An Actuarial Review for Fiscal Year 1992 of the Federal Housing Administration's Mutual Mortgage Insurance Fund

Final Report

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Price Waterhouse

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July 9, 1993

Ms. Eleanor Clark
Housing - FHA Comptroller
Department of Housing and Urban Development
Washington, DC 20410

Dear Ms. Clark:

We are pleased to present this final report of our review of the soundness of FHA's Mutual Mortgage Insurance Fund. This report presents an independent evaluation of the Fund's economic net worth through the end of fiscal year 1992, as required by the Cranston-Gonzalez National Affordable Housing Act (NAHA). The report presents our view of the actuarial position of the Fund, based on information supplied by the Department of Housing and Urban Development regarding the characteristics and the historical performance of the existing MMI Fund loan portfolio.

We find that the economic value of the Fund has increased by $2.1 billion since the end of FY 1991 and is currently $1.4 billion. The capital ratio, which expresses economic value as a percentage of insurance-in-force is 0.43 percent, increasing from the estimate of -0.20 percent in our FY 1991 Review. Both the economic value and capital ratio are stated as of the end of fiscal year 1992.

The Fund does not meet the FY 1992 capital ratio target established by the NAHA. However, we project that it will meet the FY 2000 target with a capital ratio of 2.44 percent if the U.S. economy recovers as predicted in the baseline forecast. In the event of a prolonged downturn, the Fund may be unable to reach the FY 2000 target.

Our analysis depends on the quality of data provided to us by FHA and the forecasts of economic conditions available from various organizations. The analysis was conducted using economic models that are by their nature subject to some degree of error and may not exactly predict future behavior. These limitations are addressed in the technical appendices.

If you have any questions about this report, please call Mr. Barry Dennis or Dr. LaVaughn Henry at (202) 296-0800.

Very truly yours,

Price Waterhouse

Table of Contents

Executive Summary

The Cranston-Gonzalez National Affordable Housing Act (NAHA) requires an independent actuarial analysis of the economic net worth and soundness of the FHA's Mutual Mortgage Insurance Fund. This report presents our findings with respect to this required analysis for Fiscal Year 1992.

The purpose of our review was to estimate:

- The economic value of the MMI Fund, defined as the sum of existing capital plus the net present value of current books of business
- The current and projected capital ratio, defined as the economic value divided by the total insurance-in-force

Under the base case scenario, the economic value of the MMI Fund as of the end of FY 1992 is $1,405 million, producing a current capital ratio of 0.43 percent. The FY 1992 book itself is projected to contribute $923 million to the economic value of the Fund, in present value terms, measured to the end of FY 1992. The FY 2000 capital ratio is projected to be 2.44 percent.

These values depend on the future experience of the MMI Fund. The most important factors that will influence the ultimate economic value of the Fund are the following:

- U.S. macroeconomic conditions
- Household choices and perceptions of net equity holdings
- FHA premiums and risk management practices

Impact of Economic Forecasts

The economic value of the Fund and its pattern of capital accumulation to FY 2000 depends on several factors. One of the most important is the nation's future economy during the remaining lifetime of FHA's books of business. We capture the most significant factors in the U.S. economy affecting the performance of the Fund's books of business through the use of the following variables:

- FHA mortgage interest rate
- Growth rate of constant quality house prices
- Growth rate of median household incomes

The performance of FHA's books of business, measured by their economic values, are affected by changes in these variables. Interest rates affect initial and ongoing payment burdens on household cash flows, and hence default risks. Interest rates also affect the potential for prepayments due to refinancing as prevailing interest rates change during the lifetime of each book. Faster average house price growth facilitates mobility and household asset portfolio rebalancing, leading to greater turnover of housing and refinancings, thus increasing prepayment rates. Faster income growth reduces the burden of mortgage payments on household cash flows over time, reducing risks of default and claims as mortgages mature.

Our estimates of the Fund's value and the FY 2000 capital ratio are sensitive to the forecasts we use for the U.S. economy. The base case results are based upon DRI's baseline ("Control" case) forecasts for interest rates and constant quality house prices and a 3 percent growth rate forecast for median household income.[1] We considered two other scenarios, a pessimistic forecast (DRI's "Stagnation" case) and an optimistic forecast ("Optimistic" case).

[1] Our estimate of three percent is based upon the historical average growth in the components of median household income for the period 1975 through 1991.

In Exhibit 1 and Appendix C, we present our estimates of the MMI Fund's performance under each economic scenario. Throughout the body of our report, the estimates discussed are those based on the base case economic assumptions.

Exhibit 1

Summary of MMI Fund Performance By Macroeconomic Scenario			
	Pessimistic Forecast	**Base Case Forecast**	**Optimistic Forecast**
Current Economic Value (FY-92)	$730 million	$1,405 million	$2,318 million
Current Capital Ratio (FY-92)	0.22 %	0.43 %	0.71 %
Projected Capital Ratio, FY 2000	2.00 %	2.44 %	2.91 %

Note: NAHA mandated capital ratio targets are 1.25 percent for October 1, 1992, and 2.00 percent t for October 1, 2000.

FY 1992 economic value estimates under the different scenarios vary by approximately $1.5 billion. Capital ratio forecasts for FY 2000 also depend on economic forecasts. The Fund capital ratio in FY 2000 is expected to achieve the NAHA target under all three scenarios. However, these results are sensitive to the impact of the growth in household income that is likely to accompany changes in long term economic trends. A decline in future growth rates of median household income to 2% (versus the 3% in our base case) would reduce FY 1992 base case economic value by $448 million, and reduce the expected FY 2000 capital ratio by 40 basis points. An increase in the expected future growth rate of incomes to 4% would increase FY 1992 base case economic value by $267 million, and raise the FY 2000 capital ratio by 25 basis points.

Exhibit 2 presents capital ratio forecasts under the base case for FY 1992 through FY 2000. Capital ratio forecasts depend on the following five underlying assumptions regarding the future books of business and the environment in which FHA operates.

- Future books of business remain the same size as the FY 1992 book ($37 billion), and are distributed in a similar manner across loan sizes and loan-to-value ratios

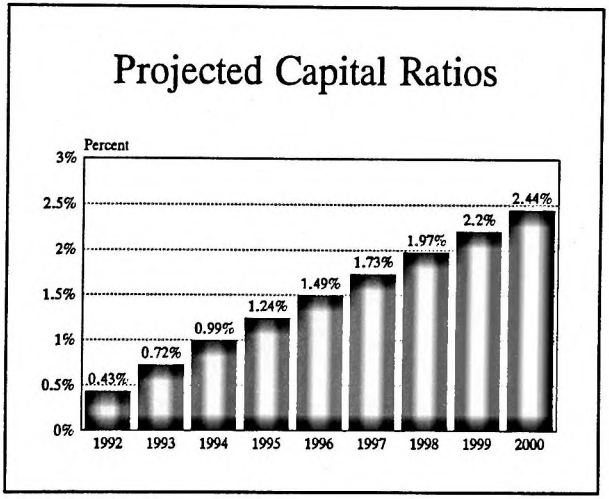
- Inflation remains at current levels

- Interest rates and growth in median household income remain stable after 1995

- Quality of borrowers and lenders remains at current levels

- FHA premium and refund practices remain unchanged

Exhibit 2



Larger future books with similar performance would raise future capital ratios. Smaller or riskier books would reduce capital ratios. Higher than anticipated inflation rates would raise capital ratios in the future. Appendix C reports the sensitivity of the MMI Fund economic value to alternative macroeconomic scenarios.

Sources of the Change in Economic Value During FY 1992

The base case estimate of FY 1992 economic value shows an improvement of $2.1 billion over the FY 1991 value. Exhibit 3 summarizes the sources of this change.

Exhibit 3

Changes in MMI Fund Economic Value Between FY 1991 and FY 1992 (In Millions of $1992)

	Explanation	Change in Value	Economic Value
(1)	FY 1991 Economic Value Reported in FY 1991 Review		**-669.4**
(2)	FY 1991 Economic Value Expressed in $1992		**-723.0**
(3)	Net EV of FY 1992 Book of Business	922.5	
(4)	Value of Improved Experience of 1991 and Earlier Books	1,057.7	
(5)	Impact of Improved Modeling of Underwriting Differences and Claims	178.1	
(6)	Updating of Economic Forecasts	-30.2	
(7)	Total Net Change in Economic Value (Sum of Rows (3) Through (6))		**2,128.1**
(8)	FY 1992 Economic Value (Sum of Rows (2) Through (6))		**1,405.1**

Row (2) reflects the present value of the FY 1991 economic value, expressed at of the end of FY 1992. That value and all numbers that follow are expressed in end of FY 1992 dollars.

The "Net EV of the FY 1992 Book" (row (3)) refers to the total surplus that the FY 1992 book is expected to generate, in present value terms, after accounting for 1992 income from up front and annual premiums ($1,529.2 million) and expected future expenses net of annual renewal premium revenues ($606.6 million).

"Value of Improved Experience of 1991 and Earlier Books," (row (4)), represents the improvement in the future experience of business written prior to FY 1992, reflecting improved claims performance during FY 1992 relative to expectations. This improvement is reflected in the current econometric model to estimate the present value of improvements over the lives of these books. This improvement is estimated using our FY 1991 econometric model, to reflect 1992 experience and to maintain comparability.

Row (5) represents improvements in the precision with which our models capture differences in FHA underwriting regimes and improved claims behavior. Appendix A details the enhancements made to the econometric model during this Review, including updates to FHA losses on claims and refinements to the claims equation.

The latest DRI forecasts predict slightly lower house price appreciation rates than those predicted when we completed our FY 1991 Review. That decline is expected to increase Fund claim experience marginally, therefore reducing Fund value. This adjustment to the economic forecasts is reflected in row (6).

Summary

The performance of the MMI Fund has improved in the following two respects since FY 1991:

- Poorer performing books of business are terminating and being replaced by better performing books

- The surviving business is performing better because marginal loans have terminated, economic prospects are improving, and prepayments are rising

A large share of the improvement in expected Fund value by FY 2000 is due to a trend toward higher prepayment rates resulting from lower interest rates. As terminations due to prepayments rise, Fund insurance in force (IIF) grows at a slower rate. Because upfront premiums were collected for books between FY 1984 and 1991, Fund economic value grows more swiftly than IIF.

Expected revenues from renewal premiums for the 1992 and later books remain critical to the MMI Fund's capability to satisfy the NAHA target. The 1992 book is expected to contribute $923 million in present value terms to Fund economic value. If the Fund is to reach its target, it is important that the 1992 and future books generate surpluses to offset the poorer performance of the books of the early and mid-1980s.

I. Introduction

The Cranston-Gonzalez National Affordable Housing Act (NAHA), enacted in 1990, mandates that the Federal Housing Administration's (FHA's) Mutual Mortgage Insurance (MMI) Fund attain a capital ratio of 1.25 percent by October 1, 1992, with a target of 2.0 percent for October 1, 2000. NAHA defines the capital ratio as the ratio of the Fund's capital or economic net worth[2] to its unamortized insurance-in-force.[3]

In addition to codifying the actuarial standard, the NAHA established the requirement that the Department of Housing and Urban Development (HUD) undergo an annual independent actuarial review of the MMI Fund. The purpose of the review is to assess the actuarial soundness of the Fund and to report on FHA compliance with respect to the new capital standards set forth in the NAHA. Price Waterhouse has conducted this required review for fiscal years 1989 through 1992. This report represents our evaluation of the actuarial soundness of the Fund as of the end of FY 1992 with an assessment of the Fund's current and forecasted capital ratios, based on information supplied by HUD regarding the historical performance of the existing MMI Fund loan portfolio.

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2 The economic net worth is defined in the National Affordable Housing Act of 1990 as the "current cash available to the Fund, plus the net present value of all future cash inflows and outflows expected to result from the outstanding mortgages in the Fund."

3 The term "unamortized insurance-in-force" is defined in the legislation as "the remaining obligation on outstanding mortgages" - - a definition generally understood to apply to amortized insurance-in-force. This apparent contradiction has led to some confusion regarding which is the appropriate measure to be used in the actuarial reviews. Price Waterhouse continues to use the unamortized insurance measure for our calculations of capital ratios. This is consistent with the FY 1989 report, in which the recommended capital ratio requirements were calculated using unamortized insurance-in-force as conventionally defined. Data on the unamortized insurance-in-force are considered more reliable than what is available on the amortized value of MMI Fund insurance-in-force.

II. Summary of Findings

This is the fourth independent actuarial review of the MMI Fund. This section discusses the findings of both the current review and the review of FY 1991. It also compares the estimates for FY 1992 made in the FY 1991 Review with actual FY 1992 experience, in order to assess the reasonableness of the model estimates.

A. The FY 1992 Actuarial Review

The FY 1992 Actuarial Review assesses the actuarial soundness of the MMI Fund as of the end of FY 1992. It was conducted using econometric and financial cash flow models to estimate loan termination rates, project future cash flows of the existing Fund portfolio, and determine the adequacy of current capital resources to meet estimated cash requirements.

The econometric and cash flow models used in the 1992 analysis are similar to those applied in the FY 1991 Review, but are based on the Fund's experience through September 1992 and an updated set of economic assumptions and forecasts to estimate the cash flows of the Fund. Technical refinements have also been made to the econometric model to improve forecasting accuracy.

The estimated economic value and capital ratio as of the end of FY 1992 for the FHA Mutual Mortgage Insurance Fund are presented in Exhibit II-I, along with last year's results.

Exhibit II-I

Estimates of MMI Fund Economic Value
End of FY 1992 and End of FY 1991
(Dollars in Millions)

	FY 1992 Review[1]	FY 1991 Review
Capital Resources		
Cash	$ 758	$ 114
Investments	5,781	6,558
Properties	1,271	988
Mortgages	2,275	1,733
Net Receivables and Payables	-582	-449
Total Capital Resources[2]	$9,503	$8,943
PV of Future Cash Flows		
Pre-1975 Business	$ 44	$ 67
1975-1988 Business	-3,137	-3,864
1989 Business	-1,074	-1,675
1990 Business	-1,634	-2,226
1991 Business	-1,690	-1,915
1992 Business	-607	
Total PV Future Cash Flows	**-$8,098**	**-$9,612**
Economic Value	**$1,405**	**-$669**
Insurance Originated[3]		
1975-1989 Origination	$347,454	$347,397
1990 Origination	47,084	47,057
1991 Origination	43,973	42,681
1992 Origination	37,038	
Total Originations	475,550	$437,135
Unamortized Insurance-in-Force at End of Year	$325,912	$327,811
Capital Ratio	**0.43%**	**-0.20%**

1 Cash flows for FY 1991 Review are valued as of the end of FY 1991. Cash flows for FY 1992 Review are valued to End of FY 1992.
2 From Audited Financial Statements.
3 As reported by FHA's A-43 database.

The major findings of this analysis are the following:

- As of the end of FY 1992, the MMI Fund had an estimated economic value of **$1,405.1 million** and an unamortized insurance-in-force portfolio of **$325.9 billion**. The capital ratio, which expresses economic value as a percentage of insurance-in-force, is **0.43 percent**, up from last year's estimate of -0.20 percent.

- The change in economic value from the FY 1991 Review is largely attributable to the following:

    - Improvements during FY 1992 in claim termination performance of 1975 to 1991 books
    - Addition of FY 1992 book of business
    - Refinement of the econometric model
    - Updates of economic forecasts

- We estimate that the FY 1992 book of business will add **$922.5 million** in present value terms to the economic value of the MMI Fund. It will be the first cash-sufficient book for the Fund since the FY 1979 book.

- The capital ratio is estimated to be **0.43 percent** as of October 1, 1992 and **2.44 percent** by October 1, 2000. The MMI Fund has not met the FY 1992 NAHA capital ratio target of 1.25 percent, but is projected to satisfy the FY 2000 target of 2.00 percent.

As of the end of fiscal year 1992, post-1986 books of business accounted for approximately 75 percent of the Fund's insurance-in-force. Their financial performance to date has been superior to that of previous books. We attribute their superior termination performance to stricter underwriting standards for books of business originating after 1986. Stricter

underwriting standards ensure that the equity contribution of borrowers to a property provides sufficient qualitative and quantitative protection from default and claim risks for the Fund. Because of their relative size and behavioral differences, the economic value of the Fund depends heavily on the ultimate claims performance of these books. However, due to the relatively small amount of historical information with regard to these books, it remains difficult to predict their ultimate termination experience.

B. The FY 1991 Actuarial Review

In December 1992 we released our evaluation of the actuarial soundness of the MMI Fund for FY 1991. That report was the third independent actuarial study of the Fund conducted by Price Waterhouse. The objective of our modeling effort was to evaluate historical loan termination experience due to defaults and prepayments, and to estimate future revenues and costs on the basis of the historical data, economic relationships, policy parameters and forecasts of future macroeconomic conditions. The resulting cash flow figures were then combined with current capital figures furnished by the audit to produce current economic values and projected capital ratios.

The FY 1991 econometric model used MMI Fund historical data from FY 1975 to FY 1991 to assess the financial position of the Fund as of the end of FY 1991, and to estimate the future performance of existing books of business. The FY 1991 model assigned costs to default claims and prepayments and projected the incidence and costs of future defaults and prepayments for existing books of business. Default and prepayment projections depended in part on the forecasted values of U.S. unemployment, interest rates, and house prices used in the model. Combining the impact of these factors with Fund capital and expected revenues yielded the Fund's economic value. That value was also the foundation for projections of Fund capital ratios and performance relative to the FY 1992 and FY 2000 legislative targets.

The major findings of the FY 1991 analysis were the following:

- As of the end of FY 1991, the MMI Fund had an estimated economic value of **-$669.4 million** and an unamortized insurance-in-force portfolio of **$327.8 billion**. The capital ratio, which expresses economic value as a percentage of insurance-in-force, was **-0.20 percent**, up from FY 1990's estimate of -0.88 percent.

- We projected the capital ratio to be **0.11 percent** in October 1992 and **2.00 percent** by October 2000, meaning that the MMI Fund was not expected to meet the FY 1992 NAHA capital ratio target of 1.25 percent, but was projected to meet the FY 2000 target of 2.00 percent.

C. Structural Change in Performance of Selected Books of Business

As we discussed in the FY 1991 Actuarial Review, an analysis of the actual claims for historical books of business revealed a distinct shift in the termination behavior of the portfolio. Books of business endorsed between 1982 and 1986 exhibited a significantly higher propensity to claim than did books for earlier years. Likewise, endorsements since 1987 have exhibited a reduced claim rate relative to the 1982-86 period.

During the course of the FY 1992 Review, we further investigated several possible causes for these shifts. We have determined that a significant cause of these shifts is the difference in underwriting procedures which existed during these periods.[4] Relative to the 1975-81 period, the 1982-1986 period was characterized by looser underwriting practices which led to increased credit risk assumption on the part of FHA. For example, by the end of FY 1992, the average cumulative claim rate for the 1982-86 books of business was 14.9 percent. The

[4] These periods also differed significantly in their economic environment. This too would lead to differing termination profiles. However, even when we control for economics, termination profiles of the various epochs remain significantly different.

average was 9.0 percent for the 1975-1981 books of business, or 40 percent less, despite their longer seasoning.

By comparison, the 1987 and succeeding books can be characterized as periods of increased enforcement of underwriting standards. By the end of its sixth policy year, the 1987 book had experienced a 5.3 percent cumulative claim rate. At a similar point in their maturity, the 1982-86 books had experienced an 11.9 percent average cumulative claim rate. At the end of their sixth policy year, the 1975-81 books had an average cumulative claim rate of 5.0 percent.

We have refined the claim rate equation to more appropriately account for these differences in underwriting regimes. Because underwriting policy directly affects the credit risk of mortgage loans, we used the market value of the borrower's equity for loans written in these years to capture this qualitative difference. Our analysis shows that during the 1982-1986 period, relatively poorer underwriting practices reduced the quality of equity, leading to greater rates of default for this period. This effect appears to be nonlinear and degrades with the passage of time. For the 1987 and following underwriting epoch, equity quality is higher, resulting in relatively lower rates of default. Although policy year information on these recent books is fairly limited, we have tested for and rejected the possibility of a degradation of this effect over time.[5]

[5] Appendix A provides a detailed description of our analysis.

D. Decomposition of the Change in Economic Value Since the End of FY 1991

In Exhibit II-2 we present the reasons for the change in the Fund's economic value since the FY 1991 Actuarial Review.

Exhibit II-2

Changes in MMI Fund Economic Value Between FY1991 and FY1992
(In Millions of $1992)

	Explanation	Change in Value	Economic Value
(1)	FY 1991 Economic Value Reported in FY 1991 Review		**-669.4**
(2)	FY 1991 Economic Value Expressed in $1992		**-723.0**
(3)	Net EV of FY 1992 Book of Business	922.5	
(4)	Value of Improved Experience of 1975-91 Books	1,080.9	
(5)	Change in EV of pre-1975 Books	-23.2	
(6)	Impact of Improved Modeling of Underwriting Differences and Claims	178.1	
(7)	Updating of Economic Forecasts	-30.2	
(8)	Total Net Change in Economic Value (Sum of Rows (3) Through (7))		**2,128.1**
(9)	FY 1992 Economic Value (Sum of Rows (2) Through (7))		**1,405.1**

1. Improvement in Economic Value Associated with Historical Books of Business

Net changes in the financial performance of Fund books of business (the sum of rows (3), (4), and (5) of Exhibit II-2) accounted for a $1,980.2 million improvement in the Fund's economic value since FY 1991.[6] There are two significant causes of this improvement:

- Economic value for the 1992 book (row(3)) - - We estimate that the net present value of revenues and costs for claims and premium refunds associated with the FY 1992 book of business will total $922.5 million. This value comprises current revenues of $1,529.2 million from up front and annual premiums and expected future disbursements of $606.6 million, in present value terms, net of expected annual premium revenues. The 1992 book is the first one fully subject to the NAHA reforms, and was projected in the FY 1991 Review to add approximately $1 billion in economic value to the Fund.

- Better than expected performance of the 1975 to 1991 books (row (4)) - - The additional year of actual termination experience provided by FY 1992 data indicates that the historical books continued to perform at better than expected levels. Forecasts of future performance based on this new information indicate that expected future costs of these books would be $1,080.9 million lower than estimated previously.

[6] Dollar values are in FY 1992 present value terms.

2. Improvements in the Modeling of Differing Underwriting Regimes and Claims

We modified our model for the FY 1992 Review to better capture and project the influence of lower claim rates. These refinements, explained in detail in Appendix A and reflected in row (6) of Exhibit II-2, include the following:

- We use equity measures for the 1982 to 1986 and post-1986 periods to capture the impact of underwriting changes on book performance. This change improved the fit of our regression equations and allowed us to replace the dummy variables used in previous reviews to capture these effects

- We included a payment-to-income ratio variable to capture the change in mortgage service cost burdens as household incomes change

3. Change in Economic Forecasts

Since the release of our FY 1991 Actuarial Review, prospects for an early and robust recovery have dimmed somewhat. The latest DRI forecast series (Jan./Feb. 1993) predicts a slower recovery. As a result, our estimates of the future performance of Fund books are lower by $30.2 million than they would have been under the previous economic forecasts (row (7) of Exhibit II-2).

III. Current Year Performance - The Effect of FY 1992 Activity on the Fund

The operations of the MMI Fund are intended to generate sufficient premium and investment income to provide for the expected losses associated with claim termination, and other costs of operation, over the life of the insured loans. The Fund's performance, and therefore the adequacy of the premiums to meet all obligations, is sensitive to fluctuations in economic conditions, the underlying risk of the existing mortgage pool, and the additional risk associated with new books of business.

The FY 1992 Review of the MMI Fund updates the FY 1991 Review by incorporating the additional insurance written in FY 1992, the experience of the historical books during FY 1992, and the current actual and expected future economic conditions affecting the housing sector and loan performance.

A. Economic Conditions Through FY 1992

The financial position of the Fund is sensitive to fluctuations in the housing and mortgage market sectors of the economy. This is because claim termination behavior, the dominant source of financial risk affecting the Fund, is closely related to movements in various housing market indicators. Economic analysis of loan foreclosure and subsequent claim termination indicates that the level of net equity in properties is important in estimating claim termination behavior. The household equity level will vary with rates of house price appreciation and interest rates. The previous and current forecasts of the critical economic conditions affecting loan performance are presented in Exhibit III-I.

Exhibit III-I

Previous and Current Forecasts of Economic Data						
	CQHP		Mortgage Interest Rate		FHLMC Mortgage Commitment Rate	
	1991	1992	1991	1992	1991	1992
1989	3.76	3.76	10.07	10.16	10.47	10.47
1990	1.49	1.49	9.71	9.71	10.10	10.10
1991	0.82	0.82	9.20	9.30	9.50	9.57
1992	1.60	1.70	8.17	8.18	8.47	8.36
1993	3.50	3.10	7.91	8.35	8.21	8.65
1994	3.90	3.20	8.40	8.65	8.70	9.04
1995	3.40	3.40	8.41	8.61	8.71	8.86
1996	3.20	3.40	8.41	8.61	8.71	8.86

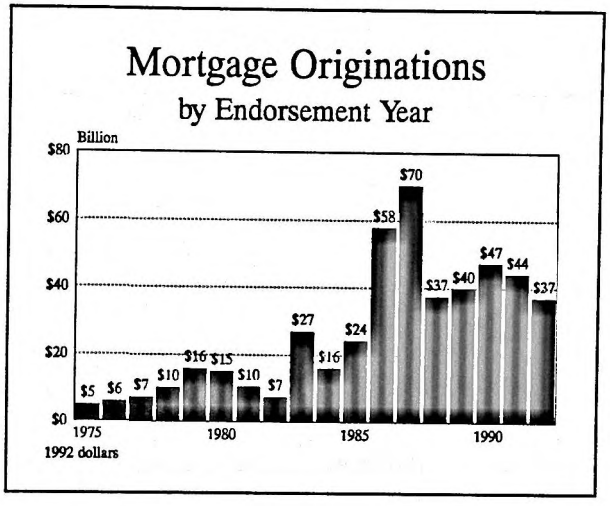
Shaded areas are actual figures taken from U.S. Census Bureau figures (CQHP and Mortgage Interest Rates) and FHLMC reports (Freddie Mac 30-Year Fixed Rate Mortgage Commitment Rates). Unshaded values are forecasts.

The current set of economic projections reflects the widely-held belief that the current expansion will not be rapid. This is shown by a reduction, relative to the 1991 projections, in the anticipated near term increase in the rate of house price appreciation, and continued moderate increases in interest rates.

B. Characteristics of the FY 1992 Book of Business

In FY 1992, FHA insured $37.0 billion in single family mortgages, bringing the total unamortized insurance-in-force to $325.9 billion. The FY 1992 book of business was 16 percent smaller than the FY 1991 book. This follows a 6.6 percent decline between the FY 1991 and FY 1990 books. Historical mortgage origination volumes are shown in Exhibit III-2.[7]

Exhibit III-2



Prior econometric studies of mortgagor termination behavior have shown that the borrower's equity position is a major determinant of default behavior. The larger the equity position, the greater the incentive to avoid default on the loan. The loan-to-value (LTV) ratio[8] is a measure of this relationship between the size of a loan and the value of the underlying

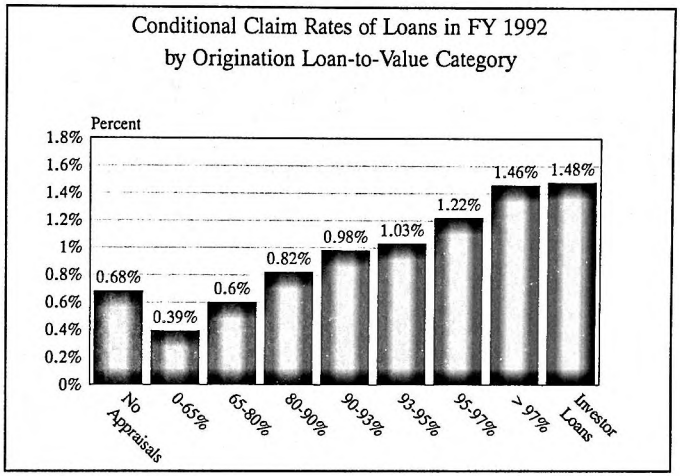
[7] Evidence from the first quarter of FY 1993 indicates that endorsements are running 26 percent higher than in 1992.

[8] In 1991, FHA began defining LTV as the mortgage amount without the mortgage insurance premium over appraised value. Prior to that time, the FHA LTV was mortgage amount without insurance premiums over appraised value plus closing costs.

property. Accordingly, the termination risk in a mortgage pool can be linked to the LTV distribution of loans at origination. During the lifetime of a loan, default risk also depends on the ratio of current outstanding mortgage principal to the estimated market value of the property.

Exhibit III-3 displays claim rates by LTV ratio for all loans terminating in FY 1992.[9] This figure illustrates the historical relationship between LTVs and aggregate claim rates.

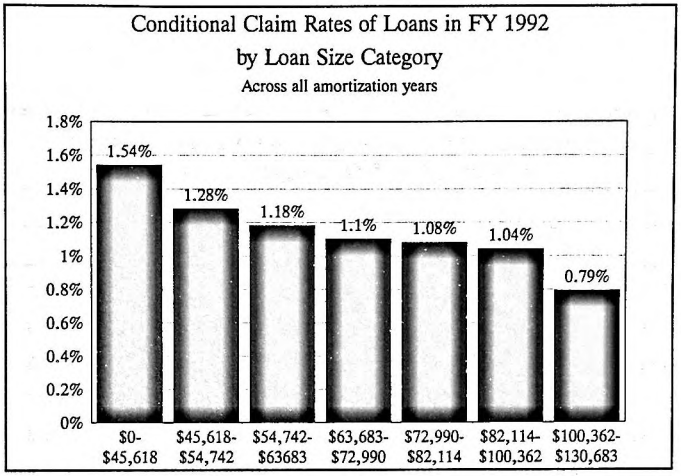
Exhibit III-3



In October of 1992 Congress raised the loan ceiling on insured loans, increasing the opportunity for potential homeowners in high house price markets to obtain FHA insurance. As shown in Exhibit III-4, there has been a significant inverse relationship between loan size and default risk in existing size categories of FHA loans.

[9] LTV classes were defined for this study as: No Appraisals, LTV 0% to 65%, 65% to 80%, 80% to 90%, 90% to 93%, 93% to 95%, 95% to 97%, >=97%, and investor loans. Limits between classes are included in the upper of two adjacent classes. The "No Appraisals" category primarily includes streamlined refinancings that did not require appraisals (streamlined refinancings *with* appraisals appear within their correct LTV categories). To a lesser extent it includes some property dispositions, where no appraisal was performed.

Exhibit III-4



There is also a relationship between loan size and the loss rate on claims. The loss rate is defined as the percentage of a claim amount that is not recovered through the sale of the property associated with the claim.[10]

10 Part of this decline in loss rates across loan sizes follows from the significant claim costs that are fixed rather than variable with the loan or home value. These include costs associated with foreclosure attorneys and property management.

Exhibit III-5 shows the distribution of loans by selected loan size categories, across both origination and termination years. Size increases with the category number, as shown in Exhibit III-6 which specifies the upper limit of each category for each fiscal year. This historical analysis was conducted for loan amounts under the FHA limit.

Exhibit III-5

Distribution of Loan Originations by Mortgage Size (Percentage of Dollar Volume)*

	Size Category							
Year	1	2	3	4	5	6	7	8
75	6.70%	8.27%	10.46%	14.82%	16.27%	28.89%	13.82%	0.77%
76	8.73%	8.92%	12.62%	17.35%	15.76%	26.67%	9.26%	0.70%
77	8.17%	8.56%	14.93%	17.79%	18.52%	24.63%	6.60%	0.80%
78	7.38%	9.69%	13.37%	16.64%	15.57%	21.35%	15.45%	0.55%
79	8.58%	9.99%	13.53%	15.64%	14.20%	22.83%	14.86%	0.35%
80	8.40%	9.26%	12.63%	14.43%	14.94%	29.84%	9.45%	1.01%
81	10.23%	8.91%	12.09%	13.77%	14.01%	25.07%	14.75%	1.16%
82	10.74%	8.78%	12.52%	12.18%	13.39%	26.48%	14.15%	1.81%
83	6.38%	7.27%	10.74%	12.63%	14.53%	28.55%	17.53%	2.31%
84	8.42%	8.08%	10.48%	12.90%	14.18%	26.22%	16.38%	3.10%
85	6.51%	6.46%	9.01%	11.80%	13.53%	27.11%	21.93%	3.80%
86	5.32%	6.64%	10.27%	13.16%	15.52%	28.56%	17.48%	3.08%
87	6.87%	8.45%	12.46%	14.82%	17.12%	26.44%	11.26%	2.60%
88	10.93%	11.17%	13.22%	15.19%	15.12%	23.27%	9.82%	1.40%
89	11.35%	11.37%	13.29%	15.08%	13.76%	22.32%	11.43%	1.35%
90	10.19%	10.33%	12.84%	14.50%	13.13%	21.08%	17.26%	0.60%
91	9.29%	9.87%	12.14%	13.96%	12.82%	20.27%	20.83%	0.72%
92	8.96%	10.12%	12.77%	15.15%	13.63%	20.29%	18.86%	0.23%
Total	8.41%	9.10%	12.10%	14.33%	14.69%	22.43%	15.21%	1.70%

* See Exhibit III-6 for dollar limits on size categories. Also, loan size category 8 is included in loan size category 7 for purposes of estimation.
Source: A-43 Database, November 1992 Extract

Exhibit III-6

Upper Limits of Loan Size Categories by Endorsement Year								
Endorse-ment Year	CQHP Increase (%)	Loan Size Categories (Upper Limits $)						
		1	2	3	4	5	6	7
1975	n/a	16,085	19,302	22,519	25,736	28,953	35,388	45,000
1976	8.43	17,442	20,930	24,419	27,907	31,395	38,372	45,000
1977	9.44	19,089	22,907	26,725	30,543	34,360	41,996	45,000
1978	13.87	21,738	26,085	30,433	34,780	39,128	47,823	60,000
1979	15.01	25,000	30,000	35,000	40,000	45,000	55,000	67,500
1980	11.37	27,842	33,411	38,979	44,548	50,116	61,253	67,500
1981	9.86	30,588	36,705	42,823	48,941	55,058	67,293	90,000
1982	5.70	32,332	38,798	45,265	51,731	58,198	71,130	90,000
1983	1.70	32,881	39,457	46,034	52,610	59,186	72,339	90,000
1984	4.03	35,505	42,606	49,707	56,808	63,909	78,112	93,420
1985	3.59	36,779	44,135	51,491	58,847	66,203	80,914	93,420
1986	4.77	38,535	46,241	53,948	61,655	69,362	84,776	93,420
1987	5.93	40,820	48,985	57,149	65,313	73,477	89,805	93,420
1988	3.60	42,290	50,748	59,206	67,664	76,122	93,038	105,098
1989	3.76	43,882	52,658	61,435	70,211	78,988	96,540	105,098
1990	1.49	44,535	53,442	62,349	71,256	80,163	97,977	129,620
1991	0.82	44,900	53,880	62,860	71,841	80,821	98,781	129,620
1992	1.70	45,618	54,742	63,683	72,990	82,114	100,362	130,683

Note: Values in shaded cells are not FHA limits since they include upfront premiums.

C. Financial Position at End of FY 1992

Our economic value calculations use information regarding the amount of resources available to the Fund to supplement our estimates of future cash flows based on forecasts of loan performance. In our measurement of Fund cash flows, we compare the current cash balances for each book of business with the ending cash balance at loan maturity, as estimated by the cash flow model. The difference between these, in present value terms, is the amount of resources that will be required to meet the Fund's obligations for that book of business. We compare the sum of these amounts for all books of business to the amount of capital resources recorded in the Fund's audited financial statements to determine whether the Fund has sufficient resources to meet its obligations relative to its current insurance-in-force.

1. Capital Resources

Capital resources are the net assets of the Fund which could, if necessary, be converted into cash to meet the Fund's obligations. These resources consist of cash, investments, properties, and mortgages, and the net of miscellaneous receivables and payables. These values, shown in Exhibit III-7, are taken from the annual audited financial statements of the Fund. The funds that make up the capital resources come from four sources:

- Residual surplus from insurance, generally endorsed prior to 1963, which has matured by FY 1992
- Conveyed property and other assets awaiting disposition
- Any prior capital provided by the government
- Current net reserve of premium income from the existing insurance-in-force

Since assets are revalued to market value when booked, shifts between the capital resource accounts have relatively little impact on our analysis. We treat them all as equivalent to cash when comparing capital resources to expected cash flows.

Exhibit III-7

MMI Fund Capital Resources End of Fiscal Year Value in FY 1988 Through FY 1992 (Dollars in Millions)					
Capital Resources	FY 1988 Audit	FY 1989 Audit	FY 1990 Audit	FY 1991 Audit	FY 1992 Audit
Cash	$32.9	$39.9	$17.9	$114.2	$758.1
Investments	6,194.0	6,067.1	6,553.9	6,557.5	5,780.8
Properties	1,489.1	1,399.3	1,067.8	987.5	1,270.6
Mortgages	1,037.5	1,162.5	1,423.9	1,732.8	2,275.0
Net Receivables and Payables	(404.1)	(540.6)	(585.1)	(449.3)	(581.7)
Total Capital Resources	$8,349.4	$8,128.2	$8,478.4	$8,942.6	$9,502.8

Source: Audited Financial Statements for FY 1988-1992

2. Cash Balances on Existing Books of Business

According to our financial cash flow model, the insurance endorsed between FY 1975 and FY 1992 has a total estimated cash balance, as of the end of FY 1992, of -$1.0 billion. We calculate the cash balances using historical claim, loss, prepayment, and interest rates, along with assumptions regarding premiums, premium refunds, and administrative costs, to simulate the cash flows associated with each of these books of business through the end of FY 1992. These cash flows are assumed to either build or deplete the initial balances of each book of business, which arise through payment of the upfront and annual premiums, to arrive at the EOY 1992 cash balance. Exhibit III-8 shows the cash balances of each book of

business from 1975 through 1992 for the overall MMI Fund as well as for the major individual loan types, based on our base case economic scenario.

Exhibit III-8

Current and Final Cash Balances by Loan Type (in 1992 Thousands of Dollars)

	Total MMI: 1992		Fixed Rate 30-Year Mortgages		Fixed Rate 15-Year Mortgages		Adjustable Rate Mortgages		Graduated Payment Mortgages	
Endorsement Year	Cash Balances EOY 1992	Final Cash Balance 1992 Dollars	Cash Balances EOY 1992	Final Cash Balance 1992 Dollars	Cash Balances EOY 1992	Final Cash Balance 1992 Dollars	Cash Balances EOY 1992	Final Cash Balance 1992 Dollars	Cash Balances EOY 1992	Final Cash Balance 1992 Dollars
1975	$254,592	$270,064	$257,542	$272,924	-$2,860	-$2,860				
1976	287,146	307,601	288,187	308,642	-1,041	-1,041				
1977	483,380	514,804	482,201	513,588	247	247			$932	$969
1978	566,501	608,823	463,677	499,975	-873	-859			103,697	109,707
1979	315,670	369,416	120,879	154,608	-1,890	-1,826			196,681	216,634
1980	-674,787	-665,051	-475,414	-471,365	-10,202	-10,081			-189,171	-183,605
1981	-1,371,205	-1,377,732	-1,022,459	-1,028,051	-12,691	-12,539			-336,055	-337,142
1982	-1,039,997	-1,061,464	-758,644	-776,379	-14,914	-14,917			-266,439	-270,168
1983	-1,726,885	-1,758,241	-1,349,001	-1,380,140	-4,899	-5,848			-372,985	-372,253
1984	-1,423,777	-1,527,795	-1,137,522	-1,230,190	-35,568	-40,154	-$111	-$123	-250,576	-257,328
1985	-1,639,420	-1,777,725	-1,478,261	-1,602,358	-35,717	-43,179	-2,642	-3,221	-122,800	-128,697
1986	-792,262	-1,802,923	-796,299	-1,749,955	44,264	6,612	-10,993	-18,964	-29,234	-40,166
1987	736,711	-482,169	649,559	-500,996	81,938	41,415	3,761	-13,240	1,453	-9,348
1988	259,373	-519,906	240,442	-479,068	16,700	424	4,926	-33,416	-2,695	-7,846
1989	564,821	-509,294	539,066	-491,614	16,593	-1,911	6,894	-9,410	2,268	-6,359
1990	1,168,857	-465,232	1,121,423	-452,318	25,690	-3,024	11,315	-2,989	10,429	-6,901
1991	1,457,503	-232,017	1,332,708	-218,917	36,010	-761	72,086	-8,417	16,699	-3,922
1992	1,529,173	922,545	1,193,968	749,835	53,462	40,456	275,236	129,399	6,507	2,855
Final	-$1,044,606	-$9,186,296	-$328,038	-$7,881,779	$154,249	-$50,296	$360,472	$39,169	-$1,231,289	-$1,293,840

Approximately 88 percent of the MMI Fund's insurance-in-force consists of 30-year Fixed Rate Mortgages (FRMs). The current cash balance on these loans are positive for the pre-1980 books of business. Since these borrowers have had time to build considerable equity,

they have a relatively low likelihood of default, and annual premiums are expected to be greater than future claims. Cash balances for these books of business can be expected to remain positive. During FY 1992, the balances on these books of business increased as more premium and interest income was earned than was disbursed to cover claims.

The estimated cash balances of business endorsed in FY 1980 through FY 1986 are negative, meaning that the Fund has been forced to use cash from sources other than the premiums on these books of business and associated interest to pay claims on failed loans from these books of business. The balances for loans originating after FY 1986 are positive, largely because losses to date have not yet depleted the resources generated from their upfront premiums.

The basic pattern of current cash balances and expected final balances observed in the 30-year FRMs is repeated in the books of business for the other mortgage types: 15-year FRMs, Adjustable Rate Mortgages (ARMs), and Graduated Payment Mortgages (GPMs).

IV. Future Performance of the Insured Loan Portfolio

Our review of actuarial soundness for the MMI Fund requires an assessment of the adequacy of the current capital resources to meet the expected future obligations of the existing insurance-in-force. Furthermore, because there is uncertainty about the future economic climate and therefore the exposure to risk of claim termination, we also assess the adequacy of current surplus capital resources to meet adverse contingencies beyond forecasted obligations. This surplus of capital resources is the economic value of the Fund.

A. Application of Economic Models for Loan Termination

Most of the Fund's risk consists of the payment of claims and recovery of losses through the sale of foreclosed property. Claim estimates are therefore a central feature of the analysis of its economic value. These estimates are used to produce cash flow projections that are then discounted to determine the present value of the expected cash flows. An analysis of prepayment propensities is also central in that the level of prepayments directly affects the cash balance position of the insurance fund. The estimation of prepayment rates also influences the estimation of future claim rates since they reduce the outstanding loan pool from which claims can be generated.

We produce claim estimates using econometric models that are based on the hypothesis that default behavior can be explained primarily by a borrower's equity position. The equity position varies depending on house price appreciation rates and changes in interest rates relative to rates at loan origination. To control for the possibility that house price appreciation rates may vary greatly across regions of the country, a regional price dispersion measure is also included in the model.

Prepayments result from household mobility and changes in interest rates. A borrower's equity growth position also influences the prepayment decision. This follows because the

likelihood that the borrower will sell his/her home to "trade up" increases as the wealth of the borrower increases.

Our models were developed by applying regression analysis to the available data and estimating relationships for specific categories of loan size, LTV and loan origination years. The forecasts based on these models depend on projections of the following factors:

- Future house price appreciation rates
- Interest rates
- House price dispersion measures
- Income growth rates

Our results are therefore sensitive to changes in these assumptions. The forecast assumptions for each of the variables in the model were presented in Exhibit III-1.

1. Claim Rate Estimates

The results of the claim rates model simulation for our base case economic scenario are presented in Exhibit IV-1. This exhibit shows conditional claim rates for each of the first ten policy years and the ultimate aggregate claim rate for each of the books of business from FY 1975 through FY 1992. (The conditional rate of claims is the number of claims during a given year as a fraction of the endorsements in force at the beginning of that fiscal year.)

The results indicate that projected conditional claim rates for books of business originating between the years of 1980-1986 will continue to remain high. However, 85 percent of the expected total number of claims on these books have already been realized. The economic costs of future claims and prepayments on the 1980 to 1986 books will be correspondingly lower as a consequence. Books originated after 1986 are expected to have much lower ultimate claim rates. Our current estimates of future claim performance are generally lower

than our FY 1991 estimates for the same books. This improvement is due to a combination of factors that includes the following:

- Somewhat better 1992 actual claims experience than was projected in the FY 1991 Report
- Refinements in the method of forecasting

Exhibit IV-2 presents a comparison of 1991 and 1992 cumulative claim rates for the 1992 termination year.

Exhibit IV-1

Historical and Forecasted Conditional Claim Rates
Annual Rates for First Ten Policy Years and 30 Year Cumulative Rate

Policy Year	Endorsement Year																					
	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	0.06	0.11	0.05	0.03	0.03	0.03	0.10	0.15	0.02	0.04	0.03	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.14	0.15	0.15	0.15
2	0.79	0.95	0.52	0.43	0.49	0.80	1.59	2.34	0.56	1.19	0.98	0.50	0.40	0.46	0.39	0.34	0.33	0.72	0.74	0.77	0.76	0.76
3	1.15	0.99	0.64	0.61	0.94	1.41	3.57	4.54	1.71	3.13	3.51	1.88	1.14	1.26	1.22	1.11	1.35	1.08	1.10	1.19	1.18	1.17
4	0.88	0.75	0.45	0.55	0.82	1.73	3.29	5.28	2.32	5.01	6.10	2.34	1.38	1.67	1.63	1.63	1.51	1.11	1.19	1.29	1.28	1.28
5	0.59	0.45	0.35	0.43	0.91	1.53	3.38	5.64	3.36	6.75	5.52	2.19	1.40	1.81	1.70	1.67	1.32	1.03	1.11	1.21	1.18	1.18
6	0.37	0.32	0.27	0.50	0.81	1.54	3.22	6.40	4.71	5.91	4.23	2.00	1.33	1.48	1.56	1.47	1.19	0.94	1.03	1.10	1.08	1.07
7	0.27	0.27	0.29	0.41	0.81	1.51	3.88	6.14	4.08	4.16	3.56	1.73	1.06	1.28	1.37	1.30	1.04	0.85	0.92	0.98	0.96	0.96
8	0.20	0.28	0.24	0.43	0.84	1.83	4.33	4.16	2.92	3.21	3.01	1.61	0.98	1.19	1.28	1.21	0.98	0.80	0.87	0.92	0.90	0.90
9	0.25	0.24	0.25	0.42	0.96	2.26	3.19	2.72	2.44	2.73	2.08	1.45	0.85	1.04	1.13	1.06	0.87	0.73	0.78	0.83	0.82	0.81
10	0.20	0.19	0.25	0.47	1.19	1.91	2.52	2.03	2.12	2.81	2.00	1.29	0.77	0.95	1.03	0.96	0.75	0.64	0.68	0.72	0.71	0.70
Cum.	5.72	5.91	5.52	7.66	11.94	16.38	21.54	20.28	16.20	20.08	18.08	16.01	10.80	11.59	11.22	11.00	9.76	9.29	9.92	10.58	10.47	10.42

= Actual Claim Rates = Forecasted Claim Rates

Exhibit IV-2

Comparison of 1991 and 1992 Cumulative Claim Rates for the 1992 Termination Year							
	Endorsement Year						
	1986	1987	1988	1989	1990	1991	1992
1992 Actual	9.20%	5.29%	4.85%	3.09%	1.43%	.34%	.01%
1991 Estimate	9.50%	5.71%	5.31%	3.73%	1.89%	.47%	.11%
Difference	-0.30	-0.42	-0.46	-0.64	-0.46	-0.13	-0.10

2. Prepayment Rate Estimates

We specified and estimated a model for prepayment termination because prepayments affect cash flows in two important ways.[11] First, borrowers whose mortgages originated after 1983 and terminate in prepayment are entitled to a partial refund of their upfront premium. This refund returns the unearned portion of the insurance premium. It is paid from the capital resources of the Fund. Second, in order to calculate the insurance-in-force in subsequent policy years, it is necessary to produce estimates for both sources of loan termination: claims and prepayments. Insurance-in-force at the end of a year is the insurance-in-force at the beginning of the year less the insurance that has terminated for any reason during the year plus new business written during the year, less the amortization of existing loans.

Our model assumes that there is a baseline prepayment rate associated with general population mobility and employment-related relocation, since borrowers prepay when they sell their home. We also assume that prepayments occur in conjunction with refinancings that are contingent upon changes in the current mortgage rate relative to the original contract rate. Therefore, our prepayment model includes an index constructed to measure the ratio of market value to book value for the remaining mortgage liability. When interest rates fall households will have an incentive to refinance their mortgages by first prepaying the FHA-

[11] See Appendix A for a discussion of model development.

insured loan. Conversely, during periods of rising interest rates, incentives are reversed: the likelihood of refinancing is reduced and relocation is made less attractive.

Results from the prepayment rates model confirm the reasonableness of the use of the relative market to book value of the remaining mortgage liability as a predictor of loan termination through prepayment.[12] By applying the forecasted interest rate assumptions, we have estimated prepayment rates for each of the books of business from FY 1975 through FY 1992. In Exhibit IV-3, we present the first ten years of prepayment rates and the ultimate prepayment rates for each of the books of business for the base case scenario.

[12] See Appendix A for details on the construction of this variable.

Exhibit IV-3

Historical and Forecasted Conditional Prepayment Rates
Annual Rates for First Ten Policy Years and 30 Year Cumulative Rate

Policy Year	Endorsement Year																					
	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	0.20	0.28	0.36	0.35	0.29	0.36	0.17	0.35	0.28	0.20	0.29	0.51	0.26	0.38	0.45	0.38	0.37	0.50	1.41	1.41	1.41	1.41
2	1.88	3.40	3.26	2.46	0.81	0.92	0.41	17.51	0.91	1.39	11.20	3.72	1.03	1.52	2.01	2.02	4.55	3.31	3.36	3.26	3.21	3.21
3	6.80	8.44	6.21	2.05	0.67	0.34	7.11	9.35	2.14	18.70	23.40	2.67	1.75	3.06	4.11	7.95	5.93	4.00	3.84	3.73	3.66	3.66
4	10.07	9.05	3.53	1.31	0.35	1.74	4.70	12.31	17.60	25.86	10.60	3.17	2.85	4.59	13.00	7.16	5.92	4.04	3.89	3.74	3.68	3.68
5	9.04	4.75	1.81	0.73	1.40	2.00	5.97	28.99	26.47	11.36	8.49	4.47	3.40	12.41	8.27	6.54	5.58	3.82	3.68	3.53	3.47	3.47
6	4.51	2.41	0.78	1.97	1.61	2.61	19.34	25.04	10.72	9.22	10.34	5.45	7.28	6.72	6.02	4.96	4.26	3.19	3.17	3.16	3.15	3.15
7	2.33	0.98	2.67	2.05	2.00	9.20	20.77	11.40	8.34	9.94	12.27	12.42	7.47	7.42	6.84	5.72	4.93	3.43	3.33	3.24	3.22	3.22
8	1.11	3.23	2.73	2.36	4.77	13.91	9.59	7.94	9.67	10.38	19.34	6.51	6.43	6.41	5.93	5.05	4.53	3.29	3.22	3.18	3.18	3.18
9	3.29	3.30	3.11	5.25	7.45	7.15	7.07	6.27	11.55	14.55	11.96	6.04	5.90	5.83	5.49	4.90	4.46	3.33	3.25	3.20	3.19	3.19
10	3.35	3.55	5.75	7.58	5.44	5.80	6.88	5.57	17.46	17.72	11.52	5.81	5.70	5.80	5.65	5.06	4.61	3.40	3.31	3.23	3.22	3.22
Cum.	75.37	74.30	71.44	70.42	69.71	75.60	76.69	78.85	80.99	78.23	79.09	71.28	73.42	74.73	75.38	73.13	72.09	65.99	63.94	61.04	60.90	60.93

= Actual Prepayment Rates = Forecasted Prepayment Rates

B. Forecasting Future Cash Flows for the Existing Loan Portfolio

Once the claim and prepayment rates were estimated by the econometric model, we estimated future cash flows using the cash flow model and discounted them to determine the present value of future cash flows. The cash flow model translates claim and prepayment rates as well as other assumptions about discount rates, administrative costs, premium refunds, recovery rates, and timing into dollar values and calculates end-of-year cash balances and insurance-in-force. It then discounts the cash flows to the end of FY 1992 to determine the resources the Fund would need today in order to be able to meet its obligations for its existing business through the scheduled maturity of the FY 1992 book of business.

The estimated cash flows for business through FY 1992 are presented in Exhibit IV-4. We estimate the present value of future cash requirements resulting from books of business written through FY 1992 to be -$8.1 billion. The addition of the FY 1992 business resulted in a net present value of future cash flows of $923 million (the present value of cash balances of $1.53 billion less expected cash outflows of $0.61 billion.)

Exhibit IV-4

Cash Flows of FY 1975-1992 Books of Business (Dollars in Millions)			
Endorsement Year	Cash Balances End of FY 1992	Present Value of Future Cash Flows	Net Present Value 1992 Dollars
1975	$255	$15	$270
1976	287	20	308
1977	483	31	515
1978	567	42	609
1979	316	54	369
1980	-675	10	-665
1981	-1,371	-7	-1,378
1982	-1,040	-21	-1,061
1983	-1,727	-31	-1,758
1984	-1,424	-104	-1,528
1985	-1,639	-138	-1,778
1986	-792	-1,011	-1,803
1987	737	-1,219	-482
1988	259	-779	-420
1989	565	-1,074	-509
1990	1,169	-1,634	-465
1991	1,458	-1,690	-232
1992	1,529	-607	923
Total	-$1,045	-$8,142	-$9,186

C. Estimating the Economic Value of the MMI Fund

According to the statutory definition, the economic value (or economic net worth) of the Fund, is the "cash available to the Fund, plus the net present value of all future cash inflows and outflows expected to result from the outstanding mortgages in the Fund." We based this value on capital resources as stated on the MMI Fund balance sheet plus the net present value of expected future cash flows of the existing loan portfolio as estimated from our financial model.

Capital resources include cash, investments, properties, mortgages, and receivables net of payables. The present value of expected future cash flows is calculated by a financial model which uses the most current information available to estimate cash flows, including the present value of the expected cash inflows (premiums, income from recoveries, and investment income) and outflows (claim payments, premium refunds, and administration costs). The cash flows included in the calculation are those from the base policy year to the final scheduled year of maturity (which is thirty years from the most recent policy year).

Exhibit IV-5 below presents our estimate of the economic value of the MMI Fund as of the end of FY 1992 for the base case scenario.

Exhibit IV-5

Estimate of MMI Fund Economic Value End of FY 1992 (Dollars in Millions)	FY 1992 Review
Capital Resources	
Cash	$ 758
Investments	5,781
Properties	1,271
Mortgages	2,275
Net Receivables and Payables	(582)
Total Capital Resources from Audited Financial Statement	**$9,503**
PV of Future Cash Flows	
Pre-1975 Business	$ 44
1975-1992 Business	(8,142)
Total PV of Future Cash Flows	**($8,098)**
Economic Value	**$ 1,405**
Unamortized Insurance-in-Force at End of FY 1992	$325,912
Capital Ratio	**0.43%**

V. Forecasting the Future Performance of the Fund

The National Affordable Housing Act requires that the MMI Fund achieve a capital ratio of 1.25 percent by October 1, 1992, and of 2.00 percent by October 1, 2000. The Fund's capital ratio is presently well below the first of these targets, but is projected to reach the second. NAHA prohibits the payment of distributive shares if it is expected that either target will not be achieved. It offers the option of changing premium structures on future books of business. Both of these alternatives involve building capital through the operations of the Fund.

We assessed the impact of future business on the economic value of the Fund, based upon assumptions regarding economic variables, claim, prepayment, refund and loss rates, premiums, administrative costs, and the volume and distribution among LTV's and loan sizes of the future books of business. We applied the same econometric model in the assessment of the performance of future books of business as we did in projecting future performance of existing business. In developing our projections, we have considered the implementation of the National Affordable Housing Act, particularly its provisions regarding premiums and refund rates. We also incorporated into our projections the change passed by Congress in October of 1992 that increased the percentage of financeable closing costs from 57.25 percent to 100 percent.

To model the changes in premium structure and closing cost policy, we focused primarily on the effect of these changes on future LTV distributions. We began by recognizing that changes in the amount of money borrowed will change the borrower's risk by affecting the initial loan-to-value ratio. With upfront premiums and closing costs assumed to be financed, and the implementation of equity caps, changes in these parameters may change the future distribution of LTVs from the current mix.

The upfront premium is not included in the determination of initial LTV because of its refundability feature. Changes in upfront premiums will not affect the future initial LTV distribution. Therefore, although NAHA mandates that upfront premiums will be gradually reduced in the future, this should not significantly affect future LTV distributions.[13]

Our previous model assumed that the reduction in the financeable portion of closing costs from 100 percent to 57.25 percent would occur at the beginning of fiscal year 1992. We have now incorporated the change from 57.25 percent back to 100 percent beginning in FY 1993. The change in the 57.25 percent rule should affect only the distribution within the highest LTV category. Borrowers with lower LTVs could reduce their downpayment to cover the non-financed closing costs under the 57.25 percent policy and with the reinstitution of full financing they could now make a higher downpayment to keep their loan sizes unchanged.

However, the distribution will tend to shift toward lower LTV's because the NAHA legislation increased the downpayment requirements by establishing maximum allowable LTV ratios. Under the legislation, the mortgage obligation, including closing costs but excluding the mortgage insurance premium, cannot be greater than 98.75 percent of the appraised property value for homes valued below $50,000. The limit for homes above $50,000 is 97.75 percent.

The establishment of a maximum LTV should reduce the loss experience for future books of business since it will require greater equity investments. Borrowers will therefore be less likely to default on their loans, since at any time during the life of their loan their net equity increment will be greater.

[13] NAHA mandates that an annual risk-based premium will also be assessed in accordance with initial LTV and year of loan initiation. Since this is assessed after the determination of the initial LTV, it too will have no effect on determining the original LTV distribution.

A. Implementation of the National Affordable Housing Act and Recent Congressional Revisions

Following the issuance of the FY 1989 Price Waterhouse Actuarial Review and the ensuing debate, Congress passed, as part of the Cranston-Gonzalez National Affordable Housing Act, various changes to the terms of the MMI Fund. The Act established the actuarial standard of 1.25 percent suggested in the FY 1989 study, as well as several of the policy changes recommended in the Price Waterhouse Actuarial Review. The revisions to the MMI Fund in the legislation focused on four major issues: 1) the development of an actuarial standard of financial soundness, 2) revisions to the minimum equity requirements, 3) changes in the pricing of insurance premiums, and 4) revisions to policies regarding distributive shares.

The implementation of the provisions of the National Affordable Housing Act regarding the MMI Fund will have a significant impact on the characteristics and performance of future books of business. The changes mandated by the Act were specifically designed to remedy the financial difficulties of the Fund. Each change is expected either to reduce the inherent risk of the additional books of business, or to adjust premiums to cover estimated risk.

The NAHA legislation required that the Fund be operated on an actuarially sound basis by providing specific capital standards for the Fund and time frames in which these standards must be met. It also defined the actuarial standard as a ratio of the Fund's capital or economic net worth to its unamortized insurance-in-force.[14]

The Act also included several changes to both the structure and size of future premiums. Under the NAHA, premiums will be based on the risk of the loan, as defined by the initial LTV of the mortgage. Beginning in July of 1991, the phase-in of a new premium schedule,

[14] The economic net worth is defined as the "current cash available to the Fund, plus the net present value of all future cash inflows and outflows expected to result from the outstanding mortgages in the Fund." Cranston-Gonzalez National Affordable Housing Act.

consisting of successively lower up-front premiums and implementation of annual premiums, was begun. The new premium schedule is presented in Exhibit V-1.

Exhibit V-1

National Affordable Housing Act Premium Schedule			
	Phase-in Years		
	1992	1993-94	1995-
Upfront Premium:	3.80%	3.00%	2.25%
Annual Premium for LTVs:			
< 90%	0.50% for 5 Years	0.50% for 7 Years	0.50% for 11 Years
≥ 90% - ≤ 95%	0.50% for 8 Years	0.50% for 12 Years	0.50% for 30 Years
> 95%	0.50% for 10 Years	0.50% for 30 Years	0.55% for 30 Years

Risk-based premiums will hopefully increase the premiums on risky loans without affecting the less risky, more financially desirable business. The switch to a combination of upfront and annual premiums should reduce the initial financing requirement for borrowers who finance the upfront premium. Annual premiums are intended to offset the resulting lower upfront revenues, resulting in no net loss in cash flow. But since the premiums are amortized more quickly (for the lower LTV loans), the outcome should be an incrementally more favorable risk profile.

In October 1992 Congress passed a modification to the NAHA which increased the percentage of closing costs that could be financed from 57.25 percent to 100 percent and raised the maximum loan size limit from $124,875 to $151,725.[15] The effect of the first change will be to increase borrower risk by allowing them to take out larger loans to finance a higher percentage of closing costs. Under this scenario, claims are likely to increase above previously predicted levels when only a fraction was financeable. The 1991 Actuarial Review estimated that as a result of this change, projected economic value will decline by $31 million annually.

While both market conditions and market receptiveness to changes in FHA policy, particularly regarding cash required at closing, may improve over time, we assume for the purposes of this analysis that volume will remain at the lower 1992 level (estimated at approximately $37 billion for the next several years, increasing with inflation.)

In a final measure to stem the outflow of capital, the NAHA legislation links the decision whether to pay distributive shares to the actuarial soundness of the entire MMI Fund (as defined in the legislation), and not solely to the performance of the loans endorsed during a particular year of business as was done in the past. This amendment should insure that distributive share payments are not made if the Fund has not achieved the capital standards established by this legislation.

B. New Business Loan Performance

Future books of business are expected to perform much better financially than historical books. The primary reason for improvement is the new premium structure, enhancing MMI revenues. Secondary reasons include anticipated improvements in the economy and the

[15] The new loan limit is still subject to the 95 percent of area median rule, thus continuing to make the FHA population consist of below median priced homes.

housing markets relative to recent and current economic conditions, and changes in the characteristics of the future books of business. Because of improvements in economic conditions (incorporated into our model through house price appreciation rates and interest rates), future business is expected to experience fewer claims in the critical first three-to-seven policy years than have been experienced by recent business.

Lower LTV loans tend to have lower default rates, and this relationship is a central determinant of claim estimates in our economic model. As a result, with the same economic forecasts, books of business with a lower average LTV will be expected to have lower claim rates in the future. Exhibit V-2 on the following page is a summary of the premiums, closing costs, and expected performance of future books of business based on our base case economic scenario.

Exhibit V-2

Future Business Premiums, Closing Costs and Loan Performance

	Phase-In II 1993	Phase-In II 1994	Phase-In III 1995	Phase-In III 1996
Up-Front Premium	3.00%	3.00%	2.25%	2.25%
% Financed	100.00%	100.00%	100.00%	100.00%
Annual Premium by LTV	0.50%	0.50%	0.50%	0.50%
LTV's < 90%	7 Years	7 Years	11 Years	11 Years
LTV's 90-95%	12 Years	12 Years	30 Years	30 Years
LTV's > 95%	30 Years	30 Years	0.55% - 30 Yrs	0.55% - 30 Yrs
Financed Portion of Closing Costs	100.00%	100.00%	100.00%	100.00%
Originations (30-year mortgages in millions)	$28,503	$28,503	$28,503	$28,503
Present Value of One Year of Business (Millions of 1992 dollars, 30-year mortgages)	$696	$644	$629	$633
Dollar Ultimate Claim Rate (30-year mortgages)	9.28%	9.92%	9.82%	9.78%
Present Value of One Year of Business (Millions of 1992 dollars, all mortgages)	$904	$837	$817	$822

C. Future Economic Value and Capital Ratios of the Fund Through the Year 2000

The overall performance of the Fund in the near term will be dominated by the pre-FY 1992 originations, which precede the implementation of NAHA provisions and are expected to lose money. However, the combined effect of premium rate increases, lower expected claim rates, and an improving economy translate into lower future cash requirements for new business. Thus future books of business will increase the economic value of the Fund. The Fund's capital has not built up rapidly enough to reach the target capital ratio of 1.25 percent for FY 1992. We project that the Fund will achieve the FY 2000 target of 2.00 percent.

Exhibit V-3

Future Economic Value and Capital Ratios Through FY 2000
(in Millions of Dollars)

	1992	1993	1994	1995	1996	1997	1998	1999	2000
IIF (EOY)	$325,912	$327,732	$332,345	$339,351	$348,085	$357,687	$367,322	$376,604	$386,105
Economic Value (BOY)		$1,405	$2,358	$3,278	$4,209	$5,179	$6,182	$7,221	$8,296
Interest on Previous Business		$49	$83	$115	$147	$181	$216	$253	$290
Addition of New Business		$904	$837	$817	$822	$822	$822	$822	$822
Economic Value (EOY)	$1,405	$2,358	$3,278	$4,209	$5,179	$6,182	$7,221	$8,296	$9,409
Capital Ratio	**0.43%**	**0.72%**	**0.99%**	**1.24%**	**1.49%**	**1.73%**	**1.97%**	**2.20%**	**2.44%**

VI. Conclusion -- Compliance with the National Affordable Housing Act

According to our estimates based on our base case economic scenario, as of the end of FY 1992 the MMI Fund had an economic value of $1,405.1 million and unamortized insurance-in-force of $326 billion, resulting in a capital ratio of 0.43 percent. While we expect that changes mandated by the National Affordable Housing Act will enable future books of business to build capital for the Fund, the Fund has not met the 1992 target of 1.25 percent. We do, however, project that the Fund will meet and exceed the FY 2000 target of 2.00 percent based on our base case economic scenario. These results are based on our base case economic assumptions. Alternative economic scenarios are provided in Appendix C.

The recent recession had a serious negative impact on the financial condition of the MMI Fund. As the economy moves out of the recession and the rate of house price appreciation improves, the financial performance of future books of business is expected to be superior to that of current and historical books. This improvement will begin to offset the negative values associated with recent books of business. This result assumes that there will be no adverse changes in the risk profile of future insurance.

Appendix A: Econometric Analysis of Loan Performance

This appendix presents our analysis of the behavior of claim and prepayment terminations for 30-year fixed-rate loans originating between 1975 and 1992. Our modeling objective was to evaluate historical experience of loan claims and prepayments, and to forecast future claims and costs to the Fund on the basis of:

- Historical claim and prepayment data
- Macroeconomic conditions and forecasts
- Household cash flow and equity accumulation measures
- Government policy parameters

The claims estimates and costs were then used to generate cash flow figures for the Fund, which, combined with current capital figures furnished by the audit, produce estimates of current Fund economic value and capital ratios. The forecasts of claims and prepayments under alternative economic scenarios were then incorporated into the financial cash flow analysis and estimation of economic value for the MMI Fund as reported in Appendix C.

I. Method to Estimate Conditional Claim Rates

We formulate and estimate economic models of claim and prepayment behavior for FHA-insured loans to determine the sensitivity of loan performance to macroeconomic, microeconomic, and policy factors. The models were estimated using data through FY 1992 for loans that originated in the period FY 1975 through FY 1990. The econometric model forecasted future claim and prepayment rates on the basis of the following factors:

- Expectations for macroeconomic variables such as interest rates, house price appreciation, and house price dispersion
- Distributions of loans across loan-to-value (LTV) groups

- Household liquidity and capital accumulation measures
- FHA policy variables

The claim and prepayment forecasts were then used to estimate Fund cash flows and economic values for the FHA books of business for fiscal years 1975 through 1992.

A. Econometric Model for Claim Rates

The econometric models used in the current report are substantially similar in underpinnings and structure to those used in the FY 1991 Actuarial Review. They are developed from the theory of consumer choice to identify expected mortgage borrowers' behavior under an objective of maximizing the expected wealth at a moment in time.[16] The following three choices are available to borrowers in the course of meeting their mortgage obligations:

- Continue paying the mortgage
- Prepay through refinancing or sale
- Default on the mortgage

The borrowers choose the option that maximizes their perceived discounted value of expected wealth over time. We initially focus on the loan default option. Prepayment options are considered in the next section. As explained below, the analysis uses claim rates rather than delinquency and default rates, which may include non-claim cases, because the focus here is on estimating the impact on MMI Fund value.

Wealth-maximization decisions occur at the individual household level. Much of the data used in this model, such as actual and expected claim rates, equity measures, and mobility

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[16] The underpinnings of our model are derived from: C. Foster, R. Van Order, "FHA: Terminations: A Prelude to Rational Mortgage Pricing", *AREUEA Journal*, V. 13(3) 1985 pp. 273-291; _____, _____, "An Option-Based Model of Mortgage Default", *Housing Finance Review*, Oct 1984, V. 3(4) pp. 351-372.

rates, occurs at a more aggregated level for groups of households that are relatively homogeneous in other respects. On the aggregate level, it is not possible to obtain the specific information needed to assess household wealth-maximizing strategies. Instead we rely on aggregate variables that are closely related to our hypotheses regarding household behavioral determinants. Borrowers' decisions to default will be determined largely by:

- Their perception of how much equity they have in their home
- Current liquidity relative to mortgage servicing requirements
- "Quality" of that equity, as explained below

When real estate markets experience significant and sustained declines, homeowners may be able to minimize their decline in wealth by walking away from the property. This choice will be exercised when the resale value of the home falls sufficiently below the market value of the remaining mortgage balance to outweigh the economic and non-economic costs of default.

A model to explain conditional claim rates, $CCR_{i,j,t}$, for FHA insured mortgages of loan size i, originated in year j, that have gone to claim in year t, can be expressed as follows:

$$CCR_{i,j,t} = f\{EM_{j,t-1}, PAYMENT_{i,j,t}, \sigma_{j,t-1}(RCQHP), D_1 \ldots D_{12}\} \quad (1)$$

where:

$EM_{j,t-1}$ - the net equity, assuming the household is not forced to make a sell decision, as a percentage of the current market value in the property, lagged a year

$PAYMENT_{i,j,t}$ - the burden of mortgage service on household cash flow, varying with contract interest rate at origination, and household income growth up to the policy year

$\sigma_{t-1}(RCQHP)$ - a house price dispersion index defined as the standard deviation of the regional percentage changes in the constant quality house

price index since the mortgage was originated divided by one plus the percentage change in the national constant quality house price index since mortgage origination

$D_1 \ldots D_{12}$ - a zero-one indicator variable for each of n policy years taking on a value of one in the respective policy year and zero otherwise.

The conditional claim rate model employs information about economic conditions and specific loan characteristics to explain borrower default behavior leading to claims. The conditional claim rate is applied rather than a default rate because the focus of the analysis is on the direct impact that claim terminations have on the cash flows of the Fund. Therefore, only those mortgages that have moved from default to claim settlement are of interest. Default rates do not provide sufficient information regarding financial impact on the Fund, since some mortgage defaults will be resolved, thus not generating a claim filing on the part of the lender/servicer.

B. Measures of Net Equity

Net equity enters the claim rate model in two forms. First, the direct effect of equity on claim behavior enters through seven variables that distinguish an equity index by loan size. This equity index compares the market value of household equity to its book value, as explained below. Increasing equity is related to lower risks of claim.[17]

Second, equity is reflected separately in the 1982 to 1986, and post-1986 periods to capture differences in the quality of loans during these periods. These quality differences are related to differences in the meaning of "equity" as the frequency of interest rate buy-downs, and FHA vigilance in lender monitoring changed over time. In periods such as 1982 through

[17] Similar indices of equity appear in C. Foster and R. Van Order op cit, and in R. L. Cooperstein et al, "Modeling Mortgage Terminations in Turbulent Times", *AREUEA Journal*, V. 19(4) 1991 pp. 473-494.

1986, less determined monitoring and tacit approval of a variety of inducements to make homeownership more attractive (the use of which has since been restricted in new FHA financings) diluted the quality of equity in a way that was not reflected by the estimated equity figures. As a consequence, equity would inhibit claims less during these years.

In contrast, the post-1986 period appears to be marked by more thorough FHA lender monitoring (as evidenced by greater numbers of referrals to and sanctions by the Lender Review Board[18]) and greater conservatism in lending practices. As a consequence, estimated equity is a more reliable measure of the influences that reduce claims incidence.

In general, increases in the perceived equity of a homeowner's property will lower the expected default incidence. Higher house price appreciation will increase homeowner equity, as will decreases in the market value of the mortgage liability. The mortgage can be viewed as an obligation to make periodic principal and interest payments with the expectation that prepayment of the remaining mortgage balance will occur before maturity. The present value of this stream of payments is estimated through the use of the current mortgage interest rate in the market as the discount rate.[19] When the current mortgage market interest rate falls below (rises above) the original FHA loan contract rate, the market value of the mortgage rises above (falls below) the remaining balance.

Another component of the homeowner's perceived equity is the asset value of the up-front premium. The up-front premium has an asset value to the borrower, since portions of the paid-in premium that are unearned will be refunded if and when the loan is prepaid. The asset value of the premium refund depreciates quickly in accordance with the refund policy

[18] See Exhibit A-4.

[19] In our analysis we use the Freddie Mac surveyed commitment rate on conforming loans as the prevailing market contract rate. This rate is generally above the FHA contract rates and thus represents an opportunity cost of mortgage financing.

whereby FHA recognizes as "earned revenue" the up-front premium cash receipts; after seven years the refund value diminishes to less than one percent of the original loan balance.

The measure of market equity used in this study is identical to that in our FY 1990 report. The reader is referred to that report for details.

C. Variability in Regional House Price Appreciation

The analysis of loan default focuses on explaining default behavior for groups of borrowers based on characteristics deemed to be important in the determination of the probability of loan default. A national measure of the average rate of change in house prices has been employed in computing the equity index. While house prices have increased consistently when measured on a nationally aggregated basis, there has been considerable variability at the four census region level. Low or negative price movements in selected regions are likely to make a greater than proportional contribution to default and claim rates. Aggregate indicators will not capture adequately the impact of weak house price appreciation in localized areas on overall rates of claim termination.

Even when average property values are rising so that widespread borrower default is not likely, there may be some borrowers who are at risk because their regional housing market is experiencing falling house prices. It is the borrowers in the tail of a distribution for national house price appreciation (persistent low or negative rates of house price appreciation) that are at greatest risk of defaulting, and resulting in claims. Assuming that increased aggregate volatility in house price movements accompanies increases in properties with small or negative changes in their house value, the house price dispersion index should reflect concentrations of regional price weakness, and hence increases in the local "at-risk" populations.

We constructed an index using the four regional constant quality house price indexes from the Bureau of the Census, to capture the effects of the dispersion in house price appreciation across regions on aggregate claim rates.[20] First, we computed the ratio of the constant quality house price index in year *t* to the value in the origination year for each of the regions and for the nation as a whole. Then, we computed the standard deviation of these regional ratios for each loan origination year and policy year and divided by the national ratio to create a measure of relative dispersion in house price appreciation. Deflating the standard deviation in house price variation by a national ratio adjusts for the general overall trend in house prices.

D. Cash Flow and Burden of Mortgage Servicing

While equity is an important determinant of claim risks, cash flow considerations also play a role in the household's decisions. When mortgage servicing costs absorb a large fraction of the household's income, the risk of default and eventual claim rises. On the individual level, these claims might occur because a small change in the income of a household barely able to afford its mortgage triggers a default leading to a claim in a case where household equity is low or negative. In this case, one would expect cash flow considerations to be more important to claim rates for higher LTV classes. Naturally, these instances are even more likely to occur with ARMs as payment burdens sometimes change to an unanticipated extent. However, they can occur for FRMs as unemployment, family breakups and other crises tax household cash flows.

In aggregate, higher median burdens for a given book of business are likely to lead to higher proportions of households at risk of cash flow problems. As a book of business matures, the burden of mortgage servicing as a fraction of average income will decline for fixed rate mortgages because mortgage costs are fixed in nominal terms while incomes rise with

[20] Dispersion indices of different descriptions are common in default and claim modeling literature. See sources referred to in footnote 17.

inflation and productivity gains. Consequently, the proportion of "at risk" households generally decreases by policy year, with fewer cash flow crises occurring. Cash generated defaults and claims should therefore decline with the seasoning of a book as cash flow becomes less of an issue and equity rises.

We measure the cash flow burden of mortgage servicing costs with a variable (PAYMENT) constructed by dividing mortgage service costs by median household income. Mortgage costs depend on the contract interest rate, mortgage term, and loan size. These costs are fixed in nominal terms for the life of the mortgage. Median household nominal income increases over time, resulting in a cash flow burden that declines with policy years for a given book of business.

E. Additional Economic Indicators Used in the Analysis

The economic data used to develop the equity index and to estimate the structural model are reported in Exhibit A-1. The FHA contract rate is taken directly from FHA's A-43 database and represents the average rate each year on FHA originated loans. The opportunity cost of mortgage financing used to compute the mortgage value is represented by the Freddie Mac surveyed commitment rates on conforming loans. This rate is always above the FHA contract rate.

Exhibit A-1

Historical Data of Economic Variables Used in the Analysis Referenced on a Fiscal Year Basis			
Year	Constant Quality House Prices	FHA Contract Interest Rate	Freddie Mac Commitment Rate
1975	43.8	8.63	9.20
1976	47.0	8.50	8.94
1977	51.5	8.25	8.82
1978	58.8	9.02	9.34
1979	67.6	9.96	10.61
1980	74.6	12.23	13.23
1981	80.6	15.10	15.76
1982	82.6	14.71	17.02
1983	84.6	12.38	13.37
1984	88.3	13.18	13.82
1985	90.1	11.85	12.91
1986	94.4	9.64	10.70
1987	100.0	9.87	9.90
1988	103.6	10.22	10.45
1989	107.5	10.16	10.47
1990	109.1	9.71	10.10
1991	110.0	9.30	9.57
1992	111.9	8.18	8.36

F. Model Estimation

The econometric model and estimation techniques used in this review are substantially similar to those used in the FY 1991 Review. The incorporation of an additional year of experience data (FY 1992) and addition of claim and prepayment rates data to the eighteenth policy year has not changed the fundamental relationships among the dependent and explanatory variables. Our analysis of the model and its performance confirmed that the model is both technically sound and appropriate for the problem that it was designed to address. We have nonetheless re-examined the model and our estimation techniques and have made refinements to the econometric method. These are described in the paragraphs below.

As in the FY 1991 Review, we use a semi-log functional form for the conditional claim rates model. For estimation purposes, the general model is applied in semi-log form:

$$\begin{aligned} \ln CCR_{i,j,t} = \alpha + \sum_{k=1}^{12} \alpha_k D_{k,t} + \sum_{k=1}^{7} \beta_k (LSD_{k,i} EM_{j,t-1}) \\ + \beta_8 EQ8286_{j,t-1} + \beta_9 RTEQ8286_{j,t-1} + \beta_{10} EQP87_{j,t-1} \\ + \gamma_1 (PAYMENT_{i,j,t}) + \gamma_2 \sigma_{j,t-1} (RCQHP) + e_{i,j,t} \end{aligned} \qquad (2)$$

where indexes i=loan size, j=origination year, t=policy year, k = a count index. The first set of indicator variables take the value 1 when policy year (t) is equal to k, and are zero otherwise. The thirteenth and later years act as the baseline for the policy year indicators. Their baseline claim rate is embedded in α. The second set of indicators (LSD) take the value 1 when loan size class equals the counter index: i=k, and are zero otherwise. EQ8286 takes the value of equity when the origination year is between 1982 and 1986, inclusive. RTEQ8286 is the square root of the equity value for these books. The square root term was added to improve our ability to fit the nonlinear effects of equity on claims for the 1982 through 1986 period. EQP87 takes the value of equity when the origination year is 1987 or

later. PAYMENT refers to cash flow burden variable. RCQHP refers to the house price dispersion index.

Most of the features of the FY 1992 econometric model are unchanged from the previous year. Time series data on conditional claim rates for up to eighteen policy years are combined with cross-sections of data defined by seven loan size amounts, i, and sixteen loan origination year categories, j. A separate regression is run for each of the defined LTV category cross-sections. The market equity index, $EM_{j,t-1}$, is lagged one policy year and separate coefficient estimates are made for each of the seven loan size cross-sections to measure the differential impact of market equity on their claim experiences. This is accomplished by multiplying the equity index by each of seven zero-one indicator variables, $LSD_{k,i}$, equaling one in loan size category $i=k$ and zero otherwise. The GLS weighting scheme used to correct for heteroscedasticity is the same as that used in the 1991 Actuarial Review.

The changes from the FY 1991 econometric model are:

- Inclusion in the claim rates equations of the PAYMENT variable, to capture cash flow burdens of mortgage servicing -- PAYMENT is the cost of mortgage servicing (depending on contract interest rate, term and loan size) divided by the annual median nominal household income.[21] This change replaced the explanative power of the unemployment variable in the claim rates equations. Therefore, the unemployment variable was eliminated from our regressions. Unemployment had been used to model the effects of economic shocks on the risk of claims. The PAYMENT variable was shown to be a better predictor of claims.

[21] In part, this variable may capture the effects of the well known "tilt" phenomenon which tends to cause households to overbuy housing when they anticipate large nominal income increases. See J. R. Follain, "Mortgage Choice", *AREUEA Journal*, V. 18(2) 1990 pp. 125-144; R. M. Schwab, "Inflation Expectations and the Demand for Housing", *American Economic Review*, V. 72(1) March 1982 pp. 143-15, for details. Related issues are raised in T.H. Goodwin, "Inflation, Risk, Taxes, and the Demand for Owner-Occupied Housing", *Review of Economics and Statistics*, 1986 pp. 197-206, L. B. Smith, et al, "Recent Developments in Economic Models of Housing Markets", *Journal of Economic Literature*, March 1988 p. 29-64

- Redistribution of observations below an LTV of 90% into new classes -- The classes were defined for this study as: "No Appraisals" including streamlined refinancings[22], LTV greater than 0% to 65%, 65% to 80% , 80% to 90%, Classes above 90% were unchanged: 90% to 93%, 93% to 95%, 95% to 97%, 97% and greater. Limits between classes are included in the upper of two adjacent classes. The change aggregates those observations where market equity erosion is least likely to be an important factor in the default and claim process (LTV's below 65%) and uses the 80% benchmark, important to private mortgage insurers (PMIs), as another delimiter. Borrowers generally do not require mortgage insurance at LTVs lower than 80%. Those who do take FHA insurance in this category would not likely qualify for a conventional mortgage.

- Inclusion in the claim rates equations of a special term for equity for the books of business from the 1982 to 1986, and post-1986 periods -- The 1975 to 1981 period thus forms the baseline for comparisons. These equity variables are used to capture the differences by book of business in the impact of equity in reducing claim risks. These differences arise from the different meanings that "equity" had at different times as standards changed for allowable interest rate buydowns and similar incentives, and as FHA vigilance over lender underwriting practices fluctuated.[23] The square root of equity was also added for the 1982 through 1986 period to improve our ability to fit the nonlinear effects of equity on claims.

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22 The "No Appraisals" LTV class is composed largely of streamlined refinancings with no appraisals. Streamline procedures allowed borrowers to obtain appraisals -- a requirement if closing costs were to be financed -- or forego an appraisal and pay closing costs out of pocket. Mortgages that were refinanced without appraisals appear in our data with LTVs exactly zero, while those with appraisals are classified under their appropriate LTV category. Streamlined refinancings began in 1983, but those without appraisals did not become a significant fraction until 1986. Other zero LTV observations may include property disposition cases and miscellaneous coding errors.

23 These changes and their impacts are documented in two reports to HUD: R. F. Cotterman, *Seller Financing of Temporary Buydowns. Part 1: Effects on Sales Prices of Homes*, Nov 10, 1992 and R. F. Cotterman, *Seller Financing of Temporary Buydowns. Part 2: Effects on Mortgage Default*, Nov 30, 1992. R. L. Cooperstein et al, "Modeling Mortgage Terminations in Turbulent Times", *AREUEA Journal*, V. 19(4) 1991 pp. 473-494 argue that market equity of homes mortgaged prior to 1980 was overstated during the 1982-86 period as well, leading to higher than expected defaults during this period.

II. Level of Aggregation in the Analysis

The conditional claim rates model employs data aggregated from the individual loan records to specified loan categories. The analysis is conducted by pooling the time series of loan performance over the 1975-92 policy years for stratified categories of loan size, LTV and loan origination years 1975-90. The time series of loan performance for each loan origination year extends from loan origination to the present (FY 1992) comprising up to eighteen policy years.

In estimating the claim rates profile, loan data are aggregated across seven loan size categories and nine LTV categories. The loan size categories are established with reference to the 1979 nominal price of properties. The loan size categories in subsequent years will increase or decrease according to changes in the constant quality house price index. This will enable a reasonable comparison to be made of loans over time as the nominal value of the loans change.

The LTV categories are defined so as to capture the expected acceleration in the conditional claim rates at the higher LTVs. A wider LTV category definition has been established for the lower LTVs from 0 to 65% and 65 to 80%, while smaller stratifications have been set up for the LTVs between 80 and 100%. We found in earlier actuarial reviews that rates increase when the original LTV moves above 90%. Separate models are estimated for each of the nine LTV categories. The pooling of data for each equation is shown in Exhibit A-2 below.

Exhibit A-2

Grouping of Data Across Loan Size Category and Policy Year				
Endorsement Year	(1,000's) Number of Mortgages	(1) Policy Years	(2) Loan Size Categories	(3)=(1)*(2) Number of Observations
1975	182	18	7	126
1976	216	17	7	119
1977	250	16	7	112
1978	258	15	7	105
1979	266	14	7	98
1980	229	13	7	91
1981	162	12	7	84
1982	114	11	7	77
1983	405	10	7	70
1984	232	9	7	63
1985	340	8	7	56
1986	810	7	7	49
1987	1,001	6	7	42
1988	549	5	7	35
1989	594	4	7	28
1990	674	3	7	21
Total Observations for Each Estimated Model				1176

A. Results for the Analysis on Conditional Claim Rates

The estimates of the coefficients in the claim rates model are presented in Exhibit A-3. The coefficients support prior expectations. Cash flow considerations (PAYMENT) in particular appear to exert an economically and statistically significant influence on claim rates. Market equity is also very significant in the regressions. Increasing market equity strongly reduces claim rates for most LTV categories as one would expect.

Exhibit A-3

Regression Results for Conditional Claim Rate Model by LTV Category

(t-statistics are in parentheses)

Variable	No Appraisals	0-65%	65-80%	80-90%	90-93%	93-95%	95-97%	97%+	Investor
Market Equity - Loan Size 1	-1.1708 (-10.4442)	-0.8332 (-4.7615)	-0.6137 (-3.5333)	-0.3919 (-2.5970)	-0.0023 (-0.0173)	-0.1448 (-1.0886)	-0.4880 (-4.5695)	-0.8721 (-10.5762)	-0.1489 (-0.9148)
Market Equity - Loan Size 2	-1.4162 (-11.5933)	-0.8804 (-4.6852)	-0.7236 (-3.9411)	-0.7524 (-4.4935)	-0.4197 (-2.7473)	-0.6521 (-4.1993)	-0.9455 (-7.4230)	-1.4354 (-14.5657)	-0.0772 (-0.4495)
Market Equity - Loan Size 3	-1.5803 (-12.5909)	-0.7922 (-4.2504)	-1.0502 (-5.7236)	-1.1250 (-6.8942)	-1.0773 (-7.3975)	-1.2029 (-8.1685)	-1.4070 (-11.3615)	-1.8420 (-18.6858)	-0.3205 (-1.8656)
Market Equity - Loan Size 4	-1.6215 (-12.6802)	-0.4335 (-2.3292)	-1.1845 (-6.4394)	-1.3637 (-8.3272)	-1.2205 (-8.3882)	-1.4600 (-10.3604)	-1.6733 (-13.6345)	-2.1086 (-19.8409)	-0.4804 (-2.7864)
Market Equity - Loan Size 5	-1.6060 (-12.2702)	-0.3559 (-1.8647)	-1.0404 (-5.6148)	-1.4282 (-8.5779)	-1.2709 (-8.7725)	-1.5019 (-10.5507)	-1.6665 (-12.8417)	-2.0973 (-17.3485)	-0.5720 (-3.2427)
Market Equity - Loan Size 6	-1.7267 (-13.6435)	-0.3486 (-1.8860)	-1.1986 (-6.7057)	-1.7928 (-11.6443)	-1.8201 (-13.9156)	-1.9867 (-16.1156)	-1.9953 (-16.7579)	-2.3827 (-20.7017)	-0.7265 (-4.2983)
Market Equity - Loan Size 7	-1.8091 (-12.5938)	-0.1889 (-0.9440)	-1.3274 (-6.5577)	-1.8902 (-10.0408)	-1.8797 (-11.3130)	-1.8582 (-10.8840)	-1.9208 (-10.9936)	-2.4343 (-13.2148)	-0.9002 (-4.2205)
House Price Dispersion	5.9982 (12.7423)	3.1423 (6.2152)	4.2779 (12.9590)	4.0569 (14.1169)	3.7869 (14.5906)	3.4151 (12.7914)	3.3640 (14.8046)	2.9264 (13.1463)	4.1015 (14.4396)
1982-86 Mkt. Equity	-4.7686 (-0.6071)	-18.4156 (-4.7962)	-2.2212 (-1.9169)	-5.3061 (-5.9976)	-3.3762 (-4.4418)	-2.0683 (-2.6635)	-3.4495 (-5.2492)	-1.4744 (-2.2746)	-4.6722 (-5.6433)
Sq. Rt. 1982-86 Mkt. Equity	5.1723 (0.6725)	16.0988 (4.6908)	1.4360 (1.8855)	3.4173 (6.8299)	2.1927 (5.5963)	1.5129 (3.9295)	2.5191 (8.0669)	1.3943 (4.7693)	3.0637 (6.5180)

Regression Results for Conditional Claim Rate Model by LTV Category

(t-statistics are in parentheses)

Variable	No Appraisals	0-65%	65-80%	80-90%	90-93%	93-95%	95-97%	97%+	Investor
1987+ Mkt. Equity	1.1489 (7.9861)	-0.7341 (-10.6543)	-1.1843 (-11.2506)	-1.1983 (-9.2274)	-1.8406 (-12.0615)	-2.2030 (-12.6628)	-1.4780 (-9.5032)	-2.7158 (-15.5906)	-1.5319 (-11.7656)
Payment Index	4.0554 (15.4366)	3.2279 (7.2641)	5.4893 (17.5476)	5.6018 (20.6112)	6.1466 (25.3970)	6.6211 (26.0558)	6.2773 (29.4842)	6.6218 (34.7359)	5.8403 (22.7305)
Summary Regression Statistics									
Adj. R-Squared	0.788	0.579	0.793	0.894	0.923	0.924	0.949	0.950	0.941
Root Mean Squared Error	0.651	0.794	0.509	0.418	0.373	0.379	0.317	0.307	0.415
F-Statistic	182.995	68.266	188.255	412.006	584.517	599.350	914.544	922.867	775.420

The loan-size-market-equity coefficients shown in Exhibit A-3 indicate that market equity generally exerts a stronger influence in reducing propensity to claim as loan size increases. The exceptions are no appraisals and the 0-65% LTV category. Where equity levels are generally high --as in the lowest LTV groups -- marginal movements in market equity are not likely to be an important marginal influence on claim rates. It is very unlikely that these households would anticipate equity erosion to such an extent that their wealth would be higher by defaulting rather than continuing to service their mortgages.

The negative coefficients on the loan-size-equity variables, across all loan sizes, indicate that increases in equity reduce the probability of claim termination within an LTV group. Larger negative coefficients on the equity variable are associated with a lower likelihood of default per unit change in market equity.

The right hand side of the regressions also includes separate equity variables for the 1982 to 1986 originations and for originations in the period from 1987 to 1992. Preliminary regression results revealed a substantial under-prediction of claims on books of business from the mid-1980s and a pronounced over-prediction for the books of the late 1980s. These departures, including the substantially increased claims experience of books written between 1982 and 1986, were due to changes in the mortgage market during that period.

Beginning in 1982, seller concessions became popular in the form of interest buy downs (IBD), seller paid mortgage origination points, and payments of other closing costs. These concessions inflated selling prices and increased loans by similar amounts. FHA's underwriting did not deduct these concessions from the value of the property, even though their future collateral value was limited or non-existent. This effectively raised the loan to value ratio, exposing FHA to additional claims risk. FHA's policy was tightened beginning in 1986 by setting maximum limits on allowable seller prepaids in both appraisal

comparables and homes insured. While recorded IBD's represent less than ten percent of the overall FHA business in this period, they have experienced substantially higher claims.[24]

To date, the claims experience of loans originating in 1987 and later has been markedly different from that of their predecessors in the 1980's. Through FY 1992, after controlling for the level of equity and economic conditions, these loans have had a measurably smaller propensity to default. The timing of this reduction in claims for these books corresponds with FHA actions to tighten underwriting standards and to eliminate problem lenders from its programs. Cash-out refinancings motivated by tax code changes in the Tax Reform Act of 1986 and its modifications might also account for the diminished risk of these recent books of business. To the extent that loans on FHA books since 1987 are second mortgage consolidations or refinancings motivated by lower interest rates, defaults are less likely.

Comparisons of actions against lenders and servicers by the FHA's Mortgage Review Board, as presented in Exhibit A-4, support our observation regarding increased FHA vigilance.

Exhibit A-4

Actions by Mortgage Review Board							
	1981-86 Avg.	1987	1988	1989	1990	1991	1992
Count	5	36	33	19	29	41	66
Recoveries ($Millions)	1.0	6.9	12.6	7.7	4.9	8.5	7.2

[24] See footnote 24 for references.

Because actions are well publicized within the lender community, the impact on lender behavior of increasing numbers of actions is likely to be greater than the magnitudes or trends in dollar recoveries might suggest.

The coefficient on equity for the 1987 and later books is negative in every case except for the no appraisals category. The coefficient for this category suggests that this group of business has experienced increasing claims over time. That trend is unique among the groups in our data. This group of business includes certain high LTV policies where the LTV is not recorded. Appraisals are made in streamlined refinancings only in cases where the borrower is financing closing costs. With the rolling recessions in the midwest, southwest, and more recently, the west and east coasts, it is likely that LTV's have increased substantially as equity has eroded. As the proportion of high-LTV loans increased in this group through the late 1980's, this group would experience rising claim rates.

Our PAYMENT variable captures cash flow considerations leading to claims. PAYMENT is defined as the cost of mortgage servicing divided by median household income. The coefficients are positive and very significant in all cases, indicating that higher burdens on household cash flows are likely to lead to higher claim rates. Higher LTV households are generally more sensitive to cash flow influences on claim rates, as we would expect, with the role of cash flow distress as a trigger for claims in high LTV cases.

House price dispersion lagged one year enters strongly with positive coefficients in every case. Price dispersion is used in an attempt to proxy for the relative importance of outliers in housing capital gains. Greater dispersion for a given average rate of growth in the house price index suggests that more housing might have suffered from slow or no equity gains, a phenomenon that is linked with a larger at risk pool of homeowners.

III. Method to Estimate Conditional Prepayment Rates

A model for conditional prepayment rates was developed to explain borrowers' decisions to prepay their mortgage. It is necessary to model prepayments for two reasons. First, prepayments generate cash outflows associated with the refund policy on the unearned portion of premiums beginning with 1984 originated loans. Second, in projecting future claims, it is necessary to estimate the pool of surviving loans, and therefore, all terminations must be accounted for to estimate the surviving loans in subsequent years.

A. Economic Model

An economic model for borrower prepayment behavior employs the same wealth-maximizing consumer choice underpinnings used in the claims rate model. In considering the options for meeting their mortgage debt obligations, borrowers will consider the prepayment option when it maximizes their expected wealth or, when they move. As with the conditional claims model, our hypothesis here is that the conditional probability of prepaying a mortgage can be estimated from financial market conditions along with household mobility patterns. Aggregating across stratified groups of borrowers, we formulate a model to explain the conditional rate of prepayment.

The following basic model is used to explain prepayment behavior, or specifically, non-claim termination rates for FHA-insured loans:

$$CPR_{i,j,t} = f(MV1\$_{i,j,t} / BV1\$_{i,j,t}, MR1_{MOV_{j,t}}, MR1_{MIN_{j,t}}, MR0_{MIN_{j,t}}) \quad (3)$$

where:

$CPR_{i,j,t}$ - is the conditional non-claim termination rate measured as the ratio of the number of non-claim terminations in a policy year to the number of loans surviving to that policy year t, for loans originated in year j and loan size i.

$(MV1\$/BV1\$)_{i,j,t}$ - the ratio of the market value of the remaining mortgage liability to the book valuation of the remaining mortgage liability,

$MR1_{MOVj,t}$ - the ratio of the average FHA contract rate during the last six years to the current new FHA contract rate, constrained to a minimum value of one,

$MR1_{MINj,t}$ - the ratio of the minimum FHA contract rate since origination to the current new FHA contract rate, restricted to a minimum value of one,

$MR0_{MINj,t}$ - the ratio of the minimum FHA contract rate since origination to the current new FHA contract rate, restricted to be less than one.

The decision to prepay the mortgage loan depends on the underlying mobility of borrowers, perception of loss (gain) at time of sale, and the path of interest rates since the loan was originated. To capture the underlying mobility effect, zero-one indicator variables are included for each of the first twelve policy years following loan origination. The years thirteen to seventeen quintennium form the default relative to which the mobility of the first twelve years is measured.

Four variables are used to capture the impacts of current interest rates relative to past levels. The first is the ratio of the current market value of the mortgage to the current book value. If the market value of the debt exceeds the book value, due to declines in interest rates, borrowers have an incentive to refinance (replace the current market value with debt equal in

value to the current book value). The market value is computed as in the homeowner equity calculation, except here the market value of the mortgage is not constrained by the book value of the mortgage liability.

The specific time path of mortgage contract rates since origination may also matter. For example, if rates initially rise for a while, this will discourage the normal prepayment of a mortgage because borrowers will not want to give up what has become a below-market rate. Also, a subsequent decline in interest rates to below the original coupon rate may have a smaller impact on prepayment as equity builds and the outstanding mortgage principal declines.

Three additional interest rate variables are used to capture these effects: the ratio of the average contract rate over the previous six years to the current new issue rate, and two variables for the ratio of the lowest value coupon rates since the mortgage origination to the current new issue rate. To allow for different responses to rises and falls in rates, we estimate different coefficients for values of the latter variable above and below unity.

B. Data Disaggregation in the Analysis of Conditional Prepayment Rates

The analysis pools the time series of loan prepayment experience across eighteen policy years, 1975-92, with specified cross-sections of loans including sixteen loan origination years, 1975-90, seven loan size and nine LTV categories. The stratification of loans corresponds to that of the claim termination analysis.

C. Estimation and Results for the Conditional Prepayment Rate Model

The prepayment model applies the same underlying semi-log functional form used in the claim termination analysis:

$$\ln CPR_{i,j,t} = \alpha + \sum_{k=1}^{12} \alpha_i PYD_{k,t} + \sum_{k=1}^{7} \beta_k (LSD_{k,i} MVR_{i,j,t}) + \Gamma(X_{i,j,t}) + e_{i,j,t} \quad (4)$$

Like the claims termination rate model, time series data for up to seventeen policy years, t, are combined with cross-sections of data defined by seven loan size categories, i, and fifteen loan origination year categories, j. Nine separate models are estimated, one for each of the defined LTV category cross-sections. Twelve zero-one indicator variables, $PYD_{k,j,t}$ are used to measure the baseline prepayment rates over all observed policy years. The thirteenth through seventeenth years act as the baseline for the policy year indicators. In addition, the estimated model is constructed to measure the interaction effects of loan size categories with the ratio of market to book valuation of the mortgage liability, $MVR_{i,j,t}$. The other variables in the model identified above are represented by $X_{i,j,t}$. The same generalized least squares estimator was applied to estimate each of the nine prepayment models here as in the conditional claims rate estimation procedure.

The estimation results are shown in Exhibit A-4. The main explanatory forces behind the probability of prepayment are changes in current mortgage interest rates relative to both the mortgage contract rate at loan origination and the path of rates since origination. The positive relationship with the conditional prepayment rate indicates that increases (decreases) in the market value of the financial liability will raise (lower) the probability of loan prepayment. The mortgage value effect is stronger for loans at the higher LTV and loan size categories indicating a greater propensity to prepay for a given mortgage liability value.

Exhibit A-5

Regression Results for Conditional Prepayment Rate Model by LTV Category

(t-statistics are in parentheses)

Variable	No Appraisals	0-65%	65-80%	80-90%	90-93%	93-95%	95-97%	97%+	Investor
Market to Book Mortgage Value Loan Size 1	3.9325 (19.9302)	5.0492 (31.8469)	5.7191 (33.6722)	6.0780 (35.7130)	6.1017 (37.3822)	6.1906 (37.2031)	5.7807 (33.9658)	5.4559 (34.4155)	5.3306 (35.4285)
Market to Book Mortgage Value Loan Size 2	4.2485 (21.4536)	5.3188 (33.3081)	5.9850 (35.0909)	6.3170 (37.1737)	6.3285 (38.7339)	6.4214 (38.6714)	6.0093 (35.3149)	5.7043 (35.9608)	5.6012 (36.9589)
Market to Book Mortgage Value Loan Size 3	4.3435 (22.0794)	5.4107 (33.8148)	6.0464 (35.5152)	6.3375 (37.4402)	6.3192 (38.9633)	6.4113 (38.8507)	6.0645 (35.8339)	5.7819 (36.7253)	5.6610 (37.3950)
Market to Book Mortgage Value Loan Size 4	4.4023 (22.3387)	5.4954 (34.3417)	6.1284 (36.0288)	6.3934 (37.7552)	6.3576 (39.3157)	6.4438 (39.0521)	6.1281 (36.2497)	5.8614 (37.2144)	5.7208 (37.7718)
Market to Book Mortgage Value Loan Size 5	4.4929 (22.8768)	5.5332 (34.3908)	6.1985 (36.3772)	6.4705 (38.2114)	6.4033 (39.5903)	6.4960 (39.3869)	6.2091 (36.7600)	5.9704 (38.0029)	5.7830 (38.1687)
Market to Book Mortgage Value Loan Size 6	4.5014 (23.0294)	5.5673 (34.7629)	6.2024 (36.4403)	6.4633 (38.2698)	6.3805 (39.6088)	6.4803 (39.5332)	6.2346 (37.2427)	6.0233 (38.7800)	5.7951 (38.1977)
Market to Book Mortgage Value Loan Size 7	4.7116 (24.0230)	5.7371 (35.6752)	6.3918 (37.4894)	6.6762 (39.4907)	6.6336 (41.0884)	6.7570 (41.2336)	6.5492 (39.0914)	6.3378 (40.6086)	6.0323 (39.7618)

Regression Results for Conditional Prepayment Rate Model by LTV Category

(t-statistics are in parentheses)

Variable	No Appraisals	0-65%	65-80%	80-90%	90-93%	93-95%	95-97%	97%+	Investor
Current New Issue Rate Over 6 yr. Mvg. Avg. (Max. Val. =1)	1.0546 (5.8383)	2.8025 (14.9922)	2.8666 (15.1160)	2.2672 (12.8766)	1.8887 (11.7171)	1.7576 (11.0038)	1.8046 (10.8892)	1.2270 (8.0737)	2.3836 (14.3178)
Current New Issue Rate Over Prior Minimum New Issue Rate (Max. Val. =1)	-1.2130 (-5.9986)	-0.4404 (-2.2725)	-0.4953 (-2.4651)	-0.3520 (-1.7994)	-0.5849 (-3.1746)	-0.9683 (-5.3522)	-0.6809 (-3.6118)	-0.4686 (-2.7311)	-0.7832 (-4.2594)
Current New Issue Rate Over Prior Minimum New Issue Rate (Min. Val. =1)	-2.1019 (-8.0092)	-5.5725 (-28.7183)	-6.3826 (-30.8722)	-6.2861 (-30.5835)	-5.6001 (-28.4279)	-5.2544 (-26.5879)	-5.3711 (-26.4076)	-4.6764 (-25.1311)	-5.3548 (-28.2318)
Summary Regression Statistics									
Adj. R-Squared	0.940	0.978	0.974	0.968	0.966	0.961	0.955	0.954	0.967
Root Mean Squared Error	0.556	0.441	0.458	0.458	0.444	0.444	0.447	0.408	0.412
F-Statistic	840.421	2322.521	1983.266	1638.192	1497.557	1301.296	1131.718	1111.346	1568.006

IV. Forecasting FHA Loan Performance

We use the estimated econometric models for conditional claim rates and prepayment rates to simulate the history of loan performance and to develop projections of future loan performance under alternative economic scenarios. The historical simulation analysis can be used to evaluate how well the model predicts claims and prepayments across the loan categories and over the policy years. The forecast analysis develops conditional claim and prepayment rates and, in turn, projections of counts for claim and prepayments from 1992 forward for each of the defined loan categories and for each loan origination year from 1975 through 1992.[25]

A. Dynamic Simulation of Historical Claims and Prepayments

We conducted a dynamic simulation of the number of claims and prepayments across the historical period from 1975 through 1992 to evaluate the ability of the model to explain and forecast the conditional claim and prepayment rates. The simulation is dynamic in the sense that the number of claims and prepayments computed each policy year is a product of the loan survivors from the previous period times the current year's predicted conditional claim rates and prepayment rates. Actual survivor data is used for the first policy year and estimated values are used thereafter. The predicted conditional probability rates multiplied by the estimated loan survivor rates at the beginning of the policy year yield a predicted number of claims and prepayments in that policy year. The survivors less the sum of claim and non-claim terminations for each year yields a projection of the number of loans that

[25] To forecast claims and prepayment rates beyond the twelfth policy year it is necessary to impute values for future policy years coefficients. A fifteen percent decay rate was applied to claim-rate policy year coefficients beyond the twelfth policy year, or the last year of actual claims experience when the historical record for a book is longer than twelve years. The fifteen percent rate was based on the average decline rate for historical books in out-years. No decay is applied to future policy year coefficients in the prepayments model because no general decline in coefficients is discernable.

survive to the beginning of the next policy year.[26] We used these claims and survivor projections to forecast MMI Fund cash flows.

It would be useful to have a measure of the accuracy of the econometric models' predictions for the years beyond the sample period (i.e. "out-sample" predictive accuracy). By definition it is not possible to evaluate predictive accuracy for future periods. However, we can approximate that test by examining the models' accuracies within the estimation period (the "in-sample" predictive accuracy). Because the model was estimated on these years, generally we would expect the accuracy over the in-sample period to be greater than the out-sample accuracy of the model.

Predictive accuracy is determined by comparing the predicted numbers of claims and prepayments with the actual claims and prepayments across selected categories of loans. Exhibits A-6 through A-8 report the results for in-sample accuracy tests classifying the data according to LTV category, loan size, termination year and loan origination year.

[26] The forecasts beginning with 1992 policy year use actual counts of surviving loans to the start of that year and estimated surviving counts thereafter.

Exhibit A-6

Dynamic Simulation of Claims and Prepayments For the Period 1975-92 By Loan Size and LTV Categories

(Fixed Rate 30 Year Mortgages across all Origination and Termination Years)

Loan Size	LTV Category	Claims			Prepayment		
		Actual	Predicted	Predicted / Actual	Actual	Predicted	Predicted / Actual
	Refinancings	44,557	55,513	125%	203,544	254,861	125%
	0-65%	3,229	3,329	103%	80,923	80,964	100%
	65-80%	14,678	12,827	87%	168,054	170,195	101%
	80-90%	29,989	26,744	89%	207,291	212,542	103%
	90-93%	29,096	25,801	89%	162,474	166,746	103%
	93-95%	29,451	26,665	91%	146,573	152,319	104%
	95-97%	78,186	72,389	93%	285,426	300,564	105%
	97%+	188,571	183,151	97%	577,553	599,899	104%
	Investors	61,133	54,731	90%	215,292	216,081	100%
1		103,666	93,087	90%	226,157	243,248	108%
2		65,874	63,801	97%	211,439	237,160	112%
3		68,730	65,856	96%	272,354	292,744	107%
4		65,859	63,725	97%	303,634	322,752	106%
5		59,569	58,973	99%	298,774	319,479	107%
6		85,176	80,700	95%	480,822	470,303	98%
7		30,016	35,010	117%	253,950	268,485	106%
Totals		478,890	461,150	96%	2,047,130	2,154,171	105%

Exhibit A-7

Dynamic Simulation of Claims and Prepayments For the Period 1975-92 By Loan Termination Years

(Fixed Rate 30 Year Mortgages Only)

	Claims			Prepayment		
Term. Year	Actual	Predicted	Predicted / Actual	Actual	Predicted	Predicted / Actual
75	108	190	176%	368	2,678	728%
76	1,677	1,225	73%	3,989	9,743	244%
77	4,159	3,032	73%	20,134	18,167	90%
78	4,830	4,833	100%	42,642	30,220	71%
79	4,961	6,746	136%	51,802	38,161	74%
80	5,106	8,401	165%	29,810	43,904	147%
81	7,360	10,461	142%	17,835	54,416	305%
82	10,224	12,491	122%	8,916	42,469	476%
83	16,960	15,962	94%	58,248	76,841	132%
84	18,333	23,099	126%	46,152	86,444	187%
85	25,080	27,662	110%	60,339	97,934	162%
86	33,109	37,317	113%	256,645	216,346	84%
87	46,161	47,011	102%	341,914	274,734	80%
88	61,308	51,465	84%	154,504	205,835	133%
89	62,694	47,544	76%	140,509	192,449	137%
90	58,811	48,868	83%	176,598	197,440	112%
91	59,496	55,529	93%	210,428	223,862	106%
92	58,513	59,313	101%	426,297	342,526	80%
Totals	478,890	461,150	96%	2,047,130	2,154,171	105%

Exhibit A-8

Dynamic Simulation of Claims and Prepayments For the Period 1975-90 By Loan Amortization Years

(Fixed Rate 30 Year Mortgages Only)

Term. Year	Claims			Prepayment		
	Actual	Predicted	Predicted / Actual	Actual	Predicted	Predicted / Actual
75	8,967	12,722	142%	103,604	117,168	113%
76	10,637	14,958	141%	117,779	125,625	107%
77	10,356	16,892	163%	118,206	143,193	121%
78	14,523	23,197	160%	105,048	135,765	129%
79	24,806	30,668	124%	96,946	131,563	136%
80	31,821	32,164	101%	105,931	136,539	129%
81	32,375	30,671	95%	89,570	155,530	174%
82	21,326	19,275	90%	75,939	71,243	94%
83	55,646	59,638	107%	249,706	208,622	84%
84	39,681	35,718	90%	137,665	134,522	98%
85	50,240	33,277	66%	197,334	126,978	64%
86	72,313	59,051	82%	215,347	178,255	83%
87	51,839	38,613	74%	149,471	206,854	138%
88	26,504	22,817	86%	108,605	108,696	100%
89	18,269	19,452	106%	108,057	98,584	91%
90	9,587	12,037	126%	67,922	75,034	110%
Totals	478,890	461,150	96%	2,047,130	2,154,171	105%

In the aggregate the model simulation predicts total claims of 96 percent of the actuals, and prepayments of 105 percent of actuals. Looking across years, the model performs best in the post-1982 period. Both the claim and prepayment models perform well in predicting claims and prepayments across LTV and loan size categories. The prepayment model is somewhat volatile in its predictive accuracy, understating prepayments for the 1982 to 1986 originations, while overpredicting earlier books.

B. Forecasting Conditional Claim and Prepayment Rates

The models are used to forecast conditional claim and prepayment rates over the thirty-year term life of the mortgage under alternative economic scenarios in order to assess the reasonableness of the results and to determine the sensitivity of the projections to changes in select components of the economic forecasts.

In Exhibits A-9 and A-10, the forecasts of conditional claim and prepayment rates on the 1986-92 books of business are summarized for each of the first eleven policy years (numbers above the step bar represent historical conditional claim rates for each origination year) and for the ultimate claim rate. (See Exhibit III-1 for forecasts of economic variables.)

Exhibit A-9

Forecast of Conditional Claim Rates 1986-92
Assuming Baseline Economics
(Values in Percents)

Policy Year	1986	1987	1988	1989	1990	1991	1992
1	0.013	0.012	0.013	0.016	0.007	0.011	0.007
2	0.503	0.397	0.459	0.390	0.342	0.325	0.722
3	1.876	1.142	1.262	1.224	1.107	1.345	1.078
4	2.340	1.379	1.666	1.627	1.629	1.513	1.109
5	2.185	1.404	1.811	1.700	1.666	1.321	1.031
6	2.003	1.332	1.481	1.558	1.465	1.191	0.943
7	1.730	1.061	1.279	1.363	1.295	1.042	0.845
8	1.612	0.975	1.189	1.279	1.200	0.975	0.801
9	1.450	0.843	1.041	1.125	1.055	0.867	0.731
10	1.287	0.770	0.950	1.027	0.954	0.751	0.638
11	1.218	0.714	0.879	0.950	0.844	0.665	0.566
Ultimate	16.005	10.795	11.585	11.219	10.999	9.761	9.290

These results indicate that for baseline economic conditions, the conditional claim rates are expected to decline somewhat from the high levels in the early- and mid-1980s. The moderately low ultimate claim rates forecast for loans originated in 1987 follows directly from the combined effect of favorable housing economic conditions in that year and the relatively low proportion of loans above 95 percent LTV.[27] The marked upturn in predicted claim termination rates in 1988 and 1989 is attributable to the shift in loan distribution toward higher LTVs. The reversal in conditional claim rates projection for 1990 and 1991 is associated with the expanded loan ceiling. Not only are loans just below the new ceiling expected to have lower claim rates than the claims experience of the largest loans categories

[27] Some high LTV loans appear in the "No Appraisal" LTV class as do Southwest REO properties going to market.

used in our estimation, holding LTV constant, but the downpayment formula forces these loans to have a marginally lower LTV.

The addition of one year of data (FY 1992) provided an opportunity to refine our projections of ultimate claim rates for historical books of business. The MMI Fund's lower than expected claims experience in 1992 for all recent historical books led to a downward revision in expected ultimate claim rates for books written in the 1986 to 1992 period. Our FY 1991 Review estimated ultimate claim rates for the 1986 through 1991 books of: 15.53%, 12.02%, 13.2%, 13.66%, 13.49%, and 12.15%. The average reduction from FY 1991 estimates of expected ultimate claim rates is 2.37 percent for these books.

The projections for conditional prepayment rates are summarized for the baseline economic forecasts in Exhibit A-9. These projections indicate that the ultimate prepayment rate for recent historical books of business is expected to average approximately 72 percent. These projections are higher on average than our projections in the FY 1991 report, reflecting the continued decline in interest rates and corresponding increases in the volume of prepayments due to refinancings. The projection of the FY 1992 book of business, 66 percent, suggests that this trend toward refinancings will be limited by an anticipated rise in interest rates.

Exhibit A-10

Forecast of Conditional Prepayment Rates 1986-92
Assuming Baseline Economics
(Values in Percents)

Policy Year	1986	1987	1988	1989	1990	1991	1992
1	0.507	0.257	0.376	0.445	0.378	0.368	0.501
2	3.722	1.026	1.515	2.007	2.019	4.549	3.310
3	2.666	1.746	3.062	4.106	7.954	5.929	3.996
4	3.169	2.852	4.589	13.001	7.163	5.915	4.035
5	4.470	3.403	12.407	8.268	6.542	5.580	3.817
6	5.453	7.277	6.717	6.019	4.955	4.256	3.192
7	12.416	7.473	7.415	6.836	5.722	4.926	3.429
8	6.505	6.426	6.412	5.929	5.049	4.530	3.289
9	6.035	5.895	5.834	5.487	4.902	4.463	3.331
10	5.811	5.699	5.795	5.652	5.064	4.605	3.403
11	5.677	5.652	5.930	5.785	5.192	4.687	3.429
Ultimate	71.283	73.420	74.732	75.377	73.126	72.089	65.989

C. Performance of the FY 1992 Book of Business

Exhibits A-11 through A-14 present our estimates of the performance of the FY 1992 book of business. These exhibits classify the projected claim and prepayment rates for this most recent book by LTV category and loan size. As stated above, the FY 1992 book is expected to contribute approximately $922.5 millon in present value terms to the economic value of the Fund. This number is comprised of current revenues of $1,529.2 million from up front and annual premiums and expected disbursements of $606.6 million, in present value terms, net of expected annual revenues. The 1992 book is the first one fully subject to NAHA reforms.

Exhibit A-11

Forecast of Conditional Claim Rates for Loans Endorsed in 1992 by LTV Category (Values in Percents)

Policy Year	No Appraisals	0-65%	65-80%	80-90%	90-93%	93-95%	95-97%	97%+
1	0.013	0.000	0.000	0.006	0.008	0.004	0.003	0.012
2	3.475	0.114	0.148	0.198	0.235	0.252	0.345	0.569
3	4.362	0.199	0.301	0.429	0.447	0.494	0.727	1.026
4	3.933	0.264	0.398	0.563	0.584	0.610	0.865	1.094
5	3.460	0.284	0.365	0.560	0.600	0.614	0.866	1.025
6	3.275	0.270	0.348	0.533	0.545	0.593	0.806	0.882
7	2.954	0.284	0.352	0.498	0.503	0.528	0.754	0.732
8	2.597	0.328	0.349	0.532	0.523	0.535	0.738	0.682
9	2.485	0.301	0.335	0.482	0.472	0.453	0.684	0.600
10	2.122	0.299	0.316	0.443	0.429	0.399	0.598	0.533
Ultimate	24.712	3.120	4.443	6.007	5.801	5.678	8.136	8.415

Exhibit A-12

Forecast of Conditional Prepayment Rates for Loans Endorsed in 1992 by LTV Category (Values in Percents)

Policy Year	No Appraisals	0-65%	65-80%	80-90%	90-93%	93-95%	95-97%	97%+
1	2.237	0.611	0.592	0.351	0.265	0.199	0.215	0.163
2	8.335	5.449	4.002	3.240	2.841	2.653	2.323	1.904
3	7.291	5.923	4.455	3.950	3.770	3.649	3.450	2.957
4	6.707	5.363	4.048	3.859	3.829	3.812	3.714	3.266
5	6.354	5.006	3.817	3.702	3.634	3.586	3.537	3.128
6	4.187	3.638	3.064	3.044	3.073	3.073	3.101	3.072
7	3.828	4.221	3.547	3.429	3.409	3.425	3.390	3.216
8	4.056	3.733	3.236	3.238	3.232	3.204	3.230	3.115
9	4.254	3.826	3.343	3.313	3.267	3.247	3.235	3.122
10	4.522	3.889	3.274	3.245	3.318	3.325	3.341	3.182
Ultimate	62.860	79.811	72.686	69.333	68.681	67.952	65.911	60.333

Exhibit A-13

Forecast of Conditional Claim Rates for Loans Endorsed in FY 1992 by Loan Size (Values in Percents)

Policy Year	1	2	3	4	5	6	7
1	0.016	0.003	0.008	0.005	0.004	0.006	0.000
2	0.892	0.809	0.732	0.716	0.738	0.634	0.465
3	1.342	1.211	1.090	1.053	1.073	0.933	0.738
4	1.389	1.245	1.116	1.072	1.088	0.950	0.790
5	1.294	1.156	1.036	0.992	1.006	0.878	0.747
6	1.185	1.054	0.947	0.907	0.921	0.801	0.683
7	1.061	0.941	0.848	0.814	0.827	0.717	0.614
8	1.012	0.892	0.802	0.767	0.780	0.674	0.590
9	0.931	0.816	0.731	0.699	0.711	0.611	0.531
10	0.827	0.717	0.637	0.605	0.614	0.525	0.460
Ultimate	12.391	10.583	9.400	8.889	8.861	7.679	6.195

Exhibit A-14

Forecast of Conditional Prepayment Rates for Loans Endorsed in FY 1992 by Loan Size (Values in Percents)

Policy Year	1	2	3	4	5	6	7
1	0.362	0.412	0.509	0.521	0.708	0.644	0.365
2	2.270	2.951	3.181	3.412	3.719	3.698	4.351
3	2.836	3.616	3.827	4.063	4.383	4.387	5.386
4	2.882	3.674	3.867	4.094	4.406	4.413	5.478
5	2.738	3.485	3.663	3.873	4.164	4.172	5.191
6	3.000	3.067	3.111	3.145	3.217	3.214	3.779
7	3.003	3.103	3.188	3.336	3.571	3.593	4.609
8	3.000	3.055	3.094	3.173	3.360	3.376	4.301
9	3.000	3.076	3.125	3.230	3.424	3.441	4.384
10	3.000	3.111	3.181	3.309	3.548	3.561	4.516
Ultimate	55.152	62.429	64.615	66.670	68.982	69.951	78.604

V. Conclusions

Our econometric model of conditional claim rates and prepayment rates modeled these variables as functions of equity and interest rates, macroeconomic conditions and policy regimes. The analysis involved pooling of time series data for loan performance over policy years for loans categorized by loan size and loan origination years. Separate models were estimated for each of the nine LTV categories. The data suggests that there is considerable variation in loan performance across these categories. There is a pronounced rise in default experience when the LTV exceeds 90 percent and a sharper increase above 95 percent. Evaluating the impact of changing loan size indicates that higher valued loans yield a measurable reduction in default rates within the FHA loan ceiling. When equity is slow to build over time for homeowners, as measured through higher initial LTV and weak house price appreciation, then an increase in mortgage default can be expected.

There has been considerable variation in the claims and prepayments experience of the MMI Fund over the last decade and a half. The Fund enjoyed historically low claim rates and moderate prepayment rates on books of business written in the late 1970's. In contrast, there has been an enormous increase in claims experience for books from the early- to mid-1980's and conditional prepayment rates on those books appear to be higher as well. This change implies an erosion of net present value on these books for the Fund. Claim rates for books of the late-1980's appear to have reverted to more moderate risk profiles. The change is due to a combination of macroeconomic factors, behavioral changes among the client population, and management changes within FHA itself.

Appendix B: Actuarial Analysis

I. Introduction

The purpose of the actuarial analysis is to assess the Fund's ability to withstand future losses from both its current portfolio of mortgages and future books of business. Specifically, we analyze the Fund's value under alternative economic and policy assumptions by projecting future loan performance and the corresponding financial performance of the Fund. This appendix focuses on how the projections of loan performance were used to evaluate the financial viability of the Fund.

In analyzing the Fund's value, we examined the Fund as an investor would evaluate the market value of a company. An investor estimates a company's value as the present value of its current business plus the present value of new business expected to be undertaken. The value of the Fund depends on both its current portfolio of loans and future books of business. Although the method used to analyze the value of current and future business is very similar, we analyzed the two books separately to isolate the impact of future policy changes on the Fund's value. The general method for estimating future losses is described below. In the following sections, we describe the application of this method to the analysis of the current portfolio and future business.

II. Method

To analyze future changes in the Fund's equity, we developed a model that uses projections of loan performance and information about the insurance-in-force to forecast the Fund's major cash flows. The discounted value of these cash flows equals the current value of future movements in the Fund's equity. The forecasts of loan performance used to estimate future cash flows come from the econometric models discussed in Appendix A. These

models predict conditional claim and prepayment rates for each cross-sectional category of loan-to-value and loan size on an endorsement year/post-endorsement year basis.

Based on these predicted termination rates, the major components of cash flow are projected into the future. The cash flow components analyzed are presented in Exhibit B-1.

Exhibit B-1

Cash Flow Components	Cash Inflow	Cash Outflow
Premiums	X	
Refunded Premiums		X
Claim Payments		X
Proceeds from Property Dispositions	X	
Administrative Expenses		X
Distributive Shares		X

These components were projected for each cross-section of loan-to-value and loan size and then aggregated to the endorsement year and fiscal year level. The following section discusses each of these cash flow elements. First, we provide definitions of the following key terms used in the analysis:

- Insurance-in-force (IIF): the unamortized insurance-in-force value of the surviving mortgages insured by FHA[28]
- Average Outstanding Balance (AOB): the principal balance outstanding divided by the original mortgage amount; the AOB is calculated based on the term and type of the mortgage and mortgage interest rate

[28] IIF, the concept of insurance-in-force used in our capital ratio calculations, corresponds to *unamortized* insurance in force. It is distinct from the conventional notion of *amortized* insurance-in-force (IIF), which includes only the outstanding balance on surviving loans.

- Conditional Claim Rate: the number of claims during the year divided by the number of surviving loans at the beginning of the year. Referred to in the report as annual claim rate or claim rate

- Loss Ratio: the dollar loss incurred on claims divided by the claim amount

- Conditional Prepayment Rate: the number of prepayments during the year divided by the number of surviving loans at the beginning of the year. Referred to in the report as annual prepayment rate or prepayment rate

- Refund Rate: the portion of the premium that is refunded when a loan is prepaid; the refund rate is typically defined as the dollar refund per $1000 of the mortgage value at origination (e.g., the refund in the first year is $3.43/$1000 of the original mortgage value)

A. Premium

The insurance premium is the primary revenue collected by the Fund. If the Fund's mortgages are priced to be premium sufficient, the insurance premiums collected and interest earned on them will cover all costs incurred in insuring the mortgages. During the period being analyzed, the insurance premium was structured in three ways:

- Through September 1, 1983 the mortgage premium was collected on a monthly basis as a percentage of the outstanding principal balance for the period. We assumed for this analysis that the annual premium policy was in effect through the end of fiscal year 1983.

- Between September 1, 1983 and September 30, 1991 the premium was collected at the time of origination

- After the start of FY 1992, the NAHA-specified premium structure became effective. This structure specifies that an up-front premium be collected. In addition, an annual renewal premium will be assessed on the outstanding balance for a period that depends on the initial LTV of the loan.

In calculating the premiums collected on loans endorsed through 1983, we applied a premium of 0.5 percent of the mortgage's average outstanding balance for the year. Thus, the mortgage premium collected during year t equals the average outstanding balance of unamortized insurance-in-force (IIF) during year t times the annual premium:

$$Premium_t = IIF_t \times AOB_t \times 0.5\% \quad (5)$$

For loans endorsed after 1983, FHA collected an up-front premium of 3.8 percent of the mortgage origination value for 30-year mortgages and 2.4 percent for 15-year mortgages. Thus, the mortgage premium collected on loans endorsed after 1983 equals the origination mortgage amount times the appropriate insurance premium:

$$Premium_t = Origination\ Amount_t \times Mortgage\ Insurance\ Premium \quad (6)$$

For business initiated in fiscal year 1992, the premium rate structure varies by endorsement year and loan-to-value ratio. The premium structure profile is provided in Exhibit B-2.

Exhibit B-2

Premium Schedule			
	Phase-in Years		
	1992	1993-94	1995+
Up-Front Premium:	3.80%	3.00%	2.25%
Annual Premium for Initial LTVs:			
< 90%	0.50% for 5 Years	0.50% for 7 Years	0.50% for 11 Years
≥ 90% - ≤ 95%	0.50% for 8 Years	0.50% for 12 Years	0.50% for 30 Years
> 95%	0.50% for 10 Years	0.50% for 30 Years	0.55% for 30 Years

Although FHA technically receives the up-front premium at the time of origination, the mortgagor is allowed to finance the premium; therefore, the portion of the premium that is financed is often included in the initial principal value of the mortgage. The original mortgage amount used above in calculating the premium excludes the financed premium. However, when a mortgage defaults, FHA must pay a claim that consists of the unamortized portion of both the mortgage and financed premium. Therefore, FHA effectively collects very little of the up-front premium on mortgages that default early in their lives.

B. Losses Associated with Claims

Losses due to claims comprise the largest expense to the fund in the early years of mortgages' lives. When a mortgage defaults, the lender files a claim with FHA. After

FHA pays the claim, it receives the foreclosed property and must sell the property to recover its loss. These events result in the following two cash flows:

- Cash outflow of the claim payment
- Cash inflow of the net proceeds received in selling the claimed property

Since there is typically a lag between the time of the claim payment and the receipt of proceeds from property disposition, we have analyzed these two cash flow components separately.

The claim payment consists primarily of the outstanding balance at the time of the default. FHA will also pay for additional costs incurred by the lender on the defaulted mortgages. In order to account for these costs on a portfolio-wide basis, we use the following formula:

$$\textit{Claim payment}_t = \textit{IIF}_t \times \textit{AOB}_t \times \textit{Claim Rate}_t \times (1 + \textit{Lender Costs}) \times \textit{Additional Costs of Claims Settlement Adjustment Factor} \quad (7)$$

where the Bank Costs equal the average costs incurred by banks per dollar of outstanding balance, and "t" identifies the fiscal year.

In our analysis, we assumed that the primary cost associated with claims was the interest income lost by the lender between the time at which the mortgage defaults and the claim is paid. Based upon the results of the FHA's 1992 Financial Audit and previous experience, we found that the average lag between default and claim payment is currently 13.5 months. Thus, the additional lender costs were estimated as interest income lost on the outstanding balance of the mortgage for 13.5 months.

Net proceeds were estimated by multiplying the claim payment by one minus the loss ratio. However, because property sales typically lag claim payments by 7.8 months,[29] we allocated the net proceeds cash flow to the appropriate fiscal year so that proceeds received in fiscal year t are calculated as follows.

$$\textit{Net Proceeds} = \left(\frac{7.8}{12}\right) \times \textit{Claim Payments}_{t-1} \times (1 - \textit{Loss Ratio}) + \left(\frac{4.2}{12}\right) \times \textit{Claim Payments}_{t} \times (1 - \textit{Loss Ratio}) \quad (8)$$

For 30-year fixed rate mortgages, different loss ratios are used depending on the loan size category. The loss ratios for fiscal years 1991 and 1992 are presented in Exhibit B-3.

Exhibit B-3

Loss Ratios by Size Category	
Size	**Loss Ratio**
1	54.59%
2	46.29%
3	41.45%
4	38.28%
5	35.77%
6	33.44%
7	28.50%
8	47.49%

See Exhibit III-6 for a description of the loan size categories
Source: Calculations based on the January 1992 A-43 Data Extract

[29] This figure represents the average as estimated during the Fiscal Year 1988 Financial Audit of FHA.

C. Refunded Premiums

With the initiation of the up-front premium in FY 1984, FHA began refunding a portion of the premium when borrowers prepaid their mortgages. The up-front premiums are considered to be earned over the life of the loan, and upon prepayment, an approximation of the unearned portion of the premium is returned to the borrower. Thus, the amount of the refund depends upon the time in the life of the mortgage at which it is prepaid.

$$\textit{Refund Dollars}_t = \textit{IIF}_t \times \textit{Prepayment Rate}_t \times \textit{Refund Rate}_t \times \textit{Adjustment Factor for Understatement of Refunds} \quad (9)$$

The refund rates used in the analysis of the existing portfolio are those currently used by FHA.[30] In the analysis of new business, the refund rate is adjusted to reflect the fact that the model underpredicts actual refunds. This adjustment is 36 percent of the calculated refund amount.

D. Administrative Expenses

In addition to estimating cash flows associated with loan performance, the model also projects administrative costs incurred in insuring mortgages. Administrative expenses are calculated based on the outstanding balance of the insurance-in-force over the period. The factor used in this analysis is 0.0942 percent.[31]

30 Herzog, Thomas, "Introducing the Single Premium Plan", *Mortgage Banking*, April 1984.

31 Middaugh, David, "Analysis of the Insurance Reserves as of September 30, 1988", Department of Housing and Urban Development.

E. Distributive Shares

Distributive shares were designed to allow FHA to return a portion of the insurance premium to the insured borrower if the business for that endorsement year was more profitable than expected. Specifically, if the premium collected is more than sufficient to cover the costs of insuring the loans, a portion of the premium in excess of the costs can be returned to the borrower through a distributive shares payment. However, payment of distributive shares has been suspended until the Fund reaches its targeted capital ratio. This suspension is assumed to continue indefinitely.

III. Analysis of the Current Portfolio of Mortgages

In analyzing the economic value of the Fund, we first examined those loans that FHA currently has in its portfolio. The Fund's current equity plus the future value of cash flows expected to be generated by this business represents the Fund's value, assuming FHA stops insuring new business. This value relative to the current insurance-in-force provides a measure of the Fund's financial strength.

The current portfolio of loans consists of mortgages of various terms and types. To analyze the current portfolio, we grouped the loans into the following four major categories:

- 30-year fixed rate mortgages
- 15-year fixed rate mortgages
- Graduated payment mortgages
- Adjustable rate mortgages

Insurance-in-force as of the end of FY 1992 is presented in Exhibit B-4.

Exhibit B-4

Insurance in Force End of Fiscal Year 1992 (Numbers in Millions)				
Endorsement Year	30-Year Mortgages	15-Year Mortgages	Adjustable Rate Mortgages	Graduated Payment Mortgages
1975	$1,732	$0	-	-
1976	$2,258	$0	-	-
1977	$3,391	$40	-	$4
1978	$4,543	$40	-	$685
1979	$5,354	$47	-	$2,771
1980	$3,608	$46	-	$1,520
1981	$1,615	$30	-	$358
1982	$711	$37	-	$151
1983	$4,676	$712	-	$565
1984	$2,535	$381	$0.26	$267
1985	$4,708	$727	$18	$282
1986	$32,032	$3,293	$267	$409
1987	$49,916	$4,071	$796	$513
1988	$24,710	$1,262	$1,396	$254
1989	$28,775	$1,047	$483	$258
1990	$39,173	$1,359	$347	$421
1991	$37,658	$1,590	$1,912	$470
1992	$28,355	$1,872	$6,509	$154
Total[32]	$275,749	$16,556	$11,729	$9,083

[32] Small differences between the column figures and total are due to rounding error.

In analyzing the financial performance of these loans, we used a methodology which focused on 30-year FRMs, as described in the previous section. However, slight modifications were made in analyzing the other types of loans in order to adjust for differences between their behavior and that of the 30-year FRMs.

The primary difference between the graduated payment mortgage (GPM) and other 30-year mortgages is the payment plan used by the GPMs. Payment plans for GPMs actually increase the mortgage value outstanding for the first 5 to 10 years of the mortgage. Increasing, rather than decreasing, mortgage values impacts the loan performance and cash flows in two ways: (1) an increasing mortgage obligation can result in negative equity during the early years of the mortgage, thus increasing the risk of default; and (2) an increasing mortgage obligation increases the potential claim amount that FHA must pay if the mortgage defaults.

In analyzing the claim and prepayment rates of GPMs, we found that in aggregate the termination rates of GPMs are very similar to those of the other 30-year mortgages. Therefore, we applied the aggregate predicted claim and prepayment rates of the 30-year mortgages to the graduated payment mortgages. In predicting the claim payments associated with GPMs, we used an outstanding balance factor for a 5-year 7.5 percent annual growth GPM (i.e., the mortgage payment increases annually by 7.5 percent for 5 years).

As with the GPMs, the major economic difference between the 15 and 30-year mortgages is the payment plan. Because we did not develop a separate model for the claim and prepayment rates of the 15-year mortgages, we did not directly capture the impact of an accelerated reduction in principal associated with 15-year mortgages. In analyzing them more closely, we found that these mortgages tend to have claim rates approximately equal to 2/3 of their 30-year counterparts. Therefore, we reduced the predicted claims for 30-year mortgages by 1/3 in predicting claims for the 15-year mortgages. In predicting the claim

payments and associated losses for the 15-year mortgages, we applied an outstanding balance factor commensurate with the 15-year term of the mortgage.

To analyze mortgages endorsed prior to 1975, we used FHA's most recent survivorship tables for 30-year mortgages.[33] These mortgages are sufficiently seasoned so that economic conditions will not affect their performance significantly.

IV. Analysis of the Future Portfolio of Mortgages

In order to model the value of the Fund in future years, it is necessary to make assumptions regarding the characteristics of the mortgage portfolio in the future, particularly those aspects that may be affected by the National Affordable Housing Act of 1990 (NAHA). This legislation directly and indirectly altered many of the parameters used by the cash flow model to project Fund value. Chief among the factors affected by NAHA are the following: (a) mortgage premium structure; (b) projected loan origination volumes; and (c) future distribution of loan volumes across loan-to-value categories. Each of these elements is discussed below.

A. Mortgage Premium Structure

Prior to the enactment of NAHA, the Fund charged a single up-front premium on all loans. Beginning in July 1991, the premium rate structure has been determined according to endorsement year and loan-to-value ratio. The new premium rate structure was presented in Exhibit B-2.

[33] Survivorship and Decrement Tables for HUD/FHA Home Mortgage Insurance as of December 31, 1988, Herzog and Stasulli, January 1989.

B. Loan Origination Volumes

For 30-year fixed rate mortgages, a total dollar volume and a distribution across loan-to-value and loan size categories were determined to project future cash flows. Projected originations (those beginning in endorsement year 1993 and following) are assumed to remain constant at the 1992 level.

C. Distribution of Volume Across LTV Categories

Changes in the Fund's premium policy will affect the distribution of new loan volume across LTV categories. Also, between July 1991 and October 1992, 57.25 percent of a borrower's closing costs could be financed. Both of these changes probably had the ultimate effect of reducing the average LTV ratio at the time of loan origination. This is modeled as a gradual shift of volume to lower LTV categories beginning in fiscal year 1992. However, with the passage of the recent Congressional reform regarding the 100 percent financing of closing costs, the distribution reverts back to the 1991 distribution for FY 1993 and forward. Additionally, the assumption is made that no investor loans are issued beginning in 1991.

Appendix C: Sensitivity Analyses - Performance of the Fund Under Various Scenarios

This section presents the results of several sensitivity analyses we performed in the development of the MMI FY 1992 Actuarial Review. These analyses include:

- Alternative economic scenarios
- Alternative projections of median income growth

I. Alternative Economic Scenarios

For our base case estimate of the economic value of the Fund, we employed DRI's[34] base case forecasts for the years 1993-1995 of the CQHP appreciation rate and the effective mortgage interest rate on loans closed for existing homes to represent the FHA-insured mortgage interest rate.[35] DRI has judged these values most likely to approximate actual experience.

To conduct tests of the sensitivity of the Fund's economic value to the strength of the economy's recovery from the recession and to long term appreciation in house prices, we employed two alternative forecasts produced by DRI: 1) a "stagnation" forecast (referred to as "pessimistic" in this discussion) which assumes slower growth out of the recession, leading to lower growth rates in house prices, and 2) an "optimistic" forecast which assumes more rapid growth out of the recession, leading to higher growth rates in house prices. The forecasted values of the economic variables used to produce each of the economic sensitivity scenarios can be found in Exhibit C-1.

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[34] References to DRI forecasts refer to Data Resources Incorporated forecasts of U.S. annual national economic figures. Sources used in this review include the January 1993 issue of *Review of the U.S. Economy*.

[35] For 1996 and following out years, we hold the forecasted values constant at the 1995 level.

Exhibit C-1

Economic Assumptions for Sensitivity Analyses
Base Case and Economic Forecast Scenarios

Endorsement Year	CQHP Assumption			FHA-Insured Mortgage Rate			Median Household Income		
	Base Case	Pessimistic Scenario	Optimistic Scenario	Base Case	Pessimistic Scenario	Optimistic Scenario	Base Case	Pessimistic Scenario	Optimistic Scenario
1992	1.70	1.70	1.70	8.18	8.18	8.18	2.00	2.00	2.00
1993	3.10	3.10	3.70	8.35	7.93	8.77	2.50	2.50	2.50
1994	3.20	2.00	3.50	8.65	7.72	9.58	2.75	2.75	2.75
1995	3.40	2.10	3.70	8.61	7.67	9.68	3.00	3.00	3.00
1996	3.40	2.10	3.70	8.61	7.67	9.68	3.00	3.00	3.00
1997	3.40	2.10	3.70	8.61	7.67	9.68	3.00	3.00	3.00
1998	3.40	2.10	3.70	8.61	7.67	9.68	3.00	3.00	3.00
1999	3.40	2.10	3.70	8.61	7.67	9.68	3.00	3.00	3.00
2000	3.40	2.10	3.70	8.61	7.67	9.68	3.00	3.00	3.00
2001	3.40	2.10	3.70	8.61	7.67	9.68	3.00	3.00	3.00

We did not vary the payment variable by economic scenario because the relationship between growth in median household income levels (the element in the denominator), and other variable projections included in the DRI forecast, is not defined. Growth in median household income level depends upon factors such as inflation, household composition, and labor force participation rates. DRI currently does not project a median household income growth series. We believe that it would be imprudent to assign differing forecast values to each of the economic environments when a consistent link between changes in median household income levels and the general economic environment has not been established.

Exhibit C-2 reports the economic values corresponding to our pessimistic, base case, and optimistic scenarios. The current economic value of the Fund varies by approximately $1.6 billion, depending upon the economic scenario. Optimistic economic growth yields a value of $2,318 million, while an extended downturn would result in a decline to $730 million.

Exhibit C-2

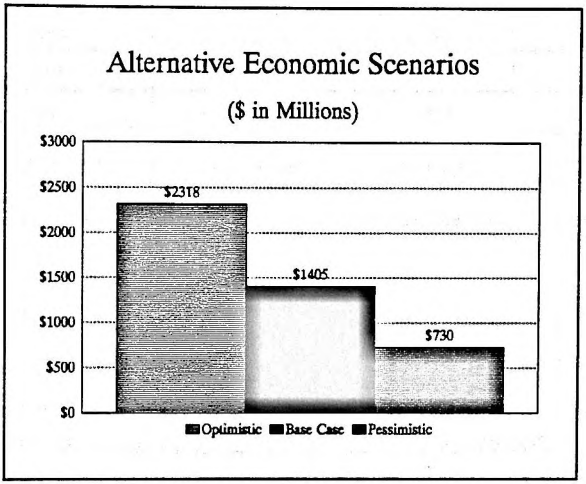

Exhibit C-3 presents the net present values (NPV) of the most recent books of business under the base case, optimistic, and pessimistic scenarios. The total NPV of the 1987-1992 books of business in the pessimistic case is $647 million lower than in the base case, while the total NPV in the optimistic case is $791 million higher than in the base case.

Exhibit C-3

Books of Business	Net Present Values ($ Millions) Under Alternative Economic Scenarios		
	Pessimistic	Base Case	Optimistic
1987	($537.4)	($482.2)	($343.6)
1988	($563.0)	($519.9)	($436.3)
1989	($573.9)	($509.3)	($396.0)
1990	($589.9)	($465.2)	($266.1)
1991	($419.9)	($232.0)	($53.1)
1992	$751.0	$922.5	$1,000.4
Total NPV of 1987-1992 Books	($1,933.1)	($1,286.1)	($494.7)

Exhibit C-4 reports the impact of the economic scenarios on future capital ratios. The NAHA-mandated FY 1992 capital ratio target is 1.25%. Our projections for the 1992 Fund capital ratio range from 0.22% to 0.71% and do not reach the target. The NAHA target for FY 2000 is 2.00%. We project a range of Fund ratios between 2.00% and 2.91% for that year. Except in the case of a prolonged economic recession or stagnation that is deeper than the pessimistic scenario predicts, the Fund can be expected to reach its FY 2000 target. In the case of a robust recovery, the target may be met as early as FY 1997, assuming no change in management practices or insurance premium policies.

Exhibit C-4

MMI FY 1992 Actuarial Review

Future Books of Business - Alternative Economic Scenarios

Pessimistic Scenario

ANALYSIS OF CAPITAL RATIO: MMI 1992 ($Millions)

	1992	1993	1994	1995	1996	1997	1998	1999	2000
IIF (EOY,Unamortized)	$325,912	$324,262	$323,961	$327,298	$333,961	$342,612	$352,272	$361,989	$372,137
Economic Value (BOY)		730	1,490	2,264	3,049	3,867	4,714	5,590	$6,497
Interest on Previous Business		26	52	79	107	135	165	196	$227
Addition of New Business		734	723	706	711	711	711	711	$711
Economic Value (EOY)	$730	$1,490	$2,264	$3,049	$3,867	$4,714	$5,590	$6,497	$7,436
CAPITAL RATIO	0.22%	0.46%	0.70%	0.93%	1.16%	1.38%	1.59%	1.79%	2.00%

Base Case

ANALYSIS OF CAPITAL RATIO: MMI 1992 ($ Millions)

	1992	1993	1994	1995	1996	1997	1998	1999	2000
IIF (EOY,Unamortized)	$325,912	$327,732	$332,345	$339,351	348,085	$357,687	367,322	$376,604	386,105
Economic Value (BOY)		1,405	2,358	3,278	4,209	5,179	6,182	7,221	8,296
Interest on Previous Business		49	83	115	147	181	216	253	290
Addition of New Business		904	837	817	822	822	822	822	822
Economic Value (EOY)	$1,405	$2,358	$3,278	$4,209	$5,179	$6,182	$7,221	$8,296	$9,409
CAPITAL RATIO	0.43%	0.72%	0.99%	1.24%	1.49%	1.73%	1.97%	2.20%	2.44%

Optimistic Scenario

ANALYSIS OF CAPITAL RATIO: MMI 1992 ($ Millions)

	1992	1993	1994	1995	1996	1997	1998	1999	2000
IIF (EOY,Unamortized)	$325,912	$327,728	$331,009	$336,025	342,434	$349,570	356,858	$363,902	371,372
Economic Value (BOY)		2,318	3,359	4,341	5,323	6,344	7,401	8,495	9,627
Interest on Previous Business		81	118	152	186	222	259	297	337
Addition of New Business		961	864	830	835	835	835	835	835
Economic Value (EOY)	$2,318	$3,359	$4,341	$5,323	$6,344	$7,401	$8,495	$9,627	$10,799
CAPITAL RATIO	0.71%	1.03%	1.31%	1.58%	1.85%	2.12%	2.38%	2.65%	2.91%

II. Median Household Income Growth Scenarios

Our payment variable models the sufficiency of the median household's cash flow to meet mortgage service obligations. As described in Appendix A, this variable is defined as the average cost of mortgage servicing per year, divided by the median household income for that year. Servicing costs are fixed in nominal dollars by the mortgage contract and consequently are easy to forecast for existing mortgages. As household income rises, we expect that the cash flow burden of existing mortgages will become progressively lighter for homeowners,[36] leading to fewer defaults and claims triggered by insufficient incomes.

Moreover, books that begin with lower payment burdens are likely to experience correspondingly lower cash flow-triggered claims in a given policy year. Hence, the pre-1980 and post-1987 books should be expected to fare better in this regard than mortgages contracted in between.

In the aggregate, mortgagors' future cash flow problems depend in large part on the growth pattern of median incomes.[37] Growth in median incomes will determine the speed with which the cash flow burden of mortgage servicing declines over time. However, it is difficult to predict future median income household growth levels. Our base case assumes growth of 3 percent per year, for 1995 and the future, with gradual increases from the 1992 level of 0.6 percent to 3.0 percent between 1993 and 1995. The 3 percent level was computed by analyzing the historical growth pattern of the variable for the period 1975 through 1991. Exhibit C-5 presents the annual growth levels used for each sensitivity scenario.

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[36] The extent of this "tilt" over time has been documented in J. Manchester, "Evidence on Possible Default Under Three Mortgage Contracts," *Housing Finance Review*, January 1985, v.4(1), pp. 517-536.

[37] J.E Pesando and S.M. Turnball, "The Time Path of Homeowner's Equity Under Different Mortgage Instruments: A Simulation Study," *Housing Finance Review*, January 1985 v.4(1), pp. 483-504, documents the varying equity accumulation rates of different mortgage instruments. The impact of cash flow versus equity may be different for different mortgage types.

Exhibit C-5

Year	Growth Scenario		
	2%	Base Case	4%
1992	1.00%	2.00%	2.00%
1993	1.50%	2.50%	2.75%
1994	1.75%	2.75%	3.50%
1995 and later years	2.00%	3.00%	4.00%

We performed sensitivity scenarios to estimate the MMI Fund's claim performance under alternative income growth scenarios using the above growth rates. The results of these sensitivity runs, for growth rates of 2 percent and 4 percent are reported below in Exhibit C-6.

Exhibit C-6

Future Books of Business - Alternative Median Income Growth Scenarios

2% Income Growth ANALYSIS OF CAPITAL RATIO: MMI 1992 ($ Millions)

	1992	1993	1994	1995	1996	1997	1998	1999	2000
IIF (EOY,Unamortized)	$325,912	$327,641	$332,122	$338,980	$347,544	$356,953	$366,370	$375,417	$384,681
Economic Value (BOY)		$957	$1,823	$2,631	$3,434	$4,257	$5,109	$5,992	$6,904
Interest on Previous Business		$34	$64	$92	$120	$149	$179	$210	$242
Addition of New Business		$832	$744	$711	$703	$703	$703	$703	$703
Economic Value (EOY)	$957	$1,823	$2,631	$3,434	$4,257	$5,109	$5,992	$6,904	$7,849
CAPITAL RATIO	0.29%	0.56%	0.79%	1.01%	1.22%	1.43%	1.64%	1.84%	2.04%

4% Income Growth ANALYSIS OF CAPITAL RATIO: MMI 1991 ($ Millions)

	1992	1993	1994	1995	1996	1997	1998	1999	2000
IIF (EOY,Unamortized)	$325,912	$327,746	$332,409	$339,498	$348,341	$358,076	$367,867	$377,318	$386,993
Economic Value (BOY)		$1,672	$2,681	$3,674	$4,692	$5,760	$6,866	$8,010	$9,195
Interest on Previous Business		$59	$94	$129	$164	$202	$240	$280	$322
Addition of New Business		$951	$899	$889	$904	$904	$904	$904	$904
Economic Value (EOY)	$1,672	$2,681	$3,674	$4,692	$5,760	$6,866	$8,010	$9,195	$10,420
CAPITAL RATIO	0.51%	0.82%	1.11%	1.38%	1.65%	1.92%	2.18%	2.44%	2.69%

The 2 percent growth rate corresponds to a -0.5 percent real rate of change in the median household income for the next three decades. Under this scenario, we estimated that the FY 2000 capital ratio would be approximately 2.04 percent. This scenario corresponds to an economic forecast of sustained decline in U.S. productivity that is unlikely to hold for a substantial length of time. The 4 percent growth scenario corresponds to 1.5 percent real growth annually for the next thirty years. This optimistic scenario suggests continued and robust long term expansion for the U.S. economy. Under these conditions the MMI Fund would comfortably reach its FY 2000 target due to reductions in expected claim rates.