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Report to Congressional Committees

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MORTGAGE FINANCING

FHA's Fund Has Grown, but Options for Drawing on the Fund Have Uncertain Outcomes

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Abbreviations

ARM	Adjustable rate mortgage
FHA	Federal Housing Administration
HUD	Department of Housing and Urban Development
LTV	Loan-to-value

GAO
Accountability * Integrity * Reliability

United States General Accounting Office
Washington, D.C. 20548

February 28, 2001

The Honorable Wayne Allard
Chairman, Subcommittee on Housing
and Transportation
Committee on Banking, Housing and
Urban Affairs
United States Senate

The Honorable Marge Roukema
Chairman, Subcommittee on Housing
and Community Opportunity
Committee on Financial Services
House of Representatives

According to the Department of Housing and Urban Development (HUD), the economic value of the Mutual Mortgage Insurance Fund (Fund) grew by about $5 billion in 1999, apparently reaching its highest level in at least the last 20 years.[1] Under this Fund, HUD's Federal Housing Administration (FHA) provides insurance for private lenders against losses on home mortgages. Borrowers who obtain FHA-insured mortgages pay insurance premiums, which are deposited into the Fund. Although the Fund has been financially self-sufficient for most of its history, it experienced substantial losses during the 1980s, primarily because foreclosure rates on single-family homes supported by the Fund were high in economically stressed regions. To help place the Fund on a financially sound basis, the Congress enacted legislation in November 1990 that required the Secretary of HUD to, among other things, take steps to ensure that the Fund achieves and maintains an economic value of at least 2 percent of the Fund's insurance-in-force. The 1990 reforms also required that an independent actuarial study be conducted annually to measure this capital ratio. In January 2000, HUD reported that, according to an independent study by Deloitte & Touche, the estimated capital ratio was 3.66 percent at the end of fiscal

[1] The economic value of the Fund is the sum of existing capital resources plus the net present value of future cash flows.

year 1999.[2] With the Fund's capital ratio now substantially above the minimum required level, proposals have surfaced to reduce the ratio either by spending some of the Fund's current resources or by reducing the net cash flows into the Fund.

Concerned about the adequacy of the minimum 2-percent requirement and about proposals to spend what some were calling excess reserves, you asked us to determine the conditions under which an estimated capital ratio of 2 percent would be adequate to maintain the actuarial soundness of the Fund. Specifically, you asked us to (1) estimate the value of the Fund at the end of fiscal year 1999, given expected economic conditions, and compare our estimate to the estimate of the value of the Fund reported by HUD for that year; (2) determine the extent to which a 2-percent capital ratio would allow the Fund to withstand worse-than-expected loan performance due to economic and other factors; and (3) describe some options for adjusting the size of the Fund if the estimated capital ratio is different than the amount needed, and describe the impact that these options might have on the Fund, FHA mortgagors, and the federal budget.

To meet these objectives, we reviewed the laws and regulations governing FHA's insurance program. In addition, to estimate the value of the Fund and determine the extent to which a 2-percent reserve would allow the Fund to withstand worse-than-expected loan performance, we developed economic models. We also met with HUD officials who administer FHA's single-family insurance program, the independent contractors that have analyzed the Fund throughout the 1990s, and other experts to better understand methodologies used to estimate the value of the Fund. In addition, we met with officials at the Office of Management and Budget and the Congressional Budget Office who are building economic models of FHA's insurance program to provide better information about the Fund's impact on the federal budget. To explore options for changing the size of the Fund, we met with HUD officials and other interested parties. To determine the impact of these changes on the Federal budget, we relied on our own experts as well as budget experts familiar with FHA's program and mortgage models at the Office of Management and Budget and the Congressional Budget Office.

[2] *Actuarial Review of MMI Fund as of FY 1999*, Deloitte & Touche. In its January 2001 actuarial review, Deloitte & Touche estimated a capital ratio of 3.51 percent at the end of fiscal year 2000. This estimate should not be compared with its reported estimate for 1999 because, in its latest report, Deloitte revised downward its estimate of the value of the Fund at the beginning of fiscal year 2000.

We conducted our work between December 1999 and February 2001 in accordance with generally accepted government auditing standards. See appendix I for a further discussion of our scope and methodology.

Results in Brief

We estimated that the Mutual Mortgage Insurance Fund had an economic value of about $15.8 billion at the end of fiscal year 1999. This estimate implies a capital ratio of 3.20 percent of the unamortized insurance-in-force. The relatively large economic value and high capital ratio reflect the strong economic conditions that prevailed during most of the 1990s and the good economic performance expected for the future as well as the increased insurance premiums put in place in 1990. HUD reported that Deloitte & Touche, using a different method of analysis, estimated an economic value of about $16.6 billion for fiscal year 1999, which on the basis of its estimate of the unamortized insurance-in-force implied a capital ratio of about 3.66 percent. Although there is uncertainty associated with any forecast, both of these estimates easily exceed the minimum required capital ratio of 2 percent that the Congress set in 1990. The difference between these estimates is due in part to differences in the timing of the analyses and the assumptions used. Nonetheless, given the uncertainty inherent in forecasting and the number of professional judgments made in this type of analysis, we conclude that these estimates are comparable.

Given the economic value of the Fund and the state of the economy at the end of fiscal year 1999, a 2-percent capital ratio appears sufficient to withstand moderately severe economic downturns that could lead to worse-than-expected loan performance. That is, such conditions would not cause the estimated value of the Fund at the end of fiscal year 1999 to decline by more than 2 percent of the Fund's insurance-in-force. Under economic scenarios that we developed to represent regional and national economic downturns that the nation experienced between 1975 and 1999, the estimated capital ratio fell by only slightly less than 0.4 percentage points. Some more severe downturns that we analyzed also did not cause the estimated capital ratio to decline by as much as 2 percentage points. However, in three of the scenarios with more severe economic conditions, an economic value of 2 percent of insurance-in-force would not be adequate. These included (1) a scenario in which the entire nation experiences a downturn similar to the one New England experienced during the late 1980s and early 1990s, (2) a scenario in which FHA experiences foreclosure rates similar to those it experienced in the late 1980s, and (3) a scenario in which 35.6 percent or more of FHA loans experience foreclosure rates similar to those experienced by FHA in the

west south central portion of the United States in the late 1980s. Because of the uncertainty and professional judgment associated with this type of analysis, we caution against relying on any one estimate or even on a group of estimates at a point in time to determine the adequacy of the Fund's reserves over the longer term. For example, recent and future FHA-insured loans might perform worse than our estimates assume for several reasons, including recent and future changes in FHA's programs and the conventional mortgage market. To the extent that this is the case, the Fund could be less able to withstand adverse economic scenarios than some of our estimates suggest. In fact, the Fund had an even higher capital ratio in 1979 when the economic value of the Fund equaled 5.3 percent of insurance-in-force, but in little more than a decade—after a national recession, the substitution of an up-front premium for annual insurance premiums, and regional real estate declines—the economic value of the Fund was negative. This report contains a recommendation that the Secretary of HUD address these limitations in evaluating the health of the Fund.

There are several options available to the Secretary of HUD under current legislative authority that could result in a lower capital ratio for the Fund. Other options would require legislative action. However, in either case, it is difficult to reliably measure the full impact of policy changes on the Fund's capital ratio and FHA borrowers without using tools designed to estimate the multiple impacts that policy changes often have. The extent to which policy changes will affect the Fund's capital ratio and FHA borrowers is difficult to estimate because the impact often depends not only on the direct effect of the changes but also on the degree to which the changes affect the volume of FHA-insured loans and the riskiness of those loans. A complete estimate would require that economic models be used to estimate these indirect effects. At this time, however, neither the models used by HUD to assess the financial health of the Fund, nor those used by others, explicitly recognize the indirect effects of policy changes on the volume and riskiness of FHA's loans. As a result, HUD cannot reliably estimate nor evaluate the full impact of policy changes on the Fund. Further, the difficulty of estimating the impact of the various policy options on the capital ratio also makes it difficult to measure precisely the impact on the federal budget. Nonetheless, any option that results in a reduction in the Fund's reserve, if not accompanied by a similar reduction in other government spending or by an increase in receipts, would result in either a reduction in the budget surplus or an increase in any existing deficit. This report contains a recommendation that the Secretary of HUD develop better tools for assessing the impact of policy changes on the Fund.

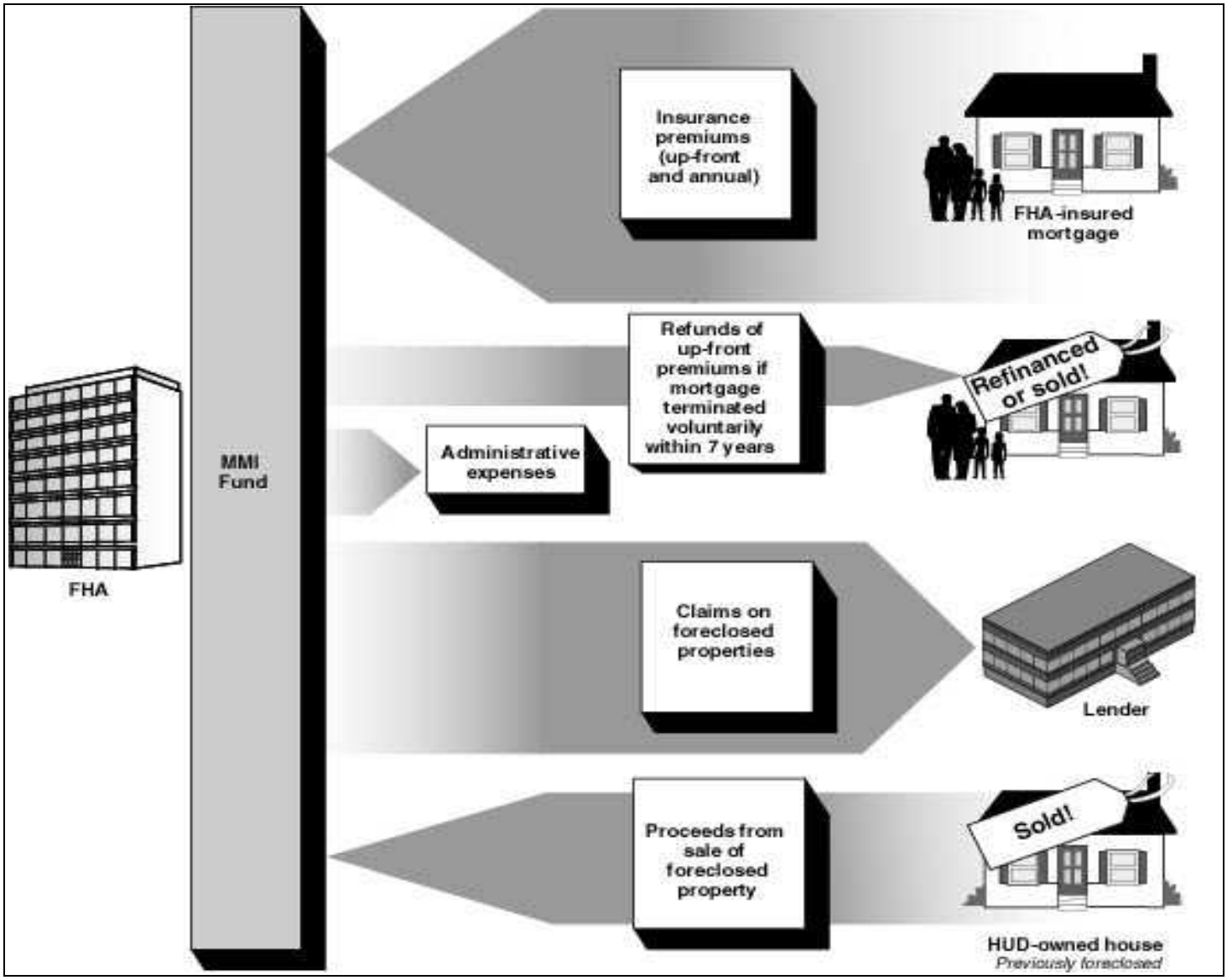
Background

FHA was established in 1934 under the National Housing Act (P.L. 73-479) to broaden homeownership, shore up and protect lending institutions, and stimulate employment in the building industry. FHA insures private lenders against losses on mortgages that finance purchases of properties with one to four housing units. Many FHA-insured loans are made to low-income, minority, and first-time homebuyers.

Generally, borrowers are required to purchase single-family mortgage insurance when the value of the mortgage is large relative to the price of the house. FHA, the Department of Veterans Affairs, and private mortgage insurers provide virtually all of this insurance. In recent years private mortgage insurers and conventional mortgage lenders have begun to offer alternatives to borrowers who want to make little or no down payment.[3] FHA provides most of its single-family insurance through a program supported by the Mutual Mortgage Insurance Fund. The Fund is organized as a mutual insurance fund in that any income received in excess of the amounts required to cover initial insuring costs, operating expenses, and losses due to claims may be paid to borrowers in the form of distributive shares after they pay their mortgages in full or voluntarily terminate their FHA insurance. The economic value of the Fund depends on the relative sizes of cash outflows and inflows over time. Cash flows out of the Fund from payments associated with claims on foreclosed properties, refunds of up-front premiums on mortgages that are prepaid, and administrative expenses for management of the program (see fig. 1). To cover these outflows, FHA deposits cash inflows—up-front and annual insurance premiums from participating homebuyers and net proceeds from the sale of foreclosed properties—into the Fund. If the Fund were to be exhausted, the U.S. Treasury would have to cover lenders' claims and administrative costs directly.

[3] Generally, borrowers are required to purchase mortgage insurance when the value of the mortgage is over 80 percent of the price of the house. Many private mortgage insurers will now insure a mortgage up to 97 percent of the value of the house being purchased. In addition, conventional mortgage lenders by offering second mortgages of up to 23 percent of the value of the house, sometimes allow borrowers to borrow more than the value of the house without obtaining mortgage insurance.

Figure 1: Cash Flows of the Mutual Mortgage Insurance Fund



The Fund remained relatively healthy from its inception until the 1980s when losses were substantial, primarily because of high foreclosure rates in regions experiencing economic stress, particularly the oil-producing states in the west south central section of the United States. These losses prompted the reforms that were first enacted in November 1990 as part of

the Omnibus Budget Reconciliation Act of 1990 (P.L. 101-508). The reforms that were designed to place the Fund on an actuarially sound basis required

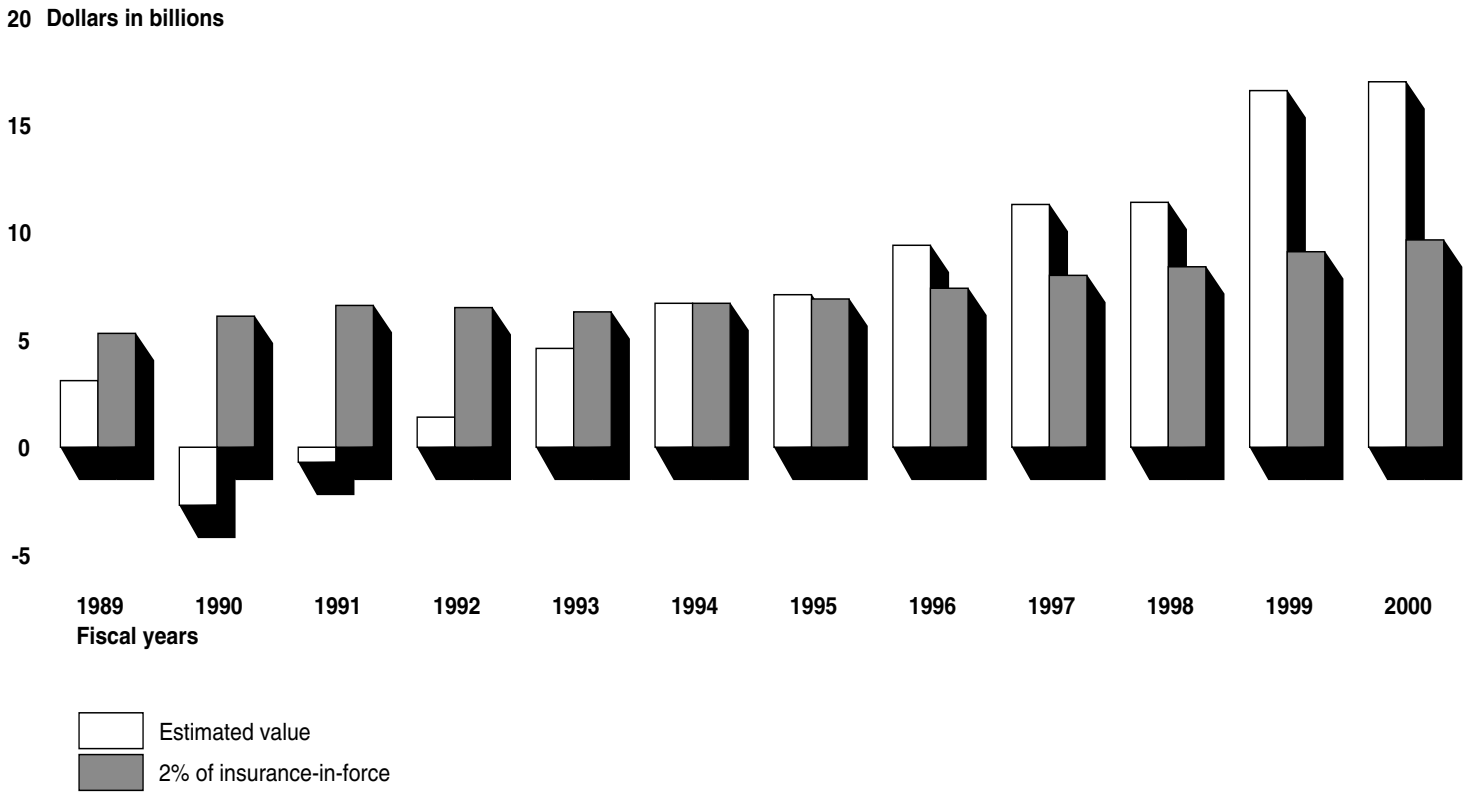
- the Secretary of HUD to take steps to ensure that the Fund attains a capital ratio of 2 percent of the insurance-in-force[4] by November 2000 and maintains that ratio at a minimum at all times thereafter;
- an independent contractor to conduct an annual actuarial review of the Fund;[5]
- the Secretary of HUD to suspend the payment of distributive shares, which had been paid continuously from 1943 to 1990, until the Fund is actuarially sound; and
- FHA borrowers to pay more in insurance premiums over the life of their loans by adding a risk-adjusted annual premium to the one time, up-front premium.

The Federal Credit Reform Act of 1990, enacted as part of the Omnibus Budget Reconciliation Act of 1990, also reformed budgeting methods for federal credit programs including FHA's mutual insurance program. The 1990 credit reforms were intended to ensure that the full cost of credit activities for the current budget year would be reflected in the federal budget so that the executive branch and the Congress could consider these costs when making annual budget decisions. As a result, FHA's budget is required to reflect the subsidy cost to the government—the estimated long-term cost calculated on a net present value basis—of FHA's loan insurance activities for that year. During the 1990s, the estimated economic value of the Fund—comprised of capital resources and the net present value of future cash flows—grew substantially. As figure 2 shows, by the end of fiscal year 1995, the Fund had attained an estimated economic value that slightly exceeded the amount required for a 2-percent capital ratio. Since that time, the estimated economic value of the Fund has continued to grow and has always exceeded the amount required for a 2-percent capital ratio.

[4] The Omnibus Budget Reconciliation Act of 1990 defined the capital ratio as the ratio of the Fund's capital, or economic net worth (economic value), to its unamortized insurance-in-force. However, the act defined unamortized insurance-in-force as the remaining obligation on outstanding mortgages—a definition generally understood to apply to amortized insurance-in-force. HUD has calculated the 2-percent capital ratio using unamortized insurance-in-force as it is generally understood—which is the initial amount of mortgages. Unless otherwise noted, the capital ratios in this report are calculated using unamortized insurance-in-force.

[5] From 1989 to 1998, Price Waterhouse performed this review; in 1999, Deloitte & Touche was awarded the contract.

Figure 2: Comparison of Estimated Economic Value and 2 Percent of Insurance-in-Force, 1989-2000



Source: GAO analysis of Price Waterhouse (now PricewaterhouseCoopers) and Deloitte & Touche data.

As a result of the 1990 housing reforms, the Fund must not only meet capital ratio requirements, but it must also achieve actuarial soundness; that is, the Fund must contain sufficient reserves and funding to cover estimated future losses resulting from the payment of claims on foreclosed mortgages and administrative costs. However, neither the legislation nor the actuarial profession defines actuarial soundness. Price Waterhouse (now PricewaterhouseCoopers) in 1989 concluded that for the Fund to be actuarially sound, it should have capital resources that could withstand losses from reasonably adverse, but not catastrophic, economic downturns. The Price Waterhouse report did not clearly distinguish adverse from catastrophic downturns; however, they said that private mortgage insurers are required to hold contingency reserves to protect against catastrophic losses. In turn, rating agencies require that private mortgage insurers have enough capital on hand to withstand severe losses

that would occur if loans they insure across the entire nation had losses similar to those experienced in the west south central states in the 1980s.

Because economic downturns put downward pressure on house prices and incomes, they can stress FHA's ability to meet its obligations. Thus, it is reasonable that measures of the financial soundness of the Fund would be based on tests of the Fund's ability to withstand recent recessions or regional economic downturns. In the last 25 years, we have experienced a national recession and regional economic declines that did or could have placed stress on FHA. For example, the nation experienced a recession in 1981 and 1982 that strained mortgage markets. Regionally, states in the west south central portion of the nation experienced an economic decline in 1986 through 1989 precipitated by a sharp drop in the price of crude oil. Similarly, the economic decline experienced by California from 1992 through 1995 placed stress on FHA. Because FHA does substantial business in these regions of the country, these experiences led to substantial losses for FHA. In contrast, the economic decline experienced by the New England states from 1989 through 1991 placed little strain on FHA because insured mortgages in this region do not make up a large portion of FHA's total portfolio. However, experiences similar to the New England downturn, during which the unemployment rate increased by almost 140 percent and house prices decreased by 5.5 percent, could place stress on FHA if they occurred in other regions or the nation as a whole.

The Fund's Estimated Economic Value Exceeds 3 Percent of Insurance-in-Force

On the basis of our economic model of FHA's home loan program and forecasts of several key economic factors, we estimate that at the end of fiscal year 1999, the Fund had an economic value of about $15.8 billion. This value, which is 3.20 percent of the unamortized insurance-in-force, reflects the robust economy and relatively high premium rates prevailing through most of the 1990s and the good economic performance forecast for the future. In comparison, Deloitte & Touche estimated that the Fund's 1999 economic value was over $800 million larger than our estimate—or about 3.66 percent of its estimate of FHA's unamortized insurance-in-force. Although we did not evaluate the quality of Deloitte's estimates, we believe that Deloitte's and our estimates are comparable because of the uncertainty inherent in forecasting and the professional judgments made in this type of analysis. However, Deloitte's analysis and ours differ in several ways, including the time when the analyses were performed and some of the assumptions made.

The Estimated Economic Value of the Fund Reflects the Robust Economy and Increased Premium Rates

Using conservative assumptions, we estimate that at the end of fiscal year 1999, the Fund had an economic value of about $15.8 billion. The economic value of the Fund consists of the capital resources on hand and the net present value of future cash flows. Documents used to prepare FHA's 1999 financial statements show that the Fund had capital resources of about $14.3 billion at the end of that fiscal year. We estimated the relationship between historical FHA foreclosures and prepayments and certain key economic factors to forecast foreclosures and prepayments and the resulting cash flows over the next 30-year period for mortgages insured by FHA before the end of fiscal 1999. As a result of this analysis, we estimate that at the end of 1999 the net present value of future cash flows was about $1.5 billion. Summing the capital resources and future cash flows gives us an economic value of about $15.8 billion. See appendix II for a detailed discussion of the forecasting and cash flow models used to estimate the economic value of the Fund.

We also estimate that the Fund's capital ratio—the Fund's economic value divided by its insurance-in-force—exceeded 3-percent at the end of fiscal year 1999. From the individual loan data provided by HUD, we calculated that the unamortized insurance-in-force at the end of fiscal year 1999 was about $494 billion and that the amortized value of that insurance, an estimate of the outstanding balance of the loans and thus FHA's insurance liability, was about $455.8 billion. Therefore, the economic value of the Fund represented 3.20 percent of the unamortized insurance-in-force and about 3.47 percent of the amortized insurance-in-force on September 30, 1999.

The robust economy and the increased premium rates established by the 1990 legislation contributed to the strength of the Fund at the end of fiscal year 1999. The Fund's economic value principally reflects the large amount of capital resources that the Fund has accrued. Because current capital resources are the result of previous cash flows, the robustness of the economy and the higher premium rates throughout most of the 1990s accounted for the accumulation of these substantial capital resources. Good economic times that are accompanied by relatively low interest rates and relatively high levels of employment are usually associated with high levels of mortgage activity and relatively low levels of foreclosure; therefore, cash inflows have been high relative to outflows during this period.

The estimated value of future cash flows also contributed to the strength of the Fund at the end of fiscal 1999. As a result of relatively low interest rates

and the robust economy, FHA insured a relatively large number of mortgages in fiscal years 1998 and 1999. These loans make up a large portion of FHA's insurance-in-force, because many borrowers refinanced their FHA-insured mortgages originated in earlier years, probably as a result of interest rates having fallen to relatively low levels in 1998 and 1999. Because these recent loans have low interest rates and because forecasts of economic variables for the near future show house prices rising while unemployment and interest rates remain fairly stable, our models predict that these new loans will have low levels of foreclosure and prepayment. As a result, our models predict that future cash flows out of the Fund will be relatively small. At the same time, we assume that FHA-insured homebuyers will continue to pay the annual premiums that were reinstituted in 1991. Thus, our models predict that cash flowing into the Fund from mortgages already in FHA's portfolio at the end of fiscal year 1999 will be more than sufficient to cover the cash outflows associated with these loans. As a result, the estimated economic value of the Fund is even higher than the level of its current capital resources.

Deloitte's Estimates Are Comparable to Ours, but the Analyses Differ in Several Ways

As table 1 shows, Deloitte's independent actuarial analysis of the Fund for fiscal year 1999 estimated a capital ratio that was somewhat higher than ours, 3.66 percent rather than 3.20 percent of unamortized insurance-in-force. Although we did not evaluate the quality of Deloitte's estimates, we did identify some reasons that its estimate of the capital ratio was higher than ours. The ratio is higher because Deloitte estimates both a higher economic value of the Fund and a lower amount of insurance-in-force. Deloitte's higher estimated economic value of the Fund includes a higher estimated value for capital resources on hand that is somewhat offset by a lower estimate of the net present value of future cash flows.

Table 1: Estimates of Capital Ratios for FHA's Mutual Mortgage Insurance Fund by GAO and Deloitte & Touche, End of FY 1999

Dollars in millions

Estimate	Total capital resources	Future cash flows	Economic value	Unamortized insurance-in-force	Capital ratio (percent)
GAO	$14,326	$1,484	$15,810	$493,990	3.20
Deloitte	15,331	1,306	16,637	454,184	3.66

Source: GAO analysis and *Actuarial Review of MMI Fund as of FY 1999*, Deloitte & Touche.

Our estimate and that of Deloitte rely on forecasts of foreclosures and prepayments over the next 30 years, and, in turn, these forecasts

necessarily rest on forecasts of certain economic factors. In addition, the estimates depend on the choices made concerning a variety of other assumptions. As a result of the inherent uncertainty and the need for professional judgment in this type of analysis, we believe that our estimates and Deloitte's estimates of the Fund's economic value and capital ratio are comparable.

Although the estimates are comparable, Deloitte's estimates of capital resources and insurance-in-force differ from ours primarily because the analyses were conducted at different times. Because Deloitte performed its analysis before the end of 1999, it had to estimate some data for which we had year-end values. In particular, Deloitte overestimated the 1999 value of capital resources by extrapolating from the 1998 value. In contrast, we used values developed for FHA's 1999 financial statements that were about $1 billion lower than Deloitte's estimate. Using our value for capital resources, Deloitte's estimated capital ratio would be 3.44 percent rather than 3.66 percent of insurance-in-force.[6] Similarly, Deloitte underestimated the number of loans that FHA insured in the fourth quarter of fiscal year 1999 and, thus, underestimated the value of loans insured for all of fiscal year 1999 by about $33 billion, though this appears to have had little effect on the estimated capital ratio.

Our analysis of the net present value of future cash flows and that of Deloitte also differ in several respects. Both our estimates and Deloitte's rely on forecasts of future foreclosures and prepayments. In turn, these forecasts are generated from models that are based on estimated relationships between the probability of loan foreclosure and prepayment and key explanatory factors, such as borrowers' home equity and interest and unemployment rates. Our model differs from Deloitte's in the way that it specifies these relationships. For example, Deloitte specified changes in household income as one of the key explanatory factors, while we did not.[7]

[6] In its 2000 actuarial review, Deloitte recognized that its 1999 estimate of capital resources was about $1 billion higher than the actual year-end value. In addition, Deloitte revised upward its measure of up-front mortgage insurance premiums and downward the net present value of future cash flows calculated at the beginning of fiscal year 2000. As a result, Deloitte estimates an economic value of the Fund of $14.1 billion at the beginning of fiscal year 2000, which would have resulted in a capital ratio even lower than 3.44 percent at the beginning of fiscal year 2000, that is, the end of fiscal year 1999.

[7] We did not include changes in household income because we believe that unemployment rates are more directly connected to changes in the ability of borrowers to make mortgage payments and are sufficient to capture those changes.

The analyses also differ in the assumptions made about some future economic values and costs associated with FHA's insurance program. For example, we assumed lower house price appreciation rates and higher discount rates for calculating net present values than did Deloitte.[8] In addition, the analyses differ in the way that they use HUD's data. We used a sample of individual loans while Deloitte grouped loans into categories to do its analysis. Although these factors could be important in identifying why the two estimates differ, we could not quantify their impact because we did not have access to Deloitte's models.

A 2-percent Capital Ratio Appears Sufficient to Withstand Some Worse-Than-Expected Loan Performance

According to our estimates, worse-than-expected loan performance that could be brought on by moderately severe economic conditions would not cause the estimated value of the fund at the end of fiscal year 1999 to decline by more than 2 percent of insurance-in-force. However, a few more severe economic scenarios that we examined could result in such poor loan performance that the estimated value of the fund at the end of fiscal year 1999 could decline by more than 2 percent of insurance-in-force. Two of the three scenarios that showed such a large decline extended adverse conditions more widely than the moderately severe scenarios and, therefore, are less likely to occur. While these estimates suggest that the capital ratios are more than sufficient to protect the Fund at this time from many worse-than-expected loan performance scenarios, factors not fully captured in our models could affect the Fund's ability to withstand worse-than-expected experiences over time. These factors include recent changes in FHA's insurance program and the conventional mortgage market that could affect the likelihood of poor loan performance and the ability of the Fund to withstand that performance. For example, conventional mortgage lenders and private mortgage insurers have recently lowered the required down payment on loans. Such actions may have attracted some lower risk borrowers who would otherwise have insured their loans with FHA. As a result, the overall riskiness of FHA's portfolio may be greater than we have estimated, making a given amount of capital less likely to withstand future economic downturns than we have predicted.

[8] Appendix II discusses the sensitivity of our results to some of the assumptions we made in our analysis.

At This Time, the Capital Ratio Appears Sufficient to Withstand Moderately Severe Economic Scenarios That Are Based on Recent Historical Experience

Beginning with the robust economy and the value of the Fund in 1999, our analysis shows that a 2-percent capital ratio appears sufficient to withstand worse-than-expected loan performance that results from moderately severe economic scenarios similar to those experienced over the last 25 years. Our model and others that are based on historical experience suggest that falling house prices and high levels of unemployment are likely to produce poor mortgage performance. Thus, to test the Fund's ability to withstand worse-than-expected loan performance, we developed economic scenarios that are based on certain regional downturns and the 1981-82 national recession.

We tested the adequacy of the capital ratio using economic scenarios that were based on three recent regional economic downturns—one in the west south central region of the United States that began in 1986, one in New England that began in 1989, and one in California that began in 1992—that produced high mortgage foreclosure rates in those regions.[9] The degree to which these downturns affected the Fund depended on their severity as well as on the volume of mortgages insured by FHA in that region. Thus, while New England suffered a severe downturn in the late 1980s and early 1990s, the Fund did not suffer significantly because the volume of loans that FHA insures in New England represents a small share of FHA's total volume of insured loans. Because regional averages diminish the impact of the adverse economic experience, from each region we selected a state with particularly poor experience as the basis for our scenarios. We also adjusted the scenarios to recognize that the forecasts start from the economic conditions that existed at the end of 1999. See appendix III for further discussion of the scenarios that we used to test the adequacy of FHA's capital ratio.

As can be seen in table 2, neither the scenarios that are based on regional downturns nor the scenario that is based on the 1981-82 national recession had much of an effect on the value of the Fund. More specifically, in these worse-than-expected scenarios that are based on specific historical experiences, the estimated capital ratio never falls below 2.8 percent, which is only 0.4 percentage points below our estimated capital ratio using

[9] The west south central region includes those states in the west south central Bureau of the Census division—Arkansas, Louisiana, Oklahoma, and Texas. The New England region includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. California is part of the Pacific region, which corresponds to the Pacific census division and also includes Alaska, Hawaii, Oregon, and Washington.

expected economic conditions. However, the national recession had the greatest impact because it affected FHA's entire portfolio.

Table 2: Capital Ratios Under Expected and Historical Economic Scenarios

Scenario	Description	Capital ratio[a] (percent)
Expected economic conditions	Unemployment and interest rates vary as Standard & Poor's DRI forecasts; house price growth is adjusted for constant quality and slower growth.[b]	3.20
West south central downturn	House prices and unemployment change as they did in Louisiana from 1986 through 1990.	3.06
New England downturn	House prices and unemployment change as they did in Massachusetts from 1988 through 1992.	3.14
Pacific downturn	House prices and unemployment change as they did in California from 1991 through 1995.	2.89
1981-82 national recession	For each state, house prices, unemployment rates, and interest rates change as they did from 1981 through 1985.	2.81

[a]In estimating these capital ratios, we assume that the scenario begins in the first year after the most recent loans were originated. In our data, the most recent loans were originated in fiscal year 1999; therefore, scenarios start in fiscal year 2000. We knew when we performed this analysis that none of these scenarios actually occurred in fiscal year 2000, but we wanted to test the ability of the Fund to withstand an economic downturn when many of FHA's loans were new and the borrowers had not accumulated much equity. In addition, results for scenarios beginning a year later had less of an effect on the Fund.

[b]Standard and Poor's DRI is a private economic forecasting company.

Source: GAO analysis.

Under More Severe Economic Scenarios, the Capital Ratio Could Fall by More Than 2 Percentage Points

Although the Fund's estimated capital ratio at the end of fiscal year 1999 fell by considerably less than 2 percentage points under economic scenarios that are based on recent regional experiences and the 1981-82 national recession, our model suggests that extensions of some historical regional scenarios to broader regions of the country could cause the capital ratio to fall by more than 2 percentage points. Specifically, to test whether a 2-percent capital ratio could withstand more severe economic conditions, we extended the regional scenarios to two regions and then to the nation as a whole. However, we recognize that these extensions are less likely to occur than the historical scenarios that affected a single region. As table 3 shows, if any of these downturns simultaneously hit two regions where FHA has significant business—the west south central and Pacific regions—the estimated capital ratio would be less than 2 percentage points lower than it would be with expected loan performance. In addition, even if the

entire nation experienced a downturn similar to two of the three regional downturns that we analyzed, the estimated capital ratio would still fall by less than 2 percentage points. However, a national downturn as severe as that experienced by Massachusetts from 1989 through 1992 would cause our estimate of the 1999 capital ratio to fall by more than 2 percentage points.

Table 3: Capital Ratios Under Expected and More Severe Economic Scenarios in Selected Locations

Scenario	Description	Capital ratio for scenarios in two regions[a] (percent)	Capital ratio for national scenarios (percent)
Expected econom conditions	Unemployment and interest rates vary as DRI forecasts; house price growth is adjusted for constant quality and slower growth.[b]	NA	3.20
Extensions of historical regional downturns			
West south central downturn	House prices and unemployment rates change as they did in Louisiana from 1986 through 1990.	2.81	2.31
New England downturn	House prices and unemployment rates change as they did in Massachusetts from 1988 through 1992.	2.14	0.81
Pacific downturn	House prices and unemployment rates change as they did in California from 1991 through 1995.	2.59	2.16
National scenarios with interest rate changes or high foreclosure rates			
Induced refinancing followed by a recession	Mortgage interest rates fall, inducing borrowers to refinance, and then a recession sets in, such that the unemployment rate rises and house prices fall.	NA	1.37
Rising interest rate scenario	Mortgage and other interest rates are higher from 2000 through 2004 than under expected economic conditions.	NA	3.36
Scenario with foreclosure rates from the 1980s	Foreclosure rates in 2000 through 2004 equal foreclosure rates from 1986 to 1990 for mortgages originated in most recent 10-year period[c]	NA	0.92

[a]The two regions are the Pacific and west south central census divisions.

[b]Standard & Poor's DRI is a private economic forecasting company.

[c]This scenario does not vary foreclosure rates for streamline refinanced or adjustable rate mortgages because there are no data on these products for the 10-year period prior to 1986.

Source: GAO analysis.

Because we were concerned that the historical scenarios we were considering might not be adequate to test the effect of changes in interest rates, we developed two additional scenarios: one in which mortgage interest rates fall and then a recession sets in and one in which mortgage and other interest rates rise to levels that are higher than those in the expected economic conditions scenario. The first scenario is more likely to exhaust a 2-percent capital ratio.

Under a scenario in which mortgage interest rates fall and then a recession sets in, the drop in interest rates might induce some homeowners to refinance their mortgages. For those homeowners who refinance outside of FHA, the fund would no longer be accumulating revenue in the form of annual premiums; if the homeowners have not had their mortgages for long, they would receive some premium refunds. Moreover, those borrowers who use FHA's streamline refinance provision that allows borrowers to refinance their mortgages without a new appraisal of their home will likely pay annual premiums for fewer years than if they had not refinanced.[10] So, cash outflows would have increased and cash inflows would have decreased before the recession hits. When the recession hits, cash outflows would increase further because of increased foreclosures among the remaining borrowers. As table 3 shows, our model predicts that the capital ratio would fall substantially—by almost 2 percentage points—under this scenario.

A scenario with rising mortgage interest rates will affect various loan types differently. Because the payments on adjustable rate mortgages increase as interest rates rise, there is an increased likelihood that borrowers with these types of mortgages will default. However, since FHA-insured mortgages are assumable, rising interest rates make fixed-rate mortgages

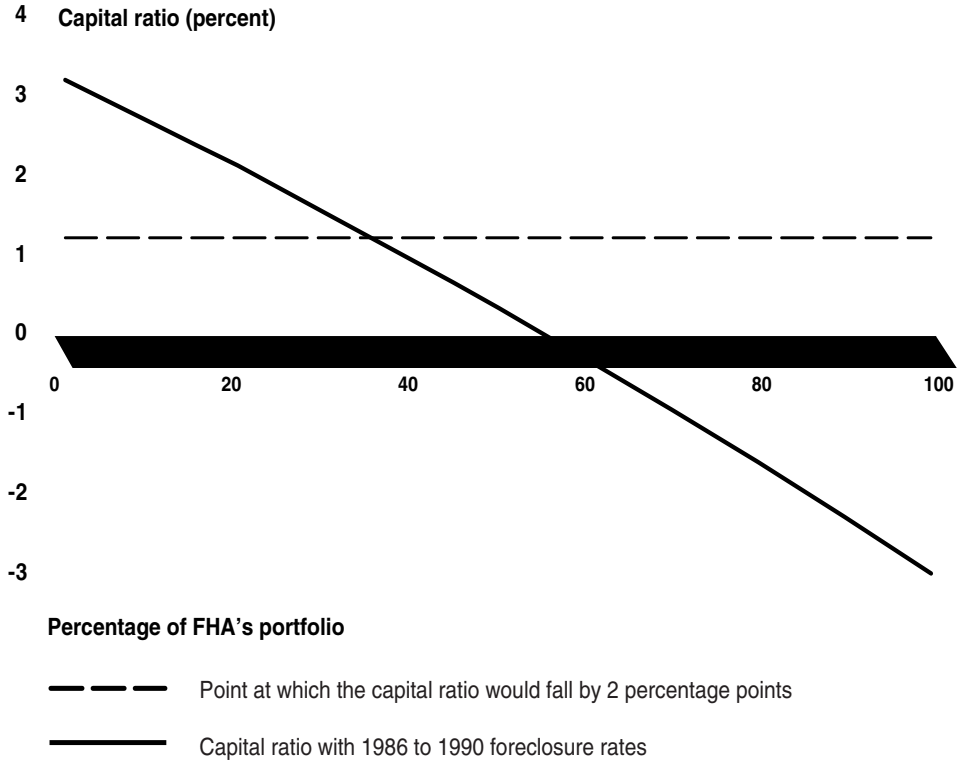
[10] Borrowers with 30-year mortgages who borrow more than 95 percent of the value of their home are required to pay annual premiums equal to 0.5 percent of the remaining balance of their mortgage for 30 years. However, if these borrowers refinance their mortgages using FHA's streamline program, they will have to pay annual premiums for no more than 7 years. In "Mortgage Refinancing, Adverse Selection, and FHA's Streamline Program", *Journal of Real Estate Finance and Economics* (vol. 21, issue 2), David Brickman and Patric Hendershott estimated that borrowers who borrowed 97 percent of the value of their homes in 1994 and immediately refinanced would have reduced the net present value of their premium payments by 32 percent.

more valuable to those borrowers holding them. This decreases the likelihood that borrowers with these types of mortgages will default. Insurance on loans originated in 1998 and 1999 make up 42 percent of FHA's portfolio at the end of fiscal year 1999, and the insured loans are predominately fixed rate mortgages. Consequently, it is not surprising that a rising interest rate scenario leads to an increase in the value of the Fund.

Because our economic model did not predict regional or national foreclosure rates as high as those experienced during the 1980s in any of our scenarios, we estimated cash flows using foreclosure rates that more closely matched regional experience during the 1980s. Specifically, we assumed that for mortgages originated from 1989 through 1999, foreclosure rates in 2000 through 2004 would equal those experienced from 1986 through 1990 by FHA-insured loans that originated between 1975 and 1985 in a given region. As table 3 shows, the capital ratio fell to 0.92 percent under this scenario. To test an even more severe scenario, one similar to that used by rating agencies for private mortgage insurers,[11] we also calculated future cash flows assuming that foreclosure rates in 2000 through 2004 extended the very poor performance of the west south central mortgages in the 1980s to ever larger portions of FHA's insurance portfolio. As figure 3 shows, we found that if 36.5 percent of FHA-insured mortgages experienced these high default rates, the estimated capital ratio for fiscal year 1999 would fall by 2 percentage points. If about 55 percent of FHA's portfolio experienced these conditions, a less likely event, the capital ratio would be 0.

[11] For example, Standard & Poor's assumes that over the next 10 years, default rates for fixed rate mortgages will equal those from the west south central states in the 1980s. In addition, they assume that no new loans will be insured. The rating for private mortgage insurers depends on how much capital a company has at the end of this 10-year experience.

Figure 3: Capital Ratios Resulting From Applying the Average 1986-90 Foreclosure Rates in the West South Central Census Division to Varying Proportions of FHA's Insurance Portfolio in 2000-04



Note: West south central mortgages made up 9 percent of FHA's portfolio in 1999. This analysis does not change foreclosure rates for streamline refinanced or adjustable rate mortgages because there are no data on these products for the 10-year period prior to 1986.

Source: GAO analysis.

Other Factors May Affect the Adequacy of the Capital Ratio

Because our models are based on the relationship between foreclosures and prepayments and certain economic factors from fiscal years 1975 through 1999, they do not account for the potential impact of recent events, such as changes in FHA's program or in the behavior of the conventional mortgage market. In addition, our models assume that no additional changes in FHA's program or the conventional mortgage market that would affect FHA-insured loans originated through 1999 take place during the forecast period, which extends from fiscal years 2000 through 2028. To the extent that any such changes cause foreclosure and prepayment rates on existing FHA-insured loans to be higher or lower than we have predicted,

the Fund's capital ratio would be different under the various scenarios we have discussed. Furthermore, our analysis does not attempt to predict how loans insured by FHA after fiscal year 1999 will behave. Future changes in FHA's program, such as the premium changes adopted as of January 1, 2001,[12] or in the conventional mortgage market may make future loans perform better or worse than we might expect from past experience. In addition, these changes may increase or reduce the amount of cash flowing into the Fund and thus its ability to withstand worse-than-expected loan performance in the future.

Changes in FHA's Insurance Program

HUD and the Congress can change FHA's insurance program in a variety of ways, including changes in refund policy and underwriting standards. In fact, HUD and the Congress have taken the following actions in recent years that could affect the Fund in ways that are not accounted for in our models:

- HUD has suggested that it will reinstitute distributive shares and Members of Congress have introduced bills requiring HUD to take that action. The immediate consequence of this action would be that cash flows out of the Fund would be higher than our estimates.
- During the late 1990s, the Congress required that FHA implement a new loss mitigation program that encourages lenders to take actions to lower defaults on FHA-insured mortgages. The program requires that lenders provide homebuyers with certain options to avoid foreclosure. While it is hoped that losses from foreclosures will decline as a result of this program, if foreclosure is simply delayed as a result of forbearance, losses could ultimately be larger in the long run. In either case, actual cash flows would likely be different than our estimates.
- FHA has also reduced up-front premiums for new homeowners who receive financial counseling before buying a home. If the program reduces the likelihood that these homeowners will default, losses would be lower than we have estimated.[13]

[12] These changes include reducing the up-front premium for all homebuyers to 1.5 percent (a reduction of up to 0.75 percentage points) and canceling the annual mortgage insurance premiums for most borrowers when the value of the mortgage reaches 78 percent of the original price of the house.

[13] As a result of the reduction in up-front premiums for all borrowers on January 1, 2001, borrowers receiving financial counseling before purchasing a home will no longer pay lower up-front premiums than other borrowers.

- HUD has taken action to improve the oversight of lenders and better dispose of properties and is continuing to implement new programs in these areas. Better oversight of lenders could mean that losses on existing business would be lower than we have predicted, and better practices for disposing of property could reduce losses associated with foreclosed properties below the level we have estimated.

Our models do not look at cash flows associated with loans that FHA would insure after fiscal year 1999. However, recent and future changes in FHA's insurance program will affect the likelihood that these loans will perform differently than past experience suggests they will. If, for example, FHA loosens underwriting standards, there is a greater likelihood that future loans would perform worse than past experience suggests. In addition, changes in premiums, such as the recent reductions in up-front premiums, could reduce cash inflows into the Fund and, therefore, reduce the Fund's ability to withstand poor loan performance. However, this premium change could also lower the riskiness of the loans FHA insures.

Changes in the Conventional Mortgage Market

Recent changes in the conventional mortgage market, especially changes in FHA's competitors' behavior, may also affect the estimates we have made concerning the Fund's ability to withstand adverse economic conditions over the long run. Homebuyers' demand for FHA-insured loans depends, in part, on the alternatives available to them. In recent years, FHA's competitors in the conventional mortgage market—private mortgage insurers and conventional mortgage lenders—are increasingly offering products that compete with FHA's for those homebuyers who are borrowing more than 95 percent of the value of their home. These developments in the conventional mortgage market may have increased the average risk of FHA-insured loans in the late 1990s. In particular, by lowering the required down payment, conventional mortgage lenders and private mortgage insurers may have attracted some borrowers who might otherwise have insured their mortgages with FHA. If, by selectively offering these low down payment loans, conventional mortgage lenders and private mortgage insurers were able to attract FHA's lower-risk borrowers, recent FHA loans with down payments of less than 5 percent may be more risky on average than they have been historically. If this effect, known as adverse selection, has been substantial, the economic value of the Fund may be lower than we estimate, and it may be more difficult for the Fund to withstand worse-than-expected loan performance than our estimates suggest. In addition, should these competitive pressures persist, newly insured loans are likely to perform worse than prior experience would suggest, and then any given capital ratio would be less able to withstand

such performance. FHA is taking some action to more effectively compete. For example, FHA is attempting to implement an automated underwriting system that could enhance the ability of lenders underwriting FHA-insured mortgages to distinguish better credit risks from poorer ones. Although this effort is likely to increase the speed with which lenders process FHA-insured loans, it may not improve the risk profile of FHA borrowers unless lenders can lower the price of insurance for better credit risks.

The Impacts of Options for Reducing FHA's Capital Ratio Are Difficult to Predict

Several options are available to the Secretary of HUD under current legislative authority that could result in reducing FHA's capital ratio. Other options would require legislative action. Reliably measuring the impacts of these options on the Fund's capital ratio and FHA borrowers is difficult without using tools designed to estimate the multiple impacts that policy changes often have. While HUD has substantially improved its ability to monitor the financial condition of the Fund, neither the models used by HUD to assess the financial health of the Fund, nor those used by others, explicitly recognize the indirect effects of policy changes on the volume and riskiness of FHA's loans. As a result, the impacts of the various policy options on the federal budget are difficult to discern. However, any option that results in a reduction in the Fund's reserve, if not accompanied by a similar reduction in other government spending or by an increase in receipts, would result in either a reduction in the surplus or an increase in any existing deficit.

The Secretary of HUD and the Congress Have Numerous Options Available to Reduce the Capital Ratio

There are several changes to the FHA single-family loan program that could be adopted if the Secretary of HUD or the Congress believes that the economic value of the Fund is higher than the amount needed to ensure actuarial soundness. For example, actions that the Secretary could take that could reduce the value of the fund include lowering insurance premiums, adjusting underwriting standards, and reinstituting distributive shares.[14] However, congressional action in the form of new legislation would be required to make other program changes that are not now

[14] Between 1943 and 1990, FHA rebated these so-called excess funds to borrowers as distributive shares. In 1990, however, the Congress suspended the payment of these shares until the Secretary of HUD determines that the Fund is actuarially sound. HUD has announced that it will resume paying distributive shares. HUD officials said that they are developing systems to facilitate the payment of these shares and expect to be ready to resume paying them in mid-2001.

authorized or clearly contemplated by the statute. These would include actions such as changing the maximum amount FHA-insured homebuyers may borrow relative to the price of the house they are purchasing and using the Fund's reserves for other federal programs.[15] Generally, the Secretary of HUD, in making any authorized changes to the FHA single-family program, must meet certain operational goals. These operational goals include (1) maintaining an adequate capital ratio, (2) meeting the needs of homebuyers with low down payments and first-time homebuyers by providing access to mortgage credit, (3) minimizing the risk to the Fund and to homeowners from homeowner default, and (4) avoiding adverse selection.

Potential Effects of Options on the Fund's Capital Ratio and FHA Borrowers Are Difficult to Measure

Reliably estimating the potential effect of various options on the Fund's capital ratio and FHA borrowers is difficult because the impacts of these policy changes are complex and tools available for handling these complexities may not be adequate. Policy changes have not only immediate, straightforward impacts on the Fund and FHA's borrowers, but also more indirect impacts that may intensify or offset the original effect. Implementing these options could affect both the volume and the average riskiness of loans made, which, in turn, could affect any future estimate of the Fund's economic value. As a result of this complexity, obtaining a reliable estimate would likely require that economic models be used to estimate the indirect effects of policy changes. In 1990, the Congress enacted legislation designed to provide better information on the Fund's financial condition. The Omnibus Budget Reconciliation Act requires annual independent actuarial reviews of the Fund and includes credit reforms that require HUD to estimate, for loans originated in a given year, the net present value of the anticipated cash flows over all the years that the loans will be in existence. The models developed by HUD to comply with these requirements are based on detailed analyses of the Fund's historical claim and loss rates and have improved HUD's ability to monitor the financial condition of the Fund. At this time, however, neither the models used by HUD to assess the financial health of the Fund, nor those used by others, explicitly recognize the indirect effects of policy changes on the volume and riskiness of FHA's loans. As a result, HUD cannot reliably estimate the impact of policy changes on the Fund. Although it is difficult to predict the overall impact of a change on the Fund's capital ratio

[15] During the 106th Congress, legislation was introduced that proposed using the Fund's resources to fund affordable rental housing (see S. 2997).

and thus on FHA borrowers as a whole, different options would likely have different impacts on current and prospective FHA-insured borrowers.

Effect on the Fund's Capital Ratio

Many of the proposals to reduce the capital ratio, such as lowering premiums or reinstituting distributive shares, will reduce the price of FHA insurance to the borrower. If no change in the volume of loans FHA insures is considered, then the effect of lowering premiums, for example, clearly would be to lower the economic value of the Fund. However, for two reasons, this price reduction is likely to increase the volume of FHA loans originated, which would increase both premium income and claims against the Fund when some of these new loans default. First, by lowering the price of FHA insurance relative to the price of private mortgage insurance, this premium reduction would likely induce some borrowers who otherwise would have obtained private mortgage insurance to obtain FHA insurance instead, thereby increasing FHA's market share. Second, people who were deferring home purchases because of the high price of FHA insurance might buy homes with FHA insurance once the price is lower. Without a complete analysis of the impact on the volume of loans, reliably estimating the effect of lowering the premiums on the Fund's economic value is difficult.

Furthermore, the economic value of the Fund is influenced not only by the volume of loans FHA insures, but also by the riskiness of those loans. Therefore, determining the effect a policy change will have on the economic value of the Fund requires determining how the policy will affect the riskiness of FHA-insured loans. In the case of lowering up-front premiums, for example, the new FHA-insured loans could be less risky than FHA's existing loans. As a result, the new loans would be profitable and offset the direct impact of lower premiums. Generally, private mortgage insurers require that borrowers meet higher credit standards than does FHA. So, to the extent that these new FHA borrowers would have obtained private mortgage insurance without the lower premiums, they are likely to have lower risk profiles than the average for all current FHA borrowers. At the same time, lowering up-front premiums is not likely to attract many

additional higher-risk borrowers who would previously not have qualified for FHA-insured loans.[16]

Because HUD does not have adequate tools to handle the complexities of estimating the ultimate impact of policy changes on the volume of FHA-insured loans and the riskiness of those loans, these factors are not always considered in assessing the impact of policy changes. For example, assuming that the volume and riskiness of FHA-insured loans will not change, HUD estimates that the recent reductions in up-front premiums combined with the introduction of mortgage insurance cancellation policies will lower the estimated value of the Fund by almost $6 billion over the next 6 years. Because this estimate does not consider the possible changes in the volume of loans that will be insured and the riskiness of those loans, it is an estimate only of the direct impact rather than the full impact of policy changes. Similarly, a recent study presents estimates that lowering up-front premiums to 1.5 percent would result in an almost fivefold increase in the likelihood that cash inflows would be less than outflows over a random 10-year period.[17] However, this study notes that it did not look at how these changes would affect the riskiness of new loans. The complexity of estimating the impact of policy changes on the Fund implies that economic models would be needed to reliably estimate the likely outcomes. The most likely sources for such models would be the studies that compute the economic value of the Fund; however, the models HUD and others have been using to assess the financial health of the Fund do not explicitly recognize the impact of policy changes on the economic value of the Fund. Instead, they assume that FHA's market share remains static.

Effect on Borrowers

Although it is difficult to predict the overall impact of a change on the Fund's capital ratio and thus on FHA borrowers as a whole, different options would likely have different impacts on various FHA-insured borrowers. Some proposals would more likely benefit existing and future

[16] Most FHA borrowers finance their up-front premiums over the life of their loans (generally 30 years), rather than paying them up-front. As a result, lowering the up-front premiums would not substantially reduce the amount of cash required from borrowers at settlement. However, those borrowers who could not qualify for a mortgage because their monthly payments would have been too high relative to their income, might then qualify because the reduction in up-front premiums would lower the monthly payment.

[17] See "Credit Risk, Capital, and FHA Mortgage Insurance," by Charles A. Capone, Jr., forthcoming in the *Journal of Housing Research* (vol. 11, issue 2).

FHA-insured borrowers, while others would benefit only future borrowers, and still others would benefit neither of these groups. One interpretation of the higher premiums that borrowers paid during the period in which the economic value of the fund has been rising is that borrowers during the 1990s "overpaid" for their insurance. Some options for reducing the capital ratio, such as reinstituting distributive shares, would be more likely to compensate these borrowers. Paying distributive shares would benefit certain existing borrowers who voluntarily terminate their mortgages. If these policies continued into the future, they would also benefit future policyholders. Alternatively, reducing up-front premiums, reducing the number of years over which annual insurance premiums must be paid, or relaxing underwriting standards would tend to benefit only future borrowers. Policy options that propose to use some of FHA's capital resources for spending on other programs would benefit neither existing nor future FHA-insured borrowers, but would instead benefit the recipients of those programs receiving the new expenditures. For example, reducing the capital ratio by shifting funds from the Fund to subsidize multifamily housing may primarily benefit renters rather than single-family homeowners. However, over time such a policy could be sustained only so long as FHA borrowers continue to pay premiums higher than the cost to FHA of insuring single-family mortgages.

Potential Impact of Options on the Federal Budget Is Difficult to Discern

Because of the difficulty in reliably measuring the effect of most actions that could be taken either by the Secretary of HUD or the Congress on the Fund's capital ratio, we cannot precisely measure the effect of these policies on the budget.[18] However, any actions taken by the Secretary or the Congress that influence the Fund's capital ratio will have a similar effect on the federal budget. Specifically, any proposal that results in a reduction in the Fund's reserve, if not accompanied by a similar reduction in other government spending or by an increase in receipts, would result in either a reduction in the surplus or an increase in any existing deficit.

If the Secretary or the Congress adopts policies, such as paying distributive shares or relaxing underwriting standards, that could reduce the profitability of the Fund, both the negative subsidy amount reported in FHA's budget submission and the Fund's reserve would be lower. Some of

[18] However, the Congressional Budget Office has begun building a model that it believes will allow it to forecast simulations and what-if analyses with the objective of making FHA's budget reporting more transparent and informative.

these policies—such as paying distributive shares—would affect FHA's cash flows immediately. Thus, the amount of money available for FHA to invest in Treasury securities would be lower. The Treasury, in turn, would have less money available for other purposes, and any overall surplus would decline or any deficit would rise. If the amounts of cash flowing out of the Fund exceeded current receipts, FHA would be required to redeem its investments in Treasury securities to make the required payments. The Treasury, then, would be required to either increase borrowing from the public or use general tax revenues to meet its financial obligations to FHA. In either case, any annual budget surplus would be lower or deficit higher.

Conclusions

At the end of fiscal year 1999, the Fund had a capital ratio that exceeded 2 percent of FHA's insurance-in-force—the minimum required by law; however, whether the fund was actuarially sound is not so clear. Neither the statute nor HUD has established criteria to determine how severe of a stress the Fund should be able to withstand, that is, what constitutes actuarial soundness. Our results show that as of the end of fiscal year 1999, only the most severe circumstances that we analyzed would cause the current economic value of the Fund to fall below 0.

One method of determining actuarial soundness would be to estimate the value of the Fund under various economic and other scenarios. In our analysis, the required minimum capital ratio of 2 percent appears sufficient to cover most of the adverse economic scenarios we tested, although it would not be possible to maintain the minimum under all scenarios. Nonetheless, we urge caution in concluding that the estimated value of the Fund today implies that the Fund could withstand the specified economic scenarios regardless of the future activities of FHA or the market. Our estimates and those of others are valid only under a certain set of conditions, including that loans FHA recently insured respond to economic conditions similarly to those it insured in the more distant past, and that cash inflows associated with future loans at least offset outflows associated with those loans. However, HUD is changing several policies that may affect the volume and quality of its future business. Further, adverse economic events cannot be predicted with certainty; therefore, we cannot attach a likelihood to any of the scenarios that we tested (even though we recognize that it is less likely that a severe economic downturn will affect the whole nation than one or two regions). It is instructive to remember in considering the uncertainty of the future, that the Fund had an even higher capital ratio in 1979 when the economic value of the Fund equaled 5.3 percent of insurance-in-force, but in little more than a decade—

after a national recession, the substitution of an up-front premium for annual insurance premiums, and regional real estate declines—the economic value of the Fund was negative. Thus, it is important to periodically reevaluate the actuarial soundness of the Fund.

Today, FHA knows more about the condition of the Fund but could still improve its evaluation of the impact that unexpected economic downturns and policy changes may have on the Fund. HUD has already taken some action that it estimates will lower the value of the Fund, including reducing up-front insurance premiums on newly insured mortgages. HUD has done so without the tools necessary to reliably measure the multiple impacts that these policies are likely to have. While the direct impact of policies that are likely to reduce the Fund's capital ratio can be estimated with the models used in the actuarial reviews, those models cannot isolate the indirect effects on the volume of loans insured by FHA and the riskiness of those loans.

Matters for Congressional Consideration

The Congress may want to consider taking action to amend the laws governing the Fund to specify criteria for determining when the Fund is actuarially sound. Because we believe that actuarial soundness depends on a variety of factors that could vary over time, setting a minimum or target capital ratio will not guarantee that the Fund will be actuarially sound over time. For example, if the Fund were comprised primarily of seasoned loans with known characteristics, a capital ratio below the current 2-percent minimum might be adequate, but under conditions such as those that prevail today, when the Fund is comprised of many new loans, a 2-percent ratio might be inadequate if recent and future loans perform considerably worse than expected. Thus, the Congress may want to consider defining the types of economic conditions under which the Fund would be expected to meet its commitments without borrowing from the Treasury.

Recommendations

If the Congress decides that no further guidance is necessary, to better evaluate the health of the Fund and determine the appropriate types and timing of policy changes, we recommend that HUD develop criteria for measuring the actuarial soundness of the Fund. These criteria should specify the economic conditions that the Fund would be expected to withstand and may specify capital ratios currently consistent with those criteria.

Because many conditions affect the adequacy of a given capital ratio, we recommend that the independent annual actuarial analysis give more attention to tests of the Fund's ability to withstand appropriate stresses. These tests should include more severe scenarios that capture worse-than-expected loan performance that may be due to economic conditions and other factors, such as changes in policy and the conventional mortgage market.

To more fully assess the impact of policy changes that are likely to permanently affect the profitability of certain FHA-insured loans, we recommend that the Secretary of HUD develop better tools for assessing the impact these changes may have on the volume and riskiness of loans that FHA insures. Such analysis is particularly important where the policy change permanently affects certain loans, as in the case of underwriting and premium changes. Without a better analytical framework to assess the full impact of policy changes that permanently affect certain loans, we recommend that such changes be made in small increments so that their impact can be monitored and adjustments can be made over time.

Agency Comments and Our Evaluation

We provided a draft of this report to the Secretary of HUD for his review and comment. HUD agreed with the report's findings regarding the estimated value of the fund, and the ability of the fund to withstand moderately severe economic downturns that could lead to worse-than-expected loan performance. However, HUD expressed concern that the report did not note the probability of the most stressful scenarios we tested and FHA's ability to react to adverse developments. HUD also thought our reference to the substantial decline in the capital ratio that occurred during the 1980s left a false impression that the Fund is currently in jeopardy. In addition, HUD expressed concern that the report did not fully recognize the improvements it has made in analyzing policy changes and monitoring the performance of the Fund and disagreed with our recommendations. HUD's letter is reproduced in appendix IV.

In response, we clarified that scenarios in which we extend historical adverse economic conditions more widely are less likely to occur. However, we cannot attribute a probability to any scenario we used. We also acknowledge that the annual actuarial reviews and the annual reestimates of the Fund required under the housing and credit reforms of 1990 enable HUD to better monitor the performance of the Fund and, therefore, react to adverse developments. However, we remain concerned that HUD's analyses of policy changes do not fully recognize the impact

that these policy changes may have on the volume of loans FHA will insure and the riskiness of those loans. We also disagree that the reference to the decline in the capital ratio experienced in the 1980s implies that the Fund is in jeopardy today. In fact, this example serves to illustrate that changes in the economy and HUD policy can have a dramatic impact on the value of the Fund.

With regard to our recommendation that HUD develop criteria for measuring the actuarial soundness of the Fund, HUD seems to infer that we believe a static capital ratio should be the criterion for measuring actuarial soundness. We do not recommend a static capital ratio for measuring actuarial soundness. Rather, we believe that it is important to measure actuarial soundness under different economic and other scenarios; therefore, we recommend that HUD specify the conditions that the Fund would be expected to withstand. We revised this recommendation to make clear that the definition of actuarial soundness should consider the economic conditions that the Fund would be expected to withstand.

Regarding our recommendation that the independent annual actuarial analysis give more attention to tests of the Fund's ability to withstand appropriate stresses, HUD noted that it believed it was already complying with this recommendation and asked that our report define more specifically what tests are needed. In response, we clarified that the annual actuarial review should include more severe scenarios that capture worse-than-expected loan performance that may be due to economic conditions and other factors, such as changes in HUD policy and the conventional mortgage market. HUD's recent actuarial analysis included two scenarios—an interest rate spike scenario and a lower house price appreciation scenario—for testing the value of the Fund under a stressed economic state, and in neither scenario do house prices decline or unemployment rates rise.[19]

With regard to our recommendation concerning tools for assessing the impact of policy changes, HUD disagreed that any tools are needed beyond those that it already has. Specifically, HUD cites the annual analyses done in compliance with the Federal Credit Reform Act of 1990 and its annual actuarial reviews that already focus on policy changes. Further, HUD notes that it has made its program data more accessible for policy analysis

[19] These scenarios are in addition to the three forecasts of key economic variables provided by Standard & Poor's DRI that Deloitte did not consider to be stressed economic states.

through the creation of the Single Family Data Warehouse. However, we remain concerned that HUD does not have adequate tools for assessing the full impact that policy changes may have. Tools such as models for estimating the change in demand and the risk characteristics of future loans would enable HUD to better estimate the full impact that policy changes may have on the value of the Fund. HUD also disagreed with the idea that any policy actions it takes should be only incremental and reversible. We revised our recommendation to make clear that incremental changes are appropriate where a policy change permanently affects certain loans.

Copies of this report will be distributed to interested congressional committees; the Honorable Mel Martinez, Secretary of the Department of Housing and Urban Development; the Honorable Mitchell E. Daniels, Jr., the Director of the Office of Management and Budget; and the Honorable Dan L. Crippen, the Director of the Congressional Budget Office. We will also make copies available to others on request.

If you or your staff have any questions about this report, please contact me at (202) 512-8678. Key contributors to this report are listed in appendix V.

Thomas J. McCool
Managing Director, Financial Markets and
Community Investment

Scope and Methodology

To estimate the economic value of the Federal Housing Administration's (FHA) Fund as of September 30, 1999, and its resulting capital ratio, we developed econometric and cash flow models. These models were based on models that we developed several years ago for this purpose. In developing the earlier models, we examined existing studies of the single-family housing programs of both the Department of Housing and Urban Development (HUD) and the Department of Veterans Affairs (VA); academic literature on the modeling of mortgage foreclosures and prepayments; and previous work that Price Waterhouse (now PricewaterhouseCoopers), HUD, VA, ourselves, and others had performed on modeling government mortgage programs. For our current analysis, we modified our previous models on the basis of our examination of work performed recently by PricewaterhouseCoopers, Deloitte & Touche, and others; discussions we held with analysts familiar with modeling mortgage foreclosures and prepayments; and program changes made by FHA since our previous work was performed. For these models, we used data supplied by FHA and Standard & Poor's DRI, a private economic forecasting company. We also used information from FHA's independent actuarial reviews in our analysis.

Our econometric analysis estimated the historical relationships between the probability of loan foreclosure and prepayment and key explanatory factors, such as the borrower's equity and the interest rate. To estimate these relationships, we used HUD's A-43 data on the default and prepayment experience of FHA-insured home mortgage loans that originated from fiscal years 1975 through 1999. To test the validity of our econometric models, we examined how well the models predicted the actual rates of FHA's loan foreclosures and prepayments through fiscal year 1999. We found that our predicted rates closely resembled the actual rates. Next, we used our estimates of these relationships and forecasts of future economic conditions provided by Standard & Poor's DRI to develop a baseline forecast of future loan foreclosures and prepayments for loans that were active at the end of fiscal year 1999.

To estimate the net present value of future cash flows of the Fund under expected economic conditions, we used our forecast of future loan foreclosures and prepayments in conjunction with a cash flow model that we developed to measure the primary sources and uses of cash for loans that originated from fiscal years 1975 through 1999. Our cash flow model was constructed to estimate cash flows for each policy year through the life of a mortgage. An important component of the model was the conversion of all income and expense streams—regardless of the period in which they

are actually forecasted to occur—into their 1999 present value equivalents. We then added the forecasted 1999 present values of the future cash flows to the current cash available to the Fund, which we obtained from documents used to prepare FHA's 1999 audited financial statements, to estimate the Fund's economic value and resulting capital ratio. A detailed discussion of our models and methodology for estimating the economic value and capital ratio of the Fund appears in appendix II.

To compare our estimates of the Fund's economic value and capital ratio with the estimates prepared for FHA by Deloitte & Touche, we reviewed Deloitte's report and met with its analysts and HUD officials to learn more about that study's methodology, data, and assumptions.

To determine the extent to which a capital ratio of 2 percent would allow the Fund to withstand worse-than-expected loan performance, we developed various scenarios for future economic conditions that we anticipated would result in substantially worse loan performance than we forecasted in our scenario using expected economic conditions. We based these scenarios on the economic conditions that led to episodes of relatively high foreclosure rates for FHA single-family loans in certain regions of the country at different times during the 1975 through 1999 period and on those experienced nationally during the 1981-82 recession. We developed additional scenarios that extended the adverse regional economic conditions to larger sections of the country to analyze how well the Fund could withstand conditions even worse than what we had experienced in the past 25 years. We also developed some additional scenarios with even higher foreclosure rates to further analyze the Fund's ability to withstand adverse conditions.

Under each of the scenarios that we developed, we used our estimated relationships between foreclosure and prepayment rates and various explanatory factors, and the future economic conditions implied by the scenarios, to forecast future foreclosures and prepayments for loans that were active at the end of fiscal year 1999. We then used these forecasts, in conjunction with our cash flow model, to estimate the economic value and capital ratio of the Fund under each scenario. The difference between these estimates and our estimate under expected economic conditions shows whether each scenario is likely to result in a reduction of the Fund's economic value of more than 2 percent and, therefore, whether a 2-percent capital ratio is likely to be sufficient to allow the Fund to withstand the worse-than-expected loan performance associated with such a scenario.

Our analysis of the adequacy of FHA's capital ratio is limited to the performance of loans in FHA's portfolio as of the end of fiscal year 1999. That is, our analysis assesses the likelihood that an economic value of 2 percent of the unamortized insurance-in-force would be sufficient to cover the excess of future payments over future cash inflows (on a net present value basis) on those loans if they perform worse than expected. Our analysis of the ability of the Fund to withstand various adverse economic conditions requires making the assumption that the adverse conditions would not also cause loans insured by FHA after fiscal year 1999 to be an economic drain on the Fund. Since the 1990 reforms, the cash flows associated with each year's loans have been estimated to have a positive economic value, thereby adding to the economic value of the entire Fund. However, during adverse economic times, new loans might perform worse than loans that were insured by FHA during the 1990s. If the newly insured loans perform so poorly that they have a negative economic value, then the loss to the Fund in any of the adverse economic scenarios that we have considered would be greater than what we have estimated. Alternatively, if the newly insured loans have positive economic values, then the Fund would continue to grow.

To identify other factors, such as recent program and market changes, that could cause worse-than-expected loan performance, we reviewed the laws and regulations governing FHA's insurance program, studied recent actuarial reviews of the Fund, and interviewed experts. We considered these other factors because the relationships estimated in our econometric models are based on historical relationships since 1975. As a result, these models might not capture the effects of recent changes in FHA programs or the conventional mortgage market on the likelihood that loans insured in the late 1990s will foreclose or prepay. In addition, our forecasts of future cash flows assume that FHA's program and the private mortgage market will not change over the 30-year forecast period in any way that would affect FHA-insured loans originated through 1999.

To identify options for adjusting the size of the Fund and determining the impact that these options might have, we reviewed the laws and regulations governing FHA's insurance program and proposals to use the Fund's economic value or otherwise change FHA's insurance program. Additionally, we interviewed experts both within and outside the federal government. When available, we collected HUD's estimates of the impact of various options on the Fund and the estimates of other experts. To determine the impact of these changes on the federal budget, we relied on

our own experts as well as those at the Office of Management and Budget and the Congressional Budget Office.

We conducted our review from December 1999 to February 2001 in accordance with generally accepted government auditing standards.

Models Used to Estimate the Economic Value of FHA's Mutual Mortgage Insurance Fund

We built econometric and cash flow models to estimate the economic value of HUD's FHA's Mutual Mortgage Insurance Fund (Fund) as of the end of fiscal year 1999. The goal of the econometric analysis was to forecast mortgage foreclosure and prepayment activity, which affect the flow of cash into and out of the Fund. We forecasted activity for all loans active at the end of fiscal year 1999 for each year from fiscal years 2000 to 2028 on the basis of assumptions stated in this appendix. We estimated equations from data covering fiscal years 1975 through 1999 that included all 50 states and the District of Columbia, but excluded U.S. territories.

Our econometric models used observations on loan years—that is, information on the characteristics and status of an insured loan during each year of its life—to estimate conditional foreclosure and prepayment probabilities.[1] These probabilities were estimated using observed patterns of prepayments and foreclosures in a large set of FHA-insured loans. More specifically, our model used logistic equations to estimate the logarithm of the odds ratio,[2] from which the probability of a loan's payment (or a loan's prepayment) in a given year can be calculated. These equations are expressed as a function of interest and unemployment rates, the borrower's equity (computed using a house's price and current and contract interest rates as well as a loan's duration), the loan-to-value (LTV) ratio, the loan's size, the geographic location of the house, and the number of years that the loan has been active. The results of the logistic regressions were used to estimate the probabilities of a loan being foreclosed or prepaid in each year.

FHA pays a claim on a foreclosed mortgage and sometimes, depending on the age of the loan, refunds a portion of the up-front premium when a mortgage prepays. These two actions contribute to cash outflows. Cash inflows are generated when FHA sells foreclosed properties and when borrowers pay mortgage insurance premiums. We forecasted the cash flows into and out of the Fund on the basis of our foreclosure and

[1] These probabilities are conditional because they are subject to the condition that the loan has remained active until a given year.

[2] If "P" is the probability that an event will occur, the "odds ratio" is defined as P/(1-P). The logistic transformation is the natural logarithm of the odds ratio, or LN[P/(1-P)], of which the logistic regression provides an estimate. See G.S. Maddala, *Limited Dependent Variables and Qualitative Variables in Econometrics* (Cambridge : Cambridge Univ. Press, 1983). Also see John H. Aldrich and Forrest D. Nelson, *Linear Probability, Logit, and Probit Models* (SAGE Publications: Beverly Hills, London, and New York, 1984), pp. 41-44.

prepayment models and key economic variables. We then used the forecasted cash flows, including an estimate of interest that would be earned, and the Fund's capital resources to estimate the economic value of the Fund.

We prepared separate estimates for fixed-rate mortgages, adjustable rate mortgages (ARMs), and investor loans. The fixed-rate mortgages with terms of 25 years or more (long-term loans) were divided between those that refinanced and those that were purchase money mortgages (mortgages associated with home purchase). Separate estimates were prepared for each group of long-term loans. Likewise, investor loans were divided between mortgages that refinanced and the loans that were purchase money mortgages. We prepared separate estimates for each group of investor loans (refinanced and purchase money mortgages). A separate analysis was also prepared for loans with terms that were less than 25 years (short-term loans).

A complete description of our models, the data that we used, and the results that we obtained is presented in detail in the following sections. In particular, this appendix describes (1) the sample data that we used; (2) our model specification and the independent variables in the regression models; (3) the model results; (4) the cash flow model, with emphasis on key economic variables; and (5) a sensitivity analysis that demonstrates the sensitivity of our forecasts to the values of some key variables.

Data and Sample Selection

For our analysis, we selected from FHA's computerized files a 10-percent sample of records of mortgages insured by FHA from fiscal years 1975 through 1999 (1,465,852 loans). For the econometric models related to long-term, fixed-rate mortgages, we used 25 percent of the long-term loans in our sample. From the FHA records, we obtained information on the initial characteristics of each loan, such as the year of the loan's origination and the state in which the loan originated; LTV ratio; loan amount; and contract interest rates. We categorized the loans as foreclosed, prepaid, or active as of the end of fiscal year 1999.

To describe macroeconomic conditions at the national and state levels, we obtained data from Standard & Poor's DRI,[3] by state, on annual civilian

[3] Formerly DRI/McGraw-Hill, Standard & Poor's DRI is a leading economic forecasting firm.

unemployment rates and data from the *2000 Economic Report of the President* on the implicit price deflator for personal consumption expenditures. We used Standard & Poor's DRI data on quarterly interest rates for 30-year mortgages on existing housing along with its forecast data, at the state level, on median house prices and civilian unemployment rates, and at the national level, on interest rates on 1- and 10-year U.S. Treasury securities.

Specification of the Model

People buy houses for consumption and investment purposes. Normally, people do not plan to default on loans. However, conditions that lead to defaults do occur. Defaults may be triggered by a number of events, including unemployment, divorce, or death. These events are not likely to trigger defaults if the owner has positive equity in his/her home because the sale of the home with realization of a profit is better than the loss of the home through foreclosure. However, if the property is worth less than the mortgage, these events may trigger defaults.

Prepayments of home mortgages can also occur. These may be triggered by events such as declining interest rates, which prompts refinancing, and rising house prices, which prompts the take out of accumulated equity or the sale of the residence. Because FHA mortgages are assumable, the sale of a residence does not automatically trigger prepayment. For example, if interest rates have risen substantially since the time that the mortgage was originated, a new purchaser may prefer to assume the seller's mortgage.

We hypothesized that foreclosure behavior is influenced by, among other things, the (1) level of unemployment, (2) size of the loan, (3) value of the home, (4) current interest rates, (5) contract interest rates, (6) home equity, and (7) region of the country within which the home is located. We hypothesized that prepayment behavior is influenced by, among other things, the (1) difference between the interest rate specified in the mortgage contract and the mortgage rates generally prevailing in each subsequent year, (2) amount of accumulated equity, (3) size of the loan, and (4) region of the country in which the home is located.

Our first regression model estimated conditional mortgage foreclosure probabilities as a function of a variety of explanatory variables. In this regression, the dependent variable is a 0/1 indicator of whether a given loan was foreclosed in a given year. The outstanding mortgage balance, expressed in inflation-adjusted dollars, weighted each loan-year observation.

Our foreclosure rates were conditional on whether the loan survives an additional year. We estimated conditional foreclosures in a logistic regression equation. Logistic regression is commonly used when the variable to be estimated is the probability that an event, such as a loan's foreclosure, will occur. We regressed the dependent variable (whose value is 1 if foreclosure occurs and 0 otherwise) on the explanatory variables previously listed.

Our second regression model estimated conditional prepayment probabilities. The independent variables included a measure that is based on the relationship between the current mortgage interest rate and the contract rate, the primary determinant of a mortgage's refinance activity. We further separated this variable between ratios above and below 1 to allow for the possibility of different marginal impacts in higher and lower ranges.

The variables that we used to predict foreclosures and prepayments fall into two general categories: descriptions of states of the economy and characteristics of the loan. In choosing explanatory variables, we relied on the results of our own and others' previous efforts to model foreclosure and prepayment probabilities and on implications drawn from economic principles. We allowed for many of the same variables to affect both foreclosure and prepayment.

Equity

The single most important determinant of a loan's foreclosure is the borrower's equity in the property, which changes over time because (1) payments reduce the amount owed on the mortgage and (2) property values can increase or decrease. Equity is a measure of the current value of a property compared with the current value of the mortgage on that property. Previous research strongly indicates that borrowers with small amounts of equity, or even negative equity, are more likely than other borrowers to default.[4]

We computed the percentage of equity as 1 minus the ratio of the present value of the loan balance evaluated at the current mortgage interest rate, to the current estimated house price. For example, if the current estimated house price is $100,000, and the value of the mortgage at the current

[4] When we discuss the likely effects of one of our explanatory variables, we are describing the marginal effects of that variable, while holding the effects of other variables constant.

interest rate is $80,000, then equity is .2 (20 percent), or 1-(80/100). To measure equity, we calculated the value of the mortgage as the present value of the remaining mortgage, evaluated at the current year's fixed-rate mortgage interest rate. We calculated the value of a property by multiplying the value of that property at the time of the loan's origination by the change in the state's median nominal house price, adjusted for quality changes, between the year of origination and the current year.[5] Because the effects on foreclosure of small changes in equity may differ depending on whether the level of equity is large or small, we used a pair of equity variables, LAGEQHIGH and LAGEQLOW,[6] in our foreclosure regression. The effect of equity is lagged 1 year, as we are predicting the time of foreclosure, which usually occurs many months after a loan first defaults.

We anticipated that higher levels of equity would be associated with an increased likelihood of prepayment. Borrowers with substantial equity in their home may be more interested in prepaying their existing mortgage and taking out a larger one to obtain cash for other purposes. Borrowers with little or no equity may be less likely to prepay because they may have to take money from other savings to pay off their loan and cover transaction costs.

For the prepayment regression, we used a variable that measures book equity—the estimated property value less the amortized balance of the loan—instead of market equity. It is book value, not market value, that the borrower must pay to retire the debt.[7] Additionally, the important effect of interest rate changes on prepayment is captured by two other equity variables, RELEQHI and RELEQLO, which are sensitive to the difference between a loan's contract rate and the interest rate on 30-year mortgages available in the current year. These variables are described below.

[5] The estimated rate of appreciation in nominal median house prices, obtained from Standard & Poor's DRI, was revised downward by 2 percentage points per year to account for depreciation and the gradual improvement in the quality of the existing housing stock over time. Also, to ensure that our estimates were conservative, we subtracted an additional 1 percent annually from Standard & Poor's DRI's forecasts.

[6] Essentially, LAGEQHIGH takes the value of equity minus .2 if equity is greater than 20 percent or 0 if equity is less than or equal to 20 percent. LAGEQLOW takes the value of equity if equity is 20 percent or less and .2 if equity is greater than 20 percent.

[7] Similarly, for foreclosures within the ARM equations, we defined equity as book equity (the estimated property value less the amortized balance of the loan) and not market equity. The effects of interest rate changes in the ARM equations were estimated using a separate variable.

LTV Ratio

We included an additional set of variables in our regressions related to equity: the initial LTV ratio. We entered LTV as a series of dummy variables, depending on its size. Loans fit into eight discrete LTV categories. In some years, FHA measured LTV as the loan amount less mortgage insurance premium financed in the numerator of the ratio and appraised value plus closing costs in the denominator. To reflect true economic LTV, we adjusted FHA's measure by removing closing costs from the denominator and including financed premiums in the numerator.

A borrower's initial equity can be expressed as a function of LTV, so we anticipated that if LTV was an important predictor in an equation that also includes a variable measuring current equity, it would probably be positively related to the probability of foreclosure. One reason for including LTV is that it measures initial equity accurately. Our measures of current equity are less accurate because we do not have data on the actual rate of change in the mortgage loan balance or the actual rate of house price change for a specific house.

Loans with higher LTVs are more likely to foreclose. For the long-term nonrefinanced equation, the ARM equation, and the short-term equation, we deleted the lower category of LTV loans. We expected LTV to have a positive sign in the foreclosure equations at higher levels of LTV. LTV in our foreclosure equations may capture the effects of income constraints. We were unable to include borrowers' income or payment-to-income ratio directly because data on borrowers' income were not available.[8] However, it seems likely that borrowers with little or no down payment (high LTV) are more likely to be financially stretched in meeting their payments and, therefore, more likely to default. The anticipated relationship between LTV and the probability of prepayment is uncertain.

For some loan type categories, we used down payment information directly, rather than the series of LTV variables. We defined down payment to ensure that closing costs were included in the loan amount and excluded from the house price.

[8] We also did not know whether individual borrowers had subsequently acquired a second mortgage or other obligations that would affect prepayment or foreclosure probabilities.

Unemployment

We used the annual unemployment rates for each state for the period from fiscal years 1975 through 1999 to measure the relative condition of the economy in the state where a loan was made. We anticipated that foreclosures would be higher in years and states with higher unemployment rates and that prepayments would be lower because property sales slow down during recessions. The actual variable we used in our regressions, LAGUNEMP, is defined as the logarithm of the preceding year's unemployment rate in that state.

Interest Rates

We included the logarithm of the interest rate on the mortgage as an explanatory variable in the foreclosure equation. We expected a higher interest rate to be associated with a higher probability of foreclosure because high interest rates cause a higher monthly payment. However, in explaining the likelihood of prepayment, our model uses information on the level of current mortgage rates relative to the contract rate on the borrower's mortgage. A borrower's incentive to prepay is high when the interest rate on a loan is greater than the rate at which money can now be borrowed, and it diminishes as current interest rates increase. In our prepayment regression, we defined two variables, RELEQHI and RELEQLO. RELEQHI is defined as the ratio of the market value of the mortgage to the book value of the mortgage but is never smaller than 1. RELEQLO is also defined as the ratio of the market value of the mortgage to the book value but is never larger than 1. When currently available mortgage rates are lower than the contract interest rate, market equity exceeds book equity because the present value of the remaining payments evaluated at the current rate exceeds the present value of the remaining payments evaluated at the contract rate. Thus, RELEQHI captures a borrower's incentive to refinance, and RELEQLO captures a new buyer's incentive to assume the seller's mortgage.

We created two 0/1 variables, REFIN and REFIN2, that take on a value of 1 if a borrower had not taken advantage of a refinancing opportunity in the past and 0 otherwise. We defined a refinancing opportunity as having occurred if the interest rate on fixed-rate mortgages in any previous year in which a loan was active was at least 200 basis points[9] below the rate on the mortgage in any year up through 1994 or 150 basis points below the rate on

[9] A basis point equals 1/100 of a percentage point.

the mortgage in any year after 1994.[10] REFIN takes a value of 1 if the borrower had passed up a refinancing opportunity at least once in the past. REFIN2 takes on a value of 1 if the borrower had passed up two or more refinancing opportunities in the past.

Several reasons might explain why borrowers passed up apparently profitable refinancing opportunities. For example, if they had been unemployed or their property had fallen in value they might have had difficulty obtaining refinancing. This reasoning suggests that REFIN and REFIN2 would be positively related to the probability of foreclosure; that is, a borrower unable to obtain refinancing previously because of poor financial status might be more likely to default.

Similar reasoning suggests a negative relationship between REFIN and REFIN2 and the probability of prepayment; a borrower unable to obtain refinancing previously might also be unlikely to obtain refinancing currently. A negative relationship might also exist if a borrower's passing up one profitable refinancing opportunity reflected a lack of financial sophistication that, in turn, would be associated with passing up additional opportunities. However, a borrower who anticipated moving soon might pass up an apparently profitable refinancing opportunity to avoid the transaction costs associated with refinancing. In this case, there might be a positive relationship, with the probability of prepayment being higher if the borrower fulfilled his/her anticipation and moved, thereby prepaying the loan.

Another explanatory variable is the volatility of interest rates, INTVOL, which is defined as the standard deviation of the monthly average of the Federal Home Loan Mortgage Corporation's series of 30-year, fixed-rate mortgage effective interest rates. We calculated the standard deviation over the previous 12 months. Financial theory predicts that borrowers are likely to refinance more slowly at times of volatile rates because there is a larger incentive to wait for a still-lower interest rate.

We also included the slope of the yield curve, YC, in our prepayment estimates, which we calculated as the difference between the 1- and 10-year Treasury rates of interest. We then subtracted 250 basis points from this difference and set differences that were less than 0 to 0. This variable

[10] Transaction costs associated with refinancing have fallen in recent years, making it more profitable than before to refinance at a smaller decrease in interest rates.

measured the relative attractiveness of ARMs versus fixed-rate mortgages; the steeper the yield curve, the more attractive ARMs would be. When ARMs have low rates, borrowers with fixed-rate mortgages may be induced into refinancing into ARMs to lower their monthly payments.

For ARMs, we did not use relative equity variables as we did with fixed-rate mortgages. Instead, we defined four variables, CHANGEPOS, CHANGENEG, CAPPEDPOS, and CAPPEDNEG, to capture the relationship between current interest rates and the interest rate paid on each mortgage. CHANGEPOS measures how far the interest rate on the mortgage has increased since origination, with a minimum of 0, while CHANGENEG measures how far the rate has decreased, with a maximum of 0. CAPPEDPOS measures how much farther the interest rate on the mortgage would rise, if prevailing interest rates in the market did not change, while CAPPEDNEG measures how much farther the mortgage's rate would fall, if prevailing interest rates did not change. For example, if an ARM was originated at 7 percent and interest rates increased by 250 basis points 1 year later, CHANGEPOS would equal 100 because FHA's ARMs can increase by no more than 100 basis points in a year. CAPPEDPOS would equal 150 basis points, since the mortgage rate would eventually increase by another 150 basis points if market interest rates did not change, and CHANGENEG and CAPPEDNEG would equal 0. Because interest rates have generally trended downwards since FHA introduced ARMs, there is very little experience with ARMs in an increasing interest rate environment.

Geographic Regions

We created nine 0/1 variables to reflect the geographic distribution of FHA loans and included them in both regressions. Location differences may capture the effects of differences in borrowers' income, underwriting standards by lenders, economic conditions not captured by the unemployment rate, or other factors that may affect foreclosure and prepayment rates. We assigned each loan to one of the nine Bureau of the Census (Census) divisions on the basis of the state in which the borrower resided. The Pacific division was the omitted category; that is, the regression coefficients show how each of the regions was different from the Pacific division. We also created a variable, JUDICIAL, to indicate states that allowed judicial foreclosure procedures in place of nonjudicial foreclosures. We anticipated that the probability of foreclosure would be lower where judicial foreclosure procedures were allowed because of the greater time and expense required for the lender to foreclose on a loan.

Loan Size

To obtain an insight into the differential effect of relatively larger loans on mortgage foreclosures and prepayments, we assigned each loan to 1 of 10 loan-size categorical variables (LOAN1 to LOAN10). The omitted category in our regressions was loans between $80,000 and $90,000, and results on loan size are relative to those loans between $80,000 and $90,000. All dollar amounts are inflation-adjusted and represent 1999 dollars.

Number of Units

The number of units covered by a single mortgage was a key determinate in deciding which loans were more likely to be investor loans. Loans were noted as investor loans if the LTV ratio was between specific values, depending on the year of the loan, or if there were two or more units covered by the loan. Once a loan was identified as an investor loan, we separated the refinanced loans from the purchase money mortgages and performed foreclosure and payoff analyses on each. For each of the investor equations, we used two dummy variables defined according to the number of units in the dwelling. LIVUNT2 has the value of 1 when a property has two dwelling units and a value of 0 otherwise. LIVUNT3 has a value of 1 when a property has three or more dwelling units and a value of 0 otherwise. The missing category in our regressions was investors with one unit. Our database covers only loans with no more than four units.

Policy Year and Refinance Indicator

To capture the time pattern of foreclosures and prepayments (given the effects of equity and the other explanatory variables), we defined seven variables on the basis of the number of years that had passed since the year of the loan's origination. We refer to these variables as YEAR1 to YEAR7 and set them equal to 1 during the corresponding policy year and 0 otherwise. Finally, for those loan type categories for which we did not estimate separate models for refinancing loans and nonrefinancing loans, we created a variable called REFINANCE DUMMY to indicate whether a loan was a refinancing loan.

Table 4 summarizes the variables that we used to predict foreclosures and prepayments. Table 5 presents mean values for our predictor variables for each mortgage type for which we ran a separate regression.

Table 4: Variable Names and Descriptions

Variable name	Variable description
Loan size dummy variables	
LOAN1	1 if loan amount is less than $40,000, else 0
LOAN2	1 if loan amount is $40,000 or above but below $50,000, else 0
LOAN3	1 if loan amount is $50,000 or above but below $60,000, else 0
LOAN4	1 if loan amount is $60,000 or above but below $70,000, else 0
LOAN5	1 if loan amount is $70,000 or above but below $80,000, else 0
LOAN6	1 if loan amount is $80,000 or above but below $90,000, else 0
LOAN7	1 if loan amount is $90,000 or above but below $100,000, else 0
LOAN8	1 if loan amount is $100,000 or above but below $110,000, else 0
LOAN9	1 if loan amount is $110,000 or above but below $130,000, else 0
LOAN10	1 if loan amount is at least $130,000, else 0
Economic variables	
LOGINT	Log of the contract mortgage interest rate
REFINANCE DUMMY	1 if the loan is a refinancing loan, else 0
RELEQLO	The ratio of the market value of the mortgage to the book value if the market value is below the book value, else 1
RELEQHI	The ratio of the market value of the mortgage to the book value if the market value is above the book value, else 1
REFIN	1 if, in at least 1 previous year, the mortgage interest rate had been at least 200 basis points below the contract rate in any year prior to 1995 or 150 basis points below the contract rate after 1994 and the borrower had not refinanced, else 0
REFIN2	1 if, in at least 2 previous years, the above situation prevailed, else 0
INTVOL	The volatility of mortgage rates, defined as the standard deviation of 30-year fixed-rate mortgage interest rates over the previous 12 months
YC	The slope of the yield curve, defined as the difference between 1- and 10-year U.S. Treasury interest rates minus 250 basis points, but not less than 0
LIVUNT2	1 if the property has two housing units, else 0
LIVUNT3	1 if the property has three or more housing units, else 0
LAGUNEMP	The log of the previous year's unemployment rate in each state
JUDICIAL	1 if state allowed judicial foreclosure (list of states varies by year), else 0
Policy year dummy variables	
YEAR1	1 if in loan's first year, else 0
YEAR2	1 if in loan's second year, else 0
YEAR3	1 if in loan's third year, else 0
YEAR4	1 if in loan's fourth year, else 0
YEAR5	1 if in loan's fifth year, else 0

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Variable name	Variable description
YEAR6	1 if in loan's sixth year, else 0
YEAR7	1 if in loan's seventh year, else 0
Loan-to-value dummy variables	
LTV0	1 if LTV equals 0, assumed missing data, else 0
LTV1	1 if LTV is above 0 and less than 60, else 0
LTV2	1 if LTV is greater than or equal to 60, but less than 85, else 0
LTV3	1 if LTV is greater than or equal to 85, but less than 92, else 0
LTV4	1 if LTV is greater than or equal to 92, but less than 96, else 0
LTV5	1 if LTV is greater than or equal to 96, but less than 98, else 0
LTV6	1 if LTV is greater than or equal to 98, but less than 100, else 0
LTV7	1 if LTV is greater than or equal to 100, but less than 102, else 0
Equity variables	
LAGEQLOW	The lagged value of market equity (defined as 1 minus the ratio of the present value of the loan balance, evaluated at the current mortgage interest rate, to the current estimated house price) if equity is less than or equal to 20 percent, else .2
LAGEQHIGH	The lagged value of market equity (defined as 1 minus the ratio of the present value of the loan balance, evaluated at the current mortgage interest rate, to the current estimated house price minus .2) if equity is greater than 20 percent, else 0
BOOKNEG	The lagged value of book equity (defined as 1 minus the ratio of the amortized loan balance to the current estimated house price) if equity is less than or equal to 20 percent, else .2
BOOKPOS	The lagged value of book equity (defined as 1 minus the ratio of the amortized loan balance to the current estimated house price minus .2), if equity is greater than 20 percent, else 0
CHANGEPOS	The amount by which the interest rate of an ARM has increased since origination, with a minimum of 0
CHANGENEG	The amount by which the interest rate of an ARM has decreased since origination, with a maximum of 0
CAPPEDPOS	The amount by which the interest rate of an ARM could still rise, if prevailing interest rates in the market did not change, with a minimum of 0
CAPPEDNEG	The amount by which the interest rate of an ARM could still decline, if prevailing interest rates in the market did not change, with a maximum of 0
DOWNPAY	The down payment, expressed as a percentage of the purchase price of the house. Closing costs were excluded from the house price and included in the loan amount
Census division dummy variables	
DV_A[a]	1 if the loan is in the Mid-Atlantic states (NY, PA, NJ), else 0
DV_E	1 if the loan is in the east south central states (KY, TN, AL, MS), else 0
DV_G	1 if the loan is in the west north central states (MN, MO, IA, NB, KS, SD, ND), else 0

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Variable name	Variable description
DV_M	1 if the loan is in the Mountain states (CO, UT, AZ, NM, NV, ID, WY, MT), else 0
DV_N	1 if the loan is in the New England states (MA, CT, RI, NH, ME, VT), else 0
DV_R	1 if the loan is in the east north central states (IL, MI, OH, IN, WI), else 0
DV_S	1 if the loan is in the South Atlantic states (GA, NC, SC, VA, MD, DC, DE, WV), else 0
DV_W	1 if the loan is in the west south central states (TX, OK, LA, AR), else 0

[a] DV = Division.

Table 5: Means of Predictor Variables

	Loan type					
Predictor variable name	Long-term FRM[a]	Long-term FRM refinance	Short-term FRM	ARM[a]	Investor	Investor refinance
Loan size dummy variables						
LOAN1	0.0635	0.0160	0.1531	0.0044	0.0617	0.0267
LOAN2	0.0860	0.0355	0.1253	0.0148	0.0789	0.0504
LOAN3	0.1197	0.0648	0.1369	0.0336	0.1038	0.0829
LOAN4	0.1338	0.1043	0.1391	0.0577	0.1165	0.1175
LOAN5	0.1292	0.1294	0.1216	0.0849	0.1253	0.1337
LOAN6	0.1130	0.1434	0.1034	0.1087	0.1189	0.1293
LOAN7	0.0980	0.1362	0.0774	0.1231	0.1102	0.1102
LOAN8	0.0862	0.1171	0.0575	0.1228	0.0886	0.0858
LOAN9	0.1033	0.1461	0.0582	0.2032	0.1070	0.1272
LOAN10	0.0673	0.1070	0.0276	0.2468	0.0891	0.1363
Economic variables						
LOGINT	-2.3773	-2.4890	-2.4165	-2.6864	-2.3025	-2.5168
REFINANCE DUMMY	-	-	0.3650	0.1088	-	-
RELEQHI	1.0613	1.0535	1.0286	-	1.0793	1.0461
RELEQLO	0.9450	0.9855	0.9745	-	0.9601	0.9845
REFIN	0.1174	0.0506	0.1082	0.0734	0.1892	0.0453
REFIN2	0.0779	0.0237	0.0734	0.0281	0.1302	0.0240
LIVUNT2	-	-	-	-	0.3085	0.2396
LIVUNT3	-	-	-	-	0.0859	0.0944

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	Loan type					
Predictor variable name	**Long-term FRM[a]**	**Long-term FRM refinance**	**Short-term FRM**	**ARM[a]**	**Investor**	**Investor refinance**
LAGUNEMP	-2.8063	-2.8870	-2.8379	-2.9155	-2.7788	-2.9044
Policy year dummy variables						
YEAR1	0.1514	0.2527	0.1634	0.2453	0.1363	0.2729
YEAR2	0.1384	0.1993	0.1509	0.2299	0.1299	0.2048
YEAR3	0.1227	0.1501	0.1354	0.1820	0.1185	0.1495
YEAR4	0.1054	0.1285	0.1210	0.1206	0.1043	0.1228
YEAR5	0.0873	0.1059	0.1047	0.0850	0.0900	0.0972
YEAR6	0.0734	0.0903	0.0911	0.0597	0.0784	0.0817
YEAR7	0.0603	0.0431	0.0628	0.0337	0.0672	0.0435
Loan-to-value dummy variables						
LTV0	0.0327	0.7301	0.2551	0.0555	0.0099	0.2330
LTV1	0.0097	0.0067	0.0620	0.0017	0.0054	0.0064
LTV2	0.0842	0.0621	0.2366	0.0517	0.2321	0.6263
LTV3	0.0976	0.0892	0.0970	0.1231	0.5280	0.1027
LTV4	0.2038	0.0654	0.1146	0.2898	0.0689	0.0158
LTV5	0.1937	0.0326	0.0770	0.3673	0.0526	0.0093
LTV6	0.1683	0.0025	0.0855	0.0464	0.0463	0.0009
LTV7	0.1476	0.0081	0.0576	0.0518	0.0411	0.0036
LTV8	0.0624	0.0034	0.0146	0.0126	0.0157	0.0019
Equity variables						
LAGEQLOW	0.1226	0.0718	0.1649	-	0.1518	0.1429
LAGEQHIGH	0.1049	0.0131	0.1470	-	0.1068	0.0412
BOOKNEG	0.1312	0.0943	0.1628	0.1142	0.1652	0.1628
BOOKPOS	0.0903	0.0153	0.1438	0.0112	0.1063	0.0386
CHANGEPOS	-	-	-	0.8844	-	-
CHANGENEG	-	-	-	-0.4940	-	-
CAPPEDPOS	-	-	-	0.1462	-	-
CAPPEDNEG	-	-	-	-0.0860	-	-
DOWNPAY	-	0.0337	-	-	-	0.1173
Census division dummy variables						
DV_A[a]	0.0725	0.0536	0.0757	0.0578	0.1579	0.1181
DV_E	0.0737	0.0394	0.0890	0.0454	0.0499	0.0713
DV_G	0.0874	0.1063	0.1242	0.1036	0.0700	0.0796
DV_M	0.1344	0.1932	0.1286	0.1377	0.1418	0.1708
DV_N	0.0098	0.0137	0.0077	0.0320	0.0274	0.0294

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	Loan type					
Predictor variable name	Long-term FRM[a]	Long-term FRM refinance	Short-term FRM	ARM[a]	Investor	Investor refinance
DV_P	0.1425	0.1589	0.0726	0.2050	0.1471	0.1305
DV_R	0.1164	0.0822	0.1315	0.1711	0.1300	0.1362
DV_S	0.2060	0.2152	0.1575	0.2043	0.1706	0.1792
DV_W	0.1574	0.1375	0.2132	0.0432	0.1054	0.0848

[a]ARM = Adjustable rate mortgage; DV = Division; FRM = Fixed-rate mortgage.

Estimation Results

As previously described, we used logistic regressions to model loan foreclosures and prepayments as a function of a variety of predictor variables. We estimated separate regressions for fixed-rate purchase money mortgages (and refinanced loans) with terms over and under 25 years, ARMs, and investor loans. We used data on loan activity throughout the life of the loans for loans originated from fiscal years 1975 through 1999. The outstanding loan balance of the observation weighted the regressions.

The logistic regressions estimated the probability of a loan being foreclosed or prepaid in each year. The standard errors of the regression coefficients are biased downward because the errors in the regressions are not independent. The observations are on loan years, and the error terms are correlated because the same underlying loan can appear several times. However, we did not view this downward bias as a problem because our purpose was to forecast the dependent variables, not to test hypotheses concerning the effects of independent variables.

In general, our results are consistent with the economic reasoning that underlies our models. Most importantly, the probability of foreclosure declines as equity increases, and the probability of prepayment increases as the current mortgage interest rate falls below the contract mortgage interest rate. As shown in tables 6 and 7, both of these effects occur in each regression model and are very strong. These tables present the estimated coefficients for all of the predictor variables for the foreclosure and prepayment equations.

Table 6 shows our foreclosure regression results. As expected, the unemployment rate is positively related to the probability of foreclosure and negatively related to the probability of prepayment. Our results also

indicate that generally the probability of foreclosure is higher when LTV and contract interest rate are higher. The overall goodness of fit was satisfactory: Chi-Square statistics were significant on all regressions at the 0.01-percent level.

Because the coefficients from a nonlinear regression can be difficult to interpret, we transformed some of the coefficients for the long-term, nonrefinanced, fixed-rate regressions into statements about changes in the probabilities of foreclosure and prepayment. Overall conditional foreclosure probabilities for this mortgage type are estimated to be about 0.5 percent.[11,12] In other words, on average, there is a ½ of a 1-percent chance for a loan of this type to result in a claim payment in any particular year.[13] By holding other predictor variables at their mean values, we can describe the effect on the conditional foreclosure probability of changes in the values of predictor variables of interest. For example, if the average value of the unemployment rate were to increase by 1 percentage point from its mean value (in our sample) of about 6 percent to about 7 percent, the conditional foreclosure probability would increase by about 20 percent (from 0.5 percent to about 0.6 percent). Similarly, a 1-percentage-point increase in the mortgage contract rate from its mean value of about 9.25 to about 10.25 would also raise the conditional foreclosure probability by 20 percent (from about 0.5 percent to about 0.6 percent). Values of homeowners' equity of 10 percent, 20 percent, 30 percent, and 40 percent result in conditional foreclosure probabilities of 0.8 percent, 0.7 percent, 0.5 percent, and 0.3 percent, respectively, illustrating the importance of increased equity in reducing the probability of foreclosure.

Table 7 shows our prepayment regression results. The overall conditional prepayment probability for long-term, fixed-rate mortgages is estimated to be 4.8 percent. This means that, in any particular year, about 5 percent of

[11] The conditional foreclosure probability is calculated as $F(Z) = EXP(Z)/[1+EXP(Z)]$, where $Z = \Sigma_i (X_i * B_i)$, where X_i refers to the mean value of the i^{th} explanatory variable and the B_is are the estimated coefficients.

[12] Conditional foreclosure probabilities for the other mortgage types were estimated as follows: long-term, fixed-rate, refinancing mortgages (0.3); short-term, fixed-rate mortgages (0.2); ARMs (0.3); investor, nonrefinancing mortgages (0.6); and investor, refinancing mortgages (0.2).

[13] This average is for the dollar worth of a loan, not the number of loans.

the loan dollars outstanding will prepay, on average.[14] Prepayment probability is quite sensitive to the relationship between the contract interest rate and the currently available mortgage rates. We modeled this relationship using RELEQHI and RELEQLO. Holding other variables at their mean values, if the spread between mortgage rates available in each year and the contract interest rate widened by one percentage point, the conditional prepayment probability would increase by about 80 percent to 8.6 percent.

Table 6: Coefficients From Foreclosure Equations and Summary Statistics

	Loan type					
Predictor variable name	**Long-term FRM[a]**	**Long-term FRM refinance**	**Short-term FRM**	**ARM[a]**	**Investor**	**Investor refinance**
INTERCEPT	2.8424	8.4917	5.1918	5.7426	4.4798	6.1160
Loan size dummy variables						
LOAN1	0.4559	0.2015	0.6280	0.3699	0.2301	0.1214
LOAN2	0.2089	0.3401	0.3577	0.5417	0.1367	0.4806
LOAN3	0.1238	0.1857	0.2741	0.4112	0.0957	0.0825
LOAN4	0.0630	0.0670	0.1755	0.1728	0.0019	-0.1074
LOAN5	-0.0077	0.1196	-0.0346	0.0389	0.1093	0.1611
LOAN7	0.0533	0.0941	0.0829	-0.0570	-0.0522	-0.0088
LOAN8	-0.0116	0.2417	0.0100	-0.0213	-0.0226	0.3838
LOAN9	0.0499	0.3755	0.3107	-0.0142	-0.1076	0.2515
LOAN10	0.1640	0.6596	0.2550	-0.0841	0.1166	0.5903
Economic variables						
LOGINT	1.7604	2.8065	3.3779	1.3074	2.5642	2.3067
REFINANCE DUMMY	-	-	-0.1033	0.0806	-	-
REFIN	0.2757	0.1427	-0.0690	-	0.3024	0.2010
REFIN2	-0.0467	-	-0.1968	-	0.1159	-
LIVUNT2	-	-	-	-	0.2031	-0.6954
LIVUNT3	-	-	-	-	0.3245	-0.5352
LAGUNEMP	1.1322	1.8867	1.2634	1.1528	1.1581	1.3849

[14] Conditional prepayment probabilities for the other mortgage types were estimated as follows: long-term, fixed-rate, refinancing mortgages (7.7); short-term, fixed-rate mortgages (5.9); ARMs (8.2); investor, nonrefinancing mortgages (5.3); and investor, refinancing mortgages (6.6).

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	Loan type					
Predictor variable name	**Long-term FRM[a]**	**Long-term FRM refinance**	**Short-term FRM**	**ARM[a]**	**Investor**	**Investor refinance**
INTVOL	0.0661	-0.2651	0.2815	-1.8350	0.1054	-0.4593
Policy year dummy variables						
YEAR1	-3.6549	-4.2892	-3.9423	-5.1043	-3.4559	-3.7991
YEAR2	-1.1583	-1.5378	-1.6170	-1.6688	-0.6838	-1.5670
YEAR3	-0.1734	-0.3399	-0.5061	-0.3611	0.2215	-0.5058
YEAR4	0.1139	-0.0013	-0.2101	0.1190	0.3735	-0.1317
YEAR5	0.2077	0.1734	-0.1072	0.3006	0.4455	-0.1305
YEAR6	0.1868	0.0751	-0.0328	0.3101	0.4040	0.1324
YEAR7	0.1154	-0.0667	-0.0601	0.0950	0.2865	0.0287
Loan-to-value dummy variables						
LTV0	0.5864	-0.0349	1.3391	-0.7377	0.0208	0.2826
LTV1	-	-	-	-	0.2383	-
LTV2	-0.0521	-	0.9851	-0.7269	0.3093	-
LTV3	0.2225	-	1.2587	-1.0359	0.3037	-
LTV4	0.3585	-	1.5278	-0.8733	0.2516	-
LTV5	0.4427	-	1.7433	-0.8449	0.1997	-
LTV6	0.4746	-	1.8241	-0.8075	0.2456	-
LTV7	0.4290	-	1.7740	-1.0976	0.3345	-
LTV8	0.4634	-	1.4832	-1.1230	-	-
Equity variables						
DOWNPAY	-	0.1062	-	-	-	-0.3661
LAGEQLOW	-1.5913	-1.7065	-1.3388	-	-1.7707	-0.9796
LAGEQHIGH	-3.9061	-4.8967	-3.4301	-	-4.0435	-8.4771
BOOKNEG	-	-	-	-3.3058	-	-
BOOKPOS	-	-	-	-7.8496	-	-
CHANGENEG	-	-	-	-0.1630	-	-
CHANGEPOS	-	-	-	-0.2325	-	-
CAPPEDNEG	-	-	-	0.4445	-	-
CAPPEDPOS	-	-	-	0.0120	-	-
Census division dummy variables						
DV_A [a]	-0.0961	-0.6324	0.0873	-0.7830	-0.3807	0.1808
DV_E	-0.2442	-0.6969	0.0282	-1.0519	0.1646	-0.3263
DV_G	0.0559	-0.4792	0.1847	-1.1353	0.2876	-0.3948
DV_M	0.3434	-0.4969	0.4345	-0.7531	0.6335	-0.2241
DV_N	0.2225	0.1393	1.0141	-0.2386	0.4703	1.0258

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	Loan type					
Predictor variable name	**Long-term FRM[a]**	**Long-term FRM refinance**	**Short-term FRM**	**ARM[a]**	**Investor**	**Investor refinance**
DV_R	-0.0896	-0.7246	-0.0257	-0.6189	-0.1482	-0.5150
DV_S	0.1450	-0.3786	0.1830	-0.4121	0.3052	-0.1798
DV_W	0.3436	-0.3450	0.5660	-0.8390	0.7350	-0.2109
JUDICIAL	-0.1350	-0.2168	-0.0671	-0.3836	-0.1600	-0.6095
Summary statistics						
Percentage of concordant pairs	76.1	82.6	78.2	80.0	78.4	83.0
Percentage of tied pairs	3.6	3.3	9.1	3.1	2.7	4.4
Number of unweighted observations	1,526,825	503,253	498,723	473,573	660,253	52,715

[a]ARM = Adjustable rate mortgage; DV = Division; FRM = Fixed-rate mortgage.

Table 7: Coefficients From Prepayment Equations and Summary Statistics

	Loan type					
Predictor variable name	**Long-term FRM[a]**	**Long-term FRM refinance**	**Short-term FRM**	**ARM[a]**	**Investor**	**Investor refinance**
INTERCEPT	-16.4264	-18.1645	-24.7363	-5.2631	-16.9717	-16.4240
Loan size dummy variables						
LOAN1	-0.4966	-0.7217	-0.5502	-0.5199	-0.6714	-0.5439
LOAN2	-0.3867	-0.5551	-0.3690	-0.4400	-0.4162	-0.2566
LOAN3	-0.2690	-0.3367	-0.2361	-0.3412	-0.2607	-0.1642
LOAN4	-0.1513	-0.2250	-0.1493	-0.2173	-0.1544	-0.0420
LOAN5	-0.0965	-0.1058	-0.0535	-0.1171	-0.0624	-0.0518
LOAN7	0.0786	0.0739	0.0717	0.1057	0.0866	0.0984
LOAN8	0.1645	0.1680	0.1333	0.1553	0.1433	0.1179
LOAN9	0.2682	0.2349	0.2028	0.2360	0.2433	0.2469
LOAN10	0.3601	0.3576	0.2155	0.3823	0.3287	0.3947
Economic variables						
JUDICIAL	-	-	-	0.0834	-	-
RELEQHI	8.6248	10.6524	10.8280	-	6.5717	9.7379
RELEQLO	4.0974	0.5224	9.9514	-	6.8953	1.1596
REFINANCE DUMMY	-	-	0.1667	0.0511	-	-

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	Loan type					
Predictor variable name	**Long-term FRM[a]**	**Long-term FRM refinance**	**Short-term FRM**	**ARM[a]**	**Investor**	**Investor refinance**
REFIN	-0.4126	-0.7985	-0.4159	-	-0.2148	-0.6270
REFIN2	-0.9690	-	-0.4800	-	-0.8893	-
LIVUNT2	-	-	-	-	-0.2852	-0.3853
LIVUNT3	-	-	-	-	-0.3735	-0.3973
LAGUNEMP	-0.3093	-0.9917	-0.3465	-1.3883	-0.3207	-0.6892
INTVOL	-0.1532	-0.9027	0.0953	-1.4628	0.2270	-0.4564
YC	0.6490	0.9190	1.0536	-1.9892	0.9197	0.7492
Policy year dummy variables						
YEAR1	-1.8664	0.0919	-1.3950	-1.7499	-1.5846	-0.0012
YEAR2	-0.3667	0.8526	-0.2351	-0.0641	-0.3511	0.8935
YEAR3	0.1074	0.9118	0.0214	0.2971	-0.0011	0.9970
YEAR4	0.2406	0.6924	0.0387	0.2847	0.1072	0.7482
YEAR5	0.1514	0.4692	0.0234	0.3413	0.0246	0.7789
YEAR6	0.0957	0.4168	-0.0102	0.2567	-0.0519	0.6648
YEAR7	0.2151	0.2470	0.0501	0.2376	0.2114	0.4584
Loan-to-value dummy variables						
LTV0	0.0623	0.8115	0.2864	0.4611	-0.3276	0.0329
LTV1	-0.1218	-	0.0824	-	-0.2461	-
LTV2	-0.0816	0.3427	0.2249	-0.2133	-0.3234	-
LTV3	-0.0370	0.4700	0.2172	-0.1507	-0.0841	-
LTV4	-0.0471	0.4921	0.2534	-0.1352	-0.2134	-
LTV5	-0.1297	0.4100	0.1665	-0.1460	-0.2729	-
LTV6	-0.1679	0.9448	0.1273	-0.4552	-0.3270	-
LTV7	-0.2416	0.7392	0.0910	-0.5858	-0.3709	-
LTV8	-	0.7018	-	-0.4581	-	-
Equity variables						
BOOKNEG	1.3572	1.1104	0.8176	2.2369	1.2333	1.1330
BOOKPOS	0.7731	1.9607	1.3009	1.1137	0.6994	3.3660
CHANGENEG	-	-	-	0.1549	-	-
CHANGEPOS	-	-	-	-0.1754	-	-
CAPPEDNEG	-	-	-	-0.2042	-	-
CAPPEDPOS	-	-	-	-0.1181	-	-
DOWNPAY	-	-	-	-	-	-1.7804
Census division dummy variables						
DV_A[a]	-0.4397	-0.3413	-0.3437	-0.5644	-0.2616	-0.4401

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	Loan type					
Predictor variable name	Long-term FRM[a]	Long-term FRM refinance	Short-term FRM	ARM[a]	Investor	Investor refinance
DV_E	-0.1071	0.2771	0.1027	-0.1597	-0.0949	0.0914
DV_G	0.1191	0.2663	0.0900	-0.4870	0.0932	0.1025
DV_M	0.1169	0.4774	0.2433	0.0334	0.0118	0.3155
DV_N	-0.2030	-0.4385	0.0817	-0.6094	-0.0892	-0.0299
DV_R	0.0951	0.3203	0.2295	-0.2247	0.1049	0.2867
DV_S	-0.2746	-0.0977	-0.1176	-0.5520	-0.2545	-0.1784
DV_W	-0.3377	0.0109	-0.2565	-0.4196	-0.3003	-0.0208
Summary statistics						
Percentage of concordant pairs	78.5	72.5	73.7	74.1	76.3	73.3
Percentage of tied pairs	0.5	0.8	0.7	0.5	0.6	0.8
Number of unweighted observations	1,526,825	503,253	498,723	473,573	660,253	52,715

[a]ARM = Adjustable rate mortgage; DV = Division; FRM = Fixed-rate mortgage.

Model Predictions for Historical Period

To test the validity of our model, we examined how well the model predicted actual patterns of FHA's foreclosure and prepayment rates through fiscal year 1999. Using a sample of 10 percent of FHA's loans made from fiscal years 1975 to 1999, we found that our predicted rates closely resembled actual rates.

To predict the probabilities of foreclosure and prepayment in the historical period, we combined the model's coefficients with the information on a loan's characteristics and information on economic conditions described by our predictor variables in each year from a loan's origination through fiscal year 1999. If our model predicted foreclosure or prepayment in any year, we determined the loan's balance during that year to indicate the dollar amount associated with the foreclosure or prepayment. We estimated cumulative foreclosure and prepayment rates by summing the predicted claim and prepayment dollar amounts for all loans originated in each of the fiscal years 1975 through 1999. We compared these predictions with the actual cumulative (through fiscal year 1999) foreclosure and prepayment rates for the loans in our sample. Figure 4 compares actual and predicted cumulative foreclosure rates, and figure 5 compares actual and predicted cumulative prepayment rates.

Figure 4: Cumulative Foreclosure Rates by Book of Business for 30-Year, Fixed-Rate, Nonrefinanced, Mortgages; Actual and Predicted, Fiscal Years 1975-99

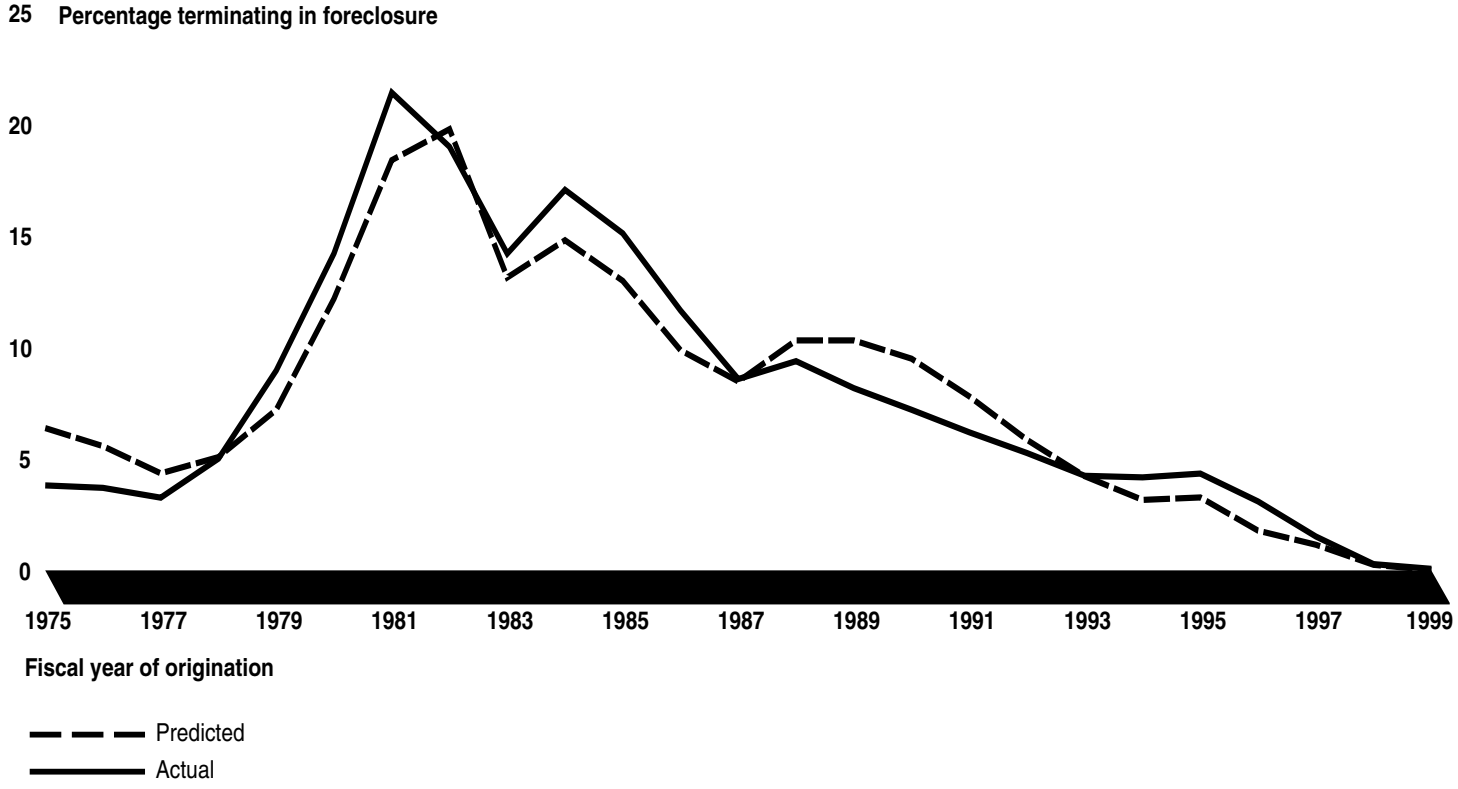
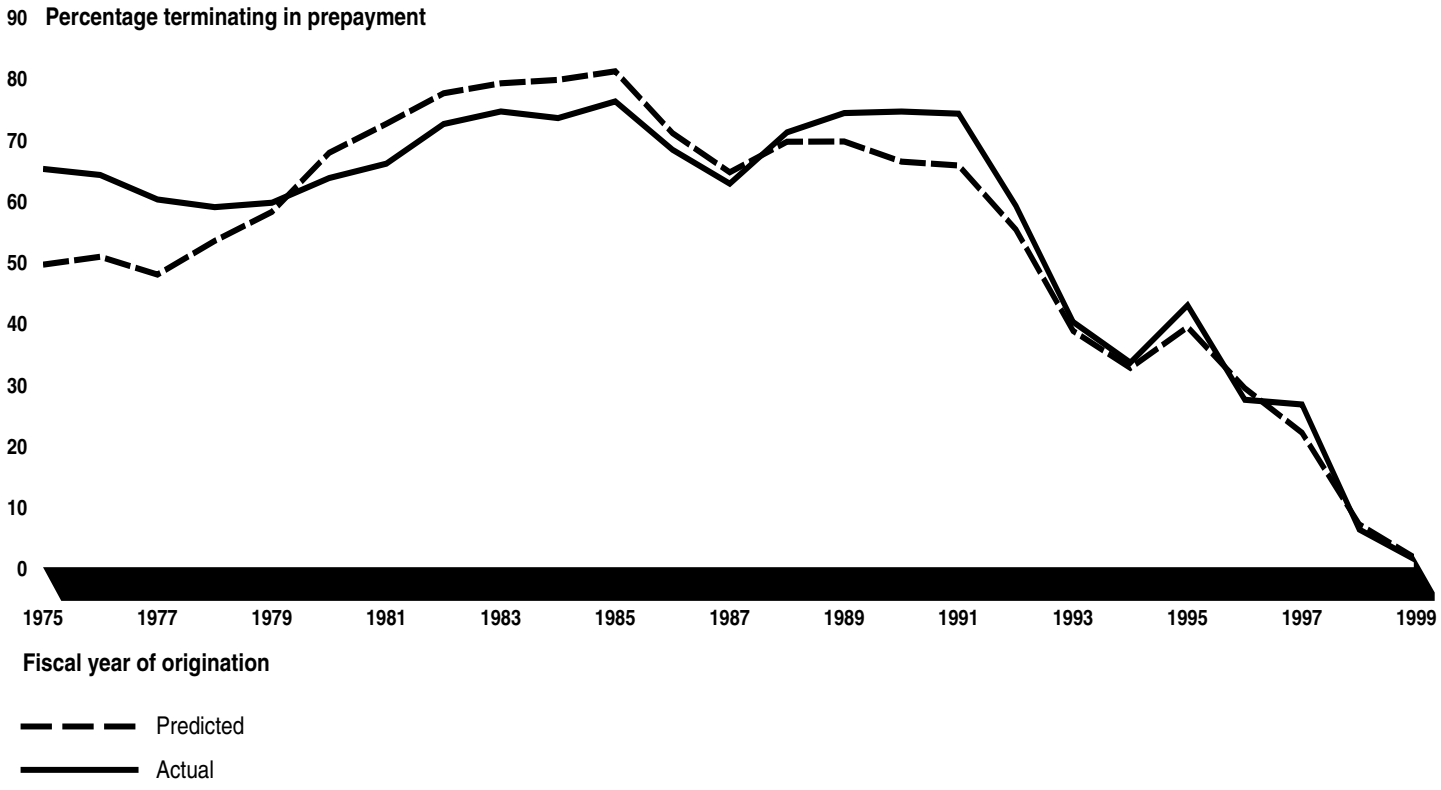


Figure 5: Cumulative Prepayment Rates by Book of Business, for 30-Year, Fixed-Rate, Nonrefinanced, Mortgages: Actual and Predicted, Fiscal Years 1975-99



Estimation of the Economic Value of the Fund

The economic value of the Fund is defined in the Omnibus Budget Reconciliation 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." We obtained information on the capital resources of the Fund from documents used to prepare FHA's audited financial statements. These capital resources were reported to be $14.3 billion.

To estimate the net present value of future cash flows of the Fund, we constructed a cash flow model to estimate the five primary future outflows and inflows of cash through 2028 resulting from the books of business written from fiscal years 1975 through 1999. Cash flows out of the fund from payments associated with claims on foreclosed properties, refunds of up-front premiums on mortgages that are prepaid, and administrative

expenses for management of the program. Cash flows into the fund from income from mortgagees' insurance premiums and from the net proceeds from the sale of foreclosed properties.

To estimate the Fund's cash flow, we first forecasted, for active loans at the end of 1999, the dollar value of loans predicted to foreclose or prepay in any year through 2028. From those estimates, we derived estimates of the outstanding principal balances for the loans remaining active for each year in the forecast period. Our cash flow model used these estimates of foreclosure and prepayment dollars and outstanding principal balances to derive estimates of each of the primary cash flows.

We forecasted future loan activity (foreclosures and prepayments) on the basis of the regression results described above and forecasts of the key economic and housing market variables made by Standard & Poor's DRI. Standard & Poor's DRI forecasts the median sales price of existing housing, by state and year, through fiscal year 2005. We assumed that after 2005 those prices would rise at 3 percent per year. In creating the borrower's equity variable, we used DRI forecasts of existing housing prices by state and subtracted 2 percentage points per year to adjust for improvements in the quality of housing over time and the depreciation of individual housing units. We also subtracted another 1 percentage point per year from the company's forecasts, to be conservative. We made similar adjustments to our assumed value of median house price change for the years beyond the range of these forecasts. We used DRI forecasts of each state's unemployment rate and assumed that rates from fiscal year 2026 on would equal the rates in 2025. We also used Standard & Poor's DRI forecasts of interest rates on 30-year mortgages and 1- and 10-year Treasury securities.

Using the results of the econometric model, the cash flow model estimates cash flows for each policy year through the life of a mortgage. An important component of the model is converting all income and expense streams—regardless of the period in which they actually occurred—into 1999 present value dollars. We applied discount rates to match as closely as possible the rate of return FHA likely earned in the past or would earn in the future from its investment in Treasury securities.[15] As an

[15] Actual rates vary by the specific date on which the investment is made and the length of maturity of the note. Precise data on the length of maturity of FHA's investments were unavailable, but we estimated the average to be approximately 7 years and used this estimate as the basis for our selection of discount rates.

approximation of what FHA earned for each book of business,[16] we used a rate of return comparable to the yield on 7-year Treasury securities prevailing when that book was written to discount all cash flows occurring in the first 7 years of that book's existence. We assumed that after 7 years, the Fund's investment was rolled over into new Treasury securities at the interest rate prevailing at that time and used that rate to discount cash flows to the rollover date. For rollover dates occurring in fiscal year 1999 and beyond, we used 6 percent as the new discount rate. As an example, cash flows associated with the fiscal year 1992 book of business and occurring from fiscal years 1992 through 1998 (i.e., the first 7 policy years) were discounted at the 7-year Treasury rate prevailing in fiscal year 1992. Cash flows associated with the fiscal year 1992 book of business but occurring in fiscal year 1999 and beyond are discounted at a rate of 6 percent.

Our methodology for estimating each of the five principal cash flows is described below.

Premium Income

Because FHA's premium policy has changed over time, our calculations of premium income to the Fund change depending on the date of the mortgage's origination. We describe all premium income, including up-front premiums, even though they play no role in estimating the future cash flows for the Fund at the end of fiscal year 1999.

For loans originating from fiscal years 1975 through 1983, premiums equal the annual outstanding principal balance times 0.5 percent. For loans originating from fiscal years 1984 through June 30, 1991, premiums equal the original loan amount times the mortgage insurance premium. The mortgage insurance premium during this period was equal to 3.8 percent for 30-year mortgages and 2.4 percent for 15-year mortgages. Because there are no annual premiums for this group of loans, the future cash flows would include no premium income. For the purposes of this analysis, mortgages of other lengths of time are grouped with those they most closely approximate. Effective July 1, 1991, FHA added an annual premium of 0.5 percent of the outstanding principal balance to its up-front premiums. The number of years for which a borrower would be liable for making premium payments depended on the LTV ratio at the time of origination. (See tables 8 and 9.) For loans originating from July 1, 1991,

[16] New mortgage loans insured by FHA in a given fiscal year.

through the time of our review, premiums equal the original loan amount times the respective up-front premium plus the product of the annual outstanding principal balance times the respective annual premium rate for as many years as annual premiums were required.

Table 8: Premium Schedule for 30-Year Non-Streamline Mortgages, by Date of Mortgage Origination

Applicable dates	Up-front premium rates for 30-year non-streamline loans	Annual premium rates and durations for 30-year non-streamline loans	Applicable LTV ratio
10/1/74 - 9/30/83	None	0.5% for 30 years	All loans
10/1/83 - 6/30/91	3.80%	None	-
7/1/91 - 9/30/92	3.80%	0.5% for 5 years 0.5% for 8 years 0.5% for 10 years	Under 90% 90% through 95% Over 95%
10/1/92 - 4/16/94	3.00%	0.5% for 7 years 0.5% for 12 years 0.5% for 30 years	Under 90% 90% through 95% Over 95%
4/17/94 - present	2.25%[a]	0.5% for 7 years 0.5% for 12 years 0.5% for 30 years	Under 90% 90% through 95% Over 95%

[a]From September 3, 1996, to January 1, 2000, new homeowners who received financial counseling before buying an FHA-insured home were eligible for reduced up-front premiums.

Table 9: Premium Schedule for 15-Year Non-Streamline Mortgages, by Date of Mortgage Origination

Applicable dates	Up-front premium rates for 15-year non-streamline loans	Annual premium rates and durations for 15-year non-streamline loans	Applicable LTV ratio
10/1/74 - 9/30/83	None	0.50% for 15 years	All loans
10/1/83 - 6/30/91	2.40%	None	-
7/1/91 - 9/30/92	3.80%	0.5% for 5 years 0.5% for 8 years 0.5% for 10 years	Under 90% 90% through 95% Over 95%
10/1/92 - 12/25/92	3.00%	0.5% for 7 years 0.5% for 12 years 0.5% for 15 years	Under 90% 90% through 95% Over 95%
12/26/92 – present	2.00%	None 0.25% for 4 years 0.25% for 8 years	Under 90% 90% through 95% Over 95%

Some loans that originated in the 1990s are streamline refinanced mortgages that are subject to different premium rates. Since streamline refinances do not require an appraisal, we decided that mortgages coded in FHA's database with an LTV of 0 could reasonably be assumed to represent streamline refinance business. For streamline refinance mortgages that originated before July 1, 1991, we applied the premium rates from table 10.

Table 10: Premium Schedule for 15- and 30-Year Streamline Refinanced Mortgages That Originated Before July 1, 1991

Applicable refinancing dates	Up-front premium rates for 30-year loans	Annual premium rates for 30-year loans	Up-front premium rates for 15-year loans	Annual premium rates for 15-year loans
Before 7/1/91	3.80%	None	2.40%	None
7/1/91 - 4/24/92	3.80%	0.5% for 5 years	3.80%	0.5% for 5 years
4/24/92 – 12/25/92	3.80%	None	3.80%	None
12/26/92 – present	3.80%	None	2.40%	None

For all streamline refinance mortgages that originated after July 1, 1991, we applied the premium rates for non-streamline loans. That is, for up-front premium rates, we followed the 15-year or 30-year non-streamline premium schedule for loans of those maturities. For annual premium rates and number of years that annual premiums are paid, we applied the rates for loans with an LTV of less than 90 percent.

Claim Payments

Claim payments equal the outstanding principal balance on foreclosed mortgages times the acquisition cost ratio. We defined the acquisition cost ratio as being equal to the total amount paid by FHA to settle a claim and acquire a property (i.e., FHA's "acquisition cost" as reported in its database) divided by the outstanding principal balance on the mortgage at the time of foreclosure. For the purposes of our analysis, we calculated an average acquisition cost ratio for each year's book of business using actual data for fiscal years 1975 through 1999. Acquisition cost ratios generally decreased over time from a high of 1.51 for loans originating in 1975 to a low of 1.09 for loans originating in 1999.

Net Proceeds

FHA's net proceeds from the sale of foreclosed properties depend on both the lag rate—the proportion of a year that passes between the time of a foreclosure and the time the proceeds are received—and the loss rate—the proportion of the cost of the property acquired that is not recovered when the property is sold. These are calculated as follows:

Net Proceeds = Lag rate x claim payments from previous period x (1 - loss rate) + (12-lag rate) x claim payments from the current period x (1 - loss rate).

The lag, which is the number of months between the payment of a claim and the receipt of proceeds from the disposition of the property, varied as follows. Before 1995, the lag was 5.9 months; in 1995, 5.35 months; in 1996, 4.7 months; and in 1997, 5.26 months. For the years after 1997, we used a lag of 5.26 months. To calculate the lag rate for each period, we divided the lag by 12.

We defined the loss rate as equal to FHA's reported dollar loss after the disposition of property divided by the reported acquisition cost over the historical period. We determined a loss rate for each year per book of business for years 1 through 25. We used an auto-regressive model to forecast future loss rates. In addition to past values of loss rates, we used

the origination year and policy year of the loan as independent variables in this model. Using the results of this model, we forecast loss rates over the period from fiscal years 2000 through 2023. For fiscal years 2024 through 2028, we used the estimated rate for 2023. Our loss rates averaged 37 percent over the forecast period.

Refunded Premiums

The amount of premium refunds paid by FHA depends on the policy year in which the mortgage is prepaid and the type of mortgage. For mortgages prepaid between October 1, 1983, and December 31, 1993, refunds were equal to the original loan amount times the refund rate. However, we converted these rates to express them as a percentage of the up-front premium. In 1993, FHA changed its refund policy to affect mortgages prepaid on or after January 1, 1994. For loans prepaying on or after January 1, 1994, refunds are equal to the up-front mortgage insurance premium times the refund rate. (See table 11.)

Table 11: Premium Refund Rates for Loans That Were Terminated After October 1, 1983

	Refund rates on loans prepaid between 10/1/83 and 12/31/93		
Year	15-year loans	30-year loans	Refund rates on all loans prepaid after 1/1/94
1	99.0%	99.0%	95.0%
2	93.0%	94.0%	85.0%
3	81.0%	82.0%	70.1%
4	66.0%	67.0%	49.4%
5	51.0%	54.0%	30.2%
6	39.0%	43.0%	15.1%
7	29.0%	35.0%	4.2%
8	21.0%	29.0%	0.0%
9	15.0%	24.0%	0.0%
10	11.0%	21.0%	0.0%
11	8.0%	18.0%	0.0%
12	6.0%	16.0%	0.0%
13	4.0%	15.0%	0.0%
14	3.0%	13.0%	0.0%
15	2.0%	12.0%	0.0%

	Refund rates on loans prepaid between 10/1/83 and 12/31/93		
Year	15-year loans	30-year loans	Refund rates on all loans prepaid after 1/1/94
16	0.0%	11.0%	0.0%
17	0.0%	10.0%	0.0%
18	0.0%	9.0%	0.0%
19	0.0%	9.0%	0.0%
20	0.0%	8.0%	0.0%
21	0.0%	7.0%	0.0%
22	0.0%	7.0%	0.0%
23	0.0%	6.0%	0.0%
24	0.0%	5.0%	0.0%
25	0.0%	5.0%	0.0%
26	0.0%	4.0%	0.0%
27	0.0%	4.0%	0.0%
28	0.0%	4.0%	0.0%
29	0.0%	4.0%	0.0%
30	0.0%	0.0%	0.0%

Administrative Expenses

Administrative expenses equal the outstanding principal balance times the administrative expense rate. The estimates of the administrative expense rates were 0.098 percent for the years before 1995, 0.113 percent for 1995, 0.097 percent for 1996, 0.102 percent for 1997, and 0.103 percent for 1998 and all future years.

Sensitivity Analysis

We conducted additional analyses to determine the sensitivity of our forecasts to the values of certain key variables. Because we found that projected losses from foreclosures are sensitive to the rates of unemployment and house price appreciation, we adjusted the forecasts of unemployment and price appreciation to provide a range of estimates of the Fund's economic value under alternative economic scenarios. Our starting points for forecasts of the key economic variables were forecasts made by Standard & Poor's DRI, as previously described.

For our low case scenario, we made these forecasts more pessimistic by subtracting 2 percentage points per year from the forecasts of house price appreciation rates and adding 1 percentage point per year to the

unemployment rate forecasts. For our high case scenario, we added 2 percentage points per year to our base case forecast of house price appreciation rates. Under these alternatives, we estimated economic values of about $13.6 billion and about $16.4 billion, respectively, for the low and high cases, compared with about $15.8 billion for our base case. These estimates correspond to estimates of the capital ratio of about 2.75 percent and 3.32 percent, respectively, for the low and high cases, compared with our base case estimate for the capital ratio of 3.20 percent. These estimates are shown in table 12.

Table 12: Alternative Estimates of Capital Ratios for FHA's Mutual Mortgage Insurance Fund

Dollars in billions

Scenario	Economic value	Capital ratio (percent)
Most likely economic conditions	$15.8	3.20
Low case scenario	13.6	2.75
High case scenario	16.4	3.32

Source: GAO analysis.

To assess the impact of our assumptions about the loss and discount rates on the economic value of the Fund, we operated our cash flow model with alternative values for these variables. We found that for the economic scenario of our base case, a 1-percentage-point increase in the forecasted loss rate resulted in a 0.7-percent decline in our estimate of the economic value of the Fund. Conversely, each percentage point decrease in the loss rate resulted in a 0.7-percent increase in our estimate of economic value. With respect to the discount rate, we found that for our base case economic scenario, a 1-percentage-point increase in the interest rate applied to most periods' future cash flow resulted in a 0.3-percent increase in our estimate of economic value. Conversely, each percentage point decrease in the discount rate resulted in a 0.4-percent decrease in our estimate of economic value.

Development of Scenarios of Adverse Economic Conditions Used to Estimate the Economic Value of the Fund

This appendix describes the scenarios that we used to estimate the ability of the Fund to withstand adverse future economic conditions. Each scenario specifies values of key economic variables, which our models indicate are associated with mortgage claims and prepayments, during the forecast period. We used these values with the forecasting models presented in appendix II to estimate future mortgage claims and prepayments. We then used these forecasted values of claim and prepayment dollars in our cash flow model to estimate the economic value of the Fund and the capital ratio under each scenario.

We developed two types of scenarios—historical and judgmental. We designed the historical scenarios to test the ability of the Fund to withstand adverse economic conditions similar to those that adversely affected the Fund in the 1980s and 1990s. Because some of these adverse conditions affected only certain regions, in some scenarios we expanded our analysis to include estimates of the capital ratio when the historical conditions were assumed to affect a larger share of FHA's business, including when they were assumed to affect the entire nation. In contrast, the judgmental scenarios that we developed are not based on historical experience. Instead, they represent conditions that we believe might place stress on the Fund.

The key economic variables for which we forecast different values in the different scenarios are the rate of house price appreciation; the unemployment rate; and, in some instances, certain interest rates, especially the mortgage interest rate. In addition, we assumed that FHA's loss per claim (the loss rate), expressed as a percentage of the claim amount, was greater than the loss rate that we used in our base case analysis under expected economic conditions. We assumed that FHA would experience higher loss rates when foreclosures were substantially higher because of the difficulty of managing and disposing of a large number of properties at the same time. In addition, the demand for housing would be likely to fall during an economic downturn, making it more difficult to dispose of properties than in the base case.

Historical Scenarios

Three regional economic downturns and the 1981-82 national recession form the bases of our historical scenarios. Each regional downturn was associated with a regional decline in house prices. Declining house prices represent a particularly adverse condition for the Fund because of the strong negative relationship between borrowers' equity and the probability of defaults leading to foreclosures. The three regional economic

downturns, and associated housing price declines, that we used were (1) the late 1980s' decline in the oil-producing states of the west south central region; (2) the late 1980s' and early 1990s' decline in New England; and (3) the early to mid-1990s' decline in the Pacific region, particularly in California.[1]

For each scenario that is based on a regional downturn, we assumed that for 4 years the rate of house price change for the part of the nation assumed to be affected by the downturn equaled the rate of house price change in the state in that region that we selected to represent the regional experience. We selected the experiences of (1) Louisiana, beginning in 1986, to represent the oil price downturn; (2) Massachusetts, beginning in 1988, to represent the New England economic downturn; and (3) California, beginning in 1991, to represent the California housing market downturn. Table 13 shows the median house prices for existing houses in these states during their economic downturns. In calculating homeowner's equity, we made the same adjustment to annual changes in median house prices that we did in our base case, as described in appendix II. Similarly, in our scenarios that are based on regional downturns, we assumed that unemployment rates would change in the affected area for 4 years by the same percentages as those rates changed in Louisiana; Massachusetts; and California, respectively.

[1] The west south central region is comprised of Arkansas, Louisiana, Oklahoma, and Texas. The Pacific region is comprised of Alaska, California, Hawaii, Oregon, and Washington. The New England region is comprised of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.

Table 13: Historical Median House Price and Unemployment Experience in States Representing Regional Downturns

			House price		Unemployment rate	
State	Year	Ordinal year	Amount	Percentage of year 0	Percent	Percentage of year 0
Louisiana	1986	0	$75.3	100.0	11.2[a]	100.0
	1987	1	78.7	104.5	12.8	114.1
	1988	2	73.5	97.6	12.5	113.4
	1989	3	69.6	92.4	11.2	100.1
	1990	4	67.3	89.4	-	-
Massachusetts	1988	0	142.3	100.0	3.1	100.0
	1989	1	137.5	96.6	3.7	118.7
	1990	2	135.4	95.1	5.4	171.2
	1991	3	128.0	90.0	8.6	274.1
	1992	4	133.1	93.5	8.7	277.7
California	1991	0	199.9	100.0	7.4	100.0
	1992	1	198.9	99.5	8.9	120.1
	1993	2	191.6	95.8	9.5	128.6
	1994	3	183.7	91.9	8.9	120.9
	1995	4	183.0	91.5	7.9	106.6

[a]For Unemployment rates in Louisiana, we used 1985 as the base year (year 0) and used changes in the unemployment rate for 3 years (1986 through 1988) only.

We developed six separate scenarios that are based on each regional downturn, by varying the scope (i.e., the number of states assumed to be affected) and timing of the adverse economic conditions in the forecast period. Specifically, we used three different scopes. In the narrowest scope, we assumed that only the particular region was affected. That is, for the scenario based on the downturn in the west south central region in the late 1980s, we assumed that during 4 years of the forecast period, all of the states in the west south central region experienced the same changes in key economic variables as Louisiana experienced from 1987 through 1990. We then expanded the scope by assuming that two regions in which FHA has a lot of borrowers, the west south central and Pacific regions, were

affected.[2] Finally, we then expanded the scope to the entire nation, by assuming that all states were affected.

Regarding timing, for each scope we developed two scenarios, one in which the downturn began in 2000 and one in which it began in 2001. Although we know that an economic downturn did not begin in 2000, we developed scenarios starting then to test the ability of the Fund to withstand an economic downturn that occurs when the portfolio contains many recent loans. Scenarios in which the downturn does not begin until 2001 would be expected to be less adverse because most of the large number of borrowers who took out mortgages in 1998 and 1999 would have seen substantial price appreciation in 2000, thereby reducing the likelihood of default.

We developed two historical scenarios that are based on the 1981-82 recession and subsequent recovery. In those scenarios, we assumed that in each state, the rates of change in house price appreciation and unemployment for 5 years during the forecast period are the same as they were from 1981 through 1985. In one scenario, we assumed that these adverse conditions replicating 1981 through 1985 began in 2000; in the other scenario, we assumed that they began in 2001. Under these scenarios, some states fared better than in the base case scenario.

Because it will be more difficult to manage and dispose of foreclosed properties during an economic downturn, we increased the loss rates on the proportion of mortgages affected by a given scenario during the years the scenario runs. We assumed that losses on affected foreclosed properties would rise to 45 percent of the property's value. Without this, loss rates average about 37 percent.

Our estimates of the economic value of the Fund and the capital ratio for the historical scenarios are presented in table 14.

[2] We used these two regions for each set of scenarios, even the set that is based on the New England decline, because FHA does relatively little business in New England, and we wanted to test the ability of the Fund to withstand a downturn like the one a decade ago in New England, if it occurred simultaneously in two regions in which FHA does a lot of business.

Judgmental Scenarios

We developed several judgmental scenarios to test the ability of the Fund to withstand various types of economic conditions that might adversely affect the Fund without regard to their relationship to historical experience. In one scenario, we assumed that median existing house prices declined by 5 percent per year for 3 consecutive years—an extremely steep rate of decline[3]—and that unemployment increased compared with the base case, with both changes beginning in 2001. Specifically, we increased the unemployment rates in each state from forecasted levels by 2 percentage points in 2001; 5 percentage points in 2002, 2003, and 2004; and 2 percentage points in 2005. In a second scenario, we allowed the mortgage interest rate to decline in 2000—by 2 percentage points from its forecasted level—and then to return to forecasted levels. We did this to precipitate a wave of refinancing. We also assumed declining house prices and rising unemployment beginning in 2001, as in the previous judgmental scenario. We used this scenario to test what might happen if premium income turns out to be substantially less than expected and premium refunds substantially more than expected because of rapid prepayment of loans, most of which would not default. In our third scenario, we added 1 percentage point to the base case forecasts of the mortgage interest rate, and 1- and 10-year Treasury rates for the year 2000, 3 percentage points to the forecasts of these interest rates between 2001 and 2003, and 1 percentage point in 2004. We used this scenario to test what might happen if interest rates were to rise more than anticipated. In a fourth scenario, we used the same rising interest rates as in the third scenario and also added one percentage point to the forecasts of median existing house prices over that period.

Our estimates of the economic value of the Fund and the capital ratio for the judgmental scenarios are also presented in table 14.

[3] Since we adjusted growth in median house prices for quality improvements, as described in appendix II, the decline in house prices facing individual borrowers is even greater.

Table 14: National Results of Alternative Scenarios

Geographic extent	Starting year	Number of loan years	Average house price	Average unemployment rate (percent)	Average equity (percent)	Economic value (millions)	Capital ratio (percent)
Base Case							
National	NA	3,974,076	$124,076	4.3	49.9	$15,810	3.20
Historical scenarios that were based on the Louisiana experience of 1986-90							
One region (WSC)	2000	4,010,385	$116,739	4.3	45.6	$15,130	3.06
Two regions (WSC and PAC)	2000	4,058,778	111,618	4.4	43.2	13,861	2.81
Nation	2000	4,308,066	85,005	4.4	29.1	11,430	2.31
One region (WSC)	2001	4,003,327	117,360	4.3	46.2	15,320	3.10
Two regions (WSC and PAC)	2001	4,040,790	112,900	4.3	44.2	14,606	2.96
Nation	2001	4,233,621	89,016	4.3	32.2	12,848	2.60
Historical scenarios that were based on the Massachusetts experience of 1988-92							
One region (NE)	2000	3,991,873	122,936	4.3	49.3	15,510	3.14
Two regions (WSC and PAC)	2000	4,024,416	112,829	4.9	43.9	10,566	2.14
Nation	2000	4,261,430	88,058	5.8	31.2	4,020	0.81
One region (NE)	2001	3,985,822	123,108	4.3	49.5	15,623	3.16
Two regions (WSC and PAC)	2001	4,020,651	113,934	4.8	44.8	12,291	2.49
Nation	2001	4,211,557	91,832	5.5	33.9	7,759	1.57
Historical scenarios that were based on the California Experience of 1991-95							
One region (PAC)	2000	4,026,719	118,921	4.4	47.5	14,281	2.89
Two regions (WSC and PAC)	2000	4,057,387	112,031	4.4	43.5	12,815	2.59
Nation	2000	4,304,672	86,298	4.5	30.1	10,683	2.16
One region (PAC)	2001	4,013,887	119,695	4.3	48.0	14,912	3.02
Two regions (WSC and PAC)	2001	4,041,526	113,280	4.4	44.4	14,353	2.91
Nation	2001	4,231,923	90,223	4.4	33.0	12,319	2.49
Historical scenarios that were based on state-by-state experiences during the 1981-82 recession							
Nation	2000	4,025,522	123,503	4.7	49.1	13,876	2.81
Nation	2001	3,997,043	127,824	4.5	50.2	14,673	2.97
Judgmental scenario: mortgage rate decline in 2000 followed by 3 years of 5 percent declines in house prices and increased unemployment starting in 2001							
Nation	2000	3,795,878	86,731	5.4	29.5	6,779	1.37
Judgmental scenario: 3 years of 5 percent declines in house prices and increased unemployment starting in 2001							
Nation	2001	4,285,284	87,005	5.4	30.3	6,918	1.40
Judgmental scenario: higher mortgage rates early in forecast period							
Nation	2000	4,594,178	125,287	4.3	53.9	16,608	3.36

(Continued From Previous Page)

Geographic extent	Starting year	Number of loan years	Average house price	Average unemployment rate (percent)	Average equity (percent)	Economic value (millions)	Capital ratio (percent)
Judgmental scenario: higher mortgage rates early in forecast period, accompanied by faster house price growth							
Nation	2000	4,538,531	139,330	4.3	58.1	16,818	3.40

In another type of judgmental scenario, we did not forecast the economic variables and then use the forecasted claims and prepayments from our econometric model, as we did with all of our other scenarios, both judgmental and historical. Instead, because none of our other scenarios produced foreclosure rates nearly as high as FHA experienced in the 1980s, we developed two scenarios in which we directly assumed higher foreclosure rates. First, we assumed that in 2000 through 2004, the proportion of loans insured in each region experienced for the 1989 through 1999 books of business the same foreclosure rates that the 1975 through 1985 books of business experienced in that region in 1986 through 1990. This scenario produced a capital ratio of 0.92 percent. Second, we assumed that in 2000 through 2004, varying proportions of FHA's portfolio experienced for the 1989 through 1999 books of business the same foreclosure rates that the 1975 through 1985 books of business experienced in the west south central states in 1986 through 1990. Because streamline refinanced mortgages and ARMs did not exist or were minimal parts of FHA's portfolio from 1975 through 1985, foreclosure rates were not adjusted for these types of loans. For the other products—30-year fixed-rate, 15-year fixed-rate, investor, and graduated payment mortgages—foreclosure rates were adjusted accordingly for each type of product. For this scenario, we found that if 36.5 percent of FHA-insured mortgages experienced these high default rates, the estimated capital ratio for fiscal year 1999 would fall by 2 percentage points, and if about 55 percent of FHA's portfolio experienced these conditions, the economic value would be depleted.

Comments From the Department of Housing and Urban Development

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
WASHINGTON, D.C. 20410-8000

OFFICE OF THE ASSISTANT SECRETARY
FOR HOUSING-FEDERAL HOUSING COMMISSIONER

FEB 12 2001

Mr. Thomas J. McCool
Managing Director, Financial Markets and
Community Investment
United States General Accounting Office
Washington, DC 29548

Dear Mr. McCool:

Thank you for the opportunity to comment on your draft report, Mortgage Financing: FHA's Fund has Grown, but Options for Drawing on the Fund Have Uncertain Outcomes, advance dated February 28, 2001.

Before commenting on your specific recommendations, I want to make a few general comments about your report. First, HUD is pleased that GAO's independent determination of the economic value of the Mutual Mortgage Insurance Fund (MMIF) at the end of fiscal year 1999 produced a result comparable to that produced by its independent actuarial review contractor, Deloitte & Touche. The infrastructure that Congress established in 1990 that requires HUD to conduct independent annual actuarial reviews of the MMIF appears to be working. Not only have consistent results concerning the capital strength of FHA been obtained by two different actuarial firms (Price Waterhouse and Deloitte & Touche) over the past few years, it is also reassuring that GAO has reached a comparable conclusion. As demonstrated by the most recent review by Deloitte & Touche, titled *Annual Actuarial Review of the Federal Housing Administration's Mutual Mortgage Insurance Fund as of Fiscal Year 2000*, these actuarial analyses have applied state-of-the-art analytical and financial techniques and have examined the performance of the MMIF under alternative economic scenarios.

Second, HUD is also pleased with GAO's analyses showing that a 2 percent capital ratio is adequate to withstand a variety of economic stress scenarios, assuming no programmatic changes. You state that a capital ratio of 2 percent "appears sufficient to withstand moderately severe economic downturns that could lead to worse-than-expected loan performance." Furthermore, you also state that "Under economic scenarios that we [GAO] developed to represent regional and national economic downturns that the nation experienced between 1975 and 1999, the estimated capital ratio *fell by only slightly less than 0.4 percentage points"* [emphasis added]. That is, according to your results, the worst experience since 1975 only has a minor impact on FHA's capital base. Only by running even worse economic scenarios with no historical precedent was GAO able to drive the capital ratio below 2 percent of insurance-in-force. Furthermore, the only scenarios that result in a negative value for the MMIF given its current capital ratio of well over 3 percent are open-ended economic declines specifically designed to test what it would take to reduce the MMIF capital to zero.

In this regard, it may be worthwhile to note the low probability of being confronted with the most stressful scenarios. It is also important to note FHA's ability to react to adverse developments while they are occurring in a manner that could preempt or ameliorate their worst effects, particularly during a period of prolonged economic downturn.

Third, despite its confirmation of the high economic value of the MMIF and the ability of the MMIF to withstand severe economic stress scenarios, GAO recommends more analysis of the performance of the MMIF, and it does so without acknowledging that HUD/FHA has substantially improved its ability to monitor the performance of the Fund, and has implemented new annual analyses in compliance with the Federal Credit Reform Act of 1990. HUD/FHA does not agree that new, unspecified "tools" are needed to analyze unanticipated and indirect effects. During the year spent on developing a model for this report, GAO did not develop tools for analyzing the indirect and ancillary effects, and does not suggest specific examples of the types of tools FHA might develop. Without such specifics, it is difficult for HUD to agree such tools are needed.

Finally, we offer a more technical point. You state in your conclusion section (as well as other places) that it is "instructive to remember" that the 1979 capital ratio of 5.3 percent was reduced to a negative figure during the 1980s; the fact that current FHA premiums, are substantially higher than they were during the 1980s and all times prior should at least be mentioned in order not to give the Congress or the reader a false impression that the MMIF is in jeopardy.

Specific Recommendations

If the Congress decides that no further guidance is necessary, to better evaluate the health of the Fund and determine the appropriate types and timing of policy changes, we recommend that HUD develop criteria for measuring the actuarial soundness of the Fund. These criteria should specify the conditions under which the Fund would be expected to meet its obligations without resorting to the Treasury and may specify capital ratios currently consistent with those criteria.

> Even in the most difficult days of its history, the MMIF has never "resorted to the Treasury" and is in absolutely no danger of doing so at the present time. To avoid this occurrence, FHA management has in fact acted to maintain the MMIF's economic value and capital ratio within a reasonable range, as indicated by numerous actuarial reviews as well as GAO's own analysis. These reviews already apply the criteria that GAO requests – the capital ratio. In fact, GAO's analysis showed the adequacy of a 2 percent capital ratio – a figure significantly below the 3.50 percent to 4.97 percent that Deloitte & Touche projects for Fiscal years 2000 to 2007.

Because many conditions affect the adequacy of a given capital ratio, we recommend that the independent annual actuarial analysis give more attention to tests of the Fund's ability to withstand appropriate stresses. These tests should include an analysis of the impact of a wide range of adverse economic conditions on the volume and riskiness of future loans, the weight and characteristics of recent loans, and the likely effect of recent and future insurance policy changes by HUD as well as changes in the conventional mortgage market.

In FY 1999, Deloitte & Touche assessed the likely performance of the MMIF under three different economic scenarios developed by DRI, and in FY 2000, under five scenarios, three developed by DRI and two by the contractor in consultation with HUD. Both the weight and characteristics of recent loans and the effect of recent insurance policy changes are routinely taken into account in the actuarial review. Based on these extensive analyses, HUD believes it is already complying with this recommendation. Therefore, we hope the final report could define more specifically what additional tests are needed.

To ensure that the unintended consequences of HUD actions do not inadvertently weaken the Fund, we recommend that the Secretary of HUD evaluate the costs and benefits of developing more adequate tools for assessing the impact of policy changes on the Fund. Specifically, these tools should include the ability to analyze the impacts of a variety of policy changes, such as changes in premiums, refunds, and distributive shares, and changes in the conventional mortgage market on the volume and riskiness of FHA-insured loans. Until HUD has more adequate tools with which to analyze policy changes, we recommend that any change in policies affecting the insurance program that can not be easily reversed be made in small increments and monitored carefully.

In making this recommendation, GAO has not taken into account the amount of analysis that is already focused on policy changes to the MMIF. First of all, because FHA has been insuring single family loans since 1934, there has been substantial analysis of historical experience which reduces the likelihood that policy changes will result in unanticipated effects. As noted earlier, the Congressional requirement for independent actuarial reviews has led to sophisticated, state-of-the-art analyses of FHA's claims and projected cash flows.

Second, to comply with government-wide budget and accounting standards, FHA must practice actuarial analysis on a cohort basis. Before it is able to endorse a single loan, FHA must estimate the present value of the anticipated cash flows over all the years that the cohort will be in existence. And once it endorses a cohort of loans, it must revisit its performance assumptions on an annual basis and make adjustments dictated by actual experience. Re-estimates are enacted in the agency's budget; changes in expectations result in changes to its liability for loan guarantees included in the agency's audited financial statement. Any planned or unplanned changes in program operations must be taken into account in these estimates on an annual basis. These complex analyses are integrated into the agency's annual budget and audit cycles and carried out by agency staff buttressed by extensive contract resources. They are subject to documented management review and independent audit. We believe the current draft does not recognize this enormous increase in the analytic resources being devoted to the performance of the MMIF.

Third, in the last few years, FHA has made its program data more accessible for policy analysis through the creation of the Single Family Data Warehouse (SFDW). The SFDW contains 26 million records with reliable data on FHA loan performance back to

1973. With monthly updates, the warehouse integrates data from numerous legacy systems and makes it available on the desktops of HUD/FHA program managers and analysts in Headquarters and Homeownership Centers. The data are examined from every angle to suit the needs of the highly varied users. Reliance upon a common data store reduces the likelihood that unforeseen effects will occur.

Finally, HUD does not agree that it should take only incremental, reversible policy actions. The changes Congress made to FHA's premium structure in 1990 were not incremental. Neither are some of the most important steps that FHA is taking to improve borrower credit underwriting and to increase loss recoveries. HUD believes it should take appropriate actions to maintain the financial health of the MMIF, buttressed by the best data available and professional judgment. Some of these actions will be small and incremental, but others will be suitably bold, imaginative, and responsive to changing needs and capabilities.

Sincerely,

Shaun Donovan
Deputy Assistant Secretary for
Multifamily Housing

GAO Contacts and Staff Acknowledgments

GAO Contacts

Thomas J. McCool, (202) 512-8678
Mathew Sciré, (202) 512-6794

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Related GAO Products

Financial Health of the Federal Housing Administration's Mutual Mortgage Insurance Fund (GAO/T-RCED-00-287, Sept. 12, 2000).

Level of Annual Premiums That Place a Ceiling on Distributions to FHA Policyholders (GAO/RCED-00-280R, Sept. 8, 2000).

Single-Family Housing: Stronger Measures Needed to Encourage Better Performance by Management and Marketing Contractors (GAO/T-RCED-00-180, May 16, 2000, and GAO/RCED-00-117, May 12, 2000).

Single-Family Housing: Stronger Oversight of FHA Lenders Could Reduce HUD's Insurance Risk (GAO/RCED-00-112, Apr. 28, 2000).

Homeownership: Results of and Challenges Faced by FHA's Single-Family Mortgage Insurance Program (GAO/T-RCED-99-133, Mar. 25, 1999).

Homeownership: Achievements of and Challenges Faced by FHA's Single-Family Mortgage Insurance Program (GAO/T-RCED-98-217, June 2, 1998).

Homeownership: Management Challenges Facing FHA's Single-Family Housing Operations (GAO/T-RCED-98-121, Apr. 1, 1998).

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Homeownership: Information on Single Family Loans Sold by HUD (GAO/RCED-99-145, June 15, 1999).

Homeownership: Information on Foreclosed FHA-Insured Loans and HUD-Owned Properties in Six Cities (GAO/RCED-98-2, Oct. 8, *1997*).

Homeownership: Potential Effects of Reducing FHA's Insurance Coverage for Home Mortgages (GAO/RCED-97-93, May 1, 1997).

Homeownership: FHA's Role in Helping People Obtain Home Mortgages (GAO/RCED-96-123, Aug. 13, 1996).

Mortgage Financing: FHA Has Achieved Its Home Mortgage Capital Reserve Target (GAO/RCED-96-50, Apr. 12, 1996).

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