An Actuarial Analysis of
FHA Home Equity Conversion Mortgage Loans
In the Mutual Mortgage Insurance Fund
Fiscal Year 2009

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By

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Executive Summary

The U.S. Department of Housing and Urban Development (HUD) provides reverse mortgage insurance through the Home Equity Conversion Mortgage (HECM) program. HECM enables senior homeowners to obtain additional income by accessing the equity in their homes. The program began as a pilot program in 1989 and became a permanent program in 1998. Since 2003, the number of HECM endorsements has been steadily growing due to increasingly widespread product knowledge, lower interest rates, higher home values, and higher HUD loan limits. Prior to fiscal year (FY) 2009, the HECM program was part of the General Insurance Fund (GI). The Federal Housing Administration (FHA) Modernization Act within the Housing and Economic Recovery Act of 2008 (HERA)[1] moved all new HECM program endorsements to the Mutual Mortgage Insurance (MMI) Fund effective in FY 2009.

The 1990 National Affordable Housing Act (NAHA) required an independent annual actuarial study of FHA's MMI Fund. In accordance with NAHA, an actuarial review must also be conducted on HECM books-of-business within the MMI Fund. This document reports the estimated economic value of the HECM FY 2009 book-of-business and forecasts for the FY 2010 to FY 2016 insurance cohorts. Our projections indicate that there are sufficient capital resources to meet the anticipated liabilities associated with the HECM portion of the MMI fund.

A. Status of the HECM Portfolio

In order to assess the adequacy of the current and future capital resources to meet estimated cash outflow requirements, we analyzed all HECM historical terminations and associated recoveries using loan-level HECM data reported by HUD through June 30, 2009. Based on this experience, we developed loan termination models to estimate the relationship between HECM terminations and various economic and loan-specific factors. We then estimated the future cash flows associated with the FY 2009 to FY 2016 books-of-business using various assumptions; including macroeconomic forecasts from Global Insight, Inc. and the expected HECM portfolio characteristics provided by HUD.

Using these projections, we estimate the economic value of the HECM portion of the MMI fund at the end of FY 2009 to be $909 million. We also estimate that the economic value of the HECM portfolio will continue to increase over time with the addition of new books-of-business and improvements in forecasted economic conditions. The estimated economic value at the end of FY 2016 is $19.8 billion.

The insurance-in-force (IIF) is expressed as the total maximum claim amounts (MCA) of the active portfolio. The MCA of each loan is the minimum of the appraised value and FHA's loan limit at the time of origination. The MCA of all active insured loans represents HUD's maximum risk exposure to the portfolio. As new endorsements are added to the portfolio, projected HECM IIF increases from $28.7 billion in FY 2009 to $162.9 billion in FY 2016. The economic value of the HECM portfolio in the MMI fund is projected to grow at a faster rate than the insurance-in-force, representing an increasing ratio of the program's present value to its insurance risk over time. Table ES-1 provides the economic value, MCA, and endorsements for FY 2009 to FY 2016.

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

Table ES-1: Economic Value, Insurance-in-Force, and Endorsements
For FY 2009 to FY 2016 ($ Millions)

Fiscal Year[1]	Economic Value	Insurance-in-Force[2]	Volume of New Endorsements[3]	Economic Value of Each New Book-of-Business	Investment Income
2009	$909	$28,696	$29,053	$909	$0
2010	1,875	51,016	26,266	964	2
2011	3,629	70,830	25,247	1,718	36
2012	5,921	90,688	26,885	2,190	102
2013	8,827	109,980	29,212	2,745	162
2014	12,037	128,543	31,676	2,945	265
2015	15,739	146,137	34,829	3,322	380
2016	19,830	162,868	38,264	3,601	490

1. All values, except the volume of new endorsements, are expressed as of the end of the fiscal year.
2. Insurance-in-force is estimated as the sum of the maximum claim amounts of the remaining insured loans.
3. Projections provided by HUD. Endorsement amount is expected to decrease in FY 2010 and FY2011 due to the house price depreciation projection and the discontinuation of the temporary increase in the FHA loan limit.

On September 23, 2009, HUD announced a 10 percent reduction in the principal limit factors for all loans originated in FY 2010.[2] The announcement was made after the economic value analysis of this review and the impact of the PLF reduction is not included in these estimates. The principal limit factor reduction decreases the ratio of the amount of initial equity available to the MCA at origination, and is expected to reduce HUD's insurance risk. As a result, with all other modeling assumptions held constant, the actual economic value of the FY 2010 book-of-business is expected to be greater than the estimate presented in this review.

B. Impact of Economic and Loan Factors

The projected economic value of the HECM portion of the MMI Fund depends on various economic and loan-specific factors. These include the following:

- House Price Appreciation: Impacts the recovery HUD receives on terminations and the rate at which borrowers will refinance or move out of the property.
- One-year and ten-year Treasury interest rates: Impact the growth rate of the loan balance and the amount of equity available to the borrower at origination.[3]
- Mortality Rates: Impact loan terminations due to borrower's death.
- Cash Draw Down Rates: Represents the speed at which borrowers access the equity in their homes over time, which impacts the growth rate of the loan balance.

For this analysis, the near-term economic projections used are from the Global Insight, Inc. August 2009 ten-year forecast, and the long-term projections used are from Global Insight, Inc. June 2009 thirty-year forecast. Mortality rates are obtained from the U.S. Decennial Life Table for 1999-2001 published by the

[2] Mortgagee letter 09-34, published on September 23, 2009.
[3] According to the Principal Limit Factor (PLF) table, the PLF increases with borrower age at origination and decreases with the expected mortgage interest rate (with the exception that PLFs are the same for expected rate less than or equal to 5.5 percent given a borrower age). It represents the ratio of the equity amount available to the borrower to the MCA at origination.

Centers for Disease Control and Prevention (CDC) in 2004. Borrower cash draw rates are derived from past HECM program experience with adjustments to account for the expected borrower characteristics of future books-of-business.

The realized economic value will vary from this Review's baseline estimates as the actual factors deviate from the projections used. Therefore, we conducted a sensitivity analysis to assess the impact of changes in these factors on the economic value of the HECM portfolio. We examined the following scenarios:

- More Pessimistic House Price Forecast
- Interest Rate Upward Shock
- Interest Rate Downward Shock
- Less Pessimistic House Price Forecast
- Slower Mortality
- Faster Cash Draws

Table ES-2 presents the economic value under the base case assumptions and the various alternative scenarios. House price appreciation has the most significant impact on the economic value of the HECM portfolio. For all insurance cohorts analyzed, the economic value moves proportionally to house prices. All the scenarios examined in this Review estimate the economic value of the MMI HECM portfolio to increase in future years. This indicates that capital resources will be sufficient to meet anticipated liabilities. Furthermore, all of the scenarios are estimated to result in a rising ratio of the economic value to insurance-in-force over the time frame of this study.

Table ES-2: Economic Value for FY 2009 to FY 2016
Under Various Economic and Loan Scenarios ($ Millions)

Fiscal Year[(1)]	Economic Value						
	Base Case	More Pessimistic House Price Forecast	Increase Rate Upward Shock	Interest Rate Downward Shock	Less Pessimistic House Price Forecast	Slower Mortality	Faster Cash Draws
2009	$909	$194	$531	$1,142	$1,685	$918	$994
2010	1,875	677	1,908	2,134	3,377	1,932	1,754
2011	3,629	2,408	3,635	3,900	5,321	3,739	3,305
2012	5,921	4,666	5,500	6,278	7,661	6,106	6,084
2013	8,827	7,538	8,395	9,195	10,615	9,118	9,371
2014	12,037	10,709	11,592	12,416	13,878	12,421	12,707
2015	15,739	14,369	15,280	16,129	17,638	16,208	16,197
2016	19,830	18,417	19,357	20,232	21,788	20,364	20,480

1. All values, except the volume of new endorsements, are expressed as of the end of the fiscal year.

Lastly, it is important to note that the results of this analysis are sensitive to the interest rates used for discounting future cash flows. This Review utilized the interest rates used by Federal agencies in preparing their FY 2010 budget, as provided by the Office of Management and Budget. These interest rates are projections of future economic conditions and they are lower than interest rates experienced in most historical years of program experience.[4] Interest rate assumptions are critical to economic value

[4] The discount factors published by OMB for the FY 2010 budget are based on a relatively flat yield curve assumption, reflecting the current interest rate environment.

calculations because of the time delay between claim payments and ultimate recoveries to HUD when most borrowers move and properties are sold. If future interest rates are higher than those used in these calculations, then the actual economic value of the HECM portfolio will be less than the estimations here, given that all other modeling assumptions remain the same.

Section I. Introduction

A. Implementation of NAHA and HERA

The 1990 National Affordable Housing Act (NAHA) requires an annual independent actuarial study of the Federal Housing Administration's (FHA) Mutual Mortgage Insurance (MMI) Fund. The review should estimate the economic value of the MMI Fund to determine whether the NAHA capital requirements have been met. The review should also estimate the capital ratio, which is defined by NAHA as the ratio of the Fund's economic net worth to its insurance-in-force (IIF). FHA has conducted an actuarial review of the MMI Fund since 1990.

The FHA Modernization Act within the Housing and Economic Recovery Act of 2008 (HERA)[1] moved all new endorsements for FHA's Home Equity Conversion Mortgage (HECM) program from the General Insurance (GI) Fund to the MMI Fund starting in fiscal year (FY) 2009. Therefore, in accordance with NAHA, an actuarial review must also be conducted on HECM books-of-business within the MMI Fund. This document reports the estimated economic value of the FY 2009 HECM book-of-business and includes projections for FY 2010 to FY 2016 books-of-business. This review also provides the HECM portion of the economic net worth and IIF used to assess the overall MMI capital ratio. The analysis utilizes historical loan performance data and expected future HECM originations provided by the U.S. Department of Housing and Urban Development (HUD), as well as forecasts of future economic conditions from Global Insight, Inc.

B. Program Overview

HUD provides reverse mortgage insurance through the HECM program, which enables senior homeowners to obtain additional income by accessing the equity in their homes. Since the inception of the HECM program in 1989, HUD has insured more than 500,000 reverse mortgages. To be eligible for a HECM, a homeowner must be 62 years of age or older, have a low or zero outstanding mortgage balance, and must have received HUD-approved reverse mortgage counseling to learn about the program. HECM is available from HUD-approved lending institutions. It provides homeowners with cash payments or credit lines secured by their home's equity, and require no repayment as long as the borrower continues to live in the home and meet 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.

The reverse mortgage insurance provided by HUD through the HECM program protects lenders from losses due to non-repayment. When a loan terminates and the loan balance is greater than the value of the home, the lender can file a claim for the amount of loss up to the maximum claim amount (MCA), which is defined as the minimum of the home's appraised value and the FHA loan limit at origination. A lender can also assign the mortgage note to HUD when the loan balance reaches 98 percent of the MCA and be reimbursed for the balance of the loan. When note assignment occurs, HUD switches from being the insurer to the holder of the note and services the loan until termination. At loan termination, HUD can recover the loan balance including any interest accrued. Without the loss protection provided by HUD insurance, lenders would need to increase interest rates or reduce the amount of principal available at closing to cover the additional financial risks posed by reverse mortgages. Moreover, HUD insurance protects borrowers from lenders' failure to advance funds.

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

The unique characteristics of the HECM program include:

1. Maximum Claim Amount (MCA)

MCA is the minimum of the appraised value of the home and the FHA loan limit at the time of origination. It is the maximum HECM insurance claim the lender can receive. The MCA is also used to calculate the amount of initial equity available to the borrower. A borrower's home can have an appraised value that exceeds the MCA, but the amount of equity HUD recognizes is capped by the loan limit. The MCA is determined at origination and does not change over the life of the loan. However, as a home appreciates over time, borrowers can access additional equity by refinancing. In the event of termination, the entire net sales proceeds of the home[2] can be used to pay off the outstanding loan balance, regardless of whether the maximum claim amount was capped by the HUD loan limit at origination.

2. Principal Limit and Principal Limit Factors (PLF)

HUD manages its insurance risk by limiting the percentage of equity available to the borrower by using the PLF. Conceptually, the PLF is similar to 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. Table I-1 illustrates a selected number of PLFs. The PLF increases with the borrower's age at origination[3] and decreases with the expected mortgage interest rate (with a floor of 5.5 percent).[4]

Table I-1: Selected Principal Limit Factors[5]

Expected Mortgage Interest Rate	Borrower Age at Origination		
	65	75	85
5.5%	0.649	0.732	0.819
7.0%	0.489	0.609	0.738
8.5%	0.369	0.503	0.660

The amount of equity available at origination is known as the initial principal limit and is calculated as the product of the PLF and the MCA. Over the course of the loan, the principal limit grows with the mortgage interest, mortgage insurance premium, and service fee. Once the HECM unpaid loan balance reaches the principal limit, no more cash advances are available.

3. Payment Plan

HECM borrowers access the equity available to them according to the payment plan they select. Borrowers can change their payment at any time during the course of the loan as long as they have not exhausted their principal limit. The payment plans are:

- Tenure plan: a fixed monthly cash payment as long as the borrower stays in the home
- Term plan: a fixed monthly cash payment over a specified number of years
- Line of credit: the ability to draw the remaining funds in the account at any time
- Combination of line of credit and tenure or term

[2] Net sales proceeds are the proceeds from selling the home less all eligible transaction costs.
[3] For couples, the age of the younger borrower is used to determine the corresponding PLF.
[4] The expected mortgage interest rate is defined as the sum of the ten-year interest rate at origination and the lender's margin for variable rate loans and is defined as the fixed mortgage interest rate for fixed rate loans.
[5] Further information on the principal limit factor can be found in the Appendix of HUD's Interim Report to Congress: Home Equity Conversion Insurance Demonstration, October 1990.

4. Unpaid Principal Balance (UPB) and Loan Costs

HECM differs from other mortgage insurance products as it requires no repayment as long as the borrower continues to live in the home and follows the HUD guidelines on property maintenance and real estate taxes and insurance. In general, the loan balance continues to grow with borrower cash draws, interest, premiums, and service fees until the loan terminates.[6] Borrowers can choose between a fixed or adjustable interest rate, and the adjustable rate can be adjusted annually or monthly.

The costs of a HECM can also be financed by adding them to the loan balance instead of paying for them out-of-pocket. These costs include origination fees, closing costs, mortgage insurance premiums, and annual servicing fees. The insurance premium is comprised of an upfront premium of two percent of the MCA and an annual fee of half a percent of the remaining mortgage balance.

5. Loan Terminations

HECM loans typically terminate because the borrower dies, the borrower's primary residence changes, the HECM is refinanced, or the house is sold. Other reasons for loan termination include when the borrower fails to pay property taxes or homeowners insurance, or when the borrower fails to follow HUD's guidelines in maintaining the condition of the home. When the loan terminates, the borrower is required to only pay back the current loan balance. If the proceeds from the sale of the home exceed the loan balance, the borrower or estate is entitled to the difference. If the proceeds from the sale of the property are insufficient to pay off the entire outstanding loan balance and the lender has not assigned the note, the lender can file a claim for the shortfall, capped by the MCA. The property is the only collateral for the loan, so HUD cannot use the borrower's other assets to cover any shortfall (non-recourse).

6. Assignment and Recoveries

The assignment option is a unique feature of the HECM program. When the balance of a HECM reaches 98 percent of the MCA, the lender can choose to terminate the HUD insurance by assigning the mortgage note. HUD will pay an assignment claim in the full amount of the loan balance (up to the MCA) and will continue to hold and service the note until termination. During the note holding period, the loan balance will continue to grow by incurring interest, premiums, and service fees. Borrowers can continue to draw cash as long as the loan balance is below the current principal limit. At loan termination, the borrowers or their estates are required to repay HUD the minimum of the loan balance and the net sales proceeds of the home.

C. FHA Policy Developments and Underwriting Changes

During FY 2009, FHA implemented several policy changes. In this section, we focus on two major changes in the HECM Program in FY 2009.

1. HECM for Purchase

HERA authorizes the use of HECM loan proceeds to purchase a principal residence. The maximum claim amount for the HECM loan in this case is the minimum of the property appraised value, the sales price, or the FHA mortgage limit for a one family residence.[7] HECM for Purchase borrowers

[6] Loan balance can also decrease or stay the same as the borrowers have the option to make partial or full repayment at any time of the loan.
[7] FHA Mortgagee Letters 08-33 and 09-11 published on October 20, 2008 and March 27, 2009, respectively.

are required to use cash on hand or cash from the sale or liquidation of their assets for the monetary investment required beyond the HECM proceeds.

Previously, borrowers who intended to use HECM proceeds to pay off the balance of a newly purchased home were required to first complete the transaction of the home purchase and then originate a HECM loan in a separate closing. The new policy allows the transaction to be processed in a single closing, reducing the associated transaction costs to borrowers. FHA has endorsed 178 HECM for Purchase loans from January 1, 2009 to June 30, 2009. HECM for Purchase borrowers tend to draw a larger portion of the available principal limit than other HECM borrowers. About 70 percent of the HECM for Purchase loans took more than 90 percent of the principal limit within the first month of closing.

2. Loan Limits

The HECM program had several loan limit changes during FY 2009. Prior to legislative changes in 2008, the HECM program followed the FHA single-family loan limits. The Economic Stimulus Act of 2008 (ESA) temporarily increased the single-family loan limit to 125 percent of the area median house price.[8] However, this temporary increase did not apply to the HECM Program and hence HECM loan limits in the beginning of FY 2009 remained at 95 percent of the area median house price.[9]

Subsequently, the passage of HERA allowed the HUD Secretary to increase the HECM loan limit to a national limit matching the GSE Conforming Loan Limit of $417,000, effective November 6, 2008. This did not include Alaska, Hawaii, Guam, or the Virgin Islands, who had a loan limit of the minimum of 115 percent of the area median house price and 150 percent of the GSE Conforming Loan Limit ($625,500). HERA was followed by the American Recovery and Reinvestment Act of 2009 (ARRA)[10], which mandated a temporary increase in the HECM loan limit to $625,500 nationwide, effective February 17, 2009 through December 31, 2009.

With the increase in the FHA loan limit, more borrowers with high-valued homes will originate a HECM loan, and borrowers that were previously restricted by the FHA loan limit can now access more of their equity.

D. Current and Future Market Environment

This section discusses the recent and projected market environment and the implications for the HECM program.

1. House Price Growth Rate

National average house price growth rate forecasts from the end of FY 2009 to FY 2019 are obtained from the Global Insight, Inc. August 2009 ten-year forecast. The forecasts for FY 2020 and later are obtained from the Global Insight, Inc. June 2009 thirty-year forecast. According to the forecast, the annual average house price growth rate during FY 2009 is projected to be negative 3.9 percent. The housing market is expected to continue its decline in FY 2010 with a negative 6.9 percent growth rate. The highest four-quarter decline is also forecasted in FY 2010 with a negative 8.7 percent growth rate

[8] With a floor of $271,150 and a ceiling of $729,750, except Alaska, Hawaii, Guam and the Virgin Islands.
[9] With a floor of $200,160 and a ceiling of $362,790, except Alaska, Hawaii, Guam and the Virgin Islands.
[10] ARRA was passed by the United States congress on February 13, 2009 and signed by President Barrack Obama on February 17, 2009.

in the third quarter. Under the current forecast, national house prices will begin to experience positive growth starting in the third quarter of FY 2011. The forecast suggests house price appreciation will steadily increase to around positive 5 percent by FY 2015 and will return to a long-run average of about 3.3 percent by FY 2023.

The continued deterioration in house prices affects the HECM portfolio in several ways. Recoveries on terminations will be lower in a low house price growth environment. However, as early HECM terminations are relatively rare, the impact of near-term house price declines on the FY 2009 HECM portfolio is expected to be limited. House price growth is forecasted to improve by the time the majority of the terminations are expected to occur. At the same time, a low house price forecast also reduces the additional equity that would be available through refinancing. This lowers the likelihood of refinance terminations in the near term. See Appendix A for a detailed discussion on HECM termination patterns.

For future books-of-business, the forecasted house price depreciation will reduce the amount of equity available to future HECM borrowers. This can potentially lower the attractiveness of HECM as a retirement-financing option and impact future HECM demand in the near term.

2. Interest Rates

According to Federal Reserve Board statistics, in early 2009 the U. S. Treasury note rate reached its lowest point since the 1950s. In January 2009, the ten-year and one-year U.S. Treasury note rates were 2.52 percent and 0.44 percent and increased to 3.72 percent and 0.51 percent in June 2009, respectively. Similarly, the London Interbank Offered Rate (LIBOR) ten-year rate has been steadily decreasing since 2008 and reached a historic low of 2.66 percent in January 2009 before increasing back to 4.00 percent in June 2009. The one-year LIBOR rate has also remained relatively low in 2009 at 1.90 percent and 1.68 percent in January 2009 and June 2009, respectively.

The expected mortgage interest rate (expected rate), which is calculated as the sum of the ten-year rate and the lender's margin for a variable rate HECM, affects the percentage of equity available to borrowers. The PLF increases as the expected rate declines for a given borrower age. Global Insight, Inc. has forecasted the ten-year Treasury rate to rise steadily and stabilize at around 5.5 percent by FY 2014.[11] The ten-year Treasury rate forecast implies a continued low interest rate environment, which enables borrowers to access a larger percentage of their home equity. However, even though the ten-year treasury rates remain at low levels, lender's margins have recently been increasing. This increase may partially offset the impact of low interest rates and limit the increase in equity available to borrowers.

The majority of HECM loans are monthly-adjustable rate loans (see Section IV for a detailed breakdown). The mortgage interest rate for adjustable rate HECMs is equal to the sum of the one-year rate and the lender's margin. Global Insight, Inc. has forecasted the one-year Treasury rate to rise steadily and stabilize at 4.85 percent by FY 2015. The forecasted low mortgage interest rate environment results in slower growth in loan balances, which reduces the likelihood of a claim at loan termination. As stated previously, any increase in the lender's margin may partially offset this for future endorsements.

[11] At the time of the review, Global Insight does not forecast the LIBOR ten-year rate. For modeling purposes, the U. S. Treasury rate is used as a proxy.

3. HECM Demand

HECM started as a pilot program in 1989 and became a permanent program in 1998. Since 2003, the number of HECM loans has been growing steadily because of increased product knowledge, lower interest rates, higher home values, and higher loan limits. The estimated number of endorsements[12] in FY 2009 is 115,372. HUD projects the number of endorsements to increase by 1.4 percent to 116,940 in FY 2010, and continue to increase to 151,593 by FY 2016. The average MCA per endorsement is expected to decrease in FY 2010 due to Global Insight's projected house price depreciation and the expiration of the temporary FHA loan limit increase under ARRA. HUD projects the decrease in the average MCA to continue until FY 2012 and then start to increase in FY 2013. Table I-2 contains the annualized actual number of endorsements and the dollar value of endorsements for FY 2009 as well as the volume projections for FY 2010 to FY 2016.

Table I-2: Actual FY 2009 Endorsements
and Estimated FY 2010 to FY 2016 Endorsements

Fiscal Year	Number of Endorsements	Average MCA per Endorsement ($ dollars)	Total Endorsements ($ millions)
2009	115,372	$251,818	$29,053
2010	116,940	225,076	26,266
2011	118,777	212,556	25,247
2012	124,716	215,566	26,885
2013	130,952	223,075	29,212
2014	137,500	230,373	31,676
2015	144,375	241,241	34,829
2016	151,593	252,409	38,264

Besides HECM, there are several non-government proprietary reverse mortgage products. Typically, proprietary products have higher loan limits but offer a lower percentage of home equity to borrowers. The proprietary market share is relatively small for reverse mortgages originated to date. According to the American Association of Retired Persons (AARP), HECM accounts for approximately 90 percent of all reverse mortgages. Due to the recent credit crunch, the availability of proprietary products has decreased in FY 2009 compared to prior years, further increasing HECM market share. However, as the credit market recovers, the proprietary market is expected to recover as well.

HECM borrowers represent about 0.9 percent of households with at least one member aged 62 years or older (according to AARP). If this ratio continues, the number of reverse mortgages will continue to increase with the expected growth in the retiree population. In 2009, 16 percent of the population (approximately 48 million) is 62 or older. According to the U.S. Census Bureau's projection, 20 percent of the population (approximately 67 million) will be 62 or older in 2020 and this will grow to 22 percent of the population (approximately 84 million) by 2030. Furthermore, as longevity improves, people may have insufficient savings to sustain their financial needs in retirement, potentially increasing the demand for HECM.

[12] Estimate is annualized based on data as of June 30, 2009.

4. HECM Secondary Market

The HECM secondary market increases liquidity by providing capital market funding to primary market HECM lenders, broadening distribution channels for HECM loans and expanding the investor base for the HECM product. Since the inception of the program, Fannie Mae has been the largest secondary market outlet for HECM loans. Fannie Mae estimates that its market share was approximately 90 percent of the total market of reverse mortgages as of December 31, 2008. Fannie Mae's reverse mortgage portfolio grew from $41.2 billion to $48.6 billion between December 31, 2008 and June 30, 2009.

Ginnie Mae implemented a HECM Mortgage Backed Security (HMBS) product in 2007. In this program, Ginnie Mae-approved issuers have pooled and securitized a small proportion of HECMs. The volume of Ginnie Mae HMBS has recently increased, providing liquidity in a tight credit environment. In the first six months of calendar year 2009, Ginnie Mae issued approximately $207 million worth of HMBS, compared to nearly $107 million for the same period in 2008. In FY 2009, Ginnie Mae HMBS is limited to fixed rate closed-end HECMs, of which the full principal limit is drawn at loan origination.[13]

E. Recently Announced New Plans and Initiatives

In accordance with HERA, HUD announced a new approval process for condominium projects to insure mortgages on individual units, effective October 1, 2009.[14] This plan removes the spot condo approval process and allows lenders to determine the condominium project eligibility, review project documentation, and certify compliance. HUD is also considering the use of HECM mortgages for co-ops units, as allowed in HERA.

At the time of this report, Congress is considering extending the nationwide temporary loan limit increase of $625,500 from December 31, 2009 to September 30, 2010. However, no conclusions have been drawn as of September 23, 2009. In this review, we assume the HECM loan limit will return to $417,000 starting January 1, 2010.

Lastly, on September 23, 2009, HUD announced a 10 percent reduction in the principal limit factors for all loans originated in FY 2010.[15] The announcement was made after the economic value analysis of this review and the impact of the PLF reduction is not included in these estimates. Discussions of the potential impact of this program change can be found in Section III of this report.

F. Data Sources and Future Projections

All HECM historical experience is used to understand the performance of the program and to determine the termination model specifications. This includes loans that were endorsed under the General Insurance (GI) Fund between FY 1990 and FY 2008, as well as the loans endorsed under the MMI Fund in FY 2009. The transfer from the GI to the MMI Fund has been a transparent process to both lenders and borrowers. Because there is no impact on lending operations, we assume that loan termination behavior is not impacted by the change of Fund for this analysis. Borrower characteristics and loan features are

[13] Borrowers with a closed-end HECM loan can repay the amount of the principal limit that they do not want at closing. However, they will no longer have access to the money under the current loan.
[14] Mortgagee letter 09-19 published on June 12, 2009.
[15] Mortgagee letter 09-34 published on September 23, 2009.

based on loan-level data as of June 2009. Actual historical economic data is used such as the one-year and ten-year Treasury rates and Federal Housing Finance Agency (FHFA) house price appreciation rates.

The estimate of the economic value of the HECM program is based on various assumptions. The actual performance of the FY 2009 HECM portfolio will differ from the expected performance as actual outcomes of these variables differ from the projections. Projections for future years provided in this report focus on HECM in the MMI portfolio, which consists of the current book-of-business (FY 2009) and future books-of business (FY 2010 to FY 2016). For loans endorsed in FY 2009, the actual data is annualized for the remaining three months of the year. HUD provided volume forecasts and borrower characteristics for the future books-of-business. Forecasts of economic variables are from Global Insight, Inc. The model tracks cash flows on a fiscal year basis.

G. Structure of this Report

The remainder of this report consists of the following sections:

- Section II. Summary of Findings -- presents the estimated economic value and insurance-in-force for FY 2009 to FY 2016.
- Section III. Current Status of the HECM Program -- presents the estimated economic value for FY 2009 to FY 2016.
- Section IV. Characteristics of the FY 2009 HECM Book-of-Business -- presents various characteristics of the FY 2009 book-of-business.
- Section V. Sensitivity Analysis -- presents sensitivity analyses of the HECM portfolio using various economic and borrower assumptions.
- Section VI. Summary of Methodology -- presents the econometric and cash flow models used to estimate the economic value included in this report.
- Section VII. Qualifications and Limitations -- presents any limitations in the data, assumptions, and models used to estimate the economic value included in this report.
- Appendix A. Econometric Analysis of Mortgages – provides a technical description of our econometric model.
- Appendix B. Loan Performance Projections – provides a technical description of the loan termination projection methodology
- Appendix C. Cash Flow Analysis – provides a technical description of our cash flow model.
- Appendix D. Economic Forecasts – explains the base case assumptions and the alternative economic and loan scenarios.
- Appendix E. Econometric Model Results – presents the econometric results from the termination model.

Section II. Summary of Findings

This section presents the economic value of the FY 2009 to FY 2016 HECM books-of-business. We assess the actuarial soundness of the HECM portfolio in the MMI Fund as of the end of FY 2009 and project the status of the portfolio through FY 2016. In this review, we:

- Analyze all HECM historical termination experiences and the associated recoveries using loan-level HECM data reported by HUD through June 2009.
- Develop loan termination models to estimate the relationship between loan termination and various economic and loan factors.
- Estimate future cash flows associated with the FY 2009 to FY 2016 books-of-business using various assumptions including macroeconomic forecasts from Global Insight, Inc. and borrower characteristics for future books-of-business from HUD.
- Estimate the economic value of the HECM portfolio for the period of FY 2009 to FY 2016.

Detailed descriptions of the termination model, cash flow model, and economic assumptions used are presented in Appendices A to D. The following is a summary of the major findings in this review, which is also illustrated in Table II-1.

- The economic value at the end of FY 2009 is estimated at $909 million, indicating that there are sufficient capital resources to meet the anticipated liabilities associated with the HECM portion of the MMI Fund. As the MMI Fund only includes the FY 2009 and subsequent HECM books-of-business, this estimate excludes books-of-business prior to FY 2009.
- The economic value of the HECM portfolio will continue to increase over time. The economic value increases more rapidly from FY 2010 to FY 2013 with the addition of new books-of-business and the forecasted future economic recovery. The rate of increase in economic values between fiscal years stabilizes to approximately 30 percent per year starting in FY 2014.
- The insurance-in-force (IIF) is expressed as the sum of the maximum claim amounts (MCA) of all HECM loans remaining in the insurance portfolio. The MCA is FHA's insurance commitment on HECM loans, and it represents HUD's maximum financial exposure. The estimated IIF increases with new endorsements from $28.7 billion at the end of FY 2009 to $163 billion in FY 2016.
- The economic value of the HECM portfolio is projected to grow at a faster rate than the IIF, representing an increasing ratio of the economic value to the insurance risk of the HECM portfolio in the MMI Fund over time.

Table II-1: The Economic Value, Insurance-In-Force, and Endorsements for FY 2009 to FY 2016 ($ Millions)

Fiscal Year[1]	Economic Value	Insurance-in-Force[2]	Volume of New Endorsements[3]	Economic Value of Each New Book-of-Business	Investment Income
2009	$909	$28,696	$29,053	$909	$0
2010	1,875	51,016	26,266	964	2
2011	3,629	70,830	25,247	1,718	36
2012	5,921	90,688	26,885	2,190	102
2013	8,827	109,980	29,212	2,745	162
2014	12,037	128,543	31,676	2,945	265
2015	15,739	146,137	34,829	3,322	380
2016	19,830	162,868	38,264	3,601	490

1. All values, except the volume of new endorsements, are expressed as of the end of the fiscal year.
2. Insurance-in-force is estimated as the sum of the maximum claim amounts of the remaining insured loans.
3. Projections provided by HUD.

Table II-2 includes the components of the economic value of the HECM portfolio in the MMI Fund. Since only the FY 2009 and future HECM books-of-business are included in the MMI Fund, there are no values for FY 2008. The economic value of $909 million consists of the present value of expected cash flows and net insurance income in FY 2009 on the FY 2009 book-of-business only. The net insurance income in FY 2009 is $614 million and the estimated net present value of future cash flows is $295 million, implying that the HECM portfolio has sufficient cash inflows to meet future cash outflows on the FY 2009 book-of-business.

Table II-2 Projected Economic Value of the HECM portfolio in the MMI Fund at the end of FY 2009 ($ Millions)

Item	End of FY2008	End of FY2009
Cash	$0	
Investments	0	
Properties and Mortgages	0	
Other Assets and Receivables	0	
Total Assets	$0	
Liabilities (Account Payables)	0	
Total Capital Resources	$0	
Net Gain from Investment[1]		0
Net Insurance Income in FY[2]		614
PV of Expected Insurance Income from Assigned Notes[3]		0
Total Capital Resources as of EOY		**$614**
PV of Future Cash Flows on Outstanding Business		295
Economic Value		**$909**
Insurance-In-Force		**$28,696**

(1) No gain from investment balance as of the end of FY 2008.
(2) Includes premiums inflow, claims outflow and investment income on investment balance accrued during the fiscal year.
(3) The present value of expected future recoveries of HECM notes assigned during the fiscal year.

Section III. Current Status of HECM in MMI Fund

This section presents the components of the economic value in FY 2009 and discusses the projections through FY 2016. The HECM portion of the MMI Fund has a projected economic value of $909 million at the end of FY 2009. The economic value and the insurance-in-force of the HECM program are both estimated to increase over time. Furthermore, HECM's economic value is estimated to grow at a faster rate than its insurance-in-force, representing an increasing ratio of the economic value to the insurance risk over time.

A. Estimating the Current Economic Value and Insurance-in-Force of HECM in the MMI Fund

The major components that constitute the capital ratio are the economic value and the insurance-in-force.

1. Economic Value

According to NAHA, the economic value of the Fund is defined as the "cash available to the Fund, plus the net present value of all future cash inflows and outflows expected to result from the outstanding mortgages in the Fund." We estimate the current economic value for the HECM component as the sum of the amount of capital resources and the net present value of all expected future cash flows from the estimated insurance-in-force as of the end of FY 2009. Table III-1 presents the components of the economic value for FY 2009.[16] June 2009 data was annualized to estimate the total capital resources and the loan performance at the end of FY 2009. The total economic value consists of the following components:

- *Total Capital Resources* equals assets less liabilities, and totals $614 million at the end of FY 2009. Total capital resources consists of the following components:
  - *Total Assets*, which include cash and other assets, Treasury investments, and properties and notes held by HUD. Because the FY 2009 book-of-business is the first cohort in the MMI Fund there are no FY 2008 assets.
  - *Total Liabilities*, which include the accounts payable. This is also equal to zero as of the end of FY 2008.
  - *Net Gain from Investments on capital resources available at the beginning of the current fiscal year*, which includes the estimated revenue from the investment of capital resources at the beginning of the current fiscal year. Since the FY 2009 cohort is the first HECM book-of-business in the MMI Fund, there is no net gain from capital resources available from the prior year.
  - *Net Insurance Income in the current fiscal year on the portfolio during FY 2009*, which corresponds to the net insurance income including the estimated premium, claims, recoveries, and investment income according to the activities data in FY 2009. We estimate $614 million in cash flows generated from the FY 2009 book-of-business. .
  - *Net present value of income from assigned notes*, which includes the estimated future recoveries and note holding expenses of all assigned notes in HUD's portfolio, in present value. There are no assignments associated with the FY 2009 book-of-business.
- *Net present value of future cash flows:* HECM cash inflows consist of premiums and recoveries. Cash outflows consist of claims and note holding expenses. The cash flow model projects cash

[16] Note that Table III-1 is the same as Table II-2, reproduced in this section for easy reading.

inflows and outflows using economic forecasts and loan performance projections. The net future cash flow is estimated to be $4.9 billion (undiscounted) for the current book-of-business. The corresponding net present value is $295 million as of the end of FY 2009.

Table III-1 Projected Economic Value of the HECM portfolio in the MMI Fund at the end of FY 2009 ($ Millions)

Item	End of FY2008	End of FY2009
Cash	$0	
Investments	0	
Properties and Mortgages	0	
Other Assets and Receivables	0	
Total Assets	$0	
Liabilities (Account Payables)	0	
Total Capital Resources	$0	
Net Gain from Investment(1)		0
Net Insurance Income in FY(2)		614
PV of Expected Insurance Income from Assigned Notes(3)		0
Total Capital Resources as of EOY		**$614**
PV of Future Cash Flows on Outstanding Business		295
Economic Value		**$909**
Insurance-In-Force		**$28,696**

(1) No gain from investment balance as of the end of FY 2008.
(2) Includes premiums inflow, claims outflow and investment income on investment balance accrued during the fiscal year.
(3) The present value of expected future recoveries of HECM notes assigned during the fiscal year.

2. Insurance-In-Force

Another major component of the capital ratio calculation is the insurance-in-force (IIF). According to NAHA, the IIF is defined as the "obligation on outstanding mortgages". We estimate the current IIF as the total maximum claim amount (MCA) of all HECM loans remaining in the insurance portfolio as of the end of FY 2009. MCA is FHA's insurance commitment on HECM loans, and it represents HUD's maximum financial exposure. The current loan balance is not used as the measure of IIF in this analysis. Due to the unique design of the HECM program, loan balances tend to increase over time from interest accruals, premiums, service fees, and borrower cash draws. As the main purpose of this review is to assess the long-term financial performance of HECM, using the current loan balance to estimate the IIF would under-represent FHA's long-term insurance exposure. The estimated total loan balance as of the end of FY 2009 is $14.9 billion.

MCA is the highest claim amount HUD can pay out at insurance termination. Lenders can file two types of insurance claims: (i) a shortfall claim when the net sales proceeds are insufficient to pay-off the loan balance at mortgage termination and (ii) an assignment claim when lenders choose to assign the mortgage note to HUD when the balance reaches 98 percent of the MCA. Consequently, the total MCA for all loans in FHA's insurance portfolio represents HUD's total risk exposure for a given book-of-business. At the end of FY 2009, the only HECM book-of-business in the MMI Fund is the 2009 book. The estimated IIF as of the end of FY 2009 is $28.7 billion.

B. Projected Future Economic Values and Insurance-In-Force of HECM in the MMI Fund

In this section, we present the forecasts of the future economic values and insurance-in-force projections for HECM. We estimate these future values by applying our termination and cash flow models to the endorsement and borrower characteristic forecasts provided by HUD.

Table III-2 shows the estimated economic value of future HECM books and the corresponding insurance-in-force.[17] All values in the table are discounted as of the end of each corresponding fiscal year.

We estimate the projected economic value for each book-of-business to increase steadily from $909 million in FY 2009 to $3.6 billion in FY 2016. This is due to the projected increase in new endorsements and the improvement in the economic forecast over time. Consequently, the economic value of the entire HECM portfolio is estimated to increase over time. The increase is most rapid from FY 2009 to FY 2013 as the portfolio grows from having only one book-of-business in the MMI Fund to several books-of-business. The rate of increase of the total economic value stabilizes to approximately 30 percent per year beginning in FY 2014.

With the addition of new endorsements, the total insurance-in-force is estimated to increase from $28.7 billion at the end of FY 2009 to $163 billion in FY 2016. As the house price forecast improves over time, the rate of increase in the economic value of the Fund is higher than the rate of increase in insurance-in-force. This represents a growing ratio of the HECM portfolio's insurance value to insurance risk in the MMI Fund over time.

Table III-2 Projected Economic Value of the HECM portfolio in the MMI Fund in Future Years ($ Millions)

Fiscal Year[(1)]	Economic Value	Insurance-in-Force[(2)]	Volume of New Endorsements[(3)]	Economic Value of Each New Book-of-Business	Investment Income
2009	$909	$28,696	$29,053	$909	$0
2010	1,875	51,016	26,266	964	2
2011	3,629	70,830	25,247	1,718	36
2012	5,921	90,688	26,885	2,190	102
2013	8,827	109,980	29,212	2,745	162
2014	12,037	128,543	31,676	2,945	265
2015	15,739	146,137	34,829	3,322	380
2016	19,830	162,868	38,264	3,601	490

1. All values, except the volume of new endorsements, are expressed as of the end of the fiscal year.
2. Insurance-in-force is estimated as the sum of the maximum claim amounts of the remaining insured loans.
3. Projections provided by HUD.

Due to the timing of HUD's announcement, the impact of the recent PLF reduction for the FY 2010 book-of-business is not captured in these economic estimates. The 10 percent reduction in PLFs will decrease the ratio of the amount of initial equity available to the MCA, and is expected to reduce HUD's insurance risk. As a result, with all other modeling assumptions held constant, the actual economic value of the FY 2010 book-of-business is expected to be greater than the estimates presented in this review.

[17] Note that Table III-2 is the same as Table II-1, reproduced in this section for easy reading.

Lastly, it is important to note that the results of this analysis are sensitive to the interest rates used for discounting future cash flows. This Review utilized the interest rates used by Federal agencies in preparing their FY 2010 budget, as provided by the Office of Management and Budget. These interest rates are projections of future economic conditions and they are lower than interest rates experienced in most historical years of program experience.[18] Interest rate assumptions are critical to economic value calculations because of the time delay between claim payments and ultimate recoveries to HUD when most borrowers move and properties are sold. If future interest rates are higher than those used in these calculations, then the actual economic value of the HECM portfolio will be less than the estimations here, given that all other modeling assumptions remain the same.

[18] The discount factors published by OMB for the FY 2010 budget are based on a relatively flat yield curve assumption, reflecting the current interest rate environment.

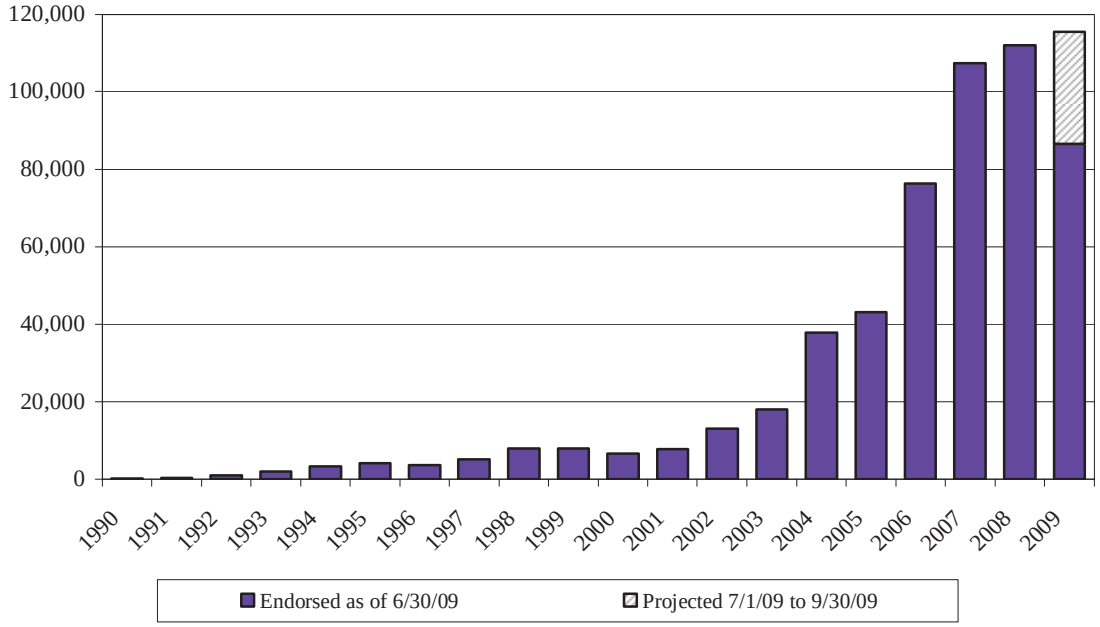
Section IV. Characteristics of the FY 2009 HECM Book-of-Business

This section presents the characteristics of the FY 2009 HECM book-of-business. All data used for this analysis is provided by HUD and is based on an extract from the FHA Single Family Data Warehouse as of June 30, 2009.

A. Volume and Share of Mortgage Originations

FHA endorsed 86,529 HECM loans with a total dollar value, defined as the MCA, of $21.8 billion from October 1, 2008 to June 30, 2009. The annualized number of endorsements in FY 2009 is 115,372 and the corresponding dollar value is $29.1 billion. Since the inception of HECM program, it has been the largest reverse mortgage product, representing approximately 90 percent of total reverse mortgage endorsements in the market. Figure IV-1 presents the count of HECM endorsements over time.

Figure IV-1: Number of HECM endorsements per Fiscal Year



B. Payment Types

HECM borrowers receive loan proceeds by selecting from various payment plans. Table IV-1 presents the distribution of FY 2009 HECM loans by payment plan. As of June 30, 2009, the majority of HECM borrowers (83 percent) selected the line of credit option in FY 2009. Approximately five percent chose a line of credit plan combined with a term or tenure payment plan.

Table IV-1: Distribution of FY 2009 HECM Loans by Payment Type

Payment Type	Number of Loans	Percent of Total
Line of Credit	71,719	82.9%
Tenure	2,788	3.2
Term & Line of Credit	2,136	2.5
Tenure & Line of Credit	1,867	2.2
Term	1,403	1.6
Missing Payment Type	6,616	7.6
Total	**86,529**	**100**

C. Interest Rate Type

HECM borrowers can select fixed or adjustable rate mortgages. Table IV-2 shows the distribution of FY 2009 endorsements by interest rate type. The majority of HECM borrowers (95 percent) selected monthly or annually adjustable rate mortgages in FY 2009. The percentage of fixed rate endorsements has increased steadily throughout FY 2009, constituting 5 percent of the endorsements as of June 30, 2009.

Seventy percent of FY 2009 HECM endorsements were indexed to the U.S. Treasury rate. HUD introduced the LIBOR as a HECM index option on October 12, 2007. LIBOR-indexed endorsements have steadily increased since. Approximately 25 percent of FY 2009 endorsements were LIBOR-indexed endorsements. The percentage of LIBOR-indexed loans is expected to increase as Fannie Mae, a major HECM purchaser, has announced that it will discontinue the purchase of U. S. Treasury-indexed HECMs as of September 1, 2009.[19]

Table IV-2: Distribution of FY 2009 HECM Loans by Interest Rate Type

Interest Rate Type		Number of Loans	Percent of Total
US Treasury-Indexed	Monthly Adjustable	59,753	69%
	Annual Adjustable	751	1
LIBOR-Indexed	Monthly Adjustable	21,641	25
	Annual Adjustable	19	0
Fixed Rate		4,365	5
Total		**86,529**	**100**

D. Product Type

Almost all of the 86,529 loans endorsed in FY 2009 are traditional HECMs, whereby the borrower purchased their home prior to taking out the reverse mortgage. The exception is the 178 loans endorsed under the HECM for Purchase program that were introduced in January 2009. Among the HECM for Purchase loans, over 70 percent of borrowers drew 90 percent of their maximum available equity within the first month of loan endorsement. These loans represent a small portion of the total FY 2009 HECM book-of-business.

[19] See Fannie Mae Selling and Servicing Guides Announcement 09-16, published on June 1, 2009.

E. Maximum Claim Amount Distribution

The MCA is the minimum of the FHA loan limit and the appraised value. It is used as the basis of the initial principal limit determination and as the cap of the potential insurance claim amount. Table IV-3 shows the distribution of FY 2009 endorsements by MCA. Approximately 66 percent of loans endorsed in FY 2009 have an MCA less than $300,000.

As discussed in Section I, FHA HECM loan limits changed several times in FY 2009. The FHA loan limits increased from area-specific loan limits capped at $362,790 in non-high-cost areas to a nationwide limit of $417,000 in November 2008. In February 2009, the limit was subsequently increased to a nationwide limit of $625,500 until December 31, 2009. According to an analysis on endorsement data, the average MCA has gradually increased with the loan limit changes. The increase follows a typical time lag that results from the time for application and market adoption of the new policy.

The percentage of FY 2009 endorsements with an MCA between $300,000 and $417,000 steadily increased from October 2008 to February 2009 at which time it represented 40 percent of endorsements. Subsequently, it dropped as the percentage of endorsements with an MCA greater than $417,000 increased from 12 percent in April 2009 to 26 percent in June 2009.

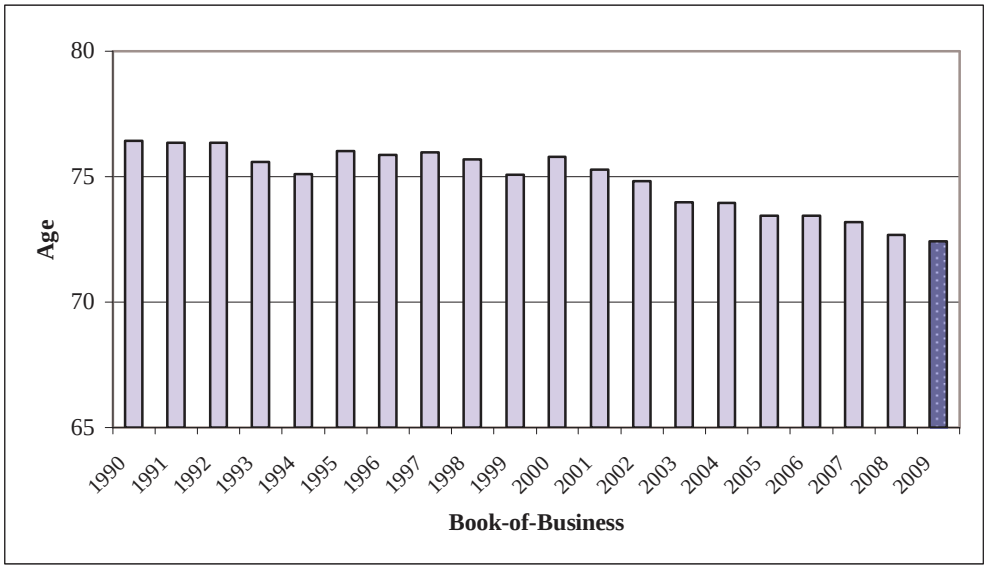
Table IV-3: Distribution of FY 2009 HECM Loans by MCA Level

		Level of MCA					
Month	**Number of Loans**	**Less Than $100k**	**$100k to $200k**	**$200k to $300k**	**$300k to $417k**	**Greater Than $417k**	**Total**
October, 2008	10,125	14%	42%	27%	17%	0%	100%
November, 2008	7,770	13	41	26	19	0	100
December, 2008	9,758	11	34	23	31	0	100
January, 2009	9,855	10	29	23	38	0	100
February, 2009	9,081	8	29	23	40	0	100
March, 2009	11,253	10	31	24	34	2	100
April, 2009	11,681	9	33	23	23	12	100
May, 2009	8,375	9	31	21	18	20	100
June, 2009	8,631	10	29	20	15	26	100
Total	**86,529**	**10**	**33**	**23**	**26**	**7**	**100**

F. Borrower Age Distribution

The age profile of a book-of-business affects loan termination rates and the percentage of initial equity available to the borrower. Figure IV-2 presents the average borrower age at origination for FY 1990 to FY 2009 books-of-business (note that only FY 2009 book-of-business is part of the MMI Fund). The average borrower age has declined over time. This indicates that HECM is becoming more popular with younger retirees, and the trend may continue with future books-of-business. Younger borrowers are associated with a greater mortality risk for FHA as they have a longer life expectancy. To manage this risk, the PLFs are lower for younger borrowers, allowing them to access a smaller portion of their equity. The average age of the FY 2009 book-of-business is 72 years.

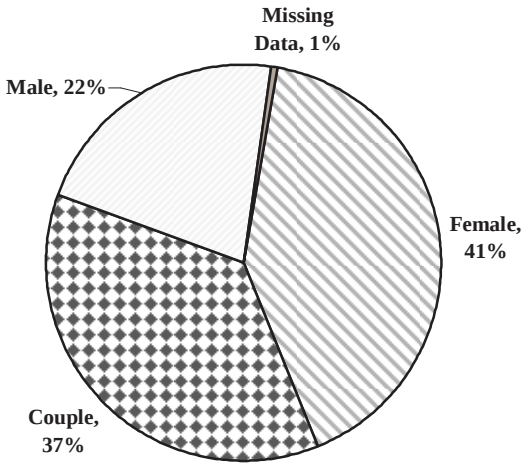
Figure IV-2: Average Borrower Age at Origination by Book-of-Business



G. Borrower Gender Distribution

Gender also affects termination behavior due to differences in mortality. The gender distribution of the HECM portfolio has remained steady over time. HECM performance-to-date shows that males tend to terminate the fastest, followed by females, and couples terminate most slowly. Figure IV- 3 presents the gender distribution for the FY 2009 HECM book-of-business. Females comprise the majority of the FY 2009 book-of-business at 41 percent, followed by males at 37 percent, and couples at 22 percent.

Figure IV-3: Distribution of FY 2009 HECM Endorsements by Gender



H. Cash Draw Distribution

Data shows that younger borrowers draw a higher percentage of the initial amount of equity available to them than older borrowers. Table IV-4 shows the distribution of first month cash draw as a percentage of the initial principal limit among different borrower age groups. Fifty-eight percent of the 62 to 70 age

group drew over 80 percent of the initial principal limit, compared to 45 percent for the greater than 80 years-old age group.

Table IV-4: First Month Borrower Cash Draw
as a Percentage of the Initial Principal Limit[20]

Age Group	Number of Loans	0 - 40% of Initial Prinicpal Limit	40 - 80% of Initial Prinicpal Limit	80 - 100% of Initial Prinicpal Limit	Total
62 - 70	39,698	16%	25%	58%	100%
70 - 80	33,074	24	25	51	100
80 +	13,757	32	23	45	100
Total	**86,529**	**46**	**16**	**38**	**100**

Although younger borrowers typically draw a higher percentage of the initial principal limit in the first month, the amount of cash drawn represents a smaller percentage of the appraised value of their home. This is because the PLF is lower for younger borrowers to account for their longer life expectancy. No borrowers in the 62 to 70 age group drew over 80 percent of the appraised value, compared to seven percent for the greater than 80-years-old age group. Table IV-5 shows the distribution of first month cash draw as a percentage of the appraised value among different borrower age groups.

Table IV-5: First Month Borrower Cash Draw
as a Percentage of Appraised Value

Age Group	Number of Loans	0 - 40% of Appraised Value	40 - 80% of Appriased Value	80 - 100% of Appraised Value	Total
62 - 70	39,698	30%	70%	0%	100%
70 - 80	33,074	34	66	0	100
80 +	13,757	41	52	7	100
Total	**86,529**	**34**	**65**	**1**	100

[20] As of the time of this review, about 1,770 loans do not have cash draw data populated. For the purpose of this analysis, these loans are considered to have no cash draw in the first month.

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Section V. Sensitivity Analysis

A sensitivity analysis was conducted to assess the impact of various economic and loan scenarios on the economic value of the FY 2009 to FY 2016 HECM books-of-business. This section presents the results of this analysis. Relevant scenarios were identified that may have a substantial impact on HECM performance and aid in understanding the relative sensitivity of the HECM economic value to key economic and loan assumptions. The following scenarios were selected for the sensitivity analysis:

- More pessimistic house price forecast
- Interest rate upward shock
- Interest rate downward shock
- Less pessimistic house price forecast
- Slower mortality
- Faster cash draws

The base case economic scenario used the August 2009 Global Insight ten-year forecast for the near-term; and the June 2009 Global Insight thirty-year forecast for FY 2020 and later. This includes the FHFA national house price index, the ten-year Treasury rate, and the one-year Treasury rate. The base case mortality rates were based on the 1999-2001 U. S. Decennial Life Table published by the Center for Disease Control and Prevention in 2004. Borrower cash draw assumptions were based on past program experience with adjustments to account for the different borrower composition provided by HUD. The data used for each of these economic scenarios is presented in Appendix D.

Table V-1 presents the projected economic value of the FY 2009 to FY 2016 HECM books-of-business under the base case scenario.[21] The economic value of the HECM portfolio in the MMI Fund at the end of FY 2009 is $909 million. Table V-I also presents the projected economic value through FY 2016. The economic value is positive for all books-of-business, with the economic value of the HECM portfolio of the MMI Fund growing to $19.8 billion by the end of FY 2016.

Table V-1: HECM Economic Value under Base Case Scenario
($ Millions)

Fiscal Year[(1)]	Economic Value	Insurance-in-Force[(2)]	Volume of New Endorsements[(3)]	Economic Value of Each New Book-of-Business	Investment Income
2009	$909	$28,696	$29,053	$909	$0
2010	1,875	51,016	26,266	964	2
2011	3,629	70,830	25,247	1,718	36
2012	5,921	90,688	26,885	2,190	102
2013	8,827	109,980	29,212	2,745	162
2014	12,037	128,543	31,676	2,945	265
2015	15,739	146,137	34,829	3,322	380
2016	19,830	162,868	38,264	3,601	490

1. All values, except the volume of new endorsements, are expressed as of the end of the fiscal year.
2. Insurance-in-force is estimated as the sum of the maximum claim amounts of the remaining insured loans.
3. Projections provided by HUD.

[21] Note that Table V-1 is the same as Table II-1, reproduced in this section for easy reading.

The impact of each of the alternate scenarios on the performance of the HECM portion of the MMI Fund is detailed below.

A. More Pessimistic House Price Forecast

One of the most important elements of the HECM program is the rate at which home values appreciate. When home values decrease, the likelihood of HECM loan balances exceeding home values rises, increasing the probability of higher loan losses. Moreover, lower cumulative house growth lowers the likelihood of refinance and reduces borrowers' incentive to move out.

In order to test the HECM program's financial resilience to a more pessimistic house price forecast, a sensitivity analysis was conducted with lower house price growth assumptions. The July 2009 forecast created by Global Insight, Inc is more pessimistic than the base case assessment of the HECM economic value. Therefore, this alternative scenario uses the July 2009 forecasted FHFA House Price Index (HPI) to estimate the FY 2010 rate of house price growth. The August 2009 forecast predicts a house price appreciation (HPA) rate of negative 6.9 percent in FY 2010, whereas the July 2009 forecast predicts a HPA rate of negative 10.5 percent in FY 2010.

Table V-2 presents the projected economic values of the FY 2009 to FY 2016 HECM books-of-business under the more pessimistic house price forecast. The economic value of the FY 2009 book-of-business decreases from the baseline $909 million to $194 million under this alternative scenario. This is primarily due to the lower HPA which decreases the amount of recovery at termination. Similarly, the economic value of the FY 2010 book-of-business is also lower under this scenario. Because only the FY 2010 HPA rate is adjusted, the economic values of subsequent books-of-business are not impacted. However, the cumulative impact of all books-of-business results in a reduction in the overall economic values of the HECM portfolio from FY 2009 to FY 2016.

Table V-2: HECM Economic Value under a More Pessimistic House Price Forecast
($ Millions)

Fiscal Year[1]	Economic Value	Insurance-in-Force [2]	Volume of New Endorsements[3]	Economic Value of Each New Book-of-Business	Investment Income
2009	$194	$28,696	$29,053	$194	$0
2010	677	52,412	26,266	483	0
2011	2,408	73,409	25,247	1,718	13
2012	4,666	94,025	26,885	2,190	68
2013	7,538	113,923	29,212	2,745	127
2014	10,709	132,596	31,676	2,945	226
2015	14,369	149,821	34,829	3,322	338
2016	18,417	165,803	38,264	3,601	447

1. All values, except the volume of new endorsements, are expressed as of the end of the fiscal year.
2. Insurance-in-force is estimated as the sum of the maximum claim amounts of the remaining insured loans.
3. Projections provided by HUD.

B. Interest Rate Upward Shock

To test the impact of potentially higher near-term interest rates on the HECM portfolio in the MMI Fund, 300 basis points were added to all interest rate forecasts for FY 2010, FY 2011, and FY 2012. The two interest rates that directly affect HECM modeling are the one-year and ten-year Treasury rates.[22]

Table V-3 presents the projected economic values of the FY 2009 to FY 2016 HECM books-of-business under the interest rate upward shock scenario. The economic value of the FY 2009 book-of-business decreases from the baseline $909 million to $531 million under this alternative scenario. The increase in the one-year Treasury rate increases interest accruals. This results in greater exposure for FHA as it increases the possibility that the accumulated UPB will exceed the proceeds from the sale of the house at termination.

For loans endorsed between FY 2010 and FY 2012, an upward interest rate shock also affects the expected mortgage interest rate (expected rate) at the time of endorsement. A higher expected rate lowers the percentage of equity borrowers can access according to the Principal Limit Factor table. It results in lowered loan balance throughout the life of the loan, which reduces claim risks but also lowers FHA revenue from annual premium and interest on assigned notes. Together with the impact of the one-year Treasury rate, the net impact is an increase in economic value for the FY 2010 book-of-business and a decrease in economic value for FY 2011 and FY 2012 books-of-business.

Since the interest rate upward shock only applies to loans endorsed from FY 2010 to FY 2012, the economic values of subsequent books-of-business are not impacted. The cumulative effect on all books-of-business in FY 2009 through FY 2016 is a decrease in economic value when compared to the baseline scenario, with the exception of FY 2010.

Table V-3: HECM Economic Value under Interest Rate Upward Shock
($ Millions)

Fiscal Year[(1)]	Economic Value	Insurance-in-Force[(2)]	Volume of New Endorsements[(3)]	Economic Value of Each New Book-of-Business	Investment Income
2009	$531	$28,696	$29,053	$531	$0
2010	1,908	51,760	26,266	1,375	1
2011	3,635	71,694	25,247	1,691	36
2012	5,500	90,500	26,885	1,763	102
2013	8,395	108,902	29,212	2,745	150
2014	11,592	126,936	31,676	2,945	252
2015	15,280	145,894	34,829	3,322	366
2016	19,357	167,030	38,264	3,601	475

1. All values, except the volume of new endorsements, are expressed as of the end of the fiscal year.
2. Insurance-in-force is estimated as the sum of the maximum claim amounts of the remaining insured loans.
3. Projections provided by HUD.

[22] At the time of the review, Global Insight does not forecast the LIBOR ten-year rate. For modeling purposes, the U. S. Treasury rate is used as a proxy.

C. Interest Rate Downward Shock

To test the impact of lower near-term interest rates on the HECM portfolio in the MMI Fund, 300 basis points were subtracted from all interest rate forecasts for FY 2010, FY 2011, and FY 2012 (rates are not allowed to be negative numbers).

Table V-4 presents the projected economic values of the FY 2009 to FY 2016 books-of-business under the interest rate downward shock scenario. The result of this scenario is an increase in economic value across all affected books-of-business, FY 2009 through FY 2012. The increase in economic value is primarily driven by the decrease in the one-year Treasury rate.[23] It results in slower UPB growth and lowers the potential claim risk. The relative increase in economic value is the largest in the FY 2009 book-of-business. As the house price forecast improves, the impact of the interest rate downward shock on economic value for the future books-of-business are reduced. The cumulative impact of all books-of-business results in an overall increase in the economic value of the HECM portfolio from FY 2009 to FY2016.

Table V-4: HECM Economic Value under Interest Rate Downward Shock
($ Millions)

Fiscal Year(1)	Economic Value	Insurance-in-Force (2)	Volume of New Endorsements(3)	Economic Value of Each New Book-of-Business	Investment Income
2009	$1,142	$28,696	$29,053	$1,142	$0
2010	2,134	51,901	26,266	990	3
2011	3,900	72,267	25,247	1,725	41
2012	6,278	91,659	26,885	2,269	110
2013	9,195	111,629	29,212	2,745	171
2014	12,416	131,285	31,676	2,945	276
2015	16,129	150,121	34,829	3,322	392
2016	20,232	166,755	38,264	3,601	502

1. All values, except the volume of new endorsements, are expressed as of the end of the fiscal year.
2. Insurance-in-force is estimated as the sum of the maximum claim amounts of the remaining insured loans.
3. Projections provided by HUD.

D. Less Pessimistic House Price Forecast

In order to test the impact of a less pessimistic house price forecast on the HECM program's financial performance, a sensitivity analysis was conducted with higher house price growth assumptions. The July 2008 forecast created by Global Insight, Inc is less pessimistic than the August 2009 forecast used in the base case assessment of the HECM economic value. Therefore, this alternative scenario uses last July's forecasted FHFA House Price Index (HPI) to estimate the FY 2010 and FY 2011 rate of house price growth. The August 2009 forecast predicts HPA of negative 6.9 percent in FY 2010 and negative 1.1

[23] Unlike the interest rate upward shock scenario, we assume future borrowers can access the same amount of equity in the downward shock scenario as they do in the baseline scenario. This is because, for every borrower age, the Principal Limit factors are the same for all expected rate less than or equal to 5.5 percent. Since the expected rates for both baseline and the interest rate downward shock scenario in FY 2010 to FY 2012 are under 5.5 percent, the PLFs are the same between the two scenarios.

percent in FY 2011 whereas the July 2008 forecast predicts HPA of negative 0.8 percent in FY 2010 and positive 0.9 percent for FY 2011.

Table V-5 presents the projected economic values of the FY 2009 to FY 2016 HECM books-of-business under the less pessimistic house price scenario. The economic value of the FY 2009 book-of-business increases from the baseline $909 million to $1.7 billion under this alternative scenario. Higher HPA results in significantly higher recoveries at loan termination and a higher economic value.

Similarly, the economic values for the FY 2010 and FY 2011 books-of-business are also increased under this scenario. Since the change in HPA only applies to FY 2010 and FY 2011, the economic values of subsequent books-of-business are not impacted. The cumulative effect of all books-of-business results in an increase in the overall economic values of the HECM portfolio from FY 2009 to FY 2016.

Table V-5: HECM Economic Value under Less Pessimistic House Price Forecast
($ Millions)

Fiscal Year[1]	Economic Value	Insurance-in-Force[2]	Volume of New Endorsements[3]	Economic Value of Each New Book-of-Business	Investment Income
2009	$1,685	$28,696	$29,053	$1,685	$0
2010	3,377	51,075	26,266	1,688	4
2011	5,321	70,938	25,247	1,880	64
2012	7,661	90,855	26,885	2,190	150
2013	10,615	110,207	29,212	2,745	209
2014	13,878	128,871	31,676	2,945	319
2015	17,638	146,574	34,829	3,322	438
2016	21,788	163,418	38,264	3,601	549

1. All values, except the volume of new endorsements, are expressed as of the end of the fiscal year.
2. Insurance-in-force is estimated as the sum of the maximum claim amounts of the remaining insured loans.
3. Projections provided by HUD.

E. Slower Mortality

Another important factor in forecasting the performance of the HECM portion of the MMI Fund in future years is mortality, which is a key input of the econometric model used to forecast termination rates. Through improvements in technology and modern medicine, the general population continues to outlive previous mortality experience. Mortality rates obtained from the U.S. Decennial Life Table for 1999-2001 (published in 2004 by CDC)[24] are used to forecast the base case mortality terminations. The alternative scenario uses the 2004 Annual Life Table published by the CDC in 2007. The 2004 Annual Life Table includes mortality rates up to age 99, and the mortality rates for age 100 to 109 are extrapolated based on the average rate of change between the 2001 and 2004 life tables.

Table V-6 presents the projected economic values of the FY 2009 to FY 2016 HECM books-of-business under the lower mortality rates. The economic value at the end of FY 2009 increases from $909 million

[24] The 1999-2001 U.S. Decennial Life Table is the most recent study published by the Center of Disease Control and Prevention that includes mortality rates up to age 109.

under the base case assumptions to $918 million under this scenario. The economic value also increases for all years from FY 2010 to FY 2016.

Slower mortality delays terminations due to death. Slower terminations allow more time for the unpaid principal balance (UPB) to grow, which increases the likelihood of the accumulated UPB exceeding the proceeds from the sale of the home at termination. Slower terminations also increase the time between assignment and termination (note holding period), during which time HUD receives mortgage premium, servicing fees and interest income. The increase in interest and premium revenue from a longer life expectancy offsets any decrease in recovery income, causing the overall economic value to increase. As slower mortality rates primarily affect cash flows in later policy years, the flat yield curve[25] used to discount future cash flows has a relatively large impact on the result of this analysis.

Table V-6: HECM Economic Value under Slower Mortality
($ Millions)

Fiscal Year(1)	Economic Value	Insurance-in-Force(2)	Volume of New Endorsements(3)	Economic Value of Each New Book-of-Business	Investment Income
2009	$918	$28,696	$29,053	$918	$0
2010	1,932	51,116	26,266	1,012	2
2011	3,739	71,070	25,247	1,770	37
2012	6,106	91,128	26,885	2,262	105
2013	9,118	110,648	29,212	2,845	167
2014	12,421	129,501	31,676	3,028	274
2015	16,208	147,396	34,829	3,395	392
2016	20,364	164,422	38,264	3,652	504

1. All values, except the volume of new endorsements, are expressed as of the end of the fiscal year.
2. Insurance-in-force is estimated as the sum of the maximum claim amounts of the remaining insured loans.
3. Projections provided by HUD.

F. Faster Cash Draws

In this alternative scenario, we consider the situation where borrowers accelerate their cash draws after policy year one.[26] Specifically, we model the cash draw rate in policy year two as the sum of the rates in policy years two and three from the baseline scenario. Similarly, we model the cash draw rate in policy year three as the sum of the rates in policy years four and five from the baseline model. The cash draw rates in subsequent policy years were accelerated forward accordingly.

Table V-7 presents the projected economic values of the FY 2009 to FY 2016 HECM books-of-business under the faster cash draw scenario. The economic value at the end of FY 2009 increases from $909 million under the base case assumptions to $994 million under this scenario. Accelerated cash draw results in a higher loan balance, which increases HUD's mortgage premium and interest revenue during the note holding period. On the other hand, it also increases the likelihood of shortfall claims. The FY

[25] As discussed in the end of Section III, the discount factors published by OMB for the FY 2010 budget are based on a relatively flat yield curve assumption, reflecting the current interest rate environment.
[26] First-year cash draw estimate for FY 2009 book-of-business is based on the annualized data. For FY 2010 and FY 2016 books-of-business, first-year cash draw estimates are provided by HUD.

2009 book-of-business has a relatively low first-year cash draw such that the increase in interest and premium revenue generated by the faster cash draws outweighs the increase in claim cost.

Subsequent books-of-business have higher first-year cash draws. The economic values for the FY 2010 and FY 2011 books-of-business are less than the base case. This is because the increase in claim cost caused by the faster cash draws outweighs the increase in interest and premium revenue. Starting in FY 2012, faster cash draws results in higher economic value for the new books. This is primarily driven by the house price appreciation forecast. The house price appreciation forecast moves from negative to positive in FY 2012 and steadily increases thereafter. This increases the expected sales proceeds, which lowers the likelihood of shortfall sales and increases the amount of interest revenue. Overall, the faster cash draws increase the economic value in later fiscal years.

Table V-7: HECM Economic Value under Faster Cash Draws
($ Millions)

Fiscal Year[1]	Economic Value	Insurance-in-Force[2]	Volume of New Endorsements[3]	Economic Value of Each New Book-of-Business	Investment Income
2009	$994	$28,696	$29,053	$994	$0
2010	1,754	51,024	26,266	759	2
2011	3,305	70,845	25,247	1,517	33
2012	6,084	90,709	26,885	2,686	93
2013	9,371	109,863	29,212	3,121	166
2014	12,707	127,710	31,676	3,054	281
2015	16,197	143,862	34,829	3,089	401
2016	20,480	159,444	38,264	3,778	504

1. All values, except the volume of new endorsements, are expressed as of the end of the fiscal year.
2. Insurance-in-force is estimated as the sum of the maximum claim amounts of the remaining insured loans.
3. Projections provided by HUD.

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Section VI. Summary of Methodology

This section describes the overall analytical approach implemented in this review. Detailed descriptions of the statistical and forecasting models for HECM loan terminations are provided in Appendices A and B, respectively. Appendix C provides details on the cash flow model, and Appendix D provides details on the sensitivity analysis.

A. Termination Model Specification

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, move-out, 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.

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). This 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: move-out, 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, and the first month cash draw percentage.
- Dynamic variables based entirely on loan/borrower characteristics: mortgage age (i.e., policy year) and mortality rate.
- Dynamic variables derived by combining loan characteristics with extraneous economic data: interest rates, house price indices (determines the cumulative house price growth), and the amount of additional equity available to the borrower through refinancing.

The logit model for each termination event is unique, including only the variables that impact the occurrence of that particular event. For example, the mobility model includes a series of piece-wise linear spline functions to model the impact of mortgage age on the likelihood of move-out. The refinance model includes a first month cash draw variable that acts as an indicator of borrowers' behavioral pattern drawing cash. The mortality model includes the attained age of the borrower over the life of the loan and the gender to model the impact of age and gender on the probability of death.

B. Loan Event and Economic Data

The termination model specifications are determined using historical data from all endorsed HECM loans (from FY 1990 to FY 2009 books-of-business) and actual economic experience through June 30, 2009. We used loan-level data to construct the quarterly history by relating mortgage origination information to contemporaneous values of time-dependent factors.

Loan-level historical experience obtained from HUD is used to align with key economic predictors of HECM terminations such as changes in house prices and interest rates. The Federal Housing Finance Agency (FHFA) Metropolitan Statistical Area (MSA)-level house price appreciation rates are used when available, otherwise state-level FHFA data is used. Interest rate data is obtained from Global Insight, Inc.

The estimated future termination rates are based on all characteristics of the surviving portfolio and forecasts of economic variables. Each loan is expanded from its origin to the policy year associated with the borrower age reaching 109, the maximum age in the mortality tables. Actual data is used between the time of origination and FY 2009 and forecasted data is used beginning in FY 2010. For future house price appreciation, nation-wide forecasts are used rather than the MSA or state-level indices to develop model specifications.

C. Cash Flow Modeling

The cash flow model estimates the HECM MMI economic value for the FY 2009 to FY 2016 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. For future books-of-business, we utilize the expected borrower characteristics, volume, and loan size forecasts provided by HUD.

The HECM cash flow model consists of four components: premiums, claims, payments, and recoveries on notes in inventory. Cash flows are discounted according to the most recent Federal credit subsidy present value conversion factors.[27]

[27] At the time of this review, the latest annual discount factors published by the Office of Management and Budget (OMB) were in November 2008.

Section VII. 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 a number of 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 current discount factors. 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. Sensitivity to Economic Projections and Discount Factors

The financial estimates presented in this review require economic forecasts forty years into the future. The economic forecasts, including house price appreciation and interest rate trends are from Global Insight, Inc. 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 value are also sensitive to the discounting 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 the discount factors adopted in this review. As the interest rate environment changes, the updated yield curve assumptions will have a noticeable impact on the projected cash flows in future years.

B. Limited Program Experience

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, HECM has a limited number of loans that have remained in FHA's portfolio for more than five years. The lack of long-run performance data potentially limits the robustness of the models' predictive capacity for later policy years.

C. Changing Reverse Mortgage Market Landscape

Changes in financial markets and retirement needs will affect both the reasons why borrowers participate in the HECM Program and the specifics of new product offerings. This will affect the loan characteristics and performance of future endorsements including cash draw patterns and repayment behavior. Borrower characteristics will vary with the changing demographic as the large baby boomer population transitions to retirement. Hence, the accuracy of the estimates on the performance of future books is sensitive to the borrower composition and behavioral assumptions.

Appendix A

Econometric Analysis of Mortgages

Appendix A: Econometric Analysis of Mortgages

This appendix describes the methodology used to estimate the historical and future performance of HECM loans. The most common reasons why HECM loans terminate are mobility, refinance, and mortality. Since each loan can terminate for only one of these reasons, a competing risk logit model was created. A separate logit model was developed for each type of termination. The probability of termination from each model was then aggregated to estimate the probability a particular loan would terminate in any policy year.

All historical HECM termination and survivorship data is used to formulate this model. This includes loans that were endorsed under the General Insurance (GI) fund between FY 1990 and FY 2008, and loans endorsed under the Mutual Mortgage Insurance (MMI) fund in FY 2009. The change from the GI fund to MMI fund has been a transparent process to the lenders and borrowers with no impact on the lending operation. It is assumed that the fund has no impact on loan termination behavior. It is also important to note that insurance is terminated at mortgage note assignment but the HECM loan does not terminate at this time. Hence, note assignments are not modeled as terminations in this review.

The structure of this appendix is as follows: Section I provides a general background of logistic regression, specifically the competing risk logit model. Section II details the model specification for each of the three competing risk models. Section III shows the final parameter estimates and model fit statistics for each of the three competing risk models.

I. The Competing Risk Logit Model

Similar to Szymanoski, DiVenti and Chow (2000) and Yuen-Reed and Szymanoski (2007), a competing risk logistic regression or logit model approach is used to estimate the probability of HECM loan termination events. The log function in the logit model takes on values between 0 and 1, so it is ideal for use in determining the probability of an event occurrence. The competing risk logit model also ensures the probability that the loan terminates under all three risks and the probability that the loan survives always sum to 1.

The termination of HECM loans is unique because a loan can terminate due to one of three reasons (mobility, refinance, and mortality), and for only one of these reasons. For instance, a loan that terminates due to mortality cannot terminate at a later time due to a refinance. Therefore, it is important to model each of these events separately to produce the most accurate probability of termination.

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.

II. Individual Model Specifications

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

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

$$P_R(t) = \frac{e^{\alpha_R + X_R(t)\beta_R}}{1 + e^{\alpha_M + X_M(t)\beta_M} + e^{\alpha_R + X_R(t)\beta_R} + e^{\alpha_D + X_D(t)\beta_D}} \qquad \{Equation\ 2\}$$

$$P_D(t) = \frac{e^{\alpha_D + X_D(t)\beta_D}}{1 + e^{\alpha_M + X_M(t)\beta_M} + e^{\alpha_R + X_R(t)\beta_R} + e^{\alpha_D + X_D(t)\beta_D}} \qquad \{Equation\ 3\}$$

The constant terms α_M , α_R , and α_D as well as the coefficient vectors β_M , β_R and β_D are the unknown parameters that are estimated by the multinomial logit model. The subscripts "M", "R", and "D" denote mobility, refinance, and mortality. The vectors of dependent variables for predicting the conditional probability of termination due to mobility, refinance, and mortality are represented by $X_M(t)$, $X_R(t)$ and $X_D(t)$. 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*).

A. Mobility Model

The mobility model was constructed to estimate 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 were examined to define the final model specification as illustrated *Equation 4* below:

$$X_M(t) = Intercept + Duration_1 + Duration_2 + FirstYear_{Dummy} + OriginationAge + Gender + CumulativeHPA + ChangeOneYearCMT \qquad \{Equation\ 4\}$$

The model consists of the following variables:

1. Duration Variables

Historical experience of mobility terminations shows the likelihood of a HECM borrower paying off their loan due to mobility. The $FirstYear_{Dummy}$ variable has a value of 1 if it is the first year of the loan and 0 for all other years of the loan. This variable was included in the model to reflect the limited number of loans terminating in the first policy year

Historical experience then shows a sharp increase in mobility terminations from the second to the fourth year of the loan. In the fifth year, mobility terminations remain fairly steady and begin to taper off starting in the ninth year. To model this experience, a duration variable for policy years one

through five and a duration variable for policy years greater than nine were used. The specification of the duration variable is shown in *Equation 5*;

$$Duration_1 = \begin{cases} \text{Policy Year}, & \text{if Policy Year} \le 5 \\ 5, & \text{if Policy Year} > 5 \end{cases}$$

$$Duration_2 = \begin{cases} 0, & \text{if Policy Year} \le 9 \\ \text{Policy Year} - 9, & \text{if Policy Year} > 9 \end{cases} \qquad \textit{\{Equation 5\}}$$

2. Household Variables

Household characteristics are also key drivers of move-out likelihood. Historical experience suggests that age at origination and gender are two major determining factors. The effect of the *OriginationAge* variable does not vary over time because it is defined as the age at loan origination. Historical experience suggests that older borrowers have a higher likelihood of moving. *Gender* is a categorical variable with possible values of female, male, and couple. For the *Gender* variable, female is used as the baseline since the majority of HECM borrowers are females. Typically couples are less likely to move out of the home and males are more likely to move out of the home.

3. Economic Variables

Cumulative house price appreciation (*CumulativeHPA)* and the percentage change in the one-year constant maturity Treasury rate since last time period (*ChangeOneYearCMT*) are the economic variables included in the mobility model. These economic factors impact loan balances and resale values of the homes.

Historical experience suggests that faster house price appreciation increases likelihood of move-outs. 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 from the Federal Housing Finance Authority (FHFA) house price Index (HPI), based on the MSA/State of the loan. Historical data on interest rates is obtained from Global Insight, Inc.

B. Refinance Model

The refinance model was constructed to estimate the probability a HECM loan will terminate due to the borrower refinancing the loan. The model specification for the Refinance Model is shown below.

$$X_R(t) = Intercept + PolicyYear + 1stYear_{Dummy} + 2ndYear_{Dummy} + 3rdYear_{Dummy} + OriginationAge + Gender + refinanceIndex + 1stMonthCashDraw \qquad \textit{\{Equation 6\}}$$

The model consists of the following variables:

1. Duration Variables

Prior HECM experience shows that the majority of refinances occur after the first few years of the loan. The variables *PolicyYear*, $1stYear_{Dummy}$, $2ndYear_{Dummy}$, and $3rdYear_{Dummy}$ are designed to account for this experience. The variable *PolicyYear* has a value equal to the number of years the loan has been active.

2. Household Variables

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. Similarly, borrowers with different genders also refinance at differing rates. *Gender* is a categorical variable with possible values of female, male, and couple; with female as the baseline. Historical experience suggests that couples are less likely to refinance than females, and males are more likely to refinance than females.

The likelihood of refinances is also driven by the cash draw pattern of the borrower. We found that the first-month cash draw (*1st month cash draw*) is a representative indicator to the likelihood of future refinances. Borrowers who draw large amounts of cash initially are more likely to refinance than borrowers who do not.

3. Economic Variables

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 7* depicts the refinance incentive measure calculation

$$rfi_t = MAX\left[\frac{MCA_0 \times \Delta H \times PLF_t - C - PL_t}{C}, 0\right] \qquad \{Equation\ 7\}$$

where MCA_0 = Original maximum claim amount for loan at time 0

$\Delta H = \frac{HPI_t}{HPI_0}$, HPI is the FHFA houseprice index per MSA/State

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 principle limit on the original HECM loan at time t

C. Mortality Model

The mortality model was designed to estimate the probability a HECM loan would terminate due to the death of the borrower. We utilized the Social Security Administration data provided by HUD 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 two major factors in forecasting death terminations are mortality rates and gender. Mortality rates were obtained from the 1999-2001 U.S. Decennial Life Table from the Center for Disease Control and Prevention. The final model specification for the mortality model is shown in *Equation 8*.

$$X_D(t) = Intercept + Male_{Dummy} + Couple_{Dummy} + FemaleMortality + Male_{Dummy} \times FemaleMortality + Couple_{Dummy} \times FemaleMortality \quad \{Equation\ 8\}$$

Similar to the mobility model, the female mortality rate is used as the baseline. *FemaleMortality* is interacted with the two distinct *Gender* variables to produce a conditional probability that the loan will terminate due to death. The interaction terms, $Male_{Dummy}$ *x FemaleMortality* and $Couple_{Dummy}$ *x FemaleMortality*, captures the changing impact that gender has on mortality over time.

D. Combining the Three Risks

The results of mobility, refinance, and mortality termination rates can be aggregated as a single hazard rate according to Begg & Gray (1984) as follows:

$$P(t) = \sum_{j=1}^{3} P_j(t) \quad \{Equation\ 9\}$$

where $P_j(t)$ derived from *Equations 1, 2, & 3*

The majority of HECM loans have been endorsed in the past five years, so there are a limited number of loans that have remained in FHA's portfolio for a significant amount of time. As a result, the accuracy of the competing risk logit model to predict terminations for later policy years is limited. Experience with elderly homeowners has shown that as the borrower ages, the likelihood of voluntary move-outs (mobility) and refinances decrease and hence mortality would dominate the risk of terminations. Therefore, to mitigate the risk of limited long-term surviving loans on model accuracy, the termination model integrates the hazard rate from *Equation 9* with the borrower's mortality rate.

$$h_i(t) = \begin{cases} P(t), & \text{for policy year } t = 1 \\ MAX\{P(t), m_i(t)\}, & \text{for policy year } t > 1 \end{cases} \quad \{Equation\ 10\}$$

where $m_i(t) = \text{mortality of borrower's attained age for loan } i \text{ at time } t$

The final result of $h_i(t)$ is the conditional probability that a HECM loan will terminate due to one of the three competing risks. These probabilities are calculated at the loan level so that each loan has a conditional probability of termination. The probabilities are then used to calculate termination rates at the cohort and policy year level. Appendix B discusses the technical approach to estimating future terminations at the cohort and policy year level.

III. Model Estimation Results

Tables A-1, A-2, and A-3 present the coefficient estimates for the parameters for the logit regression models that predict mobility, refinance, and mortality termination probabilities.

Table A-1: Mobility Termination Model Specifications

Variable	Coefficient
Intercept	-6.7217
Duration 1 (year 0 to 5)	0.1484
Duration 3 (year 9+)	-0.0957
First Year (Dummy)	-0.6435
Origination Age	0.0417
Gender (Couple)*	-0.0108
Gender (Male)	0.0577
Cumulative HPA (%)	0.00709
Change in 1-Year CMT from Prior Year (%)	0.00358
Log Likelihood	324,170
Number of Observations	1,075,566
Likelihood Ratio Chi-Square	20,397
Probability > Chi-Square	<.0001

* Not significant for 0.05-level asymptotic normal test, p-value = 0.1696

Table A-2: Refinance Termination Model Specifications

Variable	Coefficient
Intercept	-1.6079
Policy Year	-0.2225
First Year (Dummy)	-1.8962
Second Year (Dummy)	-0.4963
Third Year (Dummy)	-0.0813
Origination Age	-0.0206
Gender (Couple)	-0.1277
Gender (Male)	0.1633
Refinance Incentive Measure	0.2875
First Month Cash Draw (Dummy > 85%)	0.6921
Log Likelihood	221,263
Number of Observations	1,060,867
Likelihood Ratio Chi-Square	20,898
Probability > Chi-Square	<.0001

Table A-3: Mortality Termination Model Specifications

Variable	Coefficient
Intercept	-4.1518
Gender (Couple)	-2.0047
Gender (Male)	0.1868
Female Mortality Rate (%)	10.1755
Interaction (Male by Mortality) (%)	1.731
Interaction (Couple by Mortality) (%)	12.0365
Log Likelihood	208,193
Number of Observations	1,059,362
Likelihood Ratio Chi-Square	22,684
Probability > Chi-Square	<.0001

References

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Yuen-Reed, G. and Szymanoski, E. J. (2007). *What's a Savvy Senior to Do? A Competing Risk Analysis of HECM Reverse Mortgage Loan Terminations.* American Real Estate and Urban Economics Association 2007 Mid-Year Conference: Washington, D.C.

Appendix B

Loan Performance Projections

Appendix B: Loan Performance Projections

This appendix will discuss how the termination model, which was discussed in Appendix A, is used to forecast future terminations. Future economic conditions and time-specific loan characteristics are required to forecast termination rates in future years. This appendix discusses the methodology used to create future loan data as well as how this data was used to forecast future terminations.

Estimated terminations are developed for all future policy years for each active loan as of June 30, 2009. For example, in this review, a loan endorsed in FY 2006 will have termination rates that begin in policy year four since the first three policy years have already elapsed by the end of FY 2009 and any terminations that occurred in those years are accounted for by actual experience. For each of these years; duration, loan, and economic variables are derived based on loan characteristics and economic forecasts. The Global Insight, Inc. August 2009 ten-year forecast of house price appreciation and interest rates is used until FY 2019. The June 2009 Global Insight thirty-year forecast of house price appreciation and interest rates is used after FY 2019. For future house price appreciation, nationwide forecasts are used, rather than the MSA or state level data used to develop termination specifications.

For every loan and future policy year, these parameter values are then applied to the multinomial logit models as specified in Appendix A. This generates single conditional termination rate per policy year that the loan will terminate given that it survived to the prior policy year. Loan-level termination rates are then aggregated according to the year or cohort in which they were endorsed. The projected conditional termination rates by cohort and policy year are imported into the HECM cash flow model to estimate future terminations and associated cash flows of the HECM program.

Appendix C

Cash Flow Analysis

Appendix C: Cash Flow Analysis

This appendix describes the calculation for the present value of future cash flows. Future cash flow calculations are based on factors, 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: premiums, claims, note holding expenses, and recoveries on notes in inventory. HECM cash flows are discounted according to the latest official annual Federal credit subsidy present value conversion factors, specified later in this appendix.

I. Definitions

The following definitions are provided to facilitate the discussion of HECM cash flows:

- **Insurance-In-Force (IIF):** Refers to the number of active loans in the HUD insurance portfolio (prior to assignment) and the corresponding total unpaid balance.

- **Maximum Claim Amount (MCA):** The minimum of the appraised home value at origination and the HUD loan limit. This is the maximum amount for which a lender can file an insurance claim.

- **Conditional Claim Type 1 Rate (CC1R):** The likelihood a loan terminates as a shortfall claim (claim type 1), given it survived to the beginning of the time period.

- **Note Holding Period:** The amount of time from note assignment to loan termination. During this period, HUD takes possession of the loan, now called an assigned note, and services it until loan termination.

- **Recoveries**: The recovery amount received by FHA at the time of note termination, expressed as a percentage of all the cash outflow since note assignment, which includes note acquisition and note holding costs.

II. Cash Flow Components

HECM cash flows are comprised of premiums, claims, assignment costs, and recoveries. Premiums consist of upfront and annual mortgage insurance premiums, which are inflows for the HECM program. Recoveries, a cash inflow, represent cash recovered from the sale or disposition of a note once it has terminated. Claim type 1 payments are a cash outflow paid to the lender when the sale of a property is insufficient to cover the balance of the loan. Assignment claims and note holding payments are additional outflows. Table C-1 summarizes the HECM inflows and outflows.

Table C-1: HECM Cash Flows

Cash Flow Component	Inflow	Outflow
Upfront Premiums	X	
Annual Premiums	X	
Claim Type 1 Payments		X
Claim Type 2 (Assignment) Payments		X
Note Holding Expenses		X
Recoveries	X	

We next discuss the major components and calculations associated with these HECM cash flows.

A. 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 draws 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.

B. Premiums

Upfront and annual mortgage insurance premiums are the primary source of revenue for the HECM program. Borrowers typically finance the upfront premium when taking out a HECM loan. Similarly, the recurring annual premiums are accrued on the balance of the loan.

1. Upfront Premiums

The borrower pays the upfront premium at the time of closing, equal to a percentage of the MCA. For FY 2009, the upfront premium rate is 2 percent of the MCA.

2. Annual Premiums

The borrower also pays the annual premium, which is calculated as a percentage of the growing loan balance. Currently, the annual premium is 0.5 percent of the UPB.

C. Claims

HECM claims consist of claim type 1s and claim type 2s.

1. Claim Type 1

Claim type 1s factor 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. The number and amount of claim type 1 are estimated based on program claim type 1 experience adjusted by insurance-in-force.

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). The model estimates assignments to occur when the projected UPB reaches 98 percent of the MCA.

D. Note Holding Expenses

Note holding expenses are cash outflows on assigned notes during note holding period, including any cash disbursed to the borrower.

E. Recoveries

At note termination, the HECM loan is due and payable to FHA. The timing of loan terminations is based upon the results of the termination model. The details of the termination projections are discussed in Appendix A and Appendix B. The amount of recovery is estimated as the minimum of the loan balance and the net sales proceeds at termination.

III. Net Future Cash Flows

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

$$\begin{aligned} \textit{Net Cash Flow}_t = \; & \textit{Upfront Premiums}_t + \textit{Annual Premiums}_t + \textit{Recoveries}_t \\ & - \textit{Claim Type 1s}_t - \textit{Claim Type 2s}_t - \textit{Note Holding Expenses}_t \end{aligned}$$

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 according to the latest official federal present value discount factors. At the time of this review, the latest discount factors published by the Office of Management and Budget (OMB) were in November 2008, are shown below:

FY	Discount Factor
2010	0.9978
2011	0.9792
2012	0.9524
2013	0.9271
2014	0.9000
2015	0.8725
2016	0.8462
2017	0.8202
2018	0.7927
2019	0.7641
2020	0.7355
2021	0.7091
2022	0.6845
2023	0.6616
2024	0.6403
2025	0.6203
2026	0.6015
2027	0.5839
2028	0.5673
2029	0.5516

FY	Discount Factor
2030	0.5368
2031	0.5229
2032	0.5096
2033	0.4971
2034	0.4852
2035	0.4739
2036	0.4631
2037	0.4529
2038	0.4431
2039	0.4339
2040	0.4249
2041	0.4162
2042	0.4076
2043	0.3992
2044	0.3910
2045	0.3830
2046	0.3751
2047	0.3674
2048	0.3598
2049	0.3524

FY	Discount Factor
2050	0.3452
2051	0.3381
2052	0.3311
2053	0.3243
2054	0.3176
2055	0.3111
2056	0.3047
2057	0.2984
2058	0.2923
2059	0.2863
2060	0.2804
2061	0.2746
2062	0.2690
2063	0.2635
2064	0.2580
2065	0.2527
2066	0.2475
2067	0.2424
2068	0.2375
2069	0.2326

Appendix D

Economic Forecasts

Appendix D: Economic Forecasts

This appendix discusses the base case economic forecasts used to calculate the economic value of the HECM portfolio. The economic value of the fund was also assessed under alternative economic scenarios, which are also presented in this appendix. The performance of the FY 2009 HECM book-of-business based on the scenarios below is provided in Section V of the review.

I. Base Case Economic Forecast

The base case economic scenario utilized the August 2009 Global Insight, Inc. ten-year forecast for FY 2010 to 2019 and the June 2009 Global Insight, Inc. thirty-year forecast for FY 2020 and after. These economic factors include the FHFA national housing price index, the ten-year Treasury rate, and the one-year Treasury rate. The base case mortality rates were obtained from the 1999-2001 U.S. Decennial Life Table published by the Center for Disease Control and Prevention (CDC). The data used in the base case scenario is summarized in Table D-1.

Table D-1: Base Case Economic Forecast

Economic Assumptions	FY2010	FY2011	FY2012	FY2013	FY2014	FY2015	FY2016
House Price Appreciation	-6.9%	-1.1%	1.4%	3.5%	3.3%	4.7%	4.6%
One-Year Note Rate	0.95	2.48	3.62	3.94	4.84	4.85	4.85
Ten-Year Note Rate	3.79	3.92	4.50	4.81	5.49	5.49	5.49

Economic Assumptions	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023+
House Price Appreciation	4.8%	5.8%	5.5%	6.5%	5.1%	3.7%	3.3%
One-Year Note Rate	4.85	4.85	4.85	4.85	4.85	4.85	4.85
Ten-Year Note Rate	5.49	5.49	5.49	5.49	5.49	5.49	5.49

II. Alternative Scenarios

Six sensitivity scenarios were considered to determine the effects of more severe and less severe economic and program performance scenarios on the HECM program value. Four economic scenarios were tested; more pessimistic house price forecast, interest rate upward shock, interest rate downward shock, and more optimistic house price forecast. Two scenarios specific to the HECM program were also tested: slower mortality and faster cash draws.

A. More Pessimistic House Price Forecast

One of the most important elements of the HECM program is the rate at which home values appreciate. When home values decrease, the likelihood of HECM loan balances exceeding home values rises, increasing the possibility of higher loan losses. Moreover, lower cumulative house price growth lowers the likelihood of refinance and mobility terminations, increasing the amount of time FHA is exposed to potential claim risks.

In order to test the HECM program's financial resilience to lower house price appreciation, a sensitivity analysis was conducted with lower house price assumptions. The July 2009 forecast created by GI was more pessimistic than the August 2009 forecast used in the base case analysis. Therefore, the FHFA House Price Index (HPI) forecast from July 2009 was used for FY 2010 to conduct this sensitivity analysis. The August 2009 forecast includes house price appreciation (HPA) of negative 6.9 percent in FY 2010 whereas the July 2009 forecast includes HPA of negative 10.5 percent in FY 2010.

B. Interest Rate Upward Shock

To test the impact of a higher near-term interest rate environment on the HECM financial portfolio, 300 basis points were added to all interest rate forecasts for FY 2010, FY 2011, and FY 2012. The two interest rates that directly affect HECM modeling are the one-year and ten-year Treasury rates.

Increasing the two interest rates has opposite impacts on the HECM loan balance and the risk on the MMI portfolio. Higher mortgage interest rates will cause HECM borrowers' loan balances to grow at a faster rate and hence increase the likelihood of claims but also increases revenue from premium and assigned note interests. On the other hand, a higher ten-year rate corresponds to a lower set of principal limit factors for all future books-of-business, which will reduce the amount of cash available to new borrowers during the life of the loan. This will result in lower loan balances and will decrease the likelihood of claims. The net impact is dependent on the magnitude of the two effects.

C. Interest Rate Downward Shock

To test the impact of a lower near term interest rate environment on the HECM financial portfolio, 300 basis points were subtracted from all interest rate forecasts for FY 2010, FY 2011, and FY 2012. If subtracting 300 basis points resulted in a negative interest rate, interest rates are held at zero percent.

Similar to the interest rate upward shock scenario, decreasing the one-year and ten-year Treasury rates has opposite impacts on the HECM loan balance and the risk on the MMI portfolio. Lower one-year Treasury rate tends to correspond to lower mortgage interest rate. This results in slower loan balance growth, decreasing the likelihood of a claim. However, lower mortgage interest rate also contributes to lower revenue from premium and assigned note interest accrual. At the same time, a lower ten-year Treasury

rate lowers the expected interest rate at origination for future books-of-business. If the expected interest rate is greater than 5.5 percent, the drop in ten-year rate will allow new borrowers to access more equity in the form of higher principal limit factors, increasing the loan balance and hence claim risks. The net impact is dependent on the magnitude of the two effects.

D. Less Pessimistic House Price Forecast

Similar to a worsening house price environment, a better house price environment can affect HECM's financial performance. In this scenario it is assumed that the housing outlook will be more optimistic than the forecast originally provided by GI. The July 2008 forecast created by GI was less pessimistic than the August 2009 forecast used in the base case analysis. Therefore, the FHFA House Price Index (HPI) from July 2008 for FY 2010 and FY 2011 was used to conduct this analysis. The August 2009 forecast includes house price appreciation (HPA) of negative 6.9 percent in FY 2010 and negative 1.1 percent for FY 2011 whereas the July 2008 forecast includes HPA of negative 0.8 percent in FY 2010 and positive 0.9 percent for FY 2011.

E. Slower Mortality

Another important factor in forecasting the performance of HECM in future years is mortality. Through improvements in technology and modern medicine the general population continues to outlive current mortality expectations. The 1999-2001 U.S. Decennial Life Table by CDC published in 2004 is used to forecast base case mortality terminations. At the time of this review, the 1999-2001 Life Table is the most recent study conducted by the CDC with mortality rates up to 109 years old.

The CDC mortality rates from the 2004 forecast (published in 2007) contain slower mortality rates than the baseline rates. This sensitivity analysis uses the 2004 Life Table for extrapolated mortality rates up to age 99. For ages 100 to 109, the mortality rates are according to the average rate of change between the 2001 Life Table and 2004 Life Table.

Slower mortality delays terminations due to death. This results in greater risk exposure for FHA as there is more time for the UPB to grow, increasing the possibility that the accumulated UPB exceeds the proceeds from house sale at termination. On the other hand, slower terminations also increase the time between assignment and termination, where HUD services the loan and receives servicing fees and interest income. The net impact is dependent on the magnitude of the two effects and the timing of terminations.

F. Faster Cash Draws

The HECM portfolio is sensitive to the amount of cash that borrowers draw from their initial principal limit. Faster cash draws increases the loan balance which increases both the likelihood of shortfall claims and the amount of interest revenue on assigned notes. The net effect on the economic value depends on house price forecasts, termination rates, and discount factors.

In this sensitivity study, we consider the scenario where borrowers accelerate their cash draw in early policy years. Specifically, we model the policy year two cash draw rate as the sum of the policy years two and three rates from the baseline model. Similarly, we model the policy year three cash draw rate as the sum of the policy years four and five from the baseline model. The cash draw rates in subsequent policy years were accelerated accordingly.

Appendix E

Econometric Model Results

Appendix E: Econometric Model Results

Conditional Termination Rates Forecast per Endorsement Fiscal Year and Policy Year

Fiscal Year	Policy Year																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
2009	-	8.73%	8.82%	8.04%	8.73%	8.32%	8.31%	8.40%	8.58%	8.47%	8.46%	8.54%	8.70%	8.96%	9.33%	9.77%	10.27%	10.85%	11.48%
2010	5.34	7.66	8.17	8.86	9.14	9.07	9.13	9.27	9.48	9.24	9.08	9.02	9.06	9.20	9.45	9.79	10.21	10.72	11.31
2011	4.58	7.31	8.42	8.71	9.28	9.28	9.36	9.52	9.72	9.43	9.20	9.10	9.11	9.24	9.46	9.80	10.21	10.70	11.28
2012	4.37	7.48	8.24	8.78	9.43	9.44	9.53	9.68	9.85	9.50	9.25	9.14	9.15	9.27	9.49	9.82	10.23	10.73	11.31
2013	4.43	7.29	8.25	8.84	9.52	9.54	9.62	9.73	9.86	9.49	9.24	9.13	9.14	9.26	9.47	9.79	10.20	10.69	11.26
2014	4.32	7.29	8.30	8.91	9.61	9.62	9.66	9.73	9.84	9.47	9.23	9.12	9.14	9.26	9.49	9.82	10.23	10.72	11.29
2015	4.32	7.31	8.32	8.93	9.61	9.58	9.58	9.63	9.74	9.38	9.16	9.07	9.10	9.23	9.46	9.79	10.20	10.69	11.27
2016	4.33	7.34	8.36	8.97	9.62	9.55	9.54	9.59	9.70	9.36	9.14	9.06	9.09	9.22	9.46	9.79	10.20	10.70	11.28

Fiscal year	Policy Year																		
	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
2009	12.17%	12.91%	13.71%	14.58%	15.53%	16.55%	17.66%	18.89%	20.23%	21.72%	23.39%	25.30%	27.52%	30.17%	33.84%	37.98%	42.02%	45.18%	46.85%
2010	11.99	12.77	13.64	14.58	15.57	16.63	17.81	19.12	20.56	22.15	23.94	26.03	28.61	31.93	36.12	40.58	44.84	48.50	51.46
2011	11.96	12.75	13.63	14.57	15.56	16.61	17.77	19.07	20.53	22.16	24.01	26.18	28.85	32.25	36.42	40.79	44.88	48.38	51.29
2012	11.99	12.77	13.64	14.57	15.55	16.61	17.79	19.11	20.57	22.17	23.98	26.13	28.77	32.18	36.36	40.75	44.89	48.43	51.32
2013	11.94	12.73	13.60	14.54	15.53	16.59	17.76	19.06	20.51	22.12	23.93	26.04	28.64	32.02	36.24	40.70	44.94	48.56	51.48
2014	11.97	12.75	13.62	14.56	15.55	16.62	17.79	19.11	20.56	22.17	23.99	26.13	28.77	32.18	36.39	40.83	45.02	48.61	51.54
2015	11.96	12.75	13.63	14.57	15.54	16.59	17.74	19.05	20.52	22.15	23.98	26.14	28.77	32.14	36.31	40.71	44.85	48.39	51.26
2016	11.97	12.75	13.62	14.56	15.55	16.61	17.80	19.12	20.57	22.16	23.96	26.09	28.73	32.12	36.30	40.70	44.86	48.42	51.32