42	2.42
2023	0.02	0.32	0.83	1.29	1.54	1.71	1.95	2.08	2.16	2.27	2.29	2.32	2.36	2.39	2.43	2.44	2.44	2.45	2.45	2.47	2.47	2.50	2.51	2.51	2.51	2.52	2.52	2.52	2.52	2.52

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
1997	4.82	43.71	67.99	74.13	82.27	86.48	89.82	91.74	92.94	93.70	94.17	94.37	94.46	94.51	94.56	94.58	94.61	94.65	94.67	94.70	94.71	94.72	94.74	94.78	94.79	94.80	94.82	94.82	94.82	94.83
1998	10.75	48.71	60.50	76.50	84.38	89.56	92.16	93.86	94.84	95.53	95.86	96.00	96.07	96.12	96.19	96.27	96.32	96.39	96.44	96.46	96.49	96.51	96.53	96.55	96.56	96.57	96.58	96.59	96.60	96.61
1999	3.43	13.99	43.54	61.25	73.79	80.76	85.73	89.12	91.27	92.31	92.78	93.09	93.17	93.26	93.39	93.59	93.72	93.83	93.90	93.99	94.03	94.10	94.17	94.24	94.28	94.33	94.38	94.41	94.42	94.42
2000	2.65	25.21	41.63	52.93	63.09	71.01	77.39	81.79	83.37	83.68	84.04	84.18	84.33	84.63	84.90	85.18	85.44	85.59	85.71	85.83	85.92	86.02	86.11	86.25	86.35	86.41	86.43	86.48	86.51	86.55
2001	3.57	35.60	55.33	67.32	77.43	83.60	87.37	88.77	89.19	89.37	89.45	89.67	89.81	90.05	90.37	90.56	90.69	90.75	90.89	91.01	91.11	91.20	91.25	91.31	91.36	91.45	91.49	91.55	91.57	91.58
2002	6.30	40.04	56.78	69.99	78.98	84.77	87.01	87.67	87.95	88.13	88.26	88.51	88.78	89.12	89.41	89.63	89.78	89.90	90.02	90.13	90.26	90.37	90.44	90.50	90.54	90.59	90.64	90.67	90.69	90.72
2003	16.00	41.16	61.14	73.83	81.76	84.99	85.82	86.28	86.48	86.67	87.03	87.37	87.71	88.05	88.27	88.41	88.57	88.75	88.89	89.02	89.14	89.22	89.28	89.35	89.41	89.45	89.51	89.55	89.58	89.60
2004	12.42	40.10	58.50	70.31	75.12	76.38	77.05	77.36	77.69	78.23	78.77	79.43	80.12	80.65	80.94	81.26	81.61	81.93	82.20	82.40	82.58	82.71	82.83	82.93	83.03	83.10	83.16	83.21	83.27	83.30
2005	15.31	36.71	51.25	59.39	61.25	62.12	62.53	63.08	64.03	64.99	66.32	67.54	68.39	69.01	69.51	70.04	70.52	70.97	71.27	71.55	71.81	72.02	72.23	72.36	72.52	72.63	72.70	72.78	72.82	72.86
2006	6.91	22.49	35.73	42.29	44.14	44.55	45.15	46.51	48.80	51.17	53.09	54.52	55.52	56.49	56.96	57.50	57.59	58.28	58.47	58.93	59.07	59.29	59.51	59.52	59.64	59.72	59.88	60.10	60.14	60.18
2007	7.14	25.30	40.54	45.64	47.36	48.67	51.08	51.87	53.58	54.73	55.06	56.33	56.48	56.86	57.50	58.13	59.15	59.55	59.64	60.32	60.54	60.98	61.17	61.32	61.32	62.01	62.01	62.01	62.01	62.12
2008	3.36	32.20	38.39	41.25	43.79	46.96	48.21	49.28	50.77	51.56	52.13	52.71	53.36	54.19	54.68	55.02	55.47	55.61	55.82	55.92	56.19	56.24	56.34	56.41	56.41	56.51	56.64	56.80	56.80	56.87
2009	2.63	13.78	21.44	25.09	30.44	33.35	36.75	40.44	43.18	44.95	46.29	47.82	49.19	50.33	51.37	52.14	52.88	53.46	54.00	54.40	54.67	54.84	55.02	55.25	55.39	55.49	55.58	55.65	55.74	55.83
2010	4.28	15.17	19.74	27.39	33.37	40.27	45.66	49.24	51.51	53.37	55.35	57.09	58.51	59.77	60.75	61.59	62.18	62.58	62.96	63.33	63.55	63.80	63.96	64.12	64.26	64.37	64.49	64.57	64.64	64.72
2011	0.85	9.26	24.55	36.93	49.83	59.48	64.93	67.90	70.35	72.75	74.84	76.67	77.95	78.89	79.61	80.16	80.60	80.99	81.31	81.50	81.69	81.84	81.99	82.09	82.19	82.28	82.34	82.38	82.43	82.48
2012	2.00	19.31	36.78	53.14	64.69	71.23	74.77	77.49	80.28	82.44	84.14	85.28	86.22	86.88	87.33	87.65	87.99	88.24	88.38	88.55	88.67	88.77	88.85	88.92	89.00	89.04	89.08	89.09	89.14	89.19
2013	3.66	18.28	36.00	54.46	67.01	72.76	77.63	81.41	84.64	86.49	87.77	88.68	89.29	89.74	90.16	90.43	90.66	90.89	91.06	91.21	91.28	91.36	91.52	91.59	91.67	91.72	91.74	91.79	91.80	91.85
2014	4.12	38.27	60.21	71.08	76.17	80.34	84.03	86.75	88.74	90.15	91.11	91.65	92.08	92.43	92.69	92.88	93.12	93.26	93.35	93.47	93.61	93.67	93.74	93.76	93.85	93.86	93.90	93.91	93.92	93.93
2015	7.79	36.70	57.72	67.09	73.81	79.47	83.65	86.62	88.41	89.60	90.23	90.94	91.33	91.66	91.78	92.10	92.28	92.31	92.37	92.40	92.44	92.48	92.48	92.55	92.55	92.57	92.60	92.60	92.64	92.65
2016	7.63	30.42	48.72	61.66	71.58	78.65	83.30	86.39	88.26	89.41	90.36	91.06	91.46	91.71	92.00	92.22	92.43	92.51	92.64	92.70	92.76	92.80	92.84	92.86	92.89	92.91	92.93	92.94	92.97	93.00
2017	13.51	35.07	53.01	65.85	75.07	81.80	85.40	87.54	89.00	89.95	90.63	91.29	91.77	91.99	92.15	92.34	92.52	92.59	92.70	92.77	92.84	92.86	92.90	93.00	93.01	93.01	93.01	93.04	93.10	93.12
2018	13.12	41.20	61.50	72.64	79.57	84.79	87.85	89.42	90.33	90.74	91.37	91.77	92.00	92.18	92.19	92.26	92.32	92.34	92.44	92.48	92.70	92.88	92.89	92.95	93.07	93.10	93.12	93.12	93.13	93.13
2019	17.20	49.86	68.11	77.08	82.92	87.29	89.39	90.61	91.33	91.90	92.36	92.71	93.09	93.27	93.36	93.42	93.49	93.54	93.60	93.62	93.66	93.72	93.74	93.75	93.76	93.78	93.78	93.80	93.80	93.80
2020	21.18	55.58	71.32	79.22	84.16	86.97	88.62	89.68	90.28	90.67	91.28	91.59	91.79	92.05	92.16	92.23	92.32	92.40	92.42	92.43	92.46	92.47	92.51	92.59	92.59	92.62	92.68	92.69	92.69	92.69
2021	29.60	61.24	74.26	80.65	84.61	86.81	87.99	88.81	89.19	89.68	89.99	90.25	90.38	90.55	90.67	90.71	90.72	90.73	90.73	90.75	90.77	90.83	90.84	90.85	90.86	90.86	90.87	90.90	90.91	90.91
2022	33.31	66.20	76.57	81.20	83.88	85.38	86.48	87.08	87.58	88.05	88.37	88.57	88.68	88.72	88.76	88.83	88.86	88.88	88.92	88.94	89.01	89.02	89.04	89.05	89.06	89.06	89.07	89.07	89.09	89.09
2023	33.45	65.28	75.73	80.15	82.71	84.54	85.64	86.26	86.66	86.99	87.24	87.44	87.54	87.61	87.66	87.72	87.78	87.80	87.82	87.83	87.83	87.86	87.88	87.89	87.90	87.94	87.94	87.97	87.97	87.97

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
1986	44.72	49.90	49.36	47.25	45.84	45.08	44.88	42.83	41.94	41.90	42.49	42.61	42.96	44.18	42.43	44.34	48.46	49.03	50.04	68.68	64.71	73.44	119.15	106.40	105.60	129.83	139.47	190.58	150.96	354.99
1987	46.19	47.39	45.35	44.31	44.95	43.99	42.27	40.92	40.40	40.96	41.60	41.65	44.43	43.09	42.43	47.53	49.60	48.84	61.14	71.53	90.87	101.02	105.85	122.12	122.82	139.19	113.43	139.02	207.95	251.17
1988	42.57	43.02	43.22	43.77	44.29	43.99	44.29	45.59	45.64	45.78	47.26	49.36	48.84	49.13	50.23	47.51	54.20	65.71	67.42	95.45	109.49	110.60	124.52	117.90	113.78	135.66	112.29	216.89	164.49	109.58
1989	49.30	44.99	43.53	44.75	45.36	45.95	47.86	48.41	48.10	49.68	51.47	50.13	47.63	47.52	49.08	54.39	64.35	78.23	102.24	128.60	110.54	113.24	120.86	122.29	131.93	126.22	167.84	146.06	109.32	108.63
1990	44.56	44.96	43.89	45.16	47.42	49.32	51.15	51.50	52.00	52.95	51.38	49.26	52.88	53.13	53.25	61.60	71.25	96.29	116.77	99.04	118.57	127.02	119.42	119.38	102.90	162.16	137.28	108.98	115.81	117.55
1991	45.85	43.33	43.54	46.04	48.83	50.31	52.65	52.78	52.76	48.41	48.21	44.37	45.23	48.63	62.40	78.73	93.77	116.20	103.50	103.66	109.14	106.84	106.95	111.05	137.94	103.63	108.15	114.98	123.27	123.86
1992	44.74	42.00	41.91	43.85	45.79	48.04	48.40	48.61	45.11	40.79	37.22	33.51	43.48	49.53	62.64	81.88	99.91	87.64	101.16	100.91	89.16	98.28	92.22	112.28	102.63	99.37	100.58	115.86	116.37	114.72
1993	36.35	37.87	40.68	41.69	44.71	44.54	42.79	40.04	34.48	32.24	33.56	38.99	45.54	60.12	72.53	87.49	86.92	85.33	93.66	83.30	86.36	83.26	89.85	100.71	99.33	107.43	112.64	113.51	110.48	112.27
1994	30.35	38.17	40.59	42.07	42.56	40.82	37.61	32.45	31.19	32.05	34.73	47.86	53.44	69.89	90.95	76.36	85.63	90.14	86.09	91.46	81.42	95.10	98.16	96.19	102.25	108.28	106.97	111.27	112.57	115.26
1995	36.39	38.31	39.93	41.05	41.15	40.20	35.65	34.57	36.45	37.21	44.43	50.35	78.56	84.21	81.74	86.42	90.36	87.57	88.92	84.27	91.10	87.55	93.33	100.69	104.93	110.96	111.70	111.43	114.98	114.46
1996	31.52	38.34	38.76	38.33	37.12	34.11	32.18	33.70	35.26	41.84	52.98	65.81	80.05	84.50	84.39	93.51	85.40	82.38	77.55	87.96	88.96	92.88	98.81	104.74	108.18	104.86	107.23	112.20	112.06	119.84
1997	26.13	37.99	37.05	35.50	33.29	32.53	32.72	36.58	41.21	49.84	65.82	81.33	81.86	88.29	88.83	86.72	86.61	80.51	83.73	89.44	88.03	97.64	101.32	102.78	105.15	105.88	108.12	112.58	113.18	117.69
1998	27.92	36.39	33.24	31.20	30.64	30.54	33.09	37.89	47.25	63.88	76.22	79.05	81.17	85.35	88.12	81.53	73.18	79.08	83.19	84.51	91.73	96.21	101.33	102.76	106.32	107.41	108.25	115.42	116.34	120.67
1999	28.61	32.85	30.69	29.63	29.61	32.57	37.88	44.29	60.81	72.74	74.33	76.86	84.39	81.97	76.55	73.70	75.84	80.52	83.73	88.29	95.89	99.17	101.98	104.12	104.96	104.30	108.80	112.67	117.70	117.88
2000	26.62	31.15	30.37	33.05	35.40	40.31	48.01	60.40	76.49	78.65	81.85	89.45	88.18	83.30	77.32	84.00	84.09	84.77	89.00	94.48	98.95	99.52	99.55	102.47	103.17	106.70	111.15	114.83	117.33	118.19
2001	28.50	29.89	32.82	35.84	39.43	45.76	58.60	70.92	74.16	77.94	84.54	82.78	78.19	72.15	79.31	79.93	81.95	86.98	93.31	96.43	98.15	100.22	99.95	104.38	104.66	107.93	112.61	117.05	117.07	127.18
2002	24.88	31.27	35.05	38.38	43.08	53.42	64.86	68.81	73.25	77.47	79.15	72.77	68.94	74.88	76.68	79.36	83.35	87.76	92.59	92.58	93.91	96.21	97.85	102.96	103.99	110.77	112.62	117.05	117.99	120.25
2003	29.34	34.60	35.61	40.68	50.16	60.43	64.25	68.35	71.55	72.95	67.90	66.12	67.70	72.75	75.64	80.62	84.49	86.75	89.33	90.57	93.18	96.90	99.03	102.47	106.90	110.32	115.46	119.13	120.40	118.48
2004	29.41	33.17	38.66	48.17	57.84	62.53	65.85	70.85	70.92	66.58	63.89	65.94	72.08	73.96	78.23	82.40	84.87	86.37	88.64	89.69	92.68	95.21	100.16	103.27	105.63	110.99	113.25	116.78	119.59	120.99
2005	32.92	38.04	47.70	58.66	63.11	67.26	71.10	72.12	69.25	65.90	67.12	70.49	73.28	77.29	79.93	83.27	83.20	84.06	84.23	87.28	90.70	95.31	97.06	101.19	104.89	107.12	110.41	111.69	116.72	118.42
2006	38.22	44.29	56.42	62.55	67.19	71.51	73.37	72.40	70.31	71.29	74.43	75.17	80.58	86.21	86.99	87.71	87.91	88.12	89.23	91.69	94.06	96.46	97.28	103.43	107.56	107.84	111.04	115.29	116.33	114.62
2007	33.17	52.76	60.53	65.98	70.12	74.45	73.28	71.35	72.47	73.67	73.09	79.24	84.65	88.78	89.19	88.10	88.39	91.77	90.64	95.16	97.23	99.84	105.13	102.75	110.87	111.55	111.68	119.36	120.61	122.46
2008	41.92	53.85	59.25	62.77	65.50	65.27	63.75	65.37	66.17	66.77	73.56	79.06	83.14	85.12	84.72	85.96	86.85	91.07	91.04	94.82	96.47	101.60	104.58	107.42	110.29	110.76	114.00	117.22	118.32	121.63
2009	40.69	50.39	53.04	54.70	53.36	54.45	56.32	58.28	59.68	63.46	68.77	72.57	74.86	76.63	76.71	79.40	82.85	84.08	86.76	89.91	93.62	96.72	100.05	103.66	106.97	106.30	111.72	114.49	111.96	121.69
2010	40.43	45.11	45.58	44.28	46.34	48.31	49.86	51.24	52.57	56.42	60.90	63.43	65.57	68.27	70.75	73.30	76.50	79.73	81.39	85.86	89.26	91.13	96.61	98.66	102.67	103.49	106.99	107.73	113.67	118.10
2011	35.47	39.33	38.32	40.98	43.71	43.61	45.49	46.14	50.04	53.10	56.01	58.58	60.96	65.29	69.17	72.13	74.64	77.38	79.07	85.06	89.09	92.14	95.02	96.53	100.36	102.16	107.43	107.94	113.34	117.11
2012	36.71	34.61	37.08	40.48	38.94	39.98	41.26	44.30	46.27	48.99	51.38	54.32	56.54	62.38	66.66	72.23	72.04	75.77	80.96	83.56	84.97	89.28	93.51	95.45	99.57	99.73	102.57	105.57	106.03	112.12
2013	33.53	34.78	37.88	35.48	37.02	37.81	42.02	43.39	44.33	46.00	47.75	52.49	57.63	63.29	66.42	69.29	71.40	74.53	78.14	80.77	82.71	89.15	93.14	91.57	96.00	100.31	102.33	102.53	107.52	115.82
2014	24.20	30.94	30.00	32.66	36.24	40.01	42.78	43.75	43.78	44.73	49.73	53.53	58.14	63.54	64.39	68.64	73.54	76.06	77.22	83.39	85.21	87.04	92.38	92.32	97.61	100.59	102.41	107.10	111.31	
2015	33.80	27.59	29.42	32.65	37.15	39.50	40.54	40.56	40.88	42.27	47.38	51.14	57.31	60.73	65.27	69.64	70.05	72.66	77.28	79.94	82.24	83.47	88.70	90.84	93.49	94.84	98.86	100.98	103.83	103.88
2016	25.87	28.15	31.55	36.16	38.83	39.98	40.05	40.02	40.86	44.21	49.77	54.16	58.12	62.27	66.42	71.24	70.71	74.09	77.82	79.56	82.22	86.07	89.08	90.58	94.39	94.81	98.04	98.90	103.73	107.79
2017	30.49	31.72	35.38	38.56	40.28	41.21	41.80	42.13	43.99	47.27	51.94	55.79	60.53	65.53	70.53	72.83	74.99	77.34	79.35	81.56	83.52	89.82	89.17	92.26	94.51	97.09	97.16	103.79	105.93	111.10
2018	34.33	34.00	36.30	37.95	39.30	40.36	41.03	43.25	45.68	49.71	53.28	57.89	64.17	68.66	72.29	75.67	76.62	79.31	82.34	85.16	88.15	88.54	92.25	96.03	99.18	98.99	97.87	101.13	115.93	
2019	35.44	33.66	34.58	35.70	36.71	37.93	39.93	42.23	45.75	47.21	53.27	59.58	64.57	70.64	72.07	74.39	76.22	78.55	83.10	83.73	85.86	87.55	92.86	97.84	95.90	100.13	102.08	107.20	108.57	114.68
2020	29.05	31.28	32.61	33.98	35.10	37.74	39.39	42.39	44.07	49.13	54.41	59.58	65.34	72.49	74.55	76.80	79.90	82.61	84.60	86.71	89.24	89.06	95.31	97.90	99.06	98.33	101.04	104.54	105.88	112.06
2021	30.73	30.60	31.71	33.38	34.55	37.84	40.84	41.97	45.18	50.51	54.90	61.08	66.36	71.62	74.38	77.77	79.25	83.68	83.12	86.12	90.22	90.82	93.75	95.22	100.08	100.30	100.68	101.40	107.30	115.05
2022	29.68	29.48	31.11	34.10	36.08	39.44	40.79	44.19	47.67	52.59	57.57	62.63	69.42	73.14	79.29	77.31	79.86	83.32	86.78	88.43	90.22	92.99	94.10	98.30	98.59	104.36	99.58	106.20	109.52	112.61
2023	32.19	29.61	31.80	34.89	37.62	39.09	42.71	46.71	50.59	53.16	58.60	64.25	68.17	72.75	75.86	77.22	78.43	80.58	84.38	86.56	89.57	91.62	92.24	95.82	98.68	100.02	103.30	105.84	111.23	113.41

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
1986	44.81	50.04	49.38	47.17	45.78	44.98	44.80	42.74	41.89	41.70	42.36	42.43	42.92	44.17	42.12	44.45	48.51	49.17	49.86	70.32	66.03	73.44	119.15	106.26	105.39	130.61	141.06	190.43	150.96	354.77
1987	46.01	47.41	44.93	44.06	44.89	43.91	42.19	40.99	40.48	41.20	41.60	41.93	45.16	44.11	42.79	47.79	50.91	50.57	60.14	72.73	88.79	102.92	109.06	126.18	122.64	143.41	114.53	138.26	225.03	257.55
1988	44.75	43.07	42.72	43.84	43.92	43.51	43.94	45.00	45.58	45.35	47.36	49.88	49.05	49.34	50.81	47.21	54.03	65.61	66.74	98.48	110.07	110.31	129.66	119.08	117.73	139.28	108.44	219.18	166.15	108.67
1989	51.06	45.07	43.50	44.54	45.10	45.46	47.31	47.96	47.69	49.30	51.40	49.95	48.14	47.68	47.76	54.59	64.40	78.23	102.74	132.25	109.97	114.78	122.85	120.61	136.97	126.09	170.79	147.54	108.71	107.89
1990	46.20	45.03	43.61	44.91	47.18	48.87	50.76	51.27	51.57	53.10	51.14	49.47	52.81	53.06	53.53	61.43	71.64	96.89	116.77	99.03	119.12	128.84	118.93	119.99	102.79	162.16	137.28	108.82	115.81	120.42
1991	44.58	43.29	43.59	45.93	48.52	50.30	52.80	52.36	53.01	48.90	49.13	43.90	45.89	49.97	61.05	78.51	95.44	117.35	103.71	102.17	108.34	109.47	105.74	112.78	138.55	106.28	107.77	115.46	130.41	122.04
1992	48.17	41.33	42.28	43.83	46.27	48.60	49.08	50.03	45.80	41.65	39.67	33.75	44.63	53.23	65.28	84.81	102.03	86.74	99.30	101.07	89.92	98.85	99.27	116.35	105.78	99.59	99.03	127.01	128.89	116.01
1993	36.79	36.57	38.93	39.95	43.02	43.00	42.27	40.22	35.53	33.04	34.76	40.31	45.93	59.30	72.90	89.71	87.55	87.17	92.10	86.06	88.88	84.43	95.60	101.64	98.77	107.64	116.77	116.34	116.64	92.90
1994	35.62	36.51	38.18	39.85	41.21	41.04	38.29	34.10	32.93	32.68	36.07	49.22	57.08	70.41	88.61	77.44	88.41	92.45	87.97	91.78	82.24	94.66	101.31	97.77	102.69	109.45	110.54	116.88	115.61	124.90
1995	30.72	37.49	38.64	40.49	42.07	41.50	36.83	36.44	37.16	37.83	44.69	50.92	77.59	85.02	81.03	85.04	91.70	88.15	87.87	85.23	92.48	86.83	91.68	101.64	107.13	114.09	121.32	118.47	119.00	116.72
1996	34.32	36.24	38.02	39.52	37.98	35.35	33.67	34.59	35.65	43.01	53.68	65.59	80.65	84.26	85.76	94.16	85.64	82.42	75.09	90.13	88.68	93.12	100.55	108.57	114.69	106.75	109.49	115.38	118.10	122.31
1997	24.52	36.63	37.74	37.06	34.97	34.40	34.26	37.17	41.50	51.32	66.37	81.25	82.33	88.65	89.19	88.30	87.96	79.26	83.05	88.13	87.75	99.82	105.20	103.85	109.69	111.91	111.88	120.16	119.33	118.89
1998	27.97	36.80	34.44	32.22	31.54	31.00	33.28	38.81	47.25	65.23	78.02	79.78	81.78	85.39	88.06	81.74	73.89	79.56	83.46	84.08	91.19	96.61	103.27	105.25	109.60	107.71	109.26	117.86	113.17	122.79
1999	30.79	34.27	31.37	30.34	30.07	32.92	38.29	44.59	60.97	73.91	75.16	77.04	85.03	83.14	77.21	73.78	77.03	80.52	83.53	88.11	96.00	99.51	102.24	104.09	107.72	104.97	109.01	114.48	118.17	117.73
2000	27.77	31.22	30.58	33.24	35.69	40.81	48.98	61.61	78.07	80.84	83.32	90.44	88.87	84.74	79.17	85.61	85.15	85.13	90.24	96.40	101.35	102.65	102.31	106.07	107.34	107.78	113.52	119.14	118.65	128.95
2001	28.79	30.32	33.24	36.52	40.08	46.45	58.94	71.02	74.76	78.12	85.02	83.02	78.14	72.35	79.94	80.01	81.28	86.42	93.05	97.32	98.80	100.03	100.18	103.73	104.03	108.27	113.48	117.25	113.70	124.42
2002	28.72	32.12	35.98	39.67	44.42	54.39	65.28	69.80	73.59	77.41	79.68	72.63	69.47	75.06	76.96	79.13	82.91	88.08	92.96	93.34	93.81	97.49	97.15	102.70	104.10	111.90	114.59	118.63	116.13	123.74
2003	34.18	36.60	37.25	42.48	51.51	61.08	64.68	69.01	71.52	73.18	68.02	66.46	68.13	72.77	74.88	79.16	83.60	86.31	88.67	90.99	93.44	94.35	96.54	100.67	106.41	107.89	114.62	116.20	119.98	111.86
2004	30.18	34.39	39.91	48.99	58.60	62.70	66.27	71.30	71.06	66.84	64.62	66.99	72.22	73.82	77.77	81.91	84.09	85.55	88.09	89.37	92.42	93.92	100.02	104.19	105.30	110.69	112.26	115.05	119.50	122.09
2005	34.12	39.48	47.93	58.61	63.03	67.02	70.92	72.09	69.48	66.29	67.60	70.78	73.43	77.85	80.20	83.87	83.84	85.02	84.59	87.38	92.06	95.57	98.02	103.36	107.97	109.06	111.64	116.11	116.19	117.27
2006	41.47	44.39	56.12	62.38	66.92	71.43	73.28	72.55	70.36	71.61	75.07	75.32	80.91	87.09	87.92	88.78	88.67	89.07	90.25	93.11	94.27	96.63	99.12	105.28	105.81	107.84	111.74	117.32	115.94	111.95
2007	32.88	52.87	60.31	65.72	69.87	74.28	73.15	71.12	72.45	73.43	73.06	79.00	84.77	88.68	89.52	88.75	88.96	92.38	90.95	95.72	98.27	100.65	104.46	102.57	112.84	111.20	111.61	121.11	119.47	123.39
2008	42.55	53.58	58.80	62.16	64.85	64.46	63.02	64.62	65.48	65.98	72.90	78.64	82.64	84.94	84.62	85.94	87.24	90.86	90.60	94.58	95.55	101.72	105.33	107.78	111.02	111.80	112.78	117.79	117.01	120.83
2009	40.14	48.30	50.67	51.87	50.36	51.26	53.48	54.61	55.55	59.15	65.18	69.33	71.89	73.42	74.19	76.69	80.12	81.04	83.90	87.04	91.75	93.72	97.53	101.29	105.50	104.71	108.24	112.99	110.09	116.11
2010	32.67	38.59	40.60	42.65	45.86	46.38	47.98	48.74	53.43	58.47	60.74	62.83	65.78	67.90	70.33	73.56	77.52	79.21	83.22	86.25	87.68	94.67	95.06	100.92	101.06	103.02	105.43	110.75	113.89	116.11
2011	26.65	32.27	32.85	37.71	41.23	40.60	42.27	43.17	46.94	50.39	54.17	56.03	58.07	62.92	66.22	69.64	71.47	73.92	75.18	81.11	86.02	89.51	91.38	92.69	96.69	99.71	101.72	104.42	111.58	112.32
2012	32.03	27.45	33.36	36.72	34.43	36.16	37.38	41.23	42.74	45.75	48.03	51.75	53.00	59.23	63.23	69.46	68.32	71.80	78.91	79.00	83.48	86.80	89.65	90.26	95.80	97.04	99.00	103.10	102.08	110.30
2013	20.56	28.61	31.28	30.50	32.70	33.95	38.13	39.87	40.71	41.84	45.58	49.30	53.30	59.92	62.92	65.13	66.69	70.82	73.80	76.83	80.14	83.96	89.11	86.56	93.95	96.72	95.78	98.04	101.37	105.43
2014	16.26	27.26	28.38	31.64	35.20	39.02	41.98	42.86	43.51	48.78	52.52	57.10	62.29	67.30	71.75	74.45	76.33	81.54	84.46	85.66	90.80	89.79	96.25	99.61	100.07	103.30	105.56	109.13	112.40	116.50
2015	23.08	26.37	28.60	31.67	36.22	38.98	39.62	40.03	40.15	41.31	46.57	50.12	56.00	59.62	63.99	68.77	68.70	71.61	75.53	78.56	80.36	82.28	86.01	90.58	92.11	93.87	97.78	99.16	101.89	100.87
2016	25.10	26.93	30.97	35.65	38.98	39.83	39.95	39.70	40.14	43.50	48.39	53.34	56.66	61.06	64.24	68.70	69.36	72.75	76.84	77.93	81.45	85.30	87.84	88.97	93.62	94.06	97.33	97.13	102.31	106.17
2017	29.78	31.24	35.46	38.47	40.32	41.02	41.56	41.84	43.95	46.81	51.12	55.55	59.78	64.89	69.95	71.79	74.59	76.97	79.20	80.58	83.68	90.11	88.64	91.95	94.65	98.22	95.51	103.37	105.57	110.51
2018	31.71	33.71	35.90	37.71	39.10	40.12	40.63	42.64	45.23	49.08	52.65	57.46	63.09	67.39	71.39	74.89	76.07	78.39	82.52	84.16	85.21	87.58	90.69	93.50	97.61	97.06	96.82	103.48	105.13	117.32
2019	33.26	32.61	34.20	35.29	36.48	37.58	39.36	41.47	45.17	46.66	52.24	58.84	63.73	69.38	71.04	73.84	75.60	78.09	82.88	82.46	84.80	87.40	91.43	95.12	95.15	100.06	100.40	104.49	106.78	115.60
2020	28.93	30.76	32.11	33.28	34.54	36.98	38.77	41.45	42.71	47.74	52.29	58.24	63.50	69.75	71.36	73.44	76.76	78.63	81.65	82.95	85.02	86.46	91.63	92.83	94.55	95.33	99.19	102.40	105.44	112.05
2021	30.63	30.39	31.34	32.68	33.97	37.19	40.46	40.99	44.43	48.71	53.54	59.64	64.18	69.78	71.87	75.69	77.06	81.59	80.75	82.49	87.79	88.48	91.85	92.32	96.46	98.88	99.13	101.04	103.83	114.89
2022	29.67	29.42	30.86	33.23	35.47	38.31	39.83	42.96	46.33	50.81	55.77	60.70	66.97	71.87	77.26	74.97	78.15	81.16	84.23	86.15	86.80	90.27	91.33	95.54	95.22	99.62	98.17	105.63	107.97	113.44
2023	31.30	29.43	31.43	34.34	37.21	38.45	41.96	45.76	49.61	52.17	57.12	63.30	66.84	72.36	74.81	76.02	77.19	79.85	83.12	84.61	89.05	90.69	91.39	93.33	96.22	99.18	102.44	104.99	108.31	115.00

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
1995	28.68	41.51	43.76	42.36	44.23	34.50	33.17	29.62	35.33	49.78	67.98	29.74	77.89	147.63	87.54	89.74	89.54	65.41	107.40	99.09	77.71	116.15	134.36	113.57	0.00	161.61	0.00	125.29	137.10	127.59
1996	30.27	40.63	39.75	38.30	34.34	28.22	29.87	30.92	26.62	33.89	56.36	65.76	74.00	104.63	77.40	67.45	69.09	87.24	68.25	68.34	94.96	96.49	86.81	101.44	109.26	123.67	116.34	126.55	120.08	0.00
1997	32.05	36.35	36.74	33.00	26.52	25.79	23.20	30.46	45.29	28.77	101.14	78.44	63.84	94.88	79.08	118.34	81.23	94.34	77.32	102.01	99.75	111.63	104.83	0.00	116.68	0.00	0.00	122.63	0.00	116.75
1998	20.63	30.97	26.33	24.17	23.49	26.26	29.28	33.40	45.06	56.69	63.17	74.22	78.86	82.64	80.77	77.36	67.15	74.52	76.76	85.32	95.13	99.30	98.80	106.74	97.12	140.01	108.59	115.80	136.46	118.92
1999	23.29	24.74	25.17	23.68	25.90	29.35	33.70	43.44	62.44	60.88	70.45	75.34	74.26	73.58	67.54	73.30	68.80	80.95	86.36	90.66	100.64	102.81	101.68	117.00	99.65	108.99	126.38	113.36	135.15	128.60
2000	11.99	24.61	24.92	29.52	28.87	32.16	40.77	41.10	85.84	102.93	62.19	82.34	120.29	109.89	82.28	93.14	91.42	89.78	92.34	98.15	130.47	103.89	112.67	110.66	0.00	121.70	114.66	0.00	0.00	0.00
2001	17.67	25.86	29.45	30.42	33.81	40.59	55.87	71.01	72.89	77.82	82.30	82.43	79.43	71.39	71.94	79.71	86.96	92.86	100.14	95.71	101.34	104.77	104.66	115.38	110.63	115.10	122.41	126.97	123.02	139.11
2002	16.84	28.68	31.71	33.86	37.34	51.72	64.32	67.30	71.84	77.72	76.94	72.64	65.81	72.33	76.63	83.55	88.06	90.69	96.77	97.11	105.55	102.22	105.44	112.45	106.95	115.97	119.40	119.78	123.29	123.01
2003	21.31	30.66	32.33	36.78	46.79	60.19	62.36	65.97	70.46	71.40	65.91	64.19	65.99	72.82	77.73	84.74	86.99	89.23	92.12	90.35	93.93	104.48	103.98	107.39	110.27	118.33	122.18	129.67	126.09	125.79
2004	29.04	31.25	36.37	46.26	56.57	61.32	63.92	68.84	68.71	64.43	60.57	61.85	71.94	74.80	80.84	85.58	88.98	90.50	90.88	94.54	96.33	101.33	102.71	104.41	107.51	109.70	115.85	123.50	122.67	118.27
2005	28.69	34.33	45.96	58.89	63.40	67.12	70.29	68.91	67.27	62.55	63.35	69.48	74.99	80.31	86.20	89.29	89.74	90.81	89.36	95.94	97.26	106.07	103.76	114.77	108.52	107.71	118.18	122.80	129.60	135.37
2006	31.09	40.72	58.69	62.20	68.80	71.93	72.97	70.20	67.15	66.48	66.67	74.43	80.27	84.27	86.61	88.76	90.42	90.70	97.51	92.96	109.54	100.43	102.77	106.51	116.08	113.41	117.81	139.66	125.18	146.19
2007	33.54	51.84	63.57	70.29	74.08	76.68	75.98	76.01	72.42	79.61	76.57	85.25	88.79	94.79	91.42	89.65	91.43	97.21	99.00	97.81	95.75	111.93	117.12	108.31	103.19	123.58	151.92	120.92	132.27	141.05
2008	38.24	56.81	64.68	70.39	74.73	75.31	72.89	75.12	75.09	75.69	82.17	86.42	91.47	91.21	89.89	92.16	91.70	99.15	101.50	102.18	107.10	106.48	110.08	110.98	115.16	116.68	121.09	136.63	124.30	131.92
2009	43.13	54.52	56.81	59.76	59.20	60.79	62.29	65.95	67.66	71.59	76.30	79.75	81.84	84.11	82.73	85.87	87.83	90.86	93.22	95.04	97.87	103.18	106.01	108.67	109.70	112.92	115.55	119.08	117.52	129.29
2010	45.45	51.50	52.96	51.25	54.00	54.63	59.05	61.16	64.00	68.38	70.09	73.85	74.57	77.85	79.57	83.59	85.49	88.78	89.35	89.41	94.67	99.26	103.59	106.67	106.34	110.77	116.45	113.94	117.13	134.23
2011	37.15	44.89	44.27	45.97	48.07	51.45	54.63	54.18	59.08	61.77	61.54	66.10	67.74	72.11	74.14	77.27	81.46	82.28	84.48	92.48	91.83	92.63	100.39	101.87	102.74	111.47	115.73	105.10	120.55	129.30
2012	37.85	38.09	41.26	45.01	47.47	47.63	49.38	51.30	54.44	55.64	56.47	59.82	62.26	67.01	71.12	76.08	76.75	81.87	84.74	88.49	85.20	90.97	97.76	101.03	105.15	106.59	107.36	108.31	110.59	113.88
2013	35.60	37.73	43.35	42.94	43.82	43.90	48.59	49.59	50.74	53.32	51.31	56.94	64.91	67.49	71.55	74.74	76.70	79.04	83.90	84.97	85.46	95.27	97.01	98.24	98.66	106.43	111.86	113.12	114.49	123.92
2014	35.39	42.00	39.77	39.54	42.29	46.93	48.15	49.27	50.79	53.53	55.89	60.00	64.03	70.69	72.56	74.68	81.91	81.77	84.55	91.09	90.40	93.70	100.11	98.66	101.31	107.30	114.08	111.76	124.89	
2015	51.32	30.76	31.75	35.85	40.50	42.18	44.70	43.18	44.58	47.35	50.57	57.06	62.83	66.36	69.66	73.69	73.91	76.17	82.92	84.75	89.50	89.90	97.64	90.48	99.84	96.24	103.13	107.33	114.44	110.99
2016	28.40	31.98	33.18	38.53	38.35	40.62	40.31	42.04	44.02	47.94	58.11	57.26	65.56	67.09	74.11	79.16	76.07	80.53	80.04	85.38	84.79	89.43	93.37	102.75	97.20	95.75	100.15	115.99	105.59	122.44
2017	37.64	33.07	34.75	38.87	39.48	42.14	44.44	46.67	43.25	52.28	64.82	61.61	66.51	70.41	73.94	82.12	77.59	84.41	81.20	95.26	80.41	87.92	95.85	97.46	94.09	93.90	109.97	109.00	108.07	122.83
2018	40.73	35.40	40.15	41.99	43.57	49.40	52.61	53.72	58.52	59.93	72.29	86.86	85.80	89.39	89.01	88.42	91.26	104.87	99.93	110.18	114.42	106.03	118.54	128.59	123.31	111.88	127.44	91.70	127.36	0.00
2019	42.92	37.82	36.92	40.78	39.14	42.92	49.66	52.91	54.72	56.24	70.59	78.70	80.39	89.20	86.22	87.26	93.05	87.46	86.74	97.44	98.98	89.20	117.57	126.24	107.44	104.61	112.69	126.31	121.55	0.00
2020	0.00	33.28	34.96	38.80	38.61	43.12	45.17	51.18	53.76	60.55	72.27	77.18	85.84	91.57	90.31	95.63	99.88	100.27	95.65	110.01	110.68	104.88	115.74	121.37	118.84	104.12	110.24	113.20	109.83	154.08
2021	31.69	31.47	33.43	37.73	38.27	43.45	43.89	51.90	53.93	65.65	69.72	76.38	85.76	89.33	92.84	92.51	96.13	94.34	93.30	108.30	107.85	108.84	117.66	112.54	113.79	105.38	114.06	99.86	128.50	139.53
2022	0.00	29.32	32.05	39.57	39.91	47.17	48.15	54.76	57.80	66.94	73.71	81.08	90.01	88.12	93.55	97.46	97.85	101.05	98.44	103.97	105.65	107.79	111.98	114.26	113.44	113.05	111.50	108.01	118.89	0.00
2023	30.12	30.31	33.17	37.81	39.14	43.08	47.79	54.27	58.01	61.04	68.94	73.63	80.67	76.75	84.70	87.20	89.11	86.36	92.88	99.69	93.57	100.72	102.94	109.81	111.86	102.63	104.94	107.42	124.25	150.80

Book\Policy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2001	0.00	36.71	42.78	47.83	50.49	61.46	83.09	68.11	62.48	62.88	127.86	179.38	167.19	231.63	1009.34
2002	3.76	43.24	40.65	48.00	42.35	61.88	83.99	87.74	91.42	104.66	122.70	83.09	136.40	280.69	212.29
2003	73.56	44.38	41.44	46.84	60.75	68.99	74.01	75.57	88.81	130.18	104.07	105.82	107.25	104.80	74.09
2004	24.44	38.47	52.01	55.92	60.98	72.12	69.89	77.41	82.32	71.97	80.12	109.55	74.07	76.77	72.30
2005	50.17	43.86	46.17	56.73	62.49	70.76	78.16	89.07	95.18	77.89	89.24	74.25	66.83	76.59	82.74
2006	39.55	51.61	59.90	68.05	70.87	81.17	89.08	75.47	96.38	88.46	79.93	68.35	74.14	79.74	78.93
2007	56.44	52.44	66.21	75.47	79.00	89.04	86.13	82.92	97.71	79.51	59.37	74.54	76.37	88.32	82.53
2008	48.04	52.48	62.73	69.58	75.96	75.28	71.64	73.25	74.35	67.48	69.86	75.93	81.94	80.96	87.52
2009	51.27	54.36	59.16	60.92	59.14	62.23	68.46	63.73	63.35	67.14	71.21	72.72	80.66	85.67	79.38
2010	0.00	46.83	48.23	51.49	51.03	55.58	59.19	60.23	62.06	68.37	64.83	69.90	80.94	79.34	78.72
2011	38.31	49.44	41.52	48.11	53.53	52.45	55.24	56.12	59.29	59.70	66.11	61.59	73.30	86.35	73.20
2012	64.69	35.08	41.96	50.37	49.39	52.03	52.91	55.85	53.65	59.03	63.10	57.76	67.72	64.68	79.67
2013	22.43	49.52	46.78	44.74	44.14	47.51	51.77	52.58	54.05	58.35	61.31	54.26	61.69	71.64	68.42
2014	0.00	42.95	42.94	46.18	48.00	55.58	52.42	52.26	52.89	54.97	63.98	62.56	65.98	79.47	79.68
2015	0.00	45.34	43.32	47.43	48.14	49.94	51.19	52.98	55.69	56.21	60.22	63.60	67.36	68.03	63.59
2016	0.00	41.39	43.91	51.98	47.46	49.73	52.94	51.72	44.79	56.28	54.61	69.65	74.39	94.75	61.46
2017	9.35	53.97	57.88	60.56	57.34	56.24	52.61	52.32	57.99	48.36	63.64	59.79	71.52	83.13	65.59
2018	33.28	42.20	62.68	64.32	56.37	59.54	57.05	53.26	59.98	51.02	67.75	66.56	80.11	65.12	76.95
2019	0.00	55.91	58.41	53.27	57.92	59.68	45.51	59.25	56.48	40.47	75.84	71.01	61.13	79.04	55.55
2020	73.26	62.23	45.37	47.16	55.30	58.80	57.99	49.36	61.64	49.58	58.42	69.29	80.95	82.39	66.51
2021	59.64	56.77	54.70	43.54	56.21	52.07	49.42	41.98	48.58	70.86	69.75	64.06	78.25	76.92	87.23
2022	42.30	37.20	53.64	55.96	55.07	60.13	51.09	50.58	72.80	54.17	51.40	65.59	78.49	57.52	66.79
2023	61.98	50.44	52.58	48.58	53.86	57.99	59.13	52.65	57.54	60.35	65.13	66.07	65.64	78.04	74.96

Loss Rates — **Fixed Rate 15 Year Mortgages** — **by Credit Subsidy Endorsement Cohort**

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
1995	133.47	48.34	42.13	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	72.87	120.27	124.46	191.85	0.00	775.83	0.00
1997	0.00	36.60	49.63	49.84	62.06	52.94	63.11	90.91	33.06	81.46	86.76	0.00	96.95	0.00	0.00
1998	0.00	23.13	30.97	31.10	45.62	42.60	38.81	49.07	164.79	139.28	96.76	127.82	126.99	378.47	291.83
1999	0.00	37.90	30.75	24.01	37.73	37.21	34.93	49.52	81.04	77.44	83.44	129.71	127.26	233.10	71.03
2000	0.00	16.17	41.32	21.59	27.01	60.86	86.36	91.37	123.65	106.26	142.54	0.00	261.86	334.23	0.00
2001	0.00	27.58	41.85	40.90	47.19	50.39	58.35	150.12	127.18	104.75	101.97	107.42	134.03	147.05	1432.42
2002	0.00	36.62	35.98	41.54	43.93	59.36	69.61	72.65	108.84	68.03	121.70	120.40	83.89	227.64	**260.18**
2003	0.00	35.82	38.46	42.76	65.36	67.56	93.00	74.91	83.91	80.61	99.89	78.66	90.31	**123.02**	**74.26**
2004	32.55	42.10	37.95	48.87	61.16	67.95	79.25	71.42	83.27	77.47	82.30	107.43	**83.15**	75.56	77.48
2005	37.19	35.37	52.24	64.34	60.40	69.76	82.80	89.55	79.33	73.39	106.59	**79.68**	62.67	72.99	84.37
2006	0.00	42.04	63.55	55.95	68.95	69.72	97.74	74.71	93.19	67.18	**94.84**	73.95	76.08	78.68	90.52
2007	0.00	42.88	60.86	56.90	93.04	61.88	72.98	46.54	-64.95	**70.77**	59.70	82.24	84.96	0.00	80.19
2008	0.00	41.35	77.38	54.55	72.41	77.34	67.97	72.93	**66.19**	66.04	71.46	68.11	80.76	85.53	84.42
2009	0.00	56.40	56.84	62.02	64.02	69.26	65.77	**59.31**	63.55	64.43	69.18	73.91	77.38	84.79	79.39
2010	57.34	56.19	56.21	60.43	66.87	72.73	**64.65**	**59.40**	64.59	70.88	76.16	75.01	86.72	77.75	92.71
2011	0.00	50.24	41.43	41.73	48.50	**59.45**	57.65	**59.96**	74.84	76.78	72.37	75.13	60.79	0.00	85.37
2012	0.00	40.82	45.39	54.16	**48.74**	52.99	53.07	60.23	61.68	60.98	67.00	64.34	62.99	83.16	78.18
2013	0.00	29.34	45.88	**42.92**	47.97	44.55	51.36	57.59	58.42	55.88	63.50	68.78	75.79	78.87	81.79
2014	0.00	21.15	**41.97**	46.40	47.81	55.89	54.16	36.89	59.88	61.27	70.27	53.58	68.01	84.74	80.66
2015	0.00	28.04	40.27	49.76	46.08	49.72	45.01	38.90	64.79	64.88	72.99	65.09	76.43	79.05	71.73
2016	**0.00**	33.85	44.97	49.81	54.49	46.78	48.75	46.58	58.87	57.80	60.39	67.43	70.39	70.20	85.22
2017	**0.00**	37.28	45.37	45.79	39.26	52.98	43.66	47.32	40.72	69.72	43.75	65.41	70.52	73.18	64.83
2018	**42.24**	51.66	34.42	57.16	54.13	53.23	51.51	49.61	72.87	68.84	65.54	0.00	110.26	0.00	0.00
2019	**34.51**	49.42	50.16	42.14	49.45	53.70	66.54	79.60	50.10	50.81	66.04	96.99	0.00	0.00	0.00
2020	**0.00**	68.48	46.95	44.73	39.00	46.03	46.58	58.48	58.05	55.62	83.31	67.86	77.70	73.29	63.89
2021	**35.52**	40.57	60.37	45.91	57.81	50.09	39.94	65.02	60.12	57.25	44.53	100.18	58.99	105.15	120.87
2022	**29.01**	46.56	47.03	54.39	59.61	64.03	53.82	61.39	45.33	51.21	77.57	65.25	70.94	92.20	91.74
2023	**36.29**	12.01	43.68	49.31	50.88	48.96	52.46	55.38	66.80	46.28	52.23	48.92	78.77	100.51	85.67

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
1994	26.75	38.14	39.62	40.56	40.46	37.16	33.95	29.02	26.62	30.49	29.47	42.20	38.89	62.35	115.62	70.23	89.60	90.87	89.58	94.03	79.40	85.75	85.15	92.02	96.67	103.04	102.85	107.09	110.23	113.34
1995	39.36	38.87	41.55	41.70	39.39	37.35	32.50	29.40	34.60	33.59	41.46	47.99	83.83	76.36	86.82	91.54	82.51	87.27	91.51	79.30	85.99	88.95	95.62	98.97	103.38	108.11	108.20	109.84	113.90	113.88
1996	40.27	41.65	39.80	36.35	35.70	31.79	28.55	31.38	34.12	36.10	47.01	66.04	78.85	80.74	79.67	95.11	87.67	82.78	93.08	80.33	87.95	91.58	96.12	98.92	103.04	101.98	105.68	111.10	109.84	119.42
1997	26.53	40.25	36.41	33.59	31.19	29.97	30.18	35.01	39.83	45.24	62.43	82.02	81.46	86.73	86.77	81.34	82.45	83.86	87.32	93.60	88.61	91.59	95.99	101.62	101.66	106.89	110.89	112.07	117.15	
1998	29.55	38.46	33.17	31.37	30.28	29.82	33.85	32.05	48.79	53.80	67.64	75.46	75.33	87.58	83.15	82.65	68.84	79.18	82.14	88.13	92.34	93.45	97.88	97.01	102.42	106.42	107.20	113.71	116.63	119.90
1999	0.00	33.39	30.34	28.35	26.97	28.87	33.66	35.06	51.11	61.56	65.33	73.50	83.20	73.28	79.10	71.15	66.32	78.46	82.05	86.86	87.50	92.41	100.88	97.20	98.84	99.68	104.40	109.20	113.90	116.09
2000	20.74	31.50	28.90	32.01	32.52	36.34	39.01	51.19	64.11	63.48	70.31	81.57	80.67	68.02	61.93	60.46	74.66	80.57	82.17	87.72	91.52	91.90	93.45	95.99	98.61	105.10	108.77	112.07	116.54	116.70
2001	0.00	27.91	32.29	32.66	37.27	41.11	53.20	65.60	66.89	75.98	78.29	70.63	69.32	64.93	66.35	72.15	79.38	81.17	82.67	85.55	87.38	96.99	93.17	98.83	103.82	105.36	104.95	116.24	121.54	127.36
2002	17.95	27.68	32.19	31.38	38.76	47.35	61.18	63.44	71.31	77.77	76.79	73.48	66.24	76.04	69.87	71.51	77.87	80.69	85.85	85.90	86.43	89.67	94.03	89.02	102.55	107.56	109.93	113.91	116.82	118.31
2003	20.11	32.03	31.68	37.26	48.37	55.58	66.22	72.73	77.99	79.29	76.40	66.69	69.78	66.30	72.37	75.25	80.87	80.67	86.98	88.44	90.13	91.62	99.10	101.34	103.88	107.32	110.81	115.33	115.88	121.87
2004	25.75	30.44	36.24	46.74	56.65	64.10	67.64	71.98	75.92	72.95	65.70	66.88	70.92	71.30	73.59	76.79	78.98	82.69	85.99	85.01	88.34	92.92	97.33	99.86	103.82	110.96	111.87	115.27	117.39	120.27
2005	33.90	36.40	47.82	58.34	63.62	68.97	74.08	76.20	69.23	66.63	66.96	69.10	69.76	70.84	74.18	78.26	77.40	79.23	81.20	84.17	86.45	91.97	93.94	97.71	101.99	105.36	107.71	114.80	117.42	
2006	27.18	46.36	59.08	66.03	70.90	71.54	73.90	71.91	70.95	66.61	68.08	71.82	74.17	74.50	74.08	77.92	78.98	79.14	82.87	85.62	89.74	94.45	92.33	99.22	108.04	106.57	108.29	109.56	116.31	114.93
2007	0.00	50.73	58.67	65.03	69.33	72.04	66.94	65.91	67.62	69.44	65.72	73.35	71.90	81.97	76.21	73.80	76.96	81.11	84.17	86.70	88.73	91.90	103.12	101.58	106.26	109.60	105.86	112.63	114.18	113.07
2008	12.12	49.38	53.90	60.26	58.73	58.84	58.00	60.69	56.20	58.51	60.57	66.78	68.80	73.11	72.93	76.94	75.43	83.95	82.32	90.06	90.74	95.64	96.32	102.58	105.28	103.86	112.99	110.71	122.05	118.75
2009	32.91	45.77	52.04	49.98	46.27	51.63	50.22	53.74	54.98	57.79	63.04	62.45	70.97	73.11	71.57	75.94	86.98	81.67	84.92	91.10	92.03	95.38	97.04	100.54	104.83	106.16	115.53	116.58	111.78	117.35
2010	26.29	32.92	38.23	37.50	44.50	45.16	50.35	51.16	48.30	51.84	57.38	59.46	63.59	64.24	69.03	71.02	75.18	77.04	81.39	87.72	92.62	92.71	96.13	100.19	104.03	104.92	108.45	107.92	115.77	118.38
2011	0.00	29.18	30.94	39.92	41.42	42.05	45.54	45.83	49.70	54.01	55.13	60.06	61.17	64.55	72.05	73.38	78.78	83.50	88.67	89.38	90.42	95.57	97.45	100.32	106.29	102.89	112.10	114.57	113.27	117.72
2012	52.95	29.47	37.09	39.80	40.32	41.44	42.19	47.80	48.64	52.05	58.27	54.90	63.66	66.21	70.82	74.27	76.03	83.87	82.30	86.56	92.67	96.53	95.47	105.63	104.08	99.99	105.24	110.04	122.15	111.45
2013	0.00	10.98	22.52	33.89	33.07	36.83	43.99	47.38	51.69	51.00	45.40	55.73	58.47	74.60	68.47	71.58	77.64	78.80	87.25	90.43	90.57	89.80	92.58	97.99	108.64	106.36	108.52	121.61	122.36	
2014	0.00	23.34	31.33	31.96	38.65	42.44	45.29	43.96	47.63	51.88	57.18	62.44	64.62	69.10	76.53	81.09	86.95	73.34	86.86	85.43	93.66	94.39	105.58	105.76	105.47	105.99	112.04	110.97	115.11	
2015	0.00	23.97	27.94	28.78	36.62	34.68	38.20	40.82	42.26	44.44	49.40	54.58	61.80	65.95	69.30	68.37	79.92	78.72	87.20	87.10	90.66	79.23	93.89	93.36	90.22	103.93	99.32	104.58	100.38	101.84
2016	0.00	24.84	31.29	32.45	34.99	40.47	40.40	38.20	44.54	45.62	57.84	59.38	68.25	67.98	69.79	79.45	81.05	79.26	85.27	87.68	89.66	85.76	93.95	92.06	107.11	99.18	92.32	99.01	115.09	115.49
2017	0.00	30.29	33.89	39.04	39.10	45.88	43.27	40.54	48.83	53.29	60.94	55.83	71.44	70.90	78.63	70.33	77.17	72.36	72.64	86.97	89.21	87.94	96.29	96.53	92.08	101.16	112.32	106.41	106.75	116.08
2018	67.61	31.71	35.46	35.93	38.60	38.04	37.14	44.76	46.93	57.70	57.10	58.76	66.13	72.87	73.26	69.17	85.16	88.20	82.18	80.61	97.42	91.91	97.44	100.11	98.13	107.63	99.91	104.42	117.77	102.82
2019	36.25	35.76	33.97	33.94	38.03	40.15	42.27	50.12	49.68	49.45	60.63	68.13	66.51	65.49	68.12	70.35	87.04	75.43	77.36	80.82	90.73	94.79	98.83	99.04	82.89	110.77	115.44	116.52	110.07	
2020	29.90	32.23	30.98	33.85	34.95	45.24	42.32	48.09	51.83	54.15	54.51	59.34	67.97	75.35	78.30	77.38	78.30	80.64	82.50	92.73	84.52	73.71	104.80	94.41	93.48	94.14	102.29	112.57	110.74	106.34
2021	58.40	28.73	29.11	33.09	35.46	37.82	44.67	43.92	47.58	57.10	59.73	58.68	68.36	70.00	80.87	71.17	90.25	83.90	82.71	88.11	93.92	88.39	80.46	93.32	95.17	92.97	93.38	110.19	99.28	110.28
2022	39.34	30.18	30.17	29.70	36.61	42.02	45.37	50.45	48.61	51.79	59.98	67.08	68.56	70.25	72.19	77.19	76.40	85.71	83.98	78.70	94.14	87.96	99.31	86.85	88.52	105.51	98.32	108.99	119.45	104.02
2023	39.41	27.70	31.11	35.65	42.83	40.06	50.20	52.32	53.28	52.47	59.16	55.72	67.13	67.22	69.03	72.33	80.27	82.65	79.80	80.87	87.90	88.40	94.53	99.99	91.03	101.17	109.11	113.18	107.12	106.92

Loss 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
1997	28.26	38.57	32.17	30.90	27.20	20.02	27.06	27.52	47.52	29.04	34.89	60.51	70.88	86.86	141.90	70.07	63.23	83.75	40.90	67.73	57.27	0.00	110.92	0.00	110.74	0.00	111.88	0.00	0.00	164.79
1998	28.73	26.03	29.02	23.84	16.84	24.33	32.48	28.16	20.39	0.00	31.71	-35.01	74.52	52.04	77.70	79.68	86.45	48.34	112.19	85.35	0.00	96.61	109.40	110.34	112.25	121.92	112.47	115.83	0.00	0.00
1999	0.00	26.87	25.38	22.38	24.65	33.45	29.94	37.08	76.79	87.67	49.69	49.26	94.63	77.13	87.15	80.90	43.42	88.47	81.38	93.91	122.56	110.59	98.73	107.27	136.80	121.18	148.56	127.82	0.00	128.15
2000	0.00	31.84	25.06	26.05	33.64	28.74	31.08	59.15	64.01	40.90	73.64	75.11	80.55	94.70	64.29	98.09	41.75	79.22	95.77	103.94	103.64	96.48	95.24	109.81	113.03	152.89	127.88	142.69	154.20	0.00
2001	25.08	28.48	33.94	33.58	32.80	42.56	58.24	70.96	61.54	64.40	71.78	94.44	79.53	65.46	80.32	94.50	91.59	101.17	104.27	98.10	104.60	97.07	116.36	112.37	0.00	97.52	121.39	126.28	114.77	0.00
2002	11.76	25.74	29.67	31.21	37.24	49.12	66.36	66.10	72.54	75.98	75.34	73.61	70.62	65.30	75.42	82.55	84.37	87.94	93.17	93.70	95.87	95.54	102.78	111.04	110.54	119.06	116.61	129.73	128.87	134.07
2003	23.52	30.16	30.86	32.57	45.72	57.03	62.85	65.31	73.10	69.93	71.54	77.24	66.87	73.02	80.45	78.49	86.45	94.59	86.44	88.86	93.71	98.10	96.07	106.13	109.49	111.00	113.66	121.18	134.53	132.00
2004	26.31	30.13	35.78	46.69	55.25	61.72	65.47	74.65	75.92	67.91	70.10	65.51	69.29	75.12	78.29	84.17	90.05	88.77	91.89	93.42	97.63	101.62	102.89	108.27	111.39	123.60	123.28	125.93	131.14	127.85
2005	28.41	32.33	48.56	60.03	62.44	67.76	69.45	75.99	68.11	64.69	64.94	68.36	72.85	76.32	80.50	82.38	86.41	86.12	88.22	90.80	99.81	105.61	106.32	109.25	107.26	111.30	113.41	118.82	124.80	126.94
2006	0.00	45.32	52.44	59.71	68.00	72.61	74.55	61.96	75.26	45.45	68.84	74.26	82.02	81.30	88.44	76.67	81.17	73.26	0.00	106.07	118.11	0.00	100.96	0.00	103.08	0.00	136.74	0.00	0.00	141.35
2007	0.00	56.29	80.86	73.04	69.61	74.68	67.92	50.62	67.63	81.72	75.23	77.89	89.08	83.68	92.73	77.99	0.00	99.71	98.83	0.00	0.00	0.00	138.10	116.47	0.00	0.00	0.00	0.00	0.00	0.00
2008	0.00	46.07	67.75	77.64	77.64	83.33	75.10	84.09	76.79	70.27	75.10	76.37	82.19	87.84	97.41	89.78	80.25	88.25	103.33	82.38	115.78	106.78	0.00	107.82	117.29	0.00	0.00	0.00	0.00	139.78
2009	43.03	53.95	58.17	60.57	60.67	62.48	63.59	65.33	64.01	63.85	70.14	75.53	76.17	77.62	78.20	82.98	86.08	87.70	92.44	93.84	103.98	102.33	110.00	107.80	118.46	106.41	141.65	122.85	129.00	127.17
2010	41.21	48.20	51.95	54.06	57.45	55.34	61.98	59.50	66.18	63.15	67.74	72.52	76.31	79.22	82.24	87.14	86.94	91.62	85.02	98.62	103.04	106.19	104.06	113.86	105.73	129.21	124.17	126.09	120.64	123.15
2011	44.82	41.51	40.91	45.94	50.98	50.37	52.04	53.15	56.10	59.59	59.00	66.67	70.24	72.36	76.41	81.49	79.83	90.52	91.43	95.95	106.52	111.28	96.67	98.59	115.96	120.48	118.50	120.53	109.04	123.23
2012	37.13	35.57	37.22	45.17	47.68	51.70	53.25	53.94	60.69	58.77	66.14	68.69	68.26	73.46	73.49	84.95	88.40	90.14	90.11	103.25	94.74	108.91	121.87	100.21	101.25	103.28	97.34	116.72	119.29	0.00
2013	28.10	37.22	37.65	40.03	46.10	43.31	55.11	54.11	57.46	54.29	59.65	67.81	76.20	75.49	83.40	83.97	77.49	93.79	97.86	80.52	98.47	121.87	131.72	115.68	139.37	102.67	0.00	0.00	0.00	0.00
2014	0.00	33.81	42.42	39.76	41.47	44.36	51.47	49.02	58.95	58.22	54.96	74.72	76.73	89.82	105.56	85.93	80.56	106.78	79.99	131.57	107.53	115.90	0.00	90.82	128.83	117.54	124.66	0.00	0.00	0.00
2015	0.00	42.39	26.00	33.59	37.78	39.05	49.75	42.45	49.73	54.01	60.24	70.73	72.31	67.24	95.59	82.86	96.36	101.35	108.43	103.91	97.37	101.77	144.81	131.83	141.41	119.50	107.01	159.56	0.00	0.00
2016	42.91	22.33	31.72	35.10	39.02	40.28	49.91	50.87	51.32	64.69	67.94	70.93	66.70	89.19	79.36	84.69	91.15	88.69	93.31	114.74	109.55	98.50	143.93	86.79	110.67	100.37	104.33	0.00	120.19	0.00
2017	7.46	29.94	32.30	34.03	38.91	43.91	45.50	50.63	54.38	52.50	68.20	67.94	65.09	78.30	83.95	86.12	80.66	85.81	81.19	112.34	86.62	0.00	97.23	111.30	0.00	120.11	102.75	0.00	0.00	0.00
2018	24.54	30.95	35.64	34.28	43.24	44.54	57.73	46.37	41.10	53.45	56.28	70.34	88.22	93.87	0.00	0.00	100.66	65.00	89.38	97.94	0.00	83.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	31.52	39.42	39.19	38.35	42.13	35.53	52.05	48.69	60.47	57.01	61.67	67.59	65.59	80.34	67.00	84.40	94.44	0.00	91.41	72.43	110.65	0.00	0.00	102.95	96.49	0.00	0.00	0.00	0.00	0.00
2020	32.91	36.29	38.10	37.35	42.67	44.20	49.31	48.36	60.48	58.68	72.72	64.82	65.55	70.27	70.87	83.11	82.62	93.72	91.69	74.63	121.19	119.69	110.15	0.00	0.00	0.00	107.50	126.16	0.00	0.00
2021	36.94	30.52	35.93	41.45	40.49	38.85	50.87	45.96	57.76	65.46	60.53	63.72	65.28	78.33	87.44	81.42	96.62	102.89	90.89	128.90	0.00	97.56	114.25	0.00	0.00	121.43	137.66	0.00	0.00	0.00
2022	31.82	33.15	28.97	36.39	41.15	37.53	49.38	52.45	62.43	57.91	74.03	69.94	94.68	79.15	75.44	110.41	93.07	99.52	99.31	91.44	132.63	89.32	0.00	115.52	75.08	0.00	139.62	0.00	0.00	0.00
2023	31.00	31.19	30.38	37.39	40.68	40.37	46.13	47.34	61.40	64.33	82.18	76.58	69.19	68.10	70.49	109.69	84.74	92.46	84.23	108.45	102.04	89.33	84.42	109.40	0.00	102.50	0.00	0.00	0.00	0.00

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