POLICY DEVELOPMENT & RESEARCH

Refinancing Premium, National Loan Limit, and Long-Term Care Premium Waiver for FHA's HECM Program

ECONOMIC RESEARCH

U.S. Department of Housing and Urban Development

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Final Report

Prepared for:

U.S. Department of Housing and Urban Development
Office of Policy Development And Research

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May 2003

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Executive Summary

The Home Equity Conversion Mortgage Program (HECM) run by the Federal Housing Administration (FHA) provides income to senior homeowners based on the equity in their home. This program allows elderly homeowners who are "house rich" but "income poor" to live in their own home as long as possible. HECM is a form of reverse mortgage in which the homeowner receives payments from the lender. Before a loan is initiated, an appraisal determines the value of the property. The maximum claim amount is the lesser of the local area loan limit and the appraised value. In order to stay within the maximum claim amount, a lower principal limit is set which governs the amount that the homeowner can borrow. There are five different payment plans which are combinations of term (fixed payment over set term), line of credit or tenure (annuity). The principal limit is set according to the payment plan, age of borrower and current interest rate so that the outstanding balance is not projected to exceed the maximum claim amount. The accumulated balance of the loan is paid when the borrower dies or voluntarily leaves her home and it is sold. Lenders are paid by an origination fee, monthly servicing fee and an adjustable interest rate on the loan. FHA collects an upfront premium of 2 percent of the property value and an annual premium of 0.5 percent of the current balance. FHA insures the loan against lender default as a way of facilitating the reverse mortgage market.

In 2000, HUD completed an evaluation of the HECM Program entitled, "No Place Like Home: A Report to Congress on FHA's Home Equity Conversion Mortgage Program," hereafter known as the 2000 HECM Report. The current study was mandated by Congress in Section 201(a), (c) and (d) of the American Homeownership and Economic Opportunity Act of 2000 (Pub.L. 106-569, 12/27/2000). This report updates the actuarial analysis presented in the 2000 HECM Report and examines the potential impact of three legislated changes to FHA's Home Equity Conversion Mortgage Program:

- Replace local loan limits with a single, national loan limit,
- Reduce the premium for refinancing, and
- Waive the upfront premium for HECMs used exclusively for the payment of long-term care insurance policies.

The first two changes are analyzed using a simulation model whereas the third change is analyzed by considering the intersection of HECM borrowers and Long-Term Care insurance participants.

Actuarial Analysis Update

Chapter 2 presents an updated actuarial analysis using the complete set of 52,000 HECM loans originated from FY1990-FY2000 (including 14,000 new originations since the 2000 HECM Report). Over the entire history of the program, there have been 15,300 terminations with 1,200 claims up to the cutoff date of August 2001. Transactions data from August 1999 to August 2001 was used to estimate average advances, premiums and balances. Borrowers with term or tenure payment plans get scheduled payments, i.e. the amount and timing of the advance is fixed according to the schedule of the plan. Borrowers with line of credit payment plans simply request an unscheduled payment. The average advance for all loans in the first policy year is $22,580 unscheduled and $6,082 scheduled with $2,512 in upfront mortgage insurance premium and a total outstanding balance of $33,829. By the fourth policy year, the annual advances are much smaller ($1,827 unscheduled and $3,985 scheduled).

The most important change in the actuarial model since the 2000 HECM Report is the incorporation of a principal limit factor lookup table. The principal limit is the maximum that a borrower can draw in advances. It automatically increases as the borrower ages. The beginning principal limit factor depends on the age of the borrower and the current interest rate (1-year Treasury plus margin). This factor is multiplied by the maximum claim amount to determine the maximum amount of the initial advance. The maximum claim amount is the lesser of the appraised value of the property or the FHA local loan limit. It remains constant for the life of the loan. The principal limit factor lookup table was needed for the refinance analysis to assess the starting principal limit of a refinance given changes in the interest rate and age of borrower. It also led to the discovery that about 5 percent of the principal limits recorded in the data are too high relative to the property appraisal value. It is not possible to tell whether these inconsistencies were recording errors or underwriting mistakes. It could be that some appraisal values were recorded too low. To restore internal consistency, we lowered those principal limits and this reduced the incidence and size of future claims.

Another important change made to the simulation model is the determination of available principal limit at the beginning of the period before updating either the principal limit or outstanding loan balance. Previously, the principal limit was updated before the available principal limit was determined. Additional advances were not allowed if those advances and the interest, premiums and service fees for the year would exceed the principal limit calculated for the end of the year. Under the revised model, the available principal limit is calculated at the beginning of the year using the end of the previous year's values for principal limit and outstanding balances. If the available principal limit is positive, advances are allowed regardless of the predicted level of principal limit or balance for the end of the year. The impact of this technical change is to increase the ultimate outstanding balances and utilization rates (outstanding balance relative to principal limit). As a result, the new projections for fund net liability tend to be less negative.

After revising the model and updating the information on existing HECM loans, the net expected liability is -$54 million or -$1,039 per loan. In other words, the program is expected to *contribute* $54 million to FHA's General Insurance Fund. This is substantially better than -$17 million reported for the 2000 model. About $20 million of the difference is due to the correction of the principal limits recorded on previous cohorts, but that is essentially offset by the change in calculating the available principal limit. The remaining difference is due to the new cohort of originations for an additional year of low claims and reserve growth.

This fund value is quite sensitive to assumptions about the average interest rate and house price appreciation rate. On one hand, a mere 1 percentage point increase in the assumed interest rates changes the $54 million cushion into a $111 million loss. On the other hand, it is quite possible that the interest rates will be lower than the 7.8 percent we assumed in order to be consistent with the

2000 model. The current yield on the 10-year Treasury is 3.63 percent. Adding the observed average margin of 1.4 percent results in a projected interest rate closer to 5.0 percent. This means that the value of the fund might be closer to $200 million dollars. We leave it up to the reader to make a preferred assumption about future interest rates.

Given the sensitivity to future interest rate increases, a stochastic version of the actuarial model is presented in Chapter 3. This alternative model allows interest rates and house prices to vary over time according to stochastic patterns similar to past movements. The long run average of the stochastic movements is the same as the long run average interest rates and house prices from the past. However any single path has short run movements that mimic the volatility and correlation between historical interest rates and house prices. Terminations, claims and refinancing have some sensitivity to the volatility in rates and house prices. The probability that any single path correctly predicts the future is very low, but the average over many paths should give a more accurate representation of what to expect. Two other innovations incorporated into the stochastic model are a statistical model of terminations (rather than a multiple of mortality rates) and an adjustment to mortality rates to account for the expected gradual improvements in health care. The stochastic version of the actuarial model predicts a net present value for the fund of $245 million, relative to the non-stochastic projection of $54 million. This very large estimate of fund value by the stochastic model corresponds to a low average interest rate of 5.5 percent.

National Loan Limit Analysis

About 30 percent of the HECM borrowers have home appraisal values greater than the FHA local loan limit and thus would have benefited from a higher, single national loan limit. The experiment described in Chapter 4 is to see how much the net liability in the fund would change if a national loan limit had been in place when the existing HECM loans originated. Two national loan limits were tested, 87 percent and 100 percent of the conforming loan limit in each year from 1990. While the change varies widely by county and origination year, the average increase in the loan limit is $24,411 for the 87 percent option and $32,097 for the 100 percent option. The increases are much bigger for low cost areas where the local limit is far below even 87 percent of the conforming loan limit. There is also a greater benefit for the early cohorts, which were originated when maximum loan limits were even more constrained than in recent years.

The simulation model increases the maximum claim amount up to the lesser of the appraisal value or the national loan limit. Principal limits and premiums were increased in direct proportion to the change in the maximum claim amount. The higher loan limits mean the appraised value would become the limit for the maximum claim amount in all but the highest cost cities so there is less over-collateralization or cushion between the maximum claim amount and the house value than had existed before for most loans in the program. Claims increase by more than premiums (i.e. liability rises) so the net expected liability changes from -$54 million to -$37 million for the 87 percent loan limits and to -$11 million for the100 percent loan limits.

Results from the stochastic simulation model give a net expected liability of -$245 million under FHA loan limits. Allowing national loan limits decreases the net liability slightly to -$249 million for the 87 percent loan limits and to -$252 million for the 100 percent loan limits. The small effect of the national loan limits in the stochastic model reflects the prediction of low average interest rates (5.5 percent) and, to a lesser extent, higher average house price appreciation rate (3.5 percent). The increase in premiums and house prices is enough to more than offset the increase in claims.

These estimates assume there is no change in the demand for HECMs. In fact, many moderate income borrowers may have decided against HECM financing because their home equity was far greater than their maximum claim amount constrained by the low loan limits. A conservative 5 percent increase in demand (based on demographic data from the 1999 American Housing Survey) would increase the net liability somewhat. However, these changes are dwarfed by the sensitivity to interest rate assumptions.

Reduced Premium Refinance Analysis

The terms of the HECM loan are set at origination assuming average interest rates, average house price appreciation rates and no change in the loan limits. Over the longer run, these assumptions may turn out to be too conservative but the high transactions costs limit borrowers from refinancing. These constraints on future refinancing may inhibit originations as borrowers want to maintain access to the added equity if house values increase more than expected. Likewise unexpected house price appreciation may promote terminations as borrowers seek more flexible financing vehicles. By charging refinancers a smaller upfront premium (2 percent on the increase in the maximum claim amount rather than 2 percent on the full maximum claim amount), FHA may be able to retain borrowers with substantial equity increases. Chapter 4 estimates how many borrowers would take advantage of this benefit and how much it would affect the value of the insurance fund.

Three program options were tested (ranked from most flexible to least flexible from the borrowers point of view):

A) Permit all loan information to change (house prices, loan limits, interest rates, age);
B) Leave house price fixed at original appraisal, but allow loan limits, interest rates and age to change;
C) Leave house price and loan limit fixed, but allow interest rates and age to change.

Two timing options were simulated: A) refinance only in the year after rule implementation; or B) refinance anytime after the new rule takes effect.

Three participation rates were tested (assuming at least $5000 gain in the principal limit to cover transaction costs):

A) Low – 10% of low gainers and 20% of high gainers
B) Medium – 20% of low gainers and 40% of high gainers
C) High – 30% of low gainers and 60% of high gainers

The gain is measured in terms of the available principal, meaning the outstanding balance and service fee set aside are subtracted from the principal limit to determine how much more principal would be available under a refinance compared to retaining the existing loan. Altogether there are 18 combinations (3 program options by 2 timing options by 3 participation rates).

The key finding from the non-stochastic model is that even with the most flexible option and high assumed participation, the incremental effect of refinancing on net liability is less than $33 million. This is mainly because borrowers who choose to refinance are also borrowers with strong house price growth. Assuming a strong house price appreciation does not get reversed (i.e. price bubbles are rare), the appreciation makes a claim less likely, with or without a refinance. A second important finding is that the projected refinance activity is projected to be moderate (13 percent or less) because the reduced premium is a relatively small incentive. To generate large refinancing activity under the assumption of constant rates requires a historically rare combination of low interest rates and high house price appreciation rates. Of the 18 combinations, the highest participation was 4,837 or 13 percent of the 37,230 loans active in the forecast period. We think the medium level of participation is more likely, which would lower the number of refinances to 3,662 or 10 percent of active loans. For that combination (Option A with medium participation), the premiums increased by $4 million while the claims increased by $33 million. Therefore, the net liability of the fund increased by $29 million from -$54 million for the base model to -$25.5 million for the base model with refinancing.

The stochastic model provided a much more realistic approach to sensitivity testing by allowing interest rates and house prices to fluctuate following historically-accurate transition probabilities. It appears from the stochastic model results that the low refinancing rate in the non-stochastic model was largely due to the assumption of constant interest rates and house prices. The more realistic stochastic model has mean number of refinances equal to 16,591 or 45 percent of active loans. Also, claims are likely to increase much more than premiums under reduced premium refinancing. Allowing the most flexible refinancing (Option A) and assuming medium participation, the net expected liability would change from -$245 million to -$130 million or approximately 47 percent. In line with this large shift in the distribution, the percentage of trials with positive liabilities increases from 3 percent to 12 percent.

Chapter 6 combines the national loan limit change with the reduced premium refinancing and finds that the net results depend on the level and degree of fluctuation assumed for interest rates. Under the assumption that interest rates are relatively high (7.8 percent), as in the non-stochastic model, the 100 percent loan limit has a larger impact on fund value than the reduced premium refinancing. The net liability of the fund is $54 million in the base model. The 100 percent loan limit increases net liability by $43 million and the refinancing further increases net liability by $30 million to a positive net liability of $21 million. If the goal were to maintain a fund value with negative net liabilities, the fund could sustain either national loan limits or reduced premium refinancing, but not both.

The stochastic model assumes historical fluctuations with interest rates starting where they were in 2001. This approach generates an average interest rate of 5.6 percent and house price growth of 3.5 percent. In that environment, the 100 percent loan limit slightly lowers net liability from -$245 million to -$252 million. However, the refinancing has a very large impact increasing claims threefold and increasing net liabilities to -$113 million. See Exhibit 6-6. The small effect of higher loan limits is completely overwhelmed by the $139 million increase in liabilities associated with refinancing. The same pattern occurs with 87 percent loan limits. The higher loan limits decrease liabilities by $3.9 million, but the refinancing increases liabilities by $132 million leaving a net liability of $117 million. The combination of higher loan limits and refinancing not only shifts the liability distribution to the right, it widens the distribution with standard deviations from $119 million to about $123 million. In either the 87 or 100 percent models, about 16 percent of the trials have positive liabilities compared to 3 percent in the base model without refinancing. If these macroeconomic assumptions are correct, the fund could sustain both higher loan limits and reduced premium refinancing, though the risk of loss is certainly higher.

Exhibit 6-6
Comparison of Stochastic Models

	Reserve	PV Claims	PV Premiums	Net Liability
	(in $ millions)			
Base Model	176.8	61.8	129.9	-244.9
100% National Loan Limit	190.9	77.0	138.3	-252.3
Option A Refinance	176.8	205.7	158.6	-129.8
Combination Option A Refinance And 100% National Loan Limit	190.9	246.2	168.6	-113.4

Long-Term Care Insurance

Section 201(c) of the American Homeownership and Economic Opportunity Act of 2000 authorized that the 2 percent upfront premium be waived for HECM borrowers who use their advances exclusively for payment of long-term care insurance (LTCi) policies. The object of this provision is to encourage more seniors to buy long-term insurance policies, which cover medical bills and assisted living costs while people are coping with a long-term medical condition. By having the long-term insurance, seniors faced with a long illness are better able to pay their expenses and remain in their home. The requirement that HECM advances be used exclusively for payment of LTCi premiums better ensures that LTCi policyholders maintain their coverage as long as they live. LTCi premiums can be quite expensive, ranging from $250 per year for 65 year olds with basic coverage to over $2500 per year for 75 year olds with premium coverage. The owner dedicates her home equity to the long-term care insurance, but that insurance could protect the owner’s other assets, which would have to be sold to cover the expenses during a long illness.

There are some disadvantages from this policy, particularly for owners with few assets beyond the equity in their house. For low-income seniors health care expense is paid by Medicaid. The qualification rules for 2000 are a monthly income less than $532 and assets (excluding house and cars) of less than $2000. Most current HECM borrowers have little income and few assets beyond their house so they qualify for Medicaid coverage. The main selling point for LTCi is that it protects a person’s wealth from the large expenses of long-term care. But for most HECM borrowers their wealth is in their house, which is already protected by Medicaid rules. LTCi could reduce the burden of long-term care expenses on Medicaid and the states providing Medicaid funding. In this case, the HECM premium waiver would provide a modest subsidy to encourage seniors to pay for LTCi out of their own home equity rather than let Medicaid pay for it. Few low-wealth seniors would choose to tie up their primary source of wealth in order to spare Medicaid an uncertain, future expense.

Another disadvantage of this policy is that FHA would lose the revenue from the upfront premium. Without the typical 2 percent upfront MIP of $2,500, the net liability of -$1,039 per loan becomes a loss of $1,461 per loan. In other words, FHA loses over $1 million for every 1000 participants in the LTCi version of HECM.

A more hopeful perspective is that wealthier homeowners would be attracted to the HECM program and their cumulative LTCi premiums would rarely exceed their house value. Owners with substantial non-house wealth would not be eligible for Medicaid support and thus could benefit from the protection of LTCi. Also, these wealthier owners would not need to draw on their home equity to cover living expenses so the equity can be dedicated to paying the long-term care insurance premiums. However, the restriction that HECM proceeds be exclusively used to pay LTCi premiums makes this program unattractive to homeowners with substantial home equity. The inflexibility of the program discourages owners who expect their home equity to exceed the expected value of future premiums. The program might appeal most to middle income homeowners with little home equity yet substantial non-house wealth that they want to shield. This is a small household segment and we project the demand for a HECM premium waiver under the LTCi option to be extremely low.

Chapter One
Introduction

The Home Equity Conversion Mortgage Program (HECM) run by the Federal Housing Administration (FHA) provides income to senior homeowners based on the equity in their home. This program allows elderly homeowners who are “house rich” but “income poor” to live in their own home as long as possible. HECM is a form of reverse mortgage in which the homeowner receives payments from the lender. Before a loan is initiated, an appraisal determines the value of the property. The maximum claim amount is the lesser of the local area loan limit and the appraised value. In order to stay within the maximum claim amount, a lower principal limit is set which governs the amount that the homeowner can borrow. There are five different payment plans, which are combinations of term (fixed payment over set term), line of credit or tenure (annuity). The principal limit is set according to the payment plan, age of borrower and current interest rate so that the outstanding balance is not projected to exceed the maximum claim amount. The accumulated balance of the loan is paid when the borrower dies or voluntarily leaves her home and it is sold. Lenders are paid by an origination fee, monthly servicing fee and an adjustable interest rate on the loan. FHA collects an upfront premium of 2 percent of the property value and an annual premium of 0.5 percent of the current balance. FHA insures the loan against both lender loss (loan balance exceeds sale proceeds) and lender default (i.e. the lender failing to make required payments to the borrower) as a way of facilitating the reverse mortgage market.

In 2000, HUD completed an evaluation of the HECM Program entitled, “No Place Like Home: A Report to Congress on FHA’s Home Equity Conversion Mortgage Program,” hereafter known as the 2000 HECM Report. The current study was mandated by Congress in Section 201(a), (c) and (d) of the American Homeownership and Economic Opportunity Act of 2000 (Pub.L. 106-569, 12/27/2000). This report updates the actuarial analysis presented in the 2000 HECM Report and examines the potential impact of three legislated changes to FHA’s Home Equity Conversion Mortgage Program:

- Replace local loan limits with a single, national loan limit,
- Reduce the premium for refinancing, and
- Waive the upfront premium for HECMs used exclusively for the payment of long-term care insurance policies.

Several options have been considered for the first two changes. For example, two national loan limits are tested, one at 87 percent and another at 100 percent of the conforming loan limit. Many possibilities are considered for reduced-premium refinancing according to the gain in principal limit and the likely demand generated by those gains. However, in each case the upfront premium at refinancing is only charged on the increase in maximum claim amount.

The third change, waiving the upfront premium for HECMs used for long-term care (LTC) financing, presents a new application for HECMs. A major consideration is the level of demand for this type of HECM when the advances are restricted to the single purpose of paying LTC insurance premiums.

The organization of this report is as follows. In Chapter 1, we provide a brief background on reverse mortgages and the HECM Program. Another part of the basic groundwork is a discussion of the data limitations and assumptions used in the analysis. In Chapter 2, we present the actuarial model used in the subsequent analysis of the national loan limit and reduced-premium refinancing. The simulation model is an extension the actuarial model presented in *No Place Like Home* (HUD, 2000). To distinguish the two models, the current model is called the 2001 model and its predecessor is referred to as the 2000 model from the 2000 report. The stochastic model is a further extension of the 2001 model allowing interest rates and house prices to fluctuate with historically-accurate volatility. The national loan limit analysis is presented in Chapter 3 and the reduced premium refinance analysis is in Chapter 4. Given that both of these changes may be implemented, Chapter 5 considers various combinations of national loan limits and refinancing.

HECMs devoted to long-term care financing are considered in Chapter 6. We focus on the demand for these HECMs by comparing the types of people who have purchased LTC insurance policies with the people who have HECMs. We also consider ways in which these new HECMs could generate claims on the fund. Given the restrictions and limited projected demand for HECMs used for LTC financing, the chapter closes with some suggestions designed to broaden the appeal of these HECMs.

To motivate this work, we begin with a brief background on reverse mortgages and, particularly, HECMs. This is followed by a description of the underlying assumptions that color the subsequent analysis.

Background on Reverse Mortgages and HECMs

The purpose of FHA's Home Equity Conversion Mortgage is to provide elderly homeowners with a financial mechanism for turning the equity in their homes into cash without having to leave their home. Seniors often find themselves in a situation with low monthly income and occasional large bills. Most of their wealth is tied up in their home. The HECM Program, like other reverse mortgages, allows owners to convert their home-based wealth into a line of credit or a steady stream of monthly payments. Unlike other reverse mortgage programs, the HECM loan is fully insured by FHA. If the lender fails to provide payments to the homeowner, FHA will take over that responsibility. After the owner and spouse die or move out of the home, FHA ensures that the sale value of the home will cover the total loan amount. If the sale price is less than accumulated payments plus interest, FHA pays the difference to the lender. In short, FHA has tried to facilitate the reverse mortgage market by eliminating the risk for both homeowner and lender.

Despite these efforts by FHA and other reverse mortgage lenders, the market for reverse mortgages has not grown as quickly as projected. In a report entitled "The Reverse Mortgage as an Instrument for Lifetime Financial Planning: An Analysis of Market Potential," David Rasmussen and others projected a potential demand of 13.5 million households by 2000.[1] This compares with an actual demand for reverse mortgages under 100,000. The large gap between potential and actual demand suggests that elderly homeowners have serious reservations about tapping their home equity via reverse mortgages.

This contract addresses several issues that may be inhibiting the reverse mortgage market in general and the HECM market in particular. One issue affecting HECM demand is loan limits. The HECM loan limits are the same as the local loan limits from FHA's forward mortgage program. The principal limit (or present value of payments that a homeowner is allowed to borrow) is the lesser of the appraised house value or the local FHA loan limit. The purpose for having loan limits that vary from one market to the next is that average house values vary considerably across markets. The same house in Springfield, Illinois costs far less than in Boston, Massachusetts. Recognizing these large differences in house prices, FHA sets higher loan limits in high cost areas than in low cost areas, so that the loan limit is approximately the same relative to the local median house value. Higher loan limits may be important for opening the HECM market in general, because homeowners may be discouraged from participating in the program if they cannot tap all of the equity in their house. A single, national loan limit would benefit low cost areas relatively more than high cost areas because a bigger share of the low-cost market would fit within the single limit. Chapter 3 presents the results for setting a national loan limit at either 87 percent or 100 percent, and we present our plan for analyzing those options below.

A second issue limiting demand is the high cost of refinancing HECMs. Currently, there is no reduction in the substantial costs of closing and upfront premiums for a refinanced mortgage. *No Place Like Home* (p. 40) reports the typical costs in 1999 for a median HECM borrower with a maximum claim amount of $105,000 to be $1,800 in origination fee, $2,100 in mortgage insurance premium and $1,500 in closing costs, or a total of $5,400. In some states (Maryland and South Dakota), the average closing cost alone was above $5,000. Even though these costs can be financed, homeowners are reluctant to incur that debt the first time, let alone a second time.

The motivation for refinancing may not seem obvious, given that nearly all HECM loans have adjustable interest rates. However, the size of the principal limit depends on four factors that can change significantly over time: the adjusted property value, loan limits, the interest rate and the age of the borrower. The adjusted property value is the lesser of the appraised property value and the local FHA loan limit. Loan limits periodically change, and property values are constantly changing. If either one increases substantially over time, this could translate into an increase in the amount that a homeowner could borrow under a refinanced loan. In our Seattle focus group, some participants pointed out that their property taxes were rising dramatically with house values. This means, of course, that the owner's equity was rising with the appreciation of house values. But the principal limit did not increase. Under the current HECM program, the only way for the homeowner to tap this additional equity is to refinance at a considerable transaction cost. Several options have been proposed for allowing reduced-premium refinancing that would reduce this transaction cost. We analyze each of those options and present the simulation model results in Chapter 4.

1 Fannie Mae Foundation, 1996.

The third issue inhibiting demand is homeowner concern about abusive lending practices. Elderly people are vulnerable to fast-talking financial advisors who accentuate benefits while hiding excessive fees. Elderly homeowners with a sizable potential line of credit are particularly vulnerable. There have been enough reports of abusive lending associated with reverse mortgages that FHA is anxious to find ways to protect borrowers from these scams. As long as elderly homeowners (and their children) link reverse mortgages with high fees and hidden costs, the market potential for HECMs will remain unrealized.

The proposal, to waive the upfront premium for borrowers who use their HECM loans exclusively to pay for long-term care health insurance policies, presents a whole new way to boost demand for HECMs. Long-term care is a major expense for any household and the government shoulders much of that expense for moderate-income seniors. A policy that encourages households to prepare for those health expenses could reduce the burden on Medicaid. HECMs are designed to allow elderly households to remain living in their own homes. Health expenses and health problems often force seniors to leave their home. Long-Term Care insurance is designed to help seniors stay in their own home and protect their non-housing assets while coping with a long illness. In this case, the proposal is to use HECM advances to pay the premiums for LTC insurance. The existing HECM Program certainly allows advances to be used for this purpose. In fact, a tenure payment plan could be set up to ensure that scheduled advances pay the LTC premiums as long as the borrower lives in her home. To promote this use of HECMs, the proposal reduces the cost by waiving the upfront premiums paid for the HECM. In return, the borrower must commit the HECM advances exclusively for the LTC financing. This constraint on the use of HECM advances is likely to significantly limit the demand for this type of HECM. This analysis is presented in Chapter 6.

Assumptions and Limitations of the Model

The limitations, particularly of the data, lead to assumptions being made. Therefore, we start by considering the data limitations. The main source of data is the IACS (Insurance Accounting Collections System) data. One extract has historical summary information on all HECM originations and a second extract contains all transactions from August 1999 to August 2001. A separate file on claims information supplements the IACS data. Information on payment plans is limited to the most recent plan, although borrowers can change plans as often as they want. More problematic is that the reason for termination is available for only about half of the terminations. There is essentially no information on sale value of homes following termination. We assume that properties appreciate at the state average rate, but in fact we have no way to verify whether that is realistic. This is important because the model estimates the size and frequency of claims by comparing the outstanding balance to the imputed house value. If elderly female homeowners with limited income and assets do not maintain their houses to an average standard, the actual claim amounts could be systematically larger than projected.

At the modeling level, the simulation model used for this report does not have a demand component. This is not important for a winddown analysis which projects the final outcomes for existing cohorts. However, there could be demand effects from the proposed changes that are missed by this strategy. For example, some potential HECM borrowers may have decided against the program either because the loan limits were too low or because the refinancing opportunities too costly. The full effect of the proposed changes includes both the responses by existing HECM holders and new HECM participants. We assume that the net effect of the new demand will be positive for the fund (increased premiums outweigh any increase in claims), but no effort has been made to verify that assumption.

Another model limitation is that terminations are assumed to follow the simple rule of 1.3 times the mortality rate. The 2000 report did some analysis on this assumption and found it to be reasonably close overall. The current model assumes that the termination rule is still valid and would remain so under the proposed changes. A regression-based termination model would allow interest rates and house prices to affect terminations. Given that elderly want to stay in their home as long as their health permits, it seems reasonable to assume interest rates and house prices only have a second order effect on the decision to terminate the HECM. However, elderly homeowners are motivated to leave a bequest to their children so the macroeconomic factors may play a significant role in their decision when to move from their home. Termination models could be estimated and incorporated into the existing simulation model fairly easily.

A more challenging enhancement would be to allow interest rates and house prices to fluctuate in a stochastic simulation model. The non-stochastic results presented in this report assume that interest rates and house prices maintain an average level over the long run. Sensitivity tests are run to see if the final results are sensitive to the particular long run estimate chosen, but it is still assumed that the rates do not fluctuate in a way that would substantially increase claims. This assumption may be particularly important for the refinancing results. Suppose properties with high rates of appreciation tend to refinance near a cyclical peak and terminate near a cyclical trough. This allows those borrowers to increase their outstanding balance beyond the value of their house. As long as refinancers are selected from properties with strong house price appreciation, there is little danger of increased claims. But if the house price appreciation is short-lived, then the additional claims in a housing market recession could far outweigh the increased premiums collected. The solution is to extend the simulation to accommodate stochastic interest rates and house prices. Moreover, to determine the probability of the most damaging situations, the simulation model has to run through hundreds of iterations as in a Monte Carlo framework. The current simulation model has been redesigned to allow stochastic simulation, but more research is needed to test and perfect that capability.

Actuarial Analysis

This chapter repeats the 1995 and 2000 analysis, estimating the health of the HECM insurance fund. This "baseline" analysis is the foundation for later chapters, which model the various program changes outlined in the research design.

The current model is based on the actuarial model developed in Chapter 7 of HUD's 2000 evaluation report to Congress ("2000 HECM Report").[2] We first revisit the details of how the model works, then discuss what is different from the 2000 HECM Report model. Then we report the results of the new actuarial model, which still show a positive net present value of the current book of business, and compare these findings to previous results. We subject the results to sensitivity tests of various interest rate and house price growth assumptions. A logical extension of the sensitivity analysis is to allow interest rates and house prices to fluctuate rather than remain fixed at some long-run average. The stochastic model does just that by allowing interest rates and house prices to vary using parameters derived from historical estimates of volatility. Another innovation of the stochastic model is a regression-based termination model in place of 1.3 times the mortality rate of the owner. Mortality rates still play a role as one of the independent variables in the termination model, and it is assumed that mortality rates gradually decrease over the long run due to future improvements in health care.

How the Non-Stochastic Model Works

The first goal of the actuarial analysis is to use the existing book of HECM loans to determine if the present value of paid-in and future premiums will adequately cover the value of historical and expected claims. Because of uncertain future conditions, factors such as future interest and termination rates must be assumed prior to analysis.

Data

Three primary sources of data used in the HECM 2000 report, updated with the most recent loan originations, form the foundation for this current analysis. Cumulative transaction history comes from the August 2001 extract of an additional 14,000 HECM loans (added to the 2000 Report) collected by the Insurance Accounting Collections System (IACS) for a total universe of 52,000 loans. We use loan level information for all HECM loans originated since the start of the program (HUD FY90) through FY00. The IACS system contains incomplete claims information so claims were once again updated by HUD's manual claims processing system.[3] As of the end of August 2001, there were over 15,300 terminations of which 1,200 resulted in claims. HUD also maintains the Computerized Housing Underwriting Management System (CHUMS) database that contains

[2] HUD, *No Place Like Home: A Report to Congress on FHA's Home Equity Conversion Mortgage Program*, (U.S. Department of Housing and Urban Development, Washington D.C: May 2000).

[3] Once again, we would like to thank Nettie James in HUD for providing us with the most current claims information necessary for this evaluation.

important applicant background information. The primary use of this data in the HECM 2000 report was to replace missing or extreme age, interest rate, and origination date variables in the IACS data. Due to missing variables in the updated CHUMS 2001 database and tabulations indicating greater reliability in recent loan originations, we proceeded with this analysis using the FY99 CHUMS extract.[4]

Model Details

The actuarial model has two components:

- The first component involves the calculation of **the present value of the net mortgage insurance reserve** generated from all loans up to the cutoff date, which is defined as the present value of cumulative mortgage insurance premiums collected less claims already paid.

- The second component of the model consists of, for all the active loans as of the cutoff date, calibrating the **present values of future mortgage insurance premiums and future expected claim losses**.

Under the assumption that there are no new loans in the future, the model assesses whether the current reserve plus the future premiums will adequately cover future claims. Insurance claim losses are expected to occur in the event that the borrower's total outstanding loan balance exceeds the appreciated value of his/her property at the time the loan is due and payable. However, the exact timing of a loan becoming due and payable is unknown and is difficult to estimate in a deterministic framework.

The actuarial model adopts the approach of calibrating future claim losses and the time at which each loan will become due and payable (i.e. terminated) in a probabilistic framework.[5] Specifically, the model assumes the following:

- For each loan, there is a *due/payable probability* (positively related to the borrower's age) and a *loan survival probability* (negatively related to the loan duration and due/payable probability) associated with each of the projected policy years.

- Since the exact timing of a loan becoming due/payable is uncertain, so is the occurrence of a claim (and the claim losses associated with it). Instead, the model calculates, for each loan, hypothetical claim loss amounts from all policy years where the outstanding balance exceeds the projected value of the house. These policy-year-specific claim loss amounts are defined as the projected loan balance less the projected property value.

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4 Extreme or missing age, expected interest rate, and closing date variables in the newer 1999, 2000, and 2001 data was less than 0.5% of records.

5 As the HECM volume grows and more claims and paid-off loans are observed in the future, a refinement to the actuarial model will be to estimate claim, pay-off and prepayment probabilities from a loan-level hazard model. Then the actuarial model could assign claim, due and payable, and voluntary pay-off probabilities to each loan based on borrower and loan characteristics.

During policy years that the outstanding loan balance is less than house value, claim losses are set to zero.

- For each loan, the stream of potential claim losses associated with future policy years are weighted by the probabilities of due/payable (termination) and loan survival in the corresponding year. This gives the expected value of future claims.

- For each loan, projection of claim losses and other financial variables (for example, future premiums) will be done for every future policy year until the borrower reaches 110 years old. As the borrower gets older, the due/payable probability will rise and the loan survival probability will decrease so that the associated claim losses and premium amounts will be discounted accordingly.

Under this framework, the risk of potential claim losses can increase due to one or more of the following circumstances:

- The borrower remains in the house for longer than expected at the time of loan origination. The outstanding loan balance, which consists of interest charges and cumulative payments, can exceed the appraised value of the property as the loan seasons.

- Borrowers start off their loan balance at a higher level with large unscheduled payments in the early policy years. By design, a borrower with the line of credit payment plan can withdraw any portion of the loan's available principal limit at any time after the funding date. Premiums and other automatic charges will thus compound early and grow the outstanding balance. As the loan matures, the outstanding balance can exceed the projected property value.

- House values do not increase as expected over the life of the loan.

- Interest rates rise above expectations.

Therefore, assumptions about parameters and financial variables in the actuarial model will have significant impact on determining the amounts of future claim losses. Specifically, these parameters may include loan due/payable probability, payment patterns, premiums, interest charges, and property value appreciation rate. The assumptions and computation formulas of these key variables are explained in detail in the latter part of this chapter.

Present Value of Net Mortgage Insurance Reserve

After loan closing, every HECM borrower is required to pay an upfront (initial) premium of 2 percent of the maximum claim amount (adjusted property value) and a monthly mortgage insurance premium (MIP) according to the annual rate of 0.5 percent of the loan's outstanding balance. These two together generate a mortgage insurance *reserve* for the Department that can be used to compensate the FHA insurance fund for future claims as well as the ones that have already been filed. The *net reserve* is calculated by subtracting claim amounts from the corresponding year's MIP payment when the claims are disbursed. In addition, HUD can earn interest on these streams of net reserve. The first step in assessing the soundness of the overall HECM premium structure involves calculating the current value of this net reserve.

The current value (at cutoff date) of net reserve is computed as follows:

$$Reserve = \sum_{t=1}^{k} (Premium_t - Claim_t) \times (1+i)^{n-t}$$

where $Premium_t$ is the total amount of MIP paid from all loans during year *t*, $Claim_t$ is the total amount of claim disbursements during year *t*, *i* is the 10-year Treasury rate of that year, *k* is the loan duration (in years), and *n* is the total number of years between loan closing and the cutoff date. In the computation, MIP payments will be stopped once the loan is paid off or a claim disbursement amount has been paid for that loan.

This computation requires claim disbursement information as well as past MIP payment history of all loans. For claims history, we obtained all the loan-level disbursement amounts paid by HUD from the program's start until the cutoff date. This claims information was recorded in a manual system by HUD.[6]

A complete MIP transaction history was not extracted from the IACS system due to expenses, so the timing of MIP payments had to be estimated. Borrowers who chose the tenure and term payment plans receive fixed and scheduled monthly payments from the program according to a payment allocation formula. It is possible to recreate the entire MIP payment history of those loans. However, most of the HECM borrowers are in the line of credit (LOC) payment plan. The lumpiness and unscheduled nature of their payment patterns prevent us from recreating each loan's MIP payment history using a formula. Therefore, our actuarial model adopted the approach of estimating annual MIP payment patterns from the cross-sectional information of different HECM entry cohorts observed at the cutoff date. For consistency, this approach was used to model the MIP payment patterns of loans in each payment plan (including the tenure and term payment plans). The IACS system reports cumulative MIP balances paid up to the cutoff time for each loan, regardless of whether the loan is active or already terminated. Loan duration of those loans since closing spans from one month to 11 years. The data thus allow us to relate a typical loan's MIP payment amount to its loan duration, using the multiple regression approach. Specifically, to allow differentiation by payment plans, we estimated the following regression equation separately for loans belonging to each of the five payment plans:

$$Y = a + bX$$

where *Y* is the natural logarithm of the loan's cumulative MIP balance (excluding upfront premiums) at cutoff time, *X* is the natural logarithm of the corresponding loan duration in years, *a* and *b* are regression coefficients. The natural logarithm specification was introduced to account for a potential non-linear relationship between cumulative MIP amount and loan duration. Using the regression equations, for each payment plan, a smooth average cumulative MIP payment amount can be

[6] We thank Nettie K. James in HUD for providing us with the HECM claims information file necessary for this evaluation.

generated for each loan duration year. The last step in this calculation is to take the difference in the estimated cumulative MIP balance between each policy year.

Exhibit 2-1
Average Estimates of Annual Mortgage Insurance Premium Payment Patterns

	Payment Plan				
Policy Year	**Term**	**Line of Credit**	**Tenure**	**Term/LOC**	**Tenure/LOC**
1	$105	$174	$103	$115	$106
2	$155	$199	$142	$167	$148
3	$181	$210	$161	$194	$169
4	$201	$218	$176	$214	$184
5	$217	$223	$187	$230	$197
6	$231	$228	$197	$244	$207
7	$243	$232	$205	$256	$216
8	$253	$235	$213	$267	$225
9	$263	$238	$220	$277	$232
10	$272	$241	$226	$286	$239
11	$281	$244	$232	$294	$245

Data Source: IACS, through August 2001

Similar to the 2000 Report, line-of-credit borrowers have higher mortgage insurance payments in each policy year on average, followed by the term and tenure combinations. This difference is most notable in the initial year as line-of-credit borrowers tend to withdraw larger sums and will begin with higher balances. Compared to the 2000 Report, the MIP payments in the first several policy years in each payment plan are also slightly higher as expected, given that house appreciation and inflation will cause at least a nominal change in initial premium calculations.

Present Value of Future Premiums and Future Claim Losses
The second component of the actuarial model involves calculating the present values of *projected* premiums and claim losses for all loans as of August, 2001.

This projection required calculating the following key variables over the life of each loan:

- Principal available to borrower
  – Current principal limit
  – Less total loan balance to date
  – Less service fee set-aside
- Cash payments to borrowers
- Premiums
- Interest charges
- Outstanding loan balance
- Property values
- Expected claim

– size of hypothetical claim
– probability of termination

- Present value of expected claims
- Present value of mortgage insurance premiums
- Net expected insurance liability

In each year, the model first calculated the principal available to the borrower. This was used to calculate the cash payment to the borrower for that year. Premiums and interest charges on the outstanding balance were then calculated, and summed to calculate the new outstanding loan balance. This outstanding loan balance was compared to the projected property value: if the loan balance exceeded the property value, then the size of the hypothetical claim was calculated. This amount was multiplied by the probability of termination to find the probabilistic expected claim. Finally, the expected claim and insurance premiums were discounted and summed to come up with the present value of the net expected insurance liability.

Current Principal Limit

The IACS system reports the original principal limit at loan origination, which is determined by the (youngest) borrower's age, expected interest rate, and adjusted property value. The original principal limit is a calculated fraction of the maximum claim amount (which is the house's value subject to loan limits). This fraction varies with borrower age and interest rates, and allows for some of the maximum claim amount to be borrowed, and leaves the rest of the house's value to cover accumulated interest and insurance charges. The principal limit is increased each month according to the following formula:

$$\text{Principal Limit}_k = \text{Principal Limit}_0 \times (1 + i)^{k\text{-}1}$$

where i is the monthly compounding rate defined as one twelfth of the sum of the expected interest rate and annual mortgage insurance premium rate (i.e. 0.5 percent), and k is the number of months since loan origination. For loans originated after 1997, the principal limit is increased at a variable rate i*:* the 1-year treasury plus margin plus MIP.

The purpose of this rule is to allow the principal limit to remain at constant present value starting from the time when the loan was originated. The program increases the entire principal limit, irrespective of how much principal has already been drawn.

Service Fee Set-Aside

This is the amount that is set aside from the accrued principal limit to cover future monthly service fees, and is computed as the present value of the stream of service fees over the remaining maximum duration of the loan:

$$\text{Service Fee Set - Aside} = \frac{S * \left[(1+i)^m - 1\right]}{i * (1+i)^{m-1}}$$

where S is the monthly service fee, i is the monthly compounding rate as mentioned above, and m is the number of months that the loan's service fee is expected to be collected over the remaining duration of the loan[7]:

$$m = 12 \times \left[100 - \min\left(\text{Borrower's Age at Origination}, 95\right) - k + 1\right].$$

If the loan's service fee charges are included in the interest rate and thereby paid as a percentage of the outstanding loan balance, then the monthly service fee S and set-aside can be zero in this computation. For all other loans, service fee set-aside decreases as the loan duration (in months) k increases, reaching zero when the borrower is 100 years old. For each subsequent year, the value is set to zero.

Cash Payments to Borrowers

For **tenure plan borrowers,** payment formulas can be used to calculate future monthly payment amounts, given the amount of charges and advances reported at the cutoff date:

$$\text{Monthly Payment} = \text{Available Principal Limit} \times \frac{(1+i)^{m} \times i}{(1+i)^{m+1} - (1+i)}$$

where m and i are defined as above.

For borrowers with the **term payment plan,** the model assumes they continue to receive the monthly term payment reported in the IACS system as agreed. When the term is reached and if there is still available principal left, the model assumes the borrower will switch to the LOC plan and continues to accumulate advances and automatic charges on the outstanding loan balance as mentioned above. Payments will be stopped once the outstanding balance exceeds the accrued principal limit. But automatic charges will keep accumulating regardless.

For borrowers with the **line-of-credit and hybrid payment plans,** there is no algebraic formula for calculating monthly payment. Borrowers can withdraw unscheduled payments from the loan's available principal limit at their discretion, as long as the outstanding balance has not exceeded the accrued principal limit amount. It is, however, reasonable to approximate the future advance patterns by using the average payment patterns observed in the IACS system. Specifically, we were able to get a complete loan-level transaction history for the existing book of business for the 24 months preceding the cutoff date, namely August 1999 to July 2001. Some of the currently active loans were as old as 10 years, while other loans had been endorsed right before the data extract. This means that there was a sufficient variety of entry cohorts in the data that we could associate the average payment patterns to the loan policy year.

Exhibits 2-2 through 2-4 report the average advances and fees by policy year, for the line of credit and hybrid loan types. In the model, the total annual advances were normalized by expressing it as a

[7] When HUD designed the HECM program, borrowers of the tenure payment plan were assumed to live until they are 100 years old. Given that most people do not live to 100 years old, this fixed annuity is conservative compared to a life contingent annuity. The Department chose the fixed annuity assumption to keep the tenure and line of credit payment plans approximately equivalent.

utilization rate – that is, advances plus fees were expressed as a percent of the corresponding year's available principal limit. For every year after ten, we set utilization at 33 percent – i.e. borrowers drew a third of their remaining principal in each of these years.

Exhibit 2-2
Average Advances and Fees by Policy Year, Line of Credit (LOC) Loans

Policy Year	Number of Loans	Scheduled Advances	Unscheduled Advances	Interest	Upfront MIP	Annual MIP	Service Fee	Total Fees and Advances
1	1,224	$3,995	$13,827	$1,362	$2,925	$96	$269	$22,474
2	739	$4,832	$2,973	$2,305		$164	$342	$10,616
3	675	$4,238	$1,368	$2,473		$176	$345	$8,600
4	622	$3,815	$1,243	$2,950		$209	$328	$8,544
5	372	$4,044	$582	$3,163		$235	$311	$8,334
6	337	$3,956	$849	$3,694		$274	$309	$9,082
7	230	$4,213	$910	$4,466		$332	$311	$10,233
8	128	$3,149	$445	$4,424		$328	$298	$8,645
9	42	$3,508	$1,154	$4,785		$352	$285	$10,084
10	19	$3,049	$0	$5,182		$388	$268	$8,887

Data source: IACS data, August 1999 to July 2001.

Exhibit 2-3
Average Advances and Fees by Policy Year, Term and Term/LOC Loans

Policy Year	Number of Loans	Scheduled Advances	Unscheduled Advances	Interest	Upfront MIP	Annual MIP	Service Fee	Total Fees and Advances
1	912	$8,853	$13,286	$1,745	$2,487	$123	$278	$26,772
2	664	$7,735	$2,459	$2,860		$202	$346	$13,603
3	647	$5,664	$1,825	$2,843		$203	$337	$10,872
4	759	$4,171	$1,225	$3,250		$231	$338	$9,216
5	484	$3,725	$1,053	$3,605		$268	$308	$8,958
6	537	$3,554	$1,225	$4,082		$302	$303	$9,466
7	403	$3,657	$709	$4,919		$366	$304	$9,956
8	250	$3,259	$431	$4,714		$350	$295	$9,050
9	91	$3,069	$596	$5,280		$389	$285	$9,620
10	49	$2,394	$492	$4,761		$342	$281	$8,271

Data source: IACS data, August 1999 to July 2001.

Exhibit 2-4
Average Advances and Fees by Policy Year, Tenure and Tenure/LOC Loans

Policy Year	Number of Loans	Scheduled Advances	Unscheduled Advances	Interest	Upfront MIP	Annual MIP	Service Fee	Total Fees and Advances
1	7748	$6,521	$24,648	$2,418	$2,449	$170	$274	$36,479
2	5264	$3,549	$4,154	$3,652		$260	$350	$11,966
3	3754	$4,753	$2,220	$3,347		$239	$346	$10,905
4	3030	$2,861	$2,008	$3,727		$265	$335	$9,196
5	1780	$3,250	$1,674	$3,787		$280	$315	$9,306
6	1611	$2,857	$1,717	$3,894		$288	$308	$9,065
7	1075	$1,985	$1,508	$4,765		$353	$302	$8,913
8	585	$1,112	$1,540	$4,352		$322	$297	$7,624
9	172	$1,086	$2,022	$4,642		$344	$277	$8,371
10	81	$106	$2,293	$4,495		$332	$278	$7,505

Data source: IACS data, August 1999 to July 2001.

Regardless of policy year, the projected amount is the sum of automatic charges (interest, MIP, and service fees) and unscheduled advances. However for each policy year of each loan, the model also calculated the automatic charges separately. If the projected amount was smaller than the calculated automatic charges, the model assumed the outstanding balance would increase by the automatic charges amount for that year. In addition, consistent with regulations stated in the HECM handbook, the model stopped payments once the outstanding balance reached the loan's accrued principal limit amount. However, automatic charges kept accruing on the outstanding balance.

Premiums

Insurance premium charges in the HECM program include two components – upfront (initial) premiums and monthly mortgage insurance premiums (MIP). The upfront premium, which is equal to 2 percent of the maximum claim amount, is collected once at loan origination. The total value of these is already accounted for in the calculation of the mortgage insurance reserve above. The monthly MIP is charged at the annual rate of 0.5 percent of the loan's outstanding balance for the life of the loan.

Interest Charges

Interest is charged and added to the outstanding loan balance according to the previous period's outstanding loan balance on a daily basis. Lenders set interest rates at the 1-year U.S. Treasury Securities rate, plus a margin. Future interest rate levels are unknown, but it is conservative to assume they may stay at a relatively high level in the actuarial model (since the use of a lower interest rate will decrease the risk of expected claim losses). Therefore, to be consistent with the 2000 report, the actuarial model assumes each loan will accrue interest charges according to the median value of the *expected average mortgage interest rate*, 7.8 percent, observed for existing HECM loans. This rate is 8.11 percent annually when adjusted for daily compounding. The projected interest rate is assumed to remain constant throughout the life of each loan.

Outstanding Loan Balances

The IACS system reports the outstanding balance of each loan at cutoff time. In each subsequent year of the analysis, the outstanding loan balance is estimated as the previous period's loan balance plus the projected amount of cash payments to borrowers, annual total of monthly mortgage insurance premiums, annual total of service fees, and interest charges accrued during that year. While partial repayments by borrowers during the life of the loan do occur, they do not appear to happen frequently. It is thus reasonable to assume in the actuarial model that there is no partial prepayment before the loan is due and payable (i.e. terminated).

Property Values

Projected house values are another important component of the actuarial model. As mentioned above, the trajectory of future house values will determine the occurrence and magnitude of expected claim losses. The IACS system only reports the appraised property values at loan origination, and updated housing price information is not available. Our actuarial model makes use of information provided by the OFHEO house price index and adjusts the original appraised values forward into the future in two steps:

- First, we assume the appreciation rate of HECM properties followed the quarterly OFHEO state repeat-sale House Price Indexes from loan origination to cutoff time (i.e. July, 2001). For properties located in areas outside of the 50 states (for example, Puerto Rico), the Index for the US as a whole was used.

- Then, for each subsequent year beyond the cutoff date, HECM properties are projected to appreciate at a constant annual growth rate of 3 percent. This adjustment can be computed according to the following formula:

$$P_t = P_c \times (1.03)^n$$

where P_t is the projected property value at policy year t, P_c is the property value at cutoff time, and n is the number of years since cutoff.

Expected Claim Loss

The claim loss of a loan is the amount by which the total outstanding loan balance exceeds the current property value at the time the loan becomes due and payable. Since the exact date that a loan becomes due and payable is uncertain, as mentioned above, we used a probabilistic approach in the calculation. The actuarial model computes the expected claim loss associated with each projected policy year. This is defined as the excess of the projected outstanding loan balance over the projected property value in each policy year multiplied by the probability that the loan will become due and payable (i.e. terminated) during that year:

$$\text{Expected Claim}_t = (\text{Outstanding Balance}_t - \text{Property Value}_t) \times \text{Prob. of Due/Payable}_t$$

where t is the subscript for policy year. For loans and projected policy years when the property value is greater than the outstanding balance, expected claim losses are set to zero.

Present Value of Expected Claim Loss

Finally, for each loan, the present value of the expected claim loss in each projected policy year can be calculated according to the following discounting formula:

$$\text{P.V. of Expected Claim}_t = \frac{\text{Expected Claim}_t \times \text{Prob. of Loan Survival}_t}{(1+i)^n}$$

where i is the daily compounding-adjusted median value of the expected interest rate (i.e. 8.11 percent) of all the HECM loans from origination to cutoff, n is the number of years since cutoff, and t is the subscript for policy year.

Finally, the cumulative present value of expected claims is calculated as the sum of all the present values of expected claims over all the projected policy years for all loans:

$$\text{P.V. of Total Expected Claim} = \sum \text{P.V. of Expected Claim}_{t,\, k}$$

where t is the subscript for policy year and k is the loan subscript.

Present Value of Projected Mortgage Insurance Premiums

The streams of projected mortgage insurance premiums (MIP) collected in each policy year are discounted according to the following formula:

$$\text{P.V. of Projected MIP}_t = \frac{\text{Projected MIP}_t \times \text{Prob. of Loan Survival}_t}{(1+i)^n}$$

where i is median value of expected interest rate (i.e. 8.11 percent), n is the number of years since cutoff, and t is the subscript for policy year.

And then the cumulative present value of projected MIP is calculated as the sum of all the present values of projected MIP over all the projected policy years for all loans:

$$\text{P.V. of Total Projected MIP} = \sum \text{P.V. of Projected MIP}_{t,\, k}$$

where t is the subscript for policy year and k is loan subscript.

Net Expected Insurance Liability

The final step in assessing the adequacy of MIPs collected in the HECM program involves comparing the present value of expected claims with the present value of projected MIPs, taking into account the current value of the mortgage insurance reserve. The cumulative present value of premiums plus the reserve is subtracted from the cumulative present value of claims, to give the net present value of expected insurance liability.

In other words, the net expected insurance liability is calculated as:

$$\text{Net Expected Liability} = \text{P.V. of Total Expected Claims} - (\text{Reserve} + \text{P.V. of Total Projected MIP})$$

Differences Relative to the 2000 Model

While we made several refinements to the 2000 model, our goal was to preserve the theoretical framework. Adjustments were primarily made to improve the quality of the data and to adhere more accurately to the new research design. The main changes are as follows:

Programming Changes

- Incorporated the Principal Limit Factor Look-Up table allowing the model to re-calculate and adjust for data errors in the Principal Limit variable.
- Adjusted small coding errors in 2000 Report.
- Adjust calculation of available principal limit to beginning-of-year values and allow payments during the year even if those payments added to interest and fees on last year's balance would exceed the principal limit for the end of the year.

Data Updates

- Analysis using the updated 2001 IACS extract with data on 52,000 loans including over 36,500 active loans and over 15,000 terminations.[8]
- Estimated future payment utilization rates with monthly transaction data during August 1999-August 2001.[9]
- Updated the mortgage insurance premium payment patterns with the new IACS 2001data.

The first change repairs a data error. Both the 2000 and 2001 data we received contained a major error in about 5 percent of records. For these records, the reported principal limit was suspiciously high, approximately equal to the property value. This is obviously incorrect since HECM loans are designed to allow for only a percentage of the property value to be borrowed, with the rest of the property value covering interest on the loan. The effect of this data error was to inflate the projected claims. Any loan that mistakenly reported a principal limit equal to the property value would likely result in a claim, since there would be no property value left to cover interest charges.

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8 The 2000 report uses IACS data through November 1999.

9 The 2000 report uses monthly transaction data from November 1998 to October 1999.

We discovered and corrected this data error in the 2001 model. By incorporating the principal limit factor lookup table,[10] we were able to correct this problem in the 2001 data.[11] Given the age and an expected interest rate, the table "looks-up" the corresponding principal limit factor. The principal limit factor is multiplied by the maximum claim amount to determine the original principal limit.

Second, there were two minor programming errors we fixed for the 2001 Report. One change occurs in calculating line-of-credit withdrawal projections. First, the 2000 model had a small bug that had line of credit borrowers drawing 30 percent of their available principal in years 10+, instead of 33 percent. Second, the 2000 model specified that the net reserve grows at a rate pegged to the 1-year T-Bill, not the 10-year rate, thus undercalculating the size of the reserve by approximately 4 percent.

The third change has to do with the order of updates for the annual calculations. The previous approach was to treat the year as a single point in time and calculate the available principal limit after updating the principal limit but before updating the outstanding balance. The program would only allow additional payments if the interest and fees from the existing balance plus the new payments would not exceed the new principal limit. A major disadvantage of this approach is that the available principal limit could be positive and growing each year, but no payments made, because the interest charges used up nearly all of the gain in principal limit.

The new approach is more liberal with payments and more conservative with its overall estimate of net liability. Under the new approach, the available principal limit is calculated at the beginning of the annual pass before either the principal limit or outstanding balance has been updated. If the available principal limit is positive, then payments are made to the owner even if the sum of those payments, interest, premiums and servicing fees would exceed the principal limit for the end of the year. In effect, the payments are allowed in that year but the balance exceeding the principal limit at the end of that year ensures there is zero available principal limit for the next year and beyond. The model is more generous to the owner with payments and, thus, more conservative in its estimate of the fund's net liability.

The fourth, fifth and sixth major changes are a result of updated data. The analysis for this report uses the IACS 2001 extract with information on 52,000 loans divided between over 36,500 active loans, 14,000 terminated loans without claim and 1,200 claims. The new data allowed us to update the estimates of the annual mortgage insurance premium payments used in the reserve calculations. Tables estimating advances and charges were also updated using a new extract from the IACS system during the 12 months between August 1999 to July 2000. Updated estimates seemed to follow our expectation of changes among the payment plans but certain differences among the 2000 estimations will be compared later in the model summary.

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[10] *Home Equity Conversion Mortgage (HECM) Program Windows V1.0: Factors for Determining Borrower's Principal Limits* (FHA: 2001).

[11] We recomputed the maximum claim amount variable by merging in the FHA limits at origination year and made a decision to trust the accuracy of this variable in the IACS data after determining that mean and median values differed by less than .005%.

Summary of Non-Stochastic Actuarial Model Results

This section summarizes the overall actuarial model results, which report the net worth of the current book of HECM business to be $54.0 million dollars, or about $1,039 per loan. The results are compared to the 2000 model, which estimated a substantially lower net worth – this difference is explained step by step. In the next section, the results are also subjected to sensitivity analysis of interest rate and house price assumptions.

These sensitivity tests are especially important. Although the current model uses the interest rate assumptions from the 2000 model for comparability, there are good reasons to believe that the expected interest rate is lower than modeled. Current long-term interest rates imply that the actual net worth of the current book of HECM business could be closer to $200 million dollars. We include a discussion of interest rate assumptions and leave it to the reader to determine a preferred projection.

Results

Exhibit 2-5 reports the results of the 2001 actuarial model. The estimates indicate that the HECM mortgage insurance premiums are more than adequate and there is no evidence that the Department's FHA insurance fund is facing any excessive risks from this book of business. Specifically, the 2001 model estimates that the mortgage insurance reserve (less claims paid) has accumulated a total value of $176.8 million, or $3,401 per loan. The present value of future expected premiums is estimated to be $108.9 million in future insurance premiums, or about $2,094 per loan. At the same time, the present value of future expected claim losses resulting from the existing book of business is estimated to be approximately $231.7 million, or about $4,456 per loan. Therefore, the estimated present value of total premiums exceeds the projected present value of claim losses by $54.0 million, or about $1,039 per loan. In other words, this book of business is expected to have a net *worth* (or negative expected liability) of $54.0 million.

Exhibit 2-5
Actuarial Model Results, Total Estimates

Reserve (Past Premiums Less Claims)	Present Value of Future Claims	Present Value of Future Premiums	Net Expected Liability
$176.8 M	$231.7 M	$108.9 M	-$54.0 M
$3,401 per loan	$4,456 per loan	$2,094 per loan	-$1,039 per loan

Comparison to Previous Results

These results differ from the 2000 actuarial projection, which estimated net present value surpluses in the neighborhood of $17 million. Exhibit 2-6 compares our current estimate (Specification V), to the 2000 model estimate (Specification I), by successively changing different parameters. The result is that some of the difference is explained by the introduction of new data, and some by the model changes discussed above.

We ran the 2001 model on the old 2000 dataset, for comparability (Specification II). This specification isolates the difference in estimates solely attributable to a new modeling structure, keeping the dataset constant. Specification II yielded highly similar results to Specification I, but with projected claims approximately $10 million higher. This higher estimate is the result of two major modeling changes discussed in more detail above: the updating of the expected draw schedule for line of credit borrowers with more available data, and a minor bug in the 2000 model that accidentally had line of credit borrowers in the 2000 model drawing 30 percent of their available principal in years 10+ instead of 33 percent.

We then changed an important aspect of the reserve calculation (Specification III). The 2000 model had assumed that paid-in premiums grew at the 1-year Treasury rate each year, but the new model assumes that the paid-in premiums are invested at the 10-year Treasury rate, yielding a higher reserve. This increased the size of the reserve by about 4 percent.

Then, as discussed above, we corrected a data error in the 2000 dataset for comparability, as we did in the 2001 dataset (Specification IV). This data error had approximately 5 percent of records in both the 2000 and 2001 datasets with abnormally high principal limits, equal to the property value. This is obviously incorrect since HECM loans are designed to allow for only a percentage of the property value to be borrowed, with the rest of the property value covering interest on the loan. The effect of this data error was to inflate the projected claims. Any loan that mistakenly reported a principal limit equal to the property value would most likely result in a claim, since there would be no property value left to cover interest charges.

We corrected this problem in the 2000 and 2001 data, by estimating the actual property values for these 5 percent of incorrect records, using the actual HECM loan table to produce the proper initial principal limit. This significantly lowered the projected amount of claims, by about 11 percent. This is a substantial change due to either recording errors or underwriting errors. It is possible that the downward adjustment in principal limits is not correct and, in fact, the appraisals should have been adjusted upward. This issue deserves further investigation.

Finally, we added the new loan data (Specification V) to come up with our final 2001 model estimate. The new records number 51,992, or about 75 percent more than the 29,701 loans used in the 2000 analysis. For all HECM loans, the premium revenue is “front-loaded” relative to the claims, so the new loans contribute a disproportionate increase to the net expected liability. The net expected liability for the non-stochastic model on 2001 data is -$54.0 million.

Exhibit 2-6
Comparison of 2002 Results to earlier Results (per-loan data in parenthesis)

	Reserve (Past Premiums Less Claims)	Present Value of Future Claims	Present Value of Future Premiums	Net Expected Liability
I: 2000 Model	$112.2 M ($3,778)	$168.7 M ($5,680)	$73.5 M ($2,475)	-$17.0 M (-$572)
II: New model using old data and assumptions **Change:** **a)** Use 2001 model	$111.8 M ($3,764)	$178.9 M ($6,023)	$73.4 M ($2,471)	-$6.3 M (-$212)
III. New model using old data **Change:** **a)** Use 2001 model **b)** Interest rate assumption	$116.8 M ($3,933)	$178.9 M ($6,023)	$73.4 M ($2,471)	-$11.3 M (-$380)
IV: New model using old data with correct principal amounts **Change:** **a)** Use 2001 model **b)** Interest rate assumption **c)** Correct principal limits	$116.8 M ($3,933)	$159.5 M ($5,370)	$73.7 M ($2,481)	-$31.0 M (-$1,044)
V: 2001 Model **Change:** **a)** Use 2001 model **b)** Interest rate assumption **c)** Correct principal limits **d)** 2001 Data	$176.8 M ($3,401)	$209.2 M ($4,029)	$104.5 M ($2,013)	-$72.0 M (-$1,387)
VI: 2002 Model **Change:** **a)** Allow payments if available principal limit at beginning of year is positive.	**$176.8 M ($3,401)**	**$231.7 M ($4,456)**	**$108.9 M ($2,094)**	**-$54.0 M (-$1,039)**

Sensitivity and Stress Testing

We subjected the actuarial model to sensitivity tests of future interest rate and house price appreciation assumptions. Lower interest rates result in lower interest charged on drawn principal and thus lower loan balances, leading to lower claims. Greater house price appreciation creates a larger cushion against loan balances at termination, also leading to lower claims. The model results are highly sensitive to these two factors.

The sensitivity test is especially important in the 2002 model because actual interest rate conditions may be significantly lower than assumed. In the current actuarial model, we estimated the expected interest rate to be 7.8 percent, and house price appreciation to be 3 percent, for consistency with the 2000 model. Recent data suggest, however, that the expected interest rate could be much lower and that house price appreciation might be higher, both effects that would positively affect the HECM insurance fund "surplus." The actual size of the projected HECM "surplus" may actually be closer to $200 million dollars.

For example, one could reasonably expect the future interest rate (1-year T-Bill plus margin) to be predicted by the current 10-year T-bond rate of 4.57 percent, plus the average margin of 1.4 percent, or approximately 6 percent. Regarding house price, U.S. house price appreciation rates based on the OFHEO index have averaged 5.7 percent since 1975, with recent growth even higher. However, since anecdotal evidence suggests that HECM borrowers have homes that appreciate at a lower rate than the average, the conservative assumption of 3 percent house price growth seems appropriate.

Just assuming an interest rate of 6 percent alone, however, yields a significantly higher estimate of the expected net present value of the current book of HECM business. A lower interest rate results in lower accumulated interest on the borrower's outstanding loan balance, and hence less probability that the loan balance at time of termination will exceed the house value, resulting in a claim. If one assumes an interest rate of 6 percent going forward, the net present value of current HECM loans would be about $200 million dollars, or about $3,847 per loan. Exhibit 2-7 reports the net expected liability for different house price growth and interest rate assumptions.

Exhibit 2-7
Actuarial Model Results of Sensitivity Testing: Net Expected Liability, Total Estimates

		Future Expected Interest Rate			
		5.8%	**6.8%**	**7.8%**	**8.8%**
		(in $ millions)			
Future House-Price	**2%**	-182.2	-87.1	51.8	237.5
Appreciation Rate	**3%**	-234.6	-168.4	-54.0	111.3
	4%	-263.3	-230.8	-149.0	-11.1
	5%	-271.1	-266.2	-223.9	-122.8

Assuming that the interest rate will stay at 6 percent in the future seems questionable when compared to historical experience – the average rate (with margin) over the last 48 years is 7.4 percent, and interest rates are now near the historical low over that period. However, there are good reasons to believe that this is a reasonable assumption for our purposes. First, the 10-year rate is theoretically the market's actual prediction of long run interest rates. To expect long run interest rates to be at this level leaves one in good company – there are tens of thousands of informed investors that also believe this to be true. Second, the fact that we are talking about a present value projection is important – even if interest rates were to rise a few years out, the future expected claims and premiums from those years would have lower present value than what occurs in the immediate future.

Ultimately, we leave it to the reader to decide their preferred interest rate assumption. There are certainly many caveats, including the uncertainty of interest rate movements, but it seems reasonable to us to at least consider future interest rates around 6 percent. Looking at the sensitivity table, it is thus possible that the net present value of the current book of HECM business is closer to $200 million dollars, or about $3,847 per loan.

Summary of Non-Stochastic Model

The actuarial model reports that the current book of HECM business will have a net present value of $54 million dollars, or about $1,039 per loan. This result is higher than the 2000 model estimate, which is partly accounted for by model changes and an increased number of loans. The bulk of the difference however is accounted for by the correction of a data error that incorrectly reported abnormally high principal limits.

We conducted sensitivity tests on these results, by varying assumed interest rates and house price appreciation rates. These tests are especially important in the current economic environment, since current projected interest rates are much lower than the interest rates we assumed in the actuarial model. We leave it to the reader to adopt her own assumptions. But based on current conditions, one could make reasonable interest rate assumptions that would bring the actual net worth of the HECM to be closer to $200 million dollars.

Chapter Three
Actuarial Analysis - Stochastic Model Innovations

Three major improvements were made to the non-stochastic model presented in the analysis so far: a stochastic simulation of future interest rate and house price paths, a statistical model of terminations, and a mortality assumption that allows for future improvements in health care. This chapter describes the methodologies used to enhance the non-stochastic model and compares the results between the non-stochastic and stochastic versions of the model.

The non-stochastic model fixed future interest rates and house price growth at one level, and projected a single result. The stochastic simulation projects 250 random paths of future interest rates and house price appreciation rates. The model was then run for each of these future projection paths. The average, or expected value, of these 250 trials gives a more accurate prediction of what is likely to happen in the future, as opposed to a single trial with fixed interest rates and house price appreciation rates. Rather than relying on one forecast with low probability of occurring, the stochastic model randomly draws from the full distribution of possibilities and uses the expected value as the point estimate. Furthermore, the distribution of the trials gives a good sense of the probability of certain risks occurring. The stochastic projection (together with the next two innovations) predict a net present value of the fund of $244.9 million, relative to the non-stochastic projection of $54 million.

The statistical model of terminations replaces the simplistic assumption about terminations in the non-stochastic version of the model. Termination probability is an important factor in the model – a termination event creates the possibility of a claim occurring, and it is important to accurately model when these events occur. The non-stochastic version of the model predicted terminations at 130 percent of the mortality rate – which was reasonably accurate overall. In this version of the model however, we estimate terminations based on a more complete set of information, such as gender of borrower, interest rates, and age of loan. This improved the fit of the model in the historical period, especially for younger participants, and resulted in a decrease in the projected net present value of the fund by $46 million.

We also adjusted mortality rates downward to allow for future improvements in health care. There is some concern that falling mortality rates due to better medical technology might present a risk to the HECM fund. As participants live longer, there is more opportunity for their loan balances to exceed their house value. We therefore gradually reduced mortality rates into the future, resulting in a decrease in the projected net present value of the fund by $30 million.

By far the largest difference between the non-stochastic model results and the stochastic model results is the estimate of interest rates. Starting interest rate and house price growth paths from their very favorable levels in 2002, we simulate average interest rates at 5.5 percent and average house price growth rates at 3.5 percent. Applying those rates to the non-stochastic model greatly increases the net value (or decreases the net liability) of the fund to $267.9 million. Therefore, the net impact of the stochastic interest rates and house prices is really only the difference between $267.9 million and $244.9 million or $23 million. This also suggests that using higher interest rates, for example starting from the long-run average of 5.95 percent rather than the low, current rate of 2.35 percent, would greatly reduce the net value of the fund. Whether estimated with the non-stochastic model or the stochastic model, the net value of the fund depends greatly on the future projection of interest rates.

The three innovations do not affect the reserve, which is the sum of past premiums less past claims already paid out. The cumulative effect of the model innovations is presented in Exhibit 3-1.

Exhibit 3-1
Cumulative Impact of Model Innovations (in $ millions)

	Reserve (Past Premiums Less Claims)	Present Value of Future Claims	Present Value of Future Premiums	Net Expected Liability
2002 Non-Stochastic Model	**176.8**	**231.7**	**108.9**	**-54.0**
I: With statistical termination model	176.8	287.4	118.4	-7.8
II: And with improved mortality rate	176.8	323.5	124.2	22.5
III: Adjust interest rates to 5.5% and house price growth to 3.5%	176.8	36.8	127.9	-267.9
IV: And with Monte Carlo simulation (mean of 250 trials): the Stochastic Model	**176.8**	**61.8**	**129.9**	**- 244.9**

Monte Carlo Simulation

The estimated net present value of the HECM insurance fund is highly sensitive to assumed interest rates and house price growth rates. Higher-than-expected interest rates can cause rapidly compounding loan balances and higher claims, and low house price growth rates can also result in higher claims. These are large risks to the fund. It is informative to get a sense of the probability that these risks will occur, as well as the magnitude of the effect if they do.

To this end, we simulated random future movements in interest rates and house price growth rates, based on how these rates have changed historically. We ran 250 random simulations, generating a range of likely future interest rate and house price growth scenarios. The average result from these 250 trials gives a more accurate estimate of the net present value of the fund, as opposed to a single trial with static interest rates and house appreciation rates. Furthermore, by looking at the *distribution* of the results of these 250 trials, we are able to better determine the probability of certain outcomes, as well as the effect on the net liability of these outcomes.

The Monte Carlo simulation, along with the next two model innovations, projects a net present fund value of $245 million. This is our preferred estimate of the soundness of HECM insurance fund. The distribution of possible results is shown later in the chapter, in Exhibit 3-7, and gives a sense of the level of uncertainty in this projection.

We also extended the stochastic model to evaluate the refinance option, using continuous refinancing program option A, with medium participation. The result of 250 trials showed the expected net present value of the fund to be $130 million. This net present value is much lower than the no-refinance option, and reinforces the non-stochastic model results.

However, a key risk presented by refinancing is created from the *movement* of interest rates and house price growth rates, which was previously untested, since the non-stochastic model has fixed rates over the course of its simulation period. The stochastic model shows that refinancing does indeed impose a negative effect on the HECM fund.

Detail of Simulation Mechanics

The Monte Carlo model is the same as the non-stochastic model, except that interest rates and house price growth rates were allowed to change every year, instead of staying fixed. In each of 250 trials, these rates were determined randomly in a way that mimicked historical changes.

Description of Interest Rate Simulation

Interest rates were started at the current 1-Year Treasury rate of 2.35 percent.

To figure out what will happen to interest rates in the future, one approach is to look at what happened in the past. We started with the monthly historical data on the 1-Year Treasury Bill starting from April 1953, and converted this information into a transition probability matrix, assuming that interest rate movements follow a Markov probability sequence. In a given future period t, interest rates will move in a way that is dependent only on the rate at that period t, and how interest rates at a similar level have moved historically.[12]

To get a better sense of the transition probabilities, Exhibit 3-2 shows an aggregated version of the matrix used. Along the left column are the levels of interest rate for period t. Along each level is a set of probabilities according to the expected size of the interest rate change. Each row adds up to 100 percent. As an example, suppose interest rates are 4 percent in period t (second row in Exhibit 3-2). The table shows that there is a 49 percent probability that the interest rate will stay at the same level, 20 percent chance that the rate will have a small decrease by 0.5 percent and a 3 percent chance that rates will decrease more than 0.5 percent. On the other hand, there is a 27 percent probability of a small increase and a 1 percent chance that there will be a large rate increase in period t +1. For most rows the modal probability is no change. The lower interest rate levels have higher probabilities of increase than decrease whereas the higher interest rate levels are the opposite.

[12] The rows in the transition matrix hold the current interest rate (the level, rounded to the nearest 1/8th or 0.125 percent). The columns in the matrix hold possible movements, such as +0.1 percent or –0.2 percent (rounded to the nearest quarter-point). The actual elements of the matrix tell the probability of an event occurring, with each row summing to 100 percent.

Exhibit 3-2
Probability of Specific Interest Rate Change, Given Current Level

	Change in Interest Rate						
Level	-1.25 to 4%	-.5 to -1.25%	-0 to -.5%	**0**	+0 to .5%	+.5 to +1.25%	+1.25 to +2%
< 3.50%	0%	1%	18%	**58%**	23%	1%	0%
3.50 to 5.25%	0%	3%	20%	**49%**	27%	1%	0%
5.25 to 6.50%	0%	1%	29%	**38%**	31%	2%	0%
6.50 to 8.00%	0%	5%	34%	**27%**	29%	5%	0%
> 8.00%	5%	14%	22%	**18%**	25%	9%	7%

Source: Federal Reserve H.15 Series of 1-year CMT T-bills from 1953 to 2002.

For example, the current interest rate is 2.35 percent. To simulate a realistic movement in the future, we looked at all historical periods where the interest rate was close to 2.35 percent. There were 26 different months occurring in the past where interest rates were close to the 2.35 percent. Out of these 26 historical occurrences, interest rates fell 6 times, were unchanged in the next month 14 times, and went up to some degree 6 times. The decreases were in general slightly greater than the increases. Taking this information into account, we can randomly move today's interest rate in a way that mirrors historical movements, thus producing an interest rate projection for next month.

This kind of simulation technique, repeated every month[13] for 50 future years, produces a random interest rate path that closely mimics historical movements. It is true that any one given interest rate path could produce wild results. However, by simulating a large number of equally-likely interest rate paths (for example, 100 paths), we can get a sense of what is likely to happen to interest rates in the future. If 7 paths out of 100 have interest rates spiking upward, then one can reasonably say that there is a 7 percent probability that interest rates will go very high. If 65 paths out of 100 stay within a reasonable band of 4 percent and 8 percent, then one can say the probability that interest rates will be moderate and stable in the future is 65 percent. The larger the number of paths tested, the more complete and reliable is the overall picture especially in the tails of the probability distribution, which represent rare paths.

We simulated 250 random paths for the Monte Carlo trial. The average 1-Year T Bill path, as well as 50 representative paths (in gray) are shown in Exhibit 3-3. The average interest rate path makes intuitive sense, which indicates that the simulation method is successful. The 1-Year T-Bill starts at its current low levels, and by moving in a way that is consistent with history, slowly trend upwards to the long run historical average. Furthermore, a look at the individual paths shows that paths experience an upward pull as they get too low, and a slight downward pull when they get too high, as is consistent with history.[14] Exhibit 3-4 shows the average interest rate paths for conventional mortgage rates (30-year FRM) and the 10-year T-bond.

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[13] Monthly interest rates and house price growth rates were averaged into annual rates.

[14] One advantage of simulating interest rates from historical transition probabilities is that the probability of a decline falls to zero as the level approaches zero. On the other hand, interest rates are not bounded for high levels. The disadvantage of heavy reliance on historical data is that regime shifts have happened since 1953, particularly Regulation Q and the disintermediation of interest rates. While mortgage rates are now market driven, we are primarily focused on the 1-Year Treasury Rates as the index for HECMs, which are driven by the Federal Reserve.

Exhibit 3-3
50 Simulated 1-Year T-Bill Interest Rate Paths, and Average of 250 Paths

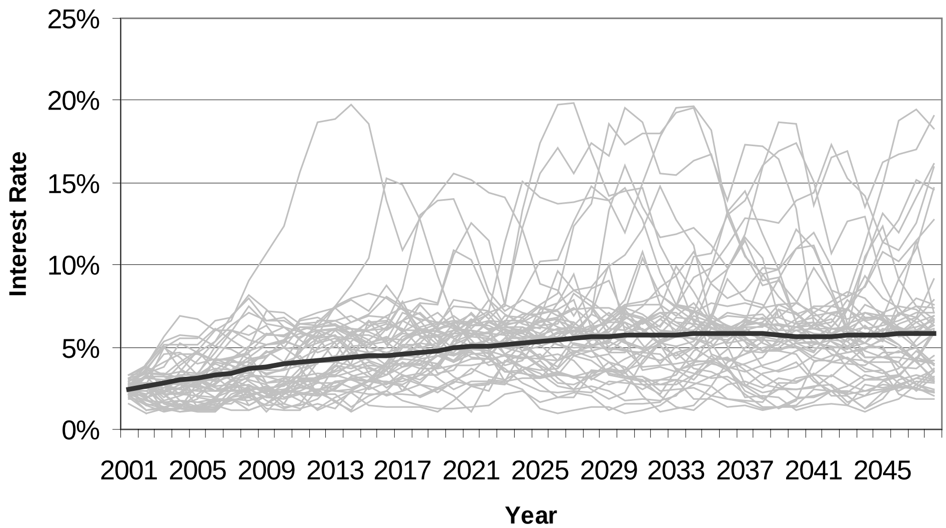
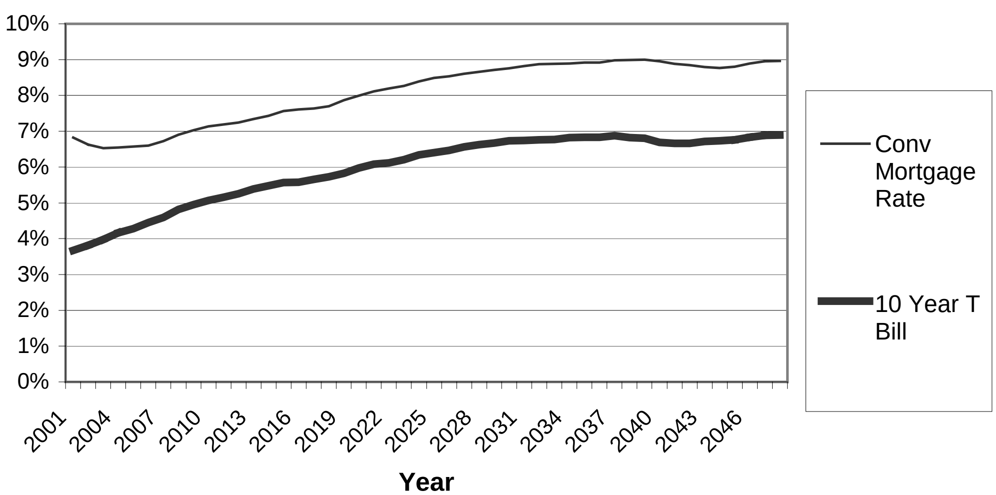


Exhibit 3-4
Averages of 250 Simulated Interest Rate Paths:
Conventional Mortgage Rate and 10-year T-Bond



Description of House Price Simulation

House prices were simulated based on how they had behaved since 1975, according to the OFHEO house price index. There is a slight wrinkle however, since house price growth rates are dependent in some part on interest rates. If interest rates are low, homebuyers can get a larger mortgage for a given income and payment amount and can thus pay more for a house, thereby inflating house prices. Therefore, a drop in interest rates is likely to be correlated with a corresponding rise in house prices.

So instead of directly simulating house prices, we tied house price movements to interest rate movements, and then added a random shock. Historically, the change in quarterly house price growth rate was found to correlate with a change in interest rates by –0.15. Therefore, the change in quarterly house price growth was the same as the change in interest rates times –0.15, plus some relatively large random shock. See Exhibit 3-5 for a summary of transition probabilities.

This random shock was simulated as interest rates were. The magnitude of the shock was determined randomly, based on the current house price growth rate, and what had happened in similar historical periods. For example, the latest quarterly house price growth rate from 2002 is 1.4 percent. To realistically simulate what will happen in the next quarter, we look to history. There were twenty quarters in the last twenty-six years with a house price appreciation rate close to 1.4 percent. We are interested in the "random shock" in house price appreciation rates that occurred in the next quarter, after netting out the predictable –0.15 correlation with interest rate movements. In these twenty cases, the subsequent shock in house price appreciation was positive in ten cases, stayed the same twice, and negative in eight cases. Therefore, we are able to model what happens to the current house price growth in the next quarter.

Exhibit 3-5
Probability of House Price Growth Rate Shock (in addition to correlation with Interest Rate Movement), Given Current Level of House Price Growth

	Shock (in addition to correlation with interest rate growth movement)						
Level	-2.25 to -1.5%	-1.5 to -.5%	-.5 to 0%	**0**	0 to +.5%	+.5 to 1.5%	+1.5 to 2.5%
< 0.50%	0%	6%	13%	**6%**	19%	50%	6%
0.5 to 1.00%	0%	11%	32%	**11%**	26%	16%	5%
1.00 to 1.50%	0%	22%	22%	**22%**	28%	6%	0%
1.50 to 2.00%	0%	17%	17%	**25%**	33%	8%	0%
2.00 to 3.00%	14%	5%	33%	**10%**	33%	5%	0%
> 3.00%	10%	20%	35%	**15%**	5%	15%	0%

Source: Authors calculations based on Federal Reserve's H.15 Series for 1-year T-bills and OFHEO's national repeat sales index.

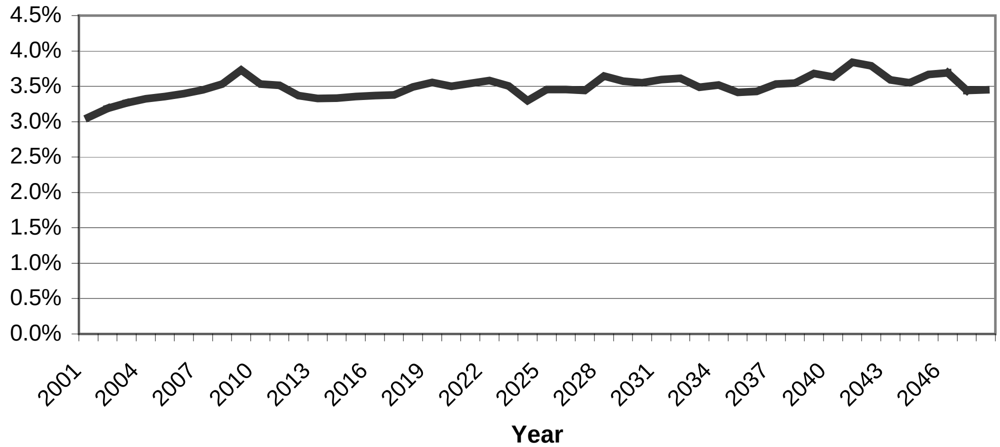
By simulating about 50 years of house price appreciation rates every quarter, we thus generated a random path consistent with interest rate movements, but with natural random shocks around this important trend.

The average house price growth rate produced was 5.6 percent per year, which is in-line with historical forecasts. This however, is higher than previously assumed in the HECM report (3 percent), so we dampened all house price growth by 40 percent, just to be conservative.[15] Looking at

[15] This is a highly conservative assumption, since there is limited, if any, evidence that older borrowers' homes appreciate slower than the national average.

Exhibit 3-6, we see that annual house price growth trends around the long run average, less 40 percent, as specified.

Exhibit 3-6
Average of 250 Simulated House Price Growth Rate Paths



The simulation predicts that the HECM insurance fund will be healthy in the future. Exhibit 3-7 shows the distribution of predicted net present value of the fund, for 250 equally likely interest rate and house price rate paths. There is only a 3 percent chance of a negative present value (7 out of 250 trials simulated), and the expected net present value of the HECM insurance fund (the mean of 250 trials) is $244.9 million. Note that this uses, as described above, a house price growth rate that is 40 percent less than the national average, in order to be conservative.

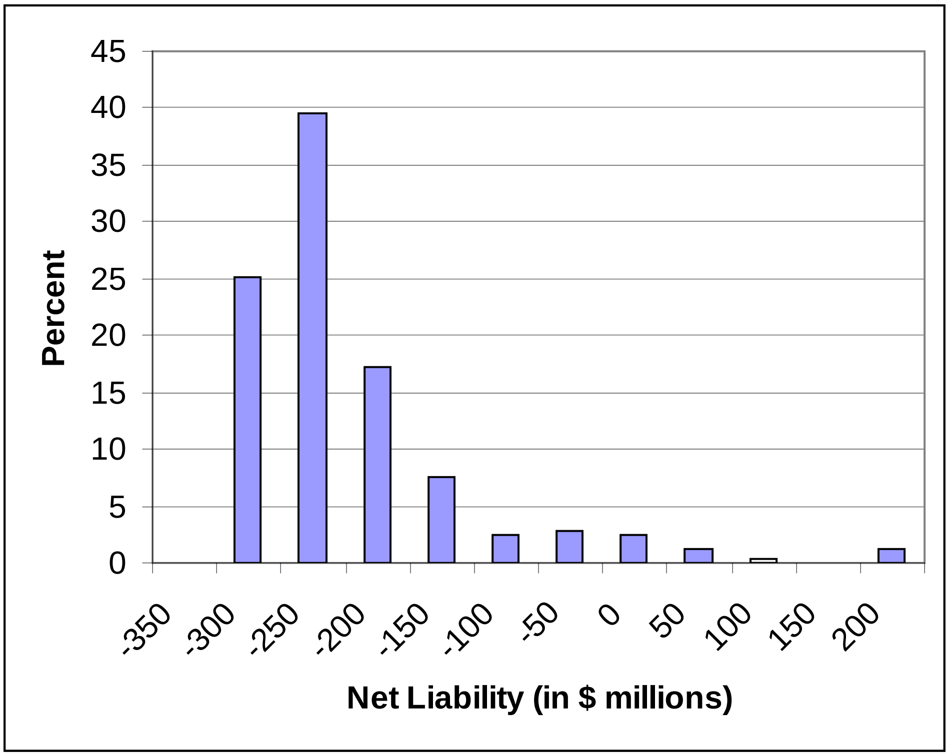
An added benefit of the stochastic model is a clearer sense of the risk that the HECM fund faces. By looking at the distribution of results in Exhibit 3-7, it is clear that the HECM fund is actually quite stable (with a net present value of over $100 million) in 92 percent of the cases. Only at the extreme tails of the distribution does the net present value make dramatic movements – the result of unlikely combinations of prolonged high interest rates and low house price growth.

Discussion: Why Are the Results Dramatically Different?

The stochastic simulation projects a dramatically higher expected net present value for the HECM fund than the non-stochastic model. Despite a number of conservative adjustments, we believe that the stochastic model presents a more accurate prediction of what will happen to the insurance fund.

The difference is mostly driven by differences in interest rates. In the non-stochastic model, we are limited to a single interest rate for the entire future period. With the desire for being conservative, and for consistency with the 2000 Report, we picked an interest rate of 7.8 percent, which was the ten-year Treasury yield at the time of the 2000 Report. Since the non-stochastic analysis depends on only one of many possible interest rate paths, we are forced to be conservative – it would be reckless to base the health of an insurance fund on a single optimistic interest rate path.

Exhibit 3-7
Net Expected Liability of HECM Insurance Fund, 250 Equally-Likely Trials
(Net Liability = -Reserve - P.V. Future Premiums + P.V. Future Claims)



However, the stochastic model allows us to choose the average result from 250 reasonable and equally likely predictions of the future interest rate path. This results in a lower average interest rate for several reasons. 1) Instead of immediately starting interest rates at the long-run projection, we start from the current low rate and let them revert to the long run mean in a realistic manner, allowing the current low interest rates to work a beneficial effect in the near term. 2) Interest rates have simply come down since the 2000 Report, which is reflected in the stochastic model. 3) Instead of using the 10-year T-Bond as a prediction of future interest rates, we are able to directly use the 1-year T-bill to grow loan balances, which is typically lower due to the shape of the yield curve. 4) Finally, the 7.8 percent assumption is a highly conservative estimate of the long-run interest rate. For the reasons discussed above, the analysis benefits from more realistic assumptions since we are no longer basing all our results on one future interest rate path.

As a result, the stochastic model uses a lower interest rate – starting at the current rate 2.35 percent and climbing to an average of about 6.0 percent, the long run historical average of the 1-year T-bill. The average over this period is 4.9 percent. When applied to loan balances, the interest rate also includes a margin set by the lender (average margin is 1.4 percent).[16] This beneficial, and more realistic, interest rate results in a much healthier outlook for the HECM fund.

In the interests of remaining conservative, one can still assess the risk of the HECM fund facing problems, by looking at the results from the 250 different trials, all of which are equally likely for the most part. This is discussed in the model results.

Termination Model

Termination probability is an important factor in the model – a termination event creates the possibility of a claim occurring, and it is important to accurately model when these events occur. The earlier version of the HECM insurance fund estimate relied on a simplistic assumption about the probability that a loan will terminate in a given year. That is, loans were assumed to terminate with a probability that was 1.3 times the mortality rate of the youngest borrower in the family.

Work by Ed Szymanoski, Theresa DiVenti and Ming Chow[17] suggests that the termination probability can be more accurately estimated using a wider range of available information about the borrower, such as gender, presence of co-borrower, assets, loan balance, etc. Starting with this prior work, we developed a model to more carefully estimate termination probability, and incorporated the result in the HECM estimation. We found that the new termination model improved the prediction of terminations in historical data. A further benefit of the new termination model is that it is sensitive to fluctuations in interest rates and house prices, making the stochastic model internally consistent.

Relative to the non-stochastic model, the net result of incorporating the new termination model was to decrease the net present value of the fund by $40 million.

Termination Model Coefficients and Accuracy Scores

Informed by Szymanoski *et al*., we picked a set of variables to predict termination. Out of twenty model specifications, the final model specification was found to greatly improve the accuracy of predicting historical terminations, relative to the "1.3 times mortality" assumption.

Data
We used the cumulative transaction history of the HECM program from the Insurance Accounting Collections System (IACS), dating FY1990-FY2000. These number 52,000 loans, of which over 15,300 terminated. The loan dataset was expanded to create a record for each policy year of each loan, increasing the universe to 180,275 loan-policy year combinations. This allows us to estimate a hazard model with time-varying covariates, specifically age, mortality rates, interest rates and house prices.

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[16] The unweighted average interest rate (including the margin) for the simulation is 6.2 percent. However, when adjusted for the probability of termination, the weighted interest rate is 5.5 percent, i.e. more weight on the early years when the termination probabilities are relatively lower and interest rates are lower.

[17] Ed Szymanoski, Theresa DiVenti and Ming Chow, "Understanding Reverse Mortgage Cash Flows: A Hazard Model of HECM Loan Terminations," Sept. 2000, mimeo

Coefficient Estimates

Terminations were predicted using a wide variety of variables (discussed below) and a complementary log-log maximum likelihood estimation approach. The termination event is assumed to be generated by Cox's proportional hazards model[18] which can be estimated with the following equation:

$$\log[\log(1-\mathrm{P}_{\mathrm{it}})] = \alpha_t + \beta_{it1}x_{it1} + \ldots + \beta_{itk}x_{itk}$$

where P_{it} is the probability of the termination and the dependent variable is the complementary log-log function of P_{it}. This transformation converts a 0,1 variable into a continuous variable between minus and plus infinity. Moreover, the β coefficients are the same as the underlying hazard model and invariant to the interval length (months vs. years).

The first set of coefficients shown in Exhibit 3-8 is the interaction of mortality with age brackets – that is, mortality is allowed to drive termination at different rates across different ages.[19] The general finding is that mortality is a key driver of termination at "young" ages (below 90), but after age 90, variation in mortality does not drive terminations. The next set of coefficients is a set of age bracket dummies. The finding is that baseline terminations are much more likely once the borrower reaches age 90.

The third set of coefficients has to do with borrower income and assets as reported at origination. Income is monthly, in thousands, and assets are in thousands. One might theorize that high outside borrower income or assets might make them more likely to terminate, since they are not relying on the HECM for subsistence. Neither of these variables had a particularly large effect on terminations. In part, this may be the result of incomplete information about the participants' current income and assets. Many report no income at origination.

The fifth set of variables deal with equity and cumulative house price growth. Equity (cumulative house value minus outstanding loan balance) was not significant. However, cumulative house price growth was significantly negative. That is, high house price growth tends to lead to lower terminations. The reasoning here may not be strictly economically rational – perhaps a HECM is seen by some as a luxury good, affordable only if the house's value, and thus wealth, increase. Looked at another way, borrowers or their children might become concerned when the house price fails to appreciate as expected. In this situation, they are more likely to terminate the HECM rather than see increasing loan balances eliminate the remaining equity.

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18 Paul D. Allison, *Survival Analysis Using the SAS System: A Practical Guide*, (Cary, NC: SAS Institute, 1995).

19 Mort70 represents mortality for those under 70, Mort7080 for ages 70 to 79, Mort8090 for ages 80 to 89, and Mort90 for those age 90 and above.

Exhibit 3-8
Predicting Terminations: Coefficients from Complementary Log-Log Estimation

	Estimate	
Variable	**Beta**	**P-Value**
Mort70	8.997	0.342
Mort7080	9.125	0.000
Mort8090	9.583	0.000
Mort90	0.603	0.372
Age70	-1.329	0.000
Age7080	-1.412	0.000
Age8090	-1.374	0.000
Income (000s monthly)	0.028	0.000
Assets (000s)	0.00028	0.133
Equity	0.036	0.439
Cumulative HP Growth	-0.219	0.035
1-Year T Bill	-2.182	0.271
Conventional 30-Year to 1-Year T Bill spread	-43.085	0.000
Male borrower	0.120	0.000
Coborrower	-0.356	0.000
First Policy Year	-0.969	0.000
Policy Year	0.000084	0.990
Census Division 2	-0.146	0.000
Census Division 3	-0.002	0.955
Census Division 4	-0.005	0.935
Census Division 5	0.017	0.681
Census Division 6	-0.017	0.819
Census Division 7	-0.330	0.000
Census Division 8	0.160	0.000
Census Division 9	-0.070	0.075
Constant	-0.356	0.090

Next we looked at the spread between the conventional mortgage rate and the current one-year treasury (in percentage points). One might theorize that a large spread made HECMs relatively more attractive to other home equity conversions, thus diminishing the motive to convert terminations to other borrowing instruments.

We looked at the demographic variables of gender and the presence of a co-borrower. As one might suspect, a female borrower or the presence of a co-borrower reduces termination. This is presumably because the probability of joint mortality or a female mortality is substantially lower than a single male mortality.

Next we looked at policy year variables, finding that policy year (number of years since origination of the loan) was largely unimportant. However, as might be expected, HECMs were unlikely to terminate within a year of origination.

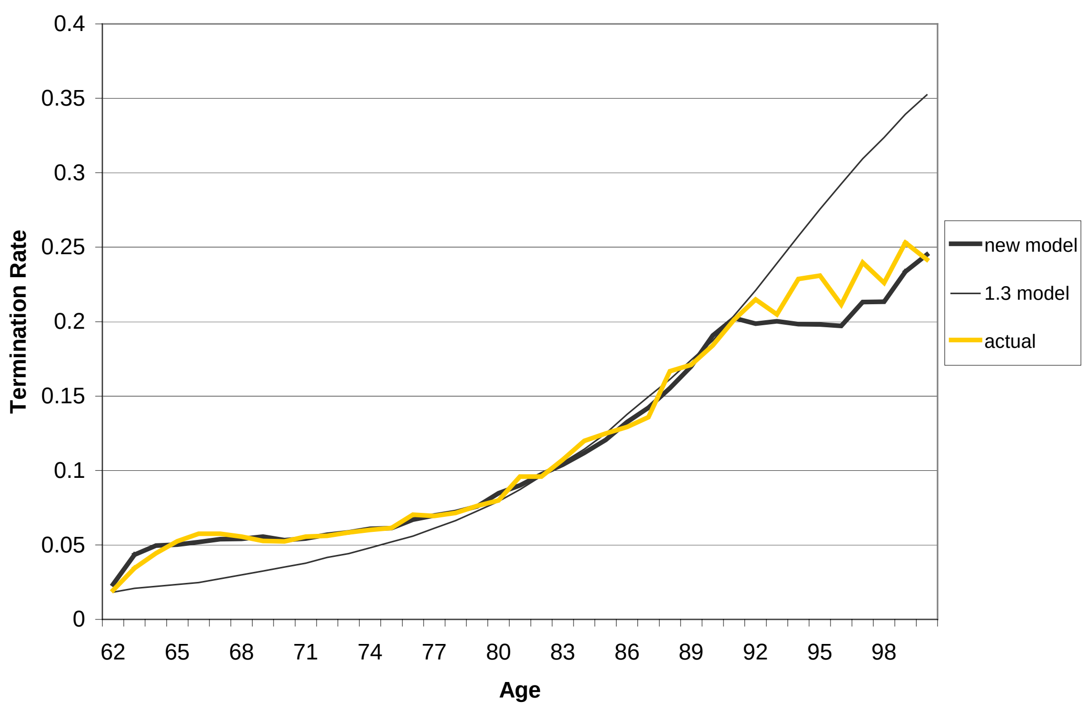
Finally we looked at geographic variation and found that most geographies exhibited no particular termination pattern. However divisions 2 (NY/NJ, PA) and 7 (TX, LA, OK) had fewer terminations and division 8 (the Southwest) had more terminations, compared to New England.

Measuring Accuracy – How Much Better is the New Termination Model?

The new termination model performs substantially better than the old 1.3 times mortality assumption for terminations over the historical period.

Exhibit 3-9 shows a plot of the termination predictions, old and new, versus the actual terminations observed at each age. The 1.3 times mortality assumption under-predicts terminations at young ages, and over-predicts terminations at late ages. The new termination model fits the curve much better.

Exhibit 3-9
Comparison of Old and New Termination Models to Actual Terminations: Plot by Age of Borrower



Turning to numerical scores, the new termination model also exhibits better mean absolute percentage errors (MAPE), sum of square, and mean absolute error scores than the original 1.3 times mortality assumption, and makes minor gains to our approximate replication of the Szymanoski et al. specification. The goodness-of-fit statistics are presented in Exhibit 3-10.

Exhibit 3-10
Comparison of Old and New Termination Models: Numerical Scores

	Estimate		
Numerical Score	**1.3 times Mortality**	**Approximate Replication of Szymanoski Spec**	**New Termination Model**
Mean Absolute Percentage Error: by Age	18.612	6.995	3.410
Mean Absolute Percentage Error: by Year	18.171	11.138	11.987
Sum of Squares	12,669	11,291	11,202
Total Mean Absolute Error	24,598	22,541	22,395

Adjustment of Regression Estimates for Very Aged

While the regression model estimates are a definite improvement over the 1.3 times mortality rate assumption within the age range of 62 to 94, the out-of-sample projections for owners over 94 is not so favorable. The fundamental problem is that the sample is very thin above 90 and practically nonexistent over 95. As a result, the regression forecasts for termination of very aged owners tends to plateau at about 8 percent per year. Obviously as the owners approach 110 years old and mortality rates reach 25 percent, the regression estimates are no longer useful. Therefore, we have adjusted the termination model estimates to be a weighted average of the regression estimates and the 1.3 times mortality rate assumption. As the owner goes from 95 to 110, the weight increases on the 1.3 times mortality rate projection. The overall effect is that the probability of loan survival reaches zero when the owner reaches 110.

Projection Results with New Termination Model

The new termination model increases the present value of future claims by $55.7 million, and future premiums by $9.5 million, resulting in an increase of net expected liability by $46.2 million.

Looking at the chart of historical comparisons between the old and new termination model, this result makes sense. The new termination model predicts dramatically fewer terminations starting at age 90, which one might suspect would result in a "thicker tail." That is, the new termination model produces more borrowers that reach an extreme age, who are much more likely to result in a claim on the insurance fund.

Furthermore, this change is even more dramatic in the projection period. While the new and old termination models are somewhat similar in the historical period, the new termination model consistently predicts lower terminations at nearly every age in the projection period. This results in longer-lived loans, with greater compounding loan balances.

Reduced Mortality Assumption

Improved health care in the future will likely reduce mortality rates. While better life expectancies are a good thing for HECM participants, it is important to make sure that the insurance fund remains healthy for these longer-lived borrowers.

We therefore reduced mortality rates by 0.95 percent for each successive year in the future. By the end of the simulation period, which is roughly 50 years in the future, simulated mortality rates declined by 38 percent from their current levels. The rate of mortality decline is based on the average decline in mortality for females age 65+, for years 1900 – 1994, obtained from the 1997 Social Security Area Population Projections Actuarial Study No 112.

This decline in mortality rates has accelerated and decelerated a bit from decade to decade, so the long-run average was used. Exhibit 3-11 reports the data in the Social Security study. It is almost certain that technology will improve health and reduce mortality rates over the long run, but how much is uncertain. The gain for the 20th century may be too optimistic, but we felt it was a reasonably conservative choice.

Exhibit 3-11
Historical Average Annual Percentage Reductions in Age-Adjusted Death Rates: Females Age 65+

1930-36	1936-54	1954-68	1968-82	1982-94	1900-94
0.32	1.82	0.77	2.03	0.42	**0.95**

The result of decreasing mortality is to increase the future claims and premiums. The present value of the net worth is reduced by $30.3 million. This makes sense – a longer life span will more likely result in a large loan balance at time of death. Assuming interest rates exceed house price growth rates in the long run, loan balances will eventually exceed house values and result in larger claims.

Summary

The stochastic model reinforces the main findings of the non-stochastic model. Under the current premium structure and moderately conservative assumptions, the expected present value of the HECM fund for the existing books of business is $245 million. Given that the cash flow from premiums comes long before the claims, adding new books of business would only increase the projected net value from the wind-down analysis. This projection is sensitive to the current low interest rate level and assumes most interest rate paths will revert to a long-run average. A projection that started at the long-run average is not likely to be so favorable.

Chapter Four
National Loan Limit Analysis

In 1999 Congress requested HUD to do an actuarial study of the effect of creating a single national loan limit for HECMs. Subsequently this study was mandated in Section 201(d) of the American Homeownership and Economic Opportunity Act of 2000 (Pub.L. 106-569, 12/27/2000). Loan limits are important not only because they limit the market of eligible properties, but also because, for HECMs, an appraisal above the loan limit means more equity cushion against future claims. As of August 2001, approximately 30 percent of HECM borrowers had home appraisal values above the FHA 203(b) local loan limit. This limitation caps the amount of house value that borrowers can use to take out a HECM loan. The remaining house value above the limit does not contribute to the initial borrowing limit, but is still used at termination against a claim, thereby providing an extra cushion against claims. Loan limits are one of the likely factors contributing to the finding of overall positive net worth from the actuarial analysis calculations. Therefore, any increase in loan limits would have offsetting effects: a reduction in the equity cushion for "overcollateralized" loans, but a potential increase in HECM demand as more owners could tap the full extent of the equity in their homes.

The evaluation in this chapter focuses on the institution of a National Loan Limit at either 87 percent or 100 percent of the Fannie Mae conforming loan limits. A simulation is conducted of the historical impact on the fund if national loan limits had been in existence at the program's inception. The quantitative analysis found that the net worth of the existing book of loans was reduced, but remained positive in both the 87 percent and 100 percent scenarios. Another analysis investigated which borrowers would be most affected by the proposed national loan limit. Some borrowers experienced a large benefit from the new loan limit, while a very few living in higher cost areas had lower benefit or no benefit.[20]

The quantitative analysis was supplemented by a qualitative discussion estimating the possible demand impact of such a nationwide loan limit. We conducted a demographic analysis using the American Housing Survey (AHS) to determine the potential change in demand for HECMs resulting from the higher limits.

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[20] The same national loan limits were applied in every loan. In 4 percent or less of the counties, this meant a decrease in the loan limit relative to what it had been historically in those high cost areas. If implemented, a national loan limit would grandfather in those areas so that no county would have lower loan limits. There would be very little difference in the results if the few loan limit reductions had been set at no change.

National Loan Limit Model

Discussion of Loan Limits

The HECM program caps the amount of a house's value that can be used to open a reverse mortgage, according to local FHA 203(b) loan limits. The amount of the house's value that can be used to open a reverse mortgage is called the maximum claim amount. If a house's appraisal value is lower than the loan limit (i.e., the loan is unconstrained by the limit), then the maximum claim is simply the house value. If the house value is equal to or above the loan limit (i.e., the loan is constrained by the limit), then the loan limit acts as the maximum claim.

We analyzed the magnitude of the proposed change from instituting national loan limits on the eligible pool of borrowers, analyzing which counties would be most affected and by how much. We also looked at the magnitude of the change on the existing book of HECM borrowers.

To give an idea of the rough magnitude of the change in loan limits, we compared the proposed national loan limits to the existing local FHA limits, for the pool of eligible HECM borrowers. While this number varies by county and year, the average for all counties since 1990 was to increase the loan limit by $24,411 in the 87 percent of Fannie Mae limits case and by $32,097 in the 100 percent case.

Exhibit 4-1 reports the distribution of change in loan limit, by county, for the year 2001. This distribution highlights a problem with putting down a flat national loan limit. First, there are many counties where loan limits would be drastically increased and others with only a small change or negligible change. Fairness issues arise – the policy would allow the same loan limit in New York City and a rural county, where house prices might differ by a factor of five or more.

Exhibit 4-1
Magnitude of Change in Loan Limit, County Breakdown

($000s)	87% of FNMA Limit		100% of FNMA Limit	
	% Counties	# Counties	% Counties	# Counties
Less than –25	1%	9	0%	4
-25 to 0	3%	32	1%	8
0 to 25	11%	123	3%	38
25 to 50	23%	267	15%	171
50 to 75	15%	173	22%	254
75 to 100	23%	259	12%	136
100 to 125	24%	281	17%	191
125+	0%	0	30%	342

In Exhibit 4-2, we also looked to see which counties would be most affected loan limits, by geography and metropolitan characteristics. The far right column shows the distribution of borrowers by location as of the IACS 2001 data extract. Looking first at geography, the loan limits seem to affect regions that match the demographic breakdown of the current book of HECM borrowers. The bottom half of Exhibit 4-2 shows the distribution of counties according to center city, suburb and rural areas. As shown in the second column, 35 percent of the central city and 51 percent of the metro, non-central city benefit from an increase in the loan limit to the 87 percent national policy. In comparison, only 14 percent of the non-metro counties benefit from the loan limit increases.

Exhibit 4-2
Demographic Breakdown of Counties Benefiting From National Loan Limit

Location	87 Percent Policy	100 Percent Policy	All Borrowers in IACS 2001
Midwest	11%	18%	13%
NorthEast	27%	25%	27%
South	16%	22%	18%
West	45%	35%	42%
Total	100%	100%	100%
Central City	35%	36%	41%
Metro Non-Central city	51%	51%	48%
Non-Metro	14%	13%	12%
Total	100%	100%	100%

Focusing more now on the actual book of HECM borrowers, we were interested to see which origination cohorts were most benefited by the new loan limits. Exhibit 4-3 reveals that early on in the program, nearly half of borrowers would have been benefited by a national loan limit. This incidence declined and today, stands at about one-quarter to one-third of borrowers. The decline is largely due to the shift in FHA maximum loan limit from 75 percent of Fannie Mae limits in 1992 to 87 percent in 1998.

Finally, we looked at the approximately 30 percent of borrowers who would have been affected by national loan limits and tabulated some statistics on the average maximum claim gained. The maximum claim gained was lower than expected. Exhibit 4-1 above predicts that well over half of counties will experience gains in the loan limit by more than $50,000. Looking at the actual book of borrowers however, Exhibit 4-4 reveals that fewer than 25 percent of borrowers would have had their maximum claim increased by more than $50,000.

This is for a number of reasons. First, not every actual HECM borrower has a very expensive house, and thus the lower binding appraisal prevents most borrowers from taking full advantage of the gain in the loan limit. Second, HECM borrowers in general seem to live in higher cost areas where existing loan limits are already near the proposed national limits, and hence would not be affected as much by a shift to the national loan limit.

Exhibit 4-3
Prevalence of Counties Benefiting From National Loan Limit[21]

Year	87 Percent Policy	100 Percent Policy
1990	46%	46%
1991	47%	47%
1992	45%	45%
1993	39%	39%
1994	38%	38%
1995	35%	35%
1996	30%	30%
1997	27%	27%
1998	25%	26%
1999	16%	24%
2000	19%	26%
2001	23%	31%

Exhibit 4-4
Magnitude of Change in Maximum Claim, Actual HECM Borrowers

Magnitude of Change ($000s)	87 Percent Policy	100 Percent Policy
-10 to 0	0%	0%
0 to 10	31%	25%
10 to 20	20%	16%
20 to 30	25%	12%
30 to 40	8%	17%
40 to 50	6%	8%
50 to 60	6%	12%
60 +	6%	11%
Total	100%	100%

Overall, a demographic breakdown of the proposed national loan limit highlights a potential problem with the proposed policy. Namely, the existing FHA loan limits vary by locality, in accordance with the local cost of living – thus, a national loan limit would have a smaller, or even negligible effect, for those counties with high cost of living. Judging by the modeled effect on the actual book of HECM borrowers, the counties that are least benefited by the national loan limit are also those counties that historically have many HECM borrowers.

21 The identical prevalence percentages for the 87% and 100% limit in early years is correct; all counties where the existing loan limit is less than both the 87% and 100% loan limit would be benefited by either policy.

Modeling Specifics

We modeled the historical effect of replacing the local FHA 203(b) loan limits with one national Fannie Mae conforming limit, at both 87 percent and 100 percent of the limit. We calculated the effect on the historical reserve, as well as future projections.

Borrowers whose maximum claim amounts were previously constrained by the local limits were assumed to take advantage of higher maximum claim amounts. There were three main steps: we increased the *new principal limit*, for borrowers who were able to increase their maximum claim amount with the new loan limits. We then took the existing estimates of historical *claims* and *premiums* paid into the reserve each year, and adjusted these numbers upward to reflect the gain in principal limit.

Principal Limits
Loans constrained by the old loan limit were allowed to increase their maximum claim amount under the new loan limit. This allowed for an increase in principal limit.

We first adjusted the initial principal limit of loans that were affected by the national loan limit using the HECM lookup table based on age and interest rates. We anticipated nearly all of the newly adjusted principal limits would increase by a similar percentage as the gain in maximum claim. However, we found that approximately six percent of principal limits actually decreased. These were of the right magnitude to suggest rounding errors in the age and interest rate variable that determines the principal limit factor. Some of this may be due to the reported data, and some of this may be the effect of our imputations of missing and extreme age and interest rate variables.[22] For these records, we used the percentage increase in the maximum claim amount to change the principal limit instead of the HECM lookup table.

Premiums
We started with historical estimates of the paid-in premium for each loan, over each year, and adjusted these premiums directly proportionately to the percentage increase in the maximum claim for those loans affected by the new loan limit.

It might seem surprising that we were able simply to increase premiums proportionately to the increase in maximum claim. However, first observe that the principal limit increases proportionately to the maximum claim, since the principal limit is calculated by multiplying a constant factor against the maximum claim. We then made the assumption that the schedule of payments would increase proportionately in the first year with the increase in the principal limit. This is a reasonable assumption, considering that the tenure and term payments are both calculated by spreading the initial principal limit over a specified number of periods – mathematically, by multiplying the principal limit

[22] Thirty-five percent of the missing age information was replaced by the ages reported in the CHUMS database. After this replacement 1.1 percent of the variables with missing and extreme variables were imputed. Less than one percent of the expected interest rate variable was replaced by the expected interest rate information from the CHUMS database.

by a monthly factor. This is also a reasonable assumption for the line-of-credit plan, since the model has the borrower draw a percentage of the principal limit in the first year.

Given that the first year's payments increased proportionately, the resulting interest charges and MIP payments also adjusted proportionately since they are simply calculated off of the loan balance. Thus, the new loan balance also increased proportionately, and going into the next year, the next year's payments and charges increased proportionately.

Claims

An increased loan limit would increase the size of a claim if one occurred – with a higher loan limit, the borrower is using the same house value to secure a larger loan. Estimating the effect on claims is not as simple as increasing claims proportionately to the increase in principal limit. A claim is composed of two factors, the outstanding loan balance (which increases proportionately with principal limit) less the house price (which is unaffected by the principal limit). Therefore, an increase in principal limit will more than proportionately increase the claim amount.

Using some simple calculations,[23] we calculated that the new claim is the old claim increased proportionally to the principal limit gain, plus the gain percentage times the house price at time of claim.

Once all the adjustments were completed under each policy scenario, the reserve model passed the new principal limits onto the projection half of the model. The model proceeded to determine the net expected insurance liability following the original actuarial model.

Actuarial Results

The simulation of national loan limits at the time of origination for current HECM borrowers indicates that the even with the higher limits, the mortgage reserve still safely covers the projected future claims. It is also worth noting that even with the higher limits, there remains a small margin of 9 and 8 percent of borrowers with appraisal values exceeding the 87 percent and 100 percent limits, respectively.

Exhibit 4-5 reports the full results of the loan limit simulation. For the 87 percent national loan limit, the reserve is increased by \$9.9 million and projected premiums by \$4.2 million, with claims increasing by \$31.0 million from the base case. For the 100 percent national loan limit, the reserve is increased by \$14.1 million and projected premiums by \$8.1 million, while projected claims increase by \$64.9 million from the base case.

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23 Let c1 = the original reported claim, tolbt = the loan balance at time of claim, and hsprct = house price at time of claim. We wish to calculate c2 = new claim, given that tolbt is increased by x%. Then:

c1 = tolbt – hsprct
c2 = (1+x)*tolbt – hsprct
c2 = (1+x)*tolbt – (1+x-x)*hsprct
c2 = (1+x)*(tolbt-hsprct) + x hsprct
c2 = (1+x)*c1 + x*hsprct

Relative to the base case, net expected liability is increased. It is not surprising that claims increase more than premiums, since the houses that were constrained by the old loan limit would be securing larger loans with the same house value. For example, if a house is worth $200,000 and had an FHA loan limit of $150,000, then the borrower would only be able to borrow as if her house was worth $150,000, leaving an "extra" $50,000 of her house's value as a cushion against claims. With the new national loan limit, she would be allowed to borrow against the full value of her home, leaving no additional cushion against a claim. However, even with the 100 percent loan limit and the model's conservative interest rate and house price growth assumptions, net expected liability remains negative, at -$11.4 million.

Exhibit 4-5
National Loan Limit Actuarial Model Results: Total Estimates

	Reserve (Past Premiums Less Claims)	Present Value of Future Claims	Present Value of Future Premiums	Net Expected Liability
	(in $ millions)			
Base Model	176.8	231.7	108.9	-54.0
87% Limit	186.7	262.7	113.1	-37.1
100% Limit	190.9	296.6	117.0	-11.4

Exhibit 4-6 reports the results of the loan limit simulation on a per-loan basis. For the 100 percent national loan limit, the reserve is increased by $272 and projected premiums by $156 per loan, while projected claims increase by $1,248 from the base case. Net expected liability is -$219 per loan.

Exhibit 4-6
National Loan Limit Actuarial Model Results: Per Loan Estimates

	Reserve (Past Premiums Less Claims)	Present Value of Future Claims	Present Value of Future Premiums	Net Expected Liability
Base Model	$3,401	$4,456	$2,094	-$1,039
87% Limit	$3,591	$5,053	$2,176	-$714
100% Limit	$3,673	$5,704	$2,250	-$219

Sensitivity Testing

We subjected the national loan limit model to sensitivity tests of future interest rate and house price appreciation assumptions. Exhibit 4-7 is split into Part a for 87 percent loan limit results and Part b for 100 percent loan limit results. There are two numbers in each cell. The top number is the net expected liability under the national loan limits and the second number (in parentheses) is the change in net liability relative to the base model with FHA loan limits. For consistency with the 2000 model, we put in bold face the cell that corresponds to an interest rate of 7.8 percent, and a house price appreciation rate of 3 percent. Under those assumed model conditions, the current book of HECM business would have an expected net liability of -$37.1 million for 87 percent and -$11.4 million for

100 percent national loan limits. However, with house price appreciation at 3 percent and future interest rates around 6 percent, the current book of HECM business would have a negative expected net liability over $200 million, with national loan limits.

Exhibit 4-7a
Actuarial Model Results of Sensitivity Testing
Net Expected Liability for 87% Loan Limits (and Change Relative to Base Model)*

		Future Expected Interest Rate			
		5.8%	**6.8%**	**7.8%**	**8.8%**
		(in $ millions)			
Future House Price Appreciation Rate	**2%**	-180.0 (2.1)	-74.5 (12.6)	+77.2 (25.3)	+277.2 (39.7)
	3%	-239.0 (-4.4)	-163.8 (4.6)	**-37.1** **(16.9)**	+142.8 (31.4)
	4%	-272.1 (-8.9)	-233.8 (-3.0)	-141.3 (7.8)	+11.0 (22.1)
	5%	-281.5 (-10.4)	-274.6 (-8.4)	-225.0 (-1.1)	-111.0 (11.8)

*Note: row indicates projected house price appreciation rate, column indicates projected interest rate. First number in cell corresponds to Net Expected Liability for the 87% loan limit simulation. The number in parentheses is the marginal change in liability due to the higher loan limits when compared to the base model.

Exhibit 4-7b
Actuarial Model Results of Sensitivity Testing
Net Expected Liability for 100% Loan Limits (and Change Relative to Base Model)*

		Future Estimated Interest Rate			
		5.8%	**6.8%**	**7.8%**	**8.8%**
		(in $ millions)			
Future House Price Appreciation Rate	**2%**	-171.1 (11.1)	-53.9 (33.3)	+110.9 (59.0)	+325.3 (87.9)
	3%	-237.5 (-2.8)	-151.3 (17.0)	**-11.4** **(42.6)**	+183.5 (72.2)
	4%	-276.6 (-13.3)	-230.1 (0.7)	-124.8 (24.3)	+42.9 (54.0)
	5%	-288.5 (-17.4)	-278.3 (-12.1)	-218.7 (5.2)	-89.5 (33.3)

*Note: row indicates projected house price appreciation rate, column indicates projected interest rate. First number in cell corresponds to Net Expected Liability for the 100% loan limit simulation. The number in parentheses is the marginal change in liability due to the higher loan limits when compared to the base model.

The marginal effects in parentheses show an interesting pattern of increasing with interest rates, but decreasing with house price appreciation rates. On average, 87 percent national loan limits increase fund liabilities by $8.6 million and 100 percent loan limits increase fund liabilities by $24.7 million. However, for low interest rates the net liabilities decrease, especially if house prices are increasing more rapidly. The impact of national loan limits on fund liability is most positive in the higher interest rates, especially if house prices are increasing more slowly.

Stochastic Model Results

The stochastic model with national loan limits barely increases the predicted net value of the fund from $244.9 million to $248.8 million for the 87 percent limit or $252.3 for the 100 percent limit (see Exhibit 4-8). Both the present values of future claims and future premiums increase as the higher limits allow borrowers to increase their loan sizes. This is the same pattern as seen in the non-stochastic model with low interest rates and moderate house price appreciation. Both the reserves and present value of future premiums are 4 to 8 percent higher for the national loan limit models. Future claims are much more sensitive to the loan limits with increases from 19 to 25 percent. The big difference is the level of future claims. In the non-stochastic model, interest rates are held at 7.8 percent and the claims are $263 to $297 million. Whereas in the stochastic model, interest rates average only 5.5 percent and the claims are much lower at $73 to $77 million. With low interest rates, the increase in premiums is more than enough to cover the claims so the net expected liability edges lower. Given the similarity in results to the non-stochastic model with low interest rates, it is likely that a stochastic model starting at higher interest rates would show that national loan limits usually increase the net expected liability of the fund.

Exhibit 4-8
National Loan Limit Stochastic Model Results: Total Estimates

	Reserve (Past Premiums Less Claims)	Present Value of Future Claims	Present Value of Future Premiums	Net Expected Liability
	(in $ millions)			
Base Model	176.8	61.8	129.9	-244.9
87% Limit	186.7	73.3	135.4	-248.8
100% Limit	190.9	77.0	138.3	-252.3

The stochastic model makes it possible to estimate a distribution around the mean prediction. Statistics from that distribution are shown in Exhibit 4-9. Only seventeen of the 250 trials have positive net liabilities, but the largest is quite substantial at $352 million for the 100 percent loan limit.

Exhibit 4-9
Distribution of Net Expected Liability from the Stochastic Model

	Mean	Confidence Interval (95%)	Standard Deviation	Minimum	Maximum
	(in $ millions)				
Base Model	-244.9	+/- 11.0	88.6	-322.7	177.7
87% Limit	-248.8	+/- 12.1	97.3	-336.1	201.8
100% Limit	-252.3	+/- 12.6	101.5	-343.4	213.6

Demand Estimation Analysis

The model for the national loan limit analysis simulates the historical effect of instituting a national loan limit from the start of the HECM program, for the current set of borrowers. However, this analysis ignores the pool of hypothetical borrowers – the policy might have made HECMs more attractive and drawn other participants into the program, for whom we have no data. For completeness, we estimated how many more homeowners might have been interested in the HECM program, if national loan limits had existed.

Using demographic data from the 1999 American Housing Survey (AHS), we estimate that participation in the HECM program would have increased by between 0 - 25 percent, with a reasonable estimate being about 5 percent. To arrive at this estimate, we used AHS data to calculate the proportion of homeowners who chose to use a HECM, based on their house's value relative to the loan limit. For example, we determined that 0.122 percent of elderly homeowners with house values between 125 and 150 percent of the average loan limit opened a HECM. Then we adjusted the loan limit up to the new national limit, and extrapolated the old participation rates, calculating that approximately 25 percent more elderly homeowners would have used the HECM program.

This estimate of 25 percent assumes that the only deciding factor in opening a HECM is the loan limit. However, the decision to open a HECM is influenced by many factors that are of greater importance than the loan limit. One might liberally speculate that the loan limit is the deciding factor in one in five decisions to open a HECM. Therefore, one could roughly estimate that the marginal effect of the loan limit would have been to increase HECM participation by 5 percent.

It is left up to the reader to decide exactly what percent of the decision calculus is influenced by loan limits, and hence what fraction of 25 percent to use as an estimate of increased demand. It is also important to note that participation could be, in theory, increased by more than 25 percent: it is possible that an increase in the national loan limit would have had unanticipated advertising effects, by for example creating a critical mass of borrowers, drawing the attention of new lenders, or increasing the awareness among new geographic pockets. While we don't believe this is likely, it is in the realm of possibility.

The discussion so far has emphasized the impact of increased HECM demand associated with increased loan limits. However, the increase in loan limits is concentrated in low-cost areas. We assume the house prices increase at the same rate in low-cost areas as high-cost areas in the long run, even though that has not been true recently. Then the key difference for the existing loans is what share of loans were constrained by the loan limits vs. the appraised value. Loans constrained by the loan limit have the equity cushion of the difference between the loan limit and the appraised value. Therefore limit-constrained loans have lower expected claims than those loans constrained by the appraised value. The substantial increase of loan limits in low-cost areas should mean that more of those loans are limited by the appraised value and, thus, more likely to claim. In essence, the higher loan limits allow owners to borrow more money against the same house value, so the probability of outstanding balances exceeding the house value has increased.

On the other hand, some of the *new* demand brought in by the higher loan limits will have house values exceeding the loan limits. These are households who considered the amount of equity they could borrow to be too small under the old loan limits. The new, higher limits may still not reach the appraised value, but those limits are now close enough to make a HECM loan worthwhile. Unlike the appraised value constrained loans discussed above which have bigger loans on the same house, these new HECM borrowers will have bigger loans and more expensive houses. To the extent that more expensive houses appreciate faster than less expensive houses, we would expect lower claim rates. The higher loan limits mean owners with houses close to or above the median house price can now benefit from HECMs. By being closer to the middle of the market, we might expect better sales prices than the less expensive, and perhaps older, houses on the lower fringe of the market.

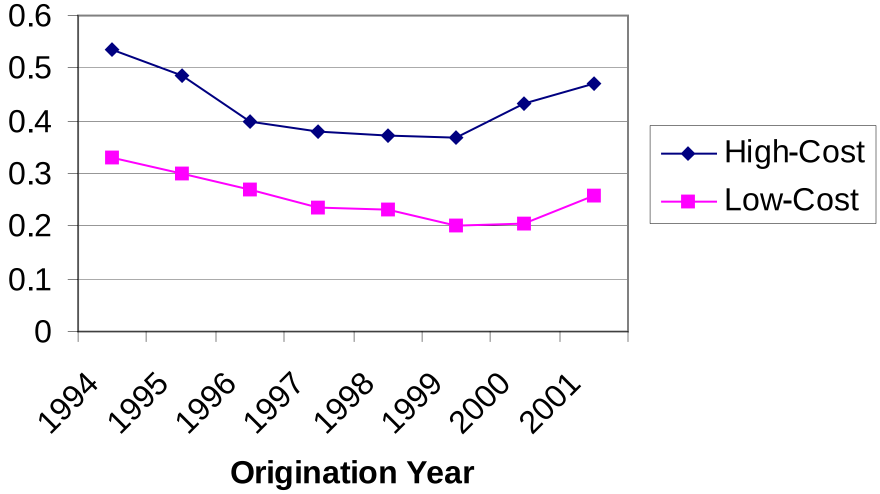
Some portion of the new demand in low-cost areas will be loan limit-constrained with lower claim rates and some portion will be appraised value-constrained. The impact on existing loans will be dominated by an increase in appraised value constrained loans, which means higher claim costs. But the impact on new loans could very well be more limit-constrained loans with lower claim costs. The net effect on the fund depends on the relative balance between those two portions.

The change in FHA loan limits in 1998 provides an interesting precedent. FHA loan limits were increased from 75 percent of conforming loan limits to 87 percent of loan limits. Exhibit 4-10 shows the share of limit-constrained loans by origination year. The upper curve shows the share of limit-constrained loans in high-cost areas and the lower curve shows the share of limit-constrained loans in low-cost areas. Loans in low-cost areas are much less likely (about 18 percentage points) to be limit-constrained. This suggests that shifting to a national loan limit, which mostly increases the limits for low-cost areas, will have less impact than increasing loan limits for all areas. Nevertheless, the mix of loans will shift with more loans from low-cost areas, which tend to be less limit-constrained and more likely to claim.

The other interesting aspect shown in Exhibit 4-10 is that the trend toward fewer limit-constrained loans reversed in 1999. The higher loan limits seemed to broaden the market appeal of HECMs because the new loans were more likely to be limit-constrained, i.e. their appraised value exceeded the loan limit. Owners from the low end of the market are more likely to be appraised value-constrained, but new borrowers from the middle of the market are more likely to be limit-constrained. It is possible that shifting to a national loan limit would have similar effects such that higher claims from the low-end borrowers are offset by lower claims from the mid-market borrowers.

An increase in demand by 5 percent would, roughly speaking, increase the net present value of the insurance fund by 5 percent. This assumes that new borrowers would have on average, the same characteristics as existing borrowers. This may turn out to be a bit optimistic – the new participants will have higher average house values but also more likely to be appraised-value constrained. However, it seems reasonable to assume that on balance the new demand generated would have the same characteristics as existing borrowers. Therefore, drawing on the loan limit analysis of existing HECM borrowers in this chapter, the net present value of the fund with 5 percent increased demand could be 5 percent higher net values, i.e., $39 million (=37.1*1.05) for the 87 percent loan limit and $12 million (=11.4*1.05) for the 100 percent loan limit scenarios.

Exhibit 4-10
Share of Limit-Constrained Originations by Origination Year



Summary

This chapter evaluated a proposed policy of instituting national loan limits. To do this, the model simulated the historical effect of instituting national loan limits for the current book of HECM loans. This is relevant to approximately 30 percent of HECM borrowers who had house values above the FHA 203(b) local loan limits, allowing these borrowers to increase their principal limits.

The effect of the new loan limits for existing HECM borrowers is most felt in low-cost areas. Some borrowers would have been greatly benefited, while others, living in higher cost area with higher current limits, would not have significantly benefited from the new loan limit. This brings up a possible equity concern with the proposed policy – the uniform loan limit constrains HECM borrowers in high price areas to a lower share of their equity than it permits borrowers in low price areas. An alternative policy would increase local loan limits a uniform proportion allowing a higher, but equal, share of equity across communities.

As expected, the effect relative to the base case was to increase net liability because the new loan limits generally increased the amount of principal available to borrowers. The net expected liability of the fund was changed from the base of -$54.0 million to -$37.1 million under the 87 percent Fannie Mae loan limits and to -$11.4 million under the 100 percent loan limits. Furthermore, the sensitivity test showed that assuming a lower interest rate of 6 percent would mean that the present value of the fund could be over -$200 million, even with the loan limits. The marginal liability effect of national loan limits depends positively on interest rates and negatively on house price appreciation rates.

The stochastic model is another way of sensitivity testing by allowing interest rates and house prices to follow the same transition probabilities that they have in the past. Results from the stochastic simulation model give a net expected liability of -$244.9 million under FHA loan limits. Allowing national loan limits decreases the net liability to -$248.8 million for the 87 percent loan limits and to -$252.3 million for the 100 percent loan limits. The stochastic model has lower average interest rates (about 5.5 percent). This reduces the level of future claims so much that the increase in premiums more than covers the increase in claims.

Finally, we estimated the effect of the policy change not just on the existing book of loans, but also on the potential change in demand for the program, by conducting a demographic analysis using the American Housing Survey. With important caveats, we estimated that demand would be affected by roughly 5 percent, although this could range anywhere from 0 to 25 percent or higher. This would, conservatively speaking, increase the net present value of the fund by 5 percent. Most new loans will be in the low-cost areas, which have a smaller percentage of limit-constrained loans and, thus, higher claim rates. However, this may be offset by new demand from owners of houses in the middle of the market, which are more likely to be limit-constrained and less likely to claim. The balance between these two components of new demand is hard to predict, but it seems unlikely to cause a dramatic reduction in the value of the fund.

Chapter Five
Reduced Premium Refinance Analysis

HECM borrowers may find it advantageous to refinance their loans if they experience unexpectedly high house price appreciation or if interest rates drop. Higher house price appreciation results in a larger cushion against a possible claim, and hence frees up more principal for borrowing. Lower interest rates make it less likely that the interest accumulating on drawn principal would exceed house value and result in a claim. Fluctuations in house prices and interest rates mean that refinancing is likely to occur under the most favorable combinations of high house prices and low interest rates. But terminations, especially those driven by mortality, can occur during unfavorable combinations of low house prices, high interest rates and little equity cushion. Refinancing allows owners to increase their principal limit and tap the excess of house value over their outstanding balance. However, that excess house value provides the insurance fund a protection against claims. *Ex ante*, neither the owner nor FHA can predict which properties will do well or poorly. If the properties that do well borrow against their gain, that leaves less cushion against future claim for those properties and fewer funds for cross-subsidy to cover the claims of properties that do poorly.

To date, few HECM loans have been refinanced with FHA. Under current rules, a HECM borrower has to prepay the old loan and originate an entirely new loan in order to refinance, paying the 2 percent upfront MIP on the entire new maximum claim amount. When refinancing, the owner is effectively paying twice for the insurance coverage of the original maximum claim amount. FHA is considering a rule change that would allow borrowers to pay the 2 percent MIP on only the difference between the new maximum claim and the old one. This would reduce the upfront premium cost of refinancing to the borrower. To give an idea of the size of this rule change, suppose that a borrower originally borrowed against a $100,000 home and paid a $2,000 upfront MIP. Suppose that her home appreciated to $150,000. Instead of originating an entirely new loan and paying a $3,000 MIP (2 percent of $150,000), she would be able to refinance and only pay a $1,000 MIP (2 percent of $50,000, the difference between the old and new maximum claim amounts).

This chapter discusses the changes to the actuarial model and results from modeling reduced premium refinancing. We first discuss the assumptions behind 18 refinancing scenarios modeled, which model three different program design options, three different assumed participation rates, and two different timing options. Then we discuss the model mechanics specifically.

Next, the results are presented. In the most flexible option with medium participation, about 10 percent of active borrowers chose to refinance, increasing projected claims by 16 percent and premiums by 5 percent. The substantial increase in claims relative to premiums means net liabilities would increase from -$54 million to -25.5 million or about 50 percent. Other options do not allow principal limits to be increased as much, so the impact on fund value is smaller.

We subject the refinance model to sensitivity tests by varying the expected interest rate and house price growth rates. In high refinance situations (driven by strong house price growth), with high participation (up to 13 percent of borrowers), the fund surplus is reduced as much as 60 percent. Unfortunately, even these sensitivity tests assume straight-line interest rate and house price appreciation, which may mask special results related to fluctuating interest rates. To capture the impact of fluctuating interest rates and house prices a Monte Carlo simulation was done for the most flexible Option A assuming medium participation. It is important to remember that the stochastic model assumes interest rate paths start from the current, very low interest rates. In those conditions, about 45 percent of owners refinance and the net liability falls from -$244.9 million to -$129.8 million or 47 percent. Premiums increase by 22 percent, but they are dominated by claims, which increase by 233 percent. Reduced premium refinancing could have a major impact on the FHA insurance fund.

Assumptions / Scenarios

There are many possible assumptions that could be used to model a hypothetical reduced premium refinance program. There are three possible program designs, two options for the timing of refinancing, and three options for program participation rates. The model ran 18 different scenarios to cover each combination of these assumptions.

Program Design

First, the model simulates three possible program designs.

A) Permit all loan information to change (house prices, loan limits, interest rates, age);
B) Leave house price fixed at original appraisal, but allow loan limits, interest rates and age to change;
C) Leave house price and loan limit fixed, but allow interest rates and age to change.

Exhibit 5-1
Summary of Reduced Premium Refinance Program Options

Assumption	House Price Growth	New, Higher Loan Limit	New, Lower Interest Rate	Increased Age
Option A – permit all loan info to change	X	X	X	X
Option B – keep original appraisal		X	X	X
Option C – Keep original max claim amount			X	X

As shown in Exhibit 5-1, Option A is the most generous to the borrower, allowing borrowers to originate a reduced-premium loan based completely on their new characteristics. This option allows borrowers to take advantage of their house price appreciation, the current interest rate, new loan limits and their current age. As discussed earlier, high house price appreciation provides a larger cushion against a possible claim, and a lower interest rate makes it less likely that the interest accumulating on the drawn principal will eventually exceed the property value. A new, higher loan limit would allow a borrower whose house value exceeded the old loan limit to use a greater portion of their house value to secure an increased principal amount. Finally, the advance of age shortens the expected length of the loan and thus lowers the interest owed and the expected loan balance, increasing the principal available to her. In effect, Option A provides the borrower all the advantages of replacing the existing loan with a new HECM, but with a reduced upfront premium.

Option B would be the same as Option A, but would not allow the borrower to increase her principal amount based on house price appreciation. Option C goes one step further, not allowing reduced premium refinancing to take advantage of new loan limits, but does adjust the principal limit for current interest rate and age characteristics.

Timing of Refinance

The model also simulates two possible program designs, regarding the timing of refinancing. The first possibility allows refinancing to occur only in the year following a rule change – presumably this would satisfy pent-up demand for a refinancing option. The second possibility, call it "the continuous refinance option" would allow the current book of borrowers to refinance any year in the future.

Participation Rates

Finally, there is no historical data that might be used to estimate the behavior of HECM borrowers – i.e. how many borrowers would choose to refinance, and under what exact conditions. Lacking this data, the model calculated the possible gain in available principal that a borrower might receive as a result of refinancing, and then classified borrowers as "high" or "low" gainers. High gainers were those who were able to increase their available principal by 20 percent, and low gainers were those who were able to increase their available principal by 10 percent. For both high and low gainers, the absolute dollar gain had to be at least $5,000 to be considered a gain at all. The $5,000 is arbitrary, but seemed the minimum necessary amount to cover the closing costs and still gain any benefit from the refinancing.

Given this pool of high and low gainers, we modeled three participation rates:

Low:	10% of low gainers and 20% of high gainers
Medium:	20% of low gainers and 40% of high gainers
High:	30% of low gainers and 60% of high gainers

For the continuous refinancing option, which allows refinancing in every year in the future, we reduced annual participation rates so that participation would reach these levels gradually over five years.

Model Specifics

Refinance activity was simulated starting from the cutoff date, thus affecting only the future projection and not the reserve calculation. There are 37,230 loans that remain active after the cutoff date.

The model first identified the hypothetical principal limit available to a borrower who was considering refinancing. The actual principal limit table used to originate loans was used to look up the current interest rate and borrower age to result in the principal limit factor, which was then multiplied by the maximum claim amount available (influenced by house price and loan limits). This resulted in a new principal limit available to the borrower. The principal limit factors determine the amount of principal an owner can borrow and still have the loan covered by the value of the house. An owner can borrow more under a lower interest rate because the outstanding balance will grow more slowly over time relative to the house price appreciation. On the other hand, higher borrower age means there is less time for the loan balance to increase, so less equity needs to be set aside for interest and more equity is available for the owner to borrow.

This hypothetical refinance principal limit was compared to the borrower's actual current principal limit. The current principal limit is grown "automatically" every year, according to HECM rules (See Chapter 2). The entire original principal limit, regardless of draws, is grown at the going interest rate plus margin and MIP, to arrive at the current principal limit. To be consistent with the 2000 report, we assumed this rate to be 7.8 percent plus 0.5 percent MIP in the model. The idea is that if the hypothetical refinanced principal limit is substantially higher than the current principal limit, a borrower is likely to want to refinance.

This hypothetical refinance principal limit was not compared directly to the "automatically grown" principal limit, however. Rather, the model first subtracted the outstanding loan balance and service fee set aside from both amounts, yielding the *available principal*, and then compared these numbers. For example, suppose the automatically grown principal limit is $100,000 and the refinanced principal limit would be $110,000. A borrower could gain a 10 percent increase in her principal limit by refinancing. This ignores, however, the outstanding loan balance. Suppose the outstanding balance owed plus set aside is $50,000. By refinancing, a borrower increases the *available* principal from $50,000 (100,000-50,000) to $60,000 (110,000-50,000), a 20 percent gain.

Transaction costs were not explicitly modeled, but they are addressed by the assumption that the refinance would not be undertaken unless the gain exceeded $5,000. Closing costs vary widely by state and lender. There may even be a time factor as there is in forward mortgages where some closing costs are reduced if the refinancing takes place soon after the origination or last refinancing. The $5,000 minimum is arbitrarily set and may have a modest effect on the estimated participation rates. A higher minimum would reduce the number of gainers, primarily low gainers, and thus shrink the overall effect, but the direction of change would be the same.

After the possible gain was computed, the model randomly flagged a certain percentage of high and low gainers that choose to refinance, according to the model scenario. For these participants, a 2 percent upfront MIP was charged on the difference in the maximum claim amounts.

Then the current principal limit for refinancers was instantaneously increased according to the lookup table. For line of credit borrowers, the model assumed that they would continue their estimated draw percentages going forward, and thus they simply drew more each year in response to the larger principal amount available. Term plan borrowers were completely switched to a line of credit plan, since we lack any information on which of many behavioral choices would be taken at that point.

Tenure borrowers were assumed to still prefer tenure payments, and the model simply stepped up their scheduled tenure payments in response to the increased principal amount available.

Non-Stochastic Model Results

The results of the non-stochastic model showed that most options for reduced premium refinancing have only a modest impact on the fund value because participation is low. However, Option A, which allows borrowers to use a current appraisal to reset their principal limit, can have a substantial effect on the fund.

Exhibits 5-2 through 5-5 report the results for the first year, and continuous refinance scenarios. The highest participation under the first-year only refinancing option was 3,317 or 8.9 percent of active loans. Participation in Options B and C under the first-year refinancing was much smaller (under 1.5 percent). The gain in premiums from the first-year refinancing was about $1,100. The gain in principal per borrower ranged from $15,053 under Option A to $29,334 under Option C. Despite the significant gains in principal limit, so few owners benefited from those gains that the net impact on the fund value was $1.1 million or less.

Allowing owners to refinance at anytime after the cutoff date increased participation. The biggest gains in principal per borrower were associated with Option A in which a new appraisal could boost principal limits. Assuming high participation, as many as 13 percent of active loans could increase their principal limit an average of $25,545 with the payment of an additional premium of about $1,400. The high participation and substantial benefits from refinancing under Option A led to an increase in claims that exceeded the modest gain in premiums. As a result, the net liability of the fund increased by $19.3 million to $32.5 million depending on degree of participation. Options B and C provided advantages to fewer borrowers so participation was low and net impact on the fund below $4 million.

Exhibit 5-2
First Year Refinance, Marginal Effect on Claims and Premiums

Scenario	**Participation:**	**High**	**Medium**	**Low**
			(in $ million)	
A – permit all loan information to change	PV Claim	5.0	3.2	1.6
	PV Premium	3.9	2.6	1.3
	Net Claim	1.1	0.6	0.3
B – keep original appraisal	PV Claim	0.3	0.2	0.1
	PV Premium	0.7	0.4	0.2
	Net Claim	- 0.4	- 0.3	- 0.1
C – keep original max claim amount	PV Claim	0.06	0.03	0.02
	PV Premium	0.01	0.01	0.004
	Net Claim	0.04	0.02	0.01

(Base Case claims = $231.7 M, Base Case premiums plus reserve = $285.7 M, Base Case net claim = -$54.0 M)

Exhibit 5-3
First Year Refinance, Key Statistics for Refinance Participants

Scenario	**Participation:**	**High**	**Medium**	**Low**
A – permit all loan information to change	Participants	**3,317**	**2,211**	**1,105**
	MIP/Borrower	$1,079*	$1,063	$1,088
	Principal/Borrower	$15,190	$15,053	$15,375
B – keep original appraisal	Participants	**541**	**361**	**179**
	MIP/Borrower	$1,102	$1,112	$1,117
	Principal/Borrower	$17,699	$17,352	$17,614
C – keep original max claim amount	Participants	**71****	**45****	**22****
	MIP/Borrower	$0	$0	$0
	Principal/Borrower	$24,260	$24,595	$29,334

(Total participants in the HECM program are 51,992)
*Note: MIP / Borrower only includes the reduced 2% upfront premium, and not the subsequently increased ongoing premiums.
**Note: many of these participants may be the result of data reporting erroneously low initial principal limits.

Exhibit 5-4
Multi-Year Refinance, Marginal Effect on Claims and Premiums

Scenario	**Participation:**	**High**	**Medium**	**Low**
		(in $ millions)		
A – permit all loan information to change	PV Claim	38.0	32.5	21.6
	PV Premium	5.4	4.1	2.3
	Net Claim	32.5	28.5	19.3
B – keep original appraisal	PV Claim	4.6	3.8	2.4
	PV Premium	0.8	0.6	0.4
	Net Claim	3.7	3.2	2.0
C – keep original max claim amount	PV Claim	1.9	1.6	0.9
	PV Premium	0.05	0.04	0.02
	Net Claim	1.9	1.5	0.9

(Base Case claims are $231.7M, Base Case premiums plus reserve is $285.7M, Base Case net claim is -$54.0 M)

Exhibit 5-5
Multi Year Refinance, Key Statistics for Refinance Participants*

Scenario	**Participation:**	**High**	**Medium**	**Low**
A – permit all loan information to change	Participants	**4,837**	**3,662**	**2,118**
	MIP/Borrower	$1,371**	$1,424	$1,490
	Principal/Borrower	$24,545	$28,215	$32,398
B – keep original appraisal	Participants	**921**	**698**	**396**
	MIP/Borrower	$994	$1,028	$1,092
	Principal/Borrower	$20,366	$21,568	$24,124
C – keep original max claim amount	Participants	**268*** **	**202*** **	**115*** **
	MIP/Borrower	$0	$0	$0
	Principal/Borrower	$14,008	$14,529	$15,032

(Total participants in the HECM program are 51,992)
*Note: statistics are weighted downward by loan survival probability.
**Note: MIP / Borrower only includes the reduced 2% upfront premium, and not the subsequently increased ongoing premiums.
***Note: many of these participants may be the result of data reporting erroneously low initial principal limits.

Caveats

There are two important assumptions that underlie this analysis that deserve further consideration. One is the assumption about spending patterns. Without historical experience on HECM advances after refinancing, we assumed that the borrower would draw advances following the same pattern by policy year. The advances would increase because the available principal limit increased, but the percentage of that principal limit would follow the rate for the policy year of the original loan. For example, suppose the owner refinances in the third year of a HECM loan and the available principal limit increased from $100,000 to $120,000. Suppose the advances in the third year were 40 percent for this type of loan. The advance rate of 40 percent would not change with the refinancing, but instead of being 40 percent of $100,000 it would be 40 percent of $120,000.

It is reasonable to speculate that borrowers would undertake the cost of refinancing because they wanted to increase their advances as a percentage of their principal limit. In this case, the advance rate of refinances in the first year after refinancing might be more like the advance rate in the first year of the original loan rather than the third or fourth policy year. The increase in utilization rate (outstanding balance relative to principal limit) would likely increase the number and size of claims. It is difficult to quantify the difference this could make in the estimates, but it is possible that more aggressive borrowing by refinancers would reduce the fund value by 5 to 10 percent.

Another caveat worth considering is that participation in the existing portfolio of HECM borrowers may be substantially lower for new borrowers. Borrowers who thought their properties might appreciate faster than the average would be reluctant to enter the HECM Program and lose their option for future gains. In effect, the rules at the time of loan origination selected out the properties with average or below average potential for appreciation. If this is an important effect, it is likely that the participation rate for the existing HECM borrowers might be lower than expected. However, borrowers that enter the program under the new rules might be more likely to take advantage of refinancing opportunities. As with the previous caveat, it is very hard to quantify this effect. It is quite possible that a change in refinancing rules could take 5 to 10 years before it has reached a higher level of participation and full impact on fund value.

Sensitivity Analysis

The results were subjected to sensitivity tests by changing the interest rate and house price growth assumptions. Exhibit 5-6 reports the effect of refinancing on the total net expected liability and Exhibit 5-7 shows the key statistics for refinance participants. For ease of understanding, sensitivity tests are reported only for continuous refinance, option A, with medium participation, because the other 17 refinance specifications behaved similarly, but to a lesser extent.

As discussed in more detail in the sensitivity analysis portion of Chapter 2, it is useful to see the broader view afforded by the sensitivity results. In the base model, we have assumed a fairly conservative house price growth rate of 3 percent and an expected interest rate of 7.8 percent, for comparability to the 2000 model. However, actual expected interest rate conditions as predicted by long-term T-bonds predict an interest rate closer to 6 percent. The lower interest rates are more suitable for the near term and may stimulate a higher rate of refinancing.

We report the results for program option A, with “continuous” refinancing and medium participation. In the most aggressive refinance scenario (5.8 percent interest rates and 5 percent house price growth), refinancing causes the net expected liability to decrease by $1.4 million dollars – refinancing is beneficial to the fund. At the other extreme of high interest rates (8.8 percent) and low house price growth (2 percent), the net liability increases by $30.7 million or about 11 percent. The change in fund value does not exceed $33.5 million, which occurs when interest rates are 8.8 percent and house price growth is 3 percent.

The key message from Exhibit 5-6 is that refinancing increases net liabilities in most situations, but the impact is moderate, usually $10 million to $30 million. Also, our selected combination of 7.8

percent interest rates and 3 percent house price appreciation generates a net liability of –$25 million, which is right on the boundary with positive liabilities. Small changes in either interest rates or house prices from that selected combination can cause large changes in the predicted net liability.

Exhibit 5-6: Results of Sensitivity Testing
Continuous Refinance, Program Option A, Medium Participation
Net Expected Liability, Total Estimates (and Marginal Effect of Refinance)

		Future Estimated Interest Rate			
		5.8%	**6.8%**	**7.8%**	**8.8%**
		(in $ millions)			
Future House Price Appreciation Rate	2%	-163.0 (19.1)	-62.3 (24.8)	+80.0 (28.1)	+268.2 (30.7)
	3%	-220.7 (13.9)	-146.3 (22.1)	**-25.3** (28.7)	+144.8 (33.5)
	4%	-256.3 (6.9)	-214.0 (16.8)	-123.1 (25.9)	+22.1 (33.2)
	5%	-272.5 (-1.4)	-257.7 (8.5)	-203.9 (20.1)	-92.5 (30.3)

Turning to the key statistics reported in Exhibit 5-7, we see that the number of refinancers is only moderately sensitive to interest rate levels. For example, holding house price appreciation rates at 2 percent, the range of refinances goes from 2,952 for an interest rate of 8.8 percent to 3,410 for interest

Exhibit 5-7: Results of Sensitivity Testing
Continuous Refinance, Program Option A, Medium Participation:
Key Statistics for Refinance Participants*

			Future Estimated Interest Rate			
			5.8%	**6.8%**	**7.8%**	**8.8%**
	2%	N:	3,410	3,189	3,062	2,952
		M/B	$1,275	$1,278	$1,283	$1,287
		P/B	$23,430	$23,841	$24,066	$24,535
	3%	N:	3,835	3,495	3,293	3,148
		M/B	$1,418	$1,418	$1,413	$1,420
		P/B	$26,035	$27,097	$27,606	$28,491
	4%	N:	4,641	3,886	3,551	3,361
		M/B	$1,638	$1,593	$1,564	$1,565
		P/B	$27,993	$30,190	$31,020	$32,237
	5%	N:	7,301	4,629	3,891	3,601
		M/B	$2,022	$1,836	$1,759	$1,743
		P/B	$27,323	$31,881	$34,690	$35,936

*N = number of refinancers, P/B = average principal limit increase per borrower, M/B = average upfront MIP per borrower. Statistics are weighted downward by loan survival probability. MIP / Borrower only includes the reduced 2% upfront premium, and not the subsequently increased ongoing premiums.

rate of 5.8 percent. The range is eight times larger when house price appreciation rates are 5 percent. The number of owners who gain from refinancing appears to depend more on house price appreciation rates than on interest rates. Although the results from Exhibit 5-7 show that house price appreciation rates are relatively more important than interest rates to owner participation, it is worth noting that interest rates are held constant in the non-stochastic model. Fluctuations in interest rates are normally very important to refinancing and this motivated extending the sensitivity tests to stochastic interest rates and house prices, which follow.

Stochastic Model Results

The stochastic model allows interest rates and house prices to fluctuate randomly according to historical transition probabilities. Refinancing in forward mortgages is quite sensitive to interest rates decreases. In reverse mortgages the motivating consideration is the change in principal limits which, in turn, depends on both house prices and interest rates. Low interest rates mean the outstanding balance will grow more slowly relative to the house price appreciation so the owner can borrow more. Lower interest rates also have an indirect effect by increasing demand for housing, which raises house prices. As in the non-stochastic model, refinancing is expected to increase loan balances and premiums, but also claims. The stochastic model simulates over the 250 trials and the average net expected liability is -$129.8 million with a 95 percent confidence interval of + or – $13.4 million. See Exhibit 5-8. This estimate is more favorable than the -$54 million of the base non-stochastic model, but much less negative than the -$244.9 million of the base stochastic model. Owners use their increase in house value and principal limit to increase their borrowing and this greatly increases the present value of claims. The present value of claims in the base stochastic model is only $61.8 million compared to $205.7 million in the refinance model. As a result, the average net liability shrinks from -$244.9 million in the base model to -$129.8 in the refinance model.

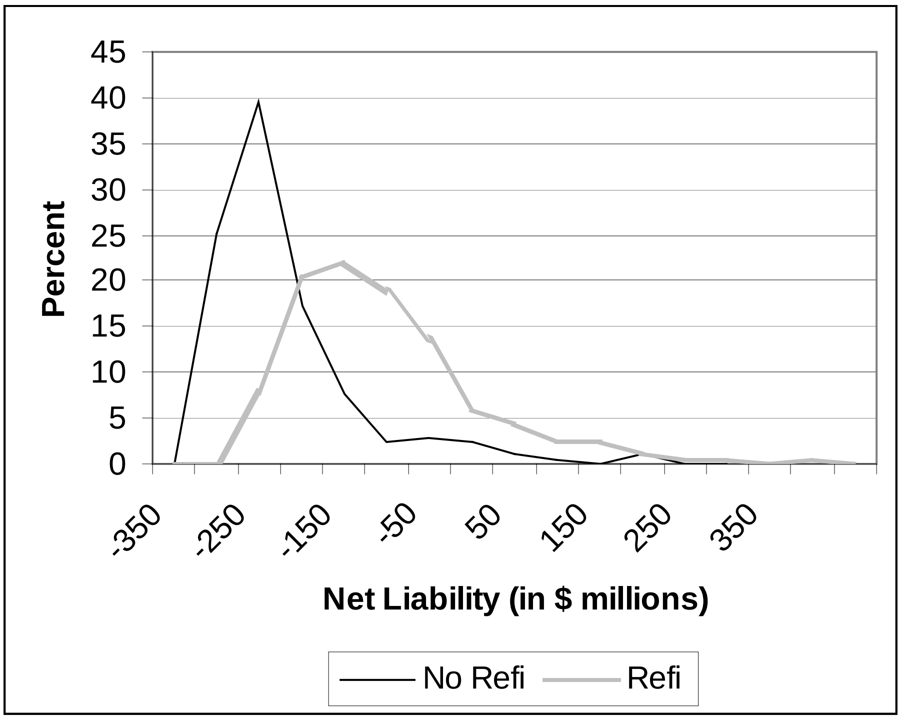
Exhibit 5-8
Summary of 250 Trials of Stochastic Model
Assume Refinance Option A, Medium Participation

	PV Claims	PV Premiums*	Net Liability
	(in $ millions)		
Mean	205.7	158.6	- 129.8
95% Confidence Interval	+/- 12.8	+/- 2.4	+/- 13.4
Standard Deviation	103.2	19.3	108.3
Minimum	54.8	110.6	-286.7
Maximum	677.4	201.4	367.9

* PV Premiums do not include the Reserve of $176.8 million.
Base Case values for comparison:
PV Claims = $61.8 M, PV Premiums = $129.9 M, Net Liability = -$244.9 M

Another way to view the impact of refinance Option A is the comparison of net liability distributions as shown in Exhibit 5-9. For most trials, the net liability is negative with extreme values down to -$286.7 million for the most favorable conditions. However, the distribution of net liabilities with refinancing is clearly shifted to the right. For 11.6 percent of the trials, there are positive liabilities with an extreme value reaching $367.9 million. The advantage of sensitivity testing via a stochastic model is that it shows the distribution of fund liabilities. The stochastic model shows that the net liability will be negative 88 percent of the time with an expected value of -$129.8 million.

Exhibit 5-9
Impact of Refinance Option A on Net Liability in the Stochastic Models
Assume Medium Participation for Refinance Option A



Perhaps the most striking difference from allowing interest rates and house prices to fluctuate is the much larger number of refinances in the stochastic model. The average number of refinances is 16,591 in the stochastic model compared to 3,662 for Option A, medium participation in the non-stochastic model. Even the high participation rate of 4,837 refinances in the non-stochastic model is dwarfed by the number of refinances in the stochastic model. Fluctuations in interest rates and house prices provide many more opportunities to the owners for refinancing. As shown in Exhibit 5-10, the range in the number of refinances is from 4,466 to 26,724. This range corresponds to the wide range in interest rates from 3.1 percent to 15.7 percent with a weighted mean of 5.6 percent. The weights are the probability of loan survival multiplied by the outstanding loan balance for each period. As the loan ages, the probability of loan survival is gradually declining. On the other hand, the loan balances are gradually increasing due to additional advances and automatic charges. Interest rates start at the low, current level, but gradually revert to the long-run average around 6 percent. The weights tend to emphasize the earlier period and weighted mean is about 0.6 percentage points lower than the unweighted mean (6.2 percent). The main point is that fluctuations in interest rates and house prices greatly increase the number of refinances and substantially reduce the value of the fund.

Exhibit 5-10
Key Statistics for Refinance Participants

Stochastic Model with Multi-Year Refinance (Option A, Medium Participation)

	No. of Refinances	Added UFMIP* (Per Refi.)	Principal Limit* Gain (per Refi.)	Interest Rate**	House Price Growth Rate**
Mean of 250 Trials	16,591	$ 42.0 M ($2,531 / Refi)	$ 532.0 M ($32,066 / Refi)	5.6%	3.5%
Standard Deviation	4,062	$ 11.2 M	$ 219.1 M	1.7%	0.7%
Minimum	4,466	$ 11.1 M	$ 67.0 M	3.1%	1.8% (-4.4%)***
Maximum	26,724	$ 74.3 M	$ 1,110 M	15.7%	5.4% (11.2%)***

* Added UFMIP is the additional upfront premiums (2% of gain in maximum claim amount). Dollar values in present value.
** Both the interest rate and house price growth rates are weighted by the product of the probability of loan survival and the outstanding loan balance for that period. The weight gives more importance to the earlier predicted years when the probability of loan survival is higher.
*** The values without parentheses are the minimum and maximum for the average house price growth. For example, 1.9% is the lowest average house price growth averaged over 48 years in a trial. The lowest single year house price growth rate in any trial is given in the parentheses, -4.4 percent. The highest single year house price growth rate in any trial is 11.2 percent.

Summary: Reduced Premium Refinancings

This chapter simulated a reduced-premium refinance program for current HECM borrowers. Participation was moderate in the non-stochastic model, with the medium participation refinance scenario involving 9.8 percent of borrowers still active in the forecast period. Given the moderate participation rate in the non-stochastic model, it is expected that the fund net liability would be moderately increased from -$54.0 million to -$25.5 million.

We then subjected the refinance model to sensitivity tests by varying the expected interest rate and house price growth rates. Even in high refinance situations (driven by strong house price growth), with high participation (sometimes up to 10 percent of borrowers), the effect on the insurance fund is modest ($10 to $30 million). Unfortunately, even these sensitivity tests assume constant interest rate and housing growth, which may mask the full effect of refinancing caused by the movement of interest rates.

Allowing interest rates and house prices to fluctuate in the stochastic model created many more opportunities for refinancing. Assuming the most flexible option for refinancing and medium participation, the stochastic model estimated an average of 44.6 percent refinancing. It appears from the stochastic model results that the low refinancing rate in the non-stochastic model was largely due to the assumption of constant interest rates and house prices. The more realistic stochastic model shows that claims are likely to increase much more than premiums under low-cost refinancing. The net effect of refinancing is to shrink the net liability of the fund by two-thirds from -$244.9 to -$129.8 million. Corresponding to that shift in mean of the distribution, the share of trials with positive liability increases from 3 percent to 12 percent due to refinancing. The conclusion from the stochastic model is that reduced premium refinancing could have a very large impact on the fund on the order of $115 million in a low interest rate environment.

Chapter Six
Combined Loan Limit and Reduced Premium Refinance Analysis

The model presented in this chapter simulates the possibility of both an increase in the national loan limit and a reduced premium refinance program. As with each separate analysis, the national loan limit was simulated as if it had been instituted from the start of the HECM program, and then combined with reduced premium refinancings starting from the 2001 program year.

The results depend on the level of interest rates. At the medium interest rates used in the non-stochastic model, the impact of the 100 percent loan limit is larger than the refinance effect and both of them reduce the value of the fund (increase the liabilities). The 100 percent loan limit increases net liabilities by $42.6 million and Option A refinancing increases net liability by about $30 million. Put together, the program changes would replace the fund surplus of $54.0 million with a deficit of $20.8 million.

The stochastic model gives a different picture, most likely because the interest rates are lower. The impact of 100 percent loan limit is to increase fund value slightly by $7 million (from $244.9 million to $252.3 million). Refinancing has a much bigger effect decreasing fund value by $115 million in the base model or $139 million in the 100 percent model. The effects are offsetting, but the negative refinance effect completely dominates the small positive effect from the higher loan limits. The pattern seems to be that in average interest rate environments, the HECM fund value is reduced moderately by both 100 percent loan limits and refinancing. In low and fluctuating interest rate environments, the effect from 100 percent loan limits is modestly favorable, but the negative effect from refinancing is much larger. The net liability predicted for the 87 percent loan limit model with Option A refinancing is -$117.1 million and -$113.4 million for the 100 percent loan limit model.

Combined Model Specifics / Assumptions

The combined model is a fairly straightforward combination of the loan limit model, which dealt primarily with the reserve fund, and the refinance model, which dealt exclusively with the projection portion of the analysis.

The modeling details and assumptions are dealt with in more detail in Chapters 4 and 5. Overall, the national loan limit simulation is carried out in the same manner as before – the model increased the principal limits of any borrowers that were historically constrained by the old loan limit, at the time of origination. From this increased principal limit, we estimated an increased premium payment schedule and claim history for those loans that terminated before the cutoff date. See Chapter 3 for more details on the estimation methods.

Once the loans reached the cutoff date, the projection side of the model took over and refinancings were simulated going forward, as described in Chapter 5. The key difference at this point from just the plain refinance model is that the loan information at the cutoff date had been adjusted to simulate the increased principal limit at time of origination. So, for the loans affected by the new loan limit, the principal limit that had been reached at the cutoff date was greater and the total outstanding loan balance was greater.

Non-Stochastic Model Results

It is useful to look at one of the 18 possible refinance possibilities to clearly isolate the effect of the loan limits. The results from Option A are reported because the effect is largest in this option and because Options B and C behave in a similar fashion, but with smaller marginal effects.

Exhibit 6-1 has the results for continuous refinance program option A, at medium participation, under three possible scenarios: plain refinance (from Chapter 4), and then refinance combined with 87% and 100% national loan limits, respectively.

Exhibit 6-1
Results for Combined National Loan Limits and Refinancing
Assumptions: Continuous Refinance, Program Option A, Medium Participation
Claims and Premiums (in millions)

		FHA Loan Limits plus Refinance	87% Loan Limits plus Refinance	100% Loan Limits plus Refinance
Total Results:	Reserve	$176.8	$186.7	$190.9
	PV Claims	$264.2	$299.1	$332.3
	PV Premiums	$112.9	$116.9	$120.5
	Net Liability	-$25.5	-$4.6	$20.8
Marginal Effect of Refinance:	PV Claims	$32.5	$36.4	$35.8
	PV Premiums	$4.1	$3.8	$3.6
	Net Liability	$28.5	$32.6	$32.2

In general, the results from increased loan limits combined with refinancing are similar to the results with FHA loan limits. The reserve portion of the calculation is unchanged, and projected claims increase by about $34 million and premiums are increased by only $4 million. As a result, net liabilities are increased by about $30 million to -$4.6 million for the 87 percent national loan limit and to $20.8 million for the 100 percent loan limit. As with the plain refinance comparison to the base case, refinance activity is from 8 to 10 percent. Exhibit 6-2 reports several key statistics around refinancing activity. Refinancing increases premiums by about $1,400 and principal limits by $28,200 to $30,200.

Exhibit 6-2
Continuous Refinance, Program Option A, Medium Participation
Key Statistics for Refinance Participants*

	FHA Loan Limits plus Refinance	87% Loan Limit plus Refinance	100% Loan Limits plus Refinance
Participants	3,662	3,471	3,129
MIP / Borrower	$1,424	$1,396	$1,480
Principal / Borrower	$28,215	$28,223	$30,160

*Statistics are weighted downward by loan survival probability. MIP / Borrower only includes the reduced 2% upfront premium, and not the subsequently increased ongoing premiums.

Sensitivity Analysis

We subjected the combined loan limit and refinance analysis to sensitivity tests, varying projected interest rates and house price appreciation rates.

Exhibits 6-3 and 6-4 report the results using the 100 percent loan limit. The results for the 87 percent case would be similar, but the changes would be smaller. Each cell in Exhibit 6-3 has two numbers. The upper number is the net expected liability and the lower number is the marginal effect of refinancing. This marginal effect is simply the difference in net liability due to refinancing, so the model with 100 percent loan limits and refinances is compared to the model with 100 percent loan limits and no refinances. Following the marginal effects along the first row in the table (2 percent house price appreciation rate but increasing interest rates), we see a pattern of decreasing impact from refinances. Not surprisingly, refinancing has a larger impact when interest rates are low and owners are more likely to gain in principal limit from refinancing. However, for higher appreciation rates this pattern reverses. For high appreciation rates, the marginal effect of refinancing is larger for higher interest rates. Owners are motivated to refinance both by low interest rates and high house price appreciation rates. The marginal effect is positive, but not very large (less than $20 million) in each combination shown.

Similar to chapter 5, there are some situations (e.g.: 5 percent house price appreciation and 5.8 percent interest rates) where refinance participation levels are relatively higher (20 percent of active loans). The higher participation rates tend to occur in combinations of low interest rates and high house price appreciation rates, which have low claim rates. Thus, the impact on the fund value is modest for the non-stochastic models.

Exhibit 6-3
Results of Sensitivity Testing
100% Loan Limit With Continuous Refinance, Option A, Medium Participation
Net Expected Liability (and Marginal Effect of Refinance in parentheses)

		Future Estimated Interest Rate			
		5.8%	**6.8%**	**7.8%**	**8.8%**
		(in $ millions)			
Future House Price Appreciation Rate	**2%**	-157.4 (13.7)	-41.1 (12.8)	+120.5 (9.6)	+330.3 (5.0)
	3%	-224.9 (12.5)	-136.4 (14.9)	**+2.7** **(14.1)**	+194.6 (11.1)
	4%	-267.9 (8.7)	-216.1 (13.9)	-108.7 (16.1)	+58.5 (15.6)
	5%	-287.5 (1.0)	-268.9 (9.4)	-203.6 (15.1)	-72.1 (17.4)

Exhibit 6-4
Results of Sensitivity Testing, 100% Loan Limit Continuous Refinance, Program Option A, Medium Participation: Key Statistics for Refinance Participants*

			Future Estimated Interest Rate			
			5.8%	**6.8%**	**7.8%**	**8.8%**
Future House Price Appreciation Rate	**2%**	N:	3,265	3,051	2,929	2,832
		M/B:	$1,279	$1,280	$1,275	$1,291
		P/B:	$23,387	$23,972	$24,077	$24,794
	3%	N:	3,701	3,359	**3,144**	3,019
		M/B:	$1,441	$1,436	**$1,437**	$1,436
		P/B:	$26,290	$27,345	**28,410**	$28,801
	4%	N:	4,540	3,728	3,393	3,209
		M/B:	$1,684	$1,606	$1,603	$1,588
		P/B:	$28,353	$30,827	$32,084	$33,077
	5%	N:	7,279	4,511	3,749	3,446
		M/B:	$2,133	$1,901	$1,787	$1,767
		P/B:	$27,858	$32,434	$35,408	$37,029

*N = number of refinancers, P/B = average principal limit increase per borrower, M/B = average upfront MIP per borrower. Statistics are weighted downward by loan survival probability. MIP / Borrower only includes the reduced 2% upfront premium, and not the subsequently increased ongoing premiums.

Stochastic Model Results

The stochastic model results for the combination of refinance under Option A with medium participation and 100 percent national loan limit are shown in Exhibit 6-5. The net expected liability is -$113.4 million, which is higher than the base model of -$244.9 million due to large increases in the present value of claims. Claims are predicted to increase by $184 million relative to the base stochastic model while premiums are predicted to increase by only $39 million. The net effect is an increase in the expected liability by $132 million relative to the base model and $16 million relative to the base model with refinancing. See Exhibit 6-6. The big increase in net liability is associated with the refinancing. In the base model, refinancing adds $115 million to net liability, and in the 100 percent model refinancing adds $139 million. By comparison, the $7 million impact of 100 percent loan limits is very small.

Exhibit 6-5
Summary of 250 Trials of Stochastic Model
Assume Refinance Option A, Medium Participation and 100% National Loan Limit

	PV Claims	PV Premiums*	Net Liability
	(in $ millions)		
Mean	246.2	168.6	-113.4
95% Confidence Interval	+/- 14.6	+/- 2.5	+/- 15.2
Standard Deviation	117.5	20.6	122.9
Minimum	70.0	117.3	-296.3
Maximum	755.7	213.8	423.7

* PV Premiums do not include the Reserve of $190.9 million.

Exhibit 6-6
Comparison of Stochastic Models

	Reserve	PV Claims	PV Premiums	Net Liability
	(in $ millions)			
Base Model	176.8	61.8	129.9	-244.9
100% National Loan Limit	190.9	77.0	138.3	-252.3
Option A Refinance	176.8	205.7	158.6	-129.8
Combination Option A Refinance And 100% National Loan Limit	190.9	246.2	168.6	-113.4

Not only is the mean expected liability higher with the combination of refinance and 100 percent loan limit, but the standard deviation is about 40 percent larger than the base model without refinancing. See Exhibit 6-7. The range from minimum to maximum has also increased by 44 percent. Of the 250 trials, there are now 16 percent with positive liabilities compared with only 3 percent in the base model and 12 percent in the base model with refinances.

Exhibit 6-7
Comparison of Net Liability Distributions Between No-Refi Base Model And 100% National Loan Limit Model With Option A Refinancing

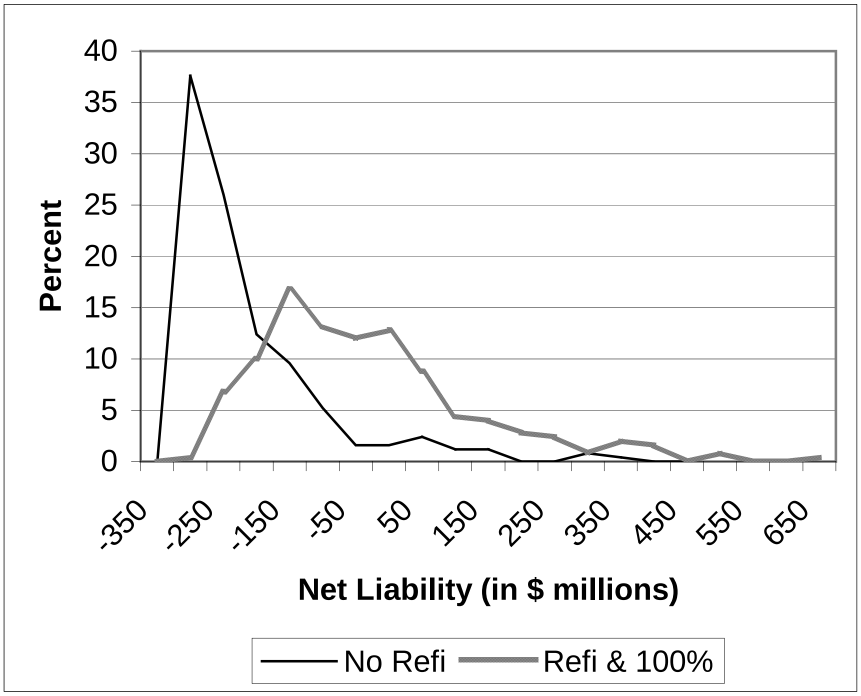


Exhibit 6-8
Key Statistics for Refinance Participants
Stochastic Model with Multi-Year Refinance (Option A, Medium Participation) and 100% Loan Limit

	No. of Refinances	Added UFMIP* (Per Refi.)	Principal Limit Gain (Per Refi.)	Interest Rate**	House Price Growth Rate**
Mean of 250 Trials	16,631	$ 12.6 M ($758 / Refi)	$ 559.1 M ($33,616 / Refi)	5.6%	3.5%
Standard Deviation	4,074	$ 4.4 M	$ 232.5 M	1.7%	0.7%
Minimum	4,426	$ 3.2 M	$ 66.0 M	3.1%	1.8% (-4.4%)***
Maximum	26,696	$ 27.8 M	$ 1,168 M	15.7%	5.4% (11.2%)***

* Added UFMIP is the additional upfront premiums (2% of gain in maximum claim amount).
** Both the interest rate and house price growth rates are weighted by the product of the probability of loan survival and the outstanding loan balance for that period. The weight gives more importance to the earlier predicted years when the probability of loan survival is higher.
*** The values without parentheses are the minimum and maximum for the average house price growth. For example, 1.8% is the lowest average house price growth averaged over 48 years in a trial. The lowest single year house price growth rate in any trial is given in the parentheses, -4.4 percent. The highest single year house price growth rate in any trial is 11.2 percent.

Despite the substantial changes in the net liability, the number of refinances is nearly the same as in the base model with refinancing (up 0.2 percent). The gain in upfront premium has increased by $480,880 or 4.0 percent and the additional principal limit is also about 5 percent larger compared to the base model with refinancing. See Exhibit 6-8. The marginal impact of the 100 percent loan limit is small in comparison to the very large impact of refinancing, especially with low and fluctuating interest rates.

Summary

The combined model simulated the possibility of both an increase in the national loan limit and a reduced premium refinance program. As with each individual analysis, the national loan limit was simulated as if it had been instituted from the start of the HECM program, and then combined with reduced premium refinancings starting from the 2001 program year.

The key findings from this section depend on the level and degree of fluctuation of interest rates. When interest rates are relatively high and held constant, as in the non-stochastic model, the impact of the 100 percent loan limit is larger than the impact of reduced premium refinancing on the value of the fund. The 100 percent loan limit increases net liabilities by $42.6 million while refinancing increases net liability by about $30 million. In combination, the fund surplus of $54 million is reduced to a deficit of $20.8 million.

When interest rates are relatively low and fluctuating, as in the stochastic model, the impact of the 100 percent loan limit is quite small compared to the overwhelming impact of refinancing. The 100 percent loan limit alone lowers net liabilities from -$244.9 million to -$252.3 million. When reduced premium refinancing is combined with 100 percent loan limits, the net liabilities increase substantially to -$113.4 million. Although the effects are technically offsetting, the $7.4 million reduction associated with higher loan limits is dwarfed by the $139 million increase associated with refinancing. A similar pattern occurs with 87 percent loan limits when combined with reduced premium refinancing. The higher loan limits alone reduce net liabilities by $3.9 million. When the 87 percent loan limits are combined with refinancing, the net liabilities increase by $132 million to -$117.1 million. It seems probable that the large impact of refinancing would be attenuated at higher interest rates. However, there are many opportunities for refinancing when interest rates are allowed to fluctuate as in the stochastic models. The realism of fluctuating interest rates and house prices adds more weight to the stochastic model results.

Chapter Seven
Long-Term Care Insurance[24]

Background

In the face of a rapidly aging population, financing long-term care (LTC) in the United States has become a serious policy issue. LTC "refers to the medical, social, personal care, and supportive services needed by people who have lost some capacity for self-care because of a chronic illness or condition. That definition excludes medical care for acute conditions; however, postacute care, such as skilled nursing care and home health care, is often classified as long-term care."[25] Nursing homes are the most prevalent providers of LTC, although home-based and community-based care are increasingly common. In 1998 the annual cost of LTC for an individual in a nursing home was an estimated $40,000, a figure expected to increase rapidly as more elderly require care.[26] The expenses can be paid for in a few ways, the most common of which are by the government (either federal or local) through Medicare or Medicaid programs, out-of-pocket using personal financial assets, or by Long-Term Care Insurance (LTCi) coverage. LTCi is a private insurance product that pays for the long-term care costs of the policyholder. According to the American Health Care Association, in 1998 69 percent of LTC was paid for by Medicaid, 7 percent by Medicare, and 24 percent by private funding sources (with LTCi accounting for only 3 percent of total LTC spending).[27]

For many elderly, government coverage through Medicare and Medicaid are not reasonable options for complete coverage. Medicare is not designed for LTC, and covers it only minimally, providing for 100 days of care in a skilled nursing facility following a hospital stay of three days or more. Medicare also provides a limited amount of money for in-home care for some homebound seniors. The Medicaid program, which bears the brunt of LTC costs, is aimed at persons with low income or those who spend down their personal assets to pay for medical or long-term coverage. Qualification rules for 2000 specified coverage for persons with monthly income less than $532 and assets (with the exception of housing and cars) of less than $2000.[28] In order to make qualification more possible, in recent years the insurance industry has developed a market for "Medicaid annuities," which are disdained by Medicaid administrators. The annuities help the elderly meet qualification requirements

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24 For the analysis that follows we have relied on a number of research papers, Long-Term Care Insurance marketing information available online, and discussions with Nanda Kumar, a Senior Associate at Abt Associates who has a doctorate in Economics and is a respected expert in the field of long-term care financing.

25 Congressional Budget Office, "Projections of Expenditures for Long-Term Care Services for the Elderly," March, 1999. Available at www.cbo.gov.

26 William J. Scanlon, Director Health Financing and Systems Issues, Health, Education, and Human Services Division. Testimony before the Special Committee on Aging, U.S. Senate, on March 8th, 1998.

27 American Health Care Association website: www.ahca.org/secure/top15.htm.

28 Judith Feder, Harriet L. Komisar, and Marlene Niefeld, "Long-Term Care in the United States: an Overview," *Health Affairs* 19(3), pp. 40-56.

by tying up their assets in annuities that distribute income amounts just under the Medicaid qualification limits each month and then typically make a balloon payment at the end of the annuity.[29] Fearing the rising costs of the Medicare and Medicaid programs, and partially in response to the development of mechanisms that abuse them, the government has been working to encourage the expansion of the LTCi market.

Elderly who do not expect to qualify for Medicare/Medicaid programs are faced with the choice between LTCi and paying out-of-pocket for long-term care. To date LTCi has not covered much of the national cost of care because it is relatively new and relatively few policies have been purchased. However, LTCi generally provides sufficient coverage for all of an individual's costs (especially when purchasers elect to take advantage of the option to have coverage adjusted for inflation). The advantage to the elderly of LTCi is that, for the price of an insurance premium each month, financial and other assets can be protected from being used to pay for care in the case that it should be required. The cost recovery level on the part of the elderly, however, is in the range of 60 to 65 percent, meaning that for each dollar paid over the life of the policy the average individual gets 60 to 65 cents back. For this reason the very wealthy tend to prefer to self-insure, i.e. pay outright for care.

Proponents of LTCi believe that coverage needs to be dramatically expanded to protect against the government being forced to cover the full cost of the aging population. However, expanding the market has proven problematic. The insurance must be purchased well in advance of the need for care for the premiums to be affordable; because policy costs increase with age the purchase of LTCi requires a reasonable degree of foresight on the part of the individual.[30] Unfortunately, the level of education or understanding of the costs and need for LTC is very low, as is understanding of the specifics of what Medicare/Medicaid will cover. Until more people recognize their need for LTCi, the government, seeking to expand the market, will be forced to find ways to encourage consumers to initiate coverage or at least encourage them to consider LTCi.

What are the Recent Provisions?

The recent change in the Housing Act regulations, which provide for a cheaper reverse mortgage if the monthly payment will be used to cover the cost of LTCi, can be in part explained by the need to expand consumer education about the subject of LTC and the LTCi market itself. By incorporating this clause elderly who are considering HECMs must now also take into consideration the possible costs of LTC. In this section we examine the specifics of the provisions and the implications that they carry for FHA.

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[29] Ann Davis, "Insurers Find Way to Help the Elderly Get Medicaid to Pay for Nursing Homes," *The Wall Street Journal* 6/6/01.

[30] Insurance premiums can range from $250 per year for 65 year-olds to $5000 or more per year for 75 year-olds, for example, with coverage typically for two years of LTC (totaling $100,000). Sample rates can be found are given by Suzanne Kimberly Cotton, "Long-Term Care Insurance Premium Expenses," The Long Term Care Insurance Decision Assistance Center. Available online at www.longtermcareinsurance.org.

The Details on the Provisions

Section 201(c)(1) under TITLE II-Homeownership for Working Families, provides that "the Secretary shall not charge or collect the single premium payment otherwise required" for mortgages for "which the *total* amount … of all future payments … will be used only for costs of a qualified long-term care insurance contract that covers the mortgagor or members of the household residing in the property that is subject to the mortgage." (Emphasis added) Thus, when a borrower takes out a HECM and uses all of the proceeds to fund long-term care insurance the initial insurance premium will not be collected. That funds are only to be used for LTCi is vitally important in the analysis that follows. This provision is likely to strongly limit interest in the program. The results could be dramatically different if only part of the payment to borrowers had to be used for LTC premiums.

The regulations do not specify if any particular form of mortgage, such as a tenure payment, term payment, or line of credit must be used. However, tenure payments would seem the most logical choice for borrowers using this form of HECM, as they will allow the borrower to pay the premium only for the period before LTC is required at which point they will no longer be living at home. It is possible that the LTC insurance premiums might vary over time either due to a change in the coverage options or premium structure. In such a case, the line of credit plan may be more appropriate. In the majority of loans, the LTC insurance premiums are set by contract so the tenure payment plan is the most suitable.

The question of mortgage type also raises the issue of how FHA could control the usage of the HECM funds. With no enforcement mechanism there is little that FHA can do to prevent borrowers from using the funds for any variety of purposes in addition to (or even at the expense of) LTCi spending. A way to avoid this would be to have the LTCi bills handled and paid directly by the loan servicer or FHA, with no monies paid out to the borrowers; implementing and coordinating this provision could require substantial resources, however. This risk is particularly acute with LOC mortgages as, short of claiming their equity in the property, once the LOC is spent there is no way for FHA to collect on the monies spent. Again, a way must be developed to ensure that all monies paid out to borrowers are used for the regulated purpose of paying for LTCi.

The Implications

One concern with this new provision is that the value of the insurance fund could remain relatively constant while the number of loans issued could increase. On a per-loan basis, then, the level of the insurance fund could decrease. This will occur only if significant interest in the LTCi HECM results from this change in the regulations. However, whether the demand will change is questionable and remains to be seen. In the next section we will consider the characteristics of elderly HECM borrowers and of LTCi purchasers and attempt to discern whether these groups are likely to intersect.

Estimating the Level of Demand

The most critical issue from HUD's point of view is estimating the demand for LTCi HECMs. The implications for the insurance pool of these loans are the driving factor behind this. Unfortunately, estimation of the degree of demand is challenging at best. The main reason for this is that, though it is obviously attractive for mortgagors to try to reduce the costs of their HECM, at the same time those mortgagors would be limited to using the mortgage payments they receive to finance LTCi policies. Thus the benefits of reduced loan costs must be weighed against the mandatory usage of the payments for LTCi.

One method by which to address the level of demand for HECM payments to cover LTCi is to compare the characteristics of LTCi purchasers with those of HECM borrowers. If there is little overlap in the characteristics of these two groups of borrowers, demand is likely to be weaker than if the groups demanding both are similar.

Previous Studies

In this subsection a summary of prior research into the demand for LTCi and for HECMs will be presented.

Characteristics of LTCi buyers

Long-term care has become increasingly important, and consequently a substantial amount of literature of varying quality exists on the issue. LTCi has received less attention, both by the popular press and by academics, but nevertheless has also been increasing in importance. This discussion will focus on the academic literature.

The tradeoff between need and expectations

A research paper entitled “Who Buys Long-Term Care Insurance” by Marc Cohen, Nanda Kumar, and Stanley Wallack provides an overview of the reasons behind LTCi purchase.[31] The analysis suggested that the strongest influences on the demand for LTCi are not particular individual demographics or assets but rather the individual’s expectation of whether she will require LTC and her degree of understanding of the cost of such care. In the first portion of their analysis the sociodemographic characteristics of those who chose to purchase insurance were compared with those of persons who were approached but ultimately elected not to purchase insurance. The groups were then compared statistically to see whether the various proportions were different and few statistically significant differences were discovered.

The analysis then proceeded to consider the individuals’ opinions about long-term care. Here important differences were identified between purchasers and those who decided not to purchase insurance. The differences in belief regarding the need to plan for possible future long-term care needs were particularly strong; 62% of purchasers strongly agreed that planning was essential, compared to 42% for non-purchasers. Also strong were the differences in beliefs about whether the government would pay for LTC needs were also strong (non-purchasers were twice as likely to believe that the government would pay for most of the costs). Non-purchasers generally underpredicted their risk of needing nursing home care, although both purchasers and non-purchasers gave similar predictions of their need for care in their own homes. Purchasers listed their desire to avoid dependency on others as the most important factor driving there purchase decision; the protection of family assets or reduction of financial exposure was a distant second. Non-purchasers

[31] Marc A. Cohen, Nanda Kumar, and Stanley S. Wallack, “Who Buys Long-Term Care Insurance,” Health Affairs, Spring, 1992, 11(1), pp. 208-223.

cited cost as the primary reason for their decision, followed by lack of understanding of the insurance policies. Finally, purchasers and non-purchasers differed on how they felt about the government's role in long-term care financing; non-purchasers generally wanted the government to provide more direct financing for long-term care, whereas purchasers preferred to see closer government regulation but not a universal program.

The Cohen, Kumar, and Wallack analysis ultimately concluded that "…in addition to cost, attitudes toward insurance and risk, the relative newness and inadequacies of some products, confused signals from the public sector, and a lack of information contribute to low demand for private long-term care."[32] The analysis results are important because they indicate that one of the primary factors behind the lack of expansion of the LTCi industry is a generally low level of understanding of the risks and costs of LTC, not just the costs of care. Whether HECM borrowers, generally considered less financially sophisticated, are likely to understand the risk and cost is questionable.

Buyer characteristics

A subsequent research paper by the same authors (and Christine E. Bishop) in 1995 modeled the decision to purchase LTCi and also the expected value of the insurance purchased as a function of a number of factors.[33] The expected value of the insurance was generated using the expected amount that the insurance would pay for LTC based on borrower characteristics and life expectancy; this is not the same as the maximum possible value of the policy. The factors for which we have similar information on HECM borrowers will be covered here.

Age: Age was negatively associated with both the propensity to buy insurance and the amount of coverage selected. This result is not surprising. As the potential buyer ages the annual premium for the insurance rises substantially due to the shorter expected period before which the insurance will be needed and the increasing probability that LTC will be necessary (partially due to the adverse selection problem).

Gender and Marital Status: With respect to gender, it was found that men were less likely to purchase LTCi, but those that did tended to purchase greater insurance amounts. Marital status also affected the purchase decision. Married individuals tended to purchase lower amounts of coverage but were found more likely than unmarried persons to purchase insurance. A reasonable explanation is that married individuals find it more desirable to protect their assets on their partner's behalf than do unmarried individuals. However, the lower amount of coverage purchased likely reflects their belief that, at least in the early stages, care could be provided by their spouse.

Education Level: Education played a complex role. The proportion of college educated was greater for policyholders than for the general population, suggesting that increased education tended to increase the likelihood of purchasing a policy. However, those without college education were found more likely to purchase insurance if approached by an agent. Increased education was positively linked, however, to the amount of insurance purchased.

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[32] Cohen, Kumar, and Wallack, p. 222.

[33] Nanda Kumar, Marc A. Cohen, Christine E. Bishop, and Stanley S. Wallack, "Understanding the Factors behind the Decision to Purchase Varying Coverage Amounts of Long-Term Care Insurance," HSR: Health Services Research 29:6 (February 1995), pp. 653-678.

Income Level: The relationship between income and LTCi was positive and strong. Increased income substantially increased the probability of LTCi purchase. Increased income also tended to increase the amount of insurance purchased.

Assets: The authors were surprised to find that asset levels did not seem to affect the decision to purchase insurance nor the amount of insurance purchased. Their study divided participants into six asset levels (home equity excluded), with the baseline category less than $20,000. This level is far above that which would make the individual eligible for Medicaid, a fact that will become important in the discussion that follows. The result that assets did not influence insurance purchase decisions is unexpected because LTCi provides a substantial degree of asset protection to policyholders. Buyers of LTCi need not spend down personal assets in order to pay for care. The authors suggest that perhaps one explanation was that at the time of their study Medicaid rules only required individuals to pay out-of-pocket for two years of LTC before Medicaid provided coverage. The authors also suggest that perhaps individuals are not as reluctant to pay outright for care as is commonly perceived. Finally, the growth of the market for "Medicaid annuities", which has only recently started to be strongly discouraged, might suggest another manner in which assets could be protected and therefore temper the asset-based interest in LTCi.

Additional Variables: In addition to the variables listed above, the model included several other predictors of LTCi purchase and insurance amount. These characteristics, such as attitude and expectation regarding LTC, HMO membership, and understanding of the Medicare and Medicaid systems, among other variables, cannot be closely matched to any of the information in the HECM database. Thus, although these results are interesting, they do not help in drawing comparisons to the population of HECM borrowers.

Characteristics of HECM borrowers

In FHA's May 2000 report to Congress on the HECM Program, entitled "No Place Like Home," a summary of the key characteristics of HECM borrowers (under the pilot program) was given. These will be briefly reviewed here.

Age: HECM borrowers, who are required to be older than 62, were found to have a median age at origination of 75, as compared to 72 for the population in general. The HECM program seemed to favor older homeowners as the distribution of ages for borrowers was universally higher than that for non-borrowers in general. This result was an expected one for two reasons. First, for the same interest rate and property value, older borrowers will receive higher monthly loan payments. Second, the need for additional monthly income is likely greater for the more elderly as they have had more time to spend down their financial assets. Thus HECM borrowers tend to be more advanced in age.

Gender/Household Composition: The study found that 59 percent of the borrowers were females living alone, 29.8 percent of the borrowers were pairs, and only 13.9% were males living alone. These results were consistent with earlier studies. This compares with elderly population percentages of 27.6 percent female alone, 64.5 percent pairs, and 7.9 percent male alone.

Income Level: Generally individuals who take out HECM loans do so in order to bolster low monthly incomes. For the most part, HECM borrowers are "house-rich" but "cash-poor" and must use the program to convert their home equity into more liquid assets. Social security benefits are typically their only other source of income. Thus, although there are not income limitations on who is eligible to make use of the HECM program, we can conclude that generally their incomes are quite low.

Assets: Although not directly summarized in the report due to the lack of specific available information, for most HECM borrowers their home is their largest, or perhaps only, financial asset. The relatively high costs associated with generating income by means of a HECM, as opposed to making use of other financial assets, generally discourages borrowers with substantial non-house assets from making use of the HECM programs. Thus we expect, for the most part, that HECM borrowers do not have substantial other financial assets and have turned to the HECM as a last resort.

Additional Observations: Other characteristics were summarized in the report, including information such as region, property characteristics, and loan characteristics. However, this information was not evaluated in the analysis of LTCi and will therefore not be discussed here.

The Probable Lack of Overlap

Having thus presented the characteristics of HECM borrowers and those of LTCi purchasers, it is now possible to address the issue of whether these groups are likely to overlap. In general the results suggest that the groups probably do not overlap significantly, if at all. There are four key areas for which this is the case.

Age: Age is one key area in which the current HECM borrowers and LTCi purchasers differ. HECM borrowers were generally more advanced in age, which would decrease the probability that they would be interested in purchasing LTCi. It is also important to note that the cost of LTCi climbs substantially with age (from $250 per year for 65 year-olds to $5000 or more per year for 75 year-olds depending on the coverage selected) and for policies to be reasonably affordable they need to be purchased in the age range between 55 and 65. With a median age of 75, HECM borrowers would likely find LTCi very expensive indeed (in the range from $250-$300 a month), and this would discourage the insurance purchase. Thus, from the point of view of age, HECM borrowers and LTCi purchasers appear to be quite different.

Gender and Household Variables: HECM borrowers tended to be female (hardly a surprise given the median age of HECM borrowers) which is associated with increased probability of LTCi purchase. However, most were single which is associated with lower probability of LTCi purchase. Consequently the overall effect on the probability of using a HECM for LTCi is difficult to guess.

Income: Income was strongly associated with LTCi purchase, yet borrowers typically start a HECM program because they are “cash-poor.” The requirement that all HECM payments be used *only* for the purchase of LTCi would not solve the problem of low-incomes for these borrowers, and would discourage them from LTCi purchase. Thus the overall low level of income of HECM borrowers suggests that LTCi would not be a priority for them in their borrowing which instead goes to finance more immediate needs.

Assets: The question of assets is a complex one. The complication arises from the fact that Medicaid will cover LTC for individuals who have non-housing (and non-car) assets of less than $2000 and incomes of less than $532. Thus, for the majority of HECM borrowers, Medicaid is probably a viable option. However, the LTCi studies discussed above found that the level of assets did not seem to affect the probability of LTCi purchase. The problem may lie in the fact that the asset information from the LTCi studies were not sufficiently fine to provide insight in to the behaviors at the level where Medicaid eligibility would be an option. The lowest category was $20,000 and under. It would be reasonable to expect a substantial drop-off at the lower end of this category as LTCi is not as helpful if Medicaid will instead cover the cost of care. Thus, although no link was found between asset levels and the insurance purchase decision in the LTCi studies, this result does not seem helpful in evaluating the situation of HECM borrowers. Overall, it is likely that HECM borrowers would not find LTCi desirable, as they are more likely to be eligible for Medicaid.

Summary

HECMs and LTCi appeal to groups with very different characteristics. We have seen above that the age profiles, income, and assets of HECM borrowers and LTCi purchasers are quite different. We also observed that unmarried individuals are less likely to purchase LTCi, and that most HECM borrowers are unmarried females. The difference in the groups is clear from these factors alone.

The most important result from the above analysis is that HECM borrowers, based on their assets and income, are more likely to be eligible for Medicaid coverage for LTC. Consequently they should have less interest in LTCi. Financing LTCi with a HECM will simply shift the burden for LTC from the public back to the less financially able elderly using the equity in their homes to buy insurance benefits that they already qualify for under Medicaid.

In addition, that HECM payments be used *only* for LTCi is a substantially limiting factor on the expected demand for HECMs for this purpose. Those elderly who are considering HECM programs are likely looking to complement their social security checks and other monthly income with access to additional monies (either in the form of income or a line of credit). If this income can only be used for the purpose of LTCi purchase, it is likely that the savings associated with not paying the up front insurance are relatively minor when compared with the transactions cost and loss of equity to any other purpose over the life of the loan. In most cases, less costly and less restrictive ways of accessing home equity for LTCi premiums (such as a forward Home Equity Line of Credit, HELOC) would be available and preferred.

Additional Influences on Demand

The above approach to assessing the probable utilization of HECMs for LTCi is clearly a simplistic one as it relies entirely on a comparison of the types of borrowers who have shown interest in each program. To do a true estimation of the demand for LTCi HECM utilization would require taking into account additional factors.

Education on the Expected Cost of LTC

The increased efforts on the part of the LTCi industry, the government, and private groups to increase the level of education among the elderly about the costs of LTC and the potential benefits of carrying LTCi would tend to increase demand for LTCi. One could reasonably expect that this would increase demand for LTCi among 55 to 65 year-olds, as the premiums would not be too unreasonable. However, the question here is whether this would increase demand among HECM borrowers. The answer to this question has two parts. First, the older HECM borrowers would face insurance premiums that appeared unmanageable and consequently choose not to purchase insurance. Second, the outcome depends in part on whether the potential borrowers properly understood their Medicaid eligibility. If understood, the exclusion of house and car equity means that those considering HECMs would not chose to purchase insurance due to their probable ability to qualify quickly (due to spending down their non-equity based assets) if not immediately.[34] The question of whether HECM borrowers are financially sophisticated enough to understand the Medicaid/LTCi tradeoff is an open one.

Access to Care

One important benefit from LTCi is that it provides the insured access to preferred care. Not all beds in LTC facilities are covered by Medicaid. Consequently there is typically a waiting list for Medicaid covered care. LTCi does not come with the same restriction, however, as the insured is paying private-pay rates which are higher than Medicaid rates. According to Nanda Kumar, the ability for the insured to select a nursing home facility of their choice and gain access to care is a major selling point for LTCi. Many nursing homes are reluctant to turn away a potential resident capable of paying the full private fee for two years. At the end of the two-year period Medicaid will step in and cover the costs of continuing care at the same facility. The insured has not only gained access to care without the delay of a Medicaid wait-list, but also has been able to select the facility of their choice.

To the extent that LTCi therefore buys preferred care, as the pressures on the Medicaid system result in increased waiting times before nursing homes become available, demand for LTCi will continue to rise. As LTCi becomes a more desirable product, demand for HECMs to fund it may also rise. Again, however, LTCi is expensive when purchased after about age 65, and whether HECM borrowers will value the access to care sufficiently to use their payments to pay for care is questionable.

Can a Simulation Model be Constructed?

The most accurate method by which an estimate of the demand for HECMs to purchase LTCi could be generated would be to construct a model of the market. This would present no small challenge, however, as existing research has generally excluded house-assets from the modeling effort as Medicaid does not take them into account. Existing LTC demand models exist, but extension to

[34] The Medicaid argument holds even if an individual purchased LTCi many years earlier and consequently only faces low premium. If the prospective borrower has reached the point of needing a HECM to pay the premium then they are likely to be eligible for Medicaid to cover LTC needs.

incorporate house-assets and also to estimate LTCi demands would be beyond the scope of this current project.[35]

Insurance Fund Implications

Returning now to the key question from HUD's point of view, the dramatically different profiles of HECM borrowers and LTCi purchasers suggests the new premium exemption for HECM-financed LTCi will have little impact on the insurance fund. Specifically, the anticipated usage of the insurance opt-out for the HECM is very low because HECM borrowers generally would be eligible for Medicaid coverage should the need arise and thus have no incentive to purchase LTCi.

Termination Considerations

For those few borrowers who do make use of LTCi HECMs, it is helpful to think about some of the consequences of this decision. Two issues in particular are worth considering, 1) what happens if the borrower returns to their home after receiving LTC and 2) what is the impact of LTCi on tenure?

Returning Home After Long-Term Care

The beginning of LTC does not necessarily mean that an individual will not return to her own home after some period of time. LTC may only be required for a period of time (which may be as long as many years) at the end of which the individual is able to return to their own home. LTCi coverage, however, is typically not able to be extended beyond the duration or financial limit of the original policy after the coverage is initially used. As an example, suppose a senior has purchased a LTCi policy that covers two full years of nursing home care. Suppose they then use all of this coverage but at the end of this period are able to return to their own home. Typically the LTCi providers would not allow this same individual to purchase additional coverage for future care.

The question that this raises in terms of LTCi HECMs is under what conditions might the individual then secure access to the remaining home equity. In this scenario, HECM payments could no longer be used to pay for LTCi as this insurance would no longer be available, and thus, according to the regulations, the HECM should be terminated. Presumably, in the absence of some option designed for this situation, the borrower would be required to refinance and make the initial premium payment into the insurance fund in order to gain access to this equity. Though one would expect this situation to occur infrequently, it is nevertheless necessary to decide how it should be handled.

The Tenure Impact of LTCi

In addition to evaluating the effect of demand for LTCi HECMs on the insurance fund, the question of claims should also be addressed. Increased tenure duration by the borrower would likely result in increased claims by lenders as the homeowner's cumulative payments exceeded their equity in the

[35] Abt Associates has a sophisticated microsimulation model of LTC demand, but this model also does not currently take house-assets into account.

home. The question, then, is whether LTCi would impact the tenure of the borrower. Unfortunately there are two opposing possibilities to consider.

On the one hand, tenure might increase as the result of LTCi. If LTCi allows borrowers to receive better care in their homes than they would get otherwise, then this care might allow them to stay at home longer. Both Medicaid and LTCi can provide for some degree of in-home care, but LTCi may be more flexible in what it will pay for. The increased services resulting from the LTCi might allow some elderly to remain at home longer than they would be able to with Medicaid coverage.

On the other hand, tenure might also decrease as a result of LTCi. To the extent that LTCi allows the elderly to attend the nursing home of their choice and will cover the cost of this for the first two years, after which they would be Medicaid eligible, then they may enter nursing homes sooner. This earlier entry could be the result of a personal decision to take advantage of availability at the nursing home of their choice. Alternatively, the earlier entry could be a result of the fact that they do not have to be placed on a Medicaid waiting list until a space becomes available.

It is difficult to say whether tenure will increase or decrease as a result of LTCi coverage. To the extent that the elderly prefer to remain at home as long as possible, one could reasonably expect tenure to increase due to the additional services available through LTCi. However, for some seniors the ability to enter a nursing facility of their choosing might outweigh the benefits of remaining at home, and they would consequently leave their homes sooner than they would if not insured. The impact of these decisions on the HECM insurance fund hinges upon the tenure time. If tenure times do increase, claims will also likely increase to some degree (as the elderly outlast their home equity) and the insurance fund will be negatively impacted.

The evaluation of these two issues illustrates that the longer-term consequences of the LTCi HECM offering warrant additional thought. However, it is important not to lose sight of the fact that the expected usage of the LTCi HECMs is low. Overall the impact of these particular issues is likely minimal relative to the entire HECM picture presented in this report.

Program Modification

The analysis presented above generally expects the LTCi HECM to have little impact on the insurance fund. The main reason is that the generally low-income and aged HECM borrowers are not the ideal candidates for LTCi purchase. The ideal LTCi purchaser is middle-class and should make the purchase decision while in his or her mid 50s to mid 60s. The very wealthy do not benefit from the purchase of LTCi because it is cheaper to self-insure given the average 60 to 65 percent recovery rate on funds paid into LTCi. For low-income HECM borrowers, Medicaid is a more realistic and appropriate alternative to LTCi. Thus to increase the utility of the LTCi HECM it is necessary to target the middle-class, for whom the purchase of LTCi is beneficial, rather than less wealthy elders. There are two main ways in which the program could be modified in order to increase its appeal to the middle class: make funds more readily available or lift the restrictions on the use of HECM payments.

The main reason that middle-income individuals do not consider HECMs in general is that the cost of transforming their home equity into income is higher than generating income by means of other assets. That is to say, HECMs are relatively expensive. Obviously, to the extent that the cost of initiating and maintaining a reverse mortgage through the HECM program is decreased, it may become relatively more worthwhile to initiate a HECM than to liquidate other assets. The reduction in the upfront payment that must be made into the HECM insurance fund with LTCi HECMs does help to reduce the costs to some degree. However, the year-to-year maintenance fees remain high. Further reducing these fees may spawn more interest in LTCi HECMs. The availability of HECM funds may also be improved by raising the equity limit that may be mortgaged. The current limit is restrictive for the middle class because they cannot tap the full equity that they have built up in their homes. By increasing the loan limits additional equity can be tapped, perhaps increasing demand.

However, the strongest factor limiting interest in the LTCi HECM is the highly restrictive requirement that the payments from the HECM may only be used to fund LTCi. The payments from the HECM cannot be used to supplement current income directly, whereas converting other assets into payments would directly supplement current income. Additionally, some borrowers would likely qualify for payment amounts higher than the LTCi premiums that they had to pay and are thus being restricted in the amount of equity that they can convert as a result of the requirement. Relative to taking out a standard HECM, then, the LTCi HECM both restricts the ability to choose how to allocate the payment and potentially reduces the amount of payment that will be received. This is an unappealing aspect of the current legislation. If the potential borrower were to instead be allowed to spend the payment as they wanted provided that they made LTCi premium payments every month, demand for the product would likely increase.

By decreasing the cost of borrowing or increasing the flexibility in spending the HECM proceeds, the LTCi HECM program could be made more appealing to the middle class, the group for whom LTCi is most appropriate and who are most likely to consider using the proceeds for this purpose.

Conclusion

Overall, the impact on the FHA HECM program as a result of the long-term care insurance provision is likely to be very limited. HECM borrowers are generally elderly and cash constrained and do not have substantial other assets from which to generate monthly revenues. LTCi purchasers, on the other hand, are generally ten to 15 years younger than HECM borrowers, are middle income and have assets in addition to their home and auto equity. The lack of overlap in the two markets means that there will likely be few loans issued for which the payments are used entirely to fund LTCi. Thus most HECM originations will continue to result in initial premium payments. Consequently, on a per-loan basis, any change in the accumulated premiums available will be negligible.

Chapter Eight
Recommendations for Additional Research

The incorporation of stochastic interest rates and house prices is a major advance for the HECM actuarial model. Fluctuations in interest rates are negatively correlated with the net value of the insurance fund and appear to have a much stronger effect than fluctuations in house prices. Allowing the interest rates and house prices to fluctuate over time creates a more realistic simulation over a far wider range of scenarios than is possible from sensitivity testing of the non-stochastic model. Two extensions of the existing model would further build confidence in the results: stress testing with extreme scenarios and allowing separate house price projections for each state or region. A third innovation, adding a demand model, would permit a more accurate cash flow analysis. Tracking each origination cohort separately would facilitate credit reform accounting and measure the degree of cross-subsidization between books of business. Each of these extensions is considered briefly below.

Stress Testing

The current stochastic model is designed to allow interest rates and house prices to change in the ways most commonly found historically. Generally we expect the pattern of changes in the future to be similar to changes in the past. The expected value for the insurance fund is the various possible outcomes weighted by their probability of occurring. This approach gives a central value and the model has shown this expected value of net assets to be safely positive. Managers of the fund may be more concerned about the unusual situation in which there is a run of high interest rates and claims. How long could the fund or a single book of business sustain the payment of claims before requiring a cross subsidy from the accumulated reserve? This is different from the normal use of the stochastic model because we would force the model to simulate a series of macroeconomic conditions, which would very rarely occur. Nevertheless, managers need to be prepared for such unusual combinations.

The model permits experimentation with rare macroeconomic situations that most managers might experience only once in their career. An important lesson is to determine just how bad things can get before the fund requires subsidy. High claims from any single book can usually be covered by the premiums from other books of business. It is instructive to know how many years of high claims can be sustained before the entire fund needs to obtain subsidy from HUD or Treasury. One useful approach is to model the worst regional recession and assume it lasts for five to ten years. Given that HECMs were barely established in the early 1990s, the fund has not endured a deep regional or national recession yet. The lack of precedent gives the research less guidance, but experimentation can determine what combination of national interest rate levels and regional house prices would deplete the fund.

Geographical Disaggregation

The national scope of the HECM insurance fund allows it to diversify against the risk of regional recession. However, the current actuarial model only predicts a single house price growth path. The reserve and historical period adjusts house prices by state using OFHEO’s repeat-sales state indexes. Distinct price paths were not predicted into the future, largely because that would have entailed some

50 separate, but correlated, forecasts. In the long run average, we expect states and regions to gradually revert to the same rate of growth as the nation as a whole. A stress test emphasizes the ramifications of short run, and quite negative, growth in a region. To more accurately assess the impact of regional recessions, the actuarial model would have to allow regions to diverge in their predicted paths.

Geographical disaggregation does not necessarily require estimation for each state, though that would be the most historically accurate way to proceed. Rather, a state-level Markov chain of transition probabilities could be estimated along with correlations with neighboring states and the national average house price growth. The random changes at the state level would gradually converge in the long run. Each state could have its own random shocks and separate path, but the state models would be essentially the same in underlying parameters. The net effect is that the model could simulate the advantages of regional diversification without trying to predict what any one region would do in the future. This approach would be far simpler to construct than 50 econometric models of state housing markets. Yet such a change would demonstrate the risk to the fund of regional recessions and allow for stress testing without assuming a national recession.

Demand Model

All the analysis done with the actuarial model has been some form of wind-down analysis. In such an analysis, the existing loans are taken as given and their future terminations are predicted. New loans enter the analysis when more recent data becomes available. One reason for this approach is that the market was so new that no one knew what to expect. Enthusiastic projections of market demand had been made[36] (Merrill, Finkel and Kutty, 1994; Rasmussen, Megbolugbe and Morgan, 1995; Rasmussen, Megbolugbe and Simmons, 1996), but the actual market seemed to fall far below its potential. By 2002, we have had twelve years of actual experience and are now in a much better position to estimate a demand model with appropriate data.

One of the primary advantages of incorporating a demand model is that the output is more appropriate for cash flow analysis. HECM loans almost always front-loaded revenue generators, meaning the premiums come early in the life of the loan, especially with the 2 percent upfront premium. The claims, however, come at the end of the loan. As long as the HECM portfolio continues to grow each year, the positive cash flow of premiums from new loans will easily offset the claims from a smaller set of terminating loans. If the fund reaches a steady state in which new books are similar in size to existing books, the managers will have to be more concerned about periods of negative cash flow when claim payments exceed incoming premiums.

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[36] Merrill, Sally R., Meryl Finkel, and Nandinee K. Kutty (1994) "Beneficiaries from Reverse Mortgage Products for Elderly Homeowners: An Analysis of American Housing Survey Data," *Journal of the American Real Estate and Urban Economics Association*, 22(2): 257-299. See also David W. Rasmussen, Isaac F. Megbolugbe and Barbara A. Morgan (1995) "Using the 1990 Public Use Microdata Sample to Estimate Potential Demand for Reverse Mortgage Products," *Journal of Housing Research*, 6(1): 1-23. Also, David W. Rasmussen, Isaac F. Megbolugbe and Patrick A. Simmons (1996) "The Reverse Mortgage as an Instrument for Lifetime Financial Planning: An Analysis of Market Potential," Fannie Mae Foundation Research Report, November.

Another advantage from including a demand component in the actuarial model is that the model can simulate the impact of competition from other reverse mortgage programs or financing alternatives. This may not seem like a high priority in the current market because HECMs dominate reverse mortgages. The very success of HECMs is likely to stimulate imitation and near alternatives. Both to broaden the market and to analyze FHA's share, it would be necessary to have a demand model. A key variable would be the price of HECMs relative to the competing alternatives. The balance between upfront and annual premiums can not only affect FHA's market share, but also the type of borrower. Many HECM borrowers prefer a LOC form of payment as a precaution for unexpected, large expenses, such as medical or house repair bills. The sizeable upfront premium and closing costs make this type of precautionary financing much more expensive than a home equity line of credit (HELOC) which charges only on the amounts borrowed. As competition increases, it may be necessary to alter the premium pricing according to the payment plan with lower upfront premiums for line of credit than for term or tenure plans. A demand model makes it possible to test alternative pricing strategies so that HUD can choose a position in the market consistent with its mission.

Cohort Accounting

The final enhancement recommended is to separate the HECM portfolio into origination cohorts and then track each cohort separately. Credit reform accounting rules require such a separation and they serve a very good purpose. For budget purposes, it is necessary to determine the amount of subsidy associated with each cohort of loans. When the cohorts are pooled together, as in the current actuarial model, it is impossible to determine how much cross-subsidy there is between cohorts. It is also difficult to determine how much of the negative net liability depends on the historical reserve built up from past cohorts. It would be far better to determine for each cohort whether the present value of claims would exceed the present value of premiums without having to rely on a cross-subsidy from other cohorts. The cohort accounting along with the demand model would also be useful for predicting the size of the credit subsidy expected for each new book of business.

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