United States General Accounting Office

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Report to the Chairman, Committee on Veterans' Affairs, U.S. Senate

September 1993

HOMEOWNERSHIP

Appropriations Made to Finance VA's Housing Program May Be Overestimated

GAO/RCED-93-173

GAO

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

Resources, Community, and
Economic Development Division

B-253530

September 8, 1993

The Honorable John D. Rockefeller IV
Chairman, Committee on Veterans' Affairs
United States Senate

Dear Mr. Chairman:

This report responds to the Committee's request for estimates of the subsidy costs that the federal government may incur on mortgages guaranteed by the Department of Veterans Affairs (VA) under its Home Loan Guaranty Program. Under this program, VA has partially guaranteed $389 billion in home loans made to veterans by private sector mortgage lenders. As of September 30, 1992, a balance of $171 billion was outstanding on these loans.

For its home loan program, VA, like other agencies that operate federal credit programs, was required, beginning in fiscal year 1992, to estimate the subsidy cost associated with the portfolio of new loans it guarantees each year. This subsidy cost estimate is to represent the true cost to the federal government of guaranteeing the loans for their full life—up to 30 years. The estimate determines the budgetary appropriation that is provided in the year the loans are originated to cover all estimated future losses from that year's portfolio of mortgage loans.

Specifically, we (1) estimated, under different economic scenarios, the costs to the federal government of guaranteeing VA's fiscal year 1992 and 1993 home mortgage loans and (2) compared our estimates with estimates prepared by the administration and accounted for any differences in these two sets of estimates.

Results in Brief

We estimate that the costs to the federal government of guaranteeing VA's fiscal year 1992 and 1993 home mortgage loans will be substantially lower than the administration estimated. Assuming a conservative rate of growth in house prices, we estimate that the federal subsidy costs for the loans made during these 2 fiscal years will probably be about $306 million lower than the administration estimated. Consequently, the costs of VA's home loan program have been overstated, VA has received more in appropriations than it needs to cover these costs, and the federal budget deficit for 1992 and 1993 has been increased unnecessarily although federal borrowing has not been affected. Our analyses also show that the

actual costs of subsidizing VA's mortgage loans will depend heavily on the rate of growth in house prices that prevails over the life of the mortgages. If the future rate of growth in house prices is different from what we assume—either less rapid (particularly if house prices remain constant or fall) or more rapid—then the actual subsidy costs/required appropriations will be higher or lower, respectively, than our estimates.

The differences between the administration's estimates and our estimates of the VA program's subsidy costs are not the result of our having assumed a higher rate of growth in house prices during the forecast period.[1] In fact, if we had assumed the administration's higher rate of appreciation in house prices, the differences in estimates would have been approximately twice as large for the 2-year period. Instead, the differences in estimates stem at least in part from differences in the modeling techniques developed and used by the Office of Management and Budget (OMB) for the administration's estimates and by us for our estimates. In particular, OMB's model does not consider factors other than the borrower's equity in estimating key determinants of subsidy costs, such as loan foreclosure rates. In contrast, our model considers the borrower's equity and other important factors, such as the rate of unemployment, the age of the borrower, the size of the loan, and the region of the country where the loan was originated. In addition, the differences in estimates may also stem in part from differences in data. OMB used data from VA on down payments on loans to compute equity, but it used data from the Department of Housing and Urban Development's (HUD) Federal Housing Administration (FHA) to estimate the effect of equity on the probability of foreclosure. In contrast, we used data from VA for all aspects of our modeling. The precise significance of the differences in methodology and data cannot be estimated unless an analysis is carried out with OMB's model using VA data only. Because our model considers more factors that influence VA's subsidy costs than OMB's model and because we used data from VA alone for all aspects of our modeling, we believe that our subsidy cost estimates are more likely than OMB's to approximate VA's actual subsidy costs.

Background

VA's Home Loan Guaranty Program is not designed to be self-sustaining. Therefore, for each year's portfolio of guaranteed loans, revenues collected from fees charged to VA borrowers at loan origination (which vary from 0.5 to 2.0 percent of the mortgage amount, depending on the

[1]Besides the forecasted rate of growth in house prices, other factors, such as some of the details of our model specification and our choice of discount rates, influence our estimates—but not by as much as the forecasted rate of growth in house prices.

amount of the down payment made and the type of veteran) and from the sale of foreclosed property are not expected to cover future losses from claims paid on foreclosed properties. The amount by which losses exceed revenues in a given year represents the additional funds needed by VA in that year to operate the program. Until fiscal year 1992, the Congress appropriated funds when needed to cover this funding need but did not estimate the total long-term program cost that the federal government would incur.

The Federal Credit Reform Act of 1990 (P.L. 101-508, title XIII) significantly revised the federal government's budgetary accounting system for federal credit programs, such as VA's home loan program. Under the act, VA is required, beginning in fiscal year 1992, to estimate the subsidy cost associated with each year's portfolio of new loan guarantees. Essentially, the estimated subsidy cost associated with each year's portfolio is the difference between the present values of the streams of expected cash outflows from and cash inflows to VA over the life of the mortgage loans.[2]

If the estimated present value of cash outflows exceeds the estimated present value of cash inflows, a subsidy cost will be expected to be incurred. An appropriation is provided each year to cover future losses expected to be incurred on each year's portfolio of mortgage loan guarantees although these losses are not financed (there is no government borrowing) until claims against the Treasury occur.[3] Each year, the subsidy cost estimates/appropriations made in past years' budgets are reestimated to reflect actual experience.[4] If an initial subsidy cost estimate is correct, the appropriated amount, the fees received from borrowers, and the interest accrued on the appropriations and fees will be sufficient to cover future losses from claims paid on foreclosed loans included in that year's portfolio. However, if an initial subsidy cost estimate is too high, the excess appropriation is required to be paid to a special fund receipt account in the U.S. Treasury and is not available to cover the cost of new

[2]To arrive at present value, cash flow is discounted by the interest rate on marketable U.S. Treasury securities of like maturity at the time a guaranteed loan is disbursed by the lender.

[3]While appropriations made to cover future losses increase the budget deficit in the year they are made, they are not financed through borrowings by the U.S. Treasury in that year. Rather, they are financed as foreclosures occur and as claims are made against VA over the life of the mortgages (up to 30 years). The pattern of federal expenditures to pay the claims is affected by the timing not of the appropriation but of the claims.

[4]In the President's fiscal year 1994 budget, for example, the subsidy costs for the fiscal year 1992 loans were reestimated and increased by $18.7 million over the subsidy costs estimated for these loans in fiscal years 1992 and 1993.

guaranteed loans unless appropriated by law. Conversely, if an initial subsidy cost estimate is too low, the appropriated amount, the fees received from borrowers, and the accrued interest will not be sufficient to cover future losses. In this case, an additional appropriation will be made in the amount of the estimated shortfall to supplement the original subsidy. These subsidy cost reestimates are submitted in each year's budget. A more detailed discussion of VA's Home Loan Guaranty Program and of the Credit Reform Act appears in appendix I.

We Estimated the Subsidy Costs of VA's Home Mortgage Loans Under Three Scenarios

VA guaranteed about $24.6 billion in home mortgage loans in fiscal year 1992 and will, we estimate, guarantee about $26.8 billion in fiscal year 1993. To estimate the subsidy costs that the federal government may incur over the life of these loans, we developed an economic model of VA's home loan program and estimated the subsidy costs under three economic scenarios for the forecast period. For our baseline economic scenario, we assumed that nominal house prices (adjusted for housing quality changes and depreciation) would increase by 1 percent annually on average and that unemployment would average 5.8 percent annually.[5] For our low-case economic scenario, we assumed that house prices would remain constant and that the unemployment rate would average about 1 percent higher than in our baseline scenario. For our high-case economic scenario, we assumed the same economic conditions as we did for our baseline scenario except that we assumed that house prices would increase by 3 percent annually on average. This rate of increase in house prices is similar to the rate that the administration assumed in its model. A detailed discussion of our model and methodology for forecasting VA's mortgage subsidy costs appears in appendix II.

Table 1 presents our estimates of the subsidy costs for VA's mortgage loans under each of our three economic scenarios. Under our baseline economic scenario, we estimated that the required subsidy rates/appropriations would be 1.84 cents for every dollar guaranteed, or a total subsidy of about $451 million, over the life of the fiscal year 1992 mortgages and 1.02 cents for every dollar guaranteed, or a total subsidy of about $273 million, over the life of the fiscal year 1993 mortgages. Under our low-case economic scenario, we estimated that the required subsidies would be greater. Conversely, under our high-case economic scenario, we estimated that the

[5]Future house prices were estimated as the price of the property at the time of loan origination times the forecasted annual increase in the median house price. The estimated appreciation in house prices was then adjusted downward by 2 percent annually to account for housing quality changes and depreciation. Thus, a 1-percent annual change in the constant-quality house price is equivalent to a 3-percent annual change in the median house price.

required subsidies would be lower. Under all three of our economic scenarios, our total subsidy cost estimates are lower for fiscal year 1993 than for fiscal year 1992. This is because interest rates are considerably lower on fiscal year 1993 loans than on fiscal year 1992 loans and because our model suggests that lower interest rates are associated with a lower probability of foreclosure.

Table 1: Estimates of Subsidy Costs for VA Mortgages

	Subsidy rate (in cents per dollar guaranteed)		Estimated subsidy (in millions of dollars)		
Scenario	Fiscal year		Fiscal year		Total
GAO	1992	1993	1992	1993	1992-93
High-case	1.23	0.53	$303	$143	$446
Baseline	1.84	1.02	451	273	$724
Low-case	2.67	1.51	656	403	$1,059
Administration[a]	2.26	2.19	557	473	$1,030

[a]Figures are from VA's fiscal year 1994 budget submission.

The Administration's Subsidy Cost Estimates Are Higher Than Ours Because of Differences in Modeling Techniques

The administration's estimates of VA's subsidy costs are substantially higher than our baseline estimates. The differences in estimates did not occur because we made more favorable assumptions than OMB about the rate of growth in future house prices for the forecast period. In fact, if we had made the same assumptions as OMB about the rate of growth in house prices, the differences in estimates would have been even greater. Rather, these differences in subsidy cost estimates stem at least in part from differences in the modeling techniques used. OMB's use of FHA rather than VA data to estimate the effect of equity on the probability of foreclosure may also have contributed to differences in the estimates.[6]

The Administration Estimated Higher Subsidy Costs Than We Did

As table 1 also shows, the administration estimated total subsidy costs of about $1 billion for VA's fiscal year 1992 and 1993 mortgage loans. This estimate is $306 million, or 42 percent, higher than our total baseline estimate of $724 million. For the fiscal year 1992 loans, the administration estimated that a subsidy rate of 2.26 cents per dollar guaranteed, or a total subsidy of $557 million, was needed to cover VA's future losses. This estimate is $106 million greater than the $451 million that we estimated in our baseline economic scenario. For the fiscal year 1993 loans, the

[6]Differences in subsidy cost estimates are not attributable to differences in estimated loss per claim because we used the administration's estimate of this measure.

administration estimated that a subsidy rate of 2.19 cents per dollar guaranteed, or a total subsidy of $473 million, was needed—or $200 million more than the $273 million that we estimated in our baseline economic scenario.[7]

Differences in Estimates Are Not Attributable to Differences in Assumptions About Rates of Appreciation in House Prices

Our lower subsidy cost estimates are not the result of our having made more favorable assumptions than the administration about the rate of growth in house prices during the forecast period. Whereas we assumed future annual constant-quality house price appreciation rates averaging 1 percent for our baseline estimates, OMB assumed 3-percent rates for its estimates, similar to the rates we assumed for our high-case scenario. Therefore, our high-case estimates are approximately the same as we would have obtained if we had used OMB's assumption for our baseline scenario. Our high-case estimates are even farther below the administration's subsidy cost estimates than our baseline estimates, or $584 million less than the administration estimated for the 2-year period—$254 million and $330 million less than it estimated for fiscal year 1992 and 1993, respectively.

For fiscal year 1993, the administration's estimate is also higher than our estimate under the low-case economic scenario, in which we assumed no appreciation in house prices (as compared with the 1-percent annual rate of appreciation assumed in our baseline scenario). For losses of the magnitude estimated by the administration to occur on fiscal year 1993 loans, we estimate, on the basis of our economic model, that house prices, after being adjusted for quality changes and depreciation, would have to decline over the life of this year's mortgages even if unemployment rates averaged 1 percent more than we assumed for our baseline.

Differences in Estimates Result From Differences in Modeling Techniques

Differences between our model and OMB's model contribute to the differences in subsidy cost estimates. Our model uses several factors to predict the effect of key subsidy cost determinants, such as the likelihood

[7]VA based its estimate of the subsidy cost for fiscal year 1993 loans on its estimate of $21.6 billion in loan originations, while we based our estimate on a higher loan volume, $26.8 billion. We used a higher loan volume because VA data on loan originations so far this year suggest that the fiscal year 1993 loan volume may exceed VA's original estimate. If our higher estimate of loan volume proves accurate, then the dollar difference between VA's estimate of the subsidy cost for fiscal year 1993 loans and ours is likely to be greater than table 1 suggests. Appendix II explains how we derived our volume estimate.

of mortgage foreclosures; OMB's model uses one factor.[8] The relationships between foreclosure rates and the factors that influence these rates are important determinants of VA's subsidy costs because these relationships affect the amount and timing of the losses that can be expected from claims paid on foreclosed properties over the life of the VA mortgages. In both our model and OMB's model, a key determinant of the likelihood of a mortgage default, leading to a foreclosure and claim against VA, is the amount of equity the borrower has in the property. Other things being equal, the lower the equity, the higher the likelihood of foreclosure.

OMB's model assumes that the probability of default on a mortgage is determined only by the amount of equity. Equity is determined by the down payment, the subsequent repayment of principal, and the rate of growth in the price of the house. In its model, OMB estimates the number of loans originated and sorts these loans at any point in time into various equity categories classified by the amount of equity the borrower has in the property. OMB then uses historical data on foreclosure rates to estimate the probability of foreclosure for loans in each equity category. Underlying this approach is the assumption that the likelihood of foreclosure is the same for all loans in a given equity category irrespective of other characteristics—of the loan, the property, the condition of the economy, or the borrower.

In contrast, our model explicitly allows the probability of default to be influenced by factors in addition to equity—such as the rate of unemployment, the age of the borrower, the size of the loan, and the region of the country where the loan is originated. We chose to include such factors in our analyses because economic reasoning and academic literature on the modeling of mortgage defaults suggest that these factors could influence foreclosures in a particular way. For example, other things being equal, higher unemployment rates are likely to be associated with higher foreclosure rates, as are younger borrowers. While our model, like OMB's, shows that foreclosure rates decline as equity increases and that this relationship is very strong, our analyses show that other factors also affect the probability of foreclosure. Our analyses indicate that even when we control for the influence of equity, these factors are significant additional predictors of foreclosure probabilities. For example, our results suggest that when other factors, including equity, are held constant, rates

[8]In order to calculate subsidy cost estimates, it is necessary to analyze prepayments as well as foreclosures. A similar difference exists in the modeling techniques used to predict mortgage prepayment. For that prediction, our model also uses more explanatory factors than OMB's model. OMB predicts prepayments on the basis of how interest rate changes over time affect borrowers' equity and the relationship between equity and the probability of prepayment.

of default tend to be lower when house prices are higher, when unemployment is lower, and when borrowers are older.

Our model further differs from OMB's in that we used different data to estimate the historical relationships between key determinants of subsidy costs, such as foreclosure probabilities, and factors associated with the likelihood of foreclosure. We used data on the rates and timing of past foreclosures on mortgages guaranteed by VA between 1971 and 1988 to estimate these relationships. OMB used data on down payments on VA loans to compute its initial equity measure (which it adjusts over time as house prices change and loan principal is repaid) to place loans in equity categories. However, OMB relied on data on loans insured by FHA over a roughly comparable period to estimate the effect of equity on the likelihood of foreclosure.

We did not analyze whether the probability of foreclosure differs for VA and FHA loans in particular equity categories.[9] Therefore, we cannot tell whether OMB would have obtained substantially different estimates if it had used only VA data to estimate this probability. If, as is implicitly assumed in OMB's model, factors other than equity are not important in predicting the probability of foreclosure, then the relationship between foreclosure and equity developed from any set of loans, even conventionally financed loans, may be applicable.[10] Only if the analysis were carried out could it be determined whether the relationship estimated with VA data would be different.

However, as discussed previously, our results indicate that other factors, including borrowers' characteristics, also influence the probability of foreclosure. Our evidence suggests that using data on VA loans rather than on FHA loans to estimate the effects of the explanatory factors on the probability of foreclosure may be important.

Conclusions

Forecasting the losses that the federal government will incur on VA's guaranteed mortgages over the next 30 years is uncertain. Loan performance and, therefore, the required subsidies, will depend heavily on the actual rate of appreciation in house prices over this period. However,

[9]There are many differences between the VA and FHA programs, such as the higher mortgage ceiling for VA guaranteed loans that might influence the relationship between equity and the probability of foreclosure.

[10]That is, if the relationship between equity and the probability of foreclosure were the same for all groups of borrowers, then the number of loans that fall into each equity category would be the only variable needed for the analysis.

to develop the best possible estimates, it is important to use a model that takes into account the influences of all factors significantly affecting the probability of loan foreclosure and prepayment, such as the age of the borrower and the size of the loan. In addition, it is important to consider the effect of these factors on the performance of VA loans in the past.

Because OMB's model (1) does not consider factors other than the borrower's equity in predicting the probability of foreclosure and the resulting claims against VA and (2) uses data on FHA loans rather than VA loans to estimate the relationship between equity and the probability of foreclosure and prepayment, its estimates of VA's subsidy costs may not closely reflect actual subsidy costs. In contrast, our model's estimates of subsidy costs may more closely reflect actual subsidy costs because our model incorporates several associated factors and uses VA data to estimate all of the key relationships. Our model's results suggest that the administration's estimates of VA's subsidy costs/required appropriations probably overstate the actual subsidy costs that the federal government will incur for mortgage loans made in 1992 and 1993 and add unnecessarily to the budget deficit for these years. Hence, there is a need for the administration to reestimate these subsidy costs to ensure that they are not overstated and the budget deficit is reduced.

Recommendations

To ensure that estimates of the VA Home Loan Guaranty Program's subsidy costs are based on a model that (1) incorporates the effects of all important factors that influence these costs and (2) uses the most relevant data, we recommend that the Secretary of Veterans Affairs and the Director, Office of Management and Budget, work together to revise OMB's economic model. Specifically, we recommend that they (1) assess and incorporate into the model factors in addition to equity—such as the rate of unemployment, the age of the borrower, and the size of the loan—that significantly affect subsidy costs and (2) use data on VA loans to estimate the effects of these factors on the likelihood of foreclosure and prepayment. We further recommend that they use this revised economic model to develop (1) reestimates of the fiscal year 1992 and 1993 subsidy costs for inclusion in the President's fiscal year 1995 budget and (2) estimates of subsidy costs for VA mortgages guaranteed in future years.

Agency Comments

We provided drafts of this report to VA and OMB officials and met with them to discuss the report. VA's Deputy Director for Loan Guaranty Service and OMB's VA Budget Examiner and Senior Economist responsible for modeling

federal credit programs generally agreed with the facts as presented on VA's home loan program. We incorporated, where appropriate, changes suggested by VA and OMB staff to further clarify certain information presented. VA and OMB officials stated that our report raised concerns about the administration's estimates of VA's subsidy costs that need to be addressed. They agreed to work together to reassess OMB's model and determine whether factors other than equity should be included in forecasting foreclosures and prepayments. They also agreed to evaluate whether using VA data rather than FHA data to estimate the relationships between equity and the probability of default and prepayment would have any effect on their subsidy cost estimates. However, they could not concur in our estimates of VA's subsidy costs without further analysis. They explained that until they had revised their model, reviewed our model in detail, and assessed the results, they would not be able to determine what adjustments, if any, would need to be made to past and future estimates of the VA home loan program's subsidy costs. As requested, we did not obtain written agency comments on a draft of this report.

Scope and Methodology

To estimate the cost to the federal government, under different economic scenarios, of subsidizing the VA mortgages guaranteed in fiscal years 1992 and 1993, we examined existing studies on the single-family housing programs of both VA and HUD, academic literature on the modeling of mortgage defaults and prepayments, and previous work performed for HUD, VA, and GAO on modeling government mortgage programs. On the basis of this examination, we developed econometric and cash flow models that we used to prepare our estimates. For these models, we used data supplied by VA and DRI/McGraw-Hill, a private economic forecasting company.

Our econometric analysis estimated historical relationships between certain explanatory factors and the probability of loan foreclosure and prepayment.[11] We used data on the performance of VA guaranteed mortgage loans originated from fiscal years 1971 through 1988 to estimate these relationships. Also, as discussed previously, we developed three forecasts of future economic conditions to estimate subsidy costs. We used our estimates of these relationships and forecasts of future loan demand, together with forecasts of economic conditions, to estimate subsidy costs. We estimated future house prices by multiplying the value of the property at the time of loan origination by the DRI/McGraw-Hill

[11]We estimated prepayment probabilities as well as foreclosure probabilities because foreclosure probabilities depend in part on prepayments. Once a borrower prepays a loan, the probability of subsequent foreclosure for that loan is zero.

forecasted annual increase in the median nominal house price. The rate of change in the median house price reflects the prices of houses actually sold yearly. Because new houses are larger and include more amenities and because existing homes are occasionally renovated, the median sales prices of new VA-guaranteed homes will increase faster than the prices for existing VA-guaranteed homes. In addition, the values of existing homes depreciate over time. The relevant consideration to the home-owning veteran however, is how much the value of his or her house has increased since purchase, not how much the value of the general housing stock has changed. Because of these considerations, we adjusted the estimated appreciation in existing house prices downward by 2 percent annually to account for changes in housing quality and depreciation.

To test the validity of our model, we examined how well our model predicted the actual rates of VA loan foreclosure and prepayment through 1990. We found that our predicted rates closely resembled actual rates.

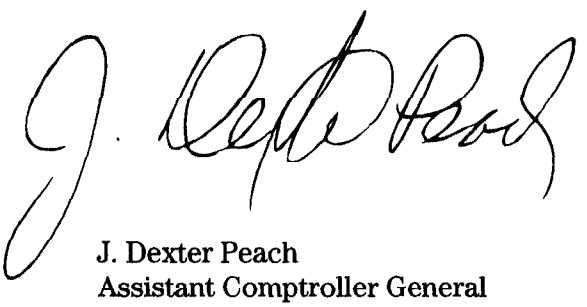
To compare our subsidy cost estimates to the administration's estimates and account for any differences in these two sets of estimates, we compared our economic model to the model developed by OMB, identified the differences, and discussed with OMB officials the rationale for the observed differences. A more detailed discussion of our model and methodology for forecasting the subsidy costs of VA's mortgage loans appears in appendix II.

We conducted our work between October 1990 and June 1993 in accordance with generally accepted government auditing standards. Our estimates, like the administration's estimates, do not include estimates of the costs of subsidizing direct loans made by VA to veterans and of guaranteed loans made for the manufactured housing components of VA's housing program. The costs of subsidizing these program components are estimated in separate budgetary accounts. Also, in recent years VA has initiated several program changes to improve the quality of the loans it guarantees and to minimize the rate of foreclosures and the losses it incurs on the sale of foreclosed properties. For example, in 1990 VA established a staff of monitors to visit lenders to determine compliance with credit and loan-processing standards, and it required pay stubs from employers to verify borrowers' income. The extent to which these and other program changes may have affected the historical relationships indicated by the fiscal year 1971-88 VA data we used in our model is not reflected in our subsidy cost estimates. Consequently, VA's actual subsidy costs may be lower than we estimated.

Unless you announce its contents earlier, we plan no further distribution of this report until 10 days from the date of this letter. At that time, we will send copies to interested congressional committees; the Secretary of Veterans Affairs; the Director, Office of Management and Budget; and other interested parties. We will make copies available to others upon request.

This work was performed under the direction of Judy A. England-Joseph, Director, Housing and Community Development Issues. If you or your staff have any questions, she can be reached at (202) 512-7631. Major contributors to this report are listed in appendix III.

Sincerely yours,



J. Dexter Peach
Assistant Comptroller General

Contents

Abbreviations

ARM	adjustable rate mortgage
BLS	Bureau of Labor Statistics
DRI	DRI/McGraw-Hill
FHA	Federal Housing Administration
GIF	Guaranty and Indemnity Fund
GIL	Guaranteed/Insured Loans
HUD	Department of Housing and Community Development
LCS	Liquidation and Claims System
LGRF	Loan Guaranty Revolving Fund
LTV	loan-to-value
OMB	Office of Management and Budget
VA	Department of Veterans Affairs

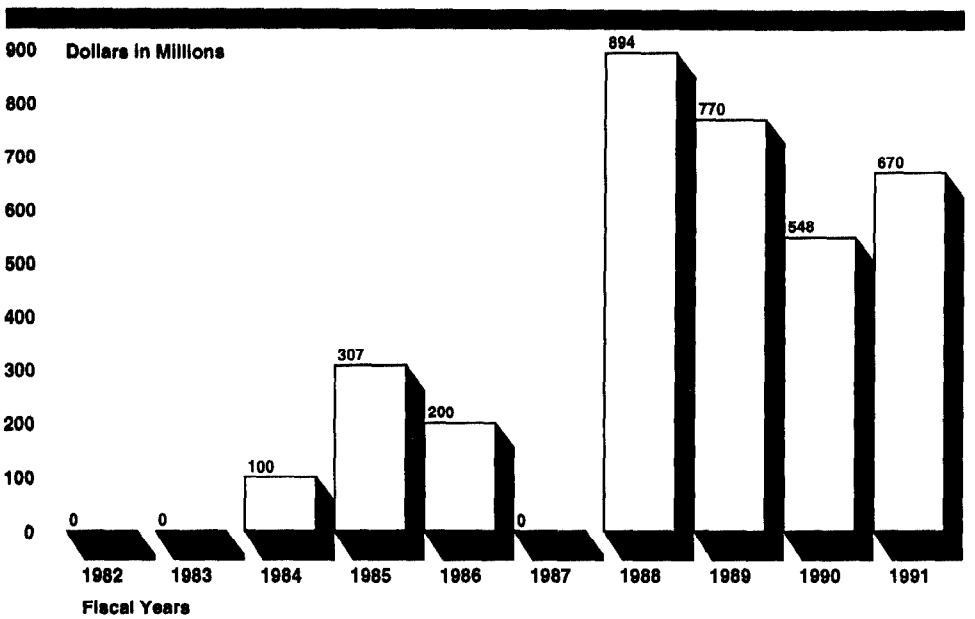
VA's Home Loan Guaranty Program

Under its Home Loan Guaranty Program, the Department of Veterans Affairs (VA) provides mortgage credit assistance to qualified veterans and their survivors. It provides credit assistance by guaranteeing mortgage lenders, such as banks and savings and loan institutions, against financial loss not to exceed a maximum amount if the loan is foreclosed. The amount of the guaranty depends on the amount of the loan. Currently, for loans of $45,000 or less, VA guarantees 50 percent of the loan amount. For loans of more than $45,000, but not more than $56,250, the guaranty is $22,500. For loans of more than $56,250, but not more than $144,000, the lesser of $36,000 or 40 percent of the loan amount is guaranteed. For loans of more than $144,000, the lesser of $46,000 or 25 percent of the loan amount is guaranteed.

Before January 1990, funding for VA's loan guaranty program was provided through the Loan Guaranty Revolving Fund (LGRF). Revenues to the fund were derived primarily from (1) a legislatively set "loan fee" of 1 percent of the loan amount charged to VA borrowers at loan origination and (2) the proceeds from the sale of foreclosed properties. Additionally, some revenues were collected by the fund when VA acquired foreclosed properties through the claim settlement process and sold the properties on credit. Such credit, or direct loan, transactions are referred to as vendee loans. VA collects monthly loan repayments and interest charges on these vendee loans and credits these revenues to LGRF.

LGRF incurs expenses mainly when VA either sells acquired foreclosed properties at a loss or pays the guaranty on foreclosed properties and leaves the properties with mortgage lenders. Although the Congress did not design the program to be self-sustaining, for many years revenues to the fund were sufficient to cover program expenditures. However, beginning in the early 1980s, foreclosures on VA guaranteed home loans began increasing and revenues to the fund did not always cover program expenditures. Consequently, fund revenues have been supplemented by annual congressional appropriations for most fiscal years between 1980 and 1991, as shown in figure I.1.

Figure I.1: Appropriations Made to Cover LGRF Losses



Source: Budget of the United States Government, Fiscal Years 1983-93.

VA's Home Loan Guaranty Program was changed to a two-fund program by the Veterans Home Loan Indemnity and Restructuring Act of 1989 (P. L. 101-237, title III), enacted on December 18, 1989. This act (1) established a new Guaranty and Indemnity Fund (GIF) to guarantee all new VA home loans, except loans for manufactured homes,[1] guaranteed after January 1, 1990, and (2) retained LGRF for those home loans guaranteed before January 1, 1990, and loans for manufactured homes. In addition the act changed the loan fee structure and established a matching government contribution (appropriation). For GIF-guaranteed loans, the one-time loan fees charged to VA borrowers at loan origination and the government matching contribution/appropriation were both set to vary from 0 to 1.25 percent and from 0.50 to 1.25 percent, respectively, of the loan amount, depending on the amount of the down payment made and the type of veteran.

The Federal Credit Reform Act (CRA) of 1990 (P. L. 101-508, title XIII) significantly revised the federal government's budgetary accounting system for federal credit programs, including VA's Home Loan Guaranty

[1]A manufactured home is defined as a moveable dwelling unit designed for year-round occupancy by a single family, on land, containing permanent eating, cooking, sleeping, and sanitary facilities.

Program. Under CRA, VA is required, beginning in fiscal year 1992, to estimate the subsidy cost associated with each year's portfolio of new loan guarantees. The subsidy cost is an estimate of the true cost to the federal government of providing loan guarantees for the full life—up to 30 years—of the VA-guaranteed mortgages. Since VA's Home Loan Guaranty Program is not designed to be self-sustaining, revenues collected from fees charged to VA borrowers at loan origination and from the sale of foreclosed property on each year's portfolio of guaranteed loans are not expected to cover future losses from claims paid on foreclosed properties from that portfolio.

Essentially, the estimated subsidy cost associated with each year's portfolio is the difference between the present values of the streams of expected cash outflows from and cash inflows to VA over the life of the mortgage loans.[2]

If the estimated present value of cash outflows exceeds the estimated present value of cash inflows, a subsidy cost will be expected to be incurred. An appropriation is provided each year to cover future losses expected to be incurred from each year's portfolio of mortgage loan guarantees although these losses are not financed (there is no government borrowing) until claims against the Treasury occur. Each year, subsidy cost estimates/appropriations made in past years' budgets are reestimated to reflect actual experience. If the initial subsidy cost estimate is correct, the appropriated amount, the fees received from borrowers, and the interest accrued on the appropriations and fees will be sufficient to cover future losses from claims paid on foreclosed loans included in that year's portfolio. However, if the initial subsidy cost estimate is too high, the excess appropriation is required to be paid to a special fund receipt account in the U.S. Treasury and is not available to cover the subsidy costs of new guaranteed loans unless appropriated by law. Conversely, if the initial subsidy cost estimate is too low, the appropriations provided, the fees received from borrowers, and the related interest accrued will not be sufficient to cover future losses. In this case, an additional appropriation will be made in the amount of the estimated shortfall to supplement the original subsidy estimate. The amounts of any subsidy reestimates are included in each year's budget submission.

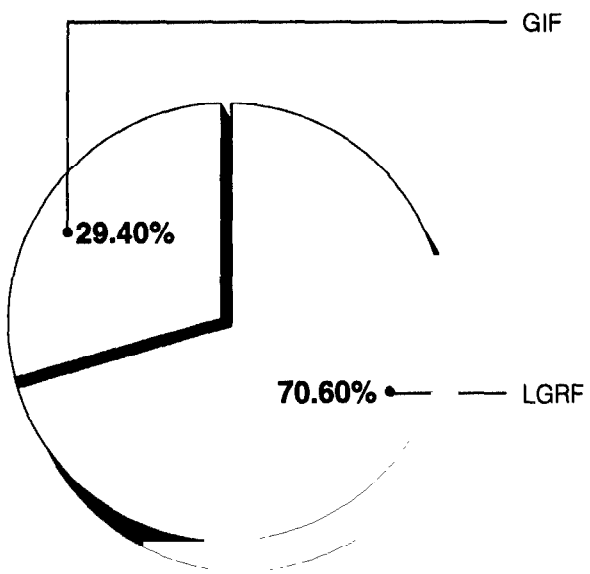
CRA also affects the matching contribution from the federal government required under the 1989 act that established GIF. VA and the Office of

[2]To arrive at present value, cash flow is discounted by the interest rate on marketable U.S. Treasury securities of like maturity at the time a guaranteed loan is disbursed by the lender.

Management and Budget (OMB) have concluded that CRA supersedes the 1989 act's provision. Consequently, while matching appropriations were provided for VA home loans guaranteed from January 1990 through September 1991, these appropriations are no longer being provided.

As of September 30, 1992, VA had guarantees outstanding on $171 billion in home loans. Figure I.2 illustrates the amount in guaranteed loans outstanding for each of the VA funds as of that date.

Figure I.2: Proportion of Loan Guarantees Outstanding, by VA Fund, as of September 30, 1992



Note: Loan guarantees outstanding at the end of fiscal year 1992 totaled $171 billion.

Source: Budget of the United States Government, Fiscal Year 1994.

To provide housing assistance, VA not only guarantees mortgage lenders against financial loss but also provides direct financing for some home sales. VA's direct home loan program was initially established to provide mortgage funds to veterans in certain geographic areas where private mortgage funds were unavailable. Since 1981, direct VA home loans have been restricted to severely disabled veterans requiring special housing. As a result, few new direct home loans have been provided. As of

September 30, 1992, direct loans outstanding to veterans totaled about $28 million.

GAO's Econometric Model Used to Forecast VA's Subsidy Costs

This appendix describes our methodology for estimating the subsidy cost to the government of guaranteeing VA mortgages that were originated in fiscal years 1992 and 1993. For this analysis, we built econometric models to predict foreclosures, prepayments, and loan originations on the basis of historical relationships between these events and key explanatory variables.

Our foreclosure and prepayment models used observations on loan-years, that is, information on the characteristics and status of a guaranteed loan during each year of its life, to estimate conditional foreclosure and prepayment probabilities.[1] More specifically, our model used logistic regressions to estimate the probability of foreclosure (or prepayment) in a given year as a function of (1) characteristics of the loan and borrower; (2) the macroeconomic environment, as characterized by interest rates and unemployment rates; (3) the borrower's equity, which depends heavily on the rate of appreciation in house prices; and (4) the length of time that has passed since VA guaranteed the loan. We estimated foreclosure and prepayment probabilities separately for new loans (loans associated with home purchase) and refinancing loans. We also used various predictor variables, including the size of the veteran population in each state, in a logistic regression to estimate VA's share of the mortgage market in 1992 and 1993.

Cash flows out of the Guaranty and Indemnity Fund (GIF) when VA pays a claim on a foreclosed mortgage. Cash flows into GIF when VA sells foreclosed property and when borrowers pay loan origination fees. We forecasted the cash flows into and out of GIF on the basis of foreclosure and prepayment models and predictions of key economic variables made by DRI/McGraw-Hill (DRI), a leading economic forecasting firm. We then used the forecasted cash flows to estimate subsidy rates on the VA programs.

The remainder of this appendix (1) describes our data sources, (2) describes the specification variables and equations used in our regression models, (3) discusses the estimation results, (4) describes how we forecasted VA's loan volume, (5) discusses the simulation methodology and results, and (6) contains a sensitivity analysis that demonstrates the sensitivity of our estimates to the values of some key variables.

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

Data and Sample Selection

For our analysis, we originally selected from VA's computerized files a 20-percent sample of records of mortgages guaranteed by VA from 1971 through 1990 (1,148,112 loans) of which 22,957 were for manufactured housing. VA maintains the Guaranteed/Insured Loan (GIL) System to provide current and historical information on the mortgage loans it guarantees. From GIL, we obtained information on the characteristics of each loan, such as the year the loan was originated, the type of property (e.g., single-family home), the location (state), the value of the property, the loan amount, and the interest rate. We categorized the loans as either new loans or refinancing loans.[2]

GIL also provided information on, among other things, a loan's status, that is, on whether the loan was active or inactive. A loan could be inactive if it had been paid off early or was foreclosed. We used information from another computerized VA data source—the Liquidation and Claims System (LCS)—to identify the inactive loans in our sample that had been terminated with a claim (foreclosed). We assumed that inactive loans not found in LCS had been prepaid.[3]

Because we were dealing with a large number of records, we selected smaller samples for our regression analyses. For our regressions of prepayments and foreclosures on new loans, we sampled 2 percent of our 1,014,684 loans of this type, thereby obtaining 18,773 loan records and 181,590 loan-year observations after deleting duplicate records and loans made to borrowers from outlying areas, such as Puerto Rico, and otherwise clearing the data. For our regressions on refinancing loans, we sampled a larger percentage—20 percent—of our 110,471 loans of this type because VA guarantees fewer of these loans than it does new loans. We thus obtained 20,778 loan records and 115,503 loan-year observations after making adjustments similar to those we made for new loans.[4]

[2]We are providing subsidy cost estimates associated with GIF. Because loans for manufactured housing are not guaranteed by GIF, our regression models are based on loans for single-family homes and exclude loans for manufactured housing.

[3]For loans that became inactive before the introduction of LCS in 1976, we used information in GIL to distinguish foreclosed from prepaid loans. According to VA officials familiar with these data, LCS foreclosure information is more reliable than GIL foreclosure information primarily because foreclosures are recorded in a more timely manner. For foreclosures occurring in the early to mid-1970s, however, the timeliness of recording is not an important issue.

[4]VA did not guarantee refinancing loans until 1981. Consequently, our sample of loans includes no refinancing loans originated before that time.

To describe macroeconomic conditions at the national and regional levels, we obtained data from the Bureau of the Census (Census), by division,[5] on annual civilian unemployment rates; data from the Department of Commerce on the implicit price deflator for personal consumption expenditures; data from DRI on quarterly interest rates on 30-year fixed-rate mortgages on new and existing housing; and data from DRI at the state level on median house prices.[6]

Model Specification

Our regression models estimated conditional mortgage foreclosure and prepayment probabilities as functions of a variety of explanatory variables. In our regressions, the dependent variable is an indicator of whether a given loan was prepaid (or foreclosed) in a given year, weighted by the loan's balance in that year. Logistic regression is commonly used when the variable to be estimated is the probability that an event, such as a loan foreclosure, will occur.[7]

The variables we used to predict foreclosures and prepayments fall into two general categories: descriptions of states of the economy and characteristics of the loan or of the borrower. 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 included most of the variables in both the foreclosure and prepayment regressions.

The single most important determinant of loan 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. Previous research strongly indicates that borrowers with small amounts of, or even negative, equity are more likely than other borrowers to default.[8]

Equity is a measure of the current value of a property compared with the current value of the mortgage on that property. We computed equity as the

[5]Census groups the states into nine divisions.

[6]We aggregated state-level house price data to the Census division level.

[7]If P_i is the probability that an event will occur in loan-year i, the "odds ratio" is defined as $P_i/(1-P_i)$. The logistic transform is the natural logarithm of the odds ratio, or $LN[P_i/(1-P_i)]$, of which the logistic regression provides an estimate. See G. S. Maddala, Limited Dependent Variables and Qualitative Variables in Econometrics (Cambridge: Cambridge University Press, 1983).

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

difference between the value of the property and the value of the mortgage, expressed as a percentage of the value of the property.[9] To measure equity, we calculated the value of the mortgage as the present value of the remaining mortgage payments, evaluated at the current year's fixed-rate mortgage interest rate. We calculated the value of the property by multiplying the value of the property at the time of loan origination by the change in the region's median nominal house price between the year of origination and the current year.[10] Because the effects on defaults of small changes in equity may differ depending on whether the level of equity is positive or negative, we used a pair of equity variables, EQPOS and EQNEG,[11] in our foreclosure regression.

We also included EQPOS and EQNEG in our prepayment regression. 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 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.

In addition to EQPOS and EQNEG, we included another variable related to equity, initial loan-to-value (LTV) ratio, in our regressions. One minus LTV measures a borrower's initial equity, so we anticipate that if LTV is an important predictor in an equation that also includes a variable measuring current equity, it will 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 rate of change for the price of each borrower's house. Another reason for including LTV and expecting it to have a positive sign in our foreclosure equation is that it may capture the effects of income constraints. We are unable to include borrowers' incomes or payment-to-income ratios directly because data on borrowers' incomes are

[9]For example, if the value of a property is $100,000 and the value of the mortgage is $80,000, then equity is 20 percent, or 0.2.

[10]The estimated rate of appreciation in nominal median house prices, obtained from DRI, was revised downward by 2 percent per year to account for depreciation and the gradual improvement in the quality of the existing housing stock over time.

[11]Essentially, EQPOS takes the value of equity if equity is positive, and EQNEG takes the value of equity if equity is negative. We selected the value of –0.015 rather than 0 as the dividing line between positive and negative equity because, during the period covered by our sample, many guaranteed loans were made for amounts that slightly exceeded the value of the property, since financing fees were included in the loan amount. Specifically, EQPOS took as its value the maximum of the value of equity as defined above or –0.015. EQNEG took as its value the minimum of these two values.

not available.[12] 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.

We included the age of the borrower in both foreclosure and prepayment regressions. We anticipated that younger borrowers would be more likely to default because they have higher rates of unemployment and lower savings, and we anticipated that they would be more likely to prepay because they are more geographically mobile. We used two variables, AGE and AGE40, to capture the effect of increasing age and to allow for the fact that the effect of increasing age is likely to be less for borrowers above age 40.[13,14]

We also included in our regressions the natural logarithm of the price of the house, LOGPRICE, to allow for the possibility that borrowers purchasing higher-priced houses would have different foreclosure or prepayment experience, although the expected direction of the effect was unclear.[15] For example, the purchasers of higher-priced houses might have higher and more stable incomes and higher asset levels, which might make foreclosure less likely. However, they might have taken on higher payment-to-income ratios to purchase these higher-priced houses, which might make foreclosure more likely.

We used the annual unemployment rates for each of the nine Census divisions for the period from 1971 through 1990 to describe the state of the economy in the region where a loan was made. We anticipated that foreclosures would be higher in years and regions with higher unemployment rates and that prepayments would be lower because property sales slow during recessions. The actual variable we used in our regressions, LAGUNEMP, is defined as the natural logarithm of the preceding year's unemployment rate in the region.

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

[13] Specifically, AGE is defined as the natural logarithm of the borrower's age if the borrower is 40 or younger in a given year, and as the natural logarithm of 40 if the borrower is older than 40. AGE40 is defined as 0 for borrowers 40 or younger in a given year, and as the natural logarithm of the borrower's age minus the natural logarithm of 40 for borrowers older than 40.

[14] The age variables are based on the initial borrower's age. Some VA loans are assumed by other borrowers, and we were not able to account for differences in the borrowers' ages.

[15]We measure price at the time a loan is made and express it in 1990 dollars.

We included the natural logarithm of the interest rate on the mortgage, LOGINT, as an explanatory variable in the foreclosure equation. Because a higher interest rate causes a higher monthly payment, we expected a higher probability of foreclosure. However, in explaining the likelihood of prepayment, our model measures the difference between current mortgage rates and 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. To capture the relative attractiveness of prepaying, we compared the interest rate on each loan with the interest rate on 30-year fixed-rate mortgages available in the current year.

In our prepayment regression, we used two relative interest rate variables, RELINTH and RELINTL, so that the effect of changes in relative interest rates could be different over different ranges. We constructed RELINTH to take on only nonnegative interest rate values and RELINTL to take on only nonpositive interest rate values. If the loan's interest rate is greater than current mortgage rates, then RELINTH is the difference between the loan's interest rate and current rate, and RELINTL is 0. In contrast, if the loan's interest rate is lower than current mortgage rates, then RELINTH is 0 and RELINTL is the difference between the loan's interest rate and the current rate.[16]

We created a 0-1 variable, REFIN, that took on a value of 1 if the borrower had not taken advantage of a refinancing opportunity in the past, and 0 otherwise, and we included this variable in our foreclosure and prepayment regressions. 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[17] below the rate on the mortgage. Several reasons might explain why borrowers had passed up apparently profitable refinancing opportunities. For example, if they had been unemployed or were experiencing financial difficulties, they might have had difficulty obtaining refinancing. This reason suggested that REFIN 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

[16]For example, if a loan was made at an interest rate of 8 percent (0.08 in decimal form) and the current mortgage rate is 9 percent (0.09), the loan's interest rate is "low" relative to the prevailing mortgage rate. RELINTH is defined as the maximum of (0.08 - 0.09) or 0, and RELINTL is defined as the minimum of these values. In this case, RELINTH is 0 and RELINTL is –0.01.

[17]A basis point equals one one-hundredth of a percentage point.

suggested a negative relationship between REFIN 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 in order to avoid the transaction costs associated with refinancing. In this case, there might be a positive relationship with the probability of prepayment if the borrower fulfilled his/her anticipation and moved, thereby prepaying the loan.

We included a variable in the prepayment equation that measures the fee that VA charges borrowers for guaranteeing a loan (FEE). Because borrowers are less likely to refinance if they have to pay a higher fee to obtain a new mortgage, we anticipated that FEE would be negatively related to the probability of prepayment.

We created nine 0-1 variables to reflect the geographic distribution of VA loans and included them in both regressions. Locational differences may capture the effects of differences in borrowers' income, rates of appreciation in house prices, 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 Census divisions on the basis of the state in which the borrower resided. The Pacific Division was the omitted category, i.e., the regression coefficients show how each of the regions was different from the Pacific.

Finally, to capture the time pattern of foreclosures and prepayments (given the effects of equity and the other explanatory variables), we defined five variables on the basis of the number of years that had passed since the year of loan origination. We refer to these variables as YEAR1, YEAR2, YEAR3, YEAR4, and YEAR5 and set them equal to 1 if, respectively, the loan was less than 1 year, between 1 and 2 years, between 2 and 3 years, between 3 and 4 years, or between 4 and 5 years, old, and zero otherwise. Table II.1 summarizes the variables we used to predict foreclosures and prepayments.

Table II.1: Summary of Predictor Variables

Time variables	
YEAR1	1 if the first year of the loan's duration, else 0
YEAR2	1 if the second year of the loan's duration, else 0
YEAR3	1 if the third year of the loan's duration, else 0
YEAR4	1 if the fourth year of the loan's duration, else 0
YEAR5	1 if the fifth year of the loan's duration, else 0
Economic variables	
LAGUNEMP	The natural logarithm of the previous year's unemployment rate in the Census division
RELINTH	The difference between the interest rate of the loan and the current interest rate on 30-year fixed-rate mortgages if the interest rate of the loan is higher than current mortgage rates, else 0
RELINTL	The difference between the interest rate of the loan and the current interest rate on 30-year fixed-rate mortgages if the interest rate of the loan is lower than current mortgage rates, else 0
EQPOS	The value of 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 greater than –0.015, else –0.015
EQNEG	The value of 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 –0.015, else –0.015
Loan and borrower variables	
LOGINT	The natural logarithm of the interest rate on the mortgage
LOGPRICE	The natural logarithm of the price of the house (in 1990 dollars)
AGE	For borrowers not older than 40 in the current year, the natural logarithm of the age of the borrower, else equal to the natural logarithm of 40
AGE40	For borrowers older than 40 in the current year, the difference between the natural logarithm of the age of the borrower in the given year and the natural logarithm of 40, else 0
LTV	Initial loan-to-value ratio
REFIN	1 if in previous years mortgage interest rates had been at least 200 basis points lower than the loan's interest rate and the borrower had not refinanced, else 0
FEE	The fee charged by VA for mortgage guarantees in the year the loan was originated, expressed in percentage terms
Census division variables	
DV A	1 if the loan was in the Mid-Atlantic (N.Y., Pa., N.J.), else 0
DV E	1 if the loan was in the East South Central (Ky., Tenn., Ala., Miss.), else 0
DV G	1 if the loan was in the West North Central (Minn., Mo., Iowa, Neb., Kans., S.D., N.D.), else 0
DV M	1 if the loan was in the Mountain (Colo., Utah, Ariz., N.M., Nev., Idaho, Wyo., Mont.), else 0

(continued)

DV N	1 if the loan was in the New England (Mass., Conn., R.I., N.H., Maine, Vt.,) else 0
DV R	1 if the loan was in the East North Central (Ill., Mich., Ohio, Ind., Wis.), else 0
DV S	1 if the loan was in the South Atlantic (Fla., Ga., N.C., S.C., Va., Md., D.C., Del., W.Va.), else 0
DV W	1 if the loan was in the West South Central (Tex., Okla., La., Ark.), else 0

Estimation Results

As described above, we used logistic regressions to model loan foreclosures and prepayments as a function of a variety of predictor variables. For new loans, we used loans originated from 1971 through 1988 to model foreclosure and prepayment rates through 1990. For refinancing loans, we used loans originated from 1981 through 1988 because VA did not offer refinancing loans before fiscal year 1981. We weighted the regressions by the outstanding loan balance of the observation.

The logistic regressions estimated the probability of a loan's being prepaid or foreclosed in each year. The standard errors of the regressions are biased downward because the errors in the regression are not independent. The observations are on loan-years, and the error terms are correlated because the same underlying loan can appear several times (up to 20 times in the case of a currently active loan written in 1971). However, we did not view this downward bias as a problem because our purpose was to forecast the dependent variable, 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. Both of these effects are very strong.[18] As expected, the age of the borrower is negatively related to the probability of both foreclosure and prepayment, while the unemployment rate is positively related to the probability of foreclosure and negatively related to the probability of

[18]Table II.3 shows that EQNEG in the new loans regression has an unexpected sign. In an alternative specification, we substituted one equity variable for the pair of spline variables reported here; as expected, increases in equity were strongly associated with lower foreclosure probabilities. Equity takes on values of less than -0.015—the magnitude used to create the spline variables—in only about 7 percent of observations. Furthermore, negative equity is generally observed in the first 2 years of a loan's duration, and use of the YEAR1 and YEAR2 variables controls for this effect of duration.

prepayment.[19] Our results also indicate that the probability of foreclosure is higher when LTV and LOGINT are higher and when LOGPRICE is lower. Tables II.2 and II.3 present the estimated coefficients and standard errors for all of the predictor variables. The overall goodness of fit was satisfactory: Chi-Square statistics were significant on all regressions at the 0.01-percent level.

Table II.2: Prepayment Equations

	Coefficient estimates	
Predictor variable	**New loans**	**Refinancing loans**
INTERCEPT	-2.094	-7.216
	(0.026)	(0.019)
YEAR1	-3.844	-2.060
	(0.011)	(0.005)
YEAR2	-0.979	-0.642
	(0.003)	(0.003)
YEAR3	0.042	-0.269
	(0.002)	(0.002)
YEAR4	0.076	0.029
	(0.002)	(0.002)
YEAR5	0.153	[a]
	(0.002)	
AGE	-0.766	[a]
	(0.006)	
AGE40	-0.681	[a]
	(0.004)	
RELINTH	83.860	87.206
	(0.086)	(0.076)
RELINTL	44.236	35.600
	(0.056)	(0.108)
REFIN	-0.859	-1.175
	(0.003)	(0.002)
FEE	-0.963	-0.532
	(0.002)	(0.003)
LOGPRICE	0.172	0.312
	(0.002)	(0.002)

(continued)

[19]In the new loan foreclosure regression, however, the estimated effect of AGE40 was statistically insignificant; that is, for homeowners over 40, there was no association between an increase in age and a reduction in the probability of default. In the refinancing regressions, we did not include one or both of the AGE variables because of convergence problems. Also, the estimated effect of unemployment on new loan prepayments was statistically insignificant.

	Coefficient estimates	
Predictor variable	**New loans**	**Refinancing loans**
LAGUNEMP	-0.001	-0.376
	(0.003)	(0.004)
LTV	0.649	1.040
	(0.009)	(0.007)
EQPOS	3.032	1.876
	(0.006)	(0.006)
EQNEG	-0.363	1.334
	(0.016)	(0.017)
DV A	-0.872	-0.620
	(0.003)	(0.003)
DV E	-0.410	-0.158
	(0.003)	(0.003)
DV G	-0.167	-0.289
	(0.003)	(0.003)
DV M	-0.136	-0.263
	(0.002)	(0.002)
DV N	0.073	0.113
	(0.004)	(0.005)
DV R	-0.165	-0.019
	(0.002)	(0.002)
DV S	-0.297	-0.303
	(0.002)	(0.002)
DV W	-0.571	-0.121
	(0.002)	(0.003)
Summary statistics		
Concordant pairs	77.7%	80.7%
Tied pairs	1.3%	1.2%
Number of observations	181,590	115,503

Note: Standard errors are in parentheses.

[a]We were unable to include this variable in this equation because of convergence problems.

Table II.3: Foreclosure Equations

	Coefficient estimates	
Predictor variable	**New loans**	**Refinancing loans**
INTERCEPT	-0.548	9.021
	(0.075)	(0.068)
YEAR1	-5.711	-23.377
	(0.031)	(129.7)
YEAR2	-1.712	-2.516
	(0.006)	(0.007)
YEAR3	-0.577	-0.826
	(0.005)	(0.004)
YEAR4	-0.025	-0.195
	(0.004)	(0.004)
YEAR5	0.109	[a]
	(0.004)	
AGE	-1.224	-1.142
	(0.011)	(0.014)
AGE40	0.007	[a]
	(0.010)	
REFIN	0.494	0.218
	(0.004)	(0.004)
LOGINT	1.645	3.593
	(0.010)	(0.016)
LOGPRICE	-0.575	-0.217
	(0.004)	(0.004)
LAGUNEMP	0.537	0.926
	(0.006)	(0.009)
LTV	10.529	3.355
	(0.054)	(0.022)
EQPOS	-3.416	-1.850
	(0.010)	(0.013)
EQNEG	0.834	-0.284
	(0.024)	(0.028)
DV A	0.157	-0.197
	(0.007)	(0.009)
DV E	-0.308	-0.165
	(0.007)	(0.008)
DV G	0.262	0.345
	(0.006)	(0.007)
DV M	0.302	0.753

(continued)

Predictor variable	Coefficient estimates	
	New loans	Refinancing loans
	(0.005)	(0.005)
DV N	-21.410	-21.168
	(314.0)	(515.7)
DV R	0.290	0.050
	(0.004)	(0.006)
DV S	-0.288	-0.121
	(0.004)	(0.005)
DV W	0.147	0.698
	(0.005)	(0.006)
Summary statistics		
Concordant pairs	82.0%	83.6%
Tied pairs	4.8%	3.7%
Number of observations	181,590	115,503

Note: Standard errors are in parentheses.

[a]We were unable to include this variable in this equation because of convergence problems.

To test the validity of our model, we examined how well the model predicted the actual patterns of VA foreclosure and prepayment rates through 1990. Using a sample of 20 percent of our loans made between 1971 and 1988, we found that our predicted rates closely resembled actual rates.

To predict the probabilities of foreclosure and prepayment, 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 between a loan's origination and 1990. If our model predicted foreclosure or prepayment, we determined the loan's balance during that year to indicate the dollar amount associated with the foreclosure or prepayment.[20] We estimated cumulative foreclosure and prepayment rates by summing the predicted foreclosure and prepayment dollar amounts for all loans originated in each of the years 1971-88. We compared these predictions to the actual cumulative (through 1990) foreclosure and prepayment rates for the loans in our sample. Figure

[20]Specifically, we added the probabilities of prepayment and foreclosure. We then compared the sum of these probabilities to a random number generated from a uniform distribution, such that 10 percent of all loans with a 10-percent probability of terminating would terminate, 2 percent of all loans with a 2-percent probability of terminating would terminate, etc. Foreclosure or prepayment further depended on the relative probabilities of these two events.

II.1 compares predicted and actual cumulative foreclosure rates, and figure II.2 compares predicted and actual cumulative prepayment rates.

Figure II.1: Cumulative Foreclosure Rates by Book of Business Through 1990, Actual and Predicted

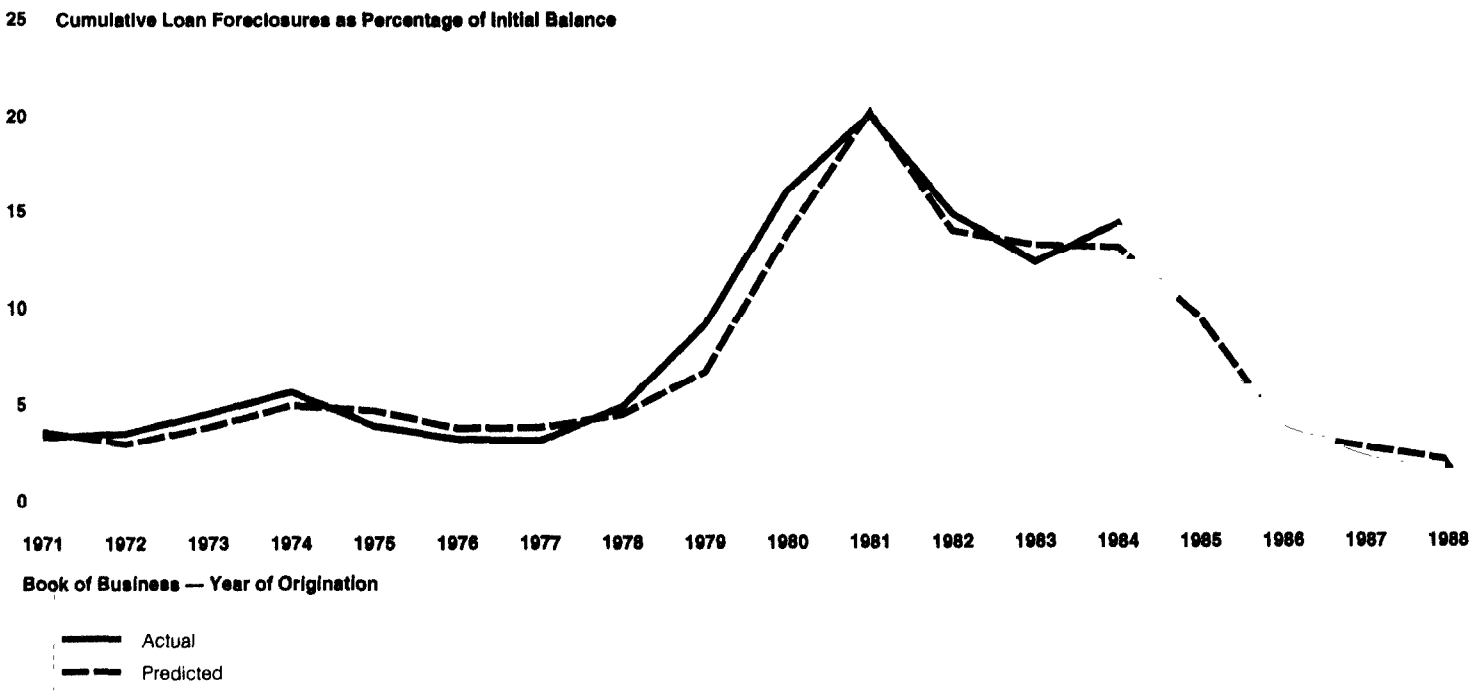
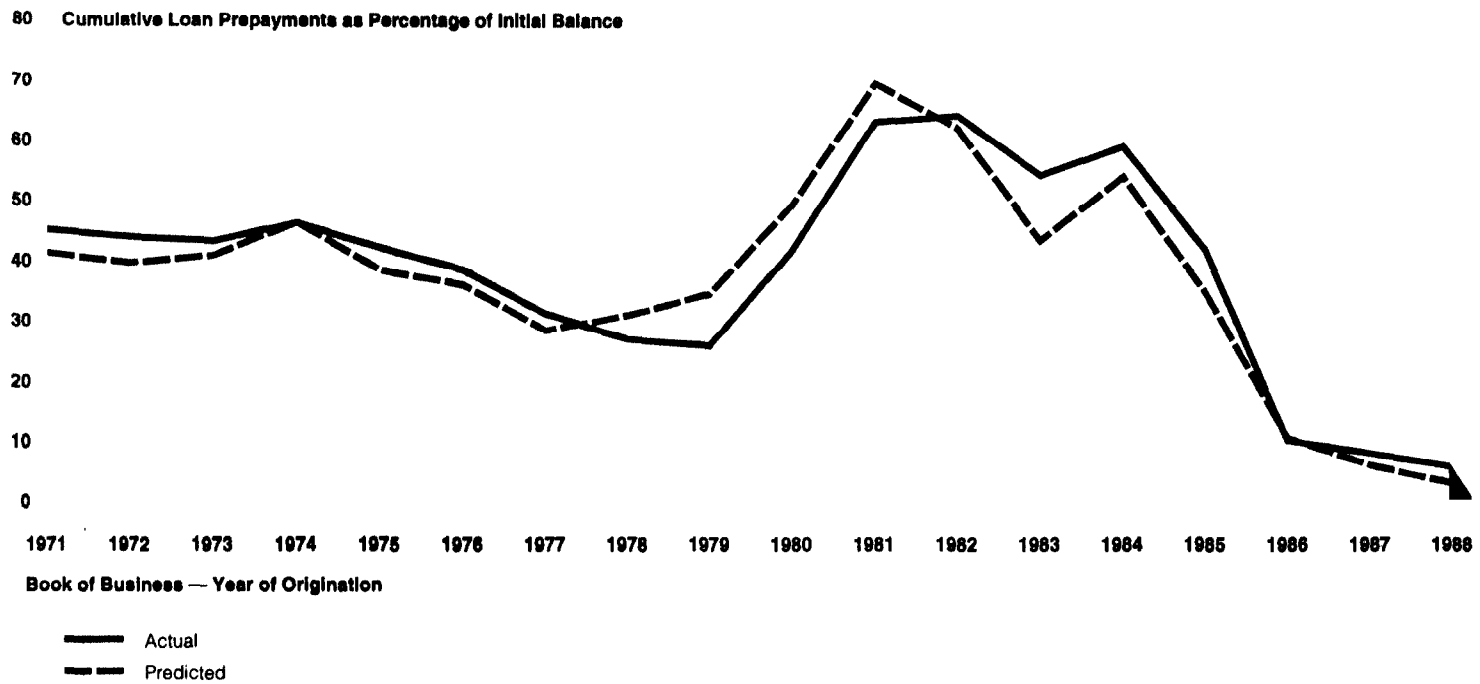


Figure II.2: Cumulative Prepayment Rates by Book of Business Through 1990, Actual and Predicted



Loan Volume Prediction

We also used regression analysis to forecast the dollar amount and number of VA guaranteed mortgage originations. This required predicting (1) VA's share of mortgage originations and (2) the likelihood that borrowers choosing to refinance would choose to refinance with VA.

VA's Share of Mortgage Originations

We used regression to predict VA's share of the market for mortgage originations on the basis of observations of VA's share of mortgages in the past and several predictor variables. For each state and Washington, D.C., and for each quarter from 1971 to 1990, we obtained an estimate of the number of mortgage originations from DRI and an estimate of the number of new VA mortgages from VA. This gave us 4,080 observations (51 jurisdictions times 80 quarters).

We predicted VA's share of originated mortgages in each state in each quarter as a function of several demographic and housing market factors.[21] A description of the predictor variables appears in table II.4, and the

[21]Data on VA mortgage originations, veteran populations, and changes in program limits and fees came from VA; other housing market data came from DRI.

results of our analysis appear in table II.5. The fraction of the population aged 18 to 44 with veteran status was a significant determinant of VA's share. The price of housing was also an important determinant of VA mortgage originations; VA's share rose in more expensive markets. VA's effective loan ceiling influenced loan volume in the most expensive states; increases in maximum loan size increased VA's market share. VA also had a larger share in booming housing markets, as evidenced by the coefficients on the variables that measured the percentage change in total (VA and non-VA) mortgage originations and the percentage change in a state's adult population relative to the percentage change for the nation. Increases in the popularity of adjustable rate mortgages (ARM) significantly reduced VA's market share. Interest rate ceilings had little influence on VA mortgage originations. The coefficient on VA fees was small and unexpectedly positive. This result may have occurred because we were unable to control for changes over time in fees for private mortgage insurance. The ratio of fees charged by VA to fees charged by private mortgage insurers would have been a more appropriate variable to include in our regression, but we found no consistent data series for private mortgage insurance fees.

Table II.4: Description of Predictor Variables, VA Loan Volume Equation

POST80	1 if year is 1981 or later, else 0
LOGWVP	The natural logarithm of the weighted veteran population share. The numerator of this share variable is the sum of the number of veterans aged 18-44, plus an estimated weight (WV45-64) times the number of veterans aged 45 - 64, plus an estimated weight (WV65) times the number of veterans aged 65 and over. The denominator of this variable is the sum of the total population aged 18-44, plus an estimated weight (WP45-64) times the population aged 45-64, plus an estimated weight (WP65) times the population aged 65 and over.
WV45-64	Weight variable, veteran population aged 45-64
WV65	Weight variable, veteran population aged 65 and over
WP45-64	Weight variable, total population aged 45-64
WP65	Weight variable, total population aged 65 and over
LOGPRICEL	The natural logarithm of the median real house price if the house price was less than $88,000 (approximately the median price in the sample), else the natural logarithm of $88,000
LOGPRICEH	The natural logarithm of the difference between the median real house price and $88,000 if the median house price was greater than $88,000, else 0
FEE	The fee charged by VA for mortgage guarantees in the year the loan was originated, expressed in percentage terms
ARM	The share of the non-VA mortgage market accounted for by ARMs, calculated at the national level
LOANCEILING	The natural logarithm of the ratio of the effective VA loan limit to the region's median house price if the ratio was less than 1.5, else the natural logarithm of 1.5
CHANGEPOP	The percentage change in a state's population aged 18 and over relative to the percentage change for the nation
RATECEILING	1 if the market mortgage rate, defined as the average 30-year fixed rate on new and existing home sales for the quarter, was more than 50 basis points above the VA ceiling, else 0
CHANGEVOL	The percentage change in mortgage originations in a state from 4 quarters ago
Census division variables	
DV A	1 if the loan was in the Mid-Atlantic, else 0
DV E	1 if the loan was in the East South Central, else 0
DV G	1 if the loan was in the West North Central, else 0
DV M	1 if the loan was in the Mountain, else 0
DV N	1 if the loan was in the New England, else 0
DV R	1 if the loan was in the East North Central, else 0
DV S	1 if the loan was in the South Atlantic, else 0
DV W	1 if the loan was in the West South Central, else 0

Table II.5: VA's Share of Mortgage Originations

Predictor variable	Coefficient
INTERCEPT	-5.785
	(1.439)
POST80	0.045
	(0.049)
LOGWVP	1.236
	(0.153)
LOGPRICEH	0.603
	(0.118)
LOGPRICEL	0.595
	(0.128)
WV45-64[a]	0.000
	(0.117)
WV65[a]	0.000
	(0.126)
WP45-64[a]	0.607
	(0.623)
WP65[a]	1.000
	(0.494)
FEE	0.134
	(0.055)
ARM	-0.225
	(0.084)
CHANGEPOP	4.088
	(1.296)
RATECEILING	0.001
	(0.025)
CHANGEVOL	0.239
	(0.044)
LOANCEILING	0.394
	(0.143)
DV A	-0.378
	(0.064)
DV E	0.133
	(0.055)
DV G	-0.230
	(0.048)
DV M	0.500
	(0.042)

(continued)

Predictor variable	Coefficient
DV N	-0.709
	(0.065)
DV R	-0.304
	(0.046)
DV S	0.290
	(0.034)
DV W	0.410
	(0.040)
Summary statistic	
Asymptotic R^2	0.843

Note: Standard errors are in parentheses.

[a]Coefficient constrained to fall between 0 and 1.

VA Refinancings

We ran a logistic regression with two explanatory variables to predict the fraction of prepaid mortgages that were refinanced with VA mortgages. One variable was the change in mortgage interest rates from the preceding year, and the other variable was VA's mortgage fee. The time period analyzed was from 1981 to 1990 because VA did not offer refinancing loans before fiscal year 1981.

Simulation Methodology

We estimated the subsidy costs of loans guaranteed in fiscal years 1992 and 1993 by estimating VA's fee income from the loans guaranteed in these years, subtracting the present value of the claim payments derived from our estimates of the number of foreclosures on loans made in these years, and adding the present value of the predicted recoveries from property sales.[22] These subsidy cost estimates are in accordance with the definition of the subsidy rate in the Credit Reform Act of 1990. To estimate fees collected by VA, we used our estimates of loan originations. To estimate claims paid and revenues from property sales, we used our predictions of future loan foreclosures. We expressed our subsidy estimates in two forms: millions of dollars, and cents per dollar of guaranteed loans.

We based the forecast of 1992 and 1993 loan originations on the regression results predicting loan volume, described above, including our estimates

[22]We used the discount rates used in VA's February 1993 budget proposal for fiscal year 1994 in our present value calculations. These rates were 7.41 percent for 1992 and 6.81 percent for 1993. Using a range of discount rates did not alter our basic results.

of refinancing activity and DRI's forecasts of the key economic and housing market variables and VA's and the Bureau of the Census's population projections.[23] For future loans, we assumed the same distributions for the borrower's age and for LTV as for loans made in 1990. We used data and forecasts of house price appreciation rates obtained from DRI to increase the price distribution of loans from the 1990 base. Because we assumed that an effective loan limit of $184,000 would hold throughout the forecast period, any loan that was projected to exceed $184,000 was held equal to $184,000.[24]

We then predicted the refinancing fraction of prepaid loans over the forecast period on the basis of DRI's forecast of mortgage interest rates. Both the prediction of prepayment activity and the predicted refinancing fraction determined our estimate of how many refinancing loans would be written each year. If foreclosure or prepayment was not predicted for a loan, we assumed that the borrower made normal periodic payments and the balance declined over the loan's amortization schedule. Active loans were combined with forecasts of loan originations in the calculation of foreclosure and prepayment probabilities in the next year.

To estimate fee income, we multiplied our forecasts of loan volume in 1992 and 1993 by VA fee schedules. For nonrefinancing loans, we determined loan volume by LTV category and multiplied by the appropriate fee: 1.25 percent for loans with LTV ratios above 95 percent, 0.75 percent for loans with LTV ratios between 90 and 95 percent, or 0.5 percent for loans with LTV ratios below 90 percent.[25] For refinancing loans, we multiplied 1992 loan volume by 1.25 percent and 1993 loan volume by 0.5 percent to reflect the fees associated with VA's streamlined interest rate reduction refinancing program begun in fiscal 1993.

[23]We used DRI's 10-year forecast of May 1992 as our primary source of forecasted information. Since DRI issued this forecast, mortgage and other long-term interest rates have dropped substantially. Interest rates are an important influence on borrowing, particularly on refinancing, and estimates of subsidy costs may be particularly sensitive to changes in mortgage rates. In light of the decrease in interest rates, our forecasts incorporated a forecast of mortgage rates that DRI made in February 1993.

[24]As described in app. I, the amount of VA's loan guaranty depends on the amount of the loan. For loans exceeding $144,000, VA currently guarantees the lesser of 25 percent of the loan amount or $46,000. Because $46,000 is 25 percent of $184,000, $184,000 becomes an effective loan limit when lenders accept the guaranty as a 25-percent down payment. We assumed that this guaranty schedule would continue.

[25]Loans to veterans with service-related disabilities do not require fee payments. Accordingly, we reduced our estimates of fee income using information from VA on the proportion of loans made to veterans with service-related disabilities. We also adjusted our estimates of 1993 fee income to reflect the higher fees charged to reservists.

To predict net claim payments in a given year, we multiplied an average net claim amount (based on VA information on net claim flows on foreclosed loans) by the number of predicted foreclosures in that year. Net claim flows are the difference between cash outflows—including property acquisition costs, claim payments, and property management and sales expenses—and cash inflows—including recoveries and proceeds from sales of foreclosed properties.[26]

Finally, we adjusted our forecasts of 1992 and 1993 subsidy costs on the basis of actual 1992 loan volume. Our forecasts had underestimated the number of nonrefinancing loans and overpredicted the number of refinancing loans as compared with VA's actual experience in 1992 (and VA's estimates of activities in 1993). We adjusted our estimates of 1992 fee income and net claim payments by scaling our estimates up or down accordingly.[27] We also used these same scaling factors to adjust our 1993 forecasts.[28]

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 of house price appreciation, we adjusted the forecasts of unemployment and price appreciation to provide a range of subsidy cost estimates under alternative economic scenarios. We also used alternative specifications of our prepayment and foreclosure regression models to provide alternative forecasts under our baseline economic scenario.

[26]We forecasted foreclosures for 20 years into the future for each of the 1992 and 1993 books of business. Although some foreclosures are likely to occur after the 20th year, we do not believe that this probability will significantly affect our subsidy cost estimates for two reasons. First, relatively few borrowers whose loans survive to year 20 default in the subsequent 10 years. Second, the present value associated with these defaults is small because the costs are deferred well into the future. For example, at the discount rate of 7.41 percent applicable to 1992 loans, the present value in 1992 of $1 in losses incurred in 2016 is only 18 cents.

[27]Because our model forecast foreclosure rates separately for refinancing and nonrefinancing loans, we were able to generate estimates of net claim payments for refinancing loans and nonrefinancing loans separately. Additionally, we forecast refinancing loan originations separately. We scaled down the fee income and net claim payments associated with refinancing loans by the ratio of actual refinancing loans to our estimate. We scaled up the fee income and net claim payments associated with nonrefinancing loans by the ratio of actual nonrefinancing loans to our estimate.

[28]This adjustment assumes that we overestimated the volume of refinancing loans in 1993 and underestimated the volume of nonrefinancing loans in 1993 by the same proportions that we overestimated or underestimated these volumes in 1992. As a practical matter, the 1993 adjustments resulted in a modest decrease in our subsidy cost estimate.

Alternative Economic Scenarios

Our baseline economic scenario assumes that nominal house prices (adjusted for quality changes and depreciation) increase by an average of 1 percent annually and that unemployment averages 5.8 percent over the forecast period. Our low-case economic scenario assumes that nominal constant-quality house prices remain constant and that the average unemployment rate is somewhat higher (6.8 percent) over the period. Our high-case economic scenario assumes that nominal constant-quality house prices increase by 3 percent annually and that the unemployment rate remains the same as in our baseline forecast.[29]

Table 1 presented the results of these alternative economic scenarios.

Alternative Model Specifications

We also estimated subsidy costs using an alternative specification of our foreclosure and prepayment regression models. In this alternative specification, we used a definition of equity based on book valuations, rather than on market valuations, of mortgage balances (for a definition of market equity, see the discussion in and preceding table II.1). Our development of this alternative specification was motivated in part by the importance of equity in explaining mortgage foreclosures and in part by OMB's use of book equity to estimate subsidy costs.[30]

Our forecast using this book equity alternative under our baseline economic scenario resulted in smaller subsidy cost estimates, as shown in table II.6. One effect of using an equity measure based on the "book" valuation of a loan balance is that, other things being equal, equity values will increase more rapidly than under a "market" valuation of the loan balance during years when prevailing market mortgage interest rates are lower than the mortgage rate existing at the time of loan origination. Our model uses a forecast of mortgage rates exhibiting this pattern initially for loans made in 1992. Since increases in equity are associated with

[29]For years through 1997, we based our estimates of nominal growth in median regional house prices on state-level nominal median house price forecasts made by DRI. Forecasted nominal median house price appreciation rates averaged approximately 5 percent nationally over this period. We used the DRI forecasts in our high-case scenario, and we subtracted 2 percent and 3 percent annually from these forecasts to obtain our estimates for these years in our baseline and low-case scenarios, respectively. For years beyond 1997, we used a constant rate of nominal median house price appreciation for each scenario: 5 percent for our high case, 3 percent for our baseline, and 2 percent for our low case. For each scenario, we then adjusted the estimated nominal appreciation rate in house prices downward by 2 percent annually to account for housing quality changes and depreciation. Thus, for example, a 1-percent annual change in the constant-quality house price is equivalent to a 3-percent annual change in the median house price.

[30]Although OMB used a different modeling approach than we did, equity measures are important in both approaches.

decreases in the probability of foreclosure, smaller subsidy cost estimates result.

Table II.6: Alternative Subsidy Cost Estimates for VA Mortgages

	Subsidy rate (in cents per dollar guaranteed)		Estimated subsidy (in millions of dollars)	
	Fiscal year		Fiscal year	
Alternative	**1992**	**1993**	**1992**	**1993**
Market equity[a]	1.84	1.02	$451	$273
Book equity[b]	1.63	0.95	401	248
Administration[b]	2.26	2.19	557	473

[a]This is our baseline scenario found in table 1.

[b]Source: VA's fiscal year 1994 budget submission.

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