# ANALYSIS OF DEEP COVERAGE MORTGAGE INSURANCE

**Prepared for:**

## U.S. Mortgage Insurers

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## A. BACKGROUND AND SCOPE

### *A.1 Background*

U.S. Mortgage Insurers (USMI)[1] is proposing to the Federal Housing Finance Agency (FHFA) that Fannie Mae and Freddie Mac (Government-Sponsored Enterprises or GSEs) could further meet the 2015 (and future) Conservatorship Scorecard requirements related to risk-sharing by substituting a portion of the current guarantee fee (G-Fee) requirements with a greater or deeper coverage mortgage insurance option. The GSEs provide a guarantee for credit risk on mortgages originated by approved lenders for inclusion in MBS Securities. In exchange for this credit risk guarantee, lenders pay a G-Fee. The components of the G-Fee include a projected cost for expected credit losses, administrative expenses and other fees, and a return on capital.

The GSEs' current charter[2] requires that a credit enhancement, such as mortgage insurance, must be in place for any loans with less than a 20% down payment at origination. It is common practice for the GSEs to lower their exposure to credit losses for 85% loan-to-value (LTV) mortgage loans to approximately 75% LTV, 90% or 95% LTV mortgage loans to approximately 67% LTV and 97% LTV mortgage loans to approximately 63% LTV with private mortgage insurance. USMI's proposal would lower the GSEs' exposure to credit losses to approximately 50% LTV at origination by leveraging the existing mortgage insurance marketplace framework.

Mortgage insurance (MI) is a first layer of credit protection for investors. Mortgage guaranty insurers disperse and pool mortgage default risk by diverting accumulated premium revenues derived from relatively strong mortgage markets to cover losses in relatively weak mortgage markets. Default risk is dispersed and pooled both geographically and temporally. At the geographic level, insurers achieve diversification by writing business nationally, thereby better enabling them to withstand severe regional economic downturns. At the temporal level, insurers are subject to stringent minimum surplus and reserve requirements imposed by state insurance regulators and the GSEs. The contingency reserve and capital requirements generally cause insurers to retain premiums earned during periods of economic expansion in order to cover losses incurred during periods of protracted economic recession.

The premise of increasing private capital by utilizing deep coverage mortgage insurance coverage and reducing risk exposure to the GSEs is the focus of this analysis. Using publicly available historical mortgage performance data, this report highlights the potential loss protection to the GSEs and estimates the cost of and potential impact of mortgage insurers providing deep coverage.

### *A.2 Scope*

Milliman, Inc. (Milliman) was retained by USMI to independently estimate the additional premium for private mortgage insurance that would generate a given return on capital assuming the extension of mortgage insurance coverage to a larger portion of the loan amount, referred to as deep coverage. The deep coverage mortgage insurance was assumed to reduce the GSEs' exposure to credit losses to less than 50% LTV

[1] U.S. Mortgage Insurers (USMI) is a trade association composed of the following private mortgage insurance companies: Arch Mortgage Insurance Company, Essent Guaranty, Inc., Genworth Financial, Mortgage Guaranty Insurance Corporation, National Mortgage Insurance Corporation, and Radian Guaranty Inc.

[2] "No such purchase of a conventional mortgage secured by a property comprising one- to four-family dwelling units shall be made if the outstanding principal balance of the mortgage at the time of purchase exceeds 80 per centum of the value of the property securing the mortgage, unless (A) the seller retains a participation of not less than 10 per centum in the mortgage; (B) for such period and under such circumstances as the corporation may require, the seller agrees Conventional Mortgages Credit Enhancement to repurchase or replace the mortgage upon demand of the corporation in the event that the mortgage is in default; or (C) that portion of the unpaid principal balance of the mortgage which is in excess of such 80 per centum is guaranteed or insured by a qualified insurer as determined by the corporation." Source: Federal National Mortgage Association Charter Act, Title II of National Housing Act, 12 U.S.C. 1716 et seq., As amended through July 21, 2010.

utilizing the current mortgage insurance master policy requirements[3]. In addition, Milliman was asked to utilize publicly available information to estimate whether the cost of substituting deep coverage mortgage insurance would have an economic impact to the average borrower compared with G-Fees currently charged by the GSEs.

To perform the analysis, Milliman utilized publicly available GSE loan performance data to calibrate a loan-level regression model to estimate incremental losses that would be incurred by mortgage insurers providing the deep coverage mortgage insurance. The loan performance data supplied directly by the GSEs includes loan origination information and performance records for a population of mortgages that were purchased or guaranteed from 1999 through 2014. This information has been specifically released to better understand the credit performance of GSE mortgage loans and to support their recent risk-sharing programs. Although the data released includes only a subset of the GSEs' total historical mortgage purchases, the fully amortizing, full documentation, single-family, conventional fixed-rate mortgages included in the data is described as more reflective of their current underwriting guidelines and is therefore useful for illustrative purposes.

In addition, Milliman utilized information supplied by the FHFA with respect to their June 5, 2014 request for input on Fannie Mae and Freddie Mac Guarantee Fees. Although detailed information about the GSEs' expected and unexpected credit losses that require G-Fee support is somewhat limited, a general framework for their construction was available and utilized by Milliman to evaluate the comparative value for the application of USMI's deep coverage mortgage insurance proposition.

This report presents the results of Milliman's analysis.

Note that Milliman's analysis is subject to Qualifications and Limitations as well as Limitations on Distribution of Results as stipulated in section D of this report. As described in that section, the analysis has been prepared solely for the use of U.S. Mortgage Insurers and cannot be provided to any other party without Milliman's prior written consent. In addition, the analysis is subject to the significant uncertainty inherent in mortgage insurance. These matters are discussed more fully in section D below.

[3] Of note is a mortgage insurer's adherence to the Homeowners Protection Act (HOPA) that generally requires that mortgage insurance will automatically terminate on the date the mortgage loan balance is first scheduled to reach 78% of the original value.

## B. EXECUTIVE SUMMARY

Mortgage loan financing is a process with defined standards and qualifications for loan product, borrower underwriting and property considerations. In the aftermath of the housing crisis and with the implementation of new legislation for mortgage loan standards, the mortgage industry has adapted new compliance requirements and has re-evaluated the costs associated with mortgage credit default risk. These costs are paid by the borrower and are included in the cost of the mortgage loan interest rate. Borrowers that do not have 20% of the cost of the home as a down payment must pay additional fees to compensate for the risk of default. These fees generally include the cost of private mortgage insurance and the cost of credit risk default as defined by the primary investors in the conventional loan market, Fannie Mae and Freddie Mac.

The GSEs provide credit risk guarantees on the loans in the securities they issue. This means that the risk of loss from borrowers not paying their mortgage payments is borne by each GSE as they guarantee the timely payment of principal and interest to investors. In exchange for this credit guarantee, the GSEs charge a fee to the lenders and issuers of the securities they guarantee. Each GSE has an internal model that provides estimated costs for three components[4] of G-Fees: expected losses for the loans they guarantee, administrative expenses, and a cost of capital. The GSEs do not specifically publish their model(s) and/or methodology for the determination of their expected losses, expenses and cost of capital and therefore it is somewhat difficult to replicate and project forward. With that said, Milliman has attempted to use publicly available information to estimate the various components of the applicable G-Fee and supplemented with Milliman's model estimated proportion of required retained expected and unexpected loss costs as necessary.

### *B.1 Deep Coverage Mortgage Insurance*

Deep coverage mortgage insurance is defined as a traditional primary mortgage insurance company (MI) reducing a GSE's loss exposure for each mortgage loan down to 50% LTV from its traditional standard coverage. All existing primary mortgage insurance business attributes have been assumed to remain the same (such as traditional lender distribution, HOPA provisions for mortgage insurance cancellation, and current master policy provisions).

**DEEP COVERAGE MORTGAGE INSURANCE**
**Coverage and Exposures Compared to Standard Coverage**

| LTV | Standard Coverage | | Deep Coverage | |
|---|---|---|---|---|
| | Coverage Percentage | Exposure Down-To | Coverage Percentage | Exposure Down-To[1] |
| 85% | 12.0% | 74.8% | 41.2% | 50.0% |
| 90% | 25.0% | 67.5% | 44.4% | 50.0% |
| 95% | 30.0% | 66.5% | 47.4% | 50.0% |
| 97% | 35.0% | 63.1% | 48.5% | 50.0% |

[1] Of note is a mortgage insurer's adherence to the HOPA that generally requires that mortgage insurance will automatically terminate on the date the mortgage loan balance is first scheduled to reach 78% of the original home value.

As illustrated in the table above and graphically on Exhibit 1, deep coverage mortgage insurance would reduce the GSE's exposure to credit related losses for a mortgage loan. For example, with a 10% down payment, a GSE's exposure would be reduced to 50.0% from 67.5% by increasing the mortgage insurance coverage from 25.0% to 44.4% (i.e., 90% - 0.444 x 90% = 50%).

[4] The GSEs must also collect and remit to Treasury a 10 basis point (bp) fee to cover Payroll Taxes under the Temporary Payroll Tax Cut Continuation Act of 2011 (TCCA). This fee is charged to borrowers as part of the total G-Fee.

### *B.2 Analysis Results*

Using a model built by Milliman using the GSEs' publicly available loan-level data and the average portfolio composition developed from the same data, Milliman generated pro-forma financial statements reflecting the cash flows related to insuring the additional deep coverage layer for a portfolio of loans with mortgage insurance.

Milliman's analysis of deep coverage mortgage insurance includes the following assumptions:

- Utilizing a required capital framework calibrated to the recently released Private Mortgage Insurer Eligibility Requirements (PMIERs) capital requirements;
- An illustrative cost of capital of 10%, which was selected to be consistent with recent statutory rate filings; and
- Other assumptions, documented in more detail below intended to estimate a primary mortgage insurer's expected losses and cash flows for providing the additional deep coverage.

The premium indication for deep coverage from the model is estimated to be approximately 18 basis points (bp) annually for the modeled portfolio utilizing the current mortgage insurance master policy framework as discussed above.

The estimated average reduction in G-Fee for the same portfolio of mortgage loans is estimated to be approximately 33 bp, resulting in a net reduction of 33 bp in the mortgage interest rate and a lower mortgage payment for borrowers as illustrated on Exhibit 2. Based on today's market rates and the defined loan characteristics, the average borrower in Milliman's analysis is estimated to benefit by the amount of approximately $8 per month assuming an original loan amount of $225,000. On average, the borrower saves approximately $2,000 to $2,500 over the average life of their loan due to the difference of private mortgage insurance's adherence to the HOPA's cancellation provisions versus the G-Fee life-of-loan requirement.

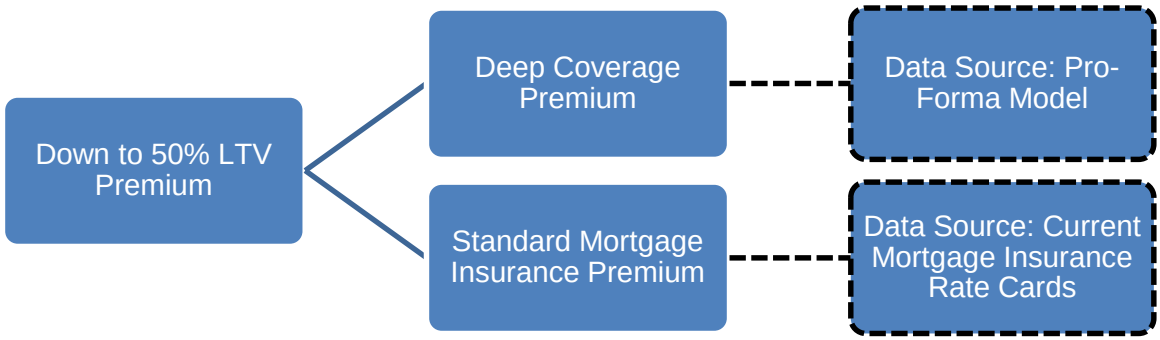
In addition to potential borrower savings, deep coverage mortgage insurance almost doubles the amount of coverage protection afforded to the GSEs and would allow the GSEs to reduce their committed capital for this risk by approximately 75%. Most of the remaining risk Milliman estimates for the GSEs is to cover losses that occur after the point in time when amortization reaches 78% LTV and mortgage insurance typically can be cancelled under HOPA as mentioned above.

#### *B.2.a Estimated Premium Rate for Deep Coverage Mortgage Insurance*

Milliman's analysis assumes the deep coverage mortgage insurance premium is collected monthly and is calculated as a fixed amount of the original loan balance in accordance with standard mortgage insurance. As such, the mortgage insurance premium paid by the borrower in Milliman's model does not decline for the period that the insurance is in-force.

The probability of the insurance remaining in-force was estimated through three components: the probability of default termination, the probability of prepayment, and the probability of cancellation at the point the loan balance amortizes below 78% of the original estimated collateral value. The default and prepayment termination probabilities were estimated using the model described in Section C. The remaining probability of being in-force was assumed to be terminated at the point the loan balance amortizes below 78% of the original collateral value. For purposes of this calculation, the original collateral value was estimated using the original loan balance and the original LTV.

Using the pro-forma balance sheet Milliman developed for this analysis, Milliman estimated the deep coverage premium rate as the additional premium indicated by the models *in excess of current premium rates* to reach a 10% return on the required amount of capital. The figure below provides a visual of the model components for estimating the deep cover premium and data sources.




***B.2.b Estimated GSE Exposure Reduction, Subsequent G-Fee Reduction and Use of Private Capital***

Milliman analyzed historical mortgage insurance payments from the GSE data to evaluate what the impact of deep coverage would have been if deep coverage had been required by the GSEs. This analysis was performed using the GSEs' Single Family Loan-level Datasets. Milliman first estimated the actual claim payments provided in the data. Next, Milliman estimated the additional claim payments that would have occurred if each loan with mortgage insurance had deep coverage mortgage insurance coverage down to 50% LTV. The table below provides a summary of the results.

| ESTIMATED EXPOSURE REDUCTION FROM DEEP COVERAGE ($ Millions) | | | |
|---|---|---|---|
| **Estimated Exposure Reduction** | **Calculation** | **Standard Coverage MI** | **Deep Coverage MI** |
| **Original Loan Volume** | A | $7,394,301 | $7,394,301 |
| **Original Loan Volume with Primary MI** | B | $1,315,785 | $1,315,785 |
| **Weighted Average Coverage Amount** | C | 25% | 45% |
| **Reduction of Risk in Force Due to MI** | D = B * C | $323,183 | $587,202 |
| **Gross GSE Losses on loans with MI** | E | $22,872 | $22,872 |
| **Indicated MI Paid Losses** | F | $9,896 | $18,848 |
| **Net GSE Losses on loans with MI** | G = E - F | $12,976 | $4,024 |
| **Reduction in GSE Losses from MI** | H = F / E | 43% | 82% |

If deep coverage mortgage insurance were in place for the loan population in the data, it could have increased the GSEs' recoveries from mortgage insurers by 90% and reduced their exposure to potential losses by over $264 billion (i.e., $264 = $587 – $323 from row D). Note that this data only includes loans from the GSEs' public loan-level data. Actual origination amounts, amount of insurance provided, and losses paid by the mortgage insurance industry over this time period are significantly larger than those indicated in the table above. Exhibit 3 provides a summary of total originations for the GSEs' mortgages by origination year against the data available from the GSEs' Single-Family Loan-level Datasets. The GSEs' loan-level data contains information on $7.4 trillion of origination volume. In contrast, data from CoreLogic's TrueStandings Servicing Data, which provides information on all GSE originations, indicates total originations of $14.6 trillion over the same time period. When filtering on only loans with an original LTV above 80%, the TrueStandings data indicates total originations of $3.1 trillion compared with $1.3 trillion from the GSE loan-level data. According to Exhibit 3, the GSE loan-level data provides information on approximately 50 percent of total historical GSE mortgages.

Assuming the loans excluded from the GSEs' loan-level data have similar loss history to those in the data and dividing the mortgage insurance paid losses by 42%, paid losses under deep coverage would have increased from approximately $23.8 billion ($23.8 = $10.0 / 42%) to approximately $45.0 billion (i.e., $45.0 = $18.9 / 42%). This estimate may be conservative because the loans excluded from the GSE loan-level data generally have higher default risk relative to the loans published in the loan-level data. In fact, the private mortgage insurers have reported paying losses greater than $44 billion since the GSEs entered conservatorship, though this may include other counterparties.

To estimate the additional amount of coverage that would have been provided under standard and deep coverage, Milliman multiplied the above 80% LTV original loan amount by an average coverage percent of 25% and 45%, respectively. This results in estimated coverage amounts of $783 billion for standard coverage and $1,410 billion for deep coverage. Deep coverage would have reduced GSEs' exposure to defaults by $627 billion (i.e., $1,410 billion - $783 billion).

In addition to estimating the impact of mortgage insurance on historical data, Milliman also used its mortgage performance models to estimate the reduction in risk to the GSEs. Milliman's models estimate that standard mortgage insurance covers 76% of expected losses on loans with mortgage insurance and 61% of losses in a stress scenario. The losses covered under a stress scenario are lower as a percent of total because actual losses exceed the coverage amount. However, with deep coverage and cancellation at 78% LTV, mortgage insurance covers 89% of losses in the expected scenario and 90% of losses in a stress scenario.

The table below summarizes the expected and unexpected losses incurred assuming standard coverage and deep coverage from the model in order to highlight the impact on the GSEs' losses. The values in the table are expressed as a percent of model estimated GSE losses assuming standard coverage mortgage insurance.

**DEEP COVERAGE MORTGAGE INSURANCE ANALYSIS**
**SUMMARY OF ESTIMATED GSE EXPECTED AND UNEXPECTED RETAINED LOSSES**

| | Expected Losses | Stress Losses | Unexpected Losses |
|---|---|---|---|
| Estimated GSEs Losses with Standard Coverage | 100% | 100% | 100% |
| Estimated GSEs Losses with Deep Coverage | 47% | 26% | 23% |
| Estimated Losses Transferred with Deep Coverage MI | 53% | 74% | 77% |
| Selected Losses Retained for G-Fee Illustration | 50% | | 25% |

Using the above results and G-Fee data published by the GSEs, Milliman estimated a G-Fee amount given deep coverage. The G-Fee under deep coverage should be lower than current G-Fee rates to account for both the reduction in expected losses and required capital to cover unexpected losses. For purposes of this analysis, Milliman estimated the GSEs' expected credit losses are reduced by 50% and unexpected credit losses are reduced by 75%. Under the assumed portfolio composition for the analysis, the average G-Fee assuming standard coverage is 64 bp. Under the revised assumptions with deep coverage mortgage insurance, Milliman estimates a reduced G-Fee of 31 bp.

The table below provides a summary of the composition of the G-Fee. Section C.6 of this report provides additional detail on the analysis.

| DEEP COVERAGE MORTGAGE INSURANCE ANALYSIS<br>G-FEE COMPOSITION (BP) | | | |
|---|---|---|---|
| | **A<br>Standard<br>Coverage** | **B<br>Deep<br>Coverage** | **C = B / A - 1<br>Change in G-Fee<br>Component** |
| Admin G&A Expenses | 7 | 7 | 0% |
| Payroll Tax - TCCA | 10 | 10 | 0% |
| Expected Losses | 8 | 4 | (50)% |
| Provision for Unexpected Losses | 39 | 10 | (75)% |
| **Total** | **64** | **31** | **(52)%** |

***B.2.c Estimated Borrower Impact***

When a borrower applies for a mortgage loan, the financing terms are provided in the form of origination processing fees, closing fees, and the interest rate and discount points for repayment of the loan. Included in the interest rate are several costs that include: mortgage coupon rate, servicing fee, and G-Fees required by the GSEs. The mortgage coupon rate is the rate the market requires to sell the loan in the secondary market. Servicing fees are generally 25 bp and cover the cost of administering and collecting the mortgage loan payments. Credit risk fees required by the GSEs are set by the GSEs based on their estimates of the expected and unexpected losses of loan default as well as GSE administrative fees. For the loan portfolio considered in this analysis, the G-Fees are estimated to be 64 bp as described above. The borrowers pay for all of these fees in the interest rate of their mortgage loan.

Borrowers with less than a 20% down payment must also obtain mortgage insurance pursuant to GSE charter guidelines. A borrower may choose to pay a lump sum amount as in a single premium payment or a split fee amount that allows for a portion upfront with the remaining amount paid with each mortgage payment. Typically, the borrowers pay mortgage insurance on a monthly basis as part of their mortgage payment. Generally, there are no upfront fees (as in Federal Housing Administration mortgage insurance) and borrower-paid mortgage insurance is required to be cancelled automatically once the LTV is reduced to 78%[5].

Exhibit 2 and the table below provide a summary of the impact on an average borrower. The table provides a comparison of standard MI and deep coverage MI with the corresponding assumptions in G-Fee and MI premium. Using deep coverage, the amount of mortgage insurance coverage increases from 26.1% to 45.5% (row B). The premium rate increases by $34 (row N) but the overall principal and interest plus mortgage insurance payment is reduced by $8. Notably, the average lifetime payments in aggregate for mortgage insurance and GSE G-Fees are expected to be $2,300 less under deep coverage mortgage insurance due to a greater portion of the credit risk fees paid by the borrower canceling at 78% LTV. By utilizing deep coverage mortgage insurance, expected losses and unexpected losses to the GSEs are reduced and thus utilizing this coverage reduces the G-Fee as well.

[5] HOPA, The Homeowners Protection Act of 1998, was passed by Congress to address borrowers' difficulties in cancelling private mortgage insurance when they had reached a certain level of equity in the property. The act provides specific cancellation and termination rights.

| DEEP COVERAGE MORTGAGE INSURANCE ANALYSIS<br>BORROWER PAYMENT COMPARISON : STANDARD TO DEEP COVERAGE MI | | | | |
|---|---|---|---|---|
| | **Calculation** | **Standard** | **Deep** | **Net Impact** |
| **Mortgage Insurance Assumptions:** | | **A** | **B** | **C = B - A** |
| Mortgage Loan Amount | A | $225,000 | $225,000 | $0 |
| Coverage Percentage | B | 26.1% | 45.5% | 19.4% |
| Risk coverage | C = A * B | $58,625 | $102,382 | $43,757 |
| Estimated Premium Rate | D | 65 bp | 83 bp | 18 bp |
| **GSE G-Fee Assumptions[1]:** | | | | |
| General & Administrative Expenses | E | 7 bp | 7 bp | 0 bp |
| Payroll Tax – TCCA | G | 10 bp | 10 bp | 0 bp |
| Expected Losses | F | 8 bp | 4 bp | (4) bp |
| Provision for Unexpected Losses | H | 39 bp | 10 bp | (29) bp |
| Estimated GSE G-FEE | I = Sum (E:H) | 64 bp | 31 bp | (33) bp |
| **Borrower Payment Impact:** | | | | |
| MBS Coupon | J | 3.00% | 3.00% | 0.00% |
| MBS Servicing | K | 0.25% | 0.25% | 0.00% |
| Borrower Note Rate | L = Sum (I:K) | 3.89% | 3.56% | (0.33)% |
| Borrower Payment before MI | M | $1,060 | $1,018 | $(42) |
| MI Premium Payment | N = D / 12 * A | $122 | $156 | $34 |
| Total Borrower Payment | O = M + N | $1,182 | $1,174 | $(8) |
| **Deep Coverage Analysis Impact:** | | | | |
| Estimated Expected Lifetime Payments of G-Fees | P | $8,267 | $3,939 | $(4,328) |
| Estimated Lifetime Payments of MI | Q | $7,470 | $9,503 | $2,033 |
| Estimated Total Lifetime Payments | R = P + Q | $16,299 | $13,442 | $(2,295) |

[1] G-Fee assumptions based on analysis of the FHFA G-Fee Request for Input, June 5, 2014. The standard coverage G-Fee reflects implied loss cost in RFI and Milliman's assumed portfolio distribution (FICO and LTV only). The reduction in G-Fee assuming deep coverage is based on Milliman's estimate of the proportion of required retained expected and unexpected costs after MI coverage termination at 78% LTV and below 50% LTV.

## C. MILLIMAN'S ANALYSIS AND ASSUMPTIONS

Milliman was retained to perform an analysis of the cost of deep coverage mortgage insurance. In performing its analysis, Milliman first developed a mortgage performance model to generate estimates of mortgage prepayment, default, and severity rates given various collateral and economic assumptions. Then, Milliman developed a pro-forma cash flow model to estimate mortgage insurance cash flows under various coverage regimes. Milliman used these models to generate estimates of cash flows related to deep coverage mortgage insurance for a portfolio of loans under various economic scenarios. Finally, Milliman used publicly available information to assess the GSE G-Fee assuming both standard and deep coverage mortgage insurance. This section of the report documents Milliman's analysis.

### *C.1 Mortgage Performance Model*

Milliman developed a mortgage performance model that is similar to the FHFA Mortgage Analytics Platform, described in a white paper released by FHFA on July 10, 2014[6]. The model estimates future prepayment, default, and severity rates for mortgages from origination through termination. The model estimates the performance of loans separately for performing loans (i.e., never 90 days delinquent) and non-performing loans (i.e., 90+ days delinquent). These estimates are aggregated to produce estimates of future prepayment and default events.

Exhibit 4 provides a visual of the main components of the model. The first stage of the model estimates the probability of a loan transitioning from performing to either prepayment or non-performing (i.e., over 90 days delinquent). The second stage of the model estimates the probability of a loan transitioning from non-performing to prepayment or default. The transition probabilities generate dynamic estimates that vary according to a loan's underwriting characteristics, loan age, and economic influences. For loans that are estimated to default, the model includes a severity component to estimate the cost of default.

#### *C.1.a Data Used on Model Parameterization*

Milliman developed the models for this analysis using the Single Family Loan-Level Datasets published by Freddie Mac[7] and Fannie Mae[8]. This data includes loan origination information and performance records for a population of mortgages that were purchased or guaranteed from 1999 through 2014. In addition, Milliman appended economic statistics to the data to capture economic impacts on mortgage performance and severity rates. Specifically, Milliman appended home price index values, unemployment rates at the Core-Based Statistical Area (CBSA), and 10-year treasury interest rates.

Exhibits 5 through 8 provide summary statistics of the data by origination year. In addition, descriptions of the datasets from Freddie Mac and Fannie Mae can be found below.

#### *C.1.a.i Freddie Mac Dataset*

According to Freddie Mac, "As part of a larger effort to increase transparency, Freddie Mac is making available loan-level credit performance data on a portion of fully amortizing 30-year fixed-rate mortgages that the company purchased or guaranteed from 1999 to 2014.The availability of this data will help investors build more accurate credit performance models in support of ongoing risk sharing initiatives highlighted by our regulator, the Federal Housing Finance Agency…"

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6 http://www.fhfa.gov/PolicyProgramsResearch/Research/PaperDocuments/FHFA_MortgageAnalyticsPlatform_Whitepaper.pdf

7 http://www.freddiemac.com/news/finance/sf_loanlevel_dataset.html

8 http://www.fanniemae.com/portal/funding-the-market/data/loan-performance-data.html

The dataset covers approximately 17 million 30-year, fixed-rate mortgages originated between January 1, 1999, and March 31, 2014. Actual loss data and monthly loan performance data, including credit performance information up to and including property disposition, is being disclosed through September 30, 2014. Specific credit performance information in the dataset includes voluntary prepayments and loans that were Foreclosure Alternatives and Real Estate Owned (REO). Specific actual loss data in the dataset includes net sales proceeds, MI recoveries, non-MI recoveries, expenses, current deferred UPB, and due date of last paid installment."

***C.1.a.ii Fannie Mae Dataset***

According to Fannie Mae, "Fannie Mae is providing loan performance data on a portion of its single-family mortgage loans to promote better understanding of the credit performance of Fannie Mae mortgage loans."

The population includes a subset of Fannie Mae's 30-year, fully amortizing, full documentation, single-family, conventional fixed-rate mortgages. This dataset does not include data on adjustable-rate mortgage loans, balloon mortgage loans, interest-only mortgage loans, mortgage loans with prepayment penalties, government-insured mortgage loans, Home Affordable Refinance Program (HARP) mortgage loans, Refi Plus™ mortgage loans, and non-standard mortgage loans. Certain types of mortgage loans (e.g., mortgage loans with LTVs greater than 97%, Alt-A, other mortgage loans with reduced documentation and/or streamlined processing, and programs or variances that are ineligible today) have been excluded in order to make the dataset more reflective of current underwriting guidelines. Also excluded are mortgage loans originated prior to 1999, mortgage loans subject to long-term standby commitments, sold with lender recourse or subject to certain other third-party risk-sharing arrangements, or were acquired by Fannie Mae on a negotiated bulk basis."

***C.1.b Performing Loan Model***

The performing loan model estimates the quarterly probability of a loan transitioning from performing status to either prepayment or first-time 90 day delinquency episode (serious delinquency). For purposes of this model, a performing loan is defined as a loan that has never been 90 days delinquent, in foreclosure, or real estate owned.

Milliman processed the data into a quarterly panel dataset that included origination characteristics, economic statistics (e.g., cumulative home price appreciation, change in unemployment rate, and others), and quarterly performance. The performing loan model includes the first record of performance data through either the first occurrence of a 90 day delinquency episode or a prepayment event.

Milliman extracted a random 25% sample of the data to develop the models. Milliman sampled data from the origination dataset provided by the GSEs and merged the sample data to the loan performance data to extract complete loan histories for the sampled loans.

The model estimates the probabilities for prepayment and serious delinquency using a series of binomial logistic cell regressions. Cell regression is used to maximize the amount of data used to develop the model and minimize the required computing capacity.

For cell regression, loans are aggregated into cells or cohorts, based on frequency distribution of the following regressors:

| CELL REGRESSORS IN PERFORMING LOAN MODEL | | |
|---|---|---|
| Loan Age (in quarters) | Cumulative Home Price Appreciation Cohort | Unemployment Rate Change Cohort |
| Origination Year | Original Combined Loan-to-Value Ratio Cohort | Burnout |
| Property Type | Original Loan-to-Value Ratio Cohort | Seasonality |
| Loan Purpose | Debt-to-Income Cohort | Mortgage Insurance Indicator |
| Occupancy Status | Mortgage Insurance Coverage Percent | Interest Rate Change Cohort |
| Loan Size Cohort | Original Interest Rate Cohort | Spread at Origination Cohort |
| In Sample Flag | | |

Each unique combination of values of the 19 variables defines a cohort or cell. Each cell includes the total number of active loans, the total number of first-time 90 day delinquencies, and the total number of prepayments for each quarter.

The modeled probabilities are combined following the results in Begg and Gray[9]. This framework is based on the assumption of independent irrelevant alternatives (IIA)[10]. According to the IIA assumption, the probabilities for each termination type are estimated separately, using different explanatory variables, and then combined to calculate final probabilities. The advantage of this approach is the ability to specify a unique function form and set of explanatory variables for each model. Once the independent probabilities are combined, the results are mathematically equivalent to a multinomial logistic model.

Equations 1 and 2 below are the model specifications for the mortgages that enter serious delinquency or prepayment termination paths, respectively:

**Equation 1:**

$$\log\left(\frac{P_D}{P_A}\right) = X_D\beta_D + \varepsilon_D$$

**Equation 2:**

$$\log\left(\frac{P_P}{P_A}\right) = X_P\beta_P + \varepsilon_P$$

In the equations above, $P_D$ is the probability of serious delinquency, $P_P$ is the probability of prepayment, $P_A$ is the probability of remaining as a performing loan, and $\varepsilon_D$and $\varepsilon_P$ are i.i.d. error terms with logistic distribution. $X_D$ and $X_P$ are predictor vectors that include variables representing initial borrower and loan-level characteristics, loan age, and macroeconomic conditions.

[9] Begg, Colin B., and Robert Gray. "Calculation of Polychotomous Logistic Regression Parameters Using Individualized Regression." *Biometrika,* 71, no. 1 (1984): 11-18.

[10] The IIA assumption generally implies that adding or removing more termination events would not affect the odds of the original termination events. This is a strong assumption, but it can be tested throughout the model development process.

After estimating model parameters $\beta_D$ and $\beta_P$ based on the historical loan information, the future $P_D$ and $P_P$ for each of the successive loan ages (in quarters) are forecast, using the following formulas:

**Equation 3:**

$$\hat{P}_D = \frac{e^{X_D \hat{\beta}_D}}{1 + e^{X_D \hat{\beta}_D} + e^{X_P \hat{\beta}_P}}$$

**Equation 4:**

$$\hat{P}_P = \frac{e^{X_P \hat{\beta}_P}}{1 + e^{X_D \hat{\beta}_D} + e^{X_P \hat{\beta}_P}}$$

Descriptions of the predictor variables in the model and their impact on serious delinquent and prepayment probabilities are shown below. In addition, Exhibits 9 and 10 provide a summary of the model specifications including the variables in the model, the levels of each variable, coefficient, and p-value.

| Variable | Value | Prepayment | Serious Delinquency |
|---|---|---|---|
| Loan-to-Value Ratio | High Ratio<br>Low Ratio | Decrease<br>Increase | Increase<br>Decrease |
| Credit Score | High Score<br>Low Score | Increase<br>Decrease | Decrease<br>Increase |
| Debt to Income Ratio | High Ratio<br>Low Ratio | N/A | Increase<br>Decrease |
| Original Loan Amount | Low Amount<br>Average Amount<br>High Amount | Decrease<br>Reference<br>Increase | Increase<br>Reference<br>Increase |
| Spread at Origination | High Spread<br>Low Spread | Increase<br>Decrease | N/A |
| Occupancy | Owner<br>Investor<br>Second | Reference<br>Decrease<br>Decrease | Reference<br>Increase<br>Decrease |
| Loan Purpose | Purchase<br>Cash out Refi<br>Rate/Term Refi | N/A | Reference<br>Increase<br>Increase |
| Property Type | SFR<br>2-4 Units<br>Condo<br>Coop | Reference<br>Decrease<br>Decrease<br>Decrease | Reference<br>Increase<br>Increase<br>Decrease |
| Change in Unemployment rate | Decrease in unemployment rate<br>Increase in unemployment rate | Increase<br>Decrease | Decrease<br>Increase |
| Cumulative Home Price Appreciation | Positive HPA<br>Negative HPA | Increase<br>Decrease | Decrease<br>Increase |
| Change in 10-Year Interest Rate | Increase in interest rate<br>Decrease in interest rate | Decrease<br>Increase | N/A |

### *C.1.c Non-Performing Loan Model*

The non-performing loan model estimates the quarterly probability of a loan transitioning from serious delinquency to prepayment or default, where default is defined as the occurrence of REO, Foreclosure, or Short Sale.

Milliman processed the data to exclude loans that received a modification and loans that were repurchased. Loan modifications delay or reduce the probability of a default once a loan is seriously delinquent. In the data, many of the loans that received modifications are unresolved and may re-default in the future. For conservatism, Milliman removed loan modifications from the non-performing portion of the model. Repurchased loans are loans that are ineligible for delivery to a GSE and therefore were excluded from consideration in this report. Both these types were removed from the non-performing portion of FHFA's Mortgage Analytics Platform and were similarly removed from Milliman's analysis.

Milliman processed the data into a quarterly panel dataset that included origination characteristics, economic statistics (e.g., cumulative home price appreciation, change in unemployment rate, and others), and quarterly performance. The performing loan model includes the first record of serious delinquency through either prepayment or default.

Since the numbers of observations for the non-performing model are significantly lower than the performing model, cell regression was not used for the non-performing model. Instead, loan-level observations were utilized for model development.

The modeled probabilities were also combined following the results in Begg and Gray (1984). Equations 5 and 6 below are the model specifications for the mortgages that enter default or prepayment termination paths, respectively:

**Equation 5:**

$$\log\left(\frac{P_D}{P_A}\right) = X_D\beta_D + \varepsilon_D$$

**Equation 6:**

$$\log\left(\frac{P_P}{P_A}\right) = X_P\beta_P + \varepsilon_P$$

In the equations above, $P_D$ is the probability of default, $P_P$ is the probability of prepayment, $P_A$ is the probability of remaining active, and $\varepsilon_D$ and $\varepsilon_P$are i.i.d. error terms with logistic distribution. $X_D$ and $X_P$ are predictor vectors that include variables representing initial borrower and loan-level characteristics, loan age, and macroeconomic conditions.

After estimating model parameters $\beta_D$ and $\beta_P$, based on the historical loan information, the future $P_D$ and $P_P$ for each of the successive loan ages (in quarters) are forecast, using the following formulas:

**Equation 7:**

$$\hat{P}_D = \frac{e^{X_D\hat{\beta}_D}}{1+e^{X_D\hat{\beta}_D}+e^{X_P\hat{\beta}_P}}$$

**Equation 8:**

$$\hat{P}_P = \frac{e^{X_P\hat{\beta}_P}}{1+e^{X_D\hat{\beta}_D}+e^{X_P\hat{\beta}_P}}$$

Descriptions of the predictor variables in the model and their impact on default and prepayment probabilities can be found below. In addition, Exhibits 11 and 12 provide a complete list of the variables in the model, the levels of each variable, coefficient, and p-value for each variable.

| Variable | Value | Prepayment | Default |
|---|---|---|---|
| Loan-to-Value Ratio | High Ratio<br>Low Ratio | Decrease<br>Increase | Increase<br>Decrease |
| Credit Score | High Score<br>Low Score | N/A | Increase<br>Decrease |
| Original Loan Amount | Low Amount<br>Average Amount<br>High Amount | Decrease<br>Reference<br>Increase | N/A |
| Occupancy | Owner<br>Investor<br>Second | Reference<br>Decrease<br>Neutral | Reference<br>Decrease<br>Decrease |
| Loan Purpose | Purchase<br>Cash out Refi<br>Rate/Term Refi | Reference<br>Decrease<br>Decrease | N/A |
| Property Type | SFR<br>2-4 Units<br>Condo<br>Coop | Reference<br>Decrease<br>Increase<br>Increase | Reference<br>Decrease<br>Increase<br>Increase |
| Loan Age at Delinquency | Within two years<br>After two years | Increase<br>Decrease | Increase<br>Decrease |
| Cumulative Home Price Appreciation as First Delinquency | Positive HPA<br>Negative HPA | Increase<br>Decrease | Decrease<br>Increase |
| Burnout after First Delinquency | No Burnout<br>Burnout | Reference<br>Increase | N/A |

***C.1.d Severity Model***

The severity model estimates the ground-up loss for a default as a percent of original loan balance. The severity model comprises three components:

1. Unpaid principal balance at termination;
2. Delinquent Interest plus Disposition Expenses; and
3. Net Sale Proceeds.

Exhibit 13 provides a visual of the model components. In the illustrative example, the severity rate estimate of 25% of the original loan balance is equal to the UPB at delinquency (95%) plus delinquent interest and disposition expense (15%) minus net sale proceeds (85%).

The calculation of the severity rate follows Equation 9.

**Equation 9:**

$$Sev_t = \frac{UPB_t + IntDispExp_t - NetSales_t}{UPB_0}$$

The unpaid principal balance is calculated for each loan using a fixed rate, 30 year amortization schedule based on the quarter of default and adjusted for the average time between last payment date and default resolution. Delinquent interest plus disposition expenses and net sales proceeds are estimated using a model developed by Milliman.

To develop the model estimates for delinquent interest plus expenses and net proceeds[11], Milliman processed the data to include only loans that terminated due to Short Sale, Foreclosure, or REO, were not a repurchase, and were not a loan modification. Milliman expressed these amounts as a percent of original loan amount. Net proceeds is a field in each dataset. For expenses, Milliman combined all expense elements into a single expense amount. Delinquent interest was calculated from the last payment date through disposition[12]. Milliman developed two linear models to estimate net proceeds and delinquent interest plus expenses at the loan level.

Equations 10 and 11 are the model specifications for the severity model for net proceeds and expenses, respectively.

**Equation 10:**

$$NetSales = \sum X_i \beta_i + \varepsilon$$

**Equation 11:**

$$IntDispExp = \sum X_i \beta_i + \varepsilon$$

Descriptions of the predictor variables in the model and their impact on net sales proceeds and disposition expenses are shown below. In addition, Exhibits 14 and 15 provide a complete list of the variables in the model, the levels of each variable, coefficient, and p-value for each variable.

[11] Note, the data included loans where the net proceeds from the sale of the property exceeded the total indebtedness of the borrower. These loans were identified in the data as having a "C" for the value of the net proceeds; "C" refers to Covered. For these loans, Milliman set the net proceeds equal to the sum of the outstanding UPB plus deferred interest plus expenses.

[12] The Freddie data does not include a disposition date. Milliman assumed an average timing of 5 months from termination date to disposition date for Freddie loans, based on averages from the Fannie data.

| Variable | Value | Net Sales Proceeds (% of Original Balance) | Disposition Expenses (% of Original Balance) |
|---|---|---|---|
| Original Loan Value | Lower<br>Higher | Decrease<br>Increase | Increase<br>Decrease |
| Original Loan to Value Ratio | Lower<br>Higher | Increase<br>Decrease | N/A |
| Cumulative Home Price Appreciation | Lower<br>Higher | Decrease<br>Increase | N/A |
| Credit Score Cohort | Lower<br>Higher | Decrease<br>Increase | N/A |
| Property Type | SFR<br>Manufactured<br>Condo<br>COOP<br>PUD<br>LEASEHOLD | Reference<br>Decrease<br>Decrease<br>Decrease<br>Increase<br>Decrease | Reference<br>Decrease<br>Decrease<br>Decrease<br>Neutral<br>Neutral |
| Time Delinquent (Months) | Less than average<br>Greater than average | Increase<br>Decrease | Decrease<br>Increase |
| Occupancy Status | Owner<br>Investor<br>Second | Reference<br>Decrease<br>Decrease | Reference<br>Increase<br>Decrease |
| Loan Purpose | Purchase<br>Cash out<br>Rate/term | Reference<br>Decrease<br>Decrease | Reference<br>Decrease<br>Decrease |
| Number of Units | 1<br>2<br>3<br>4 | Reference<br>Decrease<br>Decrease<br>Decrease | Reference<br>Increase<br>Increase<br>Increase |
| Loan Age | Low<br>High | Increase<br>Decrease | N/A |
| UPB * Interest Rate | Low<br>High | N/A | Decrease<br>Increase |

### *C.1.e Out of Sample Model Testing*

Milliman estimated the model coefficients on a sample of the data for each model, and Milliman tested the models against an out-of-sample dataset to validate the models are predictive. This section summarizes the model out-of-sample results.

### *C.1.e.i Performing Loan Model*

Milliman used 80% of the model dataset to estimate the model and 20% for out-of-sample testing. Exhibits 16 through 19 summarize the out-of-sample testing results from the model.

***C.1.e.ii Non-Performing Loan Model***

Milliman used 80% of the data to estimate the model and 20% for out-of-sample testing. Exhibits 20 through 23 summarize the out-of-sample testing results from the model.

***C.1.e.iii Severity Model***

Milliman combined Freddie and Fannie data for loans that terminated due to an REO, Foreclosure, or Short Sale. Of this data, Milliman used 80% of the data to estimate the model and 20% for out-of-sample testing. Exhibits 24 through 26 summarize the out-of-sample testing results from the aggregate severity model. The aggregate severity model refers to the total severity rate including outstanding UPB, delinquent interest, expenses, and net proceeds.

***C.2 Deep Coverage Mortgage Insurance***

The models described above estimate mortgage performance for whole-loan mortgage collateral. In contrast, standard primary mortgage insurance coverage typically insures only a portion of a mortgage loan. As such, mortgage insurance coverage is typically expressed as a fixed percentage of the original loan amount (referred to as the coverage percentage). The product of that coverage percentage and the original loan amount yields a dollar amount of mortgage insurance risk.

The portion of the mortgage covered by the primary mortgage insurance varies by loan-to-value ratio and the coverage level selected at the point of mortgage origination. Standard primary mortgage insurance coverage rates vary from 12% to 35% depending on the LTV ratio at the point of origination; however, standard primary mortgage insurance coverage typically covers the mortgage down to LTV ratios of approximately 65% to 75% of the original collateral value.

For purposes of this analysis, Milliman has defined deep coverage mortgage insurance by calculating the coverage percentages required to provide coverage down-to 50% loan-to-value at the point of origination using the following formula:

**Equation 12:**

$$Coverage = \frac{(LTV - 50)}{LTV}$$

Milliman has calculated the implied deep coverage percentages for loans with LTVs of 85%, 90%, 95%, and 97% at origination. The standard mortgage insurance coverage as highlighted on current mortgage insurance rate cards and deep mortgage insurance coverage for various LTVs are shown graphically on Exhibit 1. In addition, the table below summarizes the standard coverage percentages and the calculated deep coverage percentages utilized in Milliman's analysis:

| Loan to Value | Standard Coverage | Deep Coverage | Additional Coverage |
|---|---|---|---|
| 85 | 12.0 | 41.0 | 29.0 |
| 90 | 25.0 | 44.4 | 19.4 |
| 95 | 30.0 | 47.4 | 17.4 |
| 97 | 35.0 | 48.5 | 13.5 |

Milliman assumed other features of current primary mortgage insurance coverage would remain in place under deep coverage. In particular, Milliman assumed deep coverage mortgage insurance would be subject to cancellation at the point the loan balance amortizes below 78% of the estimated original collateral value.

### *C.3 Pro-Forma Cash Flow Model*

The loan performance models yield loan level estimates of the probability of serious delinquency, default, and prepayment over time. In order to perform its analysis, Milliman generated a framework to translate these probability estimates into mortgage insurance cash flows assuming additional risk is underwritten through deep coverage mortgage insurance. These cash flows were then supplemented by additional line-item assumptions to generate pro-forma financial statements highlighting the deep coverage mortgage insurance performance.

Milliman's pro-forma cash flow model generates estimates of mortgage insurance losses, mortgage insurance premium, required capital held against the mortgage insurance coverage, expenses, investment income, and federal income taxes. The next sections discuss each of these items in more detail.

#### *C.3.a Mortgage Insurance Losses*

Mortgage insurance losses are estimated through generating estimates of claim frequency and the severity of claim given that it occurs. In loan level analysis, claim frequency can be thought of as the probability of a loan defaulting. Claim severity can be thought of as the magnitude of the claim given that it occurs (often expressed as a percentage of the risk exposure on the mortgage loan). Modeled losses were estimated from the mortgage performance models as the product of the default probability and the insurance benefit given default. The indicated loss in time t is summarized in the following equation:

**Equation 13:**

$$Loss_t = Default\ Frequency_t\ x\ Mortgage\ Insurance\ Benefit\ Upon\ Default_t$$

#### *C.3.a.i Default Frequency*

Milliman calculated probabilistic incurred loss estimates for each period as the product of the probability of serious delinquency that results in default and the indicated magnitude of claim at the point of default. Milliman assumed a fixed amount of time from reported serious delinquency to default of 17 months. Thus, the probabilistic paid loss estimates for each period are the same as probabilistic incurred loss estimates six quarters prior.

#### *C.3.a.ii Mortgage Insurance Benefit Upon Default*

Standard mortgage insurance coverage offers a variety of options for purposes of calculating the insurance benefit upon default. For purposes of this analysis, Milliman has assumed that the mortgage insurance claim will be the lesser of the percentage option and the loss on property sale option. The percentage option is estimated as the product of the calculated loss and mortgage insurance coverage percentage. The loss on property sale option is estimated as the calculated loss less the net proceeds from the sale of the property. The calculated loss is estimated in each period as the sum of the UPB at the point of default and the model indicated interest and expenses as described in the mortgage performance model section above.

Milliman estimated the losses in the additional coverage layer as the difference between losses indicated under standard mortgage insurance coverage and deep mortgage insurance coverage.

#### *C.3.a.iii Mortgage Insurance Loss Reserves*

Mortgage insurance losses are typically incurred at the point of notification of delinquency but are not paid until the point of default. In the interim period, the mortgage insurer holds reserves against the potential future claim (known as loss reserves). Milliman calculated the indicated loss reserves at each period end as the difference between the cumulative probabilistic incurred and paid losses from origination through that period.

### *C.3.b Mortgage Insurance Premium*

Milliman's analysis assumes the deep coverage mortgage insurance premium is collected monthly and is calculated as a fixed amount of the original loan balance. As such, the mortgage insurance premium paid by the borrower does not decline for the period that the insurance is in-force. Milliman calculated probabilistic premium estimates for each period as the product of the probability the insurance was still in-force and the fixed mortgage insurance premium amount. Given that Milliman's model was developed to estimate quarterly cash flows, Milliman used the average probability of being in-force at the start and the end of a quarter to estimate the probabilistic premium estimates.

The probability of the insurance being in-force was estimated through three components: probability of default termination, probability of prepayment, and the probability of cancellation at the point the loan balance amortizes below 78% of the original estimated collateral value. The default termination probabilities were estimated as described above. The prepayment probabilities were estimated using the mortgage performance models described above. The remaining probability of being in-force was assumed to be terminated at the point the loan balance amortizes below 78% of the original collateral value. For purposes of this calculation, the original collateral value was estimated using the original loan balance and the original LTV ratio.

Note that in its portfolio analysis, Milliman used the indicated rates from current standard coverage mortgage insurance rate cards (Exhibit 27) as the basis for estimating premium timing and then calculated the indicated deep coverage premium as a constant percentage of the current standard coverage rate.

### *C.3.c Capital*

In addition to estimating premium and losses as described above, an important assumption in Milliman's analysis is the level of capital held against the risk exposure. On June 30, 2015, the GSEs issued revised Private Mortgage Insurer Eligibility Requirements (PMIERs)[13]. In "Exhibit A" of the PMIERs, the GSEs stipulated a framework for calculating the minimum required assets, which must be held against various categories of in-force risk exposure. The level of minimum required assets varies materially based on the LTV, credit score, and stage of delinquency (among other items).

Given that the PMIERs minimum required asset framework has been recently created, Milliman assumed that the additional mortgage insurance layer would be subject to a required asset framework similar to that described in the PMIERs Exhibit A, but calibrated for the deep coverage layer. As such, Milliman has reflected the PMIERs minimum required asset framework allowing for a marginally reduced severity component given that the excess portion would have a lower marginal severity than the standard mortgage insurance first loss position.

In implementing the PMIERs framework, Milliman utilized Tables 4, 5, 6, and 8 from Exhibit A which contain the performing required asset factors, the risk multipliers for certain features, the seasoning weights for performing loans, and the non-performing required asset factors, respectively. These tables are shown in Exhibit 28.

Note that the implementation of the PMIERs framework required Milliman to estimate the performing and non-performing probabilistic amortized risk in-force at each period-end. Milliman calculated the total probabilistic amortized risk in-force as the product of the estimated unpaid principal balance, the coverage percentage, and the probability that insurance coverage was still in-force at each quarter-end. Milliman calculated non-performing probabilistic amortized risk in-force as the loss reserve divided by the product of model indicated serious delinquency to default roll rate and model indicated claim severity. Performing probabilistic amortized risk in-force was then calculated as the difference between the total and the non-performing. Note that in order to calculate the required asset factor related to non-performing risk, Milliman performed an analysis of the historical distribution of serious delinquencies by missed payment group and

[13] Documentation can be found on Fannie Mae's website at (https://www.fanniemae.com/singlefamily/mortgage-insurers) and Freddie Mac's website at (http://www.freddiemac.com/singlefamily/pmiers.html).

selected the rates shown in Exhibit 29 to allocate the non-performing probabilistic amortized risk in-force to the relevant cohorts for application of PMIERs Exhibit A Table 8. Using these distributions, Milliman estimated the minimum required asset factor at each quarter-end.

In order to calibrate the adjustment to PMIERs reflected in its analysis, Milliman estimated portfolio indicated economic capital assuming both standard and deep coverage as the difference between estimated expected losses and estimated losses under the severely adverse economic scenario reflected in the Federal Reserve Board's Comprehensive Capital Analysis and Review (CCAR)[14]. Then, Milliman calculated the relativity between the indicated standard coverage economic capital and deep coverage economic capital. Milliman applied this relativity to the PMIERs framework to generate the indicated required asset levels included in the pro-forma analysis. Note that while these adjustments were calculated at a more granular level, this analysis resulted in a reduction in average required assets of 17% for the portfolio weighted additional coverage layer (i.e., the required asset level reflected in the analysis for the additional coverage layer was approximately 83% of that indicated under PMIERs).

After calculating the indicated required asset factor at each point in time, Milliman calculated the required assets as the product of the indicated required asset factor and the estimated probabilistic amortized risk in-force at each quarter-end.

### *C.3.d Expenses*

Milliman assumed there would be no incremental underwriting expenses related to the additional coverage layer given that the coverage is effectively an extension of the standard coverage currently originated by the mortgage insurer. However, Milliman included an illustrative premium tax expense equal to 2.25% of written premium in each period. In addition, Milliman included an illustrative provision for unallocated loss adjustment expenses equal to 2% of losses in each period.

### *C.3.e Investment Income*

Milliman assumed an illustrative pre-tax investment yield of 3.5%. This rate was selected based on a review of current mortgage insurance rate filings. Milliman is not able to assess the reasonability of a pre-tax annual yield of 3.5% for a mortgage insurer's investment portfolio without performing a substantial amount of additional work beyond the scope of Milliman's assignment. As such, Milliman expresses no opinion on the appropriateness of the selected annual investment yield.

### *C.3.f Federal Income Tax*

Milliman assumed a Federal Income Tax rate of 35% of pre-tax net income.

### *C.4 Portfolio Assumptions*

While Milliman's model calculates losses and premium at the loan level, Milliman's pro-forma analysis reflected a portfolio of loans. The portfolio reflected in the analysis was generated using all loans included in the Fannie Mae and Freddie Mac datasets described above, which cover origination years 1999 through 2014 and reflects a long-term average portfolio. Milliman defined the portfolio by selected LTV, credit score (e.g., FICO), debt-to-income ratio (DTI), property type, loan purpose, and occupancy type cohorts and calculated the distribution of the historical data in each cohort. In total, this resulted in 525 cohorts. All cohorts were assumed to have original loan amount of $225,000, have collateral properties with 1 unit, be fixed rate 30 year mortgages, and have an original interest rate spread of 1.9% between the mortgage rate and 10 year treasury. Exhibit 30 summarizes the portfolio distribution along certain relevant risk dimensions.

[14] This is discussed in more detail in the stress scenario analysis section below.

### *C.5 Scenario Analysis*

Milliman's analysis highlights expected cash flows related to the additional mortgage insurance coverage provided under deep coverage mortgage insurance. The deep coverage layer can be thought of as an excess coverage layer given that losses in this layer only arise in the event that the standard coverage layer on a loan is exhausted. In Milliman's analysis, home price appreciation since origination is a primary driver of loss severity for a given loan at a given point in time. As a result, the performance of the additional coverage layer varies materially given more favorable and adverse home price appreciation scenarios.

### *C.5.a Expected Scenario Analysis*

To estimate the impact of alternative home price appreciation scenarios on the model results, Milliman generated expected cash flows in the additional mortgage insurance coverage layer through an analysis of various economic scenarios. Specifically, Milliman generated estimated cash flows under 17 economic scenarios with varying levels of home price appreciation over the first three years.

Milliman selected these scenarios through a review of historical cumulative 3-year home price appreciation as highlighted in the Federal Housing Finance Agency (FHFA) All Transaction Home Price Index (HPI) at the Metropolitan Statistical Area (MSA) level. Assuming all reported 3-year HPI paths experienced by all MSAs commencing from 1976 through 2011 were equally likely, Milliman generated a distribution of potential 3-year cumulative home price appreciation rates and selected 17 scenarios intended to discretely approximate the full distribution. The empirical and selected scenarios are shown in Exhibit 31. In addition, the 3-year home price appreciation and the indicated weights assigned to those scenarios are shown in the table below:

| Scenario | Indicated 3-Year Cumulative Home Price Appreciation | Estimated Distribution Weight |
|---|---|---|
| 1 | (39.7)% | 1.0% |
| 2 | (26.7)% | 1.1% |
| 3 | (17.3)% | 2.6% |
| 4 | (10.8)% | 3.5% |
| 5 | (7.0)% | 3.1% |
| 6 | (3.9)% | 4.1% |
| 7 | (1.5)% | 3.3% |
| 8 | (0.5)% | 3.6% |
| 9 | 3.0% | 6.7% |
| 10 | 6.1% | 8.2% |
| 11 | 9.1% | 11.3% |
| 12 | 12.0% | 12.8% |
| 13 | 14.9% | 10.1% |
| 14 | 17.9% | 7.1% |
| 15 | 22.5% | 8.3% |
| 16 | 32.3% | 7.0% |
| 17 | 55.2% | 6.4% |

Note that while the home price scenario analysis assumed variation in home price appreciation over the first three years, the analysis assumed 1% annual home price appreciation over years four through seven and 3% annual home price appreciation thereafter. In addition, given the desire for the analysis to highlight long-term expected results, Milliman assumed no change in unemployment rates or interest rates in its scenario analysis.

### *C.5.b Stress Scenario Analysis*

In addition to the expected scenario analysis utilized for generating the mortgage insurance loss and premium cash flows described above, Milliman also generated expected mortgage insurance losses under a stress scenario for purposes of estimating indicated economic capital. Milliman used the severely adverse economic scenario reflected in the Federal Reserve Board's CCAR for the stress scenario. The economic assumptions for the CCAR stress can be found in the paper titled "2015 Supervisory Scenarios for Annual Stress Tests Required under the Dodd-Frank Act Stress Testing Rules and the Capital Plan Rule" dated October 23, 2014[15]. Milliman assumed flat unemployment and interest rates and 3% annual home price appreciation for the period subsequent to 2017 (the last reported period in the documentation).

### *C.5.c Scenario Output*

Milliman's mortgage performance and cash flow models generate estimated results at the loan level. In order to highlight the expected and stress scenario indications in Milliman's portfolio analysis, Exhibits 32 through 34 show the indicated loss rates (including both frequency and severity) by FICO and LTV cohort under the expected and stress scenarios and assuming both standard and deep coverage mortgage insurance. In addition, Exhibit 35 shows the indicated economic capital (calculated as the difference between the indicated stress and expected loss rates) assuming both standard and deep coverage mortgage insurance. Exhibit 35 also shows the ratio of the indicated economic capital assuming deep mortgage insurance coverage to the indicated economic capital assuming standard mortgage insurance coverage. These ratios were used to adjust the PMIERs required asset amounts as described above.

Exhibits 36 through 40 highlight the pro-forma financial statements generated in Milliman's expected scenario analysis assuming original portfolio loan amount of $1 billion. Note that these pro-forma financial statements were generated by estimating loss and indicated required assets as the difference between standard mortgage insurance coverage and deep mortgage insurance coverage in the 17 economic scenarios described above. The indicated premium flows were assumed proportional to those indicated under standard coverage; however, the level of premium was determined as that required to target a 10% return on capital. The indicated incremental premium required to generate a 10% return on capital for the additional coverage mortgage insurance portfolio was approximately 18 bp annually. On a technical note, the 10% return on capital was selected based on a review of publicly available rate filings for the mortgage insurance industry. Milliman is not able to assess the reasonability of a mortgage insurer's return on capital requirements without performing a substantial amount of additional work beyond the scope of Milliman's assignment. As such, Milliman expresses no opinion on the appropriateness of the selected return on capital nor is it opining on whether an MI would target returns on deeper coverage comparable to returns on standard coverage.

### *C.6 Estimation of Borrower Impact with Deep Coverage Mortgage Insurance*

In order analyze the borrower impact of deep coverage mortgage insurance, Milliman used publicly available information to estimate the G-Fee charged for a similar portfolio of loans assuming standard mortgage insurance coverage and the portion of the G-Fee which would be required to be charged by the GSEs with deep mortgage insurance coverage. In order to generate this estimate, Milliman first estimated the portions of the G-Fee related to expense, expected losses, and unexpected losses for a portfolio of loans similar to that used in Milliman's analysis. Then, Milliman estimated the portion of the G-Fee associated with GSE-retained expected and unexpected losses given deep coverage mortgage insurance. Finally, Milliman estimated the impact on borrower payment under both these scenarios.

[15] http://www.federalreserve.gov/newsevents/press/bcreg/20141023a.htm.

### *C.6.a Estimation of G-Fee*

As the first step of the analysis of borrower impact, Milliman estimated the average G-Fee currently charged for a portfolio of loans similar to that used in Milliman's analysis. While GSE G-Fee information at a level of granularity sufficient to ensure perfect alignment of the portfolios was unavailable, Milliman used the Federal Housing Finance Agency "Fannie Mae and Freddie Mac Guarantee Fees: Request for Input"[16] (RFI) from June 2014 to perform its analysis. This document contains information detailing the various components included in the G-Fee as well as estimated capital, charged G-Fees, and costs at the Credit Score/LTV level of granularity.

Exhibit 41 shows the derivation of the estimated aggregate charged G-Fee of 64 bp for a high LTV portfolio (greater than 80% LTV) with the Credit Score distribution reflecting the portfolio used in Milliman's analysis. The charged G-Fees by Credit Score/LTV were reported in Figure 3 of the RFI. In order to separate the components for expected and unexpected costs included in the G-Fee, Milliman used the information presented in Figures 2 and 3 from the RFI. Based on the indicated estimated costs, capital levels, other costs of 17 bp, and an assumed 10.8% return on capital, the expected credit losses included in the G-Fee related to a portfolio similar to that used in Milliman's analysis are 8 bp. Given the estimated charged G-Fee of 64 bp, the estimated expected credit losses of 8 bp, and other charges of 17 bp, the provision for estimated unexpected credit losses included in the charged G-Fee was estimated as 39 bp (i.e., 64bp – 8bp – 17bp).

Note that Exhibit 42 shows the derivation of the implied return on capital embedded in the estimated costs included in Figure 3. Based on the indicated estimated costs, capital levels, 1Q14 portfolio distribution, reported expected credit losses of 4 bp, and other costs of 17 bp, the implied return on capital for the aggregate 1Q14 portfolio is 10.8%. Note that this assumes that the same cost of capital is used for all Credit Score/LTV groups of the portfolio. Note that including risk-variant costs of capital would merely change the allocation between expected and unexpected losses in this estimate.

### *C.6.b Estimation of GSE Required Retained G-Fee*

Deep coverage mortgage insurance would transfer risk which is held by the GSEs to mortgage insurers and, as a result, would theoretically reduce the amount of the G-Fee required to be charged. In order to estimate the required retained G-Fee, Milliman estimated the proportion of the original expected and unexpected costs, which would be transferred under deep coverage mortgage insurance. Exhibit 43 shows the selection of the retained proportions of 50% of expected loss cost and 25% of unexpected loss cost.

Milliman estimated the GSE's original expected loss cost as the difference between the expected whole loan loss cost and the loss cost transferred with standard coverage mortgage insurance. Milliman estimated the GSE's retained expected loss cost as the difference between the expected whole loan loss cost and the loss cost transferred with deep coverage mortgage insurance. The indicated proportion retained was estimated as the indicated retained expected loss cost divided by the indicated original expected loss cost. Applying the selected proportion retained of 50% to the estimated expected loss cost of 8 bp generated an indicated retained expected loss cost of 4 bp.

Milliman estimated unexpected loss costs for each of these layers as the difference between the indicated loss cost under the CCAR stress scenario and the expected loss costs. Then, the indicated proportion retained was estimated as the GSEs' indicated retained unexpected loss costs divided by the GSEs' indicated original unexpected loss costs. Applying the selected proportion retained of 25% to the estimated unexpected loss cost of 39 bp generated an indicated retained unexpected loss cost of approximately 10 bp.

Assuming the GSE required retained G-Fee would still include 7bp for General and Administrative Expenses and 10 bp for the Temporary Payroll Tax Cut Continuation Act of 2011 (TCCA), the indicated required retained G-Fee for the portfolio was 31 bp.

[16] Please see http://www.fhfa.gov/PolicyProgramsResearch/Policy/Pages/Guarantee-Fees-History.aspx.

### *C.6.c Illustration of Borrower Impact*

After generating estimates of the original and retained G-Fee, Milliman estimated the illustrative borrower payment with both standard coverage mortgage insurance and deep coverage mortgage insurance. In calculating the illustrative borrower payment, Milliman assumed a 3.25% note rate prior to the inclusion of the G-Fee based on a 300 bp coupon rate and 25 bp servicing charge. Thus, the indicated borrower note rate assuming standard mortgage insurance coverage was 3.89% translating to a borrower payment before mortgage insurance premium of approximately $1,060. Based on the portfolio distribution and the standard coverage mortgage insurance premium rates shown in Exhibit 2, the estimated standard coverage mortgage insurance premium rate for the portfolio was approximately 65 bp annually. Thus, the total illustrative borrower payment assuming standard coverage mortgage insurance was $1,182.

Based on the estimated required retained G-Fee of 31 bp, the indicated illustrative borrower note rate assuming deep coverage mortgage insurance was 3.56% translating to a borrower payment before mortgage insurance premium of approximately $1,018. Adding the indicated portfolio additional coverage premium to the portfolio standard coverage mortgage insurance premium yields a deep coverage mortgage insurance premium of approximately 83 bp annually. Thus, the total illustrative borrower payment assuming deep coverage mortgage insurance was $1,174.

As shown in Exhibit 2, the estimated impact on the illustrative borrower payment was a reduction in monthly payment of approximately $8. Assuming fixed monthly payments of principal and interest and constant mortgage insurance premium, this monthly payment reduction would persist for the life of the loan; however, the deep coverage mortgage insurance premium would cancel when the loan amortizes to 78% LTV and thus the monthly borrower payment benefit would increase after the point of mortgage insurance cancellation. Assuming an original LTV of 92% and assuming the loan persistency reflected in Milliman's expected scenario analysis, the expected borrower savings would be approximately $2,300.

## D. QUALIFICATIONS AND LIMITATIONS; LIMITED DISTRIBUTION OF RESULTS

### D.1 Qualifications and Limitations

The authors and peer reviewers of this analysis are Members of the American Academy of Actuaries, Fellows of the Casualty Actuarial Society and/or have significant expertise in the evaluation of mortgage insurance and reinsurance.

In performing this analysis, Milliman has relied on GSEs' data available as of July 31, 2015 and other information provided to Milliman by or on behalf of USMI through the date of this report. Milliman has not audited or verified this data and information. If the underlying data or information is inaccurate or incomplete, the results of Milliman's analysis may likewise be inaccurate or incomplete. Except if noted specifically, Milliman is not aware of any relevant events or changes to the data subsequent to Milliman's analysis that would materially impact the results of the analysis.

In performing this evaluation, Milliman has assumed that the GSEs and USMI (a) used its best efforts to supply accurate and complete data and (b) did not knowingly provide any inaccurate data. Milliman performed a limited review of the data used directly in Milliman's analysis for reasonableness and consistency and has not found material defects in the data. If there are material defects in the data, it is possible that they would be uncovered by a detailed, systematic review and comparison of the data to search for data values that are questionable or relationships that are materially inconsistent. Such a review was beyond the scope of Milliman's assignment.

The analysis and any conclusions provided in Milliman's deliverables are based on data provided to Milliman by third-party sources. Milliman does not warrant the accuracy or completeness of any third-party data, and Milliman disclaims any and all liability in connection with such third-party data. Any errors in the data provided may affect the results of Milliman's analysis. Milliman shall not be liable for the results of its analysis to the extent errors are contained in third-party data sources.

Any analysis of unpaid claims or study of future operating results involves estimates of future contingencies. While Milliman's analysis represents Milliman's best professional judgment arrived at after careful analysis of the available information, it is important to note that a significant degree of variation from Milliman's projections is not only possible but is, in fact, probable. The sources of this variation are numerous, and include, but are not limited to: future national or regional economic conditions, mortgage prepayment speeds, and legislative changes affecting the mortgage market.

Differences between Milliman projections and actual amounts depend on the extent to which future experience conforms to the assumptions made for this analysis. It is certain that actual experience will not conform exactly to the assumptions used in this analysis. Actual amount will differ from projected amounts to the extent that actual experience is better or worse than expected.

The uncertainty associated with Milliman's estimates is also magnified by the nature of mortgage insurance. Mortgage insurance results are sensitive to economic factors such as unemployment, housing market conditions, interest rate levels and so on. Past experience may not be indicative of future conditions. A loan underwritten in a given year is generally insured over several calendar years. Therefore, adverse economic conditions in a given calendar year could affect results not only for the current underwriting year but also for prior underwriting years. Future economic developments that give rise to additional delinquencies and losses will impact ultimate losses, and unprecedented changes and stresses in the market add to uncertainty. Additionally, estimates are significantly more uncertain given the current economic environment, elevated default rates, adverse house price trends and loss mitigation activities by the GSEs, USMI and mortgage servicers. The overall results are potentially sensitive to any of these variables and reasonable deviations from the embedded assumptions could materially change the results.

Milliman's analysis does not reflect the variation of actual results differing from projections due to parameter risk or specification risk. Parameter risk refers to the risk or uncertainty associated with the selection of the parameters underlying the applicable projection model. Specification risk refers to the risk or uncertainty surrounding the selection of the type of model used for the forecast. Other than illustrating the results of alternative scenarios, Milliman has not attempted to quantify the impact of parameter or specification risk. Additionally, Milliman's analysis is limited to the variability of losses and premiums. Other risks – including but not limited to operational, asset, liquidity, legal, regulatory and strategic – are outside the scope of Milliman's analysis.

Any reader of this report must possess a certain level of expertise in areas relevant to this analysis to appreciate the significance of the assumptions and the impact of these assumptions on the illustrated results. The reader should be advised by, among other experts, actuaries or other professionals competent in the area of actuarial projections of the type in this report, so as to properly interpret the projection results.

**D.2 Disclosures**

Actuarial Standards require Milliman to disclose the following:

*Purpose*

The purpose of this assignment is to derive independent estimates of the cost of deep coverage mortgage insurance using publicly available data. Except where noted specifically to the contrary, data used in Milliman's analysis was evaluated as of August 30, 2015. The Moody's Analytics economic forecast was supplied to Milliman in August 2015, and reflects actual FHFA home price experience through March 31, 2015.

*Constraints*

There have been no unusual constraints (such as availability of data or access to staff) on Milliman's ability to provide this analysis.

*Scope*

Milliman's expected loss estimates can be characterized as actuarial central estimates. Each estimate represents an expected value over a range of reasonably possible outcomes. They do not reflect all conceivable extreme events where the contribution of such events to an expected value is not reliability estimable. The estimates are not defined by a precise statistical measure (mean, median, mode, etc.), but are selected from multiple indications produced by a variety of generally accepted actuarial methods that are intended to respond to various drivers of ultimate claim liabilities.

The economic environment (and more specifically home price appreciation) is a significant driver of future losses in Milliman's mortgage models. Therefore, changes in the home price appreciation could materially affect Milliman's analysis.

**D.3 Limited Distribution of Results**

Milliman's work is prepared solely for the benefit of USMI. Except as set forth below, Milliman's work may not be provided to third parties without Milliman's prior written consent. Milliman does not intend to legally benefit any third party recipient of its work product, even if Milliman consents to the release of its work product to a third party. USMI may distribute, publish itself, or submit for publication the final, non-draft version of the "Reports" prepared under this Agreement, as more fully described in the Proposal, without Milliman's prior review or approval. Any summaries, abstracts, or press releases prepared by USMI are subject to Milliman's prior review and approval, which shall not be unreasonably withheld or delayed. USMI shall not edit, modify, summarize, abstract or otherwise change the content of the Reports and any distribution of either Report must include such Report in its entirety. Press releases mentioning either Report may be issued by Milliman or USMI upon mutual agreement of USMI and Milliman as to their

content. Any mentions of either Report will provide citations that will allow the reader to obtain such Report in its entirety. Notwithstanding the foregoing, no Milliman work product, including either Report, shall be used by USMI in connection with any offering, prospectus, securities filing, or solicitation of investment. Professional reviewers engaged by USMI or independent journals to provide peer review of Milliman's work must agree to terms of confidentiality, which are reasonable and customary in the industry. Any piece of Milliman draft work to be provided to peer reviewers must receive prior Milliman approval, and Milliman shall not unreasonably withhold such approval. In addition to the provisions regarding review and consultation set forth in the Proposal, Milliman agrees to discuss with USMI, as requested by USMI at any phase of the project, its analysis as of that phase (and to share with USMI any drafts, if any, it has prepared as of that phase), to respond to questions raised by USMI, and to consider input provided by USMI regarding its analysis, its drafts, or any other aspect of its work on the project. Ultimate responsibility for the analysis and content of the final Reports would remain with Milliman.

♦ ♦ ♦ ♦ ♦

If you have any questions with regard to this analysis or would like to have us consider additional information, please do not hesitate to contact us.

Respectfully submitted,

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October 15, 2015

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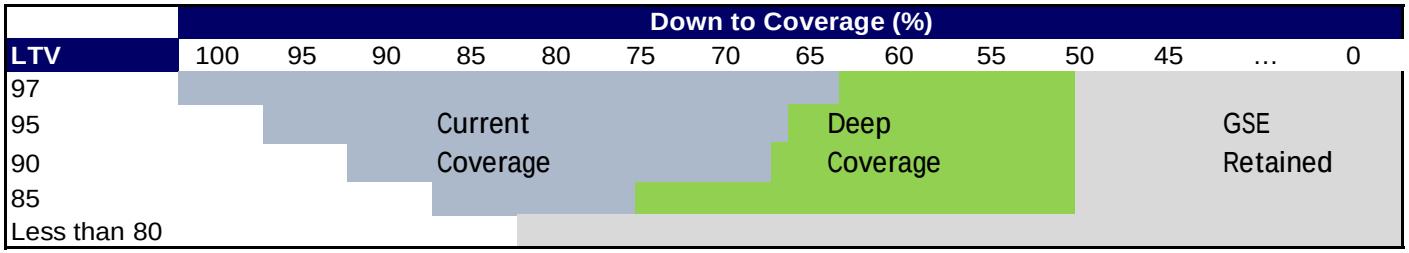
US Mortgage Insurers

Deep Coverage Mortgage Insurance Analysis

## Deep Coverage Diagram for Borrower Paid Mortgage Insurance




Notes: Assumes existing master policy and HOPA requirements.
Automatic cancellation as 78% loan-to-value (LTV) ratio.

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Illustrative Example of Impact on the Average Portfolio Loan**

| | | Standard Coverage Mortgage Insurance | Deep Coverage Mortgage Insurance | Net Impact |
|---|---|---|---|---|
| | **Mortgage Insurance Assumptions** | | | |
| A | Mortgage Loan Amount | $225,000 | $225,000 | -- |
| B | Coverage Percentage (%) | 26.1% | 45.5% | 19.4% |
| C | Risk Coverage ($) | $58,625 | $102,382 | $43,757 |
| **D** | **Estimated Premium Rate (bp)** | **65** | **83** | **18** |
| | **GSE G-Fee Assumptions** | | | |
| E | General & Administrative Expenses (bp) | 7 | 7 | 0 |
| F | Pay-Roll Tax - TCCA (bp) | 10 | 10 | 0 |
| G | Expected Losses (bp) | 8 | 4 | (4) |
| H | Provision for Unexpected Losses (bp) | 39 | 10 | (29) |
| **I=Sum(E:H)** | **Estimated Total GSE G-Fee (bp)** | **64** | **31** | **(33)** |
| | **Borrower Payment Impact** | | | |
| J | MBS Coupon (%) | 3.00% | 3.00% | -- |
| K | MBS Servicing (%) | 0.25% | 0.25% | -- |
| L=Sum(I:K) | Borrower Note Rate (%) | 3.89% | 3.56% | -0.33% |
| M | Borrower Payment Before MI ($) | $1,060 | $1,018 | ($42) |
| N | MI Premium Payment ($) | $122 | $156 | $34 |
| **O=M+N** | **Total Borrower Payment ($)** | **$1,182** | **$1,174** | **($8)** |
| P | Estimated Expected Lifetime Payments of G-Fee ($) | $8,267 | $3,939 | ($4,328) |
| Q | Estimated Lifetime Payments of MI ($) | $7,470 | $9,503 | $2,033 |
| **R=P+Q** | **Estimated Total Lifetime Payments ($)** | **$15,737** | **$13,442** | **($2,295)** |

Notes: G-Fee Assumptions based on analysis of the FHFA G-Fee Request for Input, June 5, 2014. The standard coverage G-Fee reflects implied loss cost in RFI and Milliman's assumed portfolio distribution (FICO and LTV only). The reduction in G-Fee assuming deep coverage is based on Milliman's estimate of the proportion of required retained expected and unexpected costs after MI coverage termination at 78% LTV and below 50% LTV.

**US Mortgage Insurers**

Deep Coverage Mortgage Insurance Analysis

**GSE Mortgage Originations**

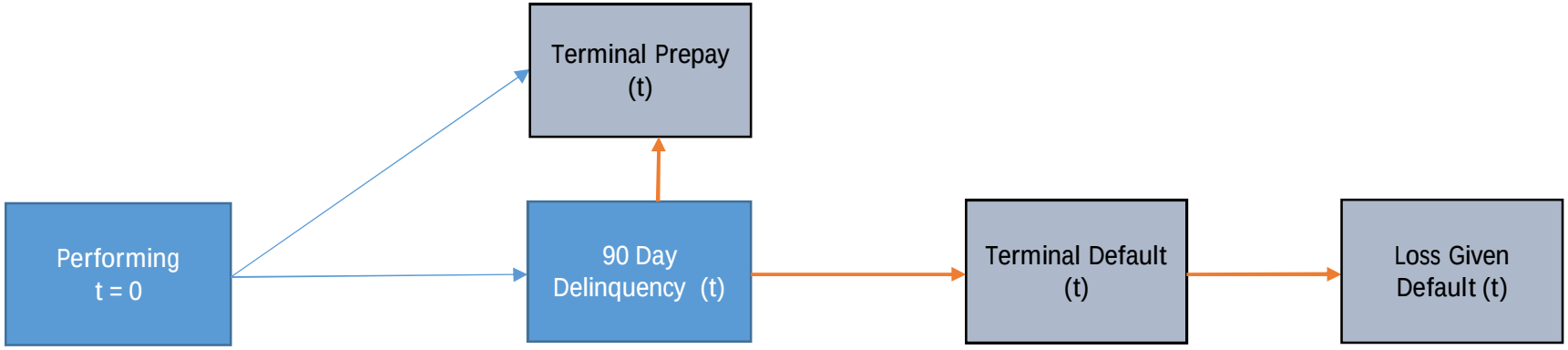
Dollars in Billions

| Origination Year | CoreLogic's TrueStandings All LTVs | CoreLogic's TrueStandings Above 80 LTVs | GSE Data All LTVs | GSE Data Above 80 LTVs | GSE Data as Percent of Total All LTVs | GSE Data as Percent of Total Above 80 LTVs |
|---|---|---|---|---|---|---|
| 1999 | 385 | 71 | 138 | 44 | 36% | 62% |
| 2000 | 262 | 72 | 235 | 83 | 90% | 115% |
| 2001 | 950 | 213 | 574 | 144 | 60% | 68% |
| 2002 | 1,355 | 243 | 639 | 129 | 47% | 53% |
| 2003 | 1,867 | 276 | 829 | 131 | 44% | 47% |
| 2004 | 873 | 158 | 386 | 65 | 44% | 41% |
| 2005 | 887 | 155 | 439 | 57 | 50% | 37% |
| 2006 | 825 | 174 | 372 | 49 | 45% | 28% |
| 2007 | 957 | 298 | 413 | 75 | 43% | 25% |
| 2008 | 717 | 171 | 472 | 96 | 66% | 56% |
| 2009 | 1,121 | 144 | 749 | 62 | 67% | 43% |
| 2010 | 979 | 180 | 477 | 43 | 49% | 24% |
| 2011 | 808 | 170 | 374 | 53 | 46% | 31% |
| 2012 | 1,189 | 344 | 597 | 102 | 50% | 30% |
| 2013 | 892 | 281 | 568 | 140 | 64% | 50% |
| 2014 | 535 | 184 | 132 | 42 | 25% | 23% |
| Total | 14,602 | 3,133 | 7,394 | 1,316 | 51% | 42% |

Notes: Data for 1999 and 2000 are recognized as potentially under-reported when compared to other data sources.

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Mortgage Performance Model Form**




First Transition (Performing Loan Model): Performing To Prepayment or First 90 Day Delinquency
Second Transition (Non-Performing Loan Model): First 90 Day Delinquency to Prepayment or Terminal Default

Notes: Transition probabilities are estimated in a multinomial logit model.
Once a loan reaches 90 day delinquency, it does not transition back to performing. The model estimates the ultimate outcome from the first 90 day delinquency to terminal prepay or terminal default.
Terminal default is defined as the occurrence of REO, Short Sale, or Foreclosure.

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Summary of Loan-Level Data**
Source: Freddie Mac and Fannie Mae Loan-Level Performance Data*

| | Number of Originations | | | Original Loan Amount ($ Millions) | | |
|---|---|---|---|---|---|---|
| **Origination Year** | **Fannie** | **Freddie** | **Total** | **Fannie** | **Freddie** | **Total** |
| 1999 | 126,418 | 973,085 | 1,099,503 | 15,880 | 122,484 | 138,364 |
| 2000 | 1,065,323 | 729,641 | 1,794,964 | 140,471 | 94,153 | 234,624 |
| 2001 | 2,340,049 | 1,533,541 | 3,873,590 | 348,940 | 224,783 | 573,723 |
| 2002 | 2,384,389 | 1,726,370 | 4,110,759 | 373,739 | 265,351 | 639,089 |
| 2003 | 3,002,790 | 2,063,594 | 5,066,384 | 496,171 | 332,979 | 829,150 |
| 2004 | 1,189,296 | 1,129,736 | 2,319,032 | 200,322 | 186,035 | 386,357 |
| 2005 | 1,125,673 | 1,289,641 | 2,415,314 | 207,426 | 232,037 | 439,463 |
| 2006 | 886,280 | 1,088,464 | 1,974,744 | 170,753 | 201,060 | 371,812 |
| 2007 | 1,044,886 | 1,061,494 | 2,106,380 | 213,796 | 199,692 | 413,489 |
| 2008 | 1,164,149 | 1,016,870 | 2,181,019 | 258,747 | 212,920 | 471,667 |
| 2009 | 1,752,537 | 1,462,493 | 3,215,030 | 416,229 | 332,715 | 748,944 |
| 2010 | 1,197,044 | 816,811 | 2,013,855 | 294,831 | 181,773 | 476,604 |
| 2011 | 1,002,352 | 593,096 | 1,595,448 | 235,183 | 138,627 | 373,810 |
| 2012 | 1,710,317 | 737,287 | 2,447,604 | 417,733 | 179,716 | 597,448 |
| 2013 | 1,519,776 | 898,386 | 2,418,162 | 355,554 | 212,318 | 567,872 |
| 2014 | 346,913 | 243,949 | 590,862 | 76,224 | 55,662 | 131,886 |
| **Total** | **21,858,192** | **17,364,458** | **39,222,650** | **4,221,997** | **3,172,304** | **7,394,301** |

Notes: Fannie Mae acquisitions between January 1, 2000 and March 31, 2014 with corresponding monthly performance data as of March 31, 2015.
Freddie Mac acquisitions between January 1, 1999 and March 31, 2014 with corresponding monthly performance data as of September 30, 2014.

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Summary of GSE Loan-level Data**
Losses to GSEs by Origination Year ($ Millions)

| | A | B | C = B / A | D | E = D / B | F | G = F / B | H | I |
|---|---|---|---|---|---|---|---|---|---|
| Origination Year | Original UPB | Original UPB Above 80% LTV | Percent of UPB with MI | Actual Standard Coverage MI Risk Exposure | Actual Standard Coverage MI Coverage Percentage | Estimated Deep Coverage MI Risk Exposure | Estimated Deep Coverage MI Coverage Percentage | Estimated Standard Coverage MI Losses | Estimated Deep Coverage MI Losses |
| 1999 | 138,364 | 43,914 | 32% | 11,965 | 27.2% | 19,683 | 44.8% | 150 | 200 |
| 2000 | 234,624 | 82,779 | 35% | 20,640 | 24.9% | 37,375 | 45.2% | 333 | 434 |
| 2001 | 573,723 | 144,372 | 25% | 34,826 | 24.1% | 64,440 | 44.6% | 657 | 974 |
| 2002 | 639,089 | 129,010 | 20% | 31,298 | 24.3% | 57,542 | 44.6% | 717 | 1,188 |
| 2003 | 829,150 | 130,775 | 16% | 31,215 | 23.9% | 57,900 | 44.3% | 897 | 1,682 |
| 2004 | 386,357 | 65,072 | 17% | 15,757 | 24.2% | 28,836 | 44.3% | 699 | 1,351 |
| 2005 | 439,463 | 57,395 | 13% | 13,865 | 24.2% | 25,448 | 44.3% | 1,185 | 2,350 |
| 2006 | 371,812 | 48,876 | 13% | 11,802 | 24.1% | 21,676 | 44.3% | 1,363 | 2,714 |
| 2007 | 413,489 | 74,883 | 18% | 18,277 | 24.4% | 33,521 | 44.8% | 2,220 | 4,512 |
| 2008 | 471,667 | 96,240 | 20% | 22,832 | 23.7% | 43,137 | 44.8% | 1,549 | 3,148 |
| 2009 | 748,944 | 61,809 | 8% | 13,327 | 21.6% | 27,251 | 44.1% | 149 | 280 |
| 2010 | 476,604 | 43,348 | 9% | 10,520 | 24.3% | 19,240 | 44.4% | 31 | 46 |
| 2011 | 373,810 | 52,869 | 14% | 13,484 | 25.5% | 23,751 | 44.9% | 14 | 19 |
| 2012 | 597,448 | 101,832 | 17% | 25,803 | 25.3% | 45,289 | 44.5% | 4 | 6 |
| 2013 | 567,872 | 140,223 | 25% | 36,345 | 25.9% | 62,849 | 44.8% | 1 | 1 |
| 2014Q1 | 131,886 | 42,388 | 32% | 11,228 | 26.5% | 19,264 | 45.4% | - | - |
| **Total** | **7,394,301** | **1,315,785** | **18%** | **323,183** | **24.6%** | **587,202** | **44.6%** | **9,968** | **18,903** |

Notes: Losses reflect actual losses reported in the data plus a calculated provision for interest expense as defined by GSEs.

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Summary of Loan-Level Data**
Source: Freddie Mac and Fannie Mae Loan-Level Performance Data*

| | Ever-to Date Default Rate (REO / Short Sale / Foreclosure) | | | Severity Rate** | | |
|---|---|---|---|---|---|---|
| **Origination Year** | **Fannie** | **Freddie** | **Total** | **Fannie** | **Freddie** | **Total** |
| 1999 | 0.92% | 0.83% | 0.84% | 7.7% | 14.8% | 13.9% |
| 2000 | 0.81% | 0.87% | 0.83% | 11.0% | 19.2% | 14.4% |
| 2001 | 0.81% | 0.90% | 0.84% | 17.3% | 26.2% | 21.0% |
| 2002 | 0.91% | 1.04% | 0.96% | 24.8% | 30.5% | 27.4% |
| 2003 | 1.37% | 1.40% | 1.38% | 27.1% | 29.3% | 28.0% |
| 2004 | 2.55% | 2.41% | 2.48% | 33.6% | 33.7% | 33.7% |
| 2005 | 5.24% | 4.94% | 5.08% | 41.5% | 41.4% | 41.5% |
| 2006 | 6.88% | 7.14% | 7.02% | 47.9% | 48.4% | 48.2% |
| 2007 | 6.73% | 7.60% | 7.15% | 45.6% | 47.8% | 46.7% |
| 2008 | 3.05% | 4.46% | 3.68% | 37.4% | 44.0% | 41.0% |
| 2009 | 0.38% | 0.51% | 0.44% | 27.7% | 34.0% | 31.0% |
| 2010 | 0.11% | 0.17% | 0.13% | 21.3% | 27.2% | 24.2% |
| 2011 | 0.04% | 0.06% | 0.05% | 17.6% | 19.5% | 18.4% |
| 2012 | 0.01% | 0.01% | 0.01% | 17.3% | 15.9% | 16.8% |
| 2013 | 0.00% | 0.00% | 0.00% | 5.5% | 8.8% | 6.3% |
| 2014 | 0.00% | 0.00% | 0.00% | N/A | N/A | N/A |
| **Total** | **1.57%** | **2.16%** | **1.82%** | **38.0%** | **41.5%** | **39.8%** |

Notes: Fannie Mae acquisitions between January 1, 2000 and March 31, 2014 with corresponding monthly performance data as of March 31, 2015.
Freddie Mac acquisitions between January 1, 1999 and March 31, 2014 with corresponding monthly performance data as of September 30, 2014.
Severity rate =(UPB + Delinquent Interest + Disposition Exepenses - Net Sales Proceeds - MI Recoveries - Non-MI Recoveries) / Original Loan Amount

**US Mortgage Insurers**

Deep Coverage Mortgage Insurance Analysis

**Summary of Loan-Level Data**

Source: Freddie Mac and Fannie Mae Loan-Level Performance Data*

| | Severity Components (Percent of Original Default Balance) | | | | | | |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G = Sum(A:C) - Sum(D:F) |
| Origination Year | Defaulting UPB | Expenses | Delinquent Interest | Net Proceeds | MI Recoveries | Non-MI Recoveries | Total |
| 1999 | 94.6% | 10.6% | 10.3% | 86.3% | 12.8% | 2.4% | 13.9% |
| 2000 | 96.9% | 10.9% | 12.1% | 84.7% | 17.0% | 3.7% | 14.4% |
| 2001 | 95.0% | 10.9% | 10.7% | 78.3% | 13.6% | 3.7% | 21.0% |
| 2002 | 93.4% | 11.3% | 10.3% | 72.8% | 11.7% | 3.0% | 27.4% |
| 2003 | 91.4% | 10.6% | 9.2% | 73.0% | 7.8% | 2.3% | 28.0% |
| 2004 | 92.5% | 10.1% | 9.5% | 69.3% | 7.3% | 1.8% | 33.7% |
| 2005 | 93.7% | 8.0% | 9.2% | 62.8% | 5.3% | 1.2% | 41.5% |
| 2006 | 95.7% | 7.5% | 10.4% | 58.9% | 5.2% | 1.2% | 48.2% |
| 2007 | 96.8% | 7.6% | 10.7% | 59.4% | 7.5% | 1.3% | 46.7% |
| 2008 | 97.4% | 7.5% | 10.4% | 64.0% | 8.9% | 1.3% | 41.0% |
| 2009 | 96.8% | 7.0% | 7.5% | 74.6% | 4.5% | 1.1% | 31.0% |
| 2010 | 97.3% | 7.8% | 6.6% | 81.2% | 4.9% | 1.3% | 24.2% |
| 2011 | 98.0% | 7.1% | 5.7% | 83.6% | 7.7% | 1.1% | 18.4% |
| 2012 | 98.6% | 5.9% | 4.6% | 83.7% | 7.8% | 0.7% | 16.8% |
| 2013 | 99.2% | 3.9% | 3.0% | 89.9% | 9.3% | 0.6% | 6.3% |
| 2014 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| **Total** | **95.2%** | **8.4%** | **10.0%** | **64.7%** | **7.4%** | **1.6%** | **39.8%** |

Notes: Fannie Mae acquisitions between January 1, 2000 and March 31, 2014 with corresponding monthly performance data as of March 31, 2015.
Freddie Mac acquisitions between January 1, 1999 and March 31, 2014 with corresponding monthly performance data as of September 30, 2014.

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Mortgage Performance Model - Performing to Prepayment Model**
Parameter Estimates

| Fit Statistics | Metric |
|---|---|
| C Statistic | 0.67 |
| Pair Concordinate | 64.8 |
| Pair Discordinate | 30.5 |

| Categorical Variables | Class | Reference | Estimate | StdErr | WaldChiSq | ProbChiSq | OddsRatioEst |
|---|---|---|---|---|---|---|---|
| Intercept | | | (7.11) | 0.01 | 530,945.33 | - | |
| Occupancy Type | INVESTOR | OWNER | (0.38) | 0.00 | 31,049.36 | - | 0.68 |
| Occupancy Type | SECOND | OWNER | (0.18) | 0.00 | 5,720.38 | - | 0.84 |
| Property Type | 2-4U | SFR | (0.29) | 0.00 | 8,440.54 | - | 0.75 |
| Property Type | COND | SFR | (0.04) | 0.00 | 614.37 | 0.00 | 0.96 |
| Property Type | COOP | SFR | (0.44) | 0.01 | 989.14 | 0.00 | 0.64 |
| Credit Score Cohort | [350-619] | [740-850] | (0.26) | 0.00 | 8,836.69 | - | 0.77 |
| Credit Score Cohort | [620-639] | [740-850] | (0.23) | 0.00 | 7,580.64 | - | 0.80 |
| Credit Score Cohort | [640-659] | [740-850] | (0.18) | 0.00 | 6,892.16 | - | 0.84 |
| Credit Score Cohort | [660-679] | [740-850] | (0.14) | 0.00 | 5,419.67 | - | 0.87 |
| Credit Score Cohort | [680-699] | [740-850] | (0.10) | 0.00 | 3,687.14 | - | 0.90 |
| Credit Score Cohort | [700-719] | [740-850] | (0.07) | 0.00 | 1,852.39 | - | 0.94 |
| Credit Score Cohort | [720-739] | [740-850] | (0.03) | 0.00 | 333.38 | 0.00 | 0.97 |
| Original Loan to Value | [0,60] | (75,80] | 0.10 | 0.00 | 5,990.22 | - | 1.10 |
| Original Loan to Value | (60,65] | (75,80] | 0.07 | 0.00 | 1,172.43 | 0.00 | 1.07 |
| Original Loan to Value | (65,70] | (75,80] | 0.04 | 0.00 | 421.79 | 0.00 | 1.04 |
| Original Loan to Value | (70,75] | (75,80] | 0.03 | 0.00 | 412.39 | 0.00 | 1.03 |
| Original Loan to Value | (80,85] | (75,80] | (0.05) | 0.00 | 333.91 | 0.00 | 0.95 |
| Original Loan to Value | (85,90] | (75,80] | (0.06) | 0.00 | 1,268.88 | 0.00 | 0.94 |
| Original Loan to Value | (90,95] | (75,80] | (0.07) | 0.00 | 1,327.22 | 0.00 | 0.94 |
| Original Loan to Value | (95+) | (75,80] | (0.14) | 0.00 | 1,138.23 | 0.00 | 0.87 |
| Original Loan Amount | [0-100,000) | [100,000-200,000 | (0.43) | 0.00 | 110,981.36 | - | 0.65 |
| Original Loan Amount | [200,000-300,000) | [100,000-200,000 | 0.23 | 0.00 | 40,157.36 | - | 1.26 |
| Original Loan Amount | [300,000-400,000) | [100,000-200,000 | 0.25 | 0.00 | 20,630.23 | - | 1.28 |
| Original Loan Amount | [400,000+) | [100,000-200,000 | 0.45 | 0.00 | 36,941.43 | - | 1.56 |
| Spread at Origination | (inf,-3) | [1,2) | (1.22) | 1.01 | 1.47 | 0.23 | 0.29 |
| Spread at Origination | [-3,-2) | [1,2) | (2.09) | 0.71 | 8.67 | 0.00 | 0.12 |
| Spread at Origination | [-2,-1) | [1,2) | (1.57) | 0.36 | 19.64 | 0.00 | 0.21 |
| Spread at Origination | [-1,0) | [1,2) | (1.00) | 0.07 | 188.91 | 0.00 | 0.37 |
| Spread at Origination | [0,1) | [1,2) | (0.50) | 0.00 | 44,310.48 | - | 0.61 |
| Spread at Origination | [2,3) | [1,2) | 0.55 | 0.00 | 300,918.33 | - | 1.74 |
| Spread at Origination | [3,4) | [1,2) | 0.83 | 0.00 | 86,044.46 | - | 2.30 |
| Spread at Origination | [4++) | [1,2) | 0.86 | 0.01 | 6,059.66 | - | 2.36 |

| Spline Variables (Time Varying) | Definition | Estimate | StdErr | WaldChiSq | ProbChiSq |
|---|---|---|---|---|---|
| Change in unemployment rate | min(wa_ur_delta,0); | 0.11 | 0.00 | 23,106.25 | - |
| Change in unemployment rate | min(2,max(wa_ur_delta,0)); | 0.12 | 0.00 | 20,896.43 | - |
| Change in unemployment rate | max(wa_ur_delta-2,0); | (0.12) | 0.00 | 40,591.49 | - |
| Loan Age | min(cert_age,3); | 0.73 | 0.00 | 144,828.73 | - |
| Loan Age | min(2,max(cert_age-3,0)); | 0.13 | 0.00 | 11,319.22 | - |
| Loan Age | min(2,max(cert_age-5,0)); | 0.08 | 0.00 | 5,383.65 | - |
| Loan Age | min(4,max(cert_age-7,0)); | (0.03) | 0.00 | 3,540.03 | - |
| Loan Age | min(9,max(cert_age-11,0)); | (0.04) | 0.00 | 41,917.30 | - |
| Loan Age | max(cert_age-20,0); | (0.01) | 0.00 | 10,428.27 | - |
| Cumulative HPA | min(wa_hpa,1); | 1.44 | 0.01 | 30,764.03 | - |
| Cumulative HPA | max(wa_hpa-1,0); | 0.92 | 0.00 | 89,453.01 | - |
| Change in 10-year interest rate | min(wa_cum_int_delta,0); | - | 0.00 | 108,952.86 | - |
| Change in 10-year interest rate | min(2,max(wa_cum_int_delta,0)); | 0.44 | 0.00 | 194,328.10 | - |
| Change in 10-year interest rate | max(wa_cum_int_delta-2,0); | 0.27 | 0.00 | 9,465.75 | - |

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Mortgage Performance Model - Performing to First Time Serious Delinquency**
Parameter Estimates

| Fit Statistics | Metric |
|---|---|
| C Statistic | 0.79 |
| Pair Concordinate | 64.8 |
| Pair Discordinate | 30.5 |

| Parameter | Class | Reference | Estimate | StdErr | WaldChiSq | ProbChiSq | OddsRatioEst |
|---|---|---|---|---|---|---|---|
| Intercept | | | (8.13) | 0.04 | 46,574.27 | - | |
| Occupancy Type | INVESTOR | OWNER | 0.19 | 0.01 | 825.93 | 0.00 | 1.21 |
| Occupancy Type | SECOND | OWNER | (0.23) | 0.01 | 574.46 | 0.00 | 0.80 |
| Loan Purpose | CASHOUT | PURCHASE | 0.41 | 0.00 | 8,902.74 | - | 1.51 |
| Loan Purpose | RATE/TERM | PURCHASE | 0.26 | 0.00 | 3,350.59 | - | 1.29 |
| Property Type | 2-4U | SFR | 0.18 | 0.01 | 339.77 | 0.00 | 1.19 |
| Property Type | COND | SFR | (0.03) | 0.01 | 42.91 | 0.00 | 0.97 |
| Property Type | COOP | SFR | (0.57) | 0.07 | 71.01 | 0.00 | 0.57 |
| Credit Score Cohort | [350-619] | [740-850] | 2.03 | 0.01 | 109,601.59 | - | 7.61 |
| Credit Score Cohort | [620-639] | [740-850] | 1.73 | 0.01 | 74,688.97 | - | 5.64 |
| Credit Score Cohort | [640-659] | [740-850] | 1.52 | 0.01 | 65,972.24 | - | 4.56 |
| Credit Score Cohort | [660-679] | [740-850] | 1.28 | 0.01 | 49,249.75 | - | 3.61 |
| Credit Score Cohort | [680-699] | [740-850] | 1.04 | 0.01 | 32,055.95 | - | 2.84 |
| Credit Score Cohort | [700-719] | [740-850] | 0.82 | 0.01 | 18,294.87 | - | 2.27 |
| Credit Score Cohort | [720-739] | [740-850] | 0.58 | 0.01 | 8,145.55 | - | 1.79 |
| Original Loan to Value | [0,60] | (75,80] | (0.95) | 0.01 | 24,548.82 | - | 0.39 |
| Original Loan to Value | (60,65] | (75,80] | (0.52) | 0.01 | 4,070.21 | - | 0.60 |
| Original Loan to Value | (65,70] | (75,80] | (0.31) | 0.01 | 2,632.79 | - | 0.73 |
| Original Loan to Value | (70,75] | (75,80] | (0.15) | 0.01 | 745.52 | 0.00 | 0.86 |
| Original Loan to Value | (80,85] | (75,80] | 0.29 | 0.01 | 1,219.39 | 0.00 | 1.33 |
| Original Loan to Value | (85,90] | (75,80] | 0.41 | 0.01 | 5,990.21 | - | 1.50 |
| Original Loan to Value | (90,95] | (75,80] | 0.58 | 0.01 | 10,522.81 | - | 1.78 |
| Original Loan to Value | (95+) | (75,80] | 0.81 | 0.01 | 6,058.45 | - | 2.25 |
| Debt-to-Income Cohort | [0,10) | [30-40) | (0.26) | 0.02 | 165.39 | 0.00 | 0.77 |
| Debt-to-Income Cohort | [10-20) | [30-40) | (0.38) | 0.01 | 2,306.73 | - | 0.68 |
| Debt-to-Income Cohort | [20-30) | [30-40) | (0.25) | 0.01 | 2,350.94 | - | 0.78 |
| Debt-to-Income Cohort | [40-50) | [30-40) | 0.23 | 0.00 | 3,266.75 | - | 1.26 |
| Debt-to-Income Cohort | [50-60) | [30-40) | 0.38 | 0.01 | 5,754.53 | - | 1.47 |
| Debt-to-Income Cohort | [60-70) | [30-40) | 0.46 | 0.01 | 3,115.37 | - | 1.58 |
| Original Loan Amount | [0-100,000) | [100,000-200,000 | 0.21 | 0.00 | 2,477.96 | - | 1.23 |
| Original Loan Amount | [200,000-300,000) | [100,000-200,000 | 0.09 | 0.00 | 427.78 | 0.00 | 1.09 |
| Original Loan Amount | [300,000-400,000) | [100,000-200,000 | 0.22 | 0.01 | 1,425.68 | - | 1.25 |
| Original Loan Amount | [400,000+) | [100,000-200,000 | 0.40 | 0.01 | 1,514.97 | - | 1.49 |

| Spline Variables (Time Varying) | Definition | Estimate | StdErr | WaldChiSq | ProbChiSq |
|---|---|---|---|---|---|
| Change in unemployment rate | min(wa_ur_delta,0); | 0.25 | 0.00 | 5,001.18 | - |
| Change in unemployment rate | max(wa_ur_delta,0); | 0.13 | 0.00 | 18,927.60 | - |
| Loan Age | min(cert_age,3); | 1.04 | 0.01 | 7,135.37 | - |
| Loan Age | min(2,max(cert_age-3,0)); | 0.25 | 0.01 | 1,648.13 | - |
| Loan Age | min(2,max(cert_age-5,0)); | 0.17 | 0.00 | 1,337.39 | 0.00 |
| Loan Age | min(4,max(cert_age-7,0)); | 0.06 | 0.00 | 1,057.76 | 0.00 |
| Loan Age | min(9,max(cert_age-11,0)); | (0.02) | 0.00 | 925.63 | 0.00 |
| Loan Age | max(cert_age-20,0); | 0.00 | 0.00 | 35.59 | 0.00 |
| Cumulative HPA | min(wa_hpa,1); | (2.53) | 0.02 | 22,023.62 | - |
| Cumulative HPA | min(.1,max(wa_hpa-1.0,0)); | (3.99) | 0.07 | 3,515.42 | - |
| Cumulative HPA | min(.1,max(wa_hpa-1.1,0)); | (0.16) | 0.08 | 3.55 | 0.06 |
| Cumulative HPA | max(wa_hpa-1.2,0); | (0.83) | 0.03 | 805.90 | 0.00 |

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Mortgage Performance Model - Serious Delinquency to Prepayment Model**
Parameter Estimates

| Fit Statistics | Metric |
|---|---|
| C Statistic | 0.69 |
| Pair Concordinate | 64.4 |
| Pair Discordinate | 26.0 |

| Parameter | Class | Reference | Estimate | StdErr | WaldChiSq | ProbChiSq | OddsRatioEst |
|---|---|---|---|---|---|---|---|
| Intercept | | | (5.33) | 0.06 | 8,769.32 | - | |
| Occupancy Type | INVESTOR | OWNER | (0.05) | 0.02 | 4.22 | 0.04 | 0.95 |
| Occupancy Type | SECOND | OWNER | 0.06 | 0.03 | 4.03 | 0.04 | 1.06 |
| Loan Purpose | CASHOUT | PURCHASE | (0.20) | 0.01 | 193.60 | 0.00 | 0.82 |
| Loan Purpose | RATE/TERM | PURCHASE | (0.11) | 0.01 | 64.43 | 0.00 | 0.89 |
| Property Type | 2-4U | SFR | (0.28) | 0.03 | 66.50 | 0.00 | 0.76 |
| Property Type | COND | SFR | 0.01 | 0.03 | 0.18 | 0.67 | 1.01 |
| Property Type | MANU | SFR | (0.06) | 0.02 | 8.93 | 0.00 | 0.94 |
| Original Loan to Value | [0,60] | (75,80] | 0.52 | 0.02 | 934.49 | 0.00 | 1.68 |
| Original Loan to Value | (60,65] | (75,80] | 0.21 | 0.03 | 66.42 | 0.00 | 1.23 |
| Original Loan to Value | (65,70] | (75,80] | 0.17 | 0.02 | 66.00 | 0.00 | 1.18 |
| Original Loan to Value | (70,75] | (75,80] | 0.10 | 0.02 | 26.79 | 0.00 | 1.10 |
| Original Loan to Value | (80,85] | (75,80] | (0.08) | 0.03 | 8.18 | 0.00 | 0.92 |
| Original Loan to Value | (85,90] | (75,80] | (0.10) | 0.02 | 31.24 | 0.00 | 0.90 |
| Original Loan to Value | (90,95] | (75,80] | (0.13) | 0.02 | 47.94 | 0.00 | 0.88 |
| Original Loan to Value | (95,100] | (75,80] | (0.27) | 0.04 | 50.64 | 0.00 | 0.77 |
| Original Loan Amount | [0-100,000) | [100,000-200,000) | (0.40) | 0.01 | 999.57 | 0.00 | 0.67 |
| Original Loan Amount | [200,000-300,000) | [100,000-200,000) | 0.13 | 0.01 | 80.32 | 0.00 | 1.14 |
| Original Loan Amount | [300,000-400,000) | [100,000-200,000) | 0.11 | 0.02 | 19.65 | 0.00 | 1.11 |
| Original Loan Amount | [400,000+) | [100,000-200,000) | 0.12 | 0.04 | 8.35 | 0.00 | 1.13 |
| Cumulative Burnout after Delq | NoBurn | 1-4 | 0.10 | 0.02 | 30.27 | 0.00 | 1.10 |
| Cumulative Burnout after Delq | 5-8 | 1-4 | 0.19 | 0.02 | 81.64 | 0.00 | 1.21 |
| Cumulative Burnout after Delq | 9-12 | 1-4 | 0.47 | 0.03 | 342.99 | 0.00 | 1.60 |
| Cumulative Burnout after Delq | 13-16 | 1-4 | 0.68 | 0.03 | 541.05 | 0.00 | 1.98 |
| Cumulative Burnout after Delq | 17-20 | 1-4 | 0.85 | 0.04 | 546.18 | 0.00 | 2.33 |
| Cumulative Burnout after Delq | 21-24 | 1-4 | 0.80 | 0.04 | 347.25 | 0.00 | 2.22 |
| Cumulative Burnout after Delq | 25-28 | 1-4 | 0.72 | 0.05 | 184.09 | 0.00 | 2.05 |
| Cumulative Burnout after Delq | 29-32 | 1-4 | 0.57 | 0.07 | 60.72 | 0.00 | 1.77 |
| Cumulative Burnout after Delq | 33-36 | 1-4 | 0.59 | 0.09 | 44.10 | 0.00 | 1.81 |
| Cumulative Burnout after Delq | 37-40 | 1-4 | 0.29 | 0.12 | 6.00 | 0.01 | 1.33 |
| Cumulative Burnout after Delq | 41-44 | 1-4 | 0.52 | 0.13 | 15.88 | 0.00 | 1.68 |
| Cumulative Burnout after Delq | 45-plus | 1-4 | 0.21 | 0.15 | 1.97 | 0.16 | 1.23 |
| Loan age at delq | 1-4 | 5-8 | 0.19 | 0.02 | 103.31 | 0.00 | 1.21 |
| Loan age at delq | 9-12 | 5-8 | (0.20) | 0.02 | 148.04 | 0.00 | 0.82 |
| Loan age at delq | 13-16 | 5-8 | (0.37) | 0.02 | 418.08 | 0.00 | 0.69 |
| Loan age at delq | 17-20 | 5-8 | (0.48) | 0.02 | 574.52 | 0.00 | 0.62 |
| Loan age at delq | 21-24 | 5-8 | (0.67) | 0.02 | 832.38 | 0.00 | 0.51 |
| Loan age at delq | 25-28 | 5-8 | (0.74) | 0.03 | 828.07 | 0.00 | 0.48 |
| Loan age at delq | 29-32 | 5-8 | (0.84) | 0.03 | 759.09 | 0.00 | 0.43 |
| Loan age at delq | 33-36 | 5-8 | (0.88) | 0.04 | 602.95 | 0.00 | 0.41 |
| Loan age at delq | 37-40 | 5-8 | (0.85) | 0.04 | 370.82 | 0.00 | 0.43 |
| Loan age at delq | 40-plus | 5-8 | (1.13) | 0.05 | 481.20 | 0.00 | 0.32 |

| Spline Variables (Time Varying) | Definition | Estimate | StdErr | WaldChiSq | ProbChiSq |
|---|---|---|---|---|---|
| Age since first 90 | min(delq_age,2); | 1.16 | 0.03 | 1,542.53 | - |
| Age since first 90 | min(2,max(delq_age-2,0)); | (0.22) | 0.01 | 316.96 | 0.00 |
| Age since first 90 | min(2,max(delq_age-4,0)); | (0.02) | 0.01 | 2.50 | 0.11 |
| Age since first 90 | min(4,max(delq_age-6,0)); | (0.03) | 0.01 | 17.48 | 0.00 |
| Age since first 90 | min(10,max(delq_age-10,0)); | (0.07) | 0.00 | 390.80 | 0.00 |
| Age since first 90 | max(delq_age-20,0); | (0.00) | 0.00 | 0.45 | 0.50 |
| Cumulative HPA at first 90 | min(cum_hpa - 1,0); | 3.80 | 0.07 | 2,834.45 | - |
| Cumulative HPA at first 90 | max(cum_hpa - 1,0); | 1.65 | 0.02 | 5,299.21 | - |

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Mortgage Performance Model - Serious Delinquency to Default**
Parameter Estimates

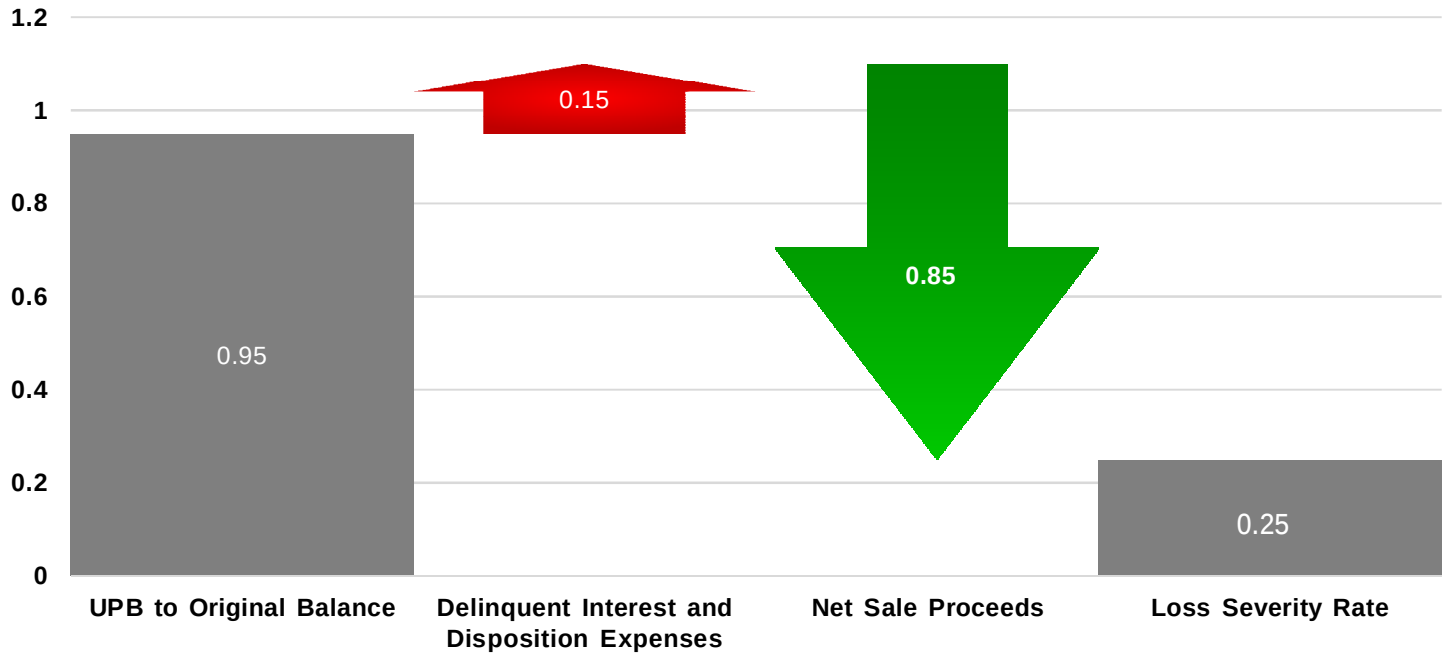
| Fit Statistics | Metric |
|---|---|
| C Statistic | 0.76 |
| Pair Concordinate | 74.0 |
| Pair Discordinate | 22.6 |

| Parameter | Class | Reference | Estimate | StdErr | WaldChiSq | ProbChiSq | OddsRatioEst |
|---|---|---|---|---|---|---|---|
| Intercept | | | (6.63) | 0.06 | 12,167.94 | - | |
| Occupancy Type | INVESTOR | OWNER | 0.27 | 0.02 | 308.81 | 0.00 | 1.31 |
| Occupancy Type | SECOND | OWNER | (0.05) | 0.02 | 7.15 | 0.01 | 0.95 |
| Property Type | 2-4U | SFR | (0.21) | 0.03 | 62.15 | 0.00 | 0.81 |
| Property Type | COND | SFR | 0.44 | 0.01 | 901.62 | 0.00 | 1.55 |
| Property Type | MANU | SFR | 0.49 | 0.01 | 1,725.68 | - | 1.63 |
| Credit Score Cohort | [350-619] | [740-850] | (0.52) | 0.02 | 1,005.09 | 0.00 | 0.59 |
| Credit Score Cohort | [620-639] | [740-850] | (0.41) | 0.02 | 657.68 | 0.00 | 0.66 |
| Credit Score Cohort | [640-659] | [740-850] | (0.35) | 0.01 | 589.85 | 0.00 | 0.71 |
| Credit Score Cohort | [660-679] | [740-850] | (0.28) | 0.01 | 421.97 | 0.00 | 0.75 |
| Credit Score Cohort | [680-699] | [740-850] | (0.22) | 0.01 | 252.39 | 0.00 | 0.80 |
| Credit Score Cohort | [700-719] | [740-850] | (0.15) | 0.01 | 108.15 | 0.00 | 0.86 |
| Credit Score Cohort | [720-739] | [740-850] | (0.09) | 0.01 | 37.33 | 0.00 | 0.91 |
| Original Loan to Value | [0,60] | (75,80] | (1.02) | 0.02 | 2,988.82 | - | 0.36 |
| Original Loan to Value | (60,65] | (75,80] | (0.58) | 0.02 | 663.39 | 0.00 | 0.56 |
| Original Loan to Value | (65,70] | (75,80] | (0.43) | 0.02 | 702.78 | 0.00 | 0.65 |
| Original Loan to Value | (70,75] | (75,80] | (0.21) | 0.01 | 222.82 | 0.00 | 0.81 |
| Original Loan to Value | (80,85] | (75,80] | 0.06 | 0.02 | 9.99 | 0.00 | 1.07 |
| Original Loan to Value | (85,90] | (75,80] | 0.18 | 0.01 | 213.71 | 0.00 | 1.20 |
| Original Loan to Value | (90,95] | (75,80] | 0.36 | 0.01 | 738.06 | 0.00 | 1.43 |
| Original Loan to Value | (95,100] | (75,80] | 0.51 | 0.02 | 539.41 | 0.00 | 1.67 |
| Age after first delq | 1-4 | 5-8 | (0.16) | 0.02 | 60.97 | 0.00 | 0.85 |
| Age after first delq | 9-12 | 5-8 | 0.02 | 0.01 | 2.35 | 0.13 | 1.02 |
| Age after first delq | 13-16 | 5-8 | 0.03 | 0.01 | 4.22 | 0.04 | 1.03 |
| Age after first delq | 17-20 | 5-8 | 0.05 | 0.01 | 13.40 | 0.00 | 1.05 |
| Age after first delq | 21-24 | 5-8 | 0.05 | 0.02 | 8.20 | 0.00 | 1.05 |
| Age after first delq | 25-28 | 5-8 | 0.03 | 0.02 | 3.23 | 0.07 | 1.03 |
| Loan age at delq | 29-32 | 5-8 | 0.01 | 0.02 | 0.50 | 0.48 | 1.01 |
| Loan age at delq | 33-36 | 5-8 | 0.00 | 0.03 | 0.03 | 0.86 | 1.00 |
| Loan age at delq | 37-40 | 5-8 | 0.01 | 0.03 | 0.12 | 0.73 | 1.01 |
| Loan age at delq | 40-plus | 5-8 | 0.13 | 0.04 | 11.39 | 0.00 | 1.14 |

| Spline Variables (Time Varying) | Definition | Estimate | StdErr | WaldChiSq | ProbChiSq |
|---|---|---|---|---|---|
| Age since first 90 | min(delq_age,2); | 1.55 | 0.03 | 2,514.39 | - |
| Age since first 90 | min(2,max(delq_age-2,0)); | 0.38 | 0.01 | 2,093.68 | - |
| Age since first 90 | min(2,max(delq_age-4,0)); | 0.05 | 0.01 | 61.75 | 0.00 |
| Age since first 90 | min(4,max(delq_age-6,0)); | (0.15) | 0.00 | 1,452.72 | - |
| Age since first 90 | min(10,max(delq_age-10,0)); | (0.09) | 0.00 | 1,244.30 | 0.00 |
| Age since first 90 | max(delq_age-20,0); | (0.06) | 0.00 | 232.69 | 0.00 |
| Cumulative HPA at first 90 | min(cum_hpa - 1,0); | (2.26) | 0.03 | 5,939.49 | - |
| Cumulative HPA at first 90 | max(cum_hpa - 1,0); | (1.99) | 0.04 | 2,160.78 | - |

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Illustrative Example of Severity Model Form**




Notes: UPB to Original Balance : Estimated using default timing and amortization
Delinquent Interest and Disposition Expenses : Estimated using a regression model
Net Sales Proceeds : Estimated using a regression model
Net Severity Rate = UPB to Original Balance + Delinquent Interest and Disposition Expenses - Net Sales Proceeds

**US Mortgage Insurers**

Deep Coverage Mortgage Insurance Analysis

**Severity Model - Net Sales Proceeds**

Parameter Estimates

| FitStatistics | Metric |
|---|---|
| R-Squared | 0.29 |

| Parameter | Class | Reference | Estimate | StdErr | ProbChiSq |
|---|---|---|---|---|---|
| Intercept | | | 0.32 | 0.0495 | 0.000 |
| Original Loan Amount | [0-100,000) | [150,000-200,000) | (0.21) | 0.0009 | 0.000 |
| Original Loan Amount | [100,000-150,000) | [150,000-200,000) | (0.06) | 0.0009 | 0.000 |
| Original Loan Amount | [200,000-250,000) | [150,000-200,000) | 0.03 | 0.0010 | 0.000 |
| Original Loan Amount | [250,000-300,000) | [150,000-200,000) | 0.04 | 0.0012 | 0.000 |
| Original Loan Amount | [300,000-350,000) | [150,000-200,000) | 0.06 | 0.0014 | 0.000 |
| Original Loan Amount | [350,000-400,000) | [150,000-200,000) | 0.07 | 0.0017 | 0.000 |
| Original Loan Amount | [400,000-450,000) | [150,000-200,000) | 0.08 | 0.0021 | 0.000 |
| Original Loan Amount | [450,000+) | [150,000-200,000) | 0.08 | 0.0078 | 0.000 |
| Credit Score Cohort | NO SCORE | [680-699] | (0.01) | 0.0045 | 0.013 |
| Credit Score Cohort | [350-619] | [680-699] | (0.02) | 0.0013 | 0.000 |
| Credit Score Cohort | [620-639] | [680-699] | (0.02) | 0.0012 | 0.000 |
| Credit Score Cohort | [640-659] | [680-699] | (0.01) | 0.0011 | 0.000 |
| Credit Score Cohort | [660-679] | [680-699] | (0.01) | 0.0011 | 0.000 |
| Credit Score Cohort | [700-719] | [680-699] | 0.00 | 0.0011 | 0.000 |
| Credit Score Cohort | [720-739] | [680-699] | 0.01 | 0.0012 | 0.000 |
| Credit Score Cohort | [740-850) | [680-699] | 0.01 | 0.0010 | 0.000 |
| Original Loan to Value | NO LTV | (80,85] | 0.03 | 0.0064 | 0.000 |
| Original Loan to Value | [0,60] | (80,85] | 0.22 | 0.0019 | 0.000 |
| Original Loan to Value | (60,65] | (80,85] | 0.13 | 0.0021 | 0.000 |
| Original Loan to Value | (65,70] | (80,85] | 0.09 | 0.0017 | 0.000 |
| Original Loan to Value | (70,75] | (80,85] | 0.05 | 0.0016 | 0.000 |
| Original Loan to Value | (75,80] | (80,85] | 0.02 | 0.0014 | 0.000 |
| Original Loan to Value | (85,90] | (80,85] | (0.02) | 0.0014 | 0.000 |
| Original Loan to Value | (90,95] | (80,85] | (0.04) | 0.0015 | 0.000 |
| Original Loan to Value | (95,100] | (80,85] | (0.04) | 0.0018 | 0.000 |
| Property Type | CO-OP | SFR | 0.01 | 0.0108 | 0.586 |
| Property Type | CONDO | SFR | (0.00) | 0.0010 | 0.000 |
| Property Type | LEASEHOLD | SFR | (0.07) | 0.0162 | 0.000 |
| Property Type | MANUFACTURED HOUSING | SFR | (0.05) | 0.0022 | 0.000 |
| Property Type | MISSING | SFR | 0.07 | 0.1540 | 0.635 |
| Property Type | PUD | SFR | 0.06 | 0.0009 | 0.000 |
| Time Delinquent | 0-6 | 16-18 | (0.01) | 0.0013 | 0.000 |
| Time Delinquent | 7-9 | 16-18 | (0.01) | 0.0011 | 0.000 |
| Time Delinquent | 10-12 | 16-18 | (0.00) | 0.0011 | 0.171 |
| Time Delinquent | 12-15 | 16-18 | 0.00 | 0.0011 | 0.000 |
| Time Delinquent | 19-21 | 16-18 | (0.00) | 0.0012 | 0.000 |
| Time Delinquent | 22+ | 16-18 | (0.01) | 0.0010 | 0.000 |
| Occupancy Status | INVESTOR | OWNER | (0.09) | 0.0011 | 0.000 |
| Occupancy Status | SECOND | OWNER | (0.03) | 0.0015 | 0.000 |
| Loan Purpose | CASHOUT | PURCHASE | (0.08) | 0.0008 | 0.000 |
| Loan Purpose | RATE/TERM | PURCHASE | (0.06) | 0.0008 | 0.000 |
| Loan Purpose | UNKNOWN | PURCHASE | (0.08) | 0.0192 | 0.000 |
| Number of Units | 2 | 1 | (0.11) | 0.0021 | 0.000 |
| Number of Units | 3 | 1 | (0.13) | 0.0062 | 0.000 |
| Number of Units | 4 | 1 | (0.09) | 0.0063 | 0.000 |

| Spline Variables (Time Varying) | Definition | Estimate | StdErr | ProbChiSq |
|---|---|---|---|---|
| Cumulative HPA | min(HPA,.8); | 0.58 | 0.00 | - |
| Cumulative HPA | min(.2,max(HPA-0.8,0)); | 0.67 | 0.01 | - |
| Cumulative HPA | min(.1,max(HPA-1.0,0)); | 1.05 | 0.01 | - |
| Cumulative HPA | min(.1,max(HPA-1.1,0)); | 0.22 | 0.02 | 0.00 |
| Cumulative HPA | min(.3,max(HPA-1.2,0)); | 0.25 | 0.01 | 0.00 |
| Cumulative HPA | max(HPA-1.5,0); | 0.18 | 0.02 | 0.00 |
| Loan Age | min(loan_age,3); | (0.00) | 0.02 | 0.97 |
| Loan Age | min(2,max(loan_age-3,0)); | (0.01) | 0.00 | 0.03 |
| Loan Age | min(2,max(loan_age-5,0)); | (0.01) | 0.00 | 0.00 |
| Loan Age | min(4,max(loan_age-7,0)); | (0.02) | 0.00 | 0.00 |
| Loan Age | min(9,max(loan_age-11,0)); | (0.00) | 0.00 | 0.00 |
| Loan Age | max(loan_age-20,0); | (0.00) | 0.00 | - |

**US Mortgage Insurers**

Deep Coverage Mortgage Insurance Analysis

**Severity Model - Expenses and Delinquent Interest**

Parameter Estimates

| FitStatistics | Metric |
|---|---|
| R-Squared | 0.66 |

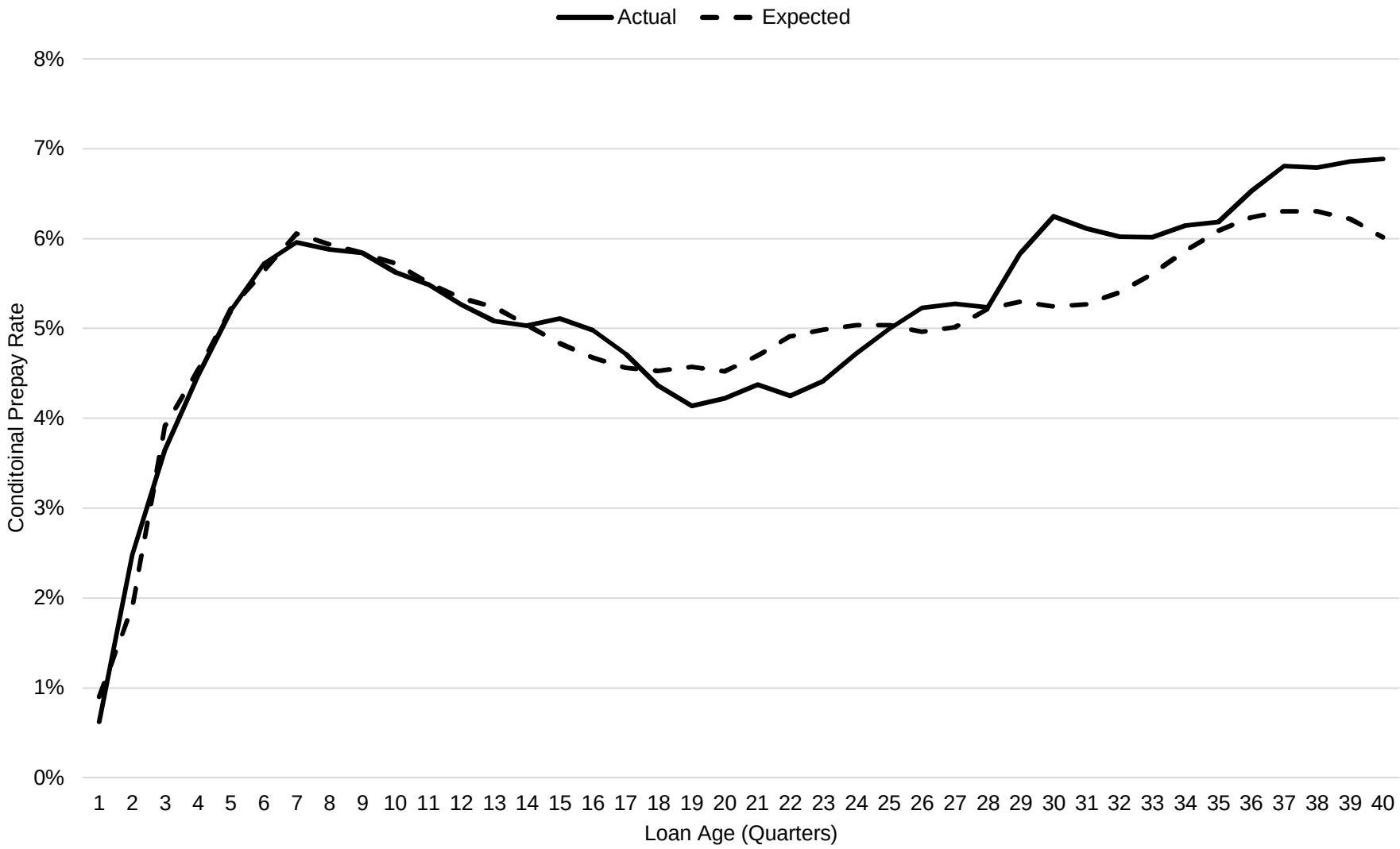
| Parameter | Class | Reference | Estimate | StdErr | ProbChiSq |
|---|---|---|---|---|---|
| Intercept | | | 0.17 | 0.0006 | 0.000 |
| Original Loan Amount | [0-100,000) | [150,000-200,000) | 0.07 | 0.0004 | 0.000 |
| Original Loan Amount | [100,000-150,000) | [150,000-200,000) | 0.03 | 0.0003 | 0.000 |
| Original Loan Amount | [200,000-250,000) | [150,000-200,000) | (0.02) | 0.0003 | 0.000 |
| Original Loan Amount | [250,000-300,000) | [150,000-200,000) | (0.04) | 0.0004 | 0.000 |
| Original Loan Amount | [300,000-350,000) | [150,000-200,000) | (0.05) | 0.0006 | 0.000 |
| Original Loan Amount | [350,000-400,000) | [150,000-200,000) | (0.07) | 0.0008 | 0.000 |
| Original Loan Amount | [400,000-450,000) | [150,000-200,000) | (0.08) | 0.0010 | 0.000 |
| Original Loan Amount | [450,000+) | [150,000-200,000) | (0.11) | 0.0025 | 0.000 |
| Property Type | CO-OP | SFR | (0.00) | 0.0031 | 0.274 |
| Property Type | CONDO | SFR | (0.01) | 0.0003 | 0.000 |
| Property Type | LEASEHOLD | SFR | 0.00 | 0.0047 | 0.416 |
| Property Type | MANUFACTURED HOUSING | SFR | (0.01) | 0.0006 | 0.000 |
| Property Type | MISSING | SFR | (0.04) | 0.0446 | 0.330 |
| Property Type | PUD | SFR | (0.00) | 0.0003 | 0.000 |
| Time delinquent (months) | 0-6 | 16-18 | (0.12) | 0.0004 | 0.000 |
| Time delinquent (months) | 7-9 | 16-18 | (0.09) | 0.0003 | 0.000 |
| Time delinquent (months) | 10-12 | 16-18 | (0.06) | 0.0003 | 0.000 |
| Time delinquent (months) | 12-15 | 16-18 | (0.03) | 0.0003 | 0.000 |
| Time delinquent (months) | 19-21 | 16-18 | 0.03 | 0.0004 | 0.000 |
| Time delinquent (months) | 22+ | 16-18 | 0.12 | 0.0003 | 0.000 |
| Occupancy Type | INVESTOR | OWNER | 0.01 | 0.0003 | 0.000 |
| Occupancy Type | SECOND | OWNER | (0.00) | 0.0004 | 0.000 |
| Loan Purpose | CASHOUT | PURCHASE | (0.01) | 0.0002 | 0.000 |
| Loan Purpose | RATE/TERM | PURCHASE | (0.01) | 0.0002 | 0.000 |
| Loan Purpose | UNKNOWN | PURCHASE | (0.00) | 0.0056 | 0.675 |
| Number of Units | 2 | 1 | 0.01 | 0.0006 | 0.000 |
| Number of Units | 3 | 1 | 0.01 | 0.0018 | 0.000 |
| Number of Units | 4 | 1 | 0.00 | 0.0018 | 0.024 |

-

| Spline Variables (Time Varying) | Estimate | StdErr | ProbChiSq |
|---|---|---|---|
| Interest Rate * UPB | 0.00 | 0.00 | - |

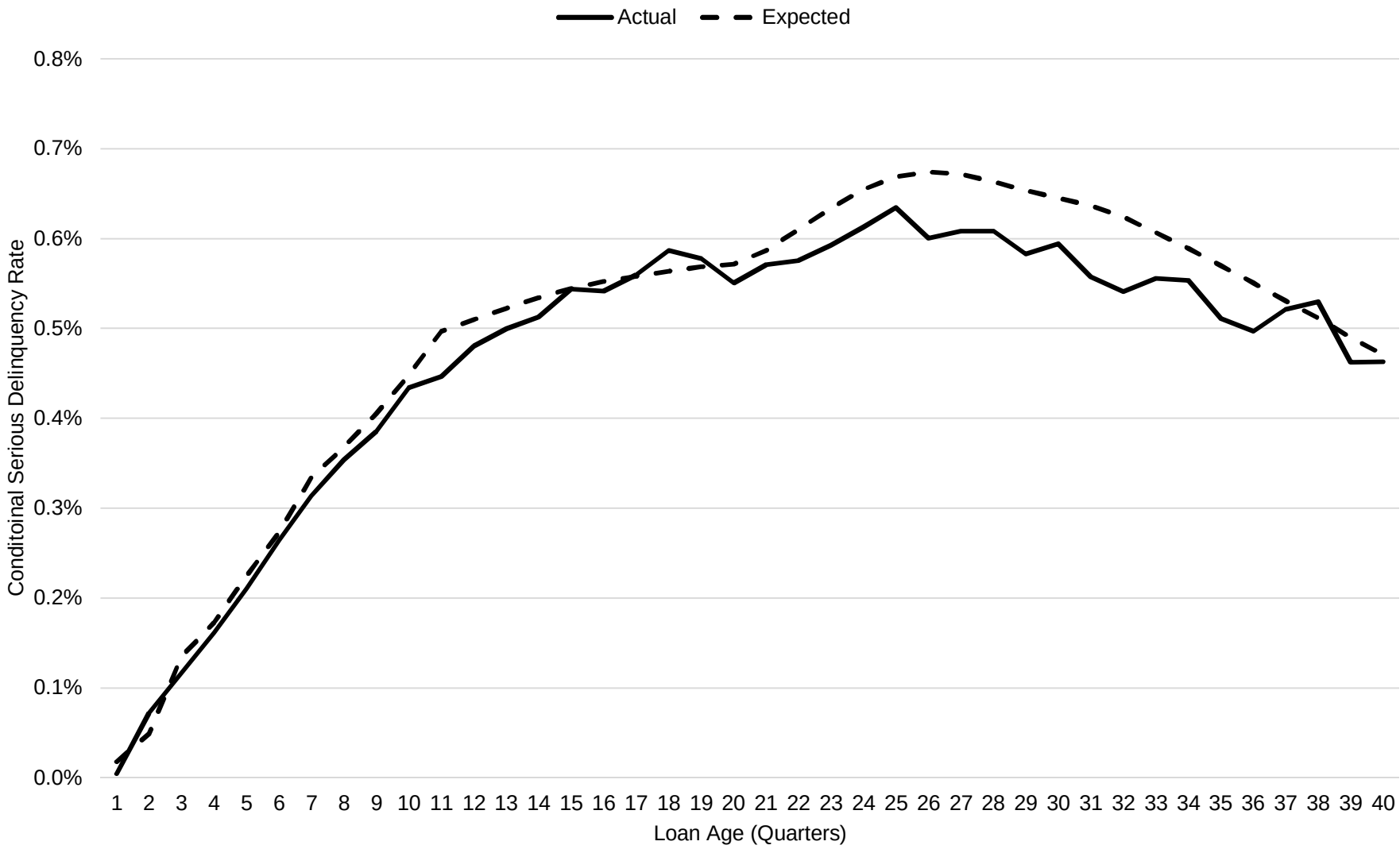
**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Performing Loan Model - Conditional Prepayment Rate**
Out of Sample Testing



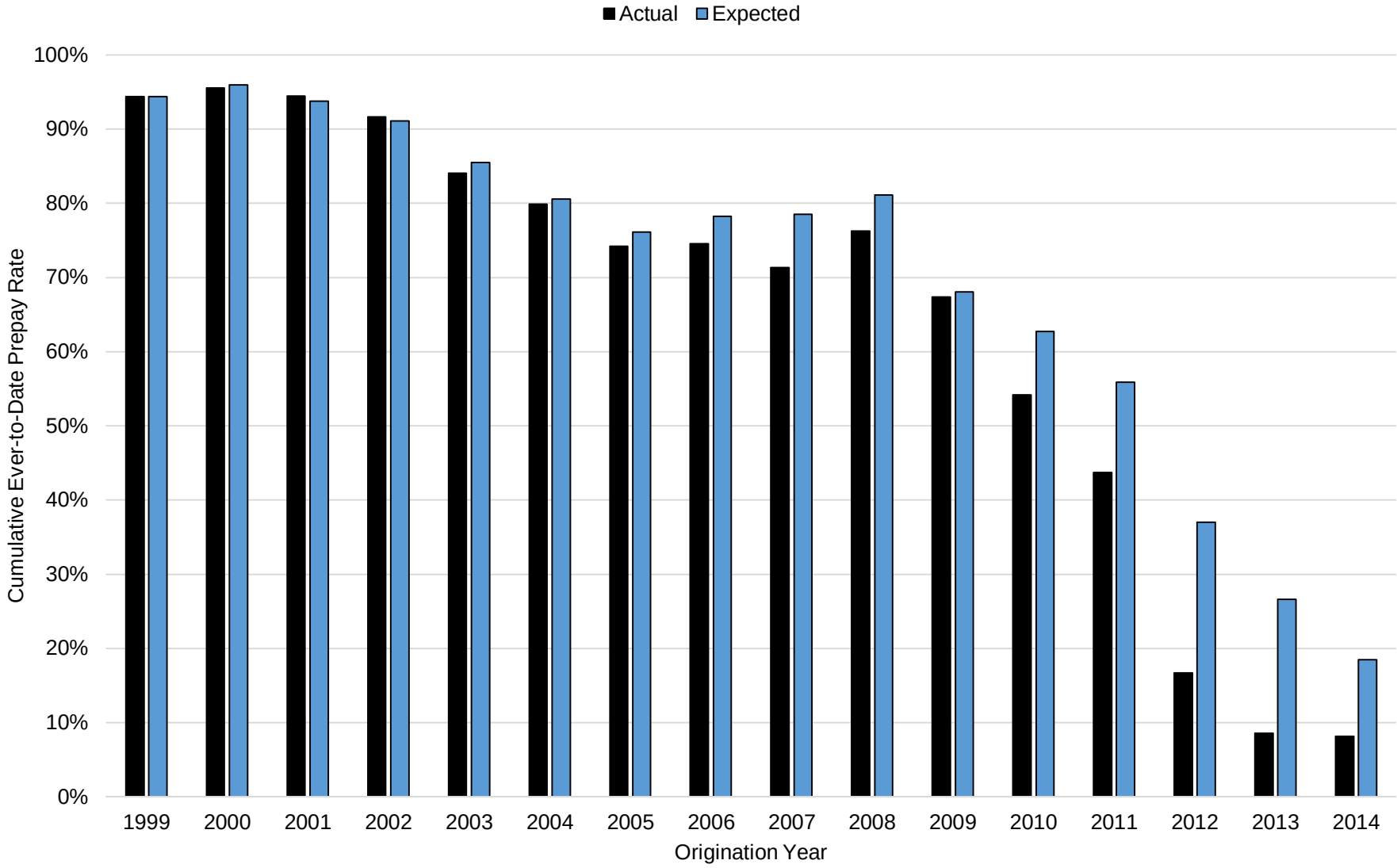
**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Performing Loan Model - Conditional Serious Delinquency Rate**
Out of Sample Testing



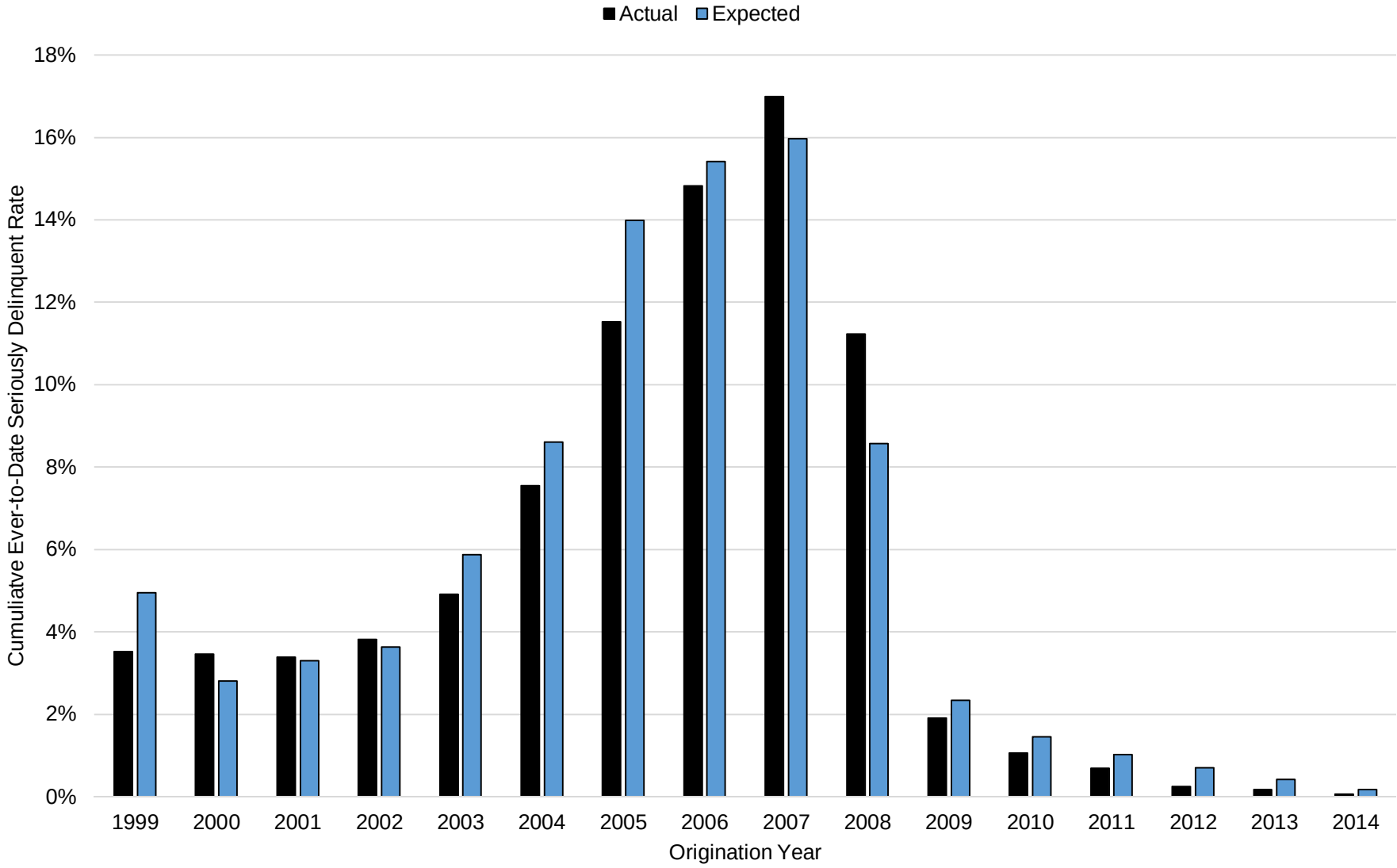
**US Mortgage Insurers**
Deep Coverage Mortgage insurance Analysis

**Performing Loan Model - Cumulative Prepayment Rate**
Out of Sample Testing



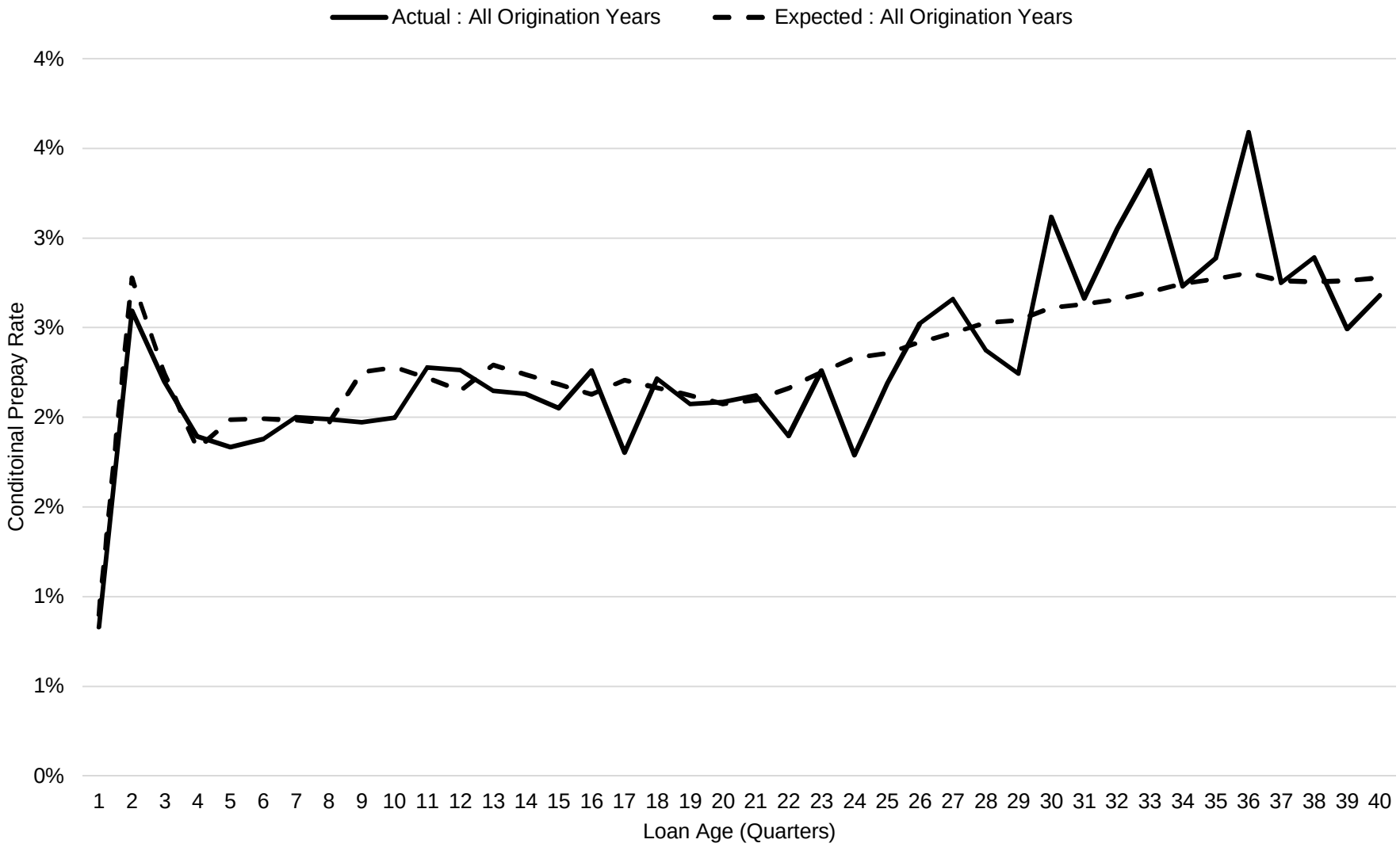
**US Mortgage Insurers**
Deep Coverage Mortgage Insurer Analysis

**Performing Loan Model - Cumulative Seriously Delinquent Rate**
Out of Sample Testing



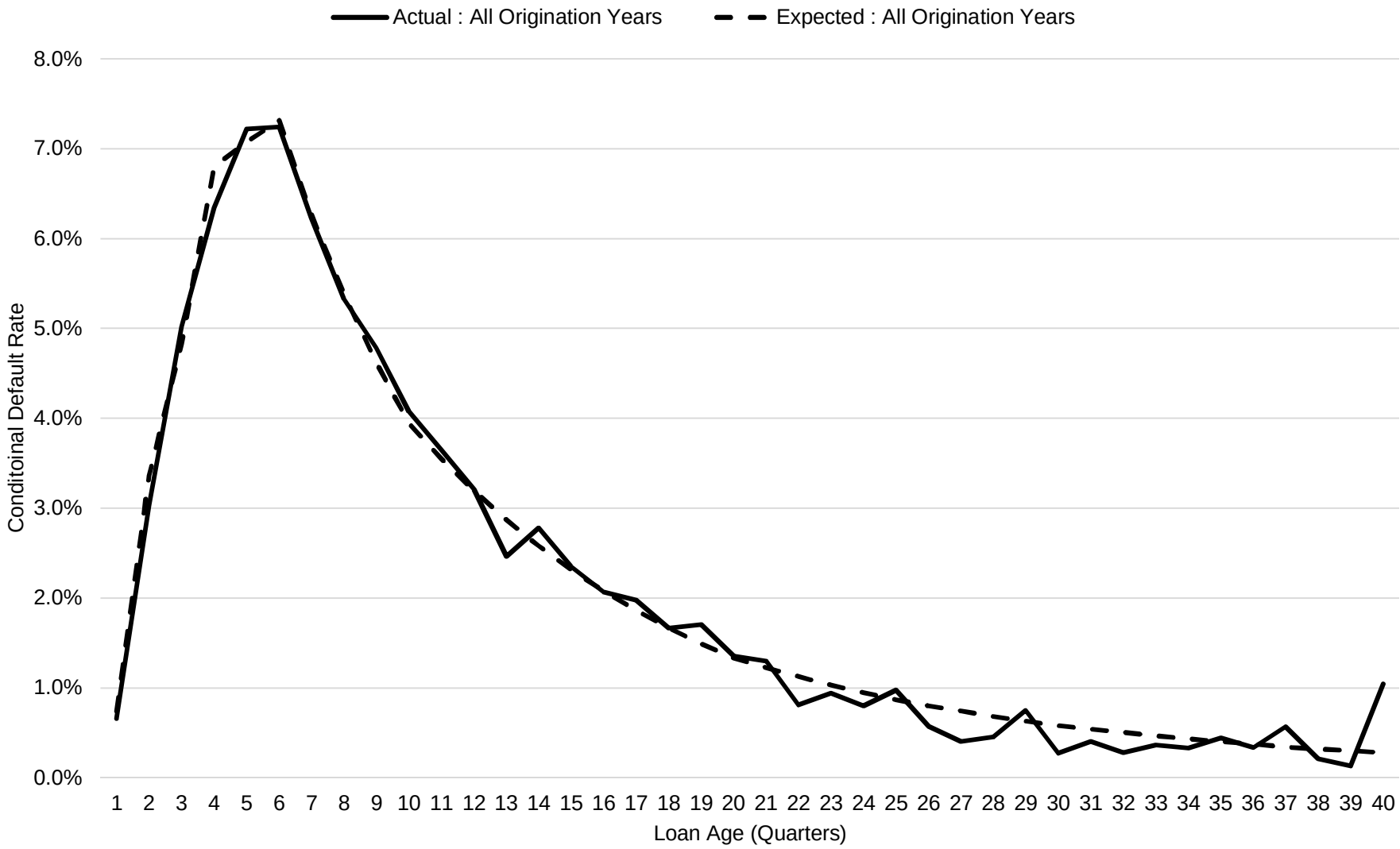
**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Non-Performing Loan Model - Conditional Prepayment Rate (Given Serious Delinquency)**
Out of Sample Testing



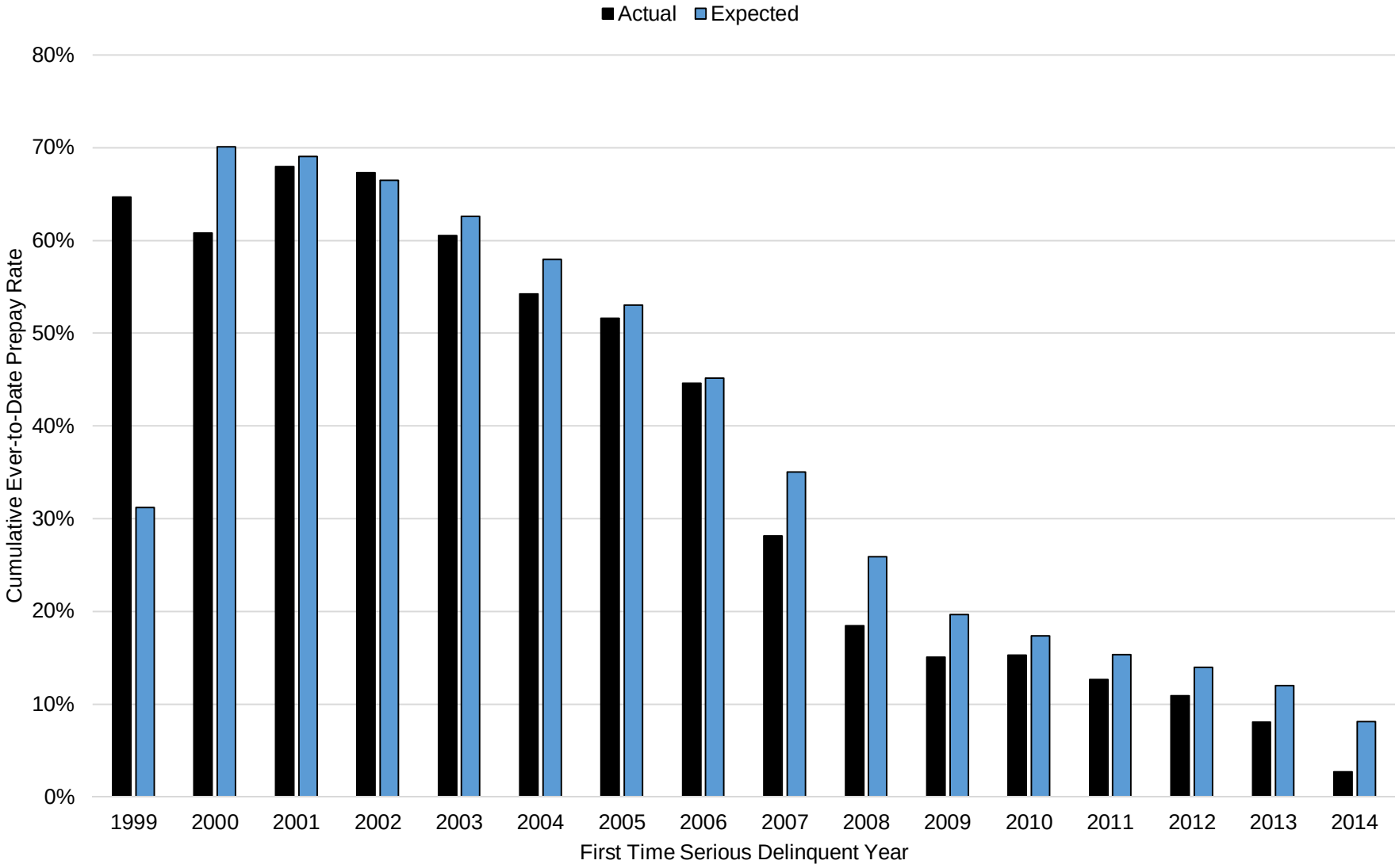
**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Non-Performing Loan Model - Conditional Default Rate (Given Serious Delinquency)**
Out of Sample Testing



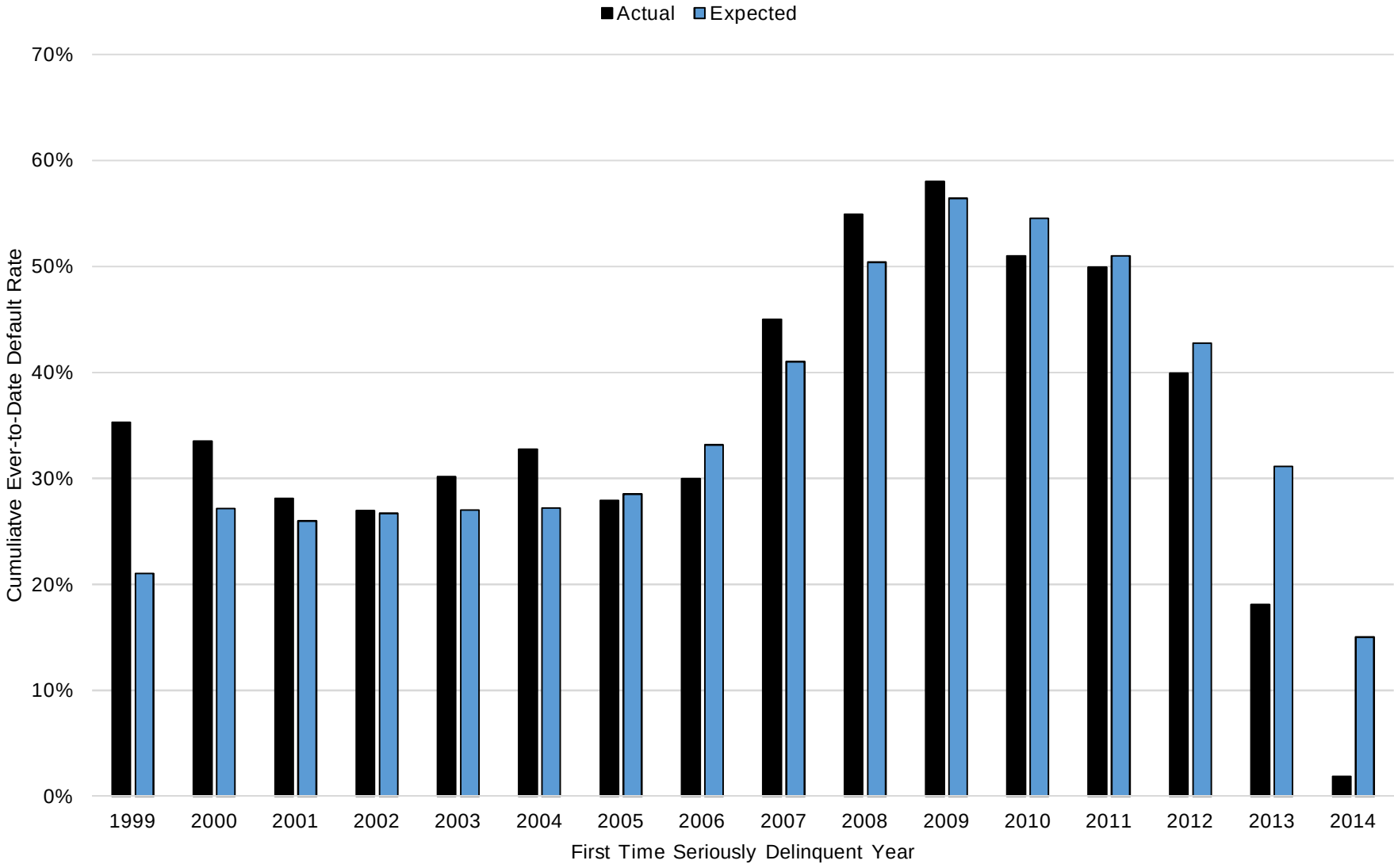
**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analsysi

**Non-Performing Loan Model - Cumulative Prepayment Rate (Given Serious Delinquency)**
Out of Sample Testing



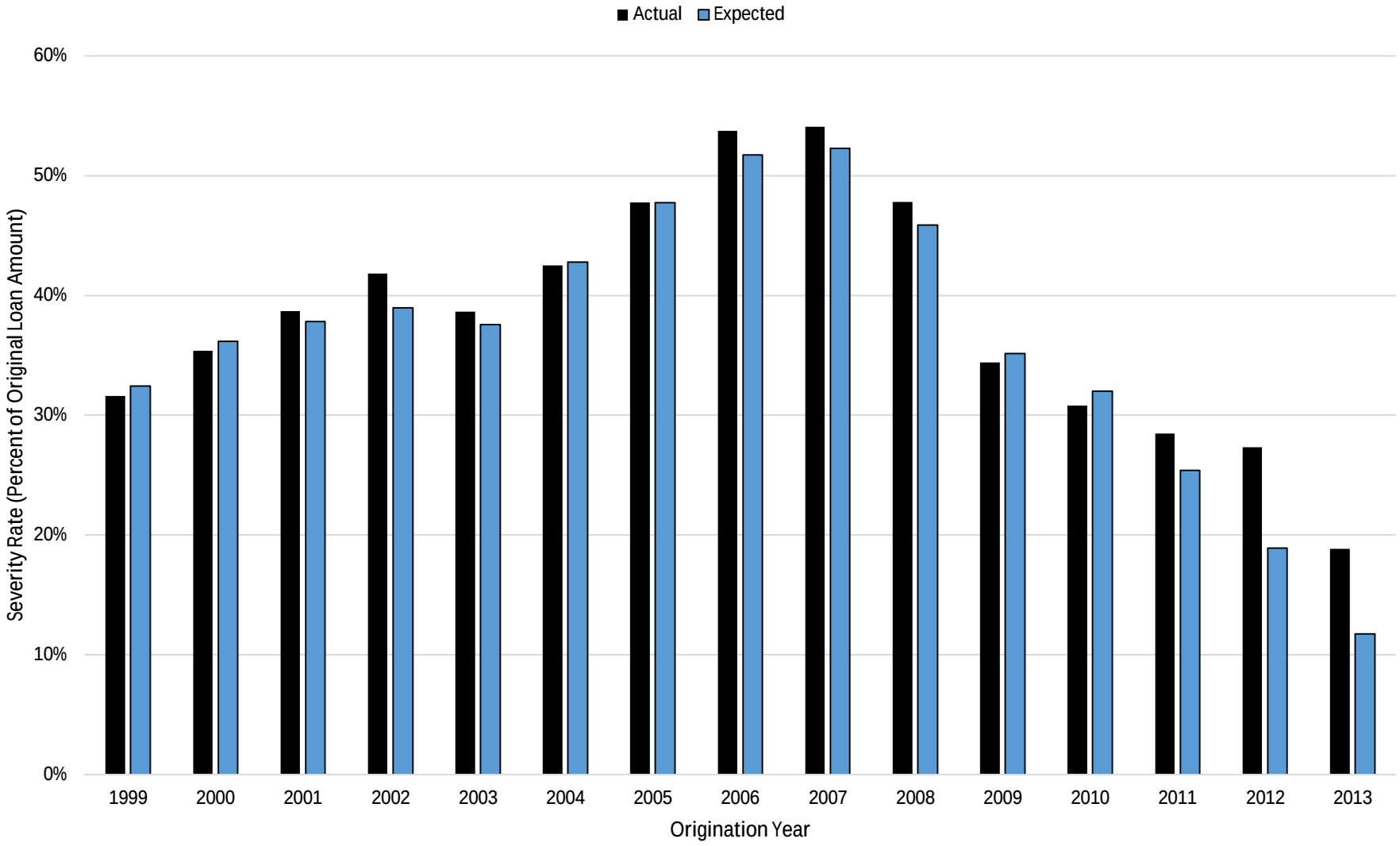
**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Non-Performing Loan Model - Cumulative Default Rate (Given Serious Delinquency)**
Out of Sample Testing



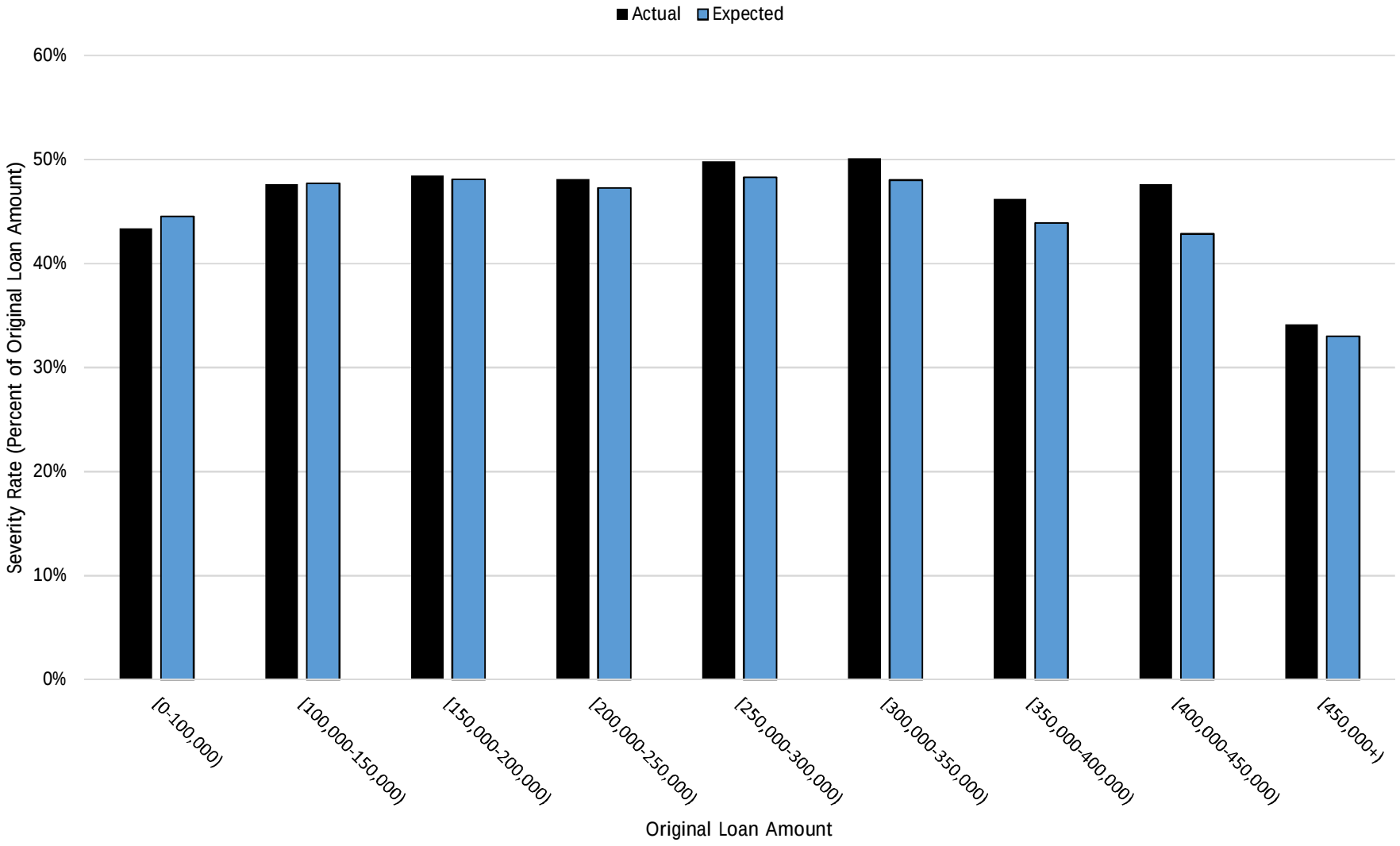
**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Severity Model**
Out of Sample Testing
by Origination Year



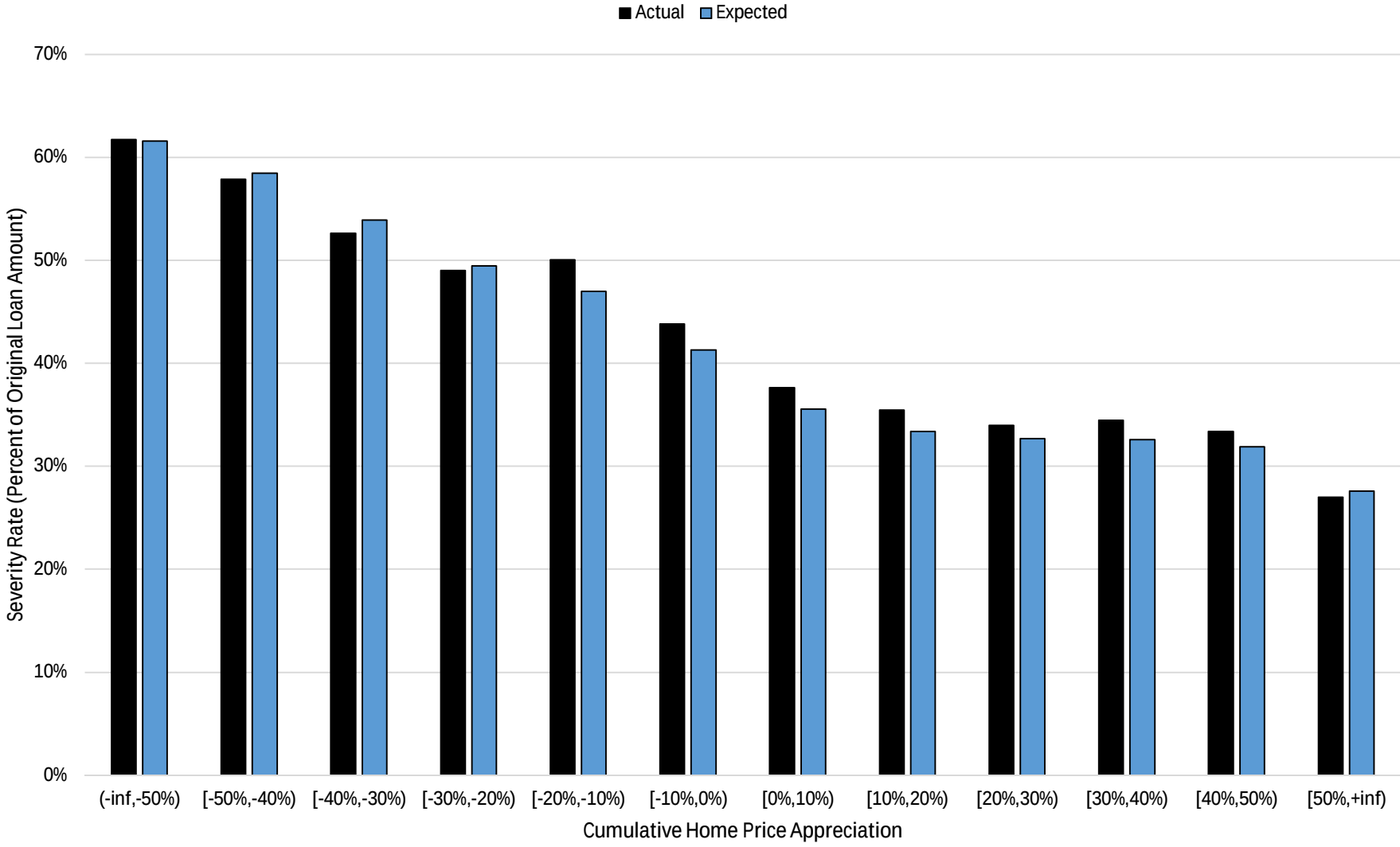
**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Severity Model**
Out of Sample Testing
by Original Loan Amount



**US Mortgage Insurers**
Deep Coverage Mortgage Insurnace Analysis

**Severity Model**
Out of Sample Testing
by Cumulative Home Price Appreciation



**US Mortgage Insurers**

Deep Coverage Mortgage Insurance Analysis

**Summary of Standard Coverage Premium Assumptions**

Modeled Standard Coverage Premium Rates

| Fixed LTV | Standard Coverage | FICO | | | |
|---|---|---|---|---|---|
| | | GE760 | 720-759 | 680-719 | 620-679 |
| **97** | **35%** | 1.05% | 1.10% | 1.31% | 1.48% |
| **95** | **30%** | 0.54% | 0.62% | 0.89% | 1.15% |
| **90** | **25%** | 0.39% | 0.44% | 0.57% | 0.71% |
| **85** | **12%** | 0.23% | 0.27% | 0.33% | 0.39% |

Modeled Standard Coverage Premium Adders

| Risk Factor | GE760 | 720-759 | 680-719 | 620-679 |
|---|---|---|---|---|
| **Investment** | 0.34% | 0.38% | 0.50% | 0.75% |
| **Second** | 0.12% | 0.14% | 0.20% | 0.35% |
| **Rate/Term Refi** | 0.05% | 0.10% | 0.15% | 0.30% |
| **Cash-Out** | 0.18% | 0.20% | 0.25% | 0.50% |
| **Manufactured Housing** | 0.18% | 0.20% | 0.30% | 0.50% |

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**PMIERs Exhibit A Tables Used in Milliman's Analysis**

Table 4: Post June 2012 Vintage, Performing, Non-HARP

| | Original Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **Original LTV** | **<620** | **620-679** | **680-699** | **700-719** | **720-739** | **740-759** | **760-850** |
| **LTV <= 85** | 13.09% | 9.17% | 5.85% | 4.66% | 3.61% | 2.73% | 1.58% |
| **85 < LTV <= 90** | 21.22% | 14.34% | 10.04% | 8.14% | 6.63% | 5.07% | 3.07% |
| **90 < LTV <= 95** | 26.43% | 17.45% | 12.96% | 10.50% | 8.95% | 6.91% | 4.39% |
| **LTV > 95** | 29.07% | 19.20% | 14.25% | 11.55% | 9.84% | 7.60% | 4.83% |

Table 5: Multipliers for Post-2008 Loans with Certain Risk Features

| Risk Feature | Multiplier |
|---|---|
| Non-Full Doc | 3.00 |
| Investment Property | 1.75 |
| DTI >50% | 1.75 |
| Not Fully Amortizing | 2.00 |
| Cash Out Refi | 1.50 |
| 20 Years or Less | 0.50 |
| LPMI (LTV > 90) | 1.10 |
| LPMI (LTV <= 90) | 1.35 |

Table 6: Seasoning Weights for Loans Aged 25 Months or More

| Loan Age | Weight |
|---|---|
| 25-36 | 0.88 |
| 37-48 | 0.81 |
| 49-60 | 0.78 |
| 61+ | 0.73 |

Table 8: Non-Performing Loans

| # Missed Payments | Factor |
|---|---|
| 2 - 3 | 55% |
| 4 - 5 | 69% |
| 6 - 11 | 78% |
| >=12 | 85% |
| Pending Claims | 106% |

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Distribution of Delinquencies by PMIERs Category and Development Quarter**

**Empirical Distribution From GSE Data - Book Years 1999-2014**

| | Development Quarter | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Category** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** |
| 2-3 Missed Payments | 100.0% | 73.9% | 63.9% | 57.7% | 53.9% | 49.5% | 45.8% | 43.1% | 41.2% | 39.0% | 37.4% | 36.1% | 35.1% | 33.9% | 32.8% | 32.1% | 31.5% | 30.9% | 30.2% | 29.7% | 29.6% | 29.3% | 29.0% | 28.8% |
| 4-5 Missed Payments | 0.0% | 21.8% | 19.7% | 19.5% | 19.6% | 19.6% | 19.3% | 18.8% | 18.3% | 17.8% | 17.2% | 16.7% | 16.1% | 15.9% | 15.5% | 14.9% | 14.6% | 14.3% | 14.0% | 13.6% | 13.3% | 13.2% | 13.0% | 12.9% |
| 6-11 Missed Payments | 0.0% | 3.6% | 15.1% | 21.1% | 22.5% | 24.6% | 26.4% | 27.3% | 27.4% | 27.8% | 27.8% | 27.4% | 26.8% | 26.4% | 26.0% | 25.8% | 25.2% | 24.7% | 24.4% | 23.8% | 23.2% | 22.9% | 22.7% | 22.5% |
| 12+ Missed Payments | 0.0% | 0.0% | 0.0% | 0.0% | 2.2% | 4.3% | 6.4% | 8.6% | 10.8% | 13.0% | 15.2% | 17.3% | 19.4% | 21.2% | 22.9% | 24.5% | 25.9% | 27.3% | 28.6% | 30.0% | 31.1% | 31.8% | 32.6% | 33.1% |
| Pending Claims | 0.0% | 0.7% | 1.3% | 1.7% | 1.9% | 2.0% | 2.1% | 2.2% | 2.3% | 2.5% | 2.5% | 2.6% | 2.6% | 2.6% | 2.7% | 2.7% | 2.8% | 2.8% | 2.9% | 2.8% | 2.8% | 2.8% | 2.8% | 2.7% |

**Selected Delinquency Distribution**

| | Development Quarter | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Category** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25+** |
| 2-3 Missed Payments | 100.0% | 75.0% | 65.0% | 57.5% | 52.5% | 50.0% | 45.0% | 42.5% | 40.0% | 40.0% | 37.5% | 35.0% | 35.0% | 35.0% | 35.0% | 32.5% | 32.5% | 30.0% | 30.0% | 30.0% | 30.0% | 30.0% | 30.0% | 30.0% | 30.0% |
| 4-5 Missed Payments | 0.0% | 22.5% | 20.0% | 20.0% | 20.0% | 20.0% | 20.0% | 20.0% | 20.0% | 17.5% | 17.5% | 17.5% | 15.0% | 15.0% | 15.0% | 15.0% | 15.0% | 15.0% | 15.0% | 12.5% | 12.5% | 12.5% | 12.5% | 12.5% | 12.5% |
| 6-11 Missed Payments | 0.0% | 2.5% | 15.0% | 20.0% | 22.5% | 25.0% | 27.5% | 27.5% | 27.5% | 27.5% | 27.5% | 27.5% | 27.5% | 27.5% | 25.0% | 25.0% | 25.0% | 25.0% | 25.0% | 25.0% | 22.5% | 22.5% | 22.5% | 22.5% | 22.5% |
| 12+ Missed Payments | 0.0% | 0.0% | 0.0% | 0.0% | 2.5% | 2.5% | 5.0% | 7.5% | 10.0% | 12.5% | 15.0% | 17.5% | 20.0% | 20.0% | 22.5% | 25.0% | 25.0% | 27.5% | 27.5% | 30.0% | 32.5% | 32.5% | 32.5% | 32.5% | 32.5% |
| Pending Claims | 0.0% | 0.0% | 0.0% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% |

Notes: Used to allocate non-performing loans to categories in FHFA PMIERs Exhibit A Table 8.

**US Mortgage Insurers**

Deep Coverage Mortgage Insurance Analysis

**Portfolio Composition for Model**

Average Composition of Above 80 LTV Loans from 1999-2014 in GSE Loan-Level Data

| Credit | Loan to Value | | | | |
|---|---|---|---|---|---|
| Score | (80,85] | (85,90] | (90,95] | (95,100] | Total |
| [620-639] | 0.5% | 1.3% | 2.2% | 0.3% | **4.4%** |
| [640-659] | 0.8% | 1.9% | 3.2% | 0.5% | **6.3%** |
| [660-679] | 0.9% | 2.4% | 3.5% | 0.6% | **7.4%** |
| [680-699] | 1.2% | 3.3% | 4.4% | 0.8% | **9.6%** |
| [700-719] | 1.3% | 3.3% | 4.7% | 0.7% | **10.0%** |
| [720-739] | 1.5% | 4.3% | 5.0% | 0.8% | **11.6%** |
| [740-850) | 7.0% | 20.8% | 20.7% | 2.3% | **50.8%** |
| **Total** | **13.2%** | **37.2%** | **43.7%** | **5.9%** | **100.0%** |

| DTI | |
|---|---|
| [0,10) | **0.1%** |
| [10-20) | **4.3%** |
| [20-30) | **22.0%** |
| [30-40) | **38.1%** |
| [40-50) | **28.5%** |
| [50-60) | **6.5%** |
| [60-70) | **0.5%** |
| **Total** | **100.0%** |

| Property Type | |
|---|---|
| CONDO | **6.2%** |
| SINGL | **93.3%** |
| 2-4U | **0.5%** |
| **Total** | **100.0%** |

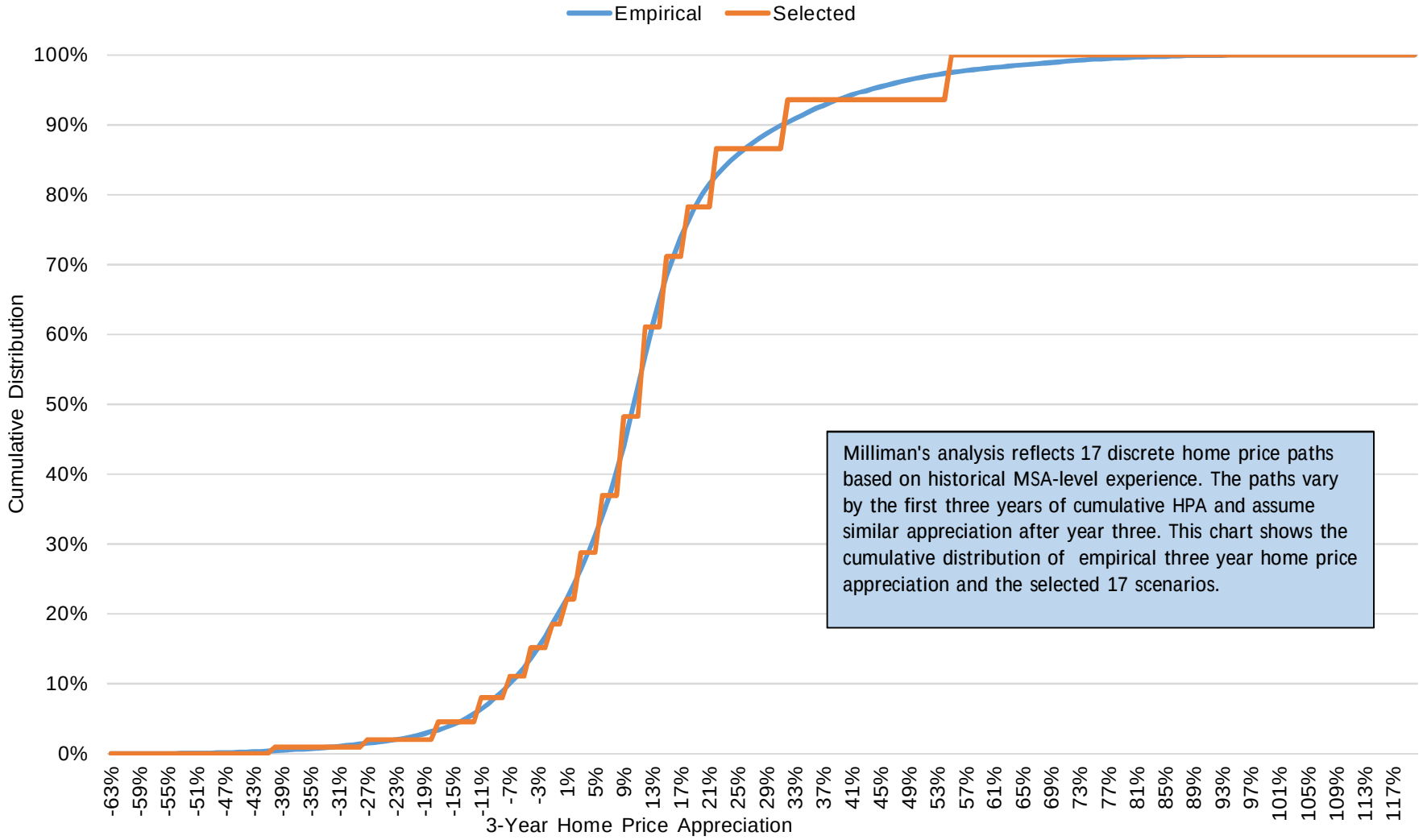
| Loan Purpose | |
|---|---|
| PURCHASE | **75.0%** |
| RATE/TERM | **21.2%** |
| CASHOUT | **3.9%** |
| **Total** | **100.0%** |

| Occupancy | |
|---|---|
| INVESTOR | **0.8%** |
| OWNER | **98.3%** |
| SECOND | **0.8%** |
| **Total** | **100.0%** |

Notes: All loans are fixed rate, 30 year, full amortization, full documentation

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Empirical vs Selected Discrete Cumulative Distributions used to Generate Expected Performance**
Historical 3-Year Cumulative Home Price Appreciation
Based on FHFA All Transaction MSA Data



**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Indicated Portfolio Weighted Scenario Claim Frequency Rates**

A : Expected Whole Loan Default Frequency

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 8.7% | 7.5% | 6.1% | 5.1% | 4.1% | 3.3% | 1.9% |
| **(85,90]** | 9.6% | 8.0% | 7.3% | 5.7% | 4.4% | 3.5% | 2.1% |
| **(90,95]** | 10.9% | 9.5% | 7.9% | 6.3% | 5.3% | 4.1% | 2.5% |
| **(95+)** | 14.3% | 12.6% | 10.6% | 8.7% | 7.3% | 5.8% | 3.5% |

C : Expected Mortgage Insurance Claim Frequency

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 5.5% | 4.7% | 3.7% | 3.1% | 2.4% | 2.0% | 1.1% |
| **(85,90]** | 7.7% | 6.3% | 5.8% | 4.4% | 3.4% | 2.7% | 1.6% |
| **(90,95]** | 9.6% | 8.3% | 6.9% | 5.4% | 4.5% | 3.5% | 2.1% |
| **(95+)** | 13.0% | 11.4% | 9.4% | 7.7% | 6.4% | 5.1% | 3.0% |

B : Stress Whole Loan Default Frequency (CCAR)

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 25.6% | 22.8% | 18.9% | 16.1% | 13.0% | 10.8% | 6.1% |
| **(85,90]** | 27.5% | 23.8% | 22.0% | 17.7% | 13.9% | 11.3% | 6.8% |
| **(90,95]** | 30.2% | 27.0% | 23.3% | 19.0% | 16.2% | 12.7% | 7.8% |
| **(95+)** | 36.8% | 33.5% | 29.1% | 24.8% | 21.0% | 17.1% | 10.5% |

D : Stress Mortgage Insurance Claim Frequency (CCAR)

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 18.1% | 15.7% | 12.7% | 10.5% | 8.3% | 6.8% | 3.8% |
| **(85,90]** | 23.7% | 20.0% | 18.4% | 14.4% | 11.2% | 9.0% | 5.3% |
| **(90,95]** | 27.7% | 24.5% | 20.8% | 16.7% | 14.2% | 11.0% | 6.6% |
| **(95+)** | 34.5% | 31.0% | 26.6% | 22.3% | 18.6% | 15.1% | 9.0% |

Notes: Mortgage insurance estimates reflect cancellation upon amortization to 78% LTV.

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Indicated Portfolio Weighted Scenario Severity Rates (Expressed as a Percent of Coverage)**

A : Expected Whole Loan Severity Rate

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 29.1% | 28.7% | 27.9% | 27.2% | 26.6% | 26.5% | 25.8% |
| **(85,90]** | 29.3% | 28.3% | 28.4% | 27.2% | 26.0% | 25.9% | 25.8% |
| **(90,95]** | 29.6% | 29.0% | 27.9% | 27.1% | 26.5% | 26.1% | 26.2% |
| **(95+)** | 28.8% | 28.1% | 27.3% | 26.7% | 26.1% | 26.0% | 25.5% |

B : Expected Standard Coverage Mortgage Insurance Claim Severity

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 114.2% | 114.1% | 114.1% | 114.1% | 114.1% | 114.0% | 114.0% |
| **(85,90]** | 105.8% | 104.0% | 103.9% | 101.6% | 98.9% | 98.8% | 98.5% |
| **(90,95]** | 95.6% | 94.2% | 91.8% | 90.1% | 88.8% | 87.8% | 88.1% |
| **(95+)** | 84.1% | 82.5% | 81.0% | 79.8% | 78.4% | 78.2% | 77.3% |

C : Expected Deep Coverage Mortgage Insurance Claim Severity

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 78.2% | 77.2% | 75.5% | 73.8% | 72.4% | 72.2% | 70.5% |
| **(85,90]** | 72.1% | 70.3% | 70.3% | 68.0% | 65.4% | 65.3% | 65.1% |
| **(90,95]** | 67.1% | 66.0% | 63.9% | 62.5% | 61.4% | 60.6% | 61.0% |
| **(95+)** | 63.4% | 62.2% | 61.0% | 60.1% | 59.0% | 58.9% | 58.3% |

D : Stress Whole Loan Severity Rate

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 43.9% | 43.2% | 42.0% | 41.0% | 40.1% | 39.9% | 38.7% |
| **(85,90]** | 44.2% | 42.8% | 42.7% | 41.1% | 39.6% | 39.3% | 38.8% |
| **(90,95]** | 44.7% | 43.8% | 42.4% | 41.2% | 40.4% | 39.7% | 39.4% |
| **(95+)** | 44.5% | 43.5% | 42.3% | 41.3% | 40.4% | 40.0% | 39.0% |

E : Stress Standard Coverage Mortgage Insurance Claim Severity

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 112.7% | 112.7% | 112.7% | 112.7% | 112.7% | 112.6% | 112.6% |
| **(85,90]** | 111.9% | 111.8% | 111.7% | 111.6% | 111.5% | 111.5% | 111.3% |
| **(90,95]** | 111.3% | 111.1% | 110.9% | 110.6% | 110.5% | 110.4% | 110.2% |
| **(95+)** | 110.3% | 109.9% | 109.4% | 109.1% | 108.7% | 108.5% | 108.2% |

F : Stress Deep Coverage Mortgage Insurance Claim Severity

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 107.8% | 107.4% | 106.6% | 105.8% | 105.0% | 104.8% | 103.9% |
| **(85,90]** | 103.6% | 102.2% | 101.9% | 100.1% | 97.8% | 97.8% | 97.5% |
| **(90,95]** | 98.7% | 97.5% | 95.3% | 93.8% | 92.5% | 91.5% | 91.8% |
| **(95+)** | 95.6% | 94.1% | 92.6% | 91.4% | 90.1% | 89.8% | 88.9% |

Notes: Mortgage insurance estimates reflect cancellation upon amortization to 78% LTV.

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Indicated Portfolio Weighted Scenario Loss Rates and Implied Economic Capital**

A : Expected Standard Coverage Mortgage Insurance Loss Rate

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 6.2% | 5.3% | 4.2% | 3.5% | 2.8% | 2.3% | 1.2% |
| **(85,90]** | 8.2% | 6.6% | 6.0% | 4.5% | 3.3% | 2.7% | 1.6% |
| **(90,95]** | 9.2% | 7.8% | 6.3% | 4.9% | 4.0% | 3.0% | 1.8% |
| **(95+)** | 10.9% | 9.4% | 7.6% | 6.2% | 5.0% | 4.0% | 2.3% |

D : Expected Deep Coverage Mortgage Insurance Loss Rate

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 4.3% | 3.6% | 2.8% | 2.3% | 1.8% | 1.4% | 0.8% |
| **(85,90]** | 5.6% | 4.4% | 4.1% | 3.0% | 2.2% | 1.8% | 1.0% |
| **(90,95]** | 6.4% | 5.5% | 4.4% | 3.4% | 2.8% | 2.1% | 1.3% |
| **(95+)** | 8.2% | 7.1% | 5.7% | 4.6% | 3.8% | 3.0% | 1.7% |

B : Stress Standard Coverage Mortgage Insurance Loss Rate

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 20.4% | 17.7% | 14.3% | 11.9% | 9.4% | 7.7% | 4.2% |
| **(85,90]** | 26.5% | 22.4% | 20.6% | 16.1% | 12.5% | 10.0% | 5.9% |
| **(90,95]** | 30.8% | 27.2% | 23.1% | 18.5% | 15.6% | 12.2% | 7.3% |
| **(95+)** | 38.0% | 34.1% | 29.1% | 24.3% | 20.3% | 16.4% | 9.8% |

E : Stress Deep Coverage Mortgage Insurance Loss Rate

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 19.5% | 16.9% | 13.5% | 11.2% | 8.8% | 7.2% | 3.9% |
| **(85,90]** | 24.6% | 20.5% | 18.8% | 14.5% | 11.0% | 8.8% | 5.2% |
| **(90,95]** | 27.4% | 23.9% | 19.8% | 15.7% | 13.1% | 10.1% | 6.1% |
| **(95+)** | 32.9% | 29.2% | 24.6% | 20.4% | 16.8% | 13.5% | 8.0% |

C = B - A : Implied Standard Coverage Mortgage Insurance Economic Capital

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 14.2% | 12.4% | 10.0% | 8.4% | 6.6% | 5.4% | 3.0% |
| **(85,90]** | 18.4% | 15.8% | 14.5% | 11.6% | 9.2% | 7.4% | 4.3% |
| **(90,95]** | 21.6% | 19.4% | 16.7% | 13.7% | 11.6% | 9.1% | 5.4% |
| **(95+)** | 27.1% | 24.7% | 21.4% | 18.2% | 15.3% | 12.4% | 7.5% |

F = E - D : Implied Deep Coverage Mortgage Insurance Economic Capital

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 15.3% | 13.3% | 10.7% | 8.9% | 7.0% | 5.7% | 3.1% |
| **(85,90]** | 19.0% | 16.0% | 14.7% | 11.4% | 8.8% | 7.0% | 4.1% |
| **(90,95]** | 20.9% | 18.4% | 15.4% | 12.3% | 10.3% | 8.0% | 4.8% |
| **(95+)** | 24.7% | 22.1% | 18.9% | 15.8% | 13.0% | 10.6% | 6.3% |

Notes: Mortgage insurance estimates reflect cancellation upon amortization to 78% LTV.

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Estimated Portfolio Weighted Capital at Origination**
Expressed as a Percentage of Risk Originated

A : Estimated FHFA PMIERs Required Asset Factor

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 10.4% | 10.7% | 10.4% | 6.8% | 5.1% | 4.1% | 3.0% |
| **(85,90]** | 16.2% | 15.4% | 16.8% | 11.5% | 9.0% | 7.0% | 5.5% |
| **(90,95]** | 18.9% | 19.1% | 19.4% | 13.9% | 11.3% | 9.4% | 7.2% |
| **(95+)** | 21.2% | 21.9% | 21.2% | 15.4% | 11.6% | 9.8% | 7.6% |

B : Indicated Economic Capital Relativity (Deep Coverage / Standard Coverage)

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 107% | 107% | 107% | 106% | 106% | 106% | 105% |
| **(85,90]** | 103% | 101% | 101% | 98% | 96% | 96% | 95% |
| **(90,95]** | 97% | 95% | 92% | 90% | 89% | 87% | 88% |
| **(95+)** | 91% | 90% | 88% | 87% | 85% | 85% | 84% |

C = A x B : Estimated Required Asset Factor for Deep Coverage Mortgage Insurance

| | Credit Score | | | | | | |
|---|---|---|---|---|---|---|---|
| **LTV** | **[620-639]** | **[640-659]** | **[660-679]** | **[680-699]** | **[700-719]** | **[720-739]** | **[740-850)** |
| **(80,85]** | 11.2% | 11.4% | 11.0% | 7.2% | 5.4% | 4.4% | 3.1% |
| **(85,90]** | 16.8% | 15.6% | 17.0% | 11.3% | 8.6% | 6.7% | 5.2% |
| **(90,95]** | 18.2% | 18.1% | 17.9% | 12.5% | 10.0% | 8.2% | 6.3% |
| **(95+)** | 19.4% | 19.6% | 18.7% | 13.4% | 9.9% | 8.4% | 6.4% |

Notes: Required asset factors reflect multipliers for portfolio risk factors.
Indicated economic capital relativity is coverage adjusted and calculated from the implied economic capital on the prior exhibit.

**US Mortgage Insurers**

Deep Coverage Mortgage Insurance Analysis

**Summary of Portfolio Analysis Premium Indication**

| | | |
|---|---|---|
| A | Assumed Weighted Average Primary Coverage | 26% |
| B | Assumed Weighted Average Deep Coverage | 46% |
| C = B - A | Difference (Additional Coverage Layer) | 19% |
| | | |
| D | Cumulative Premium (bp) | 90 |
| E | Cumulative Loss and LAE (bp) | 15 |
| F | Cumulative Premium Tax Expense (bp) | 2 |
| G | Cumulative Investment Income (bp) | 28 |
| H | Cumulative Federal Income Tax (bp) | 35 |
| I = D - E - F + G - H | Cumulative Net Income (bp) | 66 |
| J | Cumulative Average Capital (bp) | 656 |
| K = I / J | Indicated Cumulative Return on Average Capital | 10% |
| | | |
| L | Estimated Premium Duration | 5 |
| M = D / L | Indicated Additional Annual Premium Rate (bp) | 18 |
| | | |
| N | Assumed Portfolio Volume in Pro-Forma | $1,000,000,000 |

Notes: Estimated premium duration based on model indicated primary MI premium duration. Annual premium rate assumes non-declining premium structure.

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Mortgage Insurer Pro Forma Income Statement - Additional Coverage Layer**
Assumes $1 Billion of Loan Originations (Dollars in Thousands)

| | *Year* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Item** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| Net Written Premium | 1,770 | 1,516 | 1,239 | 1,022 | 863 | 717 | 599 | 526 | 351 | 275 | 148 | 11 |
| Decrease in Unearned Premium Reserve | (71) | 12 | 11 | 8 | 6 | 7 | 3 | 3 | 9 | 1 | 9 | 2 |
| Net Earned Premium | 1,699 | 1,528 | 1,250 | 1,030 | 869 | 724 | 603 | 529 | 359 | 276 | 157 | 13 |
| Commissions and Other Revenue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Underwriting Revenues** | **1,699** | **1,528** | **1,250** | **1,030** | **869** | **724** | **603** | **529** | **359** | **276** | **157** | **13** |
| | | | | | | | | | | | | |
| Net Incurred Losses | 33 | 139 | 328 | 333 | 248 | 162 | 100 | 73 | 31 | 16 | 7 | 0 |
| Incurred ULAE | 1 | 3 | 7 | 7 | 5 | 3 | 2 | 1 | 1 | 0 | 0 | 0 |
| Other Expenses | 40 | 34 | 28 | 23 | 19 | 16 | 13 | 12 | 8 | 6 | 3 | 0 |
| **Total Underwriting Expenses** | **73** | **176** | **362** | **363** | **272** | **181** | **115** | **86** | **39** | **23** | **10** | **0** |
| | | | | | | | | | | | | |
| Underwriting Income | 1,626 | 1,352 | 888 | 668 | 597 | 543 | 488 | 442 | 320 | 254 | 147 | 12 |
| Investment Income | 531 | 493 | 441 | 343 | 266 | 212 | 146 | 126 | 106 | 51 | 43 | 3 |
| Other Income (Expenses) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pre-Tax Net Income | 2,157 | 1,846 | 1,329 | 1,011 | 863 | 755 | 634 | 568 | 426 | 305 | 189 | 15 |
| Federal Tax Incurred | 755 | 646 | 465 | 354 | 302 | 264 | 222 | 199 | 149 | 107 | 66 | 5 |
| **Net Income** | **1,402** | **1,200** | **864** | **657** | **561** | **491** | **412** | **369** | **277** | **198** | **123** | **10** |

Notes: Incurred ULAE is assumed to be 2% of direct incurred losses
Assuming only incremental other expenses are premium tax estimated as 2.25% of written premium.

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Mortgage Insurer Pro Forma Balance Sheet - Additional Coverage Layer**
Assumes $1 Billion of Loan Originations (Dollars in Thousands)

| | *Year-End* | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Item** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **Assets** | **14,307** | **13,362** | **12,046** | **9,422** | **7,359** | **5,899** | **3,966** | **3,395** | **2,917** | **1,352** | **1,162** | **86** | **0** |
| Unearned Premium Reserve | 0 | 71 | 58 | 48 | 40 | 34 | 27 | 24 | 21 | 12 | 11 | 2 | 0 |
| Loss Reserve | 0 | 33 | 168 | 424 | 529 | 408 | 211 | 163 | 122 | 41 | 27 | 2 | (0) |
| **Liabilities** | **0** | **104** | **226** | **472** | **569** | **442** | **238** | **187** | **143** | **53** | **38** | **4** | **(0)** |
| **Surplus** | **14,307** | **13,258** | **11,820** | **8,950** | **6,791** | **5,457** | **3,727** | **3,208** | **2,774** | **1,298** | **1,123** | **82** | **0** |
| **Minimum Required Assets** | 14,307 | 13,291 | 11,988 | 9,374 | 7,319 | 5,865 | 3,938 | 3,371 | 2,896 | 1,339 | 1,151 | 84 | 0 |
| **Risk in Force** | 194,474 | 173,934 | 140,379 | 112,781 | 92,442 | 77,661 | 53,185 | 45,533 | 39,122 | 18,060 | 15,565 | 1,380 | 0 |
| **Implied Risk to Capital Ratio** | 13.6 | 13.1 | 11.9 | 12.6 | 13.6 | 14.2 | 14.3 | 14.2 | 14.1 | 13.9 | 13.9 | 16.8 | 0.0 |

Notes: Minimum Required Assets calculated as a percentage of PMIERs indicated required assets based on relativity of indicated required Economic Capital.
Contingency reserve not reflected in return calculations.

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Mortgage Insurer Pro Forma Statement of Cash Flows - Additional Coverage Layer**
Assumes $1 Billion of Loan Originations (Dollars in Thousands)

| | *Year* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Item** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| Beginning Assets | 14,307 | 13,362 | 12,046 | 9,422 | 7,359 | 5,899 | 3,966 | 3,395 | 2,917 | 1,352 | 1,162 | 86 |
| Net Written Premium | 1,770 | 1,516 | 1,239 | 1,022 | 863 | 717 | 599 | 526 | 351 | 275 | 148 | 11 |
| Net Paid Losses | 0 | 7 | 76 | 231 | 366 | 356 | 146 | 114 | 110 | 30 | 32 | 2 |
| Paid ULAE | 0 | 0 | 2 | 5 | 7 | 7 | 3 | 2 | 2 | 1 | 1 | 0 |
| Underwriting Expenses | 40 | 34 | 28 | 23 | 19 | 16 | 13 | 12 | 8 | 6 | 3 | 0 |
| **Cash Underwriting Expenses** | **40** | **34** | **29** | **28** | **27** | **23** | **16** | **14** | **10** | **7** | **4** | **0** |
| Net Underwriting Cash Flow | 1,730 | 1,475 | 1,133 | 764 | 471 | 338 | 437 | 398 | 231 | 239 | 112 | 9 |
| Other Income (Expenses) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Investment Income | 531 | 493 | 441 | 343 | 266 | 212 | 146 | 126 | 106 | 51 | 43 | 3 |
| Federal Income Tax Incurred | 755 | 646 | 465 | 354 | 302 | 264 | 222 | 199 | 149 | 107 | 66 | 5 |
| Capital Contribution/(Release) | (2,451) | (2,637) | (3,734) | (2,816) | (1,895) | (2,220) | (932) | (803) | (1,752) | (373) | (1,165) | (92) |
| Ending Assets | 13,362 | 12,046 | 9,422 | 7,359 | 5,899 | 3,966 | 3,395 | 2,917 | 1,352 | 1,162 | 86 | 0 |

Notes: Paid ULAE is assumed to be 2% of direct paid losses

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Mortgage Insurer Return Calculations - Additional Coverage Layer**
Assumes $1 Billion of Loan Originations (Dollars in Thousands)

| | *Year* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Item** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| Net Income | 1,402 | 1,200 | 864 | 657 | 561 | 491 | 412 | 369 | 277 | 198 | 123 | 10 |
| Cumulative Net Income | 1,402 | 2,602 | 3,466 | 4,123 | 4,684 | 5,174 | 5,587 | 5,956 | 6,233 | 6,431 | 6,554 | 6,564 |
| | | | | | | | | | | | | |
| Average Capital | 13,782 | 12,539 | 10,385 | 7,870 | 6,124 | 4,592 | 3,467 | 2,991 | 2,036 | 1,211 | 603 | 41 |
| Cumulative Average Capital | 13,782 | 26,321 | 36,706 | 44,576 | 50,700 | 55,292 | 58,759 | 61,750 | 63,786 | 64,997 | 65,600 | 65,641 |
| | | | | | | | | | | | | |
| Single Period Return | 10.2% | 9.6% | 8.3% | 8.3% | 9.2% | 10.7% | 11.9% | 12.4% | 13.6% | 16.4% | 20.4% | 24.2% |
| Cumulative Return | 10.2% | 9.9% | 9.4% | 9.2% | 9.2% | 9.4% | 9.5% | 9.6% | 9.8% | 9.9% | 10.0% | 10.0% |

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Summary of Estimated Portfolio G-Fee Components**

| | FICO Score | 620-699 | 700-739 | 740+ | All |
|---|---|---|---|---|---|
| A | Assumed Loan Portfolio Distribution in Milliman's Analysis | 27.6% | 21.6% | 50.8% | 100.0% |
| B | GSE Estimated G-Fee Cost (bp) | 152 | 112 | 73 | 103 |
| C | GSE Estimated Amount of Capital (bp) | 712 | 520 | 320 | 472 |
| D | Required After-Tax Return on Capital | 10.8% | 10.8% | 10.8% | 10.8% |
| E = (1/.65)*C*D | Implied G-Fee Amount Required for After-Tax Return on Capital (bp) | 118 | 86 | 53 | 78 |
| F | Estimated G-Fee Amount To Cover General and Administrative Expenses (bp) | 7 | 7 | 7 | 7 |
| G | G-Fee Amount to Cover TCCA Payment to Department of Treasury (bp) | 10 | 10 | 10 | 10 |
| H=B-(E+F+G) | Implied G-Fee Amount to Cover Expected Credit Related Losses (bp) | 17 | 9 | 3 | 8 |
| I | GSE Reported Charged G-Fee (bp) | 80 | 64 | 56 | 64 |
| J = I-(F+G+H) | Implied G-Fee Related to Unexpected Credit Related Losses in Charged G-Fee (bp) | 46 | 38 | 36 | 39 |

Notes: Based on June 5, 2014 FHFA: Fannie Mae and Freddie Mac Guarantee Fees: Request for Input (RFI)
(A) Assumed portfolio distribution by FICO score as reflected in Milliman's analysis.
(B) From Figure 3 of RFI
(C) From Figure 3 of RFI
(D) Selected based on overall portfolio implied return on capital
(F) From Figure 2 of RFI
(G) From Figure 2 of RFI
(I) From Figure 3 of RFI

**US Mortgage Insurers**
Deep Coverage Mortgage Insurance Analysis

**Derivation of Implied Return on Capital in GSE G-Fee Analysis**

| | LTV | <60 | | | 61-80 | | | 81-97 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Credit Score** | **620-699** | **700-739** | **740+** | **620-699** | **700-739** | **740+** | **620-699** | **700-739** | **740+** | **All** |
| A | GSE Indicated Portfolio Distribution | 3.3% | 3.2% | 12.2% | 9.8% | 11.6% | 36.5% | 3.3% | 5.5% | 14.6% | 100.0% |
| B | GSE Estimated G-Fee Cost (bp) | 50 | 36 | 29 | 139 | 89 | 54 | 152 | 112 | 73 | 72 |
| C | GSE Estimated Amount of Capital (bp) | 182 | 118 | 83 | 642 | 392 | 218 | 712 | 520 | 320 | 307 |
| D | Estimated G-Fee Amount To Cover General and Administrative Expenses (bp) | | | | | | | | | | 7 |
| E | G-Fee Amount to Cover TCCA Payment to Department of Treasury (bp) | | | | | | | | | | 10 |
| F | GSE Reported G-Fee Amount to Cover Expected Credit Related Losses (bp) | | | | | | | | | | 4 |
| G = B-(D+E+F) | Implied G-Fee Amount Required for After-Tax Return on Capital (bp) | | | | | | | | | | 51 |
| H = .65*G/C | Implied Return on Capital | | | | | | | | | | 10.8% |

Notes: Based on June 5, 2014 FHFA: Fannie Mae and Freddie Mac Guarantee Fees: Request for Input (RFI)
(A) From Figure 3 of RFI
(B) From Figure 3 of RFI, Total based on Portfolio Distribution in (A)
(C) From Figure 3 of RFI, Total based on Portfolio Distribution in (A)
(D) From Figure 2 of RFI
(E) From Figure 2 of RFI
(F) From Figure 2 of RFI

**US Mortgage Insurers**

Deep Coverage Mortgage Insurance Analysis

**Summary of Estimated GSE Expected and Unexpected Retained Losses**

(Cumulative bps)

| | Item | Expected Losses | Stress Losses | Unexpected Losses |
|---|---|---|---|---|
| A | Standard Coverage Mortgage Insurance | 89 | 329 | 240 |
| B | Additional Coverage under Deep Coverage Mortgage Insurance | 15 | 153 | 138 |
| C | Excess Losses before Mortgage Insurance Cancellation | 1 | 4 | 3 |
| D | Losses after Mortgage Insurance Cancellation | 12 | 50 | 38 |
| E = SUM(A:D) | Total | 116 | 535 | 419 |
| F = SUM(B:D) | Original GSE Coverage Layer | 28 | 206 | 179 |
| G = (C+D) / F | Percentage of Original Coverage Layer Retained | 47% | 26% | 23% |
| **H** | **Assumed GSE Retained G-Fee Costs** | **50%** | | **25%** |