Annual Actuarial Review of

The FHA Mutual Mortgage Insurance Fund

Home Equity Conversion Mortgages (HECM) Loans

Fiscal Year 2025

Submitted to:

United States Department of Housing and Urban Development

Submitted by:

IT Data Consulting, LLC (ITDC®)
12020 Sunrise Valley Dr., Suite #100
Reston, VA 20191
www.it-dc.com
info@it-dc.com

December 11, 2025

December 11, 2025

The Honorable Frank Cassidy
Assistant Secretary for Housing and Federal Housing Commissioner
U.S. Department of Housing and Urban Development (HUD)
451 Seventh Street, S.W., Room 9100
Washington, D.C. 20410

Dear Mr. Cassidy,

IT Data Consulting, LLC (ITDC) has finalized and is submitting the Fiscal Year 2025 Independent Actuarial Review of the Home Equity Conversion Mortgages (HECM) under the Mutual Mortgage Insurance Fund, pursuant to contract number 86615723C00002.

This report is based on data as of September 30, 2025, providing an overview of the Economic Net Worth and details regarding the Cash Flow Net Present Value (NPV) for the Mutual Mortgage Insurance (MMI) HECM Loan portfolio as of the conclusion of Fiscal Year 2025. We've included a comparison with the corresponding estimate from the end of Fiscal Year 2024, evaluation under various scenarios, and offered detailed insights into the models employed for developing this estimate.

ITDC is here to answer any questions or address any comments you may have about the report and its conclusions.

Respectfully,

Benny Asnake
President and CEO
IT Data Consulting, LLC

December 11, 2025

The Honorable Frank Cassidy
Assistant Secretary for Housing and Federal Housing Commissioner
U.S. Department of Housing and Urban Development (HUD)
451 Seventh Street, S.W., Room 9100
Washington, D.C. 20410

Dear Mr. Cassidy,

I, Min Ji, am a Professor of Actuarial Science and Risk Management at Towson University. My research focuses on applying actuarial models to the risk management of insurance and financial products. I am a member of the American Academy of Actuaries (MAAA), a Fellow of the Society of Actuaries (FSA), and a Fellow of the Institute and Faculty of Actuaries (FIA). I serve on the Society of Actuaries' exam and research committees, keeping well connected to academia and the latest actuarial research in the insurance industry.

I meet the Qualification Standards for Actuaries Issuing Statements of Actuarial Opinion in the United States of the American Academy of Actuaries to render the actuarial opinion contained herein. I have reviewed the "*Annual Actuarial Review of the FHA Mutual Mortgage Insurance Fund, HECM Loans, for Fiscal Year 2025*". 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 on data and information provided by the Federal Housing Administration (FHA). I have relied on FHA for the accuracy and completeness of this data. In addition, I have also relied on the reasonableness of the assumptions used in the economic projections from the FY 2026 Mid-Session Review for the President's Economic Assumptions (PEA).

It is my opinion that, on an overall basis, the methodology and underlying assumptions used in the review are reasonable and appropriate under 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 may not unfold as projected.

Respectfully,

Min Ji, Ph.D., MAAA, FSA, FIA

Table of Contents

Summary of Deliverables viii
Executive Summary 1
A. Status of the MMI HECM Portfolio 1
B. Sources of Change in the Status of the HECM Portfolio 2
C. Impact of Economic Forecasts 3
Distribution and Use 5
I. Introduction 6
A. Actuarial Reviews of the FHA Mutual Mortgage Insurance Fund 6
B. HECM Program Overview 6
i. Maximum Claim Amount (MCA) 7
ii. Principal Limits (PLs) and Principal Limit Factors (PLFs) 7
iii. Payment Plans 8
iv. Unpaid Principal Balance (UPB) and Mortgage Costs 9
v. Loan Terminations 9
vi. Assignments and Recoveries 9
C. HECM Policy Changes and Recent Mortgagee Letters 9
i. Principal Limit Factors (PLFs) Reduction 10
ii. Loan Limit Increases 11
iii. Mortgage Insurance Premium (MIP) Structure Change 11
iv. Protection for Non-Borrowing Spouses (NBS) 12
v. Financial Assessment for Borrowers 12
vi. Recent Mortgagee Letters 13
D. Current and Future Market Environment. 15
i. The HMBS Program and Secondary-Market Liquidity 15
ii. Foreclosure Prevention Programs 15
iii. House Price Growth Rates 16
iv. Interest Rates 17
E. Structure of this Report 19
II. Summary of Findings 20
A. The FY 2025 Actuarial Review 20
B. Economic Net Worth 21
C. Changes in the Economic Net Worth 22
D. Current Insurance-in-Force of HECM in the MMI Fund 24

III. Characteristics of the MMI HECM Books of Business 26
A. Volume and Share of Mortgage Originations 26
B. Payment Types 26
C. Interest Rate Type 27
D. Product Type 28
E. Endorsement Loan Counts by State 29
F. Maximum Claim Amount Distribution 30
G. Appraised House Value 31
H. Borrower Age Distribution 32
I. Borrower Gender Distribution 33
J. Cash Draw Distribution 34
IV. HECM Performance under Alternative Scenarios 39
A. FHFA House Price Indices 39
B. Secured Overnight Financing Rate (SOFR) 40
C. Stochastic Scenarios 41
D. NPV Values 42
E. Sensitivity Tests for Economic Variables and Important Assumptions 44
V. List of Methodological Appendices 46
VI. Qualifications and Limitations 50
A. Fundamental Data Limitations 50
B. Model Sensitivity to Economic Projections 50
C. Changing Reverse Mortgage Market Landscape 51
Acknowledgement 52
References 52
Appendix A. HECM Data Reconciliation 54
Appendix B. HECM Base Termination Model 58
B1. The Multinomial Logistic Model 58
B2. Death Termination Model 59
B2.1. Model Specification 59
B3. Refinance Model 62
B3.1. Model Specification 62
B3.2. Model Estimation 65
B4. Mobility Model 66
B4.1. Model Specification 66
B4.2. Model Estimation 67

B5. Model Validation 68
B6. Combine the Three Risks 73
Appendix C. HECM Loan Performance Projections 75
C1. General Approach to Loan Termination Projections 75
C2. Economic Scenarios 75
C3. Claim Type 1 Frequency Model 76
C3.1 Model Specification 76
C3.2 Model Validation 77
C4. Claim Type 1 Loss Severity Model 78
C4.1 Model Specification 78
C4.2 Model Validation 79
C5. Conveyance and Payoff Selection Model in Post-Assignment 80
C5.1 Model Specification 80
C5.2 Model Validation 81
C6. Conveyance Maintenance and Operation Expense Model 81
C6.1 Model Specification 81
C6.2 Model Validation 82
Appendix D. HECM Cash Flow Analysis 84
D1. Definition 84
D2. Cash Flow Components 85
D3. Loan Balance 85
D4. Premiums 85
D4.1. Upfront Premiums 85
D4.2. Annual Premium 86
D5. Claims 86
D5.1. Claim Type 1 86
D5.2. Claim Type 2 (Assignment) 87
D6. Note Holding Expenses after Assignment 87
D8. Net Future Cash Flows 88
D9. Tax and Insurance Default 89
Appendix E. Stochastic Simulation Models 90
E1. Historical Data 91
E1.1. Interest Rates 91
E1.2. House Price Appreciation Rates 93
E2. Stochastic Models and the Simulated Scenarios 94

E2.1. 1-Year Treasury Rate 95
E2.2. 10-Year Treasury Rate 97
E2.3. 1-Month Treasury Rate 98
E2.4. 12-Month SOFR 99
E2.5. 6-Month SOFR 100
E2.6. 1-Month SOFR 101
E2.7. House Price Appreciation Rates 103
E3. COVID-19 Pandemic Consideration 105
Appendix F. Comparison of HUD and ITDC Models and Assessment of Vulnerabilities 105
Appendix G. Tables of Historical and Projected Loan Termination Rates 105

Summary of Deliverables

Below we summarize the findings associated with each of the required deliverables:

Deliverable 1: Produce a written Actuarial Study for HECM that provides actuarial central estimates of Mutual Mortgage Insurance (MMI) Fund as of the end of Fiscal Year 2025 and assesses HUD's estimates of Economic Net Worth.

The Economic Net Worth is defined as cash available to the MMI Fund plus the Net Present Value (NPV) of all future cash outflows and inflows that are expected to result from the mortgages currently insured by the MMI Fund. As of the end of Fiscal Year 2025 ITDC's Actuarial Central Estimate (ACE) of the MMI HECM Cash Flow NPV is positive $7.472 billion.

The total capital resource is positive $9.131 billion as of the end of Fiscal Year 2025. Thus, the estimated Economic Net Worth of the MMI Fund is positive $16,603 billion*.

Deliverable 2: Include a review of the risk characteristics of existing MMI loans including commentary on how such characteristics have changed in recent years.

A review of the risk characteristics of existing MMI HECM loans and commentary of how these risk characteristics have changed is included in Section III. HECM has been the largest reverse mortgage in the US market, and the majority of HECM borrowers select the line of credit option. Detailed characteristics of HECM loans are summarized in Section III.

Deliverable 3: Apply the final actuarial HECM model to the HECM part of the MMIF portfolio to produce conditional termination rates, timing of assignment, and recovery rates and amounts, by policy year and budget/endorsement year cohort, and by sub-cohort levels defined by policy initiatives and other characteristics. The output deliverables shall be presented in formats specified by the COR and per defined deliverable dates.

Models for projecting loan terminations and performance are described in Appendices B and C. The termination rates are forecasted in quarter steps and aggregated into annual termination rates. The cash flow model is in annual steps with quarterly variables accumulated for annual projection. Cash flow summaries by major category are displayed in the table below and discussed in more detail in Sections II and IV along with a detailed analysis of the cash flow calculations in Appendix D.

Exhibit SD-1 Projected Cash Flow Summaries ($ Million)

Cash Flow Category	Net Present Value of Cash Flow
Mortgage Insurance Premium	$2,223
Claim Type 1 Loss Incurred	($1,585)
Claim Type 2 Loss Incurred	($37,561)
Recovery (Claim Type 2c and 2p)	$44,766
Note Holding Expense	($371)

Net Present Value	**$7,472**

Deliverable 4: To promote transparency of the Studies' assessments, the Studies should identify methodological vulnerabilities that may occur in its actuarial models or in HUD's analyses of Economic Net Worth. This discussion should evaluate the scope and scale of such vulnerabilities in creating possible forecast risk and suggest possible lines of research in these areas. The Studies should assess and comment upon HUD's own models that estimate Economic Net Worth for methodological vulnerabilities and compare HUD's methodologies with those in the Studies.

As part of the statutory actuarial review process, this PDF includes an embedded addendum presenting the results of the review of HUD's HECM models. The addendum provides supplemental documentation and analysis necessary to support enhanced transparency and completeness of the actuarial review.

The assumptions and judgments underlying the ITDC Studies' estimates are summarized in Appendices A through E of the report. Section IV provides a summary of the Net Present Value (NPV) calculations, which are based on simulated economic scenarios. We also discuss the economic conditions that could lead to materially adverse changes in the Cash Flow NPV.

We have examined the vulnerabilities of our studies and compared the results under various scenarios.

Deliverable 5: The Studies should include historical data on changes in program terms as well as relevant loan and borrower characteristics (e.g., credit scores, loan-to-value ratios) by cohort and other sub-populations. Loan performance data (claim rates, prepayment rates, severity, and recovery rates) both historical and projected shall be presented in the "finger-table" formats (arrayed by cohort and policy years for different loan products).

Section I provides historical information on changes in the HECM programs. A review of the risk characteristics of existing MMI loans and commentary of how these risk characteristics have changed are included in Section III.

Appendix B shows the loan and borrower characteristics variables considered in the termination models and conveyance models and lists conditional termination rates by cohort and policy year. Historical and projected termination counts and rates for cohorts 2009 through 2025 are provided in Appendix G.

Deliverable 6: The Contractor should use the President's Economic Assumptions, provided by Office of Risk Management and Regulatory Affairs (ORMRA), for the actuarial central estimates of the Studies. However, in addition to the central single path economic forecast, the Studies shall test alternative economic forecasts for stress-testing and sensitivity analysis to estimate ranges of reasonableness.

ITDC has conducted a comprehensive analysis, based on the President's Economic Assumptions for FY 2026 Mid-Session Review (PEA) provided by the Office of Management and Budget (OMB). Based on our assessment, the Cash Flow Net Present Value (NPV) by the conclusion of the 2025 fiscal year for cohort years from 2009 to 2025 is a positive $7.472 billion.

In the table below, we estimate that the range of Cash Flow NPV based on the optimistic upside and pessimistic downside stochastic simulation scenarios is between negative $3.335 billion to positive $10.707 billion. These two values from the optimistic upside and pessimistic downside are two extreme scenarios that are highly unlikely to occur. Our Baseline PEA NPV of $7.472 billion stays in the middle of $9.742 billion from the moderate upside scenario and $3.768 billion from the moderate downside scenario.

Exhibit SD-2. Net Present Value of the HECM Fund under Different Economic Scenarios ($ Million)

Scenarios*	Fiscal Year 2025
Baseline**	$7,472
Alternative 1 – Optimistic Upside	$10,707
Alternative 2 - Moderate Upside	$9,742
Alternative 3 – Moderate Downside	$3,768
Alternative 4 – Pessimistic Downside	($3,335)

* *Description of these scenarios are in Section IV and Appendix E*
***Baseline is based on the FY 2026 Mid-Session Review for PEA*

The Cash Flow NPV estimate provided by FHA to be used in the FHA Annual Report to Congress is positive $6.334 billion. Based on ITDC's actuarial central estimate utilizing the Baseline PEA and range of results from the stochastic simulation scenarios, we conclude that the FHA estimate of Cash Flow NPV is reasonable.

Deliverable 7: To provide comparability to HUD estimates of Economic Net Worth, the Contractor shall use Federal Credit Reform Act discounting assumptions and procedures.

ITDC has developed estimates of Economic Net Worth using the Federal Credit Reform Act discounting assumptions which include using the cohort specific single effective rates (SERs) supplied by FHA.

Deliverable 8: This Study should use stochastic or Monte Carlo simulations of future economic conditions including for interest rates and house price appreciation. The objective of these requirements is to illustrate the sensitivity of forecasts to economic uncertainty and other forms of forecast error.

As described in Section V, Summary of Methodology, and detailed in Appendix E, Stochastic Simulation Models, we generated seven percentile economic scenarios, namely the 1st, 10th, 25th, 50th, 75th, 90th, 99th percentiles using stochastic simulations, with the 50-percentile replaced by the baseline estimate for each economic variable. The 10^{th} to 90^{th} percentile paths are used in the NPV computation models.

Deliverable 9: Provide econometric appendices to the Study that include variable specifications and statistical output from all regressions in the Studies.

Appendix B shows the predictive model parameters and goodness of fit measures for the Termination model. Appendix C shows the parameters and goodness of fit measures for the conveyance model.

Executive Summary

The Federal Housing Administration (FHA) administers the Home Equity Conversion Mortgage (HECM) program, facilitating senior homeowners' access to cash based on the value of their homes. Initially launched as a pilot program in 1989 and solidified in 1998, the program underwent substantial expansion between 2003 and 2008. This expansion was attributed to increased product awareness, favorable interest rates, rising home values, and augmented FHA mortgage limits. Preceding Fiscal Year 2009, the HECM program was integrated into the General Insurance (GI) Fund. The Housing and Economic Recovery Act of 2008 (HERA)[1] effectively transferred all new HECM program endorsements into the Mutual Mortgage Insurance (MMI) Fund, commencing on October 1, 2008.

The Cranston-Gonzalez National Affordable Housing Act (NAHA) 1990 introduced capitalization requisites for the MMI Fund.[2] Specifically, it mandated a minimum capital ratio of 1.25% by 1992, increasing to 2.0% by 2000. The capital ratio is the ratio of the capital to unamortized insurance-in-force (IIF). The term 'capital' is the economic net worth of the MMI Fund, which is defined by NAHA as 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. NAHA stipulated the necessity of an annual independent actuarial study concerning the MMI Fund. Subsequently, HERA expanded these obligations to encompass HECM mortgages within the MMI Fund. Consequently, an actuarial review is now customarily conducted on HECM mortgages within the MMI Fund. This report analyzes the HECM portion of the MMI Fund, explicitly focusing on mortgages endorsed in Fiscal Year 2009 and onward.

A. Status of the MMI HECM Portfolio

To assess the adequacy of the current and future capital resources to meet estimated future liabilities, ITDC analyzed all HECM historical terminations and associated recoveries using loan-level HECM data reported by FHA 30, through September 2025. Based on historical experience, we developed loan level termination and cash flow models to estimate the future loan performance of FY 2009 to FY 2025 books-of-business using various assumptions, including macroeconomic forecasts from the Office of Management and Budget (OMB), Moody's Analytics (Moody), and the expected HECM portfolio characteristics provided by FHA.

Using the President's Economic Assumptions for FY 2026 Mid-Session Review (PEA) Constant Maturity Treasury (CMT) rates, Secured Overnight Finance Rates (SOFRs), and House Price Appreciation (HPA) rate, ITDC projects the performance of the FY 2009 to 2025 books of HECM loans, and estimates the HECM Cash Flow Net Present Value (NPV) as of the end of FY 2025 is positive $7.472 billion. The HECM portion of total capital resource as reported in the Annual Report

[1] HERA was passed by the United States Congress on July 24, 2008, and signed by President George W. Bush on July 30, 2008.

[2] Public Law 101-625, 101st Congress, November 28, 1990, Section 332

to Congress Regarding the Status of the FHA Mutual Mortgage Insurance Fund is positive $9.131 billion at the end of Fiscal Year 2025. Thus, the estimated Economic Net Worth of the HECM MMI Fund is positive $16.603 billion. The HECM standalone capital ratio remained positive for the fifth year in a row[3].

ITDC also estimates that the Economic Value based on randomly generated economic scenarios is between negative $3.335 billion to positive $10.707 billion. These two values from the optimistic upside and pessimistic downside are two extreme scenarios that are highly unlikely to occur. Our Baseline PEA economic net present value of $7.472 billion stays in the middle of $9.742 billion from the moderate upside scenario and $3.768 billion from the moderate downside scenario.

The Cash Flow NPV estimate provided by FHA to be used in the FHA Annual Report to Congress is a positive $6.334 billion. Based on ITDC's actuarial central estimate utilizing the baseline PEA and range of results from the stochastic simulation scenarios, we conclude that the FHA estimate of Cash Flow NPV is reasonable.

The insurance-in-force (IIF) is calculated as the total Unpaid Principal Balance (UPB) of all HECMs remaining in the insurance portfolio as September 30, 2025. New endorsements in 2025 are added to the portfolio and HECM IIF as of the end of FY 2025 is $63.740 billion. Exhibit ES-1 provides endorsements, UPB and maximum claim amount (MCA) of active loans, and the NPV for loans endorsed in FY 2009 through FY 2025. The MCA of all active insured loans represents FHA's maximum risk exposure of the portfolio and serves as the cap on the amount of insurance claims that FHA will pay the lender for unassigned loans.

Exhibit ES-1. Baseline NPV, Insurance-in-Force, and Endorsement for FY 2009 – FY 2025 ($ Million)

		Insurance-in-Force		
Cohort Year	Endorsement*	UPB**	MCA***	Net Present Value
2009-2025, N	917,655	268,730		
2009-2025, $	300,409	63,740	113,422	7,472

**Total loans endorsed from FY 2009 through FY 2025.*
***The UPBs of the active loans endorsed from FY 2009 - FY 2025 in the insurance portfolio.*
****The MCA of the active loans endorsed from FY 2009 – FY 2025 in the insurance portfolio.*

B. Sources of Change in the Status of the HECM Portfolio

The FY 2024 HECM Review reported that the net present value of the HECM portfolio was positive $8.399 billion at the conclusion of FY 2024. Contrastingly, this year's actuarial review

[3] Refer to Annual Report to Congress Regarding the Status of the FHA Mutual Mortgage Insurance Fiscal Year 2024 for historical forward mortgage stand-alone and HECM stand-alone capital ratios since 2015.

estimates a positive value of $7.472 billion at the end of FY 2025. Exhibit ES-2 compares the Cash Flow NPV and IIF estimate for Fiscal Year 2025 to the estimates in the 2024 Review.

Exhibit ES-2. Estimate of Cash Flow Changes as of End of the FY 2025 ($ Million)

Item	Cash Flow NPV	Capital Resources	Economic Net Worth	Insurance-In-Force
2024	8,399	9,022	17,421	64,845
2025	7,472	9,131	16,603	63,740
Difference	(927)	109	(818)	(1,105)
Percent Change	-11.04%	1.21%	-4.70%	-1.70%

* *Cash Flow NPV and Total Capital Resources might not sum to the Economic Net Worth due to rounding*

As seen in Exhibit ES-2, the economic net worth of the HECM portion of the MMI Fund has decreased from positive $17.421 billion to positive $16.603 billion. The HECM NPV portion of the MMI Fund's estimated Fiscal Year 2025 Cash Flow NPV has decreased by $0.927 billion.

C. Impact of Economic Forecasts

The projected economic net worth of the HECM Fund portfolio depends on various economic forecasts and the thereafter projected loan performance. These include the following:

- **House Price Appreciation:** House Price Index (HPI) reflects the relative change in housing prices from period to period. House price appreciation (HPA) impacts the recovery FHA will receive upon mortgage terminations and the termination possibility that borrowers may decide to refinance or move out of their property.

- **Expected Interest Rate:** Interest rates impact the growth of mortgage balances. All the interest rate projections used in this review are based on the PEA baseline estimates. Expected interest rates also determine the unused HECM line of credit growth and how much homeowners can get access to upon refinance, which indirectly impacts voluntary termination of a HECM loan.

- **Termination Rates:** Net present value of the HECM cash flow depends on the crossover loss at termination, that is the loan balance exceeds the collateral property value at the time the loan is due and payable. Economic factors are not only driving factors of crossover risk but also impact how long borrowers hold onto their HECM loan before selling their home, moving out, refinancing their loan, or passing away. Refer to Appendix B for the detailed economic variables used in estimating termination rates.

- **Cash Drawdown Rates:** These rates represent the speed at which borrowers draw on their available HECM fund over time, which impacts the growth of the mortgage unpaid balance (UPB). We estimate borrowers' cash draw rates based on past HECM program experience and borrower characteristics and summarize actual borrower draw patterns into ten buckets based on the first month cash draw.

- **House Sale Price Discount:** The sale price of the houses underlying HECM loans tends to be lower than the market price of otherwise identical houses, due to borrowers' failure to maintain their home adequately and expedited sale of the house after borrowers' death or relocation. A deeper discount on the sale price would negatively impact on the economic net worth of the Fund.

The projected performance of FHA's current book of business, as measured by economic net worth, depends on future forecasts of these economic drivers. The baseline scenario for the primary economic drivers was developed consistently with the PEA, which is published by the Office of Management and Budget in compliance with the requirements of the Federal Credit Reform Act.

In addition to the mandated baseline PEA forecasts, we apply four alternative stochastic simulation scenarios of potential random deviations from the PEA baseline. Stochastic scenarios are simulated using the best fitted GARPH model with mean replaced by the corresponding PEA, to ensure the simulated paths will not drift far away from the PEA while having stochastic volatilities.

Four alternative scenarios are based on combinations of selected "percentile" paths of SOFR rates, 1-year CMT rate, 10-year CMT rates and the HPI based on 1000 simulated paths, representing the combinations of economic drivers that correspond to favorable or unfavorable outcomes for the prospects of the MMI HECM Fund portfolio.

Exhibit ES-3 presents the actuarial central estimate of the HECM cash flow NPV from the projections based on the PEA and four alternative scenarios. The loan performance estimated under each scenario excludes the identified COVID-19 impact[4]. The actuarial central estimate uses the baseline PEA.

Exhibit ES-3. NPV of the HECM Fund under Different Economic Scenarios ($ Million)

Scenarios*	Fiscal Year 2025
Baseline **	$7,472
Alternative 1 – Optimistic Upside	$10,707
Alternative 2 - Moderate Upside	$9,742
Alternative 3 – Moderate Downside	$3,768
Alternative 4 – Pessimistic Downside	($3,335)

** Description of these scenarios are in Section IV and Appendix E*
***Baseline is based on the FY 2026 Mid-Session Review for PEA*

[4] A dummy variable is added to the termination model for the Covid-19 period.

Our Baseline PEA economic NPV of $7.472 billion stays in the middle of $9.742 billion from the moderate upside scenario and $3.768 billion from the moderate downside scenario. The range of NPV based on the alternative economic scenarios is negative $3.335 billion to positive $10.707 billion. These two values from the optimistic upside and pessimistic downside are two extreme scenarios that are highly unlikely to occur.

The Cash Flow NPV estimate provided by FHA to be used in the FHA Annual Report to Congress is a positive $6.334 billion. Based on ITDC's actuarial central estimate utilizing the baseline PEA and range of results from the stochastic simulation scenarios, we conclude that the FHA estimate of Cash Flow NPV is reasonable.

Distribution and Use

ITDC provides this report to the FHA and policymakers for their assessment of the Economic Net Worth of the MMI Fund. Our conclusions are based on various assumptions about future conditions and events, detailed in subsequent sections of this report. These assumptions must be comprehended to contextualize our conclusions properly. Furthermore, our work is subject to inherent limitations, also discussed in this report.

The distribution of this report is allowed on the condition that it is shared in its entirety, including all exhibits and appendices, without any excerpts. ITDC acknowledges that FHA will integrate this report into its Annual Report to Congress, and ITDC grants permission for this purpose. We are available to address any questions that may arise concerning this report.

Any third party receiving this report should understand that its provision does not replace their responsibility to conduct due diligence. They should not place reliance on this report or its enclosed data to establish any explicit or implicit representations, warranties, duties, or liabilities from ITDC to the third party.

I. Introduction

A. Actuarial Reviews of the FHA Mutual Mortgage Insurance Fund

The National Housing Act requires an annual independent actuarial review of the Federal Housing Administration's (FHA) Mutual Mortgage Insurance (MMI) Fund.[5] ITDC was engaged by the Department of Housing and Urban Development (HUD) to conduct an independent actuarial review of the MMI Fund for FY 2025.

The FHA Modernization Act within the Housing and Economic Recovery Act of 2008 (HERA)[6] moved all new endorsements for FHA's Home Equity Conversion Mortgage (HECM) program from the General Insurance Fund to the MMI Fund starting in fiscal year (FY) 2009. Therefore, an actuarial review must also be conducted on the HECM portfolio within the MMI Fund. This document reports the HECM portion of the economic net worth and insurance-in-force (IIF) of the MMI portfolios in FY 2025 that can be used to compute the overall MMI Fund capital ratio.

B. HECM Program Overview

The U.S. Department of Housing and Urban Development (HUD), Federal Housing Administration (FHA), insures reverse mortgage loans through the HECM program, which enables senior homeowners to obtain funds by borrowing against the equity in their homes. All the following conditions must be met to be eligible for HECM:

- At least one of the homeowners must be 62 years of age or older.
- If there is an existing mortgage, the outstanding balance must be paid off with the HECM proceeds.
- The borrower(s) must have received FHA-approved reverse mortgage counseling to learn about the program.

HECM's are available from FHA-approved lending institutions. These approved institutions provide homeowners with cash payments or lines of credit secured by the collateral property. There is no required repayment if the borrower continues to live in the home and meets the HUD guidelines on property taxes, homeowners' insurance, and property maintenance. Borrowers use reverse mortgages to access cash for various reasons, including home improvements, medical bills, paying off balances on existing traditional mortgages, or for everyday living. Borrowers also use HECM to purchase a primary residence if they can use cash on hand to pay the difference between the HECM proceeds and the sales price plus closing costs for the property to be purchased. A HECM loan terminates for reasons including death, moving out of the home, and refinance. The existence of negative equity does not require borrowers to pay off the mortgage and does not

[5] HERA moved the requirement from the 1990 National Affordable Housing Act (NAHA) to the Federal Housing Administration operations within the National Housing Act, 12 USC 1708(a)(4).
[6] HERA was passed by the United States Congress on July 24, 2008, and signed by President George W. Bush on July 30, 2008.

prevent the borrowers from receiving additional cash draws, if available, based on their HECM contract.

The reverse mortgage insurance provided by FHA through the HECM program protects lenders from losses due to insufficient recovery on terminated mortgages and protects borrowers from lenders' failure to advance funds. When a mortgage terminates and the mortgage balance exceeds the net sale price of the home, the lender can file a claim for loss up to the maximum claim amount (MCA). A lender has the option to assign the mortgage note to FHA if the mortgage meets the eligibility requirements when the mortgage balance reaches 98% of the MCA. On assignment, the lender is reimbursed for the balance of the mortgage (up to the MCA). When note assignment occurs, FHA switches from being the insurer to the holder of the note and controls the servicing of the mortgage until termination. At mortgage termination (post-assignment), FHA attempts to recover the mortgage balance including any expenses, accrued interest, property taxes and insurance premiums. The following are definitions of common HECM terms.

i. Maximum Claim Amount (MCA)

The MCA is the minimum of the appraised value or purchase price of the home and the FHA mortgage limit at the time of origination. It is the maximum HECM insurance claim a lender can receive. The MCA is also used together with the Principal Limit Factor (PLF) to calculate the maximum amount of initial credit available to the borrower(s). The MCA is determined at origination and does not change during the life of the mortgage. However, if the home value is appreciated over time, borrowers may access additional credit by refinancing their HECM loan. In the event of termination, the entire net sales proceeds[7] can be used to pay off the outstanding mortgage balance, regardless of whether the size of the MCA was capped by the FHA mortgage limit at origination.

ii. Principal Limits (PLs) and Principal Limit Factors (PLFs)

FHA manages its insurance risk by limiting the percentage of equity available to the borrower through a set of Principal Limit Factors (PLFs). Conceptually, the PLF is like the loan-to-value ratio applied to a traditional mortgage. It represents the ratio of the amount of initial available equity to the MCA at origination. The PLF increases with the borrower's age at origination and decreases with the expected mortgage interest rate. The PLF table was last updated in Mortgagee Letter (ML) 2017-12. Exhibit I-1 lists an extract of PLFs as of September 2025.

[7] Net sales proceeds are the proceeds from selling the home minus transaction costs.

Exhibit I-1. Selected Principal Limit Factors

Expected Mortgage Interest rate	Borrower Age at Origination *		
	65	75	85
5.5%	0.403	0.467	0.570
7.0%	0.333	0.400	0.511
8.5%	0.276	0.343	0.459

**The age of the younger borrower or spouse*

The amount of equity available at origination is known as the initial Principal Limit (PL) and is calculated as

$$PL = MCA \times PLF\ (\text{age, expected mortgage interest rate})$$

where the PLF is determined from the HUD PLF table (ML 2017-12) corresponding to the youngest borrower's age and the expected mortgage interest rate rounded to the nearest 0.125 %.

Over the course of the loan, the principal limit grows with the mortgage interest rate and mortgage insurance premium rate. Once the HECM unpaid loan balance reaches the principal limit, no more cash advances are available to the borrower.

iii. Payment Plans

HECM borrowers access the equity available to them according to the payment plan they select. Borrowers can change their payment plan at any time during the mortgage if they have not exhausted their PL. The payment plans are:

- **Tenure plan:** equal monthly payments as long as at least one borrower lives and continues to occupy the property as a principal residence.
- **Term plan:** equal monthly payments for a fixed period of months selected.
- **Line of credit:** unscheduled payments or in installments, at times and in an amount of borrower's choosing until the line of credit is exhausted.
- **Modified Tenure**: combination of line of credit and scheduled monthly payments for as long as borrower remains in the home.
- **Modified Term:** combination of line of credit plus monthly payments for a fixed period of months selected by the borrower.
- **Single Disbursement Lump Sum:** all the available loan proceeds are accessed at closing. Generally, this occurs when the borrower uses the HECM for Purchase program or to pay off a large existing mortgage on the property.

Under the current program, the initial disbursement period limitation is applicable to all payment plans and subsequent payment plan changes that occur during the initial disbursement period.

iv. Unpaid Principal Balance (UPB) and Mortgage Costs

The Unpaid Principal Balance (UPB) is the mortgage balance and represents the amount drawn from the HECM. In general, after the initial cash draw, the mortgage balance continues to grow with additional borrower cash draws and accruals of interest, premiums, and servicing fees until the mortgage terminates.[8]

v. Loan Terminations

When a HECM loan terminates, the current loan balance becomes due. If the net sales proceeds from the home sale exceed the loan balance, the borrower or the estate is entitled to the difference. If the net proceeds from the home sale are insufficient to pay off the full outstanding loan balance and the lender has not assigned the note, the lender can file a claim for the shortfall, up to the amount of the MCA. HECM loans are non-recourse, so the property is the only collateral for the loan; no other assets or the income of the borrowers can be accessed to cover any shortfall.

vi. Assignments and Recoveries

The assignment option is a unique feature of the HECM program. When the balance of a HECM reaches 98% of the MCA and meets other assignment requirements, the lender can choose to terminate the FHA insurance by redeeming the mortgage note with FHA at face value, a transaction referred to as mortgage assignment. FHA will pay an assignment claim in the full amount of the mortgage balance (up to the MCA) and will continue to hold the note until termination. During the note holding period, the mortgage balance will continue to grow by additional draws and unpaid taxes and insurance. Borrowers can continue to draw cash if the mortgage balance is below the current PL. The only exception is that borrowers on scheduled payments are not constrained by the current PL. At mortgage termination, the borrowers or their estates are required to repay FHA the minimum of the mortgage balance and the net sales proceeds of the home. These repayments are referred to as post-assignment recoveries.

C. HECM Policy Changes and Recent Mortgagee Letters

The Home Equity Conversion Mortgage (HECM) program has undergone several policy changes over the years, including changes in insurance premiums, principal limit factors, loan limits, and regulations. The goal of these changes has been to enhance the program's sustainability, protect borrowers, and improve the fiscal safety and soundness of the MMI Fund. FHA publishes the policy changes in Mortgagee Letters (ML), some of which are listed in the references at the end of this report and in footnotes. These changes generally do not affect outstanding HECM contracts.

[8] The loan balance can also decrease or stay the same since borrowers have the option to make a partial or full repayment at any time.

In this section, we highlight significant HECM policy changes and interpret recent mortgagee letters.

i. Principal Limit Factors (PLFs) Reduction

PLFs determine the maximum amount a borrower can access from their home's equity over time, which depends on several factors, including the age of the youngest borrower (or non-borrowing spouse), expected mortgage interest rates, and regulatory changes aimed at ensuring the financial soundness of the MMI Fund. There have been multiple adjustments to the PLFs, as HUD sought to balance the program's attractiveness to potential borrowers with the need to maintain its financial soundness. Exhibit I-2 below illustrates a selected set of PLFs for the standard HECM program.

- Prior to 2013: PLFs were generally higher, allowing borrowers to access a larger portion of their home's equity.
- 2013 Adjustments: Due to increasing default rates and declining home values during the housing crisis, HUD significantly reduced PLFs to improve the health of the MMI Fund.
- 2014 Adjustments: With the financial assessment requirements introduced, PLFs refined as part of the comprehensive effort to reduce tax and insurance defaults and ensure the long-term sustainability of the program.
- 2017 Adjustments: HUD implemented another significant reduction in PLFs, to reduce program risk and preserve the MMI Fund's solvency. This change effectively **reduced the maximum borrowing amount** available to new HECM borrowers.

Exhibit I-2. Selected Principal Limit Factors for Standard HECMs

		Principal Limit Factors					
Age*	Mortgage Rate	Prior to FY 2010	FY 2010	FY 2011 to FY 2013	9/30/2013 to 8/3/2014	8/4/2014 to 10/1/2017	On or after 10/1/2017
65	5.50%	0.649	0.584	0.569	0.483	0.478	0.403
	7.00%	0.489	0.440	0.428	0.363	0.332	0.333
	8.50%	0.369	0.332	0.326	0.277	0.227	0.276
75	5.50%	0.732	0.659	0.636	0.541	0.553	0.467
	7.00%	0.609	0.548	0.516	0.438	0.410	0.400
	8.50%	0.503	0.453	0.425	0.361	0.304	0.343
85	5.50%	0.819	0.737	0.703	0.597	0.644	0.570
	7.00%	0.738	0.664	0.606	0.515	0.513	0.511
	8.50%	0.660	0.594	0.531	0.451	0.414	0.459

* Age of the younger borrower or spouse at loan origination

ii. Loan Limit Increases

Maximum claim amount (MCA) serves as the loan limit, which is reviewed and potentially adjusted each year based on the housing market conditions. The Department of Housing and Urban Development (HUD) typically reviews and announces any changes to the HECM loan limits towards the end of each calendar year, which then take effect the following year. On November 28, 2023, Mortgagee Letter (ML) 2023-22 increased the HECM MCA to $1,149,825 for the period of January 1, 2024, through December 31, 2024. Mortgagee Letter 2024-22 set the 2025 FHA HECM maximum claim amount at $1,209,750 for the period of January 1, 2025, through December 31, 2025.

Exhibit I-3 displays the loan limits from 2009 through 2025. The increasing maximum mortgage limits for HECMs align with the conforming loan limits established by the Federal Housing Finance Agency (FHFA) for Freddie Mac and Fannie Mae home mortgages and reflect national House Price Appreciation, Inflation, and Cost of Living Adjustments. With a higher HECM loan limit, borrowers with higher home values can access additional equity.

Exhibit I-3. Loan Limits from FY 2009-2025

Effective Date	Maximum Mortgage Limit	Percent Change from Previous Limit
Jan-25	$1,209,750	5.21%
Jan-24	$1,149,825	5.56%
Jan-23	$1,089,300	12.21%
Jan-22	$970,800	18.05%
Jan-21	$822,375	7.42%
Jan-20	$765,600	5.38%
Jan-19	$726,525	6.90%
Jan-18	$679,650	6.84%
Dec-16	$636,150	1.70%
Feb-09	$625,500	

iii. Mortgage Insurance Premium (MIP) Structure Change

The MIP structure for HECM loans has undergone several changes in response to the evolving needs of the program and its financial health. In FY 2014, a more conservative program was implemented through Mortgagee Letter 2013-27to improve the financial viability of the HECM program. The new program had lower principal limit factors than the previous Standard program and specified initial disbursement limitations. The annual MIP was 1.25% of the outstanding loan balance, while the initial MIP had a tiered structure based on borrowers' initial disbursement limit in the first year. To be specific, the initial MIP is 0.5% of the MCA for borrowers taking 60% or less of the principal limit during the first 12 months and 2.5% of MCA otherwise.

Effective October 2017, to simplify the MIP structure and improve the sustainability of the MMI Fund, HUD standardized the upfront MIP to a flat 2% of the maximum claim amount, irrespective of how much the homeowner drew from the reverse mortgage in the first year. The annual MIP rate was reduced to 0.50 % of outstanding balance.

To summarize the annual MIP:

- a loan with case number assigned before 4/5/2010 has 0.5% annual MIP.
- a loan with case number assigned between 4/5/2010 and 10/2/2017 has 1.25% annual MIP.
- a loan with case number assigned on and after 10/2/2017 has 0.5% annual MIP.

iv. Protection for Non-Borrowing Spouses (NBS)

A non-borrowing spouse refers to a spouse who is not a borrower on the HECM loan but is married to a borrower at the time of loan origination. Given the potential hardships faced by non-borrowing spouses after the death of the borrower, HUD implemented policy changes in 2014 to provide protections and rights of non-borrowing spouses. Mortgagee Letter (ML)2014-07 amended the regulations and requirements concerning due and payable status where there is a non-borrowing spouse at the time of loan closing. At the same time, it also specified where a HECM mortgagor has identified a non-borrowing spouse, the mortgagee must base the Principal Limit on the age of the youngest mortgagor or non-borrowing spouse. ML 2014-12 published the new Principal Limit Factor (PLF) tables which had been wholly revised and included PLFs for use where there is a non-borrowing spouse younger than 62.

ML 2015-03 established the Mortgagee Optional Election Assignment (MOE Assignment) for providing non-borrowing spouses having a loan issued prior to August 4, 2015, with protection after the death of the borrower. Lenders have the option of MOE Assignments to assign the HECM loan to HUD if the surviving non-borrowing spouse wishes to remain in the home, if they meet certain requirements. ML 2021-11 expanded assignment criteria to all existing loans and eliminated the requirement for an eligible non-borrowing spouse to establish marketable title or other legal right to remain in the property.

v. Financial Assessment for Borrowers

The main goal of the Financial Assessment is to evaluate a borrower's willingness and capacity to meet their financial obligations, including property taxes, homeowner's insurance, homeowners' association (HOA) fees (if applicable), and basic home maintenance costs, due to an increasing number of tax and insurance defaults by HECM borrowers. If a borrower is deemed to be a potential default risk based on financial assessment, the lender is authorized to create a Life Expectancy Set-Aside (LESA) to pay for future tax and insurance charges. By ML 2015-09, HUD introduced the requirement and calculation of the LESA, which is used for the payment of property taxes and hazard and flood insurance premiums. If, based on financial assessment, there's concern about the borrower's ability to meet ongoing property-related expenses, the lender might establish a LESA to cover property taxes and homeowner's insurance for the expected life of the borrower. The LESA results in less loan proceeds available for withdrawal but will reduce Tax and Insurance (T&I) default rate.

vi. Recent Mortgagee Letters

Several Mortgagee Letters have been published to enhance the HECM program and reaffirm its commitment to serve the senior citizens. These policy changes benefit both HECM borrowers and mortgagees and improve marketability and liquidity of HECM loans.

- Mortgagee Letter 2025-18 eliminates procedural steps an FHA appraiser must complete during each assignment, better aligning FHA with industry standards.
- Mortgagee Letter 2024-22 continues to increase the 2025 FHA HECM limits and set the maximum claim amount at $1,209,750 for all areas effective Jan 1, 2025. An increase in MCA raises the cap on principal limit and thus increases potential disbursement and accrual base, which will expand risk exposure base.
- Mortgagee Letter (ML) 2023-23 published revisions to simplify servicing requirements to reduce the cost associated with due and payable servicing and foreclosure actions, incentivize HECM program participants, and enhance the long-term performance of the mutual mortgage insurance Fund. FHA recognized the increased costs to mortgagees participating in the HECM program in the economic cycle of rising interest rates and inflation. Following these revisions, mortgagees are allowed to verbally complete the annual occupancy certification, use corporate funds to pay for all property charges not just outstanding property taxes or insurance payments, and include homeowner and condominium association dues in a borrower's total arrearage when calculating repayment plans.
- Mortgagee Letter (ML) 2023-23 also provided loss mitigation incentives. Mortgagees may offer up to $7,500, plus an additional $5,000 for probate costs, to borrowers who agree to short sales, deeds in lieu, or post foreclosure eviction avoidance loss mitigation options. ML 2023-23 increased the threshold for when a mortgagee must submit a due and payable request to HUD for outstanding property charges from $2,000 to $5,000, to expand a mortgagee's ability to work with borrowers that have fallen behind on taxes, insurance, or other property charges.
- Mortgagee Letter (ML) 2023-18 published updates for the payment of debenture interest on HECM claims and established a process for adjusting debenture interest for claims already filed for loans that became due and payable on or after September 19, 2017, in recognition of the financial hardship to Mortgagees that hold a substantial number of loans

that were already in default before Home Equity Reverse Mortgage Information Technology (HERMIT) System was changed in January 2024 to use the date of default to determine the payment of debenture interest rates.

- Mortgagee Letter (ML) 2023-15 updated processes and improved FHA's ability to make prompt payments in the event of a mortgagee default and to ensure that HECM borrowers timely receive scheduled or requested funds. The process modification is to build consumer and market confidence in the HECM program.

- Mortgagee Letter (ML) 2023-10 streamlined early documentation submission for loan assignment at 97% MCA to reduce delays. This procedural update can accelerate cash-flow timing.

Overall, there has been no change in the principal limit factors (PLFs), interest accrual rules, annual MIP, or mortgage insurance structure for HECM in a way that would directly alter the cash-flow assumptions in NPV, since last year's actuarial review. The increase in HECM limits (MCA) via ML 2024-22 is the most significant change, since it can raise the scale of cash flow, higher balances, and more insurance exposure. Operational or procedural relaxations via ML 2025-18 could modestly improve efficiency in claim and assignment processing, potentially reducing delays or expenses, which can slightly raise net present value.

The new loan limit has been incorporated into this year's model. At the same time, CT1 loss has been adjusted based on the data analysis. This is in line with the incentive of a higher threshold for a due and payable request to reduce the overall tax and insurance default. The additional costs associated with loss mitigation have not been reflected in the data. This is left for future research to quantify the change and set appropriate assumption to accommodate the change in the future.

D. Current and Future Market Environment.

Recent Mortgagee Letters fulfilled FHA's commitment to incentivize HECM loan originations, improve securitization capacity of the HECM market, and facilitate market liquidity. Program participants' policy changes collaboratively created a supportive market environment for the development of HECM program. The financial sustainability of the HECM program depends on cost-effective access to financing for senior borrowers, a stable secondary-market infrastructure, and effective loss-mitigation mechanisms.

i. The HMBS Program and Secondary-Market Liquidity

Ginnie Mae's Home Equity Conversion Mortgages (HECM) Mortgage-Backed Securities (HMBS) Program serves as the securitization outlet for FHA-insured HECM and facilitates access to affordable housing financing for these homeowners. Through the HMBS program, Ginnie Mae furthers the financial sustainability of HECM. In 2023 Ginnie Mae proposed HMBS 2.0 program to enable the pooling of active and nonactive buy-outs into new custom, single-issuer pools, which permits the pooling of HECMs with an outstanding unpaid principal balance (UPB) of no less than 98 percent and no greater than 148 percent of MCA. Access to liquidity under HMBS 2.0 will give issuers time to resolve issues that prevent HECMs from being assigned to FHA. This access will relieve immediate liquidity stress and reduce the likelihood of mortgagee default and portfolio extinguishment, which would help improve investor confidence in the HMBS market and support the HECM program. In November 2024, Ginnie Mae published the final term sheet for HMBS 2.0. Although the policy framework is finalized, no official effective date has been announced according to HECM World (2025).

ii. Foreclosure Prevention Programs

In 2024, the District of Columbia Housing Finance Agency (DCHFA) relaunched the Reverse Mortgage Insurance & Tax Payment Program (ReMIT) to provide financial assistance to qualified senior District homeowners who are at risk of foreclosure due to delinquent property taxes, homeowner's insurance, and HOA/condo fees. The return of ReMIT is a supportive foreclosure prevention tool for D.C. residents, which helps with loss mitigation of the HECM program through Preventing involuntary terminations, reducing FHA claim frequency and severity, and supporting community stability among aging homeowners. Such local interventions are crucial for loss mitigation and help maintain the positive actuarial performance of the HECM portfolio.

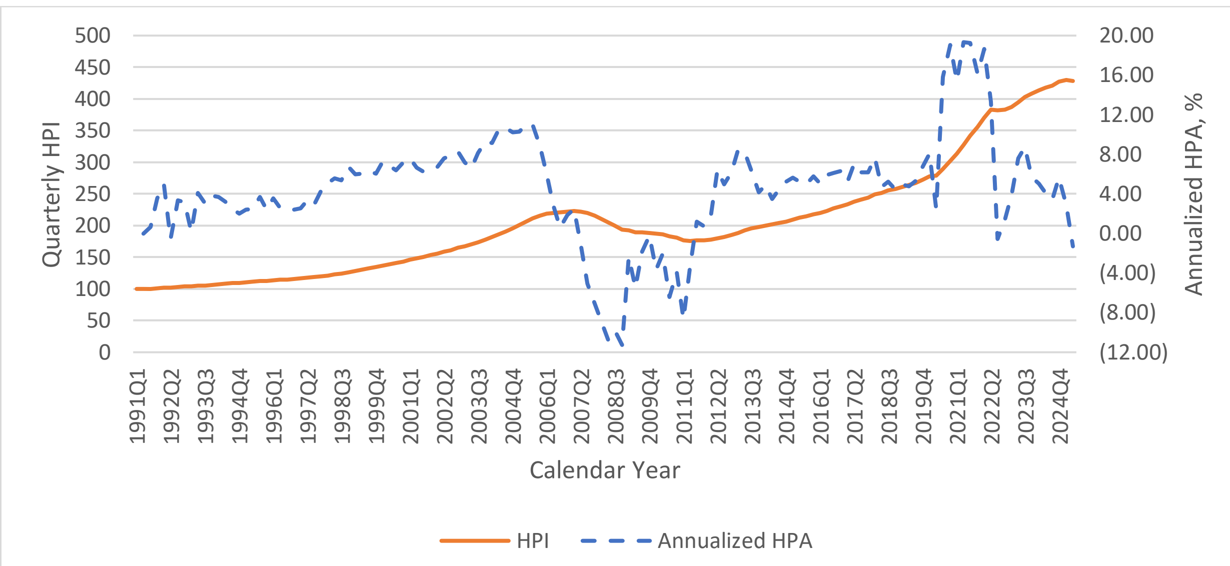
Apart from HECM policies, the economic environment has various impact on the default and claim rates, ultimately shaping the financial stability of the MMI Fund. A rise in interest rates tends to push up mortgage rates, contributing to increased default rates. On the other hand, the overall economic well-being directly affects home values, typically leading to reduced losses for the MMI Fund due to increased proceeds from home dispositions.

iii. House Price Growth Rates

The rate of home price growth exerts influence over several key factors: the volume of mortgages endorsed by FHA, the proportion of mortgage defaults, and the eventual cost of mortgage insurance claims. The yearly percentage shift in the historical Federal Housing Finance Agency (FHFA) Purchase Only House Price Index for each quarter is illustrated in Exhibit I-4.

Between 1992 and 2005, the annual rate of house appreciation experienced a steady increase, peaking at 11.2% in the second quarter of 2005[9]. However, during the housing crisis that commenced in 2006, this rate took a significant downturn, reaching a low point of -11.18% in the fourth quarter of 2008 and remaining in negative territory until the second quarter of 2011. Subsequently, the trend reversed, and this upward trajectory persisted through 2013, fluctuating between 5% and 7% until the second quarter of 2020. Then, starting in the third quarter of 2020, the rate embarked on an upward trajectory, driven by heightened housing demand, and reached its zenith at 19.45% in the second quarter of 2021. House appreciation slowed down in 2022, dropping to an average annual rate of 8.45% and continued to drop to an average annual rate of 6.50% in 2023, 4.56% in 2024, and -1.06% in 2025 Q3.

Exhibit I-4: Historical FHFA Purchase-Only House Price Index and Percent Change



Although house prices depreciated in 2025 Q2 and Q3, Both PEA projection and Moody's forecasts project that house price will continue appreciation trend in the future. The PEA projects that HPA rates will continue to be at a high level in the next few years and will drop to a lower level afterwards. While the projection is in the same trend, 2026 PEA projects lower HPI in near future and higher HPI afterwards than 2025 PEA.

[9] Calendar year is used in describing historical economic data.

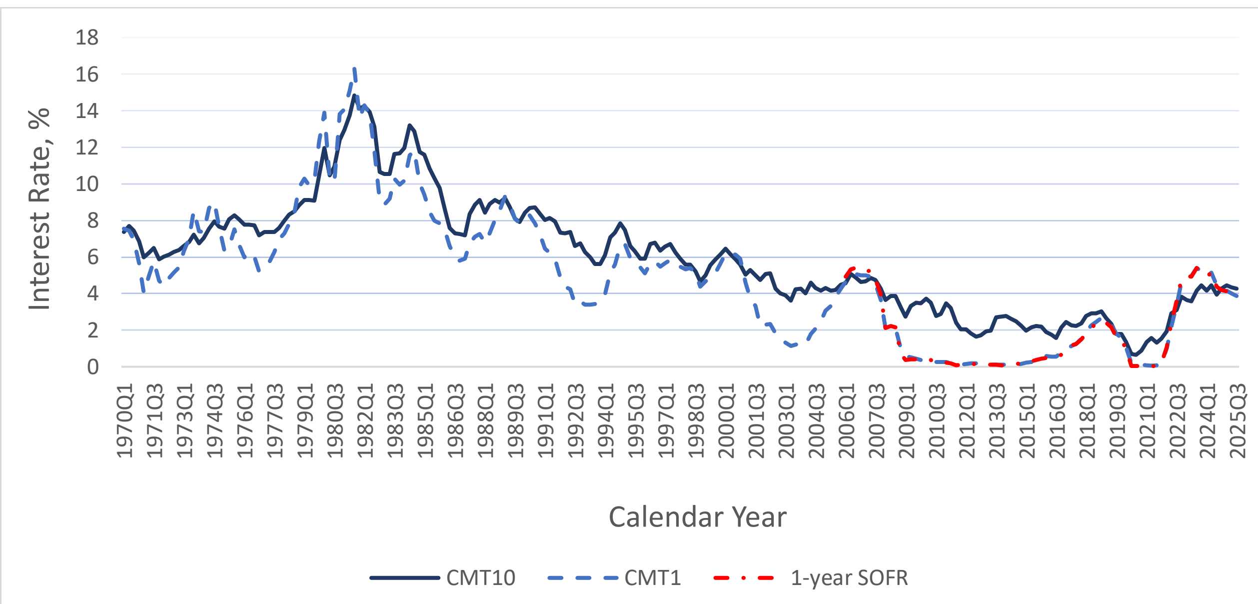
iv. Interest Rates

In 2008, in response to the housing crisis and economic recession, the Federal Reserve began decreasing interest rates as part of an active monetary policy. At the beginning of 2007, the 1-year Treasury rate was approximately 5%. Over the next seven years, the rate dropped steadily to a low of 0.1% in the second quarter of 2014. After 2014, the rate began increasing to 2.7% by December 2018. Since then, the rate has been decreasing, and as of the second quarter of 2021 reached 0.06%, the lowest level since the 1-year CMT rate began in 1953. This drop was due to monetary policy in response to the economic impact of COVID-19.

Following the peak of the COVID-19 pandemic, the Federal Reserve began increasing interest rates to curb inflationary pressures. The highest point reached 5.39% in the third quarter of 2023. Since then, the 1-year CMT rate has dropped to 4.25% in 2024 Q4 and 3.88% in 2025 Q3. Exhibit I-5 shows the historical 1-year and 10-year CMT rates.

Secured Overnight Financing Rate (SOFR) replaced London Interbank Offered Rate (LIBOR) for both new and existing adjustable rate HECM loans that were indexed to LIBOR as LIBOR started to phase out at the end of 2021. Moody's provided historical SOFRs dated back to 1998 Q1. We can see from Exhibit I-5 that Historical SOFRs closely followed 1-year CMT rates.

Exhibit I-5: Historical 1-Year and 10-Year Constant Maturity Treasury Rates



The 10-year CMT rate exhibits a similar trajectory, although the fluctuations are less pronounced. During 2007, the 10-year CMT rate stood at slightly over 5%. Subsequently, it gradually declined, falling below 2% by 2012. Post-2012, the rate increased, reaching just over 3.0% by December 2018. However, it began a descent once again and, due to the economic repercussions of COVID-19, dropped to 0.65% by the third quarter of 2020, marking the lowest level in the past three decades. The rate rebounded to 3.8% in 2022 Q4, 4.45 in 2024 Q2, and it is 4.26% in 2025 Q3.

The PEA projects lower future interest rates than last year's estimates, which will positively impact the NPV of the HECM loans with an adjustable interest rate.

E. Structure of this Report

The remainder of this report consists of the following sections:

Section II. Summary of Findings: Presents the economic net worth and insurance-in-force of the HECM portfolio as of the end of FY 2025.

Section III. The Current Status of HECMs in the MMI Fund: Analyzes the estimated economic net worth in further detail.

Section IV. Characteristics of the MMI HECM Books of Business: Presents various characteristics of HECM endorsements for FYs 2009 through 2025.

Section V. HECM Performance under Alternative Scenarios and Sensitivity Testing: Presents the HECM portfolio economic net worth using alternative economic scenarios.

Section VI. Summary of Methodology: Provides a summary of the models utilized in the analysis.

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.

Appendix A. HECM Data Reconciliation: Provides data reconciliation results.

Appendix B. HECM Base Termination Model: Provides a technical description of the loan performance model for the causes of loan termination.

Appendix C. HECM Loan Performance Projections: Provides a technical description of the loan termination projection methodology and the characteristics of the future endorsement cohorts modeled in this Review.

Appendix D. HECM Cash Flow Analysis: Provides a technical description of the cash flow model covering the various sources of cash inflows and cash outflows that HECM loans generate.

Appendix E. Stochastic Simulation of Economic Variables: Discusses the simulated economic scenarios that were generated by a Monte Carlo stochastic model to forecast the economic net worth of the MMI HECM portfolio.

Appendix F. Comparison of HUD and ITDC Models and Assessment of Vulnerabilities: As part of the statutory actuarial review process, this report includes an addendum presenting the results of the review of HUD's HECM models. The addendum is provided in the attachments section of this report and includes supplemental documentation and analysis necessary to support enhanced transparency and completeness of the actuarial review.

Appendix G. Tables of Historical and Projected Termination Rates: Provides tables of conditional and cumulative terminations by endorsement cohort years and policy years for each mortgage product. These are provided in spreadsheet files as a separate addendum to the report.

II. Summary of Findings

This section presents the projected economic net worth and insurance-in-force of the FY 2025 HECM MMI portfolio. An MMI-designated fiscal year portfolio is defined as the set of loans that survive to the end of the fiscal year and were endorsed in FY 2009 or later, when the MMI Fund was responsible for HECM losses. In addition to the capital resources as of the end of the fiscal year, the economic net worth of the HECM MMI portfolio depends on the discounted net present value of the future cash flows from the surviving portfolio of loans existing at the start of the valuation forecast (the end of the fiscal year under review).

A fiscal year's economic net worth calculation does not include the effect of endorsements in future fiscal years. According to NAHA, the economic net worth 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 estimated the current economic net worth for the HECM portfolio as the sum of the amount of capital resources and the net present value of all expected future cash flows of the active HECM loans as of the end of FY 2025.

A. The FY 2025 Actuarial Review

The FY 2025 Actuarial Review estimates the economic net worth of the HECM portfolio as of the end of FY 2025 (September 30, 2025). The objectives of our analysis include:

- Analyze all HECM historical termination experience and the associated recoveries using loan-level HECM data maintained by FHA through September 30, 2025.
- Identify the tax and insurance default and estimate the impact of tax and insurance default or extra cash out flow burden of HECM loans. We also build the conveyance/payoff selection equation.
- Construct a model using the economic scenarios of interest rates and house price appreciation rates. These economic scenarios were simulated to center around the baseline macroeconomic forecasts from the PEA.
- Provide detailed descriptions of the termination model, cash flow model, and economic assumptions used (presented in Appendices A to E). The following is a summary of the major findings in this review, which are also illustrated in Exhibit II-1.

This Review is carried out by examining historical loan performance data supplied by FHA, creating econometric models with the estimation of their parameters, and generating economic scenarios consistent with PEA. Econometric models are employed to forecast the Fund's future cash flow, and their present value is compared to the Fund's financial resources to determine the economic worth of the Fund.

Estimation of the loan status transition models utilized loan-level data on the Fund's historical loan performance from the early 1990s through to the end of FY 2025. The performance of FHA loans through the 2007-2010 mortgage crisis, the period of recovery and declining interest rates that followed the crisis, and the recent COVID-19 emergency have all provided real-world "stress tests" upon which to train our econometric models and develop forecasts of future performance. Further discussion and in-depth descriptions of the individual models, underlying assumptions, and comprehensive econometric outputs are provided in a series of appendices to the report.

B. Economic Net Worth

Exhibit II-1 presents the components of the economic net worth for FY 2025. ITDC projects the Actuarial Central Estimate (ACE) of the HECM portion of the MMI Fund at an estimated economic net worth of positive $16.603 billion at the end of FY 2025.

Exhibit II-1: Estimated Economic Net Worth of the HECM Portfolio for FY 2009-FY 2025 in the MMI Fund at the End of FY 2025 ($ Million)

Item	End of FY 2024	End of FY 2025
Total Capital Resources as of EOY*	9,022	9,131
+ NPV of Future Cash Flows on Outstanding Business	8,399	7,472
Economic Value	17,421	16,603
Insurance-In-Force (UPB)**	69,987	63,740

*Source: HUD/FHA Financial Statements
** Insurance-in-force for unassigned portfolio

Data through September 30, 2025 was used for the total capital resources. The total economic net worth consists of the following components:

- *Total Capital Resources* equals assets less liabilities in the Fund's balance sheet. The total capital resources are projected to be $9.131 billion at the end of FY 2025.

- *Net Present Value of Future Cash Flows on Outstanding Business* consists of discounted cash inflows and outflows. HECM cash inflows consist of premiums and recoveries. Cash outflows consist of claims and note-holding expenses. The cash flow model projects annual cash inflows and outflows using economic forecasts and loan performance projections. The net present value of future cash flows is estimated to be positive $7.472 billion as of the end of FY 2025.

C. Changes in the Economic Net Worth

The FY 2024 HECM Review reported that the economic net worth of the HECM portfolio was positive $17,421 billion at the conclusion of FY 2024, contrasting with this year's Review, which estimates a positive economic net worth of $16.603 billion at the end of FY 2025.

Exhibit II-2. Estimate of Cash Flow Changes as of the End of the FY 2025 ($ Million)

Item	Cash Flow NPV	Capital Resources	Economic Net Worth	Insurance-In-Force
2024	8,399	9,022	17,421	64,845
2025	7,472	9,131	16,603	63,740
Difference	(927)	109	(818)	(1,105)
Percent Change	-11.04%	1.21%	-4.70%	-1.70%

* *Cash Flow NPV and Total Capital Resources might not sum to the Economic Net Worth due to rounding*

A total change of $0.927 billion of the NPV from 8.399 billion in 2024 Review to $7.472 billion in this year's review can be attributed to the updates in our models and in the baseline assumptions.

To quantify the source of change in NPV, we identify key factors that affect the NPV and discuss total change using the following sources of change in Exhibit II-3.

Exhibit II-3. Decomposition of Changes in NPV from 2024 ($ Million)

Decomposition Steps	Change in FY 2025 NPV	FY 2025 NPV
FY 2024 NPV in FY 2024 Actuarial Report		8,399
- New Conveyance Model - Interest Rate and Annual MIP Update - New Claim Type 1 Model	(141)	8,259
- Optional Assignment Update - Full/Short Payoff Update for Conveyances	(477)	7,781
- Adding FY2025 PEA Interest Rates	154	7,935
- Adding FY2025 PEA House Prices	711	8,646
- Adding FY2025 Data (without new originations)	(1,299)	7,347
- Adding FY2025 with new originations	125	7,472
(=): FY2025 Estimate of NPV		**$7,472**

- Conveyance Model Update - The FY2025 Conveyance model has been redesigned to first project the probability of an assigned loan terminating as a conveyance (versus payoff) using a logistical regression model. Next, the Maintenance and Operations cost (M&O) as a percentage of sales price were projected using a generalized liner model (GLM). In the FY2024 Review, ITDC used historical averages as the projection for M&O costs. A model improvement implemented this year is that a logistical regression model was designed for conveyance probability and all variables were selected via a Least Absolute Shrinkage and

Selection Operator (LASSO) process to improve model fit. Model fit, validation tables and other model statistics are presented in the conveyance model section of the report.

- Annual MIP Update –In the FY2024 model, some HECM loans received an annual MIP rate of 1.25% in future years in error. This was corrected in FY2025 models.

To summarize the annual MIP:

- a loan with case number assigned before 4/5 2010 has 0.5% annual MIP.
- a loan with case number assigned between 4/5 2010 and 10/2/2017 has 1.25% annual MIP.
- a loan with case number assigned on and after 10/2/ 2017 has 0.5% annual MIP.

- Claim Type 1 Update – In this year's Review, CT1 model has been redesigned to first project the probability of CT1 claim using a logistical regression model, and the severity of Claim Type 1 loss was projected using a generalized liner model (GLM). In the FY2024 Review, ITDC used historical averages as the projections for Claim Type 1 frequency and loss severity. All Claim Type 1 model variables were selected via a Least Absolute Shrinkage and Selection Operator (LASSO) process to improve model fit. Model fit, validation tables and other model statistics are presented in the Claim Type 1 model section of the report. Along with the CT1 update for FY2025, the future interest rate merge was updated to ensure each loan has the appropriate interest rate with the new CT1 methodology.

  These three model updates reduced the NPV by 141 million as illustrated in Exhibit II-3 above.

- Optional Assign Update - Account for loans eligible for assignment but do not assign. Historically, 8.9% of loans were not assigned when eligible. Eligibility is identified as the case where current UPB >=105% of MCA. In this year's review, we use historical percentage to randomly pick 8.9% of loans into a pool of being eligible but not assigned. Currently, assignment is optional for HECM lenders/servicers once the loan UPB reaches 98% of MCA. To estimate the amount of current IIF loans that will not be assigned when eligible, we needed to account for HECM loans that were slow to complete assignment paperwork or any other issue that would slow down assignment timing once the loan UPB reached 98% of MCA. Using loans with UPB as a percentage of MCA greater than or equal to 105% allows for CT2 claim preparation and processing, ensuring we will not over-count the 'non-assigned when eligible' population.

- Full vs. Short Pay-Off for Conveyance Recoveries Update – HECM short payoff allows borrowers (or their heirs) to settle the debt for less than the total balance owed, when the home's value is less than the loan amount. In FY2025, this assumption has been updated to a 70/30 percent split between full payoff and short payoff respectively that better represents the history. We believe this assumption represents the overall housing market (as it relates to HECM) and a realistic expectation of future conveyance recoveries.

This update together with Optional Assignment update further reduces the NPV by 477 million as shown in Exhibit II-3 above.

- The PEA projects lower future interest rates than last year's estimates, which positively impacts the NPV, increasing NPV by $154 million.
- 2026 PEA projects lower HPI in near future and higher HPI afterwards than 2025 PEA, which positively impacts the NPV, increasing NPV by $711 million.
- Loan performance in FY 2025 excluding new endorsements decreases NPV by $1,299 million.
- FY2025 new endorsements adds $125 million to the NPV.
- All the changes together result in a FY 2025 baseline NPV of positive $7.472 billion.

D. Current Insurance-in-Force of HECM in the MMI Fund

According to NAHA, the insurance-in-force (IIF) is defined as the "obligation on outstanding mortgages", which is generally understood to describe unamortized insurance-in-force. We estimate IIF as the total UPB of all outstanding HECM loans in the insurance portfolio as of the end of FY2025.

Another potential measure of Insurance-in-Force (IIF) is the Maximum Claim Amount (MCA), which represents the maximum insurance liability that FHA could incur for the HECM portfolio. The MCA effectively serves as a cap on the insurance claim FHA will pay to a lender for any unassigned loan at termination. In contrast, the Unpaid Principal Balance (UPB) of active loans typically increases over time due to the accrual of interest, mortgage insurance premiums, servicing fees, and borrower draws. Consequently, the current aggregate UPB may understate FHA's long-term exposure, depending on the age distribution of loans within the portfolio. In contrast, The MCA is determined at origination and does not change during the life of the mortgage. The aggregate MCA remains relatively stable over time, as it reflects the maximum potential claim FHA could be obligated to pay at loan maturity or assignment—though it does not strictly limit the total exposure under all scenarios.

Therefore, in Exhibit II-4 we also list the aggregate MCA to indicate the insurance risk exposure of the HECM MMI Fund. Exhibit II-4 presents the estimated net present value, survival loan count and insurance-in-force and MCA for FY 2009 to FY 2025 active endorsements at the end of FY 2025.

Exhibit II-4. Estimated Survival Loan Count and Insurance-in-Force

Endorsement Fiscal Year	Net Present Value of Future Cash Flows ($ Million)	Survival Loan Count	Insurance-in-Force	
			UPB ($ Million)	MCA ($ Million)
2009	205	5,060	1,651	1,370
2010	213	3,061	1,090	888
2011	173	3,026	932	843
2012	152	2,416	737	656
2013	156	3,012	829	786
2014	268	5,885	1,272	1,537
2015	533	8,702	1,947	2,403
2016	770	9,139	2,038	2,700
2017	1,066	14,620	3,387	4,518
2018	569	16,855	3,524	5,337
2019	349	12,073	2,262	4,013
2020	1,119	20,272	4,726	7,696
2021	1,122	32,158	8,790	13,946
2022	297	53,575	15,883	26,754
2023	272	27,595	5,887	13,454
2024	84	23,754	4,299	11,910
2025	125	27,527	4,488	14,610

* *IIF is measured by the UPB*

The MMI insurance-in-force (IIF) is expressed as the sum of the UPBs of all HECM loans remaining in the insurance portfolio. The estimated IIF reflects the combined, cumulative impacts of loan terminations and new endorsements. The total IIF for 2009 to 2025 cohorts was estimated to be $63.740 billion at the end of FY 2025. The total MMI MCA for 2009 to 2025 cohorts is estimated to be $113.992 billion at the end of FY 2025.

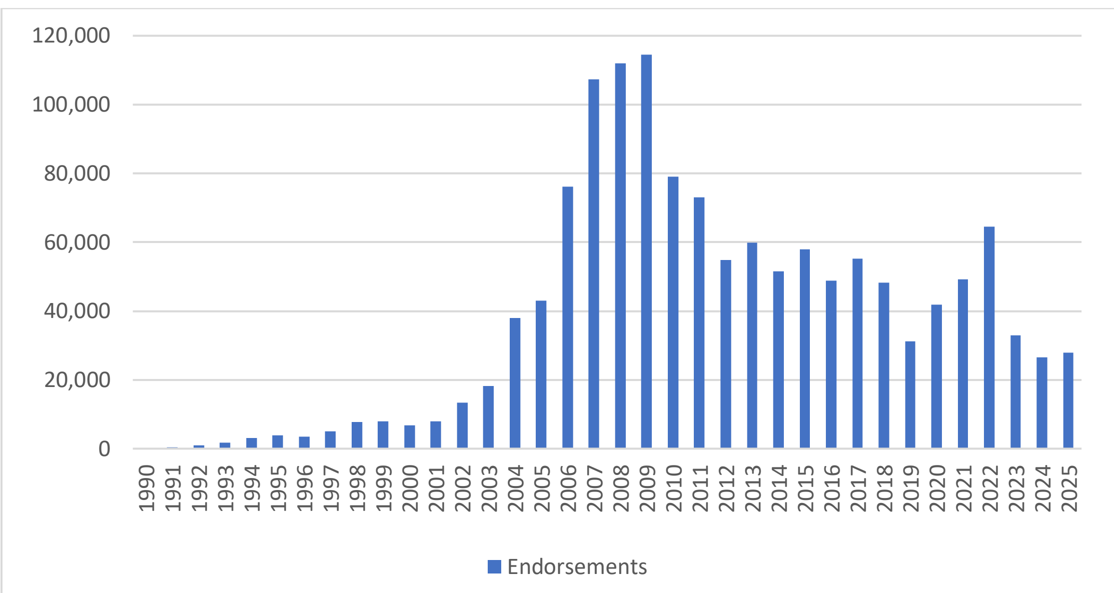
III. Characteristics of the MMI HECM Books of Business

This section presents the characteristics of the HECM portfolio for the HECM loans endorsed from FY 2009 through FY 2025. HECM loans were first included in the MMI Fund in FY 2009. The loans from these books of business that have not been terminated constitute the HECM portfolio as of the end of FY 2025. A review of the characteristics of these cohorts helps define the current risk profile of the HECM Portfolio. Some of the characteristics of previous books are shown as well to demonstrate trends.

A. Volume and Share of Mortgage Originations

FHA endorsed 27,995 HECM loans in Fiscal Year 2025, with approximate MCA of $14.87 billion. The total number of endorsements for Fiscal Years 2009 to 2025 is 917,665 with MCA of $300.41 billion. Since the inception of the HECM program, this program has been the largest reverse mortgage product in the U.S. market, representing most reverse mortgages. Exhibit III-1 presents the count of HECM endorsements by origination Fiscal Year.

Exhibit III-1: Number of HECM Endorsements per Fiscal Year



B. Payment Types

HECM borrowers receive loan proceeds by selecting from term, line of credit, tenure payment, and lump sum plans. Borrowers can also choose a combination of payment plan types. Exhibit III-2 presents the distribution of HECM loans by payment plan. The majority of HECM borrowers select the line of credit option. This option has accounted for 94.7% of the total endorsements from Fiscal Year 2009 to 2025.

Exhibit III-2: Distribution of FY 2009 - FY 2025 HECM Loans by Payment Type

Fiscal Year	Payment Type						
	Term	Line of Credit	Tenure	Term+ Line of Credit	Tenure+ Line of Credit	Lump Sum	Total, N
2009	0.8%	91.9%	1.4%	3.8%	2.0%	0.0%	114,421
2010	0.5%	94.3%	0.8%	2.8%	1.5%	0.0%	79,052
2011	0.4%	94.5%	0.8%	2.8%	1.4%	0.0%	73,109
2012	0.3%	94.9%	0.8%	2.6%	1.4%	0.0%	54,812
2013	0.4%	95.1%	0.8%	2.4%	1.2%	0.0%	59,923
2014	0.7%	93.6%	1.3%	3.0%	1.5%	0.0%	51,616
2015	0.6%	93.6%	0.9%	2.8%	1.6%	0.5%	57,989
2016	0.6%	89.4%	0.9%	2.9%	1.6%	4.6%	48,868
2017	0.5%	87.1%	0.8%	2.8%	1.6%	7.1%	55,290
2018	0.5%	87.6%	0.7%	2.7%	1.5%	7.0%	48,329
2019	0.5%	90.1%	0.6%	2.5%	1.3%	5.1%	31,272
2020	0.4%	94.5%	0.4%	2.3%	1.0%	1.5%	41,835
2021	0.4%	90.7%	0.3%	2.1%	0.8%	5.8%	49,196
2022	0.4%	93.4%	0.5%	2.1%	0.9%	2.8%	64,472
2023	0.5%	94.1%	0.7%	2.7%	1.3%	0.7%	32,974
2024	0.5%	94.4%	0.8%	2.7%	1.4%	0.1%	26,502
2025	0.8%	94.7%	0.8%	2.1%	1.6%	0.1%	27,995

C. Interest Rate Type

HECM borrowers can select fixed or adjustable-rate mortgages. Exhibit III-3 shows the distribution of HECM loans by interest rate type.

The majority of HECM borrowers selected monthly adjustable-rate mortgages in Fiscal Year 2009. The next year, however, the percentage of fixed-rate endorsements increased sharply to 69%. This was due, in part, to a significant drop in interest rates beginning in the last half of 2008. This percentage persisted in the Fiscal Years 2011 - 2013. Subsequently, the share of fixed-rate HECM loans dropped sharply. In Fiscal Year 2014, the percentage of fixed rate loans dropped to 19%, and as of the end of Fiscal Year 2020 it had dropped to less than 2% of the HECM loans originated. However, in 2021 the percentage of fixed rate loans increased to over 7% and was at 4.4% of the loans in 2022. Interest rates significantly increased in 2023, which led to a significant drop in fixed rate loans to 0.9% in 2023, about 0.2% in 2024, and 0.17% in 2025.

Beginning in 2021, the LIBOR was discontinued. As a result, the SOFR replaced LIBOR as an option for an index for adjustable mortgages. We use LIBOR to represent both in Exhibit III-3.

Exhibit III-3: Distribution of FY 2009-FY 2025 HECM Loans by Interest Rate Type

Fiscal Year	Libor Indexed		Treasury Indexed		Fixed	Total
	Annually Adjusted	Monthly Adjusted	Annually Adjusted	Monthly Adjusted		
2009	23	39,599	746	60,742	13,311	114,421
2010	7	24,174	10	392	54,469	79,052
2011	6	23,319	3	44	49,737	73,109
2012	1	16,697	4	64	38,046	54,812
2013	1	23,574	1	18	36,329	59,923
2014	1,239	40,738	0	1	9,638	51,616
2015	23,180	25,666	7	4	9,132	57,989
2016	36,854	6,793	20	0	5,201	48,868
2017	47,622	1,952	0	0	5,716	55,290
2018	42,742	685	1	0	4,901	48,329
2019	29,313	69	0	0	1,890	31,272
2020	40,988	45	4	0	798	41,835
2021	14,823	53	1,048	29,723	3,549	49,196
2022	12	0	498	61,112	2,850	64,472
2023	5	0	32	32,633	304	32,974
2024	0	0	18	26,433	51	26,502
2025	1	1	14	27,937	42	27,995

D. Product Type

There are three types of HECM loans: traditional HECM, HECM refinance, and HECM for purchase. Almost all loans endorsed in Fiscal Years 2009 through 2025 are “traditional” HECMs, where the borrowers had purchased their homes prior to taking out the reverse mortgage. A HECM for Purchase program was introduced in January 2009. This program allows seniors to purchase a new principal residence and obtain a reverse mortgage with a single transaction. However, these HECM for Purchase loans have been a small percentage of HECM endorsements each year as seen in Exhibit III-4. In our analysis, the traditional and for-purchase HECMs are treated the same, as the volume of for-purchase HECMs is small.

Exhibit III-4: Distribution of FY 2009-FY 2025 HECM Loans by Product Type

	Product Type				
			HECMs for Purchase		
Fiscal Year	Traditional HECMS	Refinance HECMS	First Month Cash Draw >= 90% of Initial Principal Limit	First Month Cash Draw < 90% of Initial Principal Limit	Total, N
2009	91.7%	7.8%	0.4%	0.1%	114,421
2010	92.1%	6.1%	1.6%	0.1%	79,052
2011	94.2%	3.7%	2.1%	0.0%	73,109
2012	94.4%	2.6%	2.9%	0.1%	54,812
2013	93.4%	3.1%	3.4%	0.0%	59,923
2014	91.8%	4.7%	3.5%	0.1%	51,616
2015	86.2%	9.6%	4.0%	0.1%	57,989
2016	84.1%	11.0%	4.5%	0.3%	48,868
2017	80.7%	14.5%	4.4%	0.4%	55,290
2018	82.5%	12.1%	5.0%	0.4%	48,329
2019	87.3%	5.4%	6.8%	0.5%	31,272
2020	73.5%	20.6%	5.5%	0.4%	41,835
2021	53.5%	42.0%	4.2%	0.3%	49,196
2022	51.5%	45.0%	3.2%	0.2%	64,472
2023	81.6%	12.2%	5.6%	0.5%	32,974
2024	85.8%	7.8%	5.8%	0.6%	26,502
2025	83.2%	10.9%	5.4%	0.5%	27,995

E. Endorsement Loan Counts by State

Among all endorsements in Fiscal Years 2009 through 2025, over half of all loans originated in the top 10 states. California has the highest endorsement volume every year over this period, while Florida has had the second highest endorsement volume since 2009. The endorsement breakdown of the top 10 states is shown in Exhibit III-5.

Exhibit III-5: Percentage of Endorsements by State for FY 2009 - FY 2025 HECM Loans

Top 10 states*	CA	FL	TX	AZ	CO	WA	NC	GA	UT	OR	Total
2009	13.7%	13.2%	6.6%	3.1%	1.8%	2.8%	1.8%	2.1%	1.5%	2.7%	49.3%
2010	14.0%	9.0%	8.0%	2.1%	1.8%	3.0%	2.0%	2.5%	1.3%	2.3%	45.9%
2011	13.5%	6.8%	9.1%	2.0%	1.9%	2.5%	2.6%	2.4%	1.4%	1.8%	43.9%
2012	12.7%	6.1%	8.9%	1.7%	2.0%	2.3%	2.8%	2.0%	1.8%	1.7%	42.1%
2013	14.1%	6.5%	8.6%	2.4%	2.1%	2.3%	3.1%	2.0%	2.0%	1.4%	44.3%
2014	17.5%	6.9%	7.4%	2.9%	2.3%	2.1%	2.6%	2.0%	1.7%	1.4%	46.9%
2015	20.3%	8.3%	7.0%	3.2%	2.4%	2.3%	2.4%	2.1%	1.7%	1.4%	51.2%
2016	21.8%	8.8%	7.6%	3.6%	3.7%	2.7%	2.5%	2.1%	1.8%	1.9%	56.5%
2017	23.7%	8.7%	7.6%	3.7%	5.4%	3.2%	2.3%	2.0%	1.9%	2.4%	61.2%
2018	22.7%	8.4%	7.4%	4.0%	5.9%	4.3%	2.5%	2.0%	2.4%	2.6%	62.1%
2019	21.1%	8.6%	7.4%	4.8%	6.0%	4.0%	2.5%	2.0%	2.8%	2.4%	61.6%
2020	24.7%	8.4%	6.4%	5.6%	7.1%	4.8%	2.4%	1.9%	3.2%	2.8%	67.4%
2021	26.0%	8.2%	6.0%	7.0%	7.0%	5.7%	2.1%	1.9%	4.2%	2.9%	71.0%
2022	23.7%	9.1%	6.6%	8.5%	6.9%	5.2%	2.3%	2.0%	5.4%	3.2%	72.8%
2023	18.5%	10.7%	8.4%	6.3%	5.2%	4.2%	3.1%	3.1%	3.5%	2.6%	65.4%
2024	17.7%	10.9%	7.6%	5.4%	4.6%	4.0%	3.2%	3.2%	2.9%	2.4%	62.1%
2025	18.0%	9.6%	7.2%	4.9%	4.5%	4.2%	3.5%	3.1%	3.0%	2.4%	60.4%

**Top 10 states by 2025 count of endorsements.*

F. Maximum Claim Amount Distribution

The MCA is the minimum of the FHA HECM loan limit and the appraised value (or, if a HECM for Purchase, the minimum of the purchase price and appraised value, not to exceed the HECM loan limit). It is used as the basis of the initial principal limit determination and the cap on the potential insurance claim amount. Exhibit III-6 shows the distribution of HECM endorsements by the MCA. Approximately 65% of loans endorsed in Fiscal Year 2009 had an MCA of less than or equal to $300,000, and this percentage increased to approximately 72% by Fiscal Year 2012. Since then, the percentage of endorsements less than $300,000 has decreased steadily to approximately 24% in FY 2023 and 24.2% in FY 2024 and 22.0% in FY 2025.

The percentage of endorsements with an MCA between $300,000 and $417,000 decreased from 17.6% in 2009 to 12-14% during Fiscal Years 2010 through 2014. Since then, it has been increasing and reached 23.4% in 2024 and 22.0% in 2025. As the principal limit has been increasing, the percentage of endorsements with an MCA over $417,000 has increased steadily since 2012 and the highest point is 57.9% in 2022. Endorsements with an MCA over $417,000 account for 52.3% and 55.9% in FY 2024 and 2025 respectively.

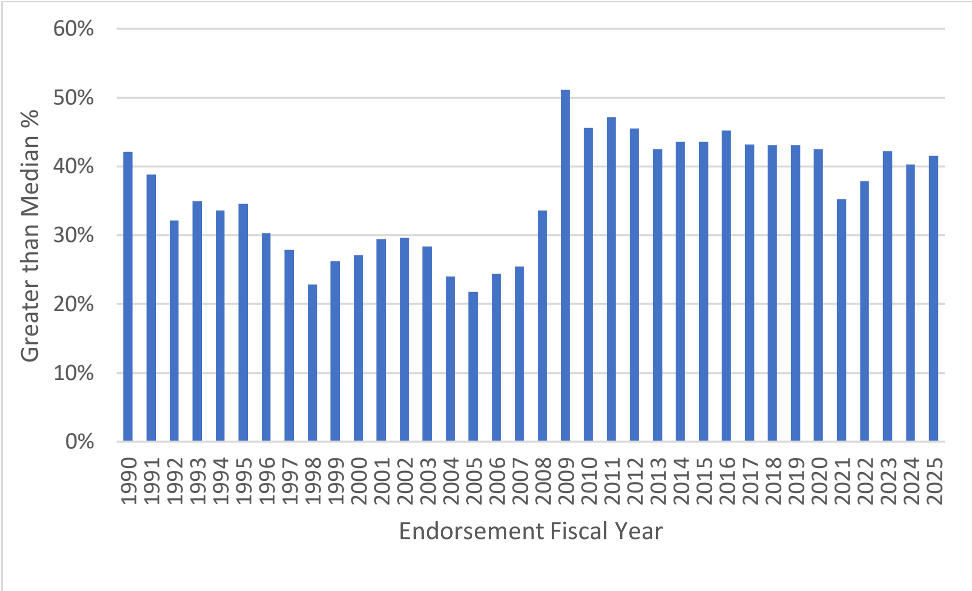
Exhibit III-6: Number of HECM Loans by MCA Level in FY 2009-FY 2025

FY	Less Than $100K	$100K to Less Than $200K	$200K to $300K	$300K to $417k	$417k to $600K	$600 to $726.2K	Greater Than $726.2K	Total
2009	10,875	36,504	26,147	20,150	15,151	5,594	-	114,421
2010	9,597	26,836	15,782	10,923	9,099	6,815	-	79,052
2011	10,886	26,097	14,199	9,438	7,232	5,257	-	73,109
2012	8,831	20,264	10,274	6,917	5,046	3,480	-	54,812
2013	9,362	21,748	11,257	7,835	5,581	4,140	-	59,923
2014	6,708	17,649	10,188	7,214	5,662	4,195	-	51,616
2015	6,385	18,193	12,018	8,838	7,254	5,301	-	57,989
2016	3,831	13,814	10,672	8,192	7,124	5,235	-	48,868
2017	3,068	13,689	12,526	10,315	9,175	6,517	-	55,290
2018	1,961	11,011	11,122	9,583	8,196	6,456	-	48,329
2019	967	6,660	7,551	6,339	5,320	3,183	1,252	31,272
2020	700	6,553	9,500	9,034	8,088	3,742	4,218	41,835
2021	404	5,415	9,452	11,150	10,841	5,099	6,835	49,196
2022	221	3,690	9,039	14,204	17,087	8,113	12,118	64,472
2023	138	2,269	5,516	7,777	7,809	3,477	5,988	32,974
2024	90	1,685	4,660	6,205	6,023	2,671	5,168	26,502
2025	62	1,485	4,602	6,185	6,484	2,957	6,220	27,995

G. Appraised House Value

FHA research has found, and our empirical findings reinforce, that loans associated with properties with an appraised value at origination greater than their area median tend to be maintained better than those with appraised value below the area median. Exhibit III-7 shows the percentage of HECM loans with an appraised house value greater than the area median value.

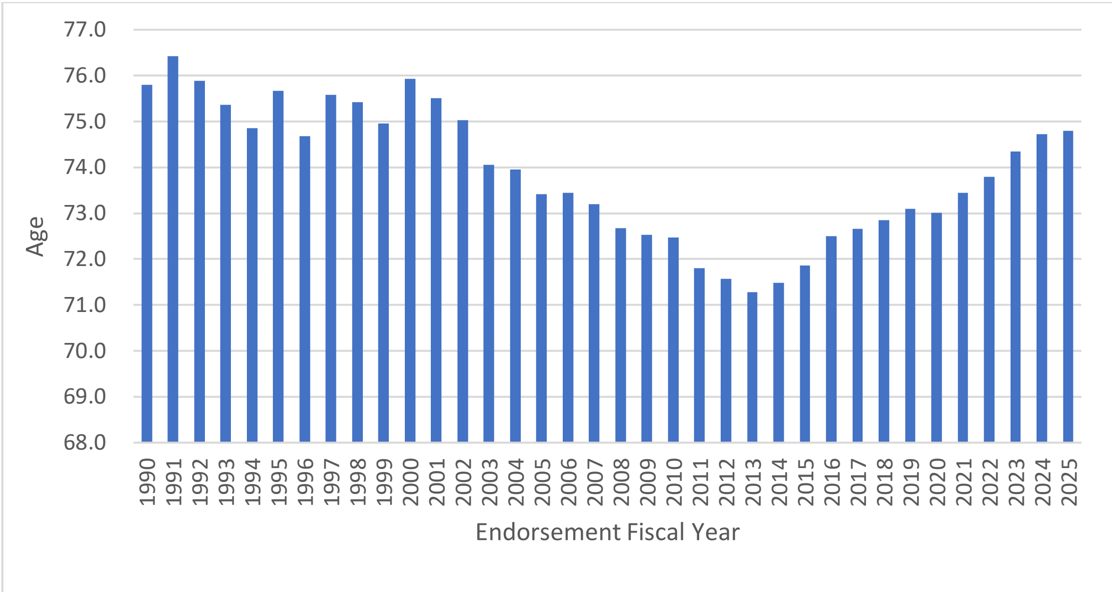
Exhibit III-7: Percentage of Borrowers with Appraised House Value Greater than Area Median Value



H. Borrower Age Distribution

The borrower age profile of an endorsement year affects loan termination rates and the PL available to the borrower. Exhibit III-8 shows the average borrower age at origination for Fiscal Years 1990 through 2025. The average borrower age had been declining through 2013 but has been increasing since then. Younger borrowers represent a higher financial risk exposure for FHA as they have a longer life expectancy. The PLFs, which limit the percentage of initial equity available to the borrower, were lowered for younger borrowers in September 2013, limiting their cash draws to a smaller portion of the equity in the house. This has caused the average borrower age to increase since 2013, and it is now almost 75 years old in Fiscal Year 2025.

Exhibit III-8: Average Borrower Age at Origination by Fiscal Year



I. Borrower Gender Distribution

Gender also affects termination behavior due to differences in mortality rates. HECM loan behavior indicates that single males tend to terminate their loans the quickest, followed by single females, with couples terminating the slowest. Exhibit III-9 shows the gender distribution of HECM endorsements, including those with missing gender information.

Exhibit III-9: Distribution of FY 2009-FY 2025 HECM Endorsements by Gender

Endorsement Fiscal Year	Male	Female	Couple	Missing
2009	20.6%	40.7%	38.1%	0.6%
2010	20.6%	41.6%	36.3%	1.4%
2011	20.1%	40.0%	38.1%	1.8%
2012	20.3%	38.9%	38.6%	2.3%
2013	20.3%	37.3%	40.1%	2.3%
2014	19.6%	38.3%	40.1%	1.9%
2015	18.6%	37.2%	43.5%	0.6%
2016	18.8%	35.8%	45.0%	0.5%
2017	18.3%	36.1%	44.7%	1.0%
2018	18.1%	35.6%	43.9%	2.3%
2019	18.7%	37.1%	42.3%	1.9%
2020	17.7%	34.2%	43.4%	4.7%
2021	18.7%	35.0%	41.9%	4.5%

Endorsement Fiscal Year	Male	Female	Couple	Missing
2022	17.9%	34.5%	43.3%	4.3%
2023	19.4%	38.6%	36.0%	6.1%
2024	20.4%	40.3%	34.2%	5.1%
2025	21.2%	40.2%	35.3%	3.3%

J. Cash Draw Distribution

Cash drawdown is an important factor in understanding the risk of the HECM portfolio. Over the years, FHA has done a tremendous job managing the competing risk of maximum borrower equity and MMI Fund solvency. FHA has sought to manage this risk through careful and deliberate adjustments to the principal limit factor (PLF) table, which is published by FHA. These PLFs dictate the amount of equity the borrower is allowed to consume based on the borrower's age and the interest rate environment.

Over the years, borrowers have become more savvy using HECM proceeds. We see on average all historic cohorts have drawn 80%+ of their initial principal limit. To identify future HECM cash draws, we have used historical experience, which includes scheduled and unscheduled borrower cash draws. Exhibit III-10 displays historical cash drawn by cohort as a percentage of initial principal limit to give a broad estimate of cash drawn. These numbers are not for presenting the equity available for future cash draws nor used in the model for loan performance or cash flow projection.

Exhibit III-10: Total Cash Draw by Cohort for FY 2009-2025

MMI Cohort	Total Cash Draw (as a % of initial principal limit)
2009	90%
2010	91%
2011	93%
2012	93%
2013	93%
2014	88%
2015	87%
2016	83%
2017	83%
2018	80%
2019	78%
2020	80%
2021	83%

MMI Cohort	Total Cash Draw (as a % of initial principal limit)
2022	83%
2023	74%
2024	70%
2025	62%

Data shows that loans which have drawn a higher percentage of the initial amount of equity available tend to have a higher likelihood of refinancing. Exhibit III-11 shows the distribution of the cash draw in the first month as a percentage of the initial PL by age group for HECM endorsements.

Exhibit III-11: First-Month Borrower Cash Draw of FY2009 - FY2025 HECM Endorsements as a Percentage of the Initial Principal Limit

Endorsement Fiscal Year	Age Group	Number of Loans	Variable Rate Loans			Fixed Rate Loans	
			0-40%	40-60%	60%-100%	0-60%	60-100%
2009	<62	-	0.0%	0.0%	0.0%	0.0%	0.0%
	62-65	23,707	11.9%	9.9%	64.6%	0.2%	13.3%
	66-70	28,213	14.5%	10.7%	61.7%	0.1%	13.0%
	71-75	24,935	18.9%	11.4%	58.3%	0.0%	11.4%
	76-85	30,664	25.0%	11.9%	53.1%	0.4%	9.6%
	85+	6,902	37.1%	10.2%	45.2%	3.0%	4.5%
	Total	114,421	19.1%	11.0%	58.3%	0.4%	11.3%
2010	<62	-	0.0%	0.0%	0.0%	0.0%	0.0%
	62-65	17,647	7.3%	4.3%	8.1%	0.2%	80.1%
	66-70	18,819	9.2%	5.3%	9.6%	0.2%	75.7%
	71-75	16,651	13.5%	6.4%	10.8%	0.1%	69.2%
	76-85	20,625	20.2%	7.7%	13.1%	0.2%	58.8%
	85+	5,310	32.8%	8.8%	14.5%	5.0%	39.0%
	Total	79,052	14.2%	6.2%	10.8%	0.5%	68.4%
2011	<62	-	0.0%	0.0%	0.0%	0.0%	0.0%
	62-65	18,801	8.4%	5.0%	9.9%	0.3%	76.4%
	66-70	18,009	10.7%	5.9%	9.5%	0.2%	73.7%
	71-75	14,799	15.4%	6.5%	10.0%	0.1%	68.0%
	76-85	17,014	22.8%	8.0%	10.8%	0.1%	58.4%
	85+	4,486	36.9%	8.1%	10.7%	0.1%	44.3%
	Total	73,109	15.5%	6.4%	10.1%	0.2%	67.9%
2012	<62	-	0.0%	0.0%	0.0%	0.0%	0.0%
	62-65	15,267	8.5%	5.4%	10.4%	0.2%	75.5%
	66-70	13,488	10.9%	5.7%	9.3%	0.1%	74.0%
	71-75	10,529	14.4%	6.5%	9.4%	0.1%	69.7%

Endorsement Fiscal Year	Age Group	Number of Loans	Variable Rate Loans			Fixed Rate Loans	
			0-40%	40-60%	60%-100%	0-60%	60-100%
	76-85	12,136	20.9%	7.1%	9.9%	0.1%	61.9%
	85+	3,392	34.6%	7.7%	10.0%	0.2%	47.5%
	Total	54,812	14.6%	6.2%	9.8%	0.1%	69.3%
2013	<62	-	0.0%	0.0%	0.0%	0.0%	0.0%
	62-65	16,876	8.0%	5.8%	20.7%	0.2%	65.4%
	66-70	15,414	9.9%	5.8%	20.5%	0.2%	63.6%
	71-75	11,624	13.8%	6.3%	19.2%	0.2%	60.6%
	76-85	12,728	19.6%	7.0%	19.1%	0.2%	54.1%
	85+	3,282	32.3%	7.1%	15.9%	0.3%	44.4%
	Total	59,924	13.4%	6.2%	19.7%	0.2%	60.4%
2014	<62	1	0.0%	0.0%	100.0%	0.0%	0.0%
	62-65	13,602	12.2%	26.5%	38.4%	1.8%	21.1%
	66-70	13,607	15.4%	24.7%	39.2%	1.7%	19.1%
	71-75	10,291	19.1%	25.4%	37.4%	1.7%	16.4%
	76-85	11,035	24.9%	26.0%	35.0%	1.9%	12.2%
	85+	3,080	37.5%	26.7%	26.5%	2.3%	7.1%
	Total	51,616	18.6%	25.7%	37.0%	1.8%	16.9%
2015	<62	2	0.0%	0.0%	100.0%	0.0%	0.0%
	62-65	14,216	12.8%	35.4%	33.0%	0.6%	18.2%
	66-70	14,772	14.9%	32.9%	33.7%	0.6%	17.8%
	71-75	12,053	18.4%	31.6%	33.9%	0.5%	15.6%
	76-85	13,376	24.0%	32.5%	31.8%	0.6%	11.0%
	85+	3,571	34.8%	33.7%	25.0%	1.0%	5.5%
	Total	57,990	18.4%	33.2%	32.6%	0.6%	15.1%
2016	<62	-	0.0%	0.0%	0.0%	0.0%	0.0%
	62-65	9,970	16.9%	34.9%	34.2%	0.8%	13.3%
	66-70	12,708	18.3%	31.4%	37.2%	0.5%	12.7%
	71-75	10,772	19.4%	31.1%	38.5%	0.2%	10.8%
	76-85	12,004	24.4%	31.8%	36.9%	0.4%	6.6%
	85+	3,414	35.6%	32.9%	28.2%	0.6%	2.7%
	Total	48,868	20.9%	32.2%	36.2%	0.5%	10.2%
2017	<62	1	0.0%	0.0%	100.0%	0.0%	0.0%
	62-65	10,663	18.1%	32.2%	36.1%	1.0%	12.6%
	66-70	14,524	17.1%	28.7%	41.6%	0.5%	12.2%
	71-75	12,495	19.3%	27.3%	42.7%	0.4%	10.3%
	76-85	13,804	22.2%	29.3%	41.4%	0.4%	6.7%
	85+	3,803	32.8%	32.2%	32.0%	0.3%	2.7%
	Total	55,290	20.2%	29.5%	40.0%	0.5%	9.8%

Endorsement Fiscal Year	Age Group	Number of Loans	Variable Rate Loans			Fixed Rate Loans	
			0-40%	40-60%	60%-100%	0-60%	60-100%
2018	<62	-	0.0%	0.0%	0.0%	0.0%	0.0%
	62-65	8,990	18.6%	32.1%	36.8%	0.7%	11.7%
	66-70	12,451	17.4%	28.1%	41.6%	0.5%	12.4%
	71-75	11,168	20.1%	27.6%	41.9%	0.3%	10.1%
	76-85	12,294	22.2%	30.2%	40.3%	0.4%	6.9%
	85+	3,426	33.3%	31.7%	31.6%	0.3%	3.0%
	Total	48,329	20.6%	29.5%	39.7%	0.5%	9.7%
2019	<62	-	0.0%	0.0%	0.0%	0.0%	0.0%
	62-65	5,470	17.7%	29.5%	45.4%	0.4%	6.9%
	66-70	7,912	17.6%	27.3%	48.2%	0.2%	6.7%
	71-75	7,267	20.0%	27.0%	46.3%	0.2%	6.5%
	76-85	8,191	24.2%	30.4%	40.7%	0.3%	4.5%
	85+	2,432	33.9%	32.4%	31.0%	0.6%	2.1%
	Total	31,272	21.2%	28.8%	44.0%	0.3%	5.8%
2020	<62	-	0.0%	0.0%	0.0%	0.0%	0.0%
	62-65	6,850	15.9%	25.8%	56.3%	0.1%	2.0%
	66-70	10,614	13.9%	24.0%	59.6%	0.1%	2.5%
	71-75	10,376	14.9%	23.7%	59.6%	0.1%	1.7%
	76-85	11,209	18.5%	26.3%	53.6%	0.2%	1.4%
	85+	2,786	30.4%	30.2%	38.2%	0.4%	0.8%
	Total	41,835	16.8%	25.3%	56.0%	0.1%	1.8%
2021	<62	-	0.0%	0.0%	0.0%	0.0%	0.0%
	62-65	6,746	12.7%	26.2%	53.2%	0.4%	7.5%
	66-70	12,150	11.1%	20.7%	60.0%	0.3%	7.9%
	71-75	12,977	10.9%	18.8%	62.4%	0.3%	7.7%
	76-85	14,107	12.6%	19.6%	61.6%	0.3%	5.9%
	85+	3,216	23.2%	23.0%	50.3%	0.2%	3.4%
	Total	49,196	12.5%	20.8%	59.5%	0.3%	6.9%
2022	<62	-	0.0%	0.0%	0.0%	0.0%	0.0%
	62-65	7,813	13.6%	25.9%	55.3%	0.2%	5.0%
	66-70	15,553	11.5%	20.6%	63.0%	0.2%	4.7%
	71-75	17,226	11.1%	18.1%	66.0%	0.2%	4.7%
	76-85	19,656	11.3%	18.1%	66.9%	0.2%	3.4%
	85+	4,222	19.5%	19.0%	59.0%	0.4%	2.2%
	Total	64,470	12.1%	19.7%	63.8%	0.2%	4.2%
2023	<62	-	0.0%	0.0%	0.0%	0.0%	0.0%
	62-65	4,435	20.6%	33.7%	44.8%	0.1%	0.8%
	66-70	7,285	19.3%	30.7%	48.8%	0.2%	1.0%

Endorsement Fiscal Year	Age Group	Number of Loans	Variable Rate Loans			Fixed Rate Loans	
			0-40%	40-60%	60%-100%	0-60%	60-100%
	71-75	7,880	19.7%	30.4%	48.8%	0.2%	0.7%
	76-85	10,273	22.0%	28.3%	49.0%	0.2%	0.6%
	85+	3,101	30.9%	24.9%	43.4%	0.2%	0.5%
	Total	32,974	21.5%	29.7%	47.8%	0.2%	0.7%
2024	<62	-	0.0%	0.0%	0.0%	0.0%	0.0%
	62-65	3,293	21.3%	38.3%	40.4%	0.0%	0.1%
	66-70	5,640	19.3%	34.9%	45.6%	0.0%	0.1%
	71-75	6,061	21.6%	32.4%	45.8%	0.0%	0.1%
	76-85	8,851	22.0%	30.1%	47.7%	0.1%	0.1%
	85+	2,657	31.3%	30.1%	38.3%	0.2%	0.1%
	Total	26,502	22.2%	32.7%	45.0%	0.1%	0.1%
2025	<62	-	0.0%	0.0%	0.0%	0.0%	0.0%
	62-65	2,543	21.3%	35.6%	43.0%	0.0%	0.0%
	66-70	4,541	20.3%	32.6%	47.0%	0.0%	0.2%
	71-75	5,013	19.5%	31.1%	49.2%	0.0%	0.2%
	76-85	7,168	21.3%	30.1%	48.5%	0.0%	0.1%
	85+	2,160	32.8%	27.0%	40.0%	0.0%	0.1%
	Total	21,425	21.8%	31.2%	46.8%	0.0%	0.1%

IV. HECM Performance under Alternative Scenarios

The HECMs' economic net worth for FY 2025 will depend on the economic conditions expected to prevail over the next 75 years and, most critically, during the next 10 years. The baseline scenario for the primary economic drivers was developed consistently with the President's Economic Assumptions (PEA) for the FY 2026 Budget, published by the Office of Management and Budget (OMB) in compliance with the requirements of the Federal Credit Reform Act. The realized economic net worth will vary from the baseline estimate if the economic conditions deviate from the baseline projections.

We have captured the most significant factors in the U.S. economy that affect the performance of the HECM loans insured by the MMI Fund and use the following variables in our models:

- 1-year constant maturity Treasury rates
- 10-year constant maturity Treasury rates
- One-year SOFR
- National and local house price indices

The PEA forecast developed by OMB provided all the economic drivers in our model, including one-year SOFR. Alternative scenarios are generated by simulating stochastic variations around the PEA assumptions.

A. FHFA House Price Indices

The actuarial central estimates are based on the PEA for the quarterly future performance of the FHFA Purchase Only (PO) seasonally adjusted HPI for the period FY 2025 FQ3 to FY 2035 FQ4 and 3% annualized HPA for years after FY 2035.

FHFA publishes both purchase-only (PO) and all-transactions (AT) versions of their HPIs. Some prior reviews have expressed the view that the HPI PO version is necessarily more accurate than the HPI AT version due to the reliance of the latter on appraisal valuations in addition to observed sale prices. We use the national FHFA Purchase Only (PO) seasonally adjusted HPI and have applied the AT version of the FHFA HPIs in model estimation for deriving local and state HPI, due to the significantly broader regional coverage provided by the AT version of the HPI, including more than 300 additional Metropolitan Statistical Area (MSA) level HPIs.

Calhoun (1991) first noted the benefits of having appraisal based HPIs during periods when sales transactions are limited or in locations where they are non-existent. Calhoun (1991) also examined the potential for greater sample-selection bias when only sales transaction data are used. Simply stated, mortgage borrowers may be willing to refinance at appraised values well below their reservation prices for selling, so that relying solely on sales prices draws from the higher end of the house price distribution at any point in time. In our view, geographic aggregation bias far outweighs concerns about appraisal bias, particularly given the overall consistency between AT and PO versions of the HPI at the same level of geography. Later research by Calhoun, Harter-Dreiman, VanderGoot (1998) and Leventis (2006) indicate that the actual evidence for systematic appraisal bias is mixed or inconclusive. On the other hand, geographic bias is large, immediate, and certain if the HPI PO version must be applied at the state level when no MSA-level HPI is available, Therefore, we opted for broader geographic coverage at the MSA level.

Nevertheless, we were required to use the PEA for the national FHFA PO HPI in developing our baseline forecast of portfolio economic net worth. To meet this requirement, we applied the following two-step procedure to obtain regional (MSA/State) HPI forecasts from the PEA national forecasts: (1) compute the period-by-period (FYFQ) differentials between the FHFA AT national forecast HPI appreciation rates and the corresponding appreciation rates for each regional HPI from the same FHFA AT forecast; and then (2) apply these differential appreciation rates to the PEA national PO HPI forecast to obtain regional HPIs forecasts consistent with the PEA national PO forecast. So as the PEA PO national forecast varies period-by-period, our regional HPIs (the newly created PEA MSA/State PO forecast) vary in a consistent manner, and enables us to retain the broader geographic coverage of the AT version of the FHFA HPIs (over 300 individual MSAs).

To be clear, we are not applying Moody's FHFA forecasts in place of the mandated PEA national HPI PO forecast. Changes in the local forecasts will still represent the pattern of house price appreciation for the PEA national forecast, plus regional differentials in appreciation rates based on observed historical patterns. Moody's AT and PO version national forecasts are quite consistent in terms of projected appreciation rates at both the national and regional levels, and the Moody's baseline national forecasts are quite like the PEA. As described in Appendix E, alternative scenarios for sensitivity analysis based on our stochastic simulation models use a similar approach to go from the simulated national PO version HPI forecasts to the corresponding simulated regional forecasts. The same procedure for developing regional forecasts from PEA national HPI forecasts was applied for both Single Family and HECM Fund performance.

B. Secured Overnight Financing Rate (SOFR)

Mortgagee Letter (ML) 2023-9 required that the Secured Overnight Financing Rate (SOFR) replace LIBOR for both new and existing adjustable rate HECM loans indexed to LIBOR to phase out LIBOR.

The Alternative Reference Rates Committee (ARRC) noted that regardless of what rate was chosen as a LIBOR alternative, there would need to be an adjustment for the difference between LIBOR and the fallback rate. Market participants preferred the 'historical mean/median approach,' which is based on the 5-year historical median difference between USD LIBOR and SOFR for the spread adjustment. Bloomberg published the following values shown in Exhibit IV-1 as the long-term spread adjustments, based on historical 5-year median spreads between USD LIBOR and compounded averages of SOFR:

Exhibit IV-1. Historical Median Difference between USD LIBOR and SOFR

LIBOR tenor being replaced	Spread applied to SOFR based rate (bps)
1-week USD LIBOR	3.839
1-month USD LIBOR	11.448
2-month USD LIBOR	18.456
3-month USD LIBOR	26.161
6-month USD LIBOR	42.826
1-year USD LIBOR	71.513

The ARRC's initial consultation demonstrated that a static spread could produce results that are as, or more, accurate than a potentially dynamic spread, and showed a static spread of 0.08% based on 5-Year median spread to SOFR for spread-adjusted loans with 5-years remaining maturity. In this review, we assume one-year SOFR plus a fixed 0.08% spread adjustment that measures the average difference between USD LIBOR and SOFR to be substantially equivalent to one-year LIBOR.

Alternative stochastic scenarios are simulated using the best GARCH models calibrated to the historical data.

C. Stochastic Scenarios

Our additional source of historical data on economic factors is Moody's Economy.com. Moody's has developed data from original sources, including the Federal Reserve, Bureau of Labor Statistics, Bureau of the Census, Bureau of Economic Analysis, Federal Housing Finance Agency, The Conference Board, Dow Jones, National Association of Realtors, and Freddie Mac. Depending on the data series, information is provided at the national, state, county, metropolitan area, and ZIP code level. Moody's data are combined with historical loan-level data from HUD's Single-Family Data Warehouse (SFDW) to build out loan-level panel data and event histories (defaults, cures, claims, prepayments) for use in estimating statistical models of loan performance. The estimated loan performance models are then combined with the forecasts of economic drivers based on the PEA to produce our baseline forecast.

In addition to the mandated baseline PEA forecasts, we apply four alternative stochastic scenarios based on Monte Carlo simulation of potential random deviations from the PEA baseline. To summarize, the five scenarios for which we report estimates of economic net worth are the following:

- Baseline - Published PEA
- Alternative 1 – Optimistic Upside Scenario
- Alternative 2 – Moderate Upside Scenario
- Alternative 3 – Moderate Downside Scenario
- Alternative 4 – Pessimistic Downside Scenario

Each of the simulated scenarios is based on combinations of simulated "percentile" paths for the economic drivers that correspond to favorable or unfavorable outcomes regarding the prospects of the HECM loan portfolio. Low interest rates with rising housing values are favorable outcomes because they lead to lower UPB growth and lower crossover risk (UPB is higher than collateralized house property). Conversely, increasing interest rates with falling house prices are unfavorable outcomes, because they lead to higher UPB and higher crossover risk. The specific combinations of paths associated with each of the overall simulated scenarios listed above are as follows:

Scenario 1 – Optimistic Upside Scenario

CMT 1-Year Rate:	10th percentile path
CMT 10-Year Rate:	10th percentile path
SOFR:	10th percentile path
HPA Rate:	90th percentile path

Scenario 2 – Moderate Upside Scenario

CMT 1-Year Rate:	25th percentile path
CMT 10-Year Rate:	25th percentile path
SOFR:	25th percentile path
HPA Rate:	75th percentile path

Scenario 3 – Moderate Downside Scenario

CMT 1-Year Rate:	75th percentile path
CMT 10-Year Rate:	75th percentile path
SOFR:	75th percentile path
HPA Rate:	25th percentile path

Scenario 4 – Pessimistic Downside Scenario

CMT 1-Year Rate:	90th percentile path
CMT 10-Year Rate:	90th percentile path
SOFR:	90th percentile path
HPA Rate:	10th percentile path

D. NPV Values

The estimated ACE NPV of the Fund as of the end of FY 2025 is positive $7.472 billion. These projections constitute the baseline against which the projections from the alternative scenarios are compared. The Fund's NPV for FY 2025 under the alternative scenarios are presented in Exhibit IV-2. Each alternative scenario is based on a single specified path of HPA, 10-year CMT rate, 1-year CMT rate, and one-year SOFR.

Exhibit IV-2. NPV of HECM under Different Economic Scenarios ($ Million)

Scenarios*	Fiscal Year 2025
Baseline PEA	$7,472
Alternative 1 – Optimistic Upside	$10,707
Alternative 2 - Moderate Upside	$9,742
Alternative 3 – Moderate Downside	$3,768
Alternative 4 – Pessimistic Downside	($3,335)

**Detailed Description of these scenarios is in Appendix E.*

The range of NPV based on the alternative economic scenarios is negative $3.335 billion to positive $10.707 billion. These two values from the optimistic upside and pessimistic downside are two extreme scenarios that are highly unlikely to occur. The NPV from the moderate upside scenario is $9.742 billion and is $3.768 billion from the moderate downside scenario. The Baseline NPV stays between these two numbers from moderate upside and downside scenarios.

FY 2025 Cash Flow NPV estimate provided by FHA is positive $6.334 billion. Based on ITDC's Cash Flow NPV estimate utilizing the Baseline PEA and range of results from the stochastic simulation scenarios, we conclude that the FHA estimate of Cash Flow NPV is reasonable.

Exhibit IV-3 Breakdown of Estimated NPV by Cohort Year for Each Scenario

	Net Present Value of Future Cash Flows ($ Million)				
Endorsement Fiscal Year	Baseline	Alternative - 1 Optimistic Upside	Alternative 2 - Moderate Upside	Alternative 3 - Moderate Downside	Alternative 4 - Pessimistic Downside
2009	205	236	221	190	159
2010	213	255	232	186	152
2011	173	207	189	150	122
2012	152	189	170	129	99
2013	156	198	177	127	87
2014	268	274	271	221	157
2015	533	643	583	444	286
2016	770	987	865	661	439
2017	1,066	1,552	1,297	848	449
2018	569	851	683	413	73
2019	349	365	332	270	52

	Net Present Value of Future Cash Flows ($ Million)				
Endorsement Fiscal Year	Baseline	Alternative - 1 Optimistic Upside	Alternative 2 - Moderate Upside	Alternative 3 - Moderate Downside	Alternative 4 - Pessimistic Downside
2020	1,119	1,593	1,342	788	181
2021	1,122	1,567	1,513	519	(569)
2022	297	1,173	1,195	(928)	(2,975)
2023	272	302	369	(80)	(854)
2024	84	142	138	(102)	(579)
2025	125	174	166	(66)	(616)
Total	7,472	10,707	9,742	3,768	(3,335)

**Fiscal Year NPVs might not sum to the Total NPV due to rounding*

*** Due to the stochastic nature of the simulated interest paths Cohort 2022 and 2023 moderate upside perform better than optimistic upside. At the portfolio level optimistic upside perform 10% better than moderate upside*

E. Sensitivity Tests for Economic Variables and Important Assumptions

The scenario test results revealed that HPI and Interest rates are important economic assumptions driving the NPV. Therefore, sensitivity tests are conducted to demonstrate the magnitude of the impact on the NPV of these two key assumptions: HPA and Interest rates. Exhibit IV-4 demonstrates sensitivity test results.

Each sensitivity test uses a 10% up/down assumption, meaning the baseline assumption vectors for interest rates and house price appreciation are increasing and decreasing by 10 %. For example, if a given HPA is 5% for a specific period, the HPA 10% up scenario would have 5.50% and the HPA 10% down scenario would be 4.50% for the same period; the same process applies to interest rates.

Exhibit IV-4. NPV Change under Different Variable Changes ($ Million)

Description	Down 10%		Baseline	Up 10%	
FY2025 HECM NPV (Baseline)			**7,472**		
House Price Appreciation	7,227	*-3.3%*		7,714	*3.2%*
Interest Rates	7,314	*-2.1%*		7,577	*1.4%*
Cash Draw Down	7,456	*-0.2%*		7,487	*0.2%*
Claim Type 1	7,615	*1.9%*		7,316	*-2.1%*

A 10% decrease in HPA leads to a 3.3% decrease in NPV while a 10% increase in HPA leads to a 3.2% increase in NPV. We see a similar impact for interest rates.

A 10% decrease in interest rates leads to a 2.1% decrease in NPV while a 10% increase in interest rates leads to a 1.4% increase in NPV.

These two economic assumptions are correlated. High interest rates can depress house appreciation, and their impact is compounded and together significantly affect the NPV projection.

A 10% decrease in cash drawdowns leads to a 0.2% decrease in NPV while a 10% increase in cash drawdowns leads to a 0.2% increase in NPV.

A 10% decrease in Claim Type 1s leads to a 1.9% increase in NPV while a 10% increase in Claim Type 1s leads to a 2.1% decrease in NPV.

V. List of Methodological Appendices

This section describes the analytical approach implemented in this Review. Detailed descriptions of the component models for HECMs are provided in Appendices A- G. The following briefly summarizes how we process the data and develop component models in appendices.

Data Reconciliation (Appendix A)

To reconcile the data processed in this review with the data provided by FHA, we compare summaries of key data elements with the summaries provided by FHA. Most of the data processed matches the FHA data totals within 1%. The summaries for the IIF, number of active assignments and the number of claims to date are shown in Appendix A.

HECM Base Termination Model (Appendix B)

No repayment of principal is required on a HECM loan when the loan is active. Termination of a HECM loan typically occurs due to death, relocation, or voluntary termination via refinance or payoff. The termination model estimates the probabilities of three mutually exclusive HECM termination events: mobility, refinance, and mortality. Multinominal logit regression modeling is adopted to capture the competing-risk structure of the different termination events. This is consistent with literature, HECM experience, and the FHA Single Family forward mortgage actuarial review.

Following Szymanoski, DiVenti, and Chow (2000) and Yuen-Reed and Szymanoski (2007), and previous years' Actuarial Review of HECM loans, a competing risk logistic regression or logit model approach is used to estimate the probability of HECM loan termination events. We test the significance of parameters to achieve a parsimonious model that provides goodness-of-fit.

The multinominal logit approach has several benefits. First, logit models eliminate the likelihood of a negative probability for any estimated event. Second, the multinomial approach ensures the event probabilities sum to 100 percent. In other words, a HECM loan can experience only one of the four possible outcomes in any period: relocation, refinance, death, or survival. Third, it captures the zero-sum nature of the different termination events, whereby the increased probability of one risk decreases the probabilities of the other risks.

The termination model adopts four main categories of explanatory variables:

- Fixed initial borrower characteristics: borrower age at origination and gender.
- Fixed initial loan characteristics: expected mortgage interest rate, origination year and quarter, the first month cash draw percentage and the estimated ratio of property value to the local area's median home values at time of origination.

- Dynamic variables based entirely on loan/borrower characteristics: mortgage age (i.e., policy year, mortality rate.)
- Dynamic variables derived by combining loan characteristics with extraneous economic data: interest rates, house price indices (determine the cumulative house price growth), the amount of additional equity available to the borrower through refinancing, and the probability of negative equity.

For each termination event, a separate logit model is estimated based on economic indicators and loan level historical HECM data. The three logit models are then aggregated to estimate the overall termination probabilities for the HECM program, following the approach suggested in Begg and Gray (1984). The logit model for each termination event is unique, including only the variables that impact the occurrence of that event.

Mortality Model

The mortality model estimates the probability that a HECM loan terminates due to the death of the borrower. Social Security Administration mortality data obtained by FHA indicates the date of death of HECM borrowers. The most updated mortality data available for this Review are up to June 2025. Death dates were aligned with a one-year shift before and two-year shift after termination dates to determine which loans terminated due to death; this accounts for possible time lags between the dates of the recorded termination and the actual death.

Cash Draw-Down Model

For estimating future borrower expected cash draws, the HECM model captures each borrower's initial cash draw-down (cash draws within the first month of endorsement) as a proxy for future cash draw patterns. Since cash draw patterns can vary due to an individual borrower's need and payment plan, the entire HECM history (to date) is used to summarize actual borrower draw patterns based on the first month cash draw. The first-month cash draw percentage is divided into 10 buckets with equal width (in an increment of 10%), and the draw patterns by policy year are summarized for each of the ten (10) buckets. The ten-bucket methodology represents how HECM borrowers are drawing the HECM proceeds over policy years. Borrowers who draw a large percentage of their principal limit in their first year tend to draw less in future years. On the other hand, borrowers who draw a small percentage of their principal limit in their first year tend to draw more in future years. When the current UPB reaches the current principal limit, the borrower not on a scheduled payment plan is no longer eligible to draw cash, and cash draw down equals zero (0). The HECM program started to ramp up in 2004, so there is limited empirical data for borrower's cash draws and payment plan changes in out years. To estimate borrower's future cash draws, in addition to the cash draw table, we assume when a borrower is past policy year 20 that all drawable equity is taken or drawn in policy year 20. Sensitivity test on cash draw-down was performed to quantify how alternative draw patterns affect the NPV.

Loan Performance Projections (Appendix C)

The multinominal logit termination model is fitted to the historical data from all endorsed HECM loans from FY 1990 to FY 2025 books-of-business and the historical economic experience through June 30, 2025. Loan-level historical experience obtained from FHA is used to align with key economic predictors of HECM terminations such as changes in house prices and interest rates. The PEA baseline estimates are used for the actuarial central estimate. The Federal Housing Finance Agency (FHFA) Metropolitan Statistical Area (MSA)-level house price appreciation rates and volatility parameters are used when available; otherwise, state-level FHFA data is used.

Using the estimated multinominal logit termination model, we forecast future termination rates for all the loans currently in force, based on all characteristics of the surviving portfolio and forecasts of economic variables. Actual data is used between the time of origination and FY 2025 and forecasted data is used beginning in FY 2026. For future house price appreciation, MSA level forecasts are used for house price appreciation with state level forecasts being used if the MSA level data is not available.

HECM Cash Flow Analysis (Appendix D)

The cash flow model estimates the HECM economic net worth for the FY 2009 to FY 2025 books of business. It projects the net present value of future cash flows for these books-of-business in the FHA insurance portfolio. For existing books-of-business, it estimates cash flows for all surviving loans at the time of this review.

The HECM cash flow model consists of four components: premiums, claims, note holding expenses, and recoveries on projected notes in inventory. Cash flows are discounted according to the cohort specific single effect rates (SERs) supplied by the FHA.

Stochastic Economic Scenarios (Appendix E)

The assumption of these future interest and house price growth rates are the fundamental economic factors that drive future termination rates and HECM loans. To forecast the economic net worths of the MMI HECM portfolio, we use the OMB economic assumptions released in April 2025 as the baseline economic scenario. To illustrate the sensitivity of forecasts to economic uncertainty and other forms of forecast error, stochastic models are conducted to provide the range of the projected economic net worths due to the variations in the economic assumptions.

Comparison of HUD and ITDC Models and Assessment of Vulnerabilities (Appendix F)

As part of the statutory actuarial review process, this report includes an addendum presenting the results of the review of HUD's HECM models. The addendum is provided in the attachments section of this report and includes supplemental documentation and analysis necessary to support enhanced transparency and completeness of the actuarial review.

Tables of Historical and Projected Loan Termination Rates and Loss Severity (Appendix G)

Conditional and cumulative claim and prepayment rates tables by endorsement and policy year.

VI. Qualifications and Limitations

The estimates provided in this review are based on models that are constructed according to certain assumptions, forecasts, and theoretical frameworks. The two models are the econometric model and the cash flow model. In this section, we discuss the limitations and potential constraints of the model estimates.

The econometric model relates the rates of loan termination to several parameters, including borrower characteristics, loan characteristics, and key macroeconomic variables such as house prices and interest rates. It captures the three major competing risks of loan terminations to date: mortality, mobility, and refinance. The impact of these parameters on loan terminations is calibrated using FHA's actual historical experience through a statistical optimization technique known as maximum likelihood estimation. Future termination estimates are determined based on the calibrated model using future loan portfolio characteristics and certain economic assumptions.

The cash flow model estimates the present value of all future cash flows for each book of business. The key inputs to the model are the estimated termination rates from the econometric model, loan characteristics, macroeconomic forecasts, and the cohort specific single effective rates (SERs). The cash flow model also draws on assumptions based on past FHA experience, including lenders' behavior regarding their option to assign as well as borrowers' behavior in drawing cash over the life of the loan.

A. Fundamental Data Limitations

The quality of any model built on historical data is constrained by the scope, availability, and accuracy of the data. Key variables determining market behavior may not be observed or they may be observed with error. Moreover, the theoretical specification of a model may not adequately capture the economic phenomena when there were material changes in market structure, regulatory policy, or technological advancement.

HECM has a relatively short program history. The pilot program began in 1989 and became permanent in 1998 after endorsing only 20,000 loans. The endorsements exceeded 10,000 loans per year in 2002 and reached 100,000 per year in 2007. Unlike the MMI Single Family forward mortgage program only a limited number of HECM loans of long standing have remained in FHA's portfolio. The lack of long-run performance data potentially limits the robustness of the models' predictive capacity for later years.

B. Model Sensitivity to Economic Projections

The financial estimates presented in this review require economic forecasts 75 years into the future. The economic forecasts, including house price appreciation and interest rate trends are from the PEA. The extent to which the realized experience differs from these model assumptions will affect how close our current estimates will be to the realized results in the future.

Due to the long-term nature of HECM cash flows, the estimates of economic net worth are very sensitive to future economic projection assumptions. Unlike the MMI Single Family forward mortgages, whose claim and recovery cash flows typically occur within the first seven years following loan origination, the majority of HECM cash flows occur in later policy years. Hence, the present value of HECM cash flows is particularly sensitive to long-term assumptions. As the interest rate environment changes, the uncertainty in the future economic environment will have a dramatic impact on the future cash flows.

C. Changing Reverse Mortgage Market Landscape

Regulatory updates, evolving demographics, economic conditions, and consumer preferences, unclear interest rate and housing market will contribute to the changing landscape of the HECM market. Changes in financial markets, retirement needs, and long-term care needs will affect borrowers' participation in the HECM program, how they use HECM loans, and the innovation in product design. This will affect the loan termination and performance of current loans.

On August 4, 2014, HUD adjusted the HECM program by allowing non-borrowing spouses younger than 62 years old. This adjustment was accompanied by reductions in the PLFs for this younger age group, while extending the eligibility of the HECM program to a larger clientele population. LESA, announced in 2015, introduced additional guidelines and assumptions for handling T&I defaults. In 2017, the MIP structure was simplified to have an annual MIP rate of 0.5 percent regardless of the amount of the mortgagor's initial draw at loan closing.

Lastly, Congress has constantly increased the loan limit every year since 2018, and the current loan limit has been raised to $1,209,750 in 2025. The continuation of the higher loan limit might attract current borrowers to refinance their current HECM to get access to home equity. As a result, the actual loan termination rates might be different from the estimate presented in this review.

Acknowledgement

ITDC acknowledges the authors and organizations responsible for the referenced reports, namely the 2022, 2016, and 2010 Actuarial Review, which have been instrumental in informing and enhancing our analysis.

References

1. Begg, C. B. and Gray, R. (1984). Calculation Of Polychotomous Logistic Regression Parameters Using Individualized Regressions. *Biometrika* (71)
2. Bera, A. K., and Higgins, M. L. (1993). ARCH Models: Properties, Estimation and Testing, *Journal of Economic Surveys,* 7, 305-366.Bollerslev, T. (1986).
3. Generalized Autoregressive Conditional Heteroskedasticity, *Journal of Econometrics*, 31, 307-327.
4. Ginnie Mae. (2024). *Fiscal Year 2024 Annual Report.* Washington, DC: U.S. Department of Housing and Urban Development. Retrieved from https://www.ginniemae.gov/about_us/what_we_do/Annual_Reports/annual_report24.pdf
5. HECM World**.** (2025, January 20). *Ginnie Mae HMBS 2.0 update: Implementation progress and outlook.* Retrieved from https://hecmworld.com/2025/01/20/blog-ginnie-mae-hmbs20-update
6. Minhas, A. M. K., Fudim, M., Michos, E. D., & Abramov, D. (2024). Has mortality in the United States returned to pre-pandemic levels? An analysis of provisional 2023 data. *Journal of Internal Medicine*, *296*(2), 168-176.
7. Mortality Tables for Determining Present Value Under Defined Benefit Pension Plans, A Proposed Rule by the Internal Revenue Service on 04/28/2022, available at https://www.soa.org/globalassets/assets/files/resources/experience-studies/2019/pri-2012-mortality-tables-report.pdf.
8. Murphy S.L., Kochanek K.D., Xu J.Q., Arias E. (2024) *Mortality in the United States, 2023*. NCHS Data Brief, no 521. Hyattsville, MD: National Center for Health Statistics. 2024. DOI: https://dx.doi.org/10.15620/cdc/170564
9. Nugroho, D. B., Priyono, A., & Susanto, B. (2021). Skew normal and skew student-t distributions on GARCH (1, 1) model. *Media Statistika*, 14(1), 21-32.
10. Glasserman, P. (2004), *Monte Carlo Methods in Financial Engineering*, Springer.
11. FHA Actuarial Review of the Mutual Mortgage Insurance Fund, available at https://www.hud.gov/program_offices/housing/rmra/oe/rpts/actr/actrmenu
12. HECM Homepage, available at https://www.hud.gov/program_offices/housing/sfh/hecm/hecmhome
13. U.S. Department of Housing and Urban Development, Office of Housing. *Report to the Commissioner on Post-Sale Report Library: HUD-Held Vacant Loan Sales (HVLS) and HUD-Held Non-Vacant Loan Sales (HNVLS).* Version 4, Mar. 2025, Washington, DC. Available at

https://www.hud.gov/sites/dfiles/Housing/documents/HVLS_HNVLS_CReport_Library_March_2025v4.pdf
14. U.S. Department of Housing and Urban Development, Office of Asset Sales. (2022, March). *Report to the Commissioner on Post Sale Reporting: HUD-Held Vacant Loan Sales for Home Equity Conversion Mortgages.* U.S. Department of Housing and Urban Development. Available at https://www.hud.gov/sites/dfiles/Housing/images/HVLSCReport_March2022_%20withhogar1_4.5.2022v2.pdf
15. Mortgagee Letters, available at https://www.hud.gov/program_offices/administration/hudclips/letters/mortgagee
16. Mayer, C., & Moulton, S. (2022). The market for reverse mortgages among older Americans. *New Models for Managing Longevity Risk: Public-Private Partnerships*, 258-300.
17. Selecting and Documenting Mortality Assumptions for Pensions American Academy of Actuaries Pension Committee, available at https://www.actuary.org/sites/default/files/files/Mortality_PN_060515_0.pdf
18. Summary of the ARRC's Fallback Recommendations October 6, 2021, available at https://www.newyorkfed.org/medialibrary/Microsites/arrc/files/2021/spread-adjustments-narrative-oct-6-2021
19. TITLE II of the Cranston-Gonzalez National Affordable Housing Act, available at https://www.hud.gov/sites/documents/19576_HOMELAWS.PDF
20. Zivot, E. (2009). Practical issues in the analysis of univariate GARCH models. In Handbook of financial time series (pp. 113-155). Berlin, Heidelberg: Springer Berlin Heidelberg.
21. U.S. Department of Housing and Urban Development (HUD). (2024). *Fiscal Year 2024 Annual Report to Congress Regarding the Financial Status of the Mutual Mortgage Insurance Fund.* Washington, DC. Retrieved from https://www.hud.gov/sites/dfiles/Housing/documents/2024FHAAnnualReportMMIFund.pdf

Appendix A. HECM Data Reconciliation

Data reconciliation is a very important step to ensure the accuracy of the model and the estimation results. To reconcile the data processed with the data provided by FHA, we compared summaries of key data elements with the summaries provided by FHA. The number of active loans, summaries for the IIF (based on UPB), number of active assignments, and the number of claims to date are shown in the following tables. The reconciliation tables are based on data as of September 30, 2025. Most of the data processed matches the FHA data totals, with immaterial differences centered on early years for number of active loans and number of claims.

Exhibit A-1: Data Reconciliation for Number of Active Loans

Credit Subsidy Cohort	Federal Housing Administration	Data Reconciliation: Independent Actuary	Difference (Actuary - FHA)	Percent Difference (Actuary - FHA) / FHA
2009	29,687	30,917	1,230	4%
2010	22,984	24,399	1,415	6%
2011	23,366	24,470	1,104	5%
2012	18,700	19,485	785	4%
2013	21,679	22,335	656	3%
2014	16,046	16,168	122	1%
2015	19,321	19,386	65	0%
2016	17,436	17,489	53	0%
2017	21,882	21,922	40	0%
2018	18,612	18,621	9	0%
2019	12,084	12,084	-	0%
2020	20,289	20,291	2	0%
2021	32,167	32,168	1	0%
2022	53,577	53,577	-	0%
2023	27,595	27,595	-	0%
2024	23,754	23,754	-	0%
2025	27,527	27,527	-	0%
Total	**406,706**	**412,188**	**5,482**	**1%**

Exhibit A-2: Data Reconciliation for Insurance-in-Force (based on UPB) ($ Million)

Credit Subsidy Cohort	Federal Housing Administration	Independent Actuary	Difference (Actuary - FHA)	Percent Difference (Actuary - FHA) / FHA
2009	$1,650	$1,651	$1	0%
2010	$1,087	$1,090	$3	0%
2011	$931	$932	$1	0%
2012	$735	$737	$2	0%
2013	$829	$829	$0	0%
2014	$1,271	$1,272	$1	0%
2015	$1,950	$1,947	($3)	0%
2016	$2,095	$2,038	($57)	-3%
2017	$3,474	$3,387	($87)	-3%
2018	$3,602	$3,524	($78)	-2%
2019	$2,310	$2,262	($48)	-2%
2020	$4,795	$4,726	($69)	-1%
2021	$8,876	$8,790	($86)	-1%
2022	$16,007	$15,883	($124)	-1%
2023	$5,956	$5,887	($69)	-1%
2024	$4,334	$4,299	($35)	-1%
2025	$4,502	$4,488	($14)	0%
Total	**$64,404**	**$63,740**	**($664)**	**-1%**

Exhibit A-3: Data Reconciliation for Number of Active Assignments

Credit Subsidy Cohort	Federal Housing Administration	Independent Actuary	Difference (Actuary - FHA)	Percent Difference (Actuary - FHA) / FHA
2009	24,630	25,857	1,227	5%
2010	19,941	21,338	1,397	7%
2011	20,343	21,444	1,101	5%
2012	16,294	17,069	775	5%
2013	18,669	19,323	654	4%
2014	10,163	10,283	120	1%
2015	10,619	10,684	65	1%
2016	8,302	8,350	48	1%
2017	7,263	7,302	39	1%
2018	1,757	1,766	9	1%
2019	11	11	0	0%
2020	19	19	0	0%
2021	10	10	0	0%
2022	2	2	0	0%
2023	0	0	0	0%
2024	0	0	0	0%
2025	0	0	0	0%
Total	**138,023**	**143,458**	**5,435**	**4%**

Exhibit A-4: Data Reconciliation for Claims to Date

Credit Subsidy Cohort	Federal Housing Administration	Independent Actuary	Difference (Actuary - FHA)	Percent Difference (Actuary - FHA) / FHA
2009	68,916	68,916	0	0%
2010	49,910	49,909	-1	0%
2011	43,323	43,322	-1	0%
2012	31,522	31,522	0	0%
2013	32,163	32,163	0	0%
2014	14,109	14,109	0	0%
2015	13,701	13,701	0	0%
2016	10,367	10,367	0	0%
2017	8,660	8,659	-1	0%
2018	2,189	2,189	0	0%
2019	59	59	0	0%
2020	52	51	-1	-2%
2021	53	53	0	0%
2022	53	53	0	0%
2023	8	8	0	0%
2024	2	2	0	0%
2025	-	0	-	0%
Total	**275,087**	**275,083**	**-4**	**0%**

Appendix B. HECM Base Termination Model

This appendix describes the base termination model used to estimate the historical and future performance of HECM loans. Each loan can terminate for one of three reasons: mobility, refinance, and mortality. A multinomial logit model was created for these competing risks. Each type of termination is modeled by a separate logit model. The probability of termination from each model was then aggregated to estimate the probability that a particular loan would terminate in any policy year.

The base termination model is estimated based on all the historical HECM termination and survivorship data, which includes HECM mortgages that were endorsed under the General Insurance (GI) Fund between Fiscal Years 1990 and 2008, and mortgages endorsed under the MMI Fund from Fiscal Year 2009 through June30, 2025. The change from the GI Fund to MMI Fund has been a transparent process to the lenders and borrowers and we assume it has no impact on loan termination behavior.

B1. The Multinomial Logistic Model

Begg and Gray (1984) showed that it is statistically equivalent to model a multinomial logit regression model as an aggregation of individually estimated binomial logit regression models. Specifically, the parameters are first determined in individual multinomial logit regression model per risk. The models are then aggregated to estimate the total likelihood of termination. This methodology requires that all risk outcomes are compared to each other in separate logit models.

For HECM termination modeling, this means that active loans are compared to mobility terminations, refinance terminations, and mortality terminations to create three individual model specifications. These risks are then combined to create a single competing risk model. This approach allows us to effectively account for the censoring effect of one termination outcome on the other two potential outcomes. For example, when a loan was terminated due to a relocation, we can account for its censoring effect of the other two termination outcomes, which are refinance and death.

Each individual termination model specification estimates the conditional probability that a loan will terminate due to one of three reasons: mortality ($P_D(t)$), refinance ($P_R(t)$), and mobility (($P_M(t)$). The mathematical expressions that correspond to each of these three risks are given by:

$$P_D(t) = \frac{e^{\alpha_D + X_D(t)\beta_D}}{1 + e^{\alpha_D + X_D(t)\beta_D} + e^{\alpha_R + X_R(t)\beta_R} + e^{\alpha_M + X_M(t)\beta_M}}$$

$$P_R(t) = \frac{e^{\alpha_R + X_R(t)\beta_R}}{1 + e^{\alpha_D + X_D(t)\beta_D} + e^{\alpha_R + X_R(t)\beta_R} + e^{\alpha_M + X_M(t)\beta_M}}$$

$$P_M(t) = \frac{e^{\alpha_M + X_M(t)\beta_M}}{1 + e^{\alpha_D + X_D(t)\beta_D} + e^{\alpha_R + X_R(t)\beta_R} + e^{\alpha_M + X_M(t)\beta_M}}$$

The constant terms α_D, α_R, and α_M as well as the coefficient vectors β_D, β_R, and β_M are the unknown parameters that are estimated by the multinomial logit model. The subscripts "D", "R" and "M" denote mortality, refinance, and mobility, respectively. The vectors of dependent variables for predicting the conditional probability of termination due to mortality, refinance, and mobility are represented by $X_D(t)$, $X_R(t)$and $X_M(t)$, respectively. There are several economic, loan, and borrower characteristics used in each vector to predict HECM terminations. Some of these components are held constant over the life of the loan while others may vary over time *(t).*

To classify historic terminations between the three possible outcomes, we first identified the terminations that resulted in refinances based on FHA's endorsement records. The remaining terminations are cross referenced with the Social Security Administration's mortality data provided by FHA. If a loan terminated within one year prior and two years after the borrower's recorded death date, the loan is considered to terminate due to death. The remaining terminations are considered as mobility terminations.

B2. Death Termination Model

B2.1. Model Specification

The death termination model estimates the probability that a HECM loan terminates due to the death of the borrower. Social Security Administration mortality data obtained by FHA indicates the date of death of HECM borrowers and co-borrowers. We obtained the most updated mortality data up to June 2025 from the Social Security Administration data provided by FHA to determine the date of death for HECM borrowers. Death dates were aligned with termination dates to determine which loans terminated due to death.

In contrast to the mobility and refinance model, the mortality model does not include economic or loan characteristics. The three major factors in forecasting death terminations are mortality rates, gender, and policy year.

The *GenderSpecificMortality* variable is used as the base mortality. It is based on the Pri-2012 Life Table, the most recent available gender-specific private retirement plan mortality table published in 2019. IRS in government publication Federal Register suggests the usage of Pri-2012 Life Table for defined benefit pension plans. HECM borrowers' mortality is lower than the general population and HECM loan is close to products of post-retirement benefit.

Pri-2012 mortality table has the base year of 2012, so we use the most recently released mortality improvement scales published by the Society of Actuaries to project it to CY 2019 to consider mortality improvement and longevity risk. At the same time, CDC provisional 2024 data analysis and peer-reviewed research, for example, Murphy et al. (2024), show that the U.S. age-adjusted death rate declined roughly back to pre-pandemic levels from the 2021 peak associated with the COVID-19 pandemic but remain above the pre-pandemic baseline. We therefore apply mortality improvement scales up to CY 2019. This application follows Actuarial Standard of Practice

(ASOP) No. 35. The overall mortality rates used in 2025 are still lower than the Decennial Life Table 1999-2001 used in previous annual review reports.

GenderSpecificMortality based on the baseline mortality table is computed as the conditional mortality rate for single life and joint lives in the case of co-borrowers. Gender and age specific mortality rate in the reference mortality tables is used. In the case of a couple, the conditional gender and age specific mortality rate is computed as the deferred failure rate of last survivor status. Mathematically,

$$GenderSpecificMortality = \begin{cases} {}_{t|}q_x & , \quad for\ a\ single\ borrower, age\ x\ at\ origination \\ {}_{t|}q_{\overline{xy}} & , \quad for\ coupled\ borrowers, age\ x\ and\ y\ at\ origination \end{cases}$$

where ${}_{t|}q_x = {}_{t+1}q_x - {}_{t}q_x = \frac{l_{x+t+1-}l_{x+t}}{l_x}$, and l_x is life index in the age specific life table constructed using the reference mortality table. ${}_{t|}q_{\overline{xy}} = {}_{t+1}q_{\overline{xy}} - {}_{t}q_{\overline{xy}}$, and ${}_{t}q_{\overline{xy}} = {}_{t}q_x\,{}_{t}q_y$ assuming coupled lives are independent of each other.

The last survivor mortality rate for a couple might be different from the mortality under independence assumptions for joint lives. The dummy variable *Gender_Couple* for couples is included to capture the unique characteristics for loans with more than one borrower.

After implementing the new formula for coupled borrowers, a dummy variable for whether the younger borrower or coborrower is male is kept from Actuarial Review 2024 after being tested for significance, while age difference variable is removed due to insignificance. The dummy variable is to capture the possible discrepancy between the last survivor mortality rate and the mortality rate that we use as the base mortality rate for a couple.

The spline variables *Pol_yr_di* for *i* =1, 2,…, 5, are used to account for the effect of loan age on the mortality termination. HECM loans have been endorsed over the past 34 years, but most of the loans were endorsed in the last 21 years. Due to the limited number of loan observations in late policy years, the estimation sample was restricted to observations that are shorter than policy year 21.

$$\text{Pol\_yr\_d1} = \begin{cases} Loan\ age, & if\ Loan\ age\ \le K_1 \\ K_1 \quad , & if\ Loan\ age\ > K_1 \end{cases},$$

$$\text{Pol\_yr\_d2} = \begin{cases} 0 & , \quad if\ Loan\ age\ \le K_1 \\ Loan\ age\ - K_1 & , \quad if\ K_1 < Loan\ age\ \le K_2, \\ K_2 - K_1 & , \quad if\ Loan\ age\ > K_2 \end{cases}$$

$$\text{Pol\_yr\_d3} = \begin{cases} 0 & , \quad if\ Loan\ age\ \le K_2 \\ Loan\ age\ - K_2 & , \quad if\ K_2 < Loan\ age\ \le K_3, \\ K_3 - K_2 & , \quad if\ Loan\ age\ > K_3 \end{cases}$$

$$Pol\_yr\_d4 = \begin{cases} 0 & , \quad if\ Loan\ age \leq K_3 \\ Loan\ age - K_3 & , \quad if\ K_3 < Loan\ age \leq K_4, \\ K_4 - K_3 & , \quad if\ Loan\ age > K_4 \end{cases}$$

$$Pol\_yr\_d5 = \begin{cases} 0 & , \quad if\ Loan\ age \leq K_4 \\ Loan\ age - K_4 & , \quad if\ Loan\ age > K_4 \end{cases},$$

where $K_1 = 2$, $K_2 = 4$, $K_3 = 11$, and $K_4 = 19$. These kinks are selected based on empirical mortality termination rates by loan age.

Historical HECM experience suggests that borrowers who experience heavier mortality than the baseline actuarial table seem to have a higher first month draw-down of their total eligible draw amount. We did empirical life test analysis of death termination by the variable first month cash draw-down and found the pattern is not monotonic. Therefore, we define spline variables $FM\_cashdd\_D\ i$ for i =1, 2, 3, and 4, to capture borrowers' self-selection at different first month cash draw-down level. The kinks for the spline function of FM_cashdd are $K_1 = 0{,}5$, $K_2 = 0.6$, and $K_3 = 0.8$, following the empirical data analysis. Using splines of first month draw-down slightly improves death termination model's performance.

One dummy variable *TermLOC_Loan* is for the Term product to reflect additional self-selection effect. The dummy variable is included to consider the impact of Covid-19 on mortality during the pandemic. 2020 and 2021 are identified as the pandemic period according to the sharp increase in mortality termination as shown in termination finger table.

B2.2. Model Estimation

Exhibit B-1 presents the estimated parameters of the binomial logit regression model for death termination and the model performance measures.

Exhibit B-1: Death Termination Model Estimation

Analysis of Maximum Likelihood Estimates					
Description	**Parameter**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
	Intercept	-7.1589	0.0292	60106.39	<.0001
Policy Year	**Pol_yr_d1**	1.5662	0.0152	10656.55	<.0001
	Pol_yr_d2	0.0949	0.00395	577.2721	<.0001
	Pol_yr_d3	0.0395	0.00102	1506.516	<.0001
	Pol_yr_d4	-0.0181	0.00135	180.0742	<.0001
	Pol_yr_d5	0.2079	0.0169	151.0136	<.0001
1st Month Cash Draw	**FM_cashdd_D1**	0.4544	0.0197	531.2255	<.0001
	FM_cashdd_D2	-1.6326	0.0969	283.5968	<.0001
	FM_cashdd_D3	-0.5356	0.0542	97.4953	<.0001
	FM_cashdd_D4	-1.5136	0.0527	823.3919	<.0001

Analysis of Maximum Likelihood Estimates					
Description	**Parameter**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Mortality Rates	**mortality_rate_speci**	10.6002	0.0304	121550	<.0001
Term Product with Line of Credit	**TermLOC_Loan**	0.1394	0.00864	260.4137	<.0001
Coupled borrowers	**Gender_Couple**	-0.7818	0.00732	11410.62	<.0001
Covid-19 Period	**Covid_Yr**	0.0234	0.00607	14.8279	0.0001
Younger male borrower	**MYID**	0.0947	0.00845	125.4924	<.0001

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	76.3	Somers' D	0.548
Percent Discordant	21.5	Gamma	0.561
Percent Tied	2.2	Tau-a	0.029
Pairs	2.70E+12	c	0.774

High concordance (76.3% well above 50%) suggests good discriminative ability. Somers' D = 0.548 indicates a moderately strong positive association between predictions and actual outcomes. Gama=0.546 confirms good predictive ordering. The c-statistics of 0.774 (AUC score) confirms the model has solid predictive power.

B3. Refinance Model

B3.1. Model Specification

The refinance logit regression model incorporates loan age, borrower related variables, economic variables, and other variables that are tested to be significant.

B3.1.1. Loan Age Variables for the Refinance Model

Prior HECM experience shows that most refinances occur after the first few years of the loan. The variables *PolicyYear*. The series of piece-wise linear spline functions for loan age are defined as follows.

$$Pol\_{yr1} = \begin{cases} Loan\ age, & if\ Loan\ age\ \leq K_1 \\ K_1\ , & if\ Loan\ age\ > K_1 \end{cases},$$

$$Pol\_{yr2} = \begin{cases} 0 & , & if\ Loan\ age\ \leq K_1 \\ Loan\ age\ - K_1 & , & if\ K_1 < Loan\ age\ \leq K_2, \\ K_2 - K_1 & , & if\ Loan\ age\ > K_2 \end{cases}$$

$$Pol\_{yr3} = \begin{cases} 0 & , & if\ Loan\ age\ \leq K_2 \\ Loan\ age\ - K_2 & , & if\ K_2 < Loan\ age\ \leq K_3, \\ K_3 - K_2 & , & if\ Loan\ age\ > K_3 \end{cases}$$

$$Pol_{\_yr4} = \begin{cases} 0 & , \quad if\ Loan\ age\ \leq K_3 \\ Loan\ age\ - K_3 & , \quad if\ K_3 < Loan\ age\ \leq K_4, \\ K_4 - K_3 & , \quad if\ Loan\ age\ > K_4 \end{cases}$$

$$Pol_{\_yr5} = \begin{cases} 0 & , \quad if\ Loan\ age\ \leq K_4 \\ Loan\ age - K_4 & , \quad if\ Loan\ age\ > K_4 \end{cases},$$

where $K_1 = 4$, $K_2 = 8$, $K_3 = 13$, and $K_4 = 18$

Coefficient estimates for each variable are the slopes of the line segments between individual knot points. The overall generic *PolicyYear* function for the five *Pol_yr* segments is given by:

$$PolicyYear = \beta_1 \times Pol_{\_yr1} + \beta_{2\times} Pol_{\_yr2} + \beta_3 \times Pol_{\_yr3} + \beta_4\ \times Pol_{\_yr4} + +\beta_5\ \times Pol_{\_yr5}$$

B3.1.2. Borrower-Related Variables for the Refinance Model

The variables *OriginationAge* and Gender are the two borrower characteristics in the refinance model. *OriginationAge* is the borrower's age at endorsement and is held constant for the life of the loan, because historical experience suggests that older borrowers are less likely to refinance. We use the following piece-wise linear spline functions for piece-wise linear spline functions *OriginationAge.*

$$Orig\_Age_1 = \min(\ OriginationAge, 62)$$

$$Orig\_Age_2 = \begin{cases} 0 & , \quad if\ OriginationAge\ \leq 62 \\ OriginationAge\ - 62 & , \quad if\ 64 < OriginationAge\ \leq 64, \\ 64 - 62 & , \quad if\ \ OriginationAge\ > 64 \end{cases}$$

$$Orig\_Age_3 = \begin{cases} 0 & , \quad if\ OriginationAge\ \leq 64 \\ OriginationAge\ - 62 & , \quad if\ 64 < OriginationAge\ \leq 81, \\ 81 - 64 & , \quad if\ \ OriginationAge\ > 81 \end{cases}$$

$$Orig\_Age_4 = \begin{cases} 0 & , \quad if\ OriginationAge\ \leq 81 \\ OriginationAge\ - 81 & , \quad if\ 81 < OriginationAge\ \leq 87, \\ 87 - 71 & , \quad if\ \ OriginationAge\ > 87 \end{cases}$$

$$Orig\_Age_5 = \begin{cases} 0 & , if\ OriginationAge\ \leq 87 \\ OriginationAge - 87 & , if\ OriginationAge\ > 87 \end{cases}$$

Current loan to value $CLTV$ also affects refinance decision. The following spline functions are used.

$$CLTV_1 = \begin{cases} CLTV, & if\ CLTV \le 0.5 \\ 0.5\ , & if\ CLTV > 0.5 \end{cases},$$

$$CLTV_2 = \begin{cases} 0 & , \quad if\ CLTV \le 0.5 \\ CLTV - 0.5 & , \quad if\ 0.5 < CLTV \le 0.8, \\ 0.3 & , \quad if\ CLTV > 0.8 \end{cases}$$

$$CLTV_3 = \begin{cases} 0 & , \quad if\ CLTV \le 0.8 \\ CLTV - 0.8 & , \quad if\ CLTV > 0.8 \end{cases}$$

The likelihood of refinancing is also affected by the cash draw utilization of the borrower and type of loan. An analysis of the data suggests that the cash draw is a positive predictor of the likelihood of future refinances. One dummy variable *LOC_Loan* for the line of credit product is used to reflect additional self-selection effect.

B3.1.3. Economic Variables for the Refinance Model

To further explain the behavior of HECM borrowers' willingness and ability to refinance a loan, the refinance incentive measure was created. The refinance incentive measure represents the net increase in principal limit for a borrower given the costs associated with refinancing. Equation 5 depicts the refinance incentive measure calculation.

$$rft_t = \frac{\min(MCA_0 * \Delta H, LoanLimit_t) * PFL_t - C - PL_t}{C}$$

where MCA_0 = Original maximum claim amount for loan at time 0; $\Delta H = \frac{HPI_t}{HPI_O}$ if HPI is the FHFA house price index per MSA (or state if loans are outside of an MSA); $LoanLimit_t$= FHA loan limit for time t; PLF_t= New principal limit factor for the borrower's age and the current interest rate at time *t*; C = Transaction cost to originate the refinanced loan; PL_t= Gross principal limit on the original HECM loan at time *t*. Two spline variables are defined in the model based on rft_t.

$$RFT_1 = \min(rft_t, 0) \text{ and } RFT_2 = \max(rft_t, 0)$$

B3.1.4. Other Variables for the Refinance Model

Three new variables introduced in 2024 Actuarial Review to the termination model are kept: age difference between borrower and coborrower, a dummy variable for whether the younger borrower or coborrower is male, and a dummy variable for the Covid-19 pandemic period. The significance of three new variables is verified based on the AIC, BIC, and likelihood ratio test results.

B3.2. Model Estimation

Exhibits B-2 presents the estimated parameters of the binomial logit regression model for refinance termination and the model performance measures.

Exhibit B-2: Refinance Termination Model Estimation

Analysis of Maximum Likelihood Estimates					
Description	**Parameter**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
	Intercept	-5.5008	0.0181	91997	<.0001
Policy Year	**Pol_yr_r1**	0.4146	0.00312	17704.23	<.0001
	Pol_yr_r2	-0.2928	0.00248	13963.75	<.0001
	Pol_yr_r3	-0.1007	0.00305	1088.975	<.0001
	Pol_yr_r4	0.2119	0.00483	1920.804	<.0001
	Pol_yr_r5	0.2018	0.0208	94.2084	<.0001
Age at Loan Origination	**Orig_Age1**	0.0564	0.00508	123.1834	<.0001
	Orig_Age2	0.0182	0.000469	1509.127	<.0001
	Orig_Age3	0.0121	0.00414	8.5516	0.0035
	Orig_Age4	-0.2574	0.00913	794.3469	<.0001
	Orig_Age5	-0.1052	0.00715	216.1861	<.0001
Borrower's Gender	**Gender_Couple**	0.5626	0.00613	8426.725	<.0001
	Gender_Female	0.1134	0.00851	177.6742	<.0001
Cash Drawdown Percentage	**cdd_bucket**	1.4448	0.0259	3100.522	<.0001
Line of Credit	**LOC_Loan**	-8.1142	0.0415	38277.23	<.0001
Current LTV	**CLTVR1**	-3.5429	0.1627	474.0681	<.0001
	CLTVR2	0.0342	0.000716	2277.901	<.0001
	CLTVR3	0.2047	0.00187	12043.46	<.0001
Age at Loan Origination	**RFI_1**	0.2931	0.00689	1811.864	<.0001
	RFI_2	0.00842	0.000976	74.4285	<.0001
Covid-19 Period	**Covid_Yr**	0.0725	0.00787	84.8789	<.0001
Age Difference	**FMAd**	-5.5008	0.0181	91997	<.0001
Younger male borrower	**MYID**	0.4146	0.00312	17704.23	<.0001

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	76.9	**Somers' D**	0.564
Percent Discordant	20.5	**Gamma**	0.579
Percent Tied	2.6	**Tau-a**	0.019
Pairs	1.63E+12	**c**	0.782

High concordance (76.9% well above 50%) suggests good discrimination ability. Somers' D = 0.564 indicates a moderately strong positive association between predictions and actual outcomes. Gama=0.579 confirms good predictive ordering. The c-statistics of 0.782 (AUC score) confirms the model has solid predictive power.

B4. Mobility Model

B4.1. Model Specification

The mobility model is for the probability that a HECM loan terminates due to the borrower moving out and paying off the loan. Factors such as borrower characteristics, economic factors, and loan specific variables are examined to define the final model specification.

B4.1.1. Loan Age Variables for the Mobility Model

As before, the *PolicyYear* is a series of piece-wise linear functions for loan age, but with different knot points in this mobility model, to make the model better fit the data. For mobility model, k1=3, k2=11, and k3=17.

B4.1.2 Borrower-Related Variables for the Mobility Model

Borrower specific characteristics are also key drivers of move-out likelihood. Historical experience suggests that gender-specific mortality rates and gender are two major determining factors.

The *Mortality* variable is used to capture the borrower's mobility based on age-related issues, including health reasons, moving to a nursing home or to an assisted-living facility, or to live with their children. *Mortality_rate_specific* is redefined for a single borrower and coupled borrowers.

Using the new definition of *Mortality_rate_specific*, the *Gender* categorical variable is included to reflect the observation that couples and females are less likely to move-out than males.

A loan-type dummy variable *Term_loan* is included. The pure Term loans seem to have mobility rates greater than for the Term loans with a LOC, which may indicate a self-selection effect for borrowers with different mobility preferences.

B4.1.3 Economic Variables for the Mobility Model

Historical experience suggests that faster house price appreciation increases the likelihood of relocation. Moreover, move-out is more likely when the one-year Treasury rate increases, which accelerates the rate of loan balance growth. Quarterly house price appreciation data is from Moody's Analytics (Moody) house price Index (HPI) at the MSA (or state if the loan is located outside of an MSA) level. *Marginal_HPI_Change* variable captures the change in the home value that motivates move-out.

The *hp_above_med* variable, which estimates the ratio of appraised property value at origination to median value in the local area, is added to this year's review. The local median house price data is attained from Moody at the MSA and state level, with the most granular level available being used for each property. This variable intends to capture the implicit differences in relocation behavior of borrowers whose homes have higher relative values than that of borrowers whose homes have lower relative values.

The distributions of individual home values are estimated based on the house price drift and volatility parameters based on FHFA House Price Indices (HPIs). The parameters a and b represent the variability of home values within a geographical area, which are specific to MSA and state. The parameter c represents the variability of home values over time, which is also specific to MSA and state. These parameter values are provided by FHA.

Historical data on interest rates is obtained from Moody's. *OneYrCmt_bucket1* and *OneYrCmt_bucket3* are defined based on the change in one-year CMT rate.

*OneYrCMT_Change = (curr_OneYrRate-last_OneYrRate)/last_OneYrRate*100*

OneYrCmt_bucket1 indicates if *OneYrCMT_Change* is less than -10 and *OneYrCmt_bucket3* is for *OneYrCMT_Change* is greater than 10.

After implementing the new mortality rates for coupled lives, the new variable FMAD, which is the age difference between borrower and coborrower, is kept based on its significance and collinearity with other variables.

B4.2. Model Estimation

Exhibits B-3 presents the estimated parameters of the binomial logit regression model for mobility termination and the model performance measures.

Exhibit B-3: Mobility Termination Model Estimation

Analysis of Maximum Likelihood Estimates					
Description	**Parameter**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
	Intercept	-8.6511	0.1921	2027.799	<.0001
Policy Year	**Pol_yr_nr1**	0.718	0.00461	24260.93	<.0001
	Pol_yr_nr2	0.0681	0.00091	5604.58	<.0001
	Pol_yr_nr3	-0.0313	0.00167	352.1714	<.0001
	Pol_yr_nr4	0.2082	0.00672	960.1096	<.0001
Age at Origination	**Orig_NR_Age1**	0.0414	0.00309	179.6755	<.0001
	Orig_NR_Age2	0.0433	0.000521	6894.076	<.0001
	Orig_NR_Age3	0.041	0.00228	323.8743	<.0001
Term Loan	**Term_Loan**	0.1964	0.0168	136.4736	<.0001
Borrower Gender	**Gender_Couple**	-0.047	0.00654	51.5919	<.0001
	Gender_Female	-0.0242	0.00553	19.1122	<.0001
1-Year HPI Change	**Marginal_HPI_Change**	1.7469	0.0284	3770.956	<.0001
One Year CMT rate	**OneYrCmt_bucket1**	-0.1287	0.00693	344.537	<.0001
	OneYrCmt_bucket3	0.1183	0.00662	319.54	<.0001
	mortality_rate_speci	1.3168	0.0798	272.0744	<.0001

Analysis of Maximum Likelihood Estimates					
Description	**Parameter**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Current LTV	**CLTVR1**	-0.4832	0.0198	597.4912	<.0001
	CLTVR2	-2.1056	0.019	12242.23	<.0001
First Month Cash Draw Percentage	**FM_pct_cashdd**	0.3306	0.00752	1933.758	<.0001
Appraised Value to Area Median House Price at Origination	**hp_above_med**	0.0884	0.00367	580.6638	<.0001
Loans before 2004	**Pre2004_Loan**	0.8044	0.00626	16537.21	<.0001
Covid-19 Period	**Covid_Yr**	0.2011	0.00629	1024.04	<.0001
Age Diffence	**FMAd**	0.0142	0.000691	423.4519	<.0001

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	67.8	**Somers' D**	0.381
Percent Discordant	29.7	**Gamma**	0.391
Percent Tied	2.5	**Tau-a**	0.024
Pairs	3.30E+12	**c**	0.69

The logistic regression model predicting mobility termination demonstrated fair discriminative ability, with 67.8% concordant pairs and a c-statistic (AUC) of 0.69. Somers' D (0.38) indicated a moderate positive association between predicted probabilities and observed outcomes. Overall, the predictive accuracy is moderate, which is reasonable given that the decision to permanently move out can be influenced by subjective, individual-specific factors that are difficult to capture in quantitative models.

B5. Model Validation

The data from 2009-2025 is randomly split into two sets: 80% of the data becomes the training data and 20% of the data is used as validation data. A uniform random variable between 0 and 1 is generated, and a case is put into the training dataset if a number less than 0.8 is generated and goes to the validation dataset otherwise. Model validation was accomplished by estimating the models using the training data set and applying the fitted model to the validation dataset.

Model validation is required to comply with Actuarial Standards of Practice 23 (Data Quality) and 56 (Modeling). ASOP 23 applies when an actuary is selecting, using, or relying on data provided by others, all of which are relevant to our review of MMI Fund performance. ASOP 56 provides guidance on designing, developing, selecting, modifying, and using models when performing actuarial services. We have employed models that are used for actuarial review of HECM since 2010. As such, the models we use are the culmination of a multi-year process of model design, development, and application that contributes meaningfully to the current validation process. Nevertheless, we are not simply relying on prior models and experience. We have undertaken an expansive and fresh look at data and model development to support the FY 2025 review.

The primary data source for our analysis is the FHA Single-Family Data Warehouse (SFDW). We consider that SFDW is compliant with ASOP 23 regarding the appropriateness, availability of current information, internal consistency of the data, and comprehensive coverage of current and past FHA mortgages. The data are well documented by the SFDW Meta Data workbook that ITDC requested from HUD to better understand the available data. The SFDW is an appropriate and sufficient source of FHA loan data.

ASOP 23 instructs us to consider known data limitations. Historically, data limitations specifically impacting HECM performance model development efforts include: (1) missing borrower gender; (2) not enough data for long-age loans; and (3) missing underwriting information on HECM refinance. We code missing gender as missing in the coding so that this issue must still be addressed in modeling. The second issue will have faded as concerns over time, and we use the loan's first 15 policy years' information to calibrate the model for this review.

Decile charts are created for each termination model using the validation dataset. All records are sorted, or ranked, by the predicted conditional termination probabilities. Ten equal sized decile groups are created with 10% of the records in each group. The sum of the actual result and the sum of the predicted result within each decile is calculated for comparison. The validation charts for three competing termination modes are shown in Exhibit B-4 through B-6. Based on the validation result, we confirm that the model outputs reasonably mimic empirical termination modes shown in the data.

Exhibit B-4: Death Termination Model Validation – Decile chart

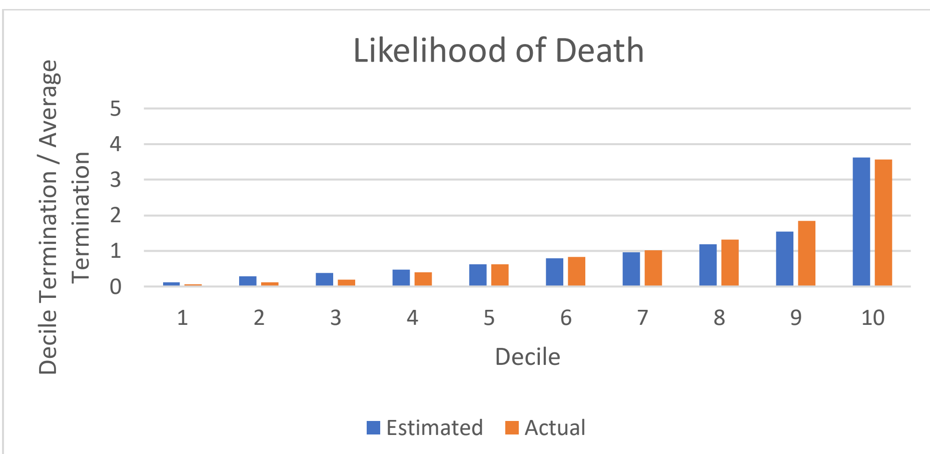


Exhibit B-5: Refinance Termination Model Validation – Decile chart

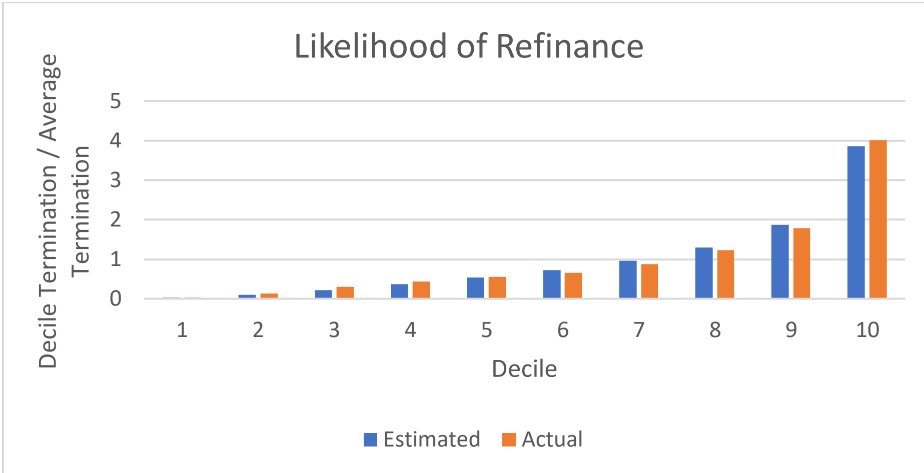
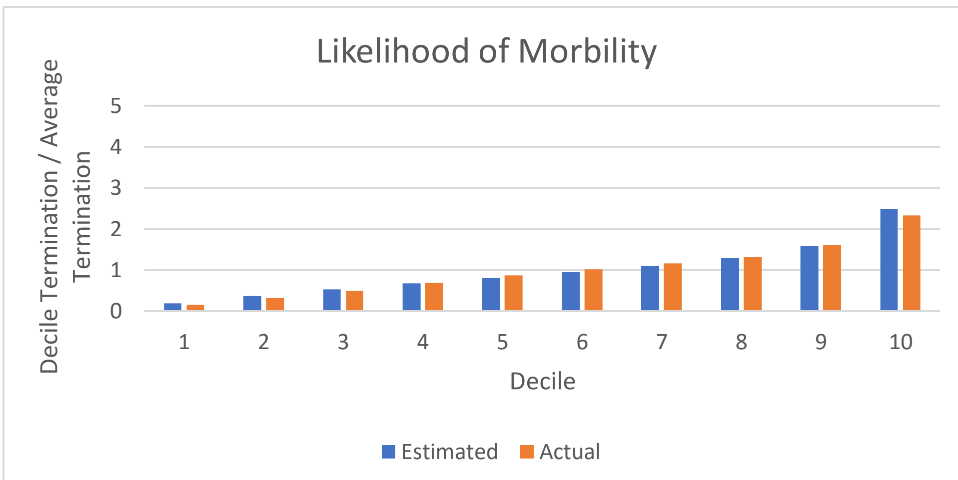


Exhibit B-6: Mobility Termination Model Validation – Decile chart



The primary ASOP 56 requirement for model output validation is that the model output reasonably represents that which is being modeled. For termination model validation[10], the validation should include testing the model output against observed historical results and evaluating whether the model output applied to hold-out data is reasonably consistent with model output developed without using the hold-out data. ASOP 56 also raises the issue of potential model over-fitting, defined as a situation where the model fits the data used to develop the model so closely that prediction accuracy materially decreases when the model is applied to different data. For example, over-fitting may occur when an excessively flexible function form is applied to a relatively small number of data points, such that the model explains those data almost perfectly, while failing to conform to other data from the same process. The voluminous data available from the SFDW essentially eliminates any possibility of over-fitting, even for models with large numbers of explanatory variables.

[10] Both termination model and severity model for property disposition are well established models. Methodology for property disposition is in Appendix D.

We use the life table estimation to obtain empirical conditional termination rate (conditional on surviving to the beginning of the policy year) and use the obtained parameters for the logit model to estimate the historical termination rates for loans with policy years less than or equal to 15. We compare the empirical termination rate from the life table test with the estimated termination rates from the model. The models used in this review are the standard models used in HECM termination analysis. In-sample comparison verifies the goodness-of-fit.

Out-of-sample validation is performed to verify whether our termination models trained by the training dataset still produce comparable outputs based on the validation dataset, that is, whether the estimated loan termination functions can reasonably represent observed average loan transition frequencies in the validation dataset.

We present the out-of-sample comparisons for each termination type and the overall termination probabilities in Exhibits B-7 through B-10. These comparisons appear reasonable, as the overall estimated termination rates align with the empirical rates. Notably, the logit regression model for mortality termination produces more conservative estimates compared with the actual mortality termination observed in the validation dataset.

This result is expected, as we included a COVID-19 period dummy variable to exclude short-term pandemic effects on mortality. For HECM loan performance, longevity risk is a concern, so adopting conservative assumptions about mortality is appropriate for liability valuation. The elevated mortality rates experienced during the pandemic should not be extrapolated into future projections.

Mobility termination is more vulnerable to borrowers' personal information and therefore more challenging to be fully explained by available variables. Our model performs very well in mobility projection. The overall model validation results confirm that termination probabilities are modeled as required by ASOP 56.

Exhibit B-7: Overall Termination Model Validation – Hazard Rate Comparison for Loans up to 15 Years

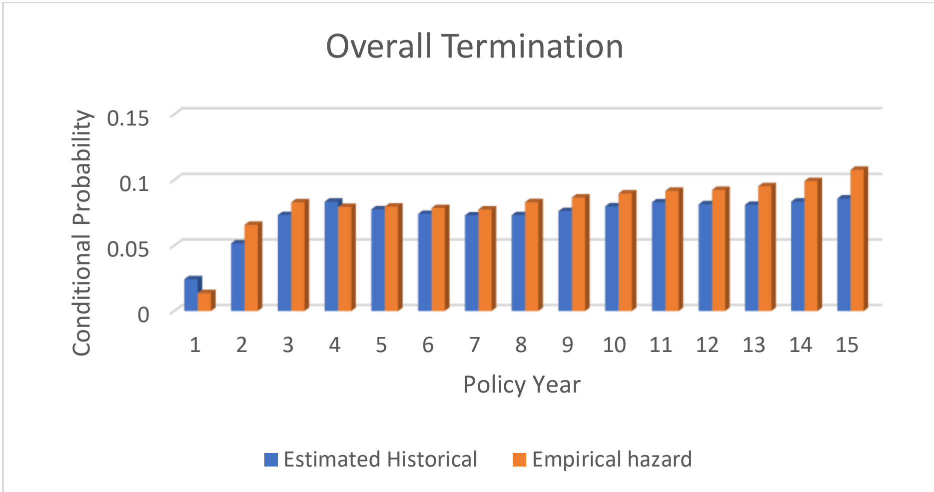


Exhibit B-8: Death Termination Model Validation – Hazard Rate Comparison for Loans up to 15 Years

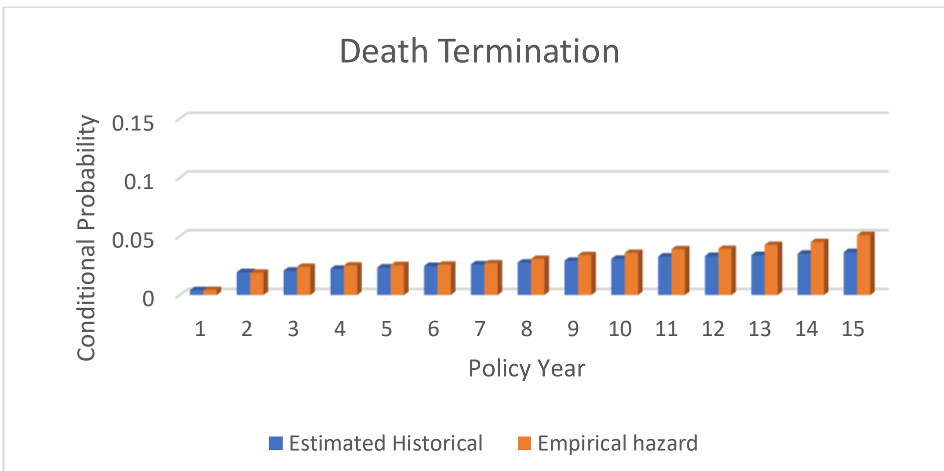


Exhibit B-9: Refinance Termination Model Validation – Hazard Rate Comparison for Loans up to 15 Years

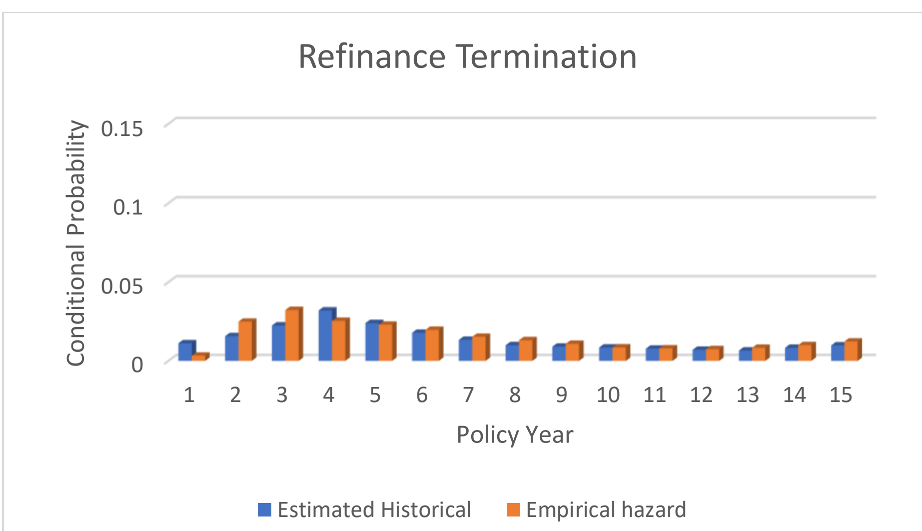
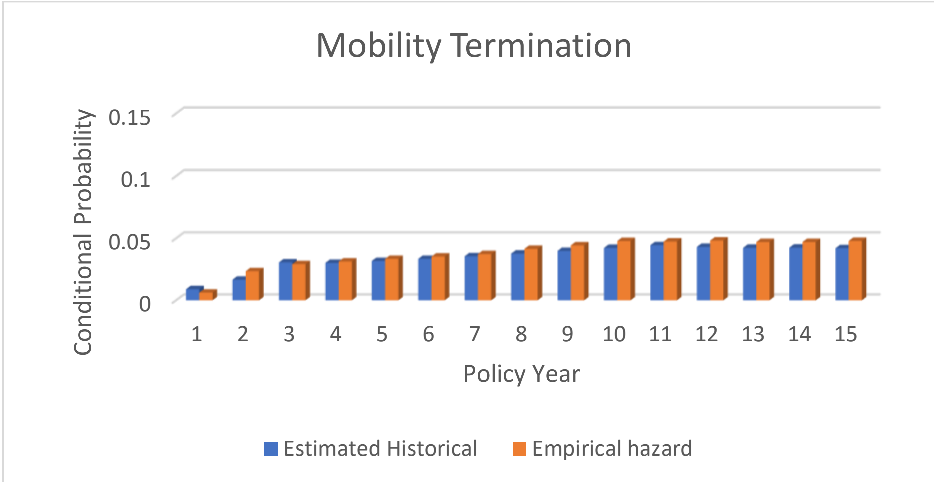


Exhibit B-10: Mobility Termination Model Validation – Hazard Rate Comparison for Loans up to 15 Years



B6. Combine the Three Risks

The joint termination hazard rate can be defined as

$$P(t) = P_D(t) + P_R(t) + P_M(t)$$

Where $P_j(t)$ for $j = D, R,$ or M is defined in Section B1.

Representing the combined hazard rate, Exhibit B-11 below shows the average conditional HECM termination rates projected by our simulation models by policy year (loan age) and the endorsement fiscal year. In Exhibit B-11 numbers above the shaded numbers are historically observed termination rates; the FY 2025 termination year (shaded) was estimated based on partial year actual data.

Exhibit B-11. HECM Termination Rates Conditional on Surviving to the Beginning of the Policy Year

Policy Year	Endorsement Fiscal Year																
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1																	
2																	6.2%
3																8.9%	9.5%
4															10.1%	11.2%	11.5%
5														7.4%	9.8%	10.5%	10.9%
6													7.9%	7.6%	9.4%	10.2%	10.3%
7												8.4%	8.1%	7.5%	9.3%	9.9%	10.0%
8											9.0%	8.7%	8.1%	7.7%	9.2%	9.7%	9.9%
9										8.7%	9.8%	8.9%	8.3%	7.9%	9.3%	10.0%	10.1%
10									8.6%	9.4%	10.1%	9.2%	8.5%	8.1%	9.6%	10.2%	10.4%
11								8.9%	9.2%	9.7%	10.5%	9.3%	8.7%	8.4%	9.9%	10.6%	10.8%

Policy Year	Endorsement Fiscal Year																
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
12							8.6%	9.1%	8.9%	9.4%	10.1%	8.8%	8.4%	8.3%	9.6%	10.3%	10.5%
13						8.3%	8.8%	8.8%	8.6%	9.0%	9.6%	8.4%	8.2%	8.1%	9.4%	10.1%	10.4%
14					7.6%	8.9%	8.8%	8.7%	8.5%	8.8%	9.5%	8.3%	8.2%	8.2%	9.4%	10.2%	10.4%
15				8.1%	8.1%	9.0%	8.9%	8.6%	8.3%	8.8%	9.5%	8.2%	8.2%	8.3%	9.5%	10.2%	10.5%
16			8.7%	8.5%	8.2%	9.2%	8.9%	8.5%	8.2%	8.8%	9.5%	8.2%	8.3%	8.4%	9.6%	10.4%	10.6%
17		9.1%	9.2%	8.7%	8.4%	9.3%	8.8%	8.5%	8.2%	8.8%	9.5%	8.2%	8.5%	8.6%	9.7%	10.5%	10.8%
18	10.9%	10.1%	10.2%	9.7%	9.2%	10.0%	9.4%	9.1%	9.0%	9.6%	10.3%	9.0%	9.4%	9.5%	10.6%	11.5%	11.8%
19	12.2%	11.0%	11.3%	10.5%	9.9%	10.7%	10.2%	9.9%	9.8%	10.5%	11.3%	9.9%	10.4%	10.6%	11.6%	12.6%	13.0%
20	14.4%	13.1%	13.2%	12.2%	11.7%	12.5%	12.0%	11.9%	11.9%	12.7%	13.6%	12.1%	12.8%	13.0%	14.1%	15.2%	15.6%
21	16.7%	15.2%	15.1%	14.1%	13.6%	14.3%	13.8%	13.9%	14.0%	14.5%	15.1%	14.1%	15.1%	15.5%	16.3%	17.4%	17.8%
22	19.3%	17.5%	17.4%	16.4%	16.0%	16.6%	16.3%	16.5%	16.7%	17.1%	17.6%	17.0%	18.1%	18.6%	19.2%	20.3%	20.7%
23	22.0%	20.4%	20.0%	19.2%	18.8%	19.4%	19.3%	19.7%	20.0%	20.3%	20.9%	20.4%	21.6%	22.2%	22.6%	23.7%	24.1%
24	25.4%	23.7%	23.2%	22.4%	22.1%	22.8%	22.8%	23.3%	23.7%	24.0%	24.6%	24.2%	25.4%	26.0%	26.3%	27.5%	27.9%
25	29.2%	27.4%	26.8%	26.1%	26.1%	26.7%	26.6%	27.3%	27.7%	28.1%	28.8%	28.3%	29.6%	30.2%	30.4%	31.6%	31.9%
26	33.6%	31.7%	31.0%	30.5%	30.4%	31.0%	30.9%	31.7%	32.1%	32.4%	33.2%	32.7%	34.0%	34.6%	34.7%	35.9%	36.3%
27	38.4%	36.6%	35.7%	35.2%	35.1%	35.7%	35.5%	36.4%	36.8%	37.0%	37.8%	37.3%	38.6%	39.2%	39.2%	40.5%	40.9%
28	43.7%	41.9%	40.7%	40.2%	40.3%	40.7%	40.3%	41.2%	41.6%	41.8%	42.7%	42.1%	43.4%	43.8%	44.0%	45.3%	45.6%
29	49.4%	47.6%	46.0%	45.6%	45.7%	45.8%	45.3%	46.2%	46.4%	46.6%	47.5%	46.9%	48.1%	48.4%	48.8%	50.1%	50.4%
30	55.3%	53.5%	51.4%	51.0%	51.1%	50.9%	50.2%	50.9%	51.1%	51.2%	52.3%	51.6%	52.7%	52.8%	53.6%	54.8%	55.1%
31	61.2%	59.6%	56.6%	56.1%	56.3%	55.5%	54.7%	55.2%	55.5%	55.5%	56.7%	56.0%	56.9%	56.9%	58.3%	59.2%	59.6%
32	67.1%	65.5%	61.3%	60.7%	60.9%	59.2%	58.7%	59.0%	59.3%	59.2%	60.7%	59.9%	60.6%	60.5%	62.5%	63.1%	63.7%
33	72.7%	71.3%	65.0%	64.1%	64.4%	61.7%	62.0%	62.1%	62.4%	62.2%	64.1%	63.1%	63.8%	63.4%	66.3%	66.4%	67.2%
34	77.8%	76.6%	67.1%	66.0%	66.2%	62.6%	64.5%	64.6%	64.9%	64.7%	66.9%	65.6%	66.3%	65.7%	69.5%	69.2%	70.1%
35	82.4%	81.4%	67.3%	66.1%	66.3%	62.5%	66.4%	66.8%	67.0%	66.8%	69.3%	67.5%	68.5%	67.7%	72.2%	71.5%	72.5%
36	86.4%	85.6%	66.3%	65.2%	65.6%	62.5%	68.0%	68.9%	69.1%	68.9%	71.4%	69.0%	70.3%	69.6%	74.5%	73.7%	74.6%
37	89.7%	89.1%	65.6%	64.9%	65.6%	63.5%	69.5%	71.0%	71.3%	71.0%	73.6%	70.4%	72.1%	71.5%	76.8%	75.9%	76.7%
38	92.3%	91.9%	66.2%	65.9%	66.9%	65.5%	71.2%	73.1%	73.5%	73.0%	75.8%	71.9%	73.9%	73.6%	79.1%	78.2%	78.8%
39	94.4%	94.2%	67.9%	67.7%	69.1%	68.1%	73.0%	75.1%	75.8%	75.2%	78.0%	73.5%	75.8%	75.9%	81.6%	80.7%	80.9%
40	96.0%	95.8%	70.0%	69.8%	71.4%	71.1%	75.0%	77.2%	78.0%	77.5%	80.2%	75.4%	77.9%	78.2%	84.1%	83.2%	82.9%
41	97.2%	97.1%	72.4%	72.1%	73.8%	74.0%	77.3%	79.6%	80.1%	80.1%	82.3%	77.7%	80.2%	80.6%	86.5%	85.8%	85.0%
42	98.0%	98.0%	75.1%	74.4%	76.3%	76.9%	79.9%	82.2%	82.1%	82.8%	84.5%	80.2%	82.7%	83.0%	88.9%	88.2%	87.1%
43	98.6%	98.6%	77.9%	76.8%	78.8%	79.6%	82.4%	84.7%	84.1%	85.5%	86.8%	82.9%	85.2%	85.4%	91.0%	90.5%	89.2%
44	99.1%	99.0%	80.8%	79.4%	81.4%	82.3%	85.0%	87.2%	86.1%	88.1%	88.9%	85.5%	87.6%	87.7%	92.9%	92.5%	91.2%
45	99.4%	99.3%	83.6%	82.2%	84.0%	84.6%	87.4%	89.5%	88.0%	90.3%	91.0%	87.9%	89.8%	89.8%	94.5%	94.1%	92.9%
46	99.6%	99.5%	86.8%	84.6%	86.5%	86.8%	89.6%	91.5%	89.9%	92.3%	92.8%	90.1%	91.7%	91.7%	95.9%	95.3%	94.5%
47	99.7%	99.7%	88.7%	86.9%	88.7%	88.8%	91.5%	93.1%	91.7%	94.0%	94.4%	92.0%	93.4%	93.3%	96.9%	96.2%	95.7%
48	99.8%	99.8%	90.7%	89.0%	90.6%	90.6%	93.1%	94.6%	93.2%	95.3%	95.7%	93.6%	94.9%	94.7%	97.8%	96.9%	96.8%
49	99.8%	99.8%	92.5%	90.9%	92.3%	92.1%	94.5%	95.7%	94.6%	96.5%	96.7%	95.0%	96.0%	95.9%	98.4%	97.4%	97.6%
50	99.9%	99.9%	93.9%	92.5%	93.8%	93.4%	95.6%	96.7%	95.7%	97.3%	97.6%	96.1%	97.0%	96.9%	98.9%	97.8%	98.2%

Appendix C. HECM Loan Performance Projections

This appendix will discuss how the termination model, discussed in Appendix B, is used to forecast future terminations. It will also describe the future economic conditions and future cohort characteristics required to forecast termination rates in future years. This appendix discusses the forecast methodology and models used in projecting future loan performance.

C1. General Approach to Loan Termination Projections

Estimated terminations are developed for all future policy years for each active loan as of September 30, 2025. For example, in this review, for a loan endorsed in FY 2022 we estimate termination rates beginning in policy year three since the first two policy years have already elapsed by the end of FY 2025 and the termination behavior is included in actual experience. For each of these years, macroeconomic variables are derived based on loan characteristics and economic forecasts; these variables include loan duration, loan characteristics, and other economic assumptions. The PEA, the Moody's October 2025 forecast, and our simulated future paths of interest rates and house price appreciations are used to develop termination specifications. MSA level forecasts are used for house price appreciation and state level forecasts are used if the MSA level data is unavailable.

For every loan and future policy year, these parameter values are then applied to the multinomial logit models as specified in Appendix B. This generates a single conditional termination rate per policy year, representing the probability the loan will terminate in a policy year given it survived to the end of the prior policy year. The projected conditional termination rates for every loan and its future policy years are imported into the HECM cash flow model to estimate future terminations and associated cash flows of the HECM program.

C2. Economic Scenarios

We use the baseline assumption plus four alternative stochastic simulation scenarios to obtain from most pessimistic to most optimistic NPV estimations. The following four alternative scenarios, which combine one of the seven simulated percentile paths of each economic variable, that we report economic net worth estimates for are:

- Optimistic Upside Scenario in Simulation, the path that is most favorable to the HECM MMI Fund.
- Moderate Upside Scenario in Simulation, the path that is moderately favorable to the HECM MMI Fund.
- Moderate Downside Scenario in Simulation, the path that is moderately unfavorable to the HECM MMI Fund.
- Pessimistic Downside Scenario in Simulation, the path that is most unfavorable to the HECM MMI Fund.

Explanatory Variables

The following is a complete list of explanatory variables used in the loan performance models in Appendix C.

Pol_Yr	Policy year
Age	Age of borrower or younger age of borrower and coborrower
Cumulative_HPI_Change	Percentage of HPI change between termination and origination
Marginal_HPI_Change	Percentage of change between current HPI and previous HPI
HP_Med_log	Log value of median house price
OneYrCMT_Change	Percentage of change between current ten-year CMT and previous ten-year CMT
TenYrCMT_Change	Percentage of change between current ten-year CMT and previous ten-year CMT
CLTV_cnvy1	min (CLTV, 0.85), where CLTV is the ratio of used UPB to house value
CLTV_cnvy2	min (max (CLTV, 0.85),1.5)-0.85
Orig_MCA_log	Log value of MCA at origination
curr_hpi_log	Log value of current HPI
endrsmnt_fy	Endorsement year
cdd_bucket	Indicator variable for first month cash draw-down greater than 0.85
Gender_Couple	Indicator variable for a loan having coupled borrowers
Gender_Male	Indicator variable for a loan having a male borrower
Before2022	Indicator variable for a loan originated before FY 2022
Covid_Yr	Covid-19 period
Scale	Scale parameter of a Gamma distribution

C3. Claim Type 1 Frequency Model

C3.1 Model Specification

The Claim type 1 payment can be expressed as

$$Claim\ Type\ I\ Payment = \min\left(MCA, max(UPB - \ Net\ Property\ Sales\ Price, 0)\right)$$

Claim type 1 payment is determined by current house price, original MCA and UPB. Those factors are important variables in the Claim Type 1 loss severity model. Using only this approach, the total CT1 cost will become unstated as house price appreciation increases over time. Historically, CT1 events have occurred with similar frequency in increased and decreased house price appreciation regimes. To account for this dynamic in this year's Review we developed regression models to estimate the frequency and associated cost of CT1 events on the HECM portfolio.

For the CT1 frequency model, we used HECM non-assigned terminated, and loans terminated as CT1's from FY 2000 through FY 2025 to model the borrower's probability of terminating as a CT1 and the associated CT1 cost. A binomial logistic model is estimated based on an indicator variable that is 1 for a non-assigned CT1 and 0 for a non-assigned non-claim termination. Total observations (689,000) were split into a training (80%) and validation dataset (20%). Exhibit C-1 shows the estimation and model performance measures.

Exhibit C-1 Parameter Estimation of Claim Type 1 Frequency Model

Analysis of Maximum Likelihood Estimates					
Parameter	**status**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept	**CT1**	0.00482	0.1380	0.0012	0.9721
Age	**CT1**	0.0117	0.000774	228.2942	<.0001
CLTV_cnvy1	**CT1**	7.4521	0.0520	20567.7075	<.0001
CLTV_cnvy2	**CT1**	9.0768	0.1240	5360.7926	<.0001
Covid_Yr	**CT1**	-0.6242	0.0187	1116.2479	<.0001
Cumulative_HPI_Change	**CT1**	-1.9479	0.0281	4802.0905	<.0001
Gender_Couple	**CT1**	-0.3260	0.0122	718.8223	<.0001
Gender_Male	**CT1**	0.2508	0.0135	345.8320	<.0001
HP_Med_log	**CT1**	-1.1653	0.0172	4605.7429	<.0001
Marginal_HPI_Change	**CT1**	4.1998	0.0984	1822.8662	<.0001
OneYrCMT_Change	**CT1**	-0.00012	0.000010	133.9868	<.0001
Orig_MCA_log	**CT1**	-0.5778	0.0120	2314.9650	<.0001
Pol_Yr	**CT1**	0.2683	0.00166	25985.7077	<.0001
TenYrCMT_Change	**CT1**	-0.3382	0.0156	467.8884	<.0001
cdd_bucket	**CT1**	0.6234	0.0117	2838.2632	<.0001
curr_hpi_log	**CT1**	0.7655	0.0193	1574.0500	<.0001

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	93.8	**Somers' D**	0.877
Percent Discordant	6.2	**Gamma**	0.877
Percent Tied	0	**Tau-a**	0.258
Pairs	44483434593	**c**	0.938

The binomial logit regression model achieves 93.8% concordance and a c-statistic (AUC) of 0.94, with Somers' D and Gamma both at 0.88. These results indicate exceptionally strong alignment between predicted probabilities and observed outcomes, confirming the model's high reliability in distinguishing claim type 1 from no claim.

C3.2 Model Validation

We use the estimated claim type 1 model to project claim type 1 and no claim in the holdout 20% validation sample. Exhibit C-2 shows the confusion matrix of model validation result.

Exhibit C-2. Claim Type 1 Frequency Model Validation Confusion Matrix

Actual \ Predicted	P_ CT1	P_ nClm	Total
CT1	16415 (11.91% of total, 65.54% of row, 78.81% of column)	8632 (6.27% of total, 34.46% of row, 7.38% of column)	25047 (18.18% of total)
nClm	4413 (3.20% of total, 3.91% of row, 21.19% of column)	108314 (78.62% of total, 96.09% of row, 92.62% of column)	112727 (81.82% of total)
Total	20828 (15.12% of total)	116946 (84.88% of total)	137774 (100%)

The 20% hold-out validation confirms that the model predicting CT1 versus No Claim performs well, with an overall accuracy of 90.3% and a c-statistic of 0.94. The model achieved high specificity (96.1%) and strong precision (78.8%), indicating that most predicted CT1 cases are truly positive. Sensitivity was more modest at 65.5%, showing the model misses some CT1 cases. Overall, the model provides reliable discrimination, favoring correct identification of No Claim while capturing a majority of CT1 cases with reasonable precision.

C4. Claim Type 1 Loss Severity Model

The claim type 1 loss severity is modeled by a Generalized Linear Model. The dataset was split into training (80%) and validation (20%) samples to support model development and evaluation.

C4.1 Model Specification

A generalized linear model is developed to model the Claim Type 1 loss severity amount. The variables defined in termination models are selected and the estimation results are presented in Exhibit C-3.

Exhibit C-3. Parameter Estimations of Claim Type 1 Loss Severity Model

Analysis Of Maximum Likelihood Parameter Estimates						
Parameter	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1.8002	0.1107	1.5833	2.0172	264.56	<.0001
Gender_Couple	-0.0506	0.0044	-0.0592	-0.0420	133.55	<.0001
Gender_Male	0.0316	0.0048	0.0221	0.0411	42.65	<.0001
Pol_Yr	0.0265	0.0007	0.0251	0.0278	1444.18	<.0001
Age	0.0018	0.0003	0.0013	0.0024	44.35	<.0001
cdd_bucket	0.1580	0.0040	0.1502	0.1657	1594.46	<.0001
Cumulative_HPI_Change	-0.0210	0.0092	-0.0391	-0.0029	5.19	0.0227
Before2022	0.5285	0.0977	0.3371	0.7199	29.29	<.0001
CLTV_cnvy1	0.6109	0.0133	0.5849	0.6369	2121.57	<.0001

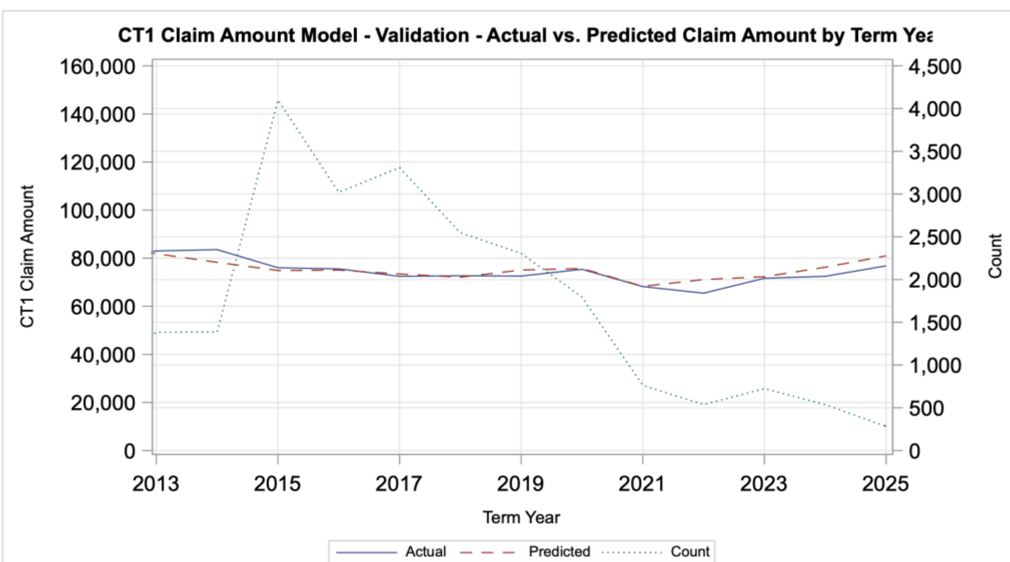
CLTV_cnvy2	1.2131	0.0167	1.1804	1.2458	5295.72	<.0001
Covid_Yr	-0.0166	0.0067	-0.0298	-0.0035	6.12	0.0133
Orig_MCA_log	0.6338	0.0034	0.6271	0.6405	34282.4	<.0001
curr_hpi_log	0.0317	0.0063	0.0192	0.0441	24.92	<.0001
Scale	2.9289	0.0125	2.9045	2.9534		

The scale parameter in a Gamma Generalized Linear Model (GLM) is automatically estimated during model fitting. Gamma distribution is naturally right-skewed, and the estimated scale parameter represents the dispersion of the response variable around its mean—quantifying how much the observed data deviate from the model's predicted values beyond what the assumed distribution inherently explains. A scale parameter of 2.93 reflects that loss severity data are volatile. Its standard error equal to 0.0125 indicates the scale parameter estimate is stable even though losses are variable.

C4.2 Model Validation

Using the 20% holdout sample, we compare the projected Claim Type 1 payment with the actual payment. In Exhibit C-4, we present the projected average CT1 claim amount and observed average CT1 claim amount from FY 2013 to FY 2025. We can see that the Claim Type 1 payments align closely with the actual pay outs. The mean absolute error (MAE) of projection is 2066, 2.75% of observed average CT1 claim amount.

Exhibit C-4. Claim Type 1 Loss Validation



C5. Conveyance and Payoff Selection Model in Post-Assignment

C5.1 Model Specification

For loans terminated with Claim Type II, borrowers or their heirs can pay off the HECM loans by paying HUD 95 percent of the appraisal house value or convey the mortgaged house to HUD. In the latter case, HUD will sell the conveyed property to recover up to the loan balance. Delay between post-assignment termination and the disposition of home equity is built in the structure of the cash flow. Such delay can have Incurred but Not Reported (IBNR) claims; however, it is not essential in actuarial review of HECM, as the review focuses on long-term provisions for future liabilities rather than address short-term volatility in the NPV. In addition, extensive termination rates based on a large volume of data are forecasted with greater accuracy, which diminishes the need for additional buffer for IBNR reserve.

In this year's Review, we used HECM loans terminated with payoff and conveyance types from FY 2004 through FY 2025 to model the borrower's conveyance and payoff selection choice and the associated Maintenance and Operations (M&O) Expenses for Conveyed properties. This is aggregated by the year of termination. There are 92,716 observations for the logistic model. A binomial logistic model is estimated based on an indicator variable that is 1 for a conveyance and 0 for a payoff. Exhibit C-5 shows the estimation results.

Exhibit C-5. HECM Conveyance Model - Frequency (Payoff vs. Conveyance)

Analysis of Maximum Likelihood Estimates (80% Training Dataset)					
Parameter	**status**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept	**CT2c**	0.1708	0.2529	0.4564	0.4993
Age	**CT2c**	0.0576	0.00206	784.8177	<.0001
CLTV_cnvy1	**CT2c**	-1.9629	0.0509	1487.3633	<.0001
CLTV_cnvy2	**CT2c**	4.0447	0.1608	632.3920	<.0001
Covid_Yr	**CT2c**	0.3466	0.0416	69.2763	<.0001
Cumulative_HPI_Change	**CT2c**	-2.5218	0.0435	3357.1860	<.0001
HP_Med_log	**CT2c**	-1.5142	0.0314	2318.1179	<.0001
Marginal_HPI_Change	**CT2c**	-2.2062	0.2660	68.7701	<.0001
OneYrCMT_Change	**CT2c**	-0.00001	0.000016	0.6276	0.4283
Pol_Yr	**CT2c**	0.0931	0.00388	573.7951	<.0001
TenYr_chg1	**CT2c**	-0.5513	0.0731	56.8455	<.0001
cdd_bucket	**CT2c**	0.6254	0.0304	423.6799	<.0001
curr_hpi_log	**CT2c**	0.4258	0.0459	86.1489	<.0001

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	83.2	**Somers' D**	0.664
Percent Discordant	16.8	**Gamma**	0.664
Percent Tied	0	**Tau-a**	0.169
Pairs	692901632	**c**	0.832

The logistic regression model demonstrated excellent discriminative ability, with 83.2% concordant pairs and a c-statistic (AUC) of 0.83. Somers' D and Gamma (both 0.66) indicated a strong positive association between predicted probabilities and observed outcomes. The absence of tied pairs further highlights the model's clear separation between cases. Overall, the model reliably distinguishes choices between conveyance and payoff

C5.2 Model Validation

We use the estimated conveyance model to project the conveyance and payoff events in the holdout 20% validation sample. Exhibit C-6 shows the confusion matrix of validation.

Exhibit C-6. HECM Conveyance Model Validation Confusion Matrix

Actual \ Predicted	P_CT2c	P_CT2p	Total
CT2c	865 (4.60% of total, 29.73% of row, 64.07% of column)	2045 (10.87% of total, 70.27% of row, 11.71% of column)	2910 (15.47% of total)
CT2p	485 (2.58% of total, 3.05% of row, 35.93% of column)	15412 (81.95% of total, 96.95% of row, 88.29% of column)	15897 (84.53% of total)
Total	1350 (7.18% of total)	17457 (92.82% of total)	18807 (100%)

The 20% hold-out validation sample confirms that the logistic regression model generalizes reasonably well to unseen data. The model achieved an overall accuracy of 86.6% and strong specificity of 97.0%, indicating it reliably identifies CT2p cases. However, sensitivity was lower at 29.7%, suggesting the model under-predicts CT2c cases and misses a portion of true events. This tradeoff implies that while the model provides stable and consistent predictions, its conservative nature favors minimizing false positives at the expense of detecting all true CT2c outcomes

C6. Conveyance Maintenance and Operation Expense Model

The M&O expense for loans projected to terminate as a conveyance is modeled by a Generalized Linear Model based on 12,700 observations. The dataset was split into training (80%) and validation (20%) samples to support model development and evaluation.

C6.1 Model Specification

The M&O expense is modeled as the ratio of maintenance and operation expenses to the value of the conveyed house property. The estimation results are presented in Exhibit C-7.

Exhibit C-7. Conveyance Maintenance and Operation Expense Rate

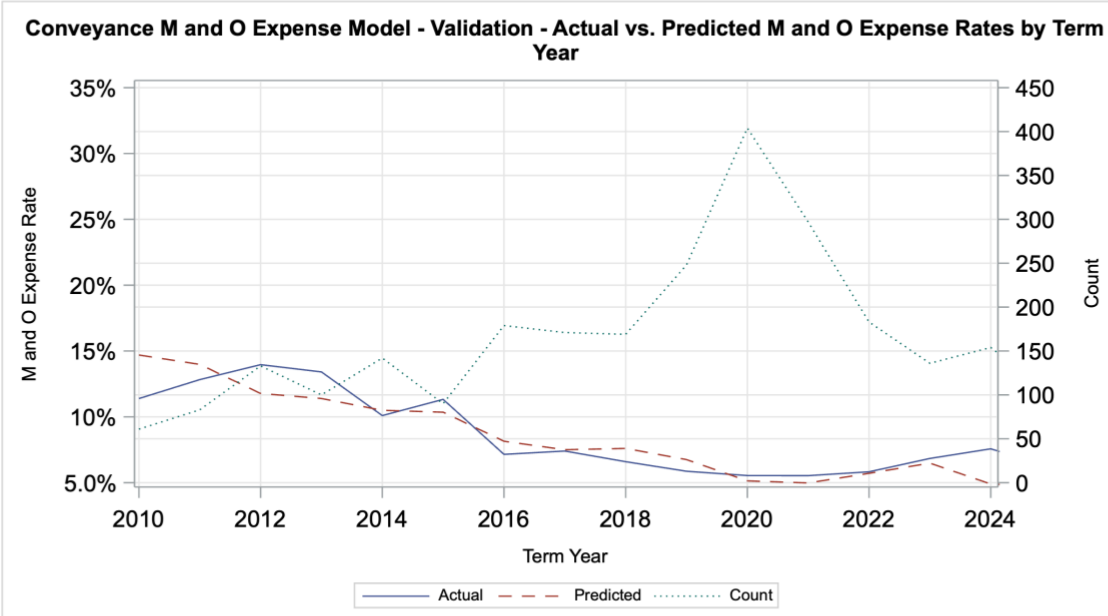
Analysis Of Maximum Likelihood Parameter Estimates						
Parameter	Estimate	Standard Error	95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	-2.1268	0.752	-3.6006	-0.6529	8	0.0047
Pol_Yr	0.0007	0.0004	-0.0001	0.0015	2.95	0.0861
Age	0.0006	0.0002	0.0003	0.0009	15.27	<.0001
Cumulative_HPI_Change	-0.0262	0.003	-0.0322	-0.0202	74.26	<.0001
Marginal_HPI_Change	-0.1494	0.0164	-0.1816	-0.1172	82.54	<.0001
TenYrCMT_Change	0.0183	0.0042	0.01	0.0266	18.75	<.0001
CLTV_cnvy1	-0.0457	0.0032	-0.052	-0.0393	198.24	<.0001
CLTV_cnvy2	0.0165	0.01	-0.0032	0.0361	2.69	0.1007
Orig_MCA_log	-0.0904	0.0018	-0.0939	-0.0869	2586.76	<.0001
curr_hpi_log	0.0084	0.0031	0.0024	0.0144	7.57	0.0059
endrsmnt_fy	0.0016	0.0004	0.0009	0.0024	18.44	<.0001
Scale	0.089	0.0006	0.0878	0.0902		

The scale parameter of Gamma GLM is automatically estimated during model fitting. The scale parameter of 0.089 indicates mild skew and tight dispersion. A relatively low level of dispersion around the fitted values suggests that the model explains most of the variability in the response variable.

C6.2 Model Validation

Using the 20% holdout sample, we compare the projected M&O expenses with the actual expenses. In Exhibit C-8, we present the projected and observed M&O Operation Expense rates for FY 2010 to 2025. We can see that the projected M&O expenses align closely with the actual M&O expenses. The mean absolute error (MAE) of projection is 0.0116.

Exhibit C- 8. Conveyance Maintenance and Operation Expense Rate



Appendix D. HECM Cash Flow Analysis

This Appendix describes the calculation of the present value of future cash flows. Future cash flow calculations are based on forecasted variables, such as house price appreciation and interest rates, in addition to individual loan characteristics and borrower behavior assumptions. There are four major components of HECM cash flows: insurance premiums, claims, note holding expenses and recoveries on notes in inventory (after assignment). HECM cash flows are discounted according to the cohort specific single effect rates (SERs) provide by FHA. These elements of cash flow and the present value calculations are described in this Appendix.

D1. Definition

The following definitions will facilitate the discussion of HECM cash flows:

Maximum Claim Amount (MCA): Maximum claim amounts are calculated as the minimum of three amounts: the HECM property's appraised value at the time of loan application, the purchase price of the property, and the national HECM FHA loan limit ($1,209,750 for FY 2025).

Insurance-In-Force (IIF): Refers to the active loans in the FHA insurance portfolio (prior to loan assignment) and calculated as the total of their UPB.

Conditional Claim Type I Rate (CC1R): Among loans that terminated without note assignment, the number of such loans that had a shortfall divided by the total number of loans active as of the beginning of the same policy year. The shortfalls are labeled as Claim Type I. The other terminations before assignment have zero claim amounts, corresponding to when the property value exceeds the outstanding loan balance by more than the sales transactions cost.

Claim Type II (Assignment): If certain conditions are met, a lender can (but is not required to) assign the promissory note to FHA. FHA pays the UPB at the time of assignment to take ownership of the note. Such assignment events are labeled as Claim Type II. One of the conditions for the promissory note to be eligible for assignment is that the outstanding UPB of a HECM reaches 98 percent of the MCA. FHA also imposes other conditions as noted in Section II.C.i.

Note Holding Period: The length of time from note assignment to loan termination. During this period, FHA takes possession of the loan, now called an assigned note, and services it (through assigned private servicers) until loan termination.

Recoveries: The property recovery amount received by FHA at the time of note termination after assignment, expressed as the minimum of the loan balance and the predicted net sales proceeds at termination. The recovery amount for refinance termination is always the loan balance.

D2. Cash Flow Components

HECM cash flows are comprised of premiums, claims, note expenses and recoveries. Premiums consist of upfront and annual mortgage insurance premiums, which are inflows to the HECM program. Recovery after assignment, a cash inflow, represents cash recovered from the sale of the underlying property once the loan terminates. Claim Type I payments are cash outflows paid to the lender when the net proceed of a property sale is insufficient to cover the balance of the loan. Assignment claims and notes holding payments are additional outflows. Exhibit CD-1 summarizes the HECM inflows and outflows.

Exhibit D-1. HECM Cash Flows

Cash Flow Component	Inflow	Outflow
Upfront Premiums	X	
Annual Premiums	X	
Claim Type I Payments		X
Claim Type II (Assignment) Payments		X
Note Holding Expenses		X
Recoveries	X	

D3. Loan Balance

The unpaid principal balance (UPB) is a key input to the cash flow calculations. The UPB at a given point in time, t is calculated as follows:

$$UPB_t = UPB_{t-1} + Cash\ Draw_t + Accruals_t$$

The UPB for each period t consists of the previous loan balance plus any new borrower cash drawn and accruals. The accruals include interest, mortgage insurance payments, and service fees. Future borrower draws are estimated by assigning draw patterns to loans based upon the first-month draw.

D4. Premiums

Upfront and annual mortgage insurance premiums, along with recoveries, are the sources of FHA revenue from the HECM program. Borrowers typically finance the upfront premium when taking out an HECM loan. Similarly, the recurring annual premiums are added to the balance of the loan.

D4.1. Upfront Premiums

The Upfront premium is due to FHA at the time of closing, equal to a percentage of the MCA. For FY2009 and FY 2010 books-of-business, the upfront premium rate is two percent of the MCA. For FYs 2011 through 2013 endorsements the upfront premium rate for the standard option and the saver option is two percent and 0.01 percent (1 basis point), respectively. HECM saver program was discontinued in 2013. In FY 2014, the upfront premium rate is 0.5 percent of the MCA if the first-year cash draw is less than or equal to 60% of the initial principal limit, and 2.5 percent of MCA if the first-year cash draw is more than 60 % of the initial principal limit.

Effective October 2017, to simplify the MIP structure and improve the sustainability of the MMI Fund, HUD standardized the upfront MIP to a flat 2% of the maximum claim amount, irrespective of how much the homeowner drew from the reverse mortgage in the first year. Typically, the upfront premium is paid in full to FHA as a positive cash flow at the loan closing and financed by the HECM loan and hence added to the loan balance.

D4.2. Annual Premium

The annual mortgage insurance premium (MIP) is calculated as a percentage of the growing loan balance. For FY 2009 and FY 2010 books-of-business, the annual premium is 0.5 percent of the UPB. From FY 2011 and onward, the annual premium is 1.25 percent of the UPB for both the Standard and Saver options (new program in 2014).

Effective October 2017, HUD standardized the upfront MIP to a flat 2% of the maximum claim amount, irrespective of how much the homeowner drew from the reverse mortgage in the first year, and annual MIP was reduced to 0.5%.

To summarize the annual MIP:

- a loan with case number assigned before 4/5/2010 has 0.5% annual MIP.
- a loan with case number assigned between 4/5/2010 and 10/2/2017 has 1.25% annual MIP.
- a loan with case number assigned on and after 10/2/2017 has 0.5% annual MIP.

D5. Claims

HECM claims consist of Claim Types 1 and 2. Claim Type 1 occurs when a HECM lender is reimbursed for deficiencies that occur when the property supporting the HECM terminates prior to assignment, and the proceeds of the sale are insufficient to cover the unpaid principal balance (UPB) of the loan. Claim Type 2 occurs when a lender assigns a loan to HUD with certain criteria met.

D5.1. Claim Type 1

Claim Type 1 factors into HECM cash flows as payments to the lender when a property is sold and the net proceeds from the sale are insufficient to cover the balance of the loan at termination. Claim Type 1 are projected using a binomial logistic model for loss frequency (the probability model) and GLM for loss severity respectively. Detailed models are referred to Appendix C4.

D5.2. Claim Type 2 (Assignment)

Lenders can assign the loan to HUD when the UPB reaches 98 percent of the MCA. HUD acquires the note resulting in acquisition costs equal to the balance (up to the MCA).

Under FHA guidelines, when the UPB reaches 98% of the MCA, the lender has the option to assign the loan to HUD for claim payment. This process transfers the loan from the private investor or servicer to HUD, at which point HUD assumes responsibility for future payments and recoveries.

In FY 2024 Review, the model treats assignments theoretically occur when the projected UPB reaches 98 percent of the MCA. Then using historical Claim Type 1 frequency and loss severity to adjust CT1 losses, to account for the loans that are not assigned, including loans that are not ineligible for assignment and due-and-payable loans.

In this year's review, we examined HECM loan assignments and found that 8.9 percent of loans with a UPB greater than or equal to 105 percent of MCA were not assigned. Non-assignment can occur under various circumstances that may not be captured by a quantitative model. Therefore, at the portfolio level, we account for this by randomly designating 8.9 percent of eligible loans as not assigned.

D6. Note Holding Expenses after Assignment

The note holding expenses include the additional cash drawn by the borrower after the loan has been assigned to HUD. Additional cash drawn by the borrowers can occur under the contract after FHA takes ownership of the note only if the total cash drawn by the borrower has not reached the maximum principal limit upon the assignment date.

D7. Recoveries from Assigned Loans

At note termination, HECM loans that are not paid off will become due and payable to FHA. The timing of loan terminations depends on the results of the termination model. The details of the termination projections are discussed in Appendix B and Appendix C. The amount of recovery is estimated as the minimum of the loan balance and the net sales proceeds at termination, where net sales proceeds are estimated as the difference between projected property value less property holding and selling expenses.

A discount or haircut is applied to the projected house sale price for the reduction in price that a HECM property would sell compared to an otherwise identical property on the market. Specifically, future house price discounts are calculated in the following way:

If the Appraisal Price at origination is below the Local Median House Price:

$$Haircut = \begin{cases} 0.2 - 0.3 * \exp\left(-0.2 * \min(6, loan\ age\right), & if\ loan\ age < 10 \\ 0.25 - 0.9 * \exp(-0.2 * \ \&loan\ age) \quad, & if\ loan\ age\ > 10 \end{cases}.$$

If the Appraisal Price at origination is above the Local Median House Price:

$$Haircut = \begin{cases} 0.13 - 0.25 * \exp\left(-0.35 * \min(4, loan\ age\right), & if\ loan\ age < 10 \\ 0.2 - 0.8 * \exp(-0.2 * \ \&loan\ age) \quad , & if\ loan\ age\ > 10 \end{cases}.$$

We don't distinguish note sales from REO in this year's Review and all holding and disposition costs including sales costs are based on assuming a REO sale. According to post-sale report published by HUD, we list in Exhibit D-2 HECM note sales since 2016. With limited records, there is no reliable projection about future note sales.

Exhibit D-2. HECM Note Sale Records

Sale ID	Sales Date	Settled Loans	Updated Balance ($ MM)	Aggregate Sales Price
HVLS 2025-3	9/24/2025	1874	546.1	292.6
HVLS 2025-2	8/6/2025	1548	446.5	249.5
HVLS 2025-1	12/11/2024	780	321.3	190
HVLS 2024-2	5/7/2024	1180	324.1	196.9
HVLS 2024-1	12/5/2023	1465	366.1	226.9
HVLS 2022-2	7/27/2022	668	136.8	84.5
HVLS 2022-2	6/8/2022	687	187	130.7
HVLS 2022-1	12/1/2021	1587	393.3	210.8
HVLS 2020-1	6/24/2020	627	143.5	62.5
HVLS 2019-2	7/24/2019	1375	310	135.5
HVLS 2019-1	12/12/2018	920	192.1	87.1
HVLS 2018-1	4/11/2018	511	108.8	55.7
HVLS 2017-2	6/21/2017	805	158.7	64.4
HVLS 2017-1	11/30/2016	1567	316.9	120.1

Depending on the number of sales in the future, FHA might potentially recover better from note sales, because note sales have faster disposition process and lower cost involved than REO. With more REO and note sales data in the future, we will be able to investigate the data to verify if there is a significant difference in the recoveries from note sales and REO and develop separate models for note sales and REO recoveries in the FY2026 Review.

D8. Net Future Cash Flows

The cash flow for a book-of-business can be found by aggregating the individual components.

$$Net\ Cash\ Flow_t = Upfront\ Premium_t + Annual\ Premium_t + Recoveries_t - Claim\ Type1_t - Claim\ Type2_t - Note\ Holding\ Expense_t$$

Note that a negative net cash flow indicates that outflows have exceeded inflows, and a positive cash flow indicates the HECM program is generating a net income. To obtain the present value of cash flows, the cash flows are discounted for each policy year and cohort using the cohort specific single effective rate (SERs) supplied by FHA.

The NPV of net cash flow depends on termination probabilities (timing of termination), discount factors, and amount of net cash flow. Economic factors that drive the net cash flow and the crossover risk are modeled by the GARCH models in Appendix E. Given the nature of long-term HECM claim, other factors that impact claim severity, including note holding expenses and house sale expenses, can be estimated from historical data with less variability and uncertainty than short-term lines of insurance. Non-parametric models and empirical assumptions with implicit margin for uncertainty are appropriate methodology for the valuation. In future research, we can investigate parametric models for these factors.

D9. Tax and Insurance Default

The HECM loans in tax and insurance default cannot assign, if the UPB is higher than the home sales price at termination, the lender can file a CT1 claim for the shortfall amount. Historical T&I loans that terminated with a CT1 claim cost are included in our CT1 model for frequency and loss amount. The additional cost to the HECM MMI portfolio is captured within our CT1 process (which reduces the estimated NPV) and does not require a separate model estimation.

Appendix E. Stochastic Simulation Models

This Appendix describes the stochastic models used to generate economic variables used in the Monte Carlo simulations of the FHA HECM Actuarial Review 2025. Based on the best fitted stochastic model, we use Monte Carlo simulation technique to simulate 1000 paths of future economic variables and obtain the 1st, 10th, 25th, 50th, 75th, 90th, and 99th percentiles of the simulated paths.

This year's review updates the simulation models used in 2024 Review to obtain percentile paths. Each quarterly point of a percentile path is the percentile value across all simulation paths at that quarter used as the percentile reference path. Whichever real simulated path that is closest to the percentile reference path is identified as the obtained percentile path. This method uses the real simulated trajectory and represents the overall percentile profile among all the simulated paths. At the same time, in our Monte Carlo simulation, the simulated paths are centered on the baseline economic assumptions, this is, the 50th percentile of the simulated path is close to the baseline PEA and replaced by the PEA baseline assumption.

The estimated simulation models are identical for the Single-Family Forward Mortgages and HECM with respect to Treasury rates, SOFRs, and national and regional HPIs. Additional forecast models for 30-year mortgage rates and unemployment rates are applied to Single-Family Forward mortgages.

The simulated scenarios of the U.S. economic economy used as the components of the forecast include:

- 1-month CMT rate,
- 1-year CMT rate,
- 10-year CMT rate,
- 1-month Secured Overnight Financing Rate (SOFR),
- 6-month SOFR,
- 12-month SOFR, and
- FHFA national Purchase Only house price appreciation rate (HPI-PO).

The stochastic models are calibrated to historic data and are chosen based on augmented Dickey–Fuller test (ADF) test and the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test for stationarity in time series; Box-Ljung (BL) for autocorrelation in residuals after model fitting; likelihood, AIC, and BIC values for parameter selection; and one-step rollover forecast test. At the same time, since all status transition probabilities are estimated and projected using a series of historically observed and projected interest rates with different maturity terms, the stochastic interest rate models are internally consistent in model calibration and forecasting. This approach is appropriate for the Actuarial Review as we are computing the present value of projected future cash flows for liability valuation.

E1. Historical Data

E1.1. 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 the 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 E-1 shows historical 1-year and 10-year CMT rates from 1970 Q1[11] to 2025 Q2. The one- year Treasury rate (CMT1) fluctuated around 6% in the early 1970s 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 around 1.2% in 2004. From then on, rates started a slow upward trend until the 2007 financial crisis and rates started a sharp downward trend reaching a historic low of 0.06% in CY 2021 Q2. Inflation turned up dramatically because of the COVID-19 pandemic. Monetary policy initiatives aimed to overturn the post-pandemic inflation, and we saw the Federal Reserve tightening where the one-year rate has been increasing up to the 5.39% in 2023 Q3 and then turning down. The one-year CMT rate is 3.88% in 2025 Q3.

The ten-year Treasury rate (CMT10) generally followed a similar long-run pattern, though with less volatility. It rose from around 7% in the early 1970s to a peak of nearly 15% in 1981 and then declined steadily over the next four decades. By 2020–2021, the 10-year CMT fell below 1% in 2020 before rising alongside post-pandemic. As inflation accelerated in the post-pandemic period, long-term rates moved upward again, reaching about 4.45% in 2024 Q2 before easing slightly. The ten-year CMT rate is 4.26% in 2025 Q3

Also shown in Exhibit E-1 is the 1-year SOFRs curve. Historical SOFRs data dated back to 2006 Q1. The SOFRs reflect Treasury-backed short-term funding costs and are closely tied to Federal Reserve policy, showing a similar cyclical pattern to the 1-year CMT but with smaller term premium. In the mid-2000s, 1-year SOFR peaked near 5.4%, fell to near 0.1% during the zero-interest-rate era, and then climbed to around 2.5%–2.7% during the 2018–2019 tightening cycle. Pandemic relief drove SOFR to record lows of 0.04–0.11% in 2020–2021 before it surged alongside policy rates, reaching 5.38% in 2023Q3. By 2025Q3, it had reduced to 3.81%, maintaining a tight alignment with the 1-year CMT.

[11] Calendar year is used in demonstrating historical economic data.

Exhibit E-1 Historical Interest Rate

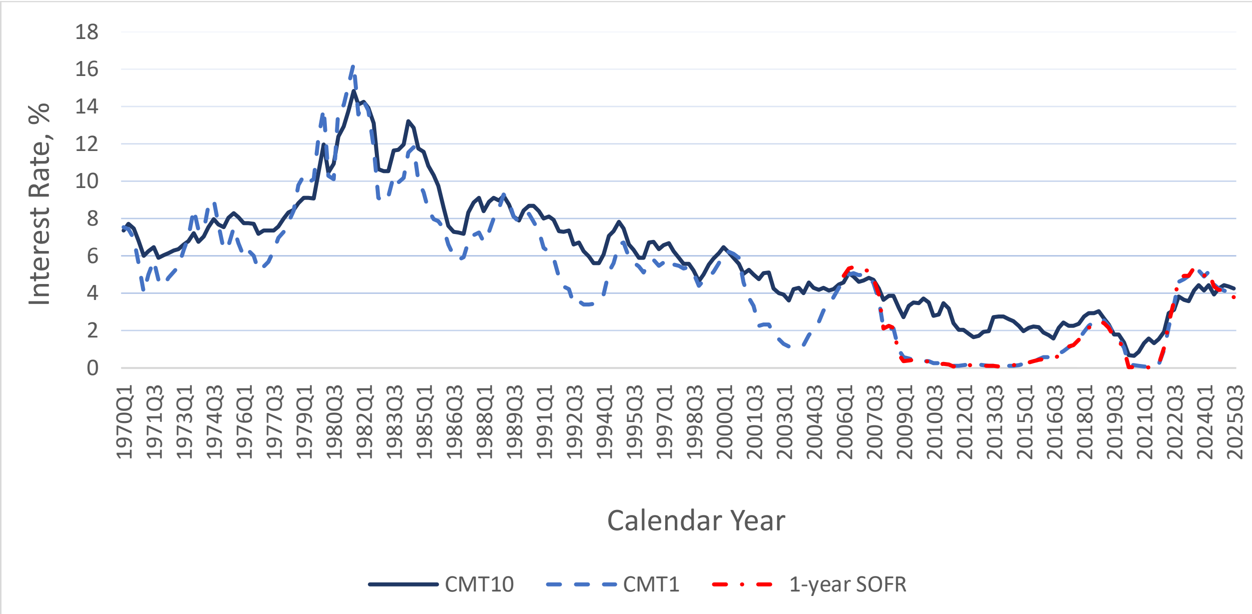
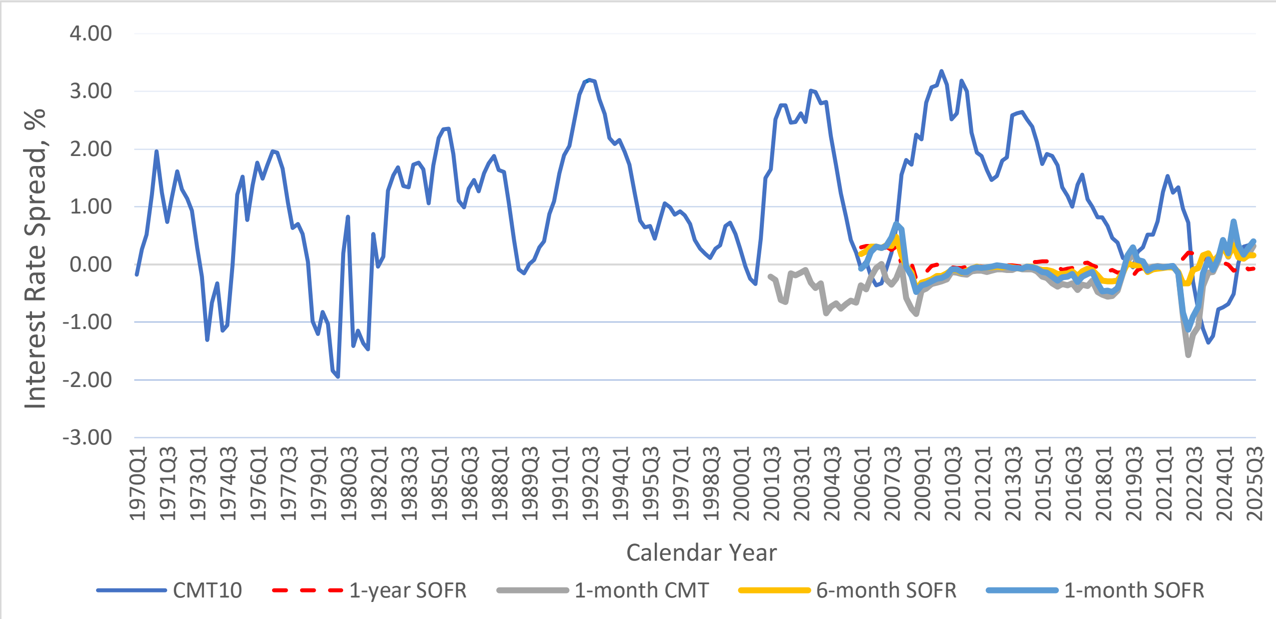


Exhibit E-2 shows historical interest rate spreads for the 10-year CMT, 1-month CMT, and SOFR tenors (1-year, 6-month, 1-month). The spread between the 10-year and 1-year Treasury rates appears to have above and below zero cycles and high volatilities. Historically, the spread has turned negative (yield curve inversion) before recessions, for example, in the late 1970s, early 1980s, 2000, 2006–2007, and again in 2022–2023. The most recent inversion, with the spread reaching –1.35% in 2023 Q2. By 2025 Q3, the spread normalized to a positive 0.38%, suggesting some easing in monetary policy and reduced recession concerns.

The spread between 1-month CMT rate and 1-year CMT rate is typically negative (–0.1 to –1.5) having liquidity premium price incorporated. Episodes when the spread narrowed toward zero or briefly turned positive during the late 1970s–early 1980s, mid-2000s, and 2022–2023 correspond to aggressive Federal Reserve rate hikes. During easing cycles and crisis periods, including the early 1990s, post-2008, and pandemic years, the spread widened.

SOFRs are tied to secured funding markets and policy expectations, and their over 1-year CMT rate fluctuates around zero with much smaller variation than Treasury spreads at comparable maturities. The ARMA-GARCH models are identified for 1-year CMT rate and interest rate spreads.

Exhibit E-2 Historical Interest Rate Spread (%) with the 1-Year CMT



E1.2. House Price Appreciation Rates

The national house price appreciation rate (HPA) is derived from the FHFA repeat sales seasonally adjusted purchase-only (PO) house price indices (HPIs). The PO HPI is used for national HPA simulation as it 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. The All Transaction (AT) version of HPI is used for deriving geographic dispersion factors as it retains significantly broader regional coverage. At the national level, the AT HPI is very close to the PO HPI.

The HPA at time t is defined as:

$$HPA_t = \frac{HPI_t}{HPI_{t-1}} - 1$$

Exhibit E-3 shows the quarterly national HPI and HPA from CY 1991 Q1 to CY 2025 Q2. The long-term average quarterly HPA is around 1.085% (4.41% annual rate). The HPI increased steadily before 2004 with an annual appreciation rate of about 4.64%. Then house prices rose sharply starting in 2004. The house price appreciation rate was around 10% annually during the subprime mortgage expansion period from 2004 to 2005 and reached its peak at an annual rate of 11.2 % in the second quarter of CY 2005. The house price appreciation slowed down in 2006. The overturn started in the second quarter of 2007 and the average growth rate of house prices became negative in 2011. Since then, house price appreciation has stabilized for 10 years. During COVID-19 pandemic period of 2021 to 2022, house prices increased at a much higher appreciation rate due to the economic stimulation policy and then slowed down after the pandemic was over. In

2025 Q2 the annualized house price appreciation rate is -1.27%. Exhibit E-4 shows the average quarterly HPA by selected historical time periods.

Exhibit E-3 Historical National HPI and Annualized HPA

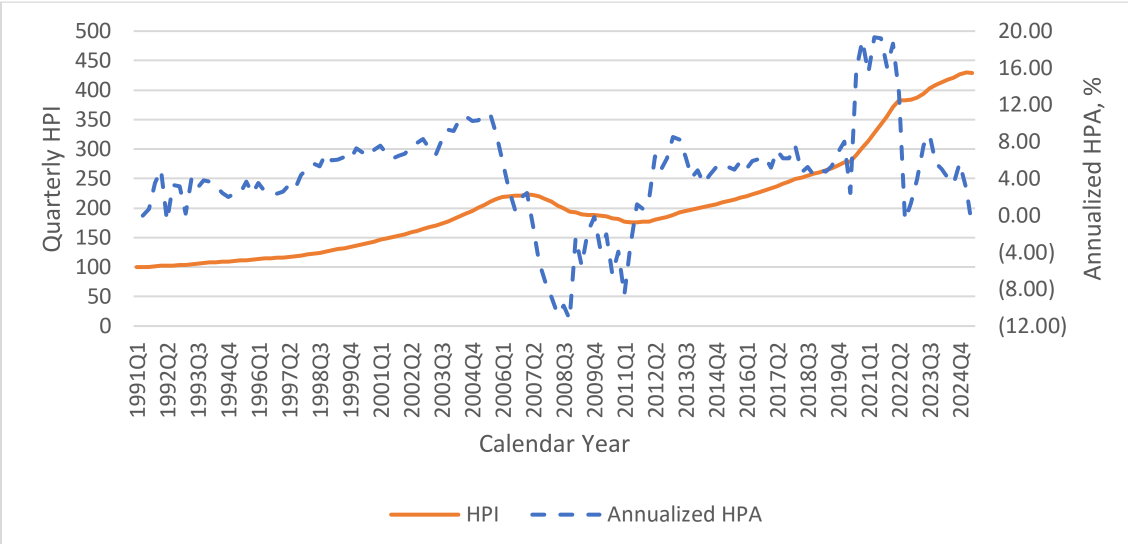


Exhibit E-4 Average Quarterly HPA by Time Span

Period	Average Annual HPA
1991 – 2003	4.64%
2004 – 2006	7.69%
2007 – 2011	-4.87%
2011 – 2020 Q2	5.26%
2020 Q3 – 2022 Q2	14.75%
2022 Q3 – 2025 Q2	3.89%

E2. Stochastic Models and the Simulated Scenarios

Economic variables, either monetary policy-driven or credit conditions driven, exhibit high jumps in volatility around regime shift. Stochastic models need to account for heteroscedastic volatilities in these economic indicators caused by high economic instability and uncertainty.

For these reasons an Autoregressive Moving Average (ARMA) - General Autoregressive Conditional Heteroscedasticity (GARCH) modeling is chosen for each economic variable. ARMA-GARCH models combine two types of time series models: Autoregressive Moving Average (ARMA) models for the mean and Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models for the variance. This approach is used when dealing with time series data that exhibits both autocorrelation (dependence of a value on its past values) and volatility clustering (periods of high volatility followed by periods of low volatility).

Stationarity is very important in forecasting. It enables the use of simpler and more accurate models to provide a solid foundation for forecasting future values. Non-stationary data, on the other hand, can lead to misleading results and inaccurate predictions because its statistical properties change over time, making it difficult to identify true trends and patterns. Therefore, ADF and KPSS) test for stationarity were performed on all variables before specifying GARCH candidate models for the velocities.

BL tests are performed to the residuals of candidate models to identify the presence of autocorrelation (serial correlation) in the residuals of a fitted model. It assesses the overall autocorrelation up to a specified lag, rather than individual lags, to identify the best model. The following is the detailed description of the chosen univariate ARMA-GARCH model for each economic variable:

E2.1. 1-Year Treasury Rate

Several Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models are tested using historical 1-year CMT rates from fiscal year 1991 Q1 to CY 2025 Q2. Based on the AIC, BIC, and Likelihood values, the best fitted model is an AR(2)- GARCH(1,1) with student's t-distribution innovations and external regressor for conditional volatility.

Let $r_{1,t}$ be the one-year Treasury rate at time t. The stochastic process takes the following form:

$$\Delta r_{1,t} = \sum_{i=1}^{3} a_{1,i} \Delta r_{1,t-i} + \sum_{i=1}^{5} b_{1,i} e_{1,t-i} + \varepsilon_t$$

where $\varepsilon_t = \sigma_t z_t$. $z_t = \sqrt{\frac{v-2}{v}} T_v$, where T_v follows a student's distribution with degrees of freedom $v > 2$, and variance ${\sigma_t}^2$ follows a GARCH (1, 1) model,

$$ {\sigma_t}^2 = \omega + \alpha {\varepsilon_{t-1}}^2 + \beta {\sigma_{t-1}}^2 $$

The estimated results are presented in Exhibit E-5.

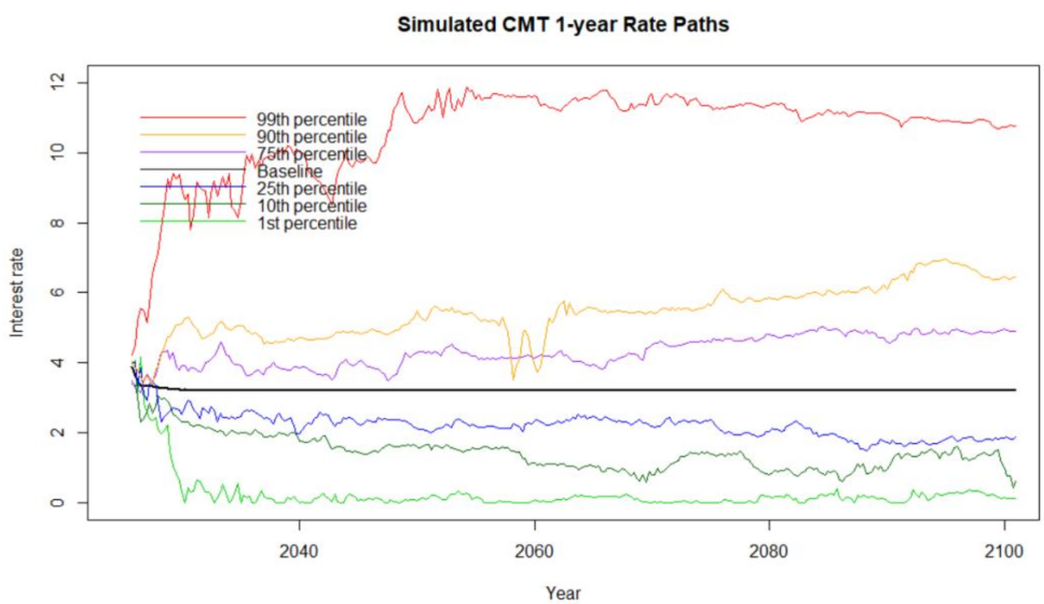
Exhibit E-5 Estimation Results for 1-Year Rate Model

Parameter	Estimate	Std. Error	t value	Pr(>|t|)
$a_{1,1}$	0.803108	0.176112	4.56022	0.000005
$a_{1,2}$	0.579228	0.184815	3.13409	0.001724
$a_{1,3}$	-0.49987	0.128146	-3.90076	0.000096
$b_{1,1}$	-0.26406	0.185094	-1.42663	0.153686
$b_{1,2}$	-0.9273	0.158987	-5.83256	0
$b_{1,3}$	0.401383	0.122984	3.26371	0.0011
$b_{1,4}$	0.260129	0.100466	2.58922	0.009619

Parameter	Estimate	Std. Error	t value	Pr(>|t|)
$b_{1,5}$	-0.23893	0.089023	-2.68393	0.007276
ω	0.000461	0.000525	0.87677	0.380609
α	0.321652	0.064511	4.98597	0.000001
β	0.677348	0.046941	14.42966	0.000001
υ	5.422451	1.199048	4.5223	0.000001

The model based on these parameters is used to simulate the one-year Treasury rates for the forecast period starting in FY 2025 Q3. When the simulation is implemented, the conditional mean is replaced by the PEA baseline forecast. This simulation method is to ensure the stochastic path of future 1-year Treasury rate is centered on the PEA baseline forecast. We applied the same procedure for the conditional mean in the 10-year Treasure rate, SOFR and HPA rate.

1000 paths of the future 75 years[12] of 1-year Treasury rates are simulated. The 1st, 10th, 25th, 75th, 90th , and 99th percentiles[13] paths are displayed. The 50th percentile path is close to the baseline forecast and replaced by the PEA baseline assumption. The resulting forecasts for the one-year Treasury rates are shown in the following chart for the baseline PEA and the four alternative stochastic percentile paths.



[12] The number of projection years is 50 in 2025 Actuarial Review.
[13] The 1st and 99th percentiles of all variables are displayed for reference, not included in computing the NPV.

E2.2. 10-Year Treasury Rate

The 10-year Treasury rate is modeled by adding a stochastic spread term to the simulated 1-year Treasure rate. We estimate the dynamics of the spread between the 10-year Treasury rate and 1-year Treasury rate from historical data.

The best model is chosen based on stationarity test, Ljung-Box test on standardized residuals, and Ljung-Box test on standardized squared residuals, together with the AIC, BIC, and likelihood values, the best fitted GARCH model is ARMA(2, 2) - GARCH(1,1).
Let $s_{10,t}$ be the spread between the 10-year and one-year Treasury rates at time t. Mathematically, the model for $s_{10,t}$ is as follows.

$$s_{10,t} = a_{10,0} + \sum_{i=1}^{2} a_{10,i} s_{10,t-i} + \sum_{i=1}^{2} b_{10,i} e_{1,t-i}$$

where ε_t is a normal innovation with mean 0 and variance ${\sigma_t}^2$ following a GARCH (1, 1) model,

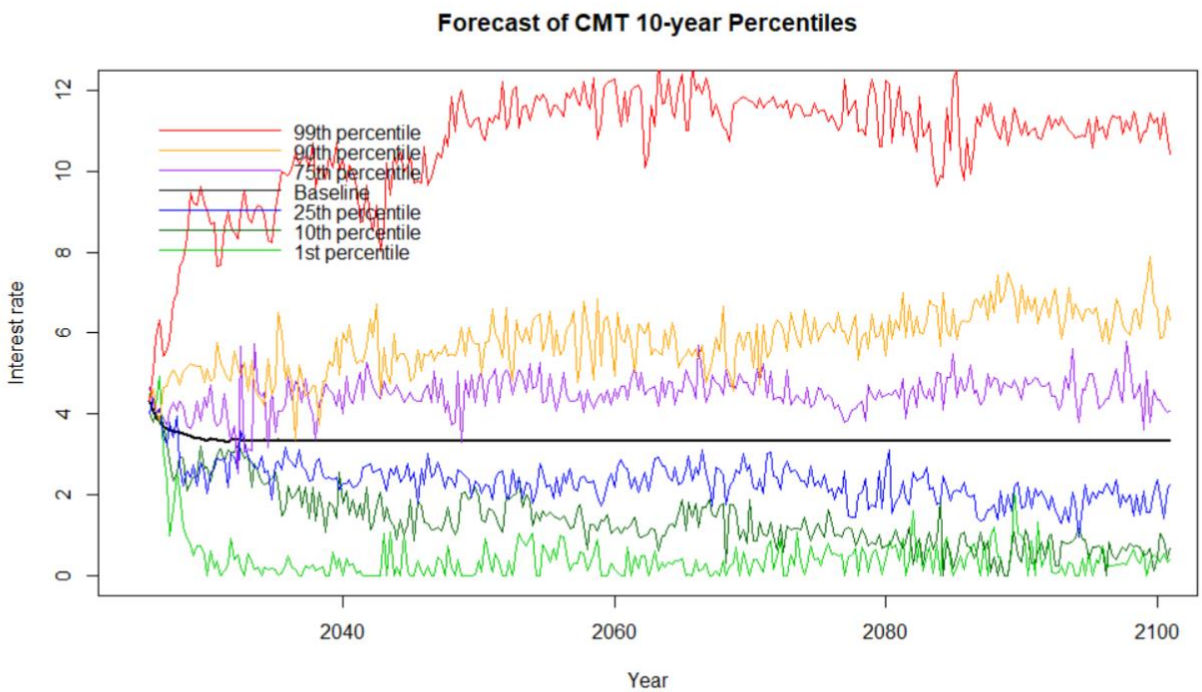
$${\sigma_t}^2 = \omega + \alpha {\varepsilon_{t-1}}^2 + \beta {\sigma_{t-1}}^2$$

The model is estimated based on historic spread data from CY 1970 Q1 to CY 2025Q2. parameters are shown in the following Exhibit E-6.

Exhibit E-6 Estimation Results for 10-Year Rate Spread Model

	Estimate	Std. Error	t value	Pr(>|t|)
$a_{10,0}$	0.770408	0.242655	3.1749	0.001499
$a_{10,1}$	1.62748	0.103137	15.7798	0
$a_{10,2}$	-0.68056	0.096812	-7.0297	0
$b_{10,1}$	-0.28468	0.136712	-2.0823	0.037314
$b_{10,2}$	-0.11635	0.086099	-1.3514	0.176578
ω	0.009441	0.005299	1.7818	0.07479
α	0.221746	0.076849	2.8855	0.003908
β	0.736279	0.075965	9.6924	0

We used the estimated parameters to simulate the spread between the 10-year and 1-year Treasury rates with the conditional mean equal to the PEA baseline forecast, such that the 1000 simulated paths are centered on the baseline estimation. The simulated spread percentile paths are added to the corresponding 1-year CMT percentile paths. Percentile paths are obtained therein. The 1st, 10th, 25th, 75th, 90th , and 99th percentiles paths, together with the PEA baseline assumption for the ten-year Treasury rates are shown in the following chart.



E2.3. 1-Month Treasury Rate

The best model is chosen based on stationarity, Ljung-Box test on standardized residuals, and Ljung-Box test on standardized squared residuals is ARMA(2, 1)-GARCH(1,1)

$$s_{1m,t} = a_{1m,0} + \sum_{i=1}^{2} a_{1m,i} s_{10,t-i} + b_{1m,1} e_{1,t-1} + \varepsilon_t$$

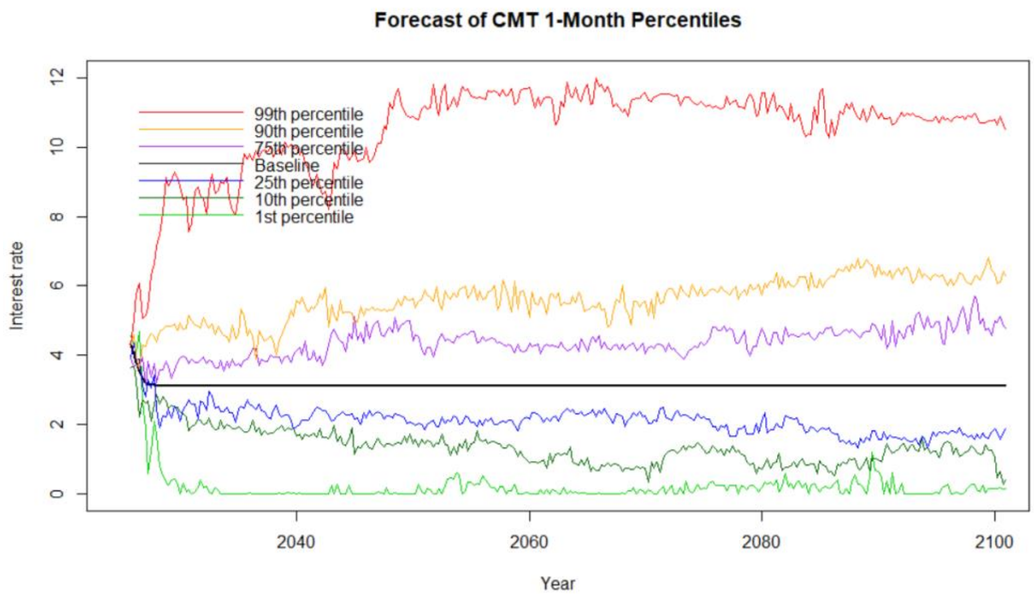
where $\varepsilon_{m,t}$ is a normal innovation with mean 0 and variance ${\sigma_t}^2$ follows a GARCH (1, 1) model,

$${\sigma_t}^2 = \omega + \alpha {\varepsilon_{t-1}}^2 + \beta {\sigma_{t-1}}^2$$

The model is estimated based on historic spread data from CY 2001 Q3 to CY 2025Q2. parameters are shown in the following Exhibit E-7.

Exhibit E-7 Estimation Results for 1-Month Rate Spread Model

	Estimate	Std. Error	t value	Pr(>|t|)
$a_{1m,0}$	-0.29547	0.0034	-86.9139	0
$a_{1m,1}$	1.730934	0.006297	274.8782	0
$a_{1m,2}$	-0.77172	0.006865	-112.412	0
$b_{1m,1}$	-1	0.002583	-387.15	0
ω	0.000723	0.000821	0.88055	0.378562
α	0.283141	0.085757	3.30167	0.000961
β	0.715858	0.06521	10.97773	0



E2.4. 12-Month SOFR

The 12-Month SOFR is modeled by simulating a spread percentile path added to the simulated 1-year Treasure rate. The dynamics of the 12-Month SOFR spread from historic data fails the augmented ADF test for stationarity, same to the 6-Month SOFR spread and 1-Month SOFR spread. The first order of difference is taken to get a stationary time series. The best fitted GARCH model is chosen based on Ljung-Box test on standardized residuals, Ljung-Box test on standardized squared residuals, the AIC, BIC, and likelihood values.

Let $\Delta s_{s12,t}$ be the first order of difference of the spread between the 12-Month SOFR and 1-year CMT rates at time t and $r_{1,t}$ 1-year CMT rate at time t, the best fitted model for 12-Month SOFR spread rate is an GARCH (1,1) model with Student's distribution innovations:

$$\Delta s_{s12,t} = \varepsilon_{s12,t}$$

where $\varepsilon_{s12,t} = \sigma_t z_t$ and innovations $z_t = \sqrt{\frac{v-2}{v}} T_v$, where T_v follows a student's distribution and variance ${\sigma_t}^2$ follows a GARCH (1, 1) model,

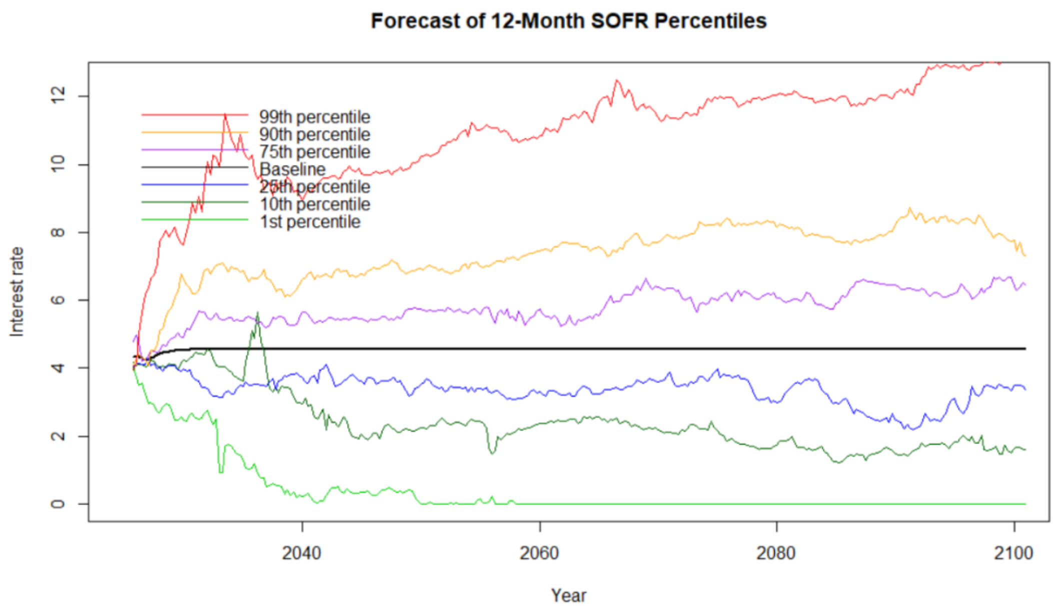
$${\sigma_t}^2 = \omega + \alpha {\varepsilon_{s12,t-1}}^2 + \beta {\sigma_{t-1}}^2$$

Moody's historical 12-Month SOFRs published in 2025, dated back to 2006 Q1. Using historical data from CY 2006 Q1 to CY 2025Q2, the estimated parameters are shown in Exhibit E-8.

Exhibit E-8 Estimation Results for the 12-Month SOFR Spread Model

	Estimate	Std. Error	t value	Pr(>|t|)
ω	0.000724	0.000587	1.2327	0.217683
α	0.58149	0.318698	1.8246	0.068064
β	0.41751	0.171547	2.4338	0.014941
v	3.538182	1.165729	3.0352	0.002404

We used the estimated parameters to simulate the 12-Month SOFR spread rate with the conditional mean equal to the baseline spread. The simulated spread percentile paths are added to the simulated 1-year CMT percentile paths. The 12-Month SOFR percentile paths are obtained therein as shown in the following chart.



E2.5. 6-Month SOFR

The first order of difference is taken to ensure stationarity in time series. Let $\Delta s_{s6,t}$ be the first order of difference of the spread between the 6-Month SOFR and 1-year CMT rates at time t and $r_{1,t}$ 1-year CMT rate at time t, the best fitted model for 6-Month SOFR spread rate is an GARCH (1,1) model with Student's distribution innovations:

$$\Delta s_{s6,t} = \varepsilon_{s6,t}$$

where $\varepsilon_{s6,t} = \sigma_t z_t$ and innovations $z_t = \sqrt{\frac{v-2}{v}} T_v$, where T_v follows a student's distribution and variance ${\sigma_t}^2$ follows a GARCH (1, 1) model,

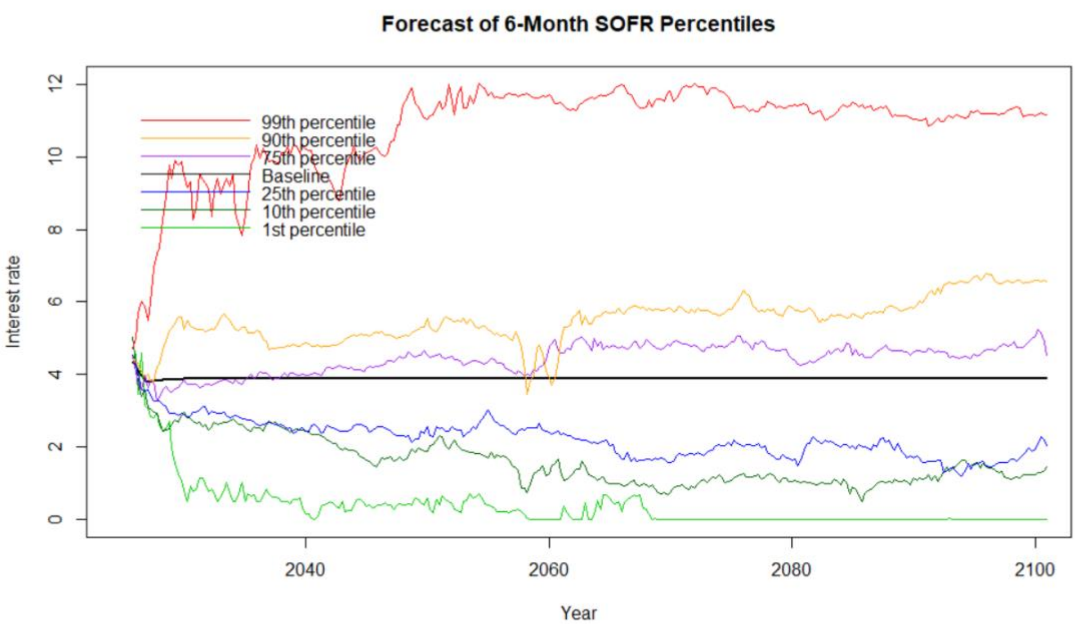
$$\sigma_t^{\ 2} = \omega + \alpha\varepsilon_{s6,t-1}^{\ \ 2} + \beta\sigma_{t-1}^{\ \ 2}$$

Moody's historical 6-Month SOFRs dated back to 2006 Q1. Using historical data from CY 2006 Q1 to CY 2025Q2, the best fitted GARCH model is chosen based on Ljung-Box test on standardized residuals, Ljung-Box test on standardized squared residuals, the AIC, BIC, and likelihood values. The estimated parameters are shown in Exhibit E-9.

Exhibit E-9 Estimation Results for the 6-Month SOFR Spread Model

	Estimate	Std. Error	t value	Pr(>|t|)
ω	0.000371	0.000474	0.78211	0.434151
α	0.434046	0.153801	2.82212	0.004771
β	0.564954	0.140785	4.01288	0.00006
v	4.224123	1.554335	2.71764	0.006575

We used the estimated parameters to simulate the 6-Month SOFR spread rate with the conditional mean equal to the baseline spread. The simulated spread percentile paths are added to the simulated 1-year CMT percentile paths. The 6-Month SOFR percentile paths are obtained therein as shown in the following chart.



E2.6. 1-Month SOFR

The first order of difference is taken to ensure stationarity in time series. Let $\Delta s_{s1,t}$ be the first order of difference of the spread between the 1-Month SOFR and 1-year CMT rates at time t

and $r_{1,t}$ 1-year CMT rate at time t, the best fitted model for 1-Month SOFR spread rate is an AR(1)-GARCH (1,1) model with Student's distribution innovations:

$$\Delta s_{s1,t} = a_{s1,1}\Delta s_{s1,t-1} + \varepsilon_{s1,t}$$

where $\varepsilon_{s1,t} = \sigma_t z_t$ and innovations $z_t = \sqrt{\frac{v-2}{v}}T_v$, where T_v follows a student's distribution and variance ${\sigma_t}^2$ follows a GARCH (1, 1) model,

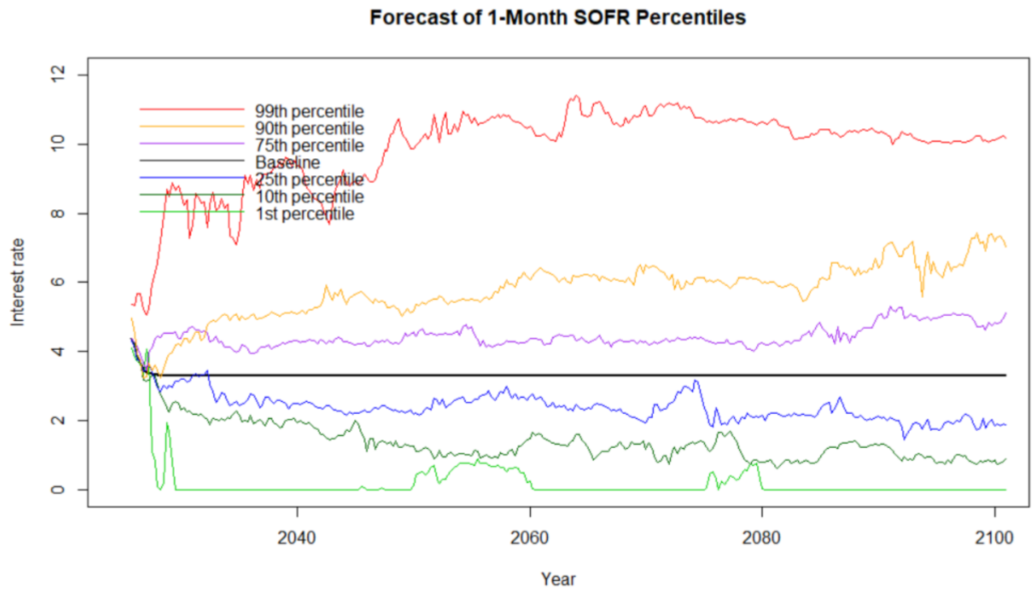
$${\sigma_t}^2 = \omega + \alpha{\varepsilon_{s1,t-1}}^2 + \beta{\sigma_{t-1}}^2$$

Moody's historical 1-Month SOFRs dated back to 2006 Q1. The best fitted GARCH model is chosen based on Ljung-Box test on standardized residuals, Ljung-Box test on standardized squared residuals, the AIC, BIC, and likelihood values. The estimated parameters are shown in Exhibit E-10.

Exhibit E-10 Estimation Results for the 1-Month SOFR Spread Model

	Estimate	Std. Error	t value	Pr(>|t|)
$a_{s1,1}$	0.189847	0.120215	1.5792	0.114285
ω	0.000688	0.000954	0.7215	0.470605
α	0.434875	0.163349	2.6622	0.007762
β	0.564125	0.170833	3.3022	0.000959
v	3.599493	0.818116	4.3997	0.000011

We used the estimated parameters to simulate the 1-Month SOFR spread rate with the conditional mean equal to the baseline spread. The simulated spread percentile paths are added to the simulated 1-year CMT percentile paths. The 1-Month SOFR percentile paths are obtained therein as shown in the following chart.



E2.7. House Price Appreciation Rates

E2.7.1. National HPA

Several GARCH models are fitted to the historical house appreciation rates and its first order of difference and one-year rollover forecast test is conducted to evaluate the models. Based on the ADF and KPSS tests for stationarity and the forecast evaluation, the AR(2)-GARCH(1,1) model is recommended as the most statistically adequate and interpretable choice.

$$HPA_t = a_{h,1}HPA_{t-1}+a_{h,2}HPA_{t-1} + \varepsilon_{h,t}$$

where $\varepsilon_{h,t}$ is a skewed t-distributed innovation with variance ${\sigma_t}^2$ modelled by a GARCH (1, 1) model,

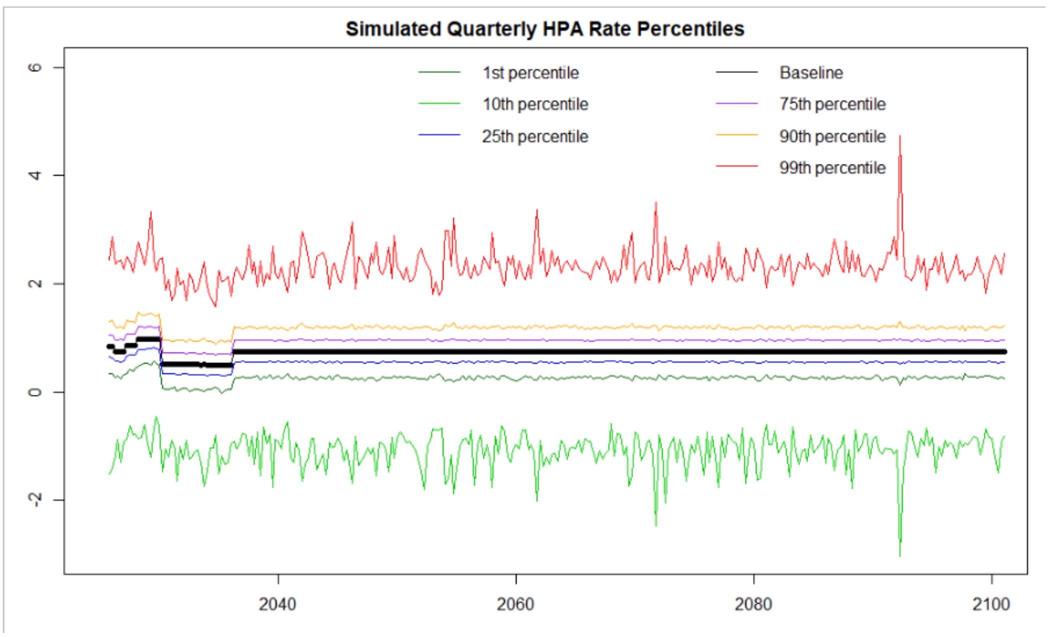
$${\sigma_t}^2 = \omega + \alpha{\varepsilon_{h,t-1}}^2 + \beta{\sigma_{t-1}}^2$$

The GARCH (1,1) model with skewed t-distributed innovations performs much better than the one with normal innovations in this model. Using the historic data from 1991Q1 to 2025Q2, we estimate the model and have the results as shown in Exhibit E-11.

Exhibit E-11 Estimation Results for the National HPA Model

	Estimate	Std. Error	t value	Pr(>|t|)
$a_{h,1}$	0.795566	0.071199	11.1739	0
$a_{h,2}$	0.205915	0.073178	2.8139	0.004894
ω	0.019701	0.012255	1.6075	0.107935
α	0.462428	0.207614	2.2273	0.025924
β	0.536572	0.163344	3.2849	0.00102
skew	0.851692	0.085036	10.0157	0
shape	4.421421	1.38624	3.1895	0.001425

We used the best fitted model to simulate 1000 future HPA paths starting from 2025 Q3, with the conditional mean equal to the PEA baseline forecast and obtain the 1st, 10th, 25th, 75th, 90th, and 99th percentile paths of the future quarterly HPA rates. Since the high volatility in HPA rates, the obtained percentile paths cross each other. Recall that the percentile path is identified to the simulated path who is closest to the quantile path, and the quantile path has every point being the corresponding percentile among the simulated values in each individual quarter. To avoid the situation of crossing simulated percentile paths, we end up with setting the HPA percentile paths to be the ranked percentile of simulated HPA rates at each individual quarter, as shown in the following chart.



E2.7.2. 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 baseline estimates 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:

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

This approach retains the relative current housing market cycle among different geographic locations, and it allows us to capture the geographical concentration of FHA's current endorsement portfolio. This approach is also consistent with Moody's logic in creating local market HPA forecasts relative to the national HPA forecast under alternative economic scenario forecasts. 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.

E3. COVID-19 Pandemic Consideration

The impact from the COVID-19 pandemic is noticeable and dramatic when analyzing these economic indicators, causing higher volatility in these economic variables. Abrupt changes in the recent historic data of these economic measures present additional challenges when fitting stochastic models. Because of the historic nature of this event and the changing economic environment before and after the pandemic, it is difficult to ascertain which impacts might be attributed solely to the pandemic, and whether these changes will persist in the future or revert to pre-pandemic conditions. Rather than apply different models including and excluding the pandemic period to interpret COVID-19 impacts, we use customized GARCH models for the individual economic variables to capture the high volatility of the COVID-19 period and subsequent economic changes in the data and to develop the simulated diversions from the PEA baseline assumptions.

The 2022 HECM Actuarial Review reported that there were no changes in portfolio composition or borrower behavior evident in the recent data; therefore, based on the information available at that time, no adjustments were undertaken to account for potential COVID-19 impacts, except the unemployment rates which had abnormal outliers during pandemic period. With 2025 economic data, the best fitted GARCH models have similar structures to the corresponding models used in 2023 and 24 Actuarial Review, with slightly changed parameters based on model validation test results. This evidences that GARCH models can capture the volatilities in various economic variables, including the impact of COVID-19. Therefore, we continue to use this approach for the FY 2025 review.

Appendix F. Comparison of HUD and ITDC Models and Assessment of Vulnerabilities

As part of the statutory actuarial review process, this report includes an addendum presenting the results of the review of HUD's HECM models. The addendum is provided in the attachments section of this report and includes supplemental documentation and analysis necessary to support enhanced transparency and completeness of the actuarial review.

Appendix G. Tables of Historical and Projected Loan Termination Rates

Note: The relevant tables are provided in a separate file along with this document.