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REVERSE MORTGAGES

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ABSTRACT

This paper describes reverse mortgages, a form of home equity conversion specifically suited to older homeowners who need cash from their homes but who still want to live in them. The basic characteristics of a reverse mortgage are described, as well as the types of guarantees generally thought necessary for a tenure reverse mortgage to be marketable. These guarantees create five types of risk susceptible to actuarial evaluation. Each risk is identified, and methods of charging for and minimizing these risks are discussed. Special underwriting hazards and the need for asset reserving are reviewed. Examples of pricing and reserving for a reverse mortgage are provided. Careful supervision of reverse mortgage lending by use of actuarial methods is recommended.

I. INTRODUCTION

More than 30 million Americans are over age 65, and their numbers are expected to grow both as a percentage of the population and in absolute numbers. People over 65 are also one of the most affluent segments of U.S. society. They should become even wealthier in the future as the poorer "old elderly" who spent much of their working years in the Depression are replaced by the post-World War II cohort.

Much of older Americans' wealth is in their home equity. Home appreciation has averaged about 5 percent per year, compounded, since they bought their first homes, and many of them have paid off mortgages [10], [12]. They have almost $1 trillion of total home equity [12]. However, many are cash-poor despite being asset-rich. Historically, their homes have appreciated faster than inflation, but their incomes often have not kept up with the cost of living, including taxes and maintenance on their homes. Many surveys show that staying in their homes is one of the highest priorities of older homeowners, while leaving an estate behind definitely is not. Therefore, many are looking for some way to get spendable cash out of their homes. The process of converting home equity into spendable cash while the homeowner is still living in the home is called home equity conversion.

Interest in home equity conversion, however, goes beyond looking for a way to get spendable cash. Because home equity conversion can also be used as a source to pay for long-term-care coverage or home health care, home equity conversion has interested public policy experts who are looking for ways to solve older homeowners' needs for cash and services without taxing other segments of society. Therefore, for older homeowners and lobbying groups who claim to represent them as well as government policymakers, academicians and private lenders, the interest in home equity conversion is real and growing.

Most methods of using home equity to provide cash are not suited to older homeowners. The most direct form of home equity conversion is selling the home, which is generally unacceptable to older homeowners because this would require moving from the home. Another option, a home equity line of credit or a first or second mortgage, is generally not available to them. These line-of-credit instruments require monthly repayments to the lender, but older homeowners generally do not have the outside income source required by lenders to assure repayment.

Another option is a combination of a life annuity and an interest-payment-only mortgage. The homeowner mortgages the home to obtain a large sum of money to purchase a life annuity, a portion of the monthly annuity payment being used to pay interest on the mortgage, with the remainder providing additional cash to the homeowner. Because of unfavorable tax consequences, the resulting additional spendable cash is too small to be of interest. Problems with all these options have led to the development of reverse mortgages as the preferred method of home equity conversion.

Home equity conversion products have been sold for about 15 years in Great Britain and have become well established there. Favorable tax treatment in Great Britain makes it possible to write a good reverse mortgage with a simple combination of a regular mortgage contract and an immediate life annuity. In the U.S., more complex products have been necessary. U.S. local and state governments created several small reverse mortgage demonstration programs during the 1970s. Today there are at least three private lenders involved in tenure reverse mortgages in the U.S., including one insurance company. A federal demonstration project has begun with authority from Congress to issue up to 2,500 (recently increased to 25,000) reverse mortgages using approved lenders as outlets [13].

Reverse mortgages allow older homeowners to convert their home equity into cash without having to sell their homes. As the name implies, a reverse mortgage operates as the reverse of a regular mortgage. In a regular mortgage, a large sum is borrowed to purchase a home, and then each month the homeowner pays the lender an amount to repay the loan. In a reverse mortgage, the lender loans an amount each month to the homeowner. The periodic loans accumulate with interest until the due date, when a large sum is repaid to the lender, usually from the proceeds of selling the home.

There are three kinds of reverse mortgages: term, split-term and tenure. In a term reverse mortgage, monthly loans are made to the homeowner over a certain period, such as ten years. At the end of this term, the homeowner must repay the loan. Term reverse mortgages have not been popular because older homeowners fear that they will lose their home at the end of the term when they have no other means of repaying the loan. The split-term reverse mortgage is like the term reverse mortgage in that monthly loans are made for only a certain period; however, unlike a term reverse mortgage, a split-term reverse mortgage guarantees that the loan need not be repaid until the homeowner dies, moves, or sells the home. The tenure reverse mortgage is the most popular because it guarantees that monthly loans continue to be made for as long as the homeowner lives in the home and that repayment is not required until the homeowner dies, moves, or sells the home. A good brief history and a description of reverse mortgages in the U.S. are given in Weinrobe [15].

The proportion of older homeowners who might enter into a reverse mortgage is unknown and would vary greatly depending on actual product features. However, experience so far indicates that older homeowners prefer the types of long-term guarantees in reverse mortgages that require the expertise, skill and perspective of actuaries. Such guarantees include the ability to stay in the home no matter how long the person lives, the continued receipt of monthly loans for as long as the person lives in the home, no repayment obligation as long as the person lives in the home, and a nonrecourse provision, which provides protection of all the homeowner's other assets by limiting the amount owed to the home's value.

Reverse mortgages represent a new challenge to actuaries. Although reverse mortgages have a superficial resemblance to annuities in that they both involve sending monthly checks to individuals, reverse mortgages present actuaries a unique set of interdisciplinary problems. Unlike a life annuity in which an insurance company receives a fixed premium for the liability of making periodic payments to the annuitant for as long as the person lives, a tenure reverse mortgage is a lending institution's asset, which grows as the lender fulfills its obligation to loan money to the homeowner for as long as the homeowner resides in the home. In an annuity, there is a mortality risk that is shifted from the annuitant to the insurer; however, the risk in a reverse mortgage is a financial risk that, when the homeowner leaves the home, the value of the home may be less than the loan balance. Unlike an annuity, in a reverse mortgage the homeowner does not have a risk of losing value by an early death; the homeowner simply owes the lender what was loaned plus interest, and the remaining equity of the home goes to the heirs. Also, unlike an annuity, the amount a homeowner will pay is unknown in advance, because the loan grows as payments are made to the homeowner and as interest accumulates.

Reverse mortgages would be a straightforward lending operation and of no interest to actuaries were it not for the guarantees that older homeowners understandably demand before they are willing to mortgage their homes. These guarantees require actuaries to evaluate such uncertainties as length of residency and variations in home appreciation rates and interest rates, because the guarantees result in some loans not being repaid in full. These guarantee features, when combined with the lending features of the reverse mortgage, place the actuary in the position of dealing with banking, investment, and risk management factors all at once. Thus, reverse mortgages are a good example of the multidisciplinary risk management that actuaries now practice.

II. IDENTIFICATION OF RISKS

Because tenure reverse mortgages are the most popular and encompass all types of risks in reverse mortgages, this paper discusses a tenure reverse mortgage with the following guarantees:

- Residency Guarantee. The homeowner can stay in the home as long as he or she wishes regardless of how large the loan balance becomes.
- Income Guarantee. Monthly loan payments will continue for as long as the homeowner lives in the home.
- Repayment Guarantee. There is no repayment obligation as long as the homeowner lives in the home.
- Nonrecourse Guarantee. The lender cannot require repayment from assets other than the home.

Although other guarantees are available, these guarantees represent the minimum level of security generally thought to be necessary by knowledgeable reverse mortgage marketers and consumerists. Scholen [9] provides an excellent discussion of reverse mortgages from the viewpoint of a consumer advisor. He not only compares features of various reverse mortgages but also identifies alternatives to reverse mortgages and describes how a decision to enter into a reverse mortgage is made.

At least five types of risk normally exist in entering into a reverse-mortgage-lending operation:

- Length-of-residency risk
- Interest rate risk
- General home appreciation risk
- Specific home appreciation risk
- Expense risk.

Figure 1 displays the basic financial characteristics of a reverse mortgage. The figure represents the results of loaning $500 per month to a homeowner age 75 who owns a $100,000 home. The loan balance grows with loan payments and accumulating interest. By the tenth year, the loan balance exceeds the original home value, and by the seventeenth year the loan balance exceeds the estimated selling price of the home. (We refer to the time at which the loan balance equals the estimated selling price as the "crossover point." After the loan reaches the crossover point, a portion of the loan is unrecoverable.) Figure 1 is based on a 10 percent nominal annual loan interest rate (compounded monthly) and a 5.6 percent annual home appreciation rate, the national average rate of appreciation during the period 1955 to 1985 according to the E.H. Boeckh and Associates residential construction cost index [10], [12]; see also "Price Index of New One-Family Houses Sold" [11].

FIGURE 1

CHARACTERISTICS OF A REVERSE MORTGAGE

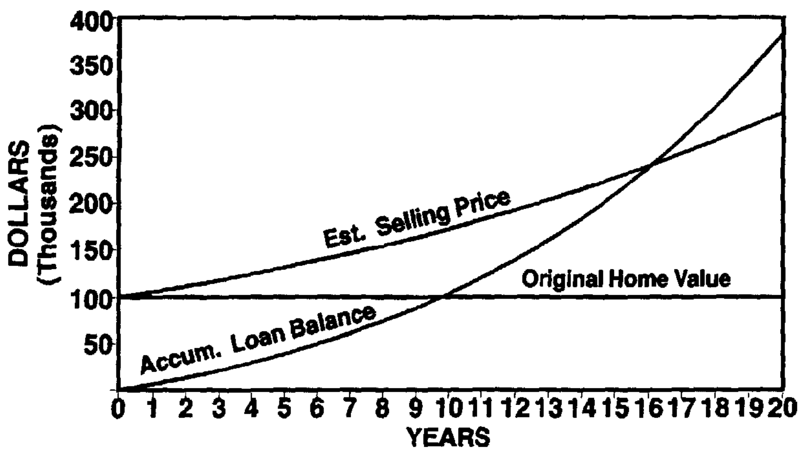


Figure 1 makes it clear that the first obstacle in developing a reverse mortgage is the increasing loan balance resulting from compound interest and continuing monthly loans. At typical interest and home appreciation rates and competitive monthly loan amounts, the loan balance will usually exceed the original value of the home in 8 to 15 years, depending upon the amount of the monthly advance and the homeowner's age. The loan balance will usually exceed the fully appreciated selling price of the home in 12 to 25 years. These sensitivities are demonstrated in the following table, which displays the year in which the loan balance exceeds the home value.

YEAR LOAN BALANCE EXCEEDS HOME VALUE
($100,000 HOME VALUE, 10% NOMINAL INTEREST, 5.6% HOME APPRECIATION)

	Borrower Age 65	Borrower Age 70	Borrower Age 75	Borrower Age 80	Borrower Age 85
Monthly Loan Amount	$275	$375	$500	$650	$825
Year Loan Balance Exceeds $100,000	14	12	10	9	7
Year Loan Balance Exceeds Appreciated Selling Price	27	21	17	13	11

Compound interest and continuing loan payments cause the unfunded excess of the loan balance over home value to increase very quickly. The compounding effect has the practical result of restricting reverse mortgages to homeowners with an expected maximum home tenure of 10 to 20 years. The only large group meeting this requirement is older homeowners. Even for these homeowners, there will be some who will stay in their home beyond the crossover point as a result of either lower-than-average home appreciation or longer-than-average tenure. Therefore, the lender must expect a loss on these particular homes because the loan balance will exceed the home value.

In regular mortgages, a maximum loan-to-value ratio of 75 percent or 80 percent is desired and is even required by state insurance laws for regular mortgage assets of life insurance companies. To provide significant cash income to the homeowner, a reverse mortgage must use the home's full value and expect appreciation of the home value as well. In direct contrast to regular mortgages, reverse mortgages are almost "loss proof" in early years but are more risky in later durations. This difference is the result of the increasing loan balance of a reverse mortgage in contrast to the declining loan balance of a regular mortgage.

Obviously, reverse mortgages pose special risks to lenders. The particular combination of the compounding effect with other risks, which can go unnoticed for over 10 years, creates a special danger for both private lenders and publicly sponsored programs. Unless a reverse mortgage program is designed and supervised carefully by using actuarial methods, the long lag time between loan origination and the time when the results of mistaken assumptions "come home to roost" can result in sudden insolvency of the lender 10 to 15 years after the first loans are made. This lag time is a problem especially for publicly guaranteed or funded programs because of the intervening changes in administrations during the 15-year period. Likewise, the long lag time increases the chances that a public program may be unsound initially or that the program may be liberalized and expanded during the early years because everything superficially appears to be working so well.

A. Length of Residency Risk

One assumption necessary in determining how much money can be loaned each month is how long homeowners will remain in their homes. This assumption creates a risk for the lender: If homeowners remain in their homes longer than expected, more homeowners than anticipated will still be living in their homes after the crossover point. Thus, more of the loans than originally projected will not be fully recoverable, and the total amount of the unfunded excess of loan balances over home values will exceed expectations.

Table 1 demonstrates the lender's sensitivity to differences in the rate of loans being repaid. Column 2 displays the loan balance for one home assuming the loan balance is composed solely of loans of $500 per month accumulating at a 10 percent nominal annual interest rate compounded monthly. Column 3 lists the estimated selling price of a home using a 5.6 percent effective annual appreciation rate. Column 4 shows the amount received if one loan is repaid, recognizing that 10 percent of the selling price is held back to pay selling costs. As a simplifying assumption, all loans terminate at the end of a loan year. Column 5 displays the number of homeowners still in their homes at the end of the year using a sample assumption about the rate at which loans are repaid. (This assumption was developed by using two decrements: death and leaving the home for health reasons. The death decrement was mortality rates derived from the 1983 Individual Annuitant Mortality Table using a five-year select period and scale G improvement projection factors [2]. The decrement of leaving the home for health reasons equaled the rates of entering a nursing home, which were derived from the

1985 National Nursing Home Survey incidence rates using a three-year select period and ten-year grading to the full incidence rates [8]. Although these two decrements give reasonable numbers, they should not necessarily be used for pricing. An actual pricing assumption should reflect the particular market, the specific contract provisions used, and the interrelationships of death rates, move-out rates, and nursing home entry rates.)

TABLE 1

DEMONSTRATION OF LENGTH-OF-RESIDENCY RISK
REVERSE MORTGAGES FOR 100 HOMEOWNERS AGE 75 WITH $100,000 HOMES
SELLING EXPENSES EQUAL 10% OF ESTIMATED SELLING PRICE

				Higher Loan Termination Rate		Lower Loan Termination Rate	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
End of Year	Accumulated Loan Balance per Home	Estimated Selling Price of a Home	Amount Received If One Loan Is Repaid This Year	Number of Homeowners Still in Their Homes at End of Year	Unfunded Excess of Loan Balance over Home Value for Loans Repaid This Year	Number of Homeowners Still in Their Homes at End of Year	Unfunded Excess of Loan Balance over Home Value for Loans Repaid This Year
1	$ 6,335	$105,600	$ 6,335	96	$ 0	97	$ 0
2	13,334	111,514	13,334	93	0	95	0
3	21,065	117,758	21,065	89	0	92	0
4	29,606	124,353	29,606	84	0	88	0
5	39,041	131,317	39,041	79	0	84	0
6	49,464	138,670	49,464	73	0	79	0
7	60,979	146,436	60,979	67	0	74	0
8	73,700	154,636	73,700	59	0	68	0
9	87,752	163,296	87,752	52	0	62	0
10	103,276	172,440	103,276	44	0	54	0
11	120,425	182,097	120,425	37	0	48	0
12	139,371	192,295	139,371	30	0	41	0
13	160,300	203,063	160,300	24	0	35	0
14	183,420	214,435	183,420	18	0	28	0
15	208,962	226,443	203,799	14	20,652	24	20,652
16	237,178	239,124	215,212	10	87,864	19	109,830
17	268,349	252,515	227,264	7	123,255	14	205,425
18	302,784	266,655	239,990	5	125,588	11	188,382
19	340,825	281,588	253,429	4	87,396	10	87,396
20	382,848	297,357	267,621	3	115,227	8	230,454
21	429,273	314,009	282,608	2	146,665	6	293,330
22	480,558	331,594	298,435	1	182,123	4	364,246
23	537,214	350,163	315,147	1	0	3	222,067
24	599,803	369,772	332,795	0	267,008	2	267,008
25	668,945	390,479	351,431	0	0	2	0
26	745,328	412,346	371,111	0	0	1	374,217
27	829,708	435,437	391,893	0	0	1	0
28	922,925	459,822	413,840	0	0	0	509,085
Total					$1,155,778		$2,872,092

The difference between the numbers in column 5 from one line to the next is the number of loans terminating in that next year. Column 6 lists the year-by-year unfunded excess of loan balance over home value for those loans repaid each year. The amounts in column 6 equal the number of terminating loans in that year times the excess of column 2 over column 4. Column 7 displays the number of homeowners still in their homes when the annual loan termination rate is reduced to 75 percent of the termination rate assumed in column 5. Finally, column 8 lists the year-by-year unfunded excess of loan balance over home value for the loans in column 7 that are repaid each year. Comparison of columns 6 and 8 demonstrates the lender's sensitivity to the length-of-residency risk. Ignoring interest, the difference between the totals of columns 8 and 6 is 17 percent of the total value of the 100 homes at origination of the loans. Discounted at the loan rate, the difference is $166,136 and equals a charge of 64 basis points per dollar of repayable loan balance each year. (Repayable loan balance equals the number of homeowners still in their homes at the beginning of a year times the amount received if a loan is repaid that year.)

Length of residency is determined by the rate at which homeowners leave their homes, death being just one cause of leaving the home. The length-of-residency risk is related just as much to variation in the rate of moving out of the home as to variation in mortality, because the loan ends as soon as the homeowner either dies or moves. The decrements of death and moving are interrelated, however, because moves caused by health problems are often soon followed by death. For example, a move necessitated by poor health may require the homeowner to live with relatives or in a nursing facility. Because poor health is related to high mortality, it is clear that move-out rates and death rates are not independent variables.

The lender must also address the question of what amount of self-selection will occur in reverse mortgages. Annuitant mortality studies have repeatedly confirmed that self-selection occurs and that the amount of self-selection varies by the type of refund feature [1], [2]. The motivations of reverse mortgage mortgagors differ from those of annuitants. Unlike an annuitant, a homeowner with a reverse mortgage does not lose a large initial premium by an early death because the homeowner simply owes what has been borrowed plus accrued interest. On the other hand, the effort, closing costs, and fees involved in obtaining a reverse mortgage are not offset by any financial advantage gained by an early death. These considerations suggest that some self-selection will occur in reverse mortgages but not as much as in individually purchased immediate life annuities.

B. Interest Rate Risk

Typically, the lender will incur a liability by borrowing money in the form of guaranteed investment contracts, bonds, or deposits and then reinvest that money in a reverse mortgage asset. Consequently, the investment risk and, in particular, the interest rate risk are highly dependent upon the degree of asset-liability matching that the lender can achieve. By matching, we mean the degree to which both the cash flows and values of corresponding assets and liabilities tend to fluctuate together in response to changing interest rates and economic conditions. Reverse mortgages have an unusual pattern of cash flows that may make it difficult to achieve immunization. Poor matching of asset and liability subjects the lender to a large C-3 risk, and disintermediation can have serious consequences to the lender because reverse mortgages are very illiquid. During 1989, the Federal National Mortgage Association (Fannie Mae) and the Federal Home Loan Mortgage Corporation (Freddie Mac) announced that they would provide a secondary market for certain types of reverse mortgages, and this development may increase the liquidity of reverse mortgage assets in the future.

In addition to their illiquidity, reverse mortgages have the added difficulty that the asset value is affected by appreciation of the home value. Home appreciation rates are not a direct factor in traditional financial instruments, but they add a crucial dimension to the task of predicting reverse mortgage asset value under various economic scenarios. The actuary's challenge will be to construct some means to measure and manage at reasonable cost the matching risk between the reverse mortgage assets and the corresponding liabilities.

The negative early cash flow of reverse mortgages is another consideration in evaluating the interest rate risk. The negative cash flow can be substantial and continue for many years. Table 2 shows the cash flow of 100 reverse mortgages, all issued at the same time. Column 2 lists the number of homeowners receiving cash during the year and is the same as column 5 in Table 1. Column 3 is $6,000 times column 2 because every homeowner receives $500 a month; it does not include accruing interest on the loans. Column 5 is the amount received from the loans that terminate, again assuming that all loans terminate at the end of a loan year. The cash flow, column 6, equals column 5 less column 3. The cash outgo is largest in the first year, but a positive cash flow does not occur until the eighth year. Table 3 displays the negative cash flow resulting from the origination of 100 reverse mortgages every year. Cash outgo is largest in the seventh year, and receipts from loan terminations do not exceed disbursements to homeowners until the thirteenth year. In a reverse mortgage operation with growing sales, the first year of positive cash flow would occur even later. Tables 2 and 3 illustrate that the cash flow of reverse mortgages is very different from the cash flow of insurance products or even of most investments. Reverse mortgages are analogous to the purchase of a series of intermediate-term zero coupon bonds.

TABLE 2

DEMONSTRATION OF NEGATIVE CASH FLOW FROM ORIGINATING 100 REVERSE MORTGAGES

(1) Year	(2) Number of Homeowners Receiving Cash during Year	(3) Total Cash Amount Loaned during Year*	(4) Number of Loans Terminating in Year	(5) Total Amount Received from Loans Repaid during Year	(6) Cash Flow
1	100	$600,000	4	$ 25,340	$ -574,660
2	96	576,000	3	40,002	-535,998
3	93	558,000	4	84,260	-473,740
4	89	534,000	5	148,030	-385,970
5	84	504,000	5	195,205	-308,795
6	79	474,000	6	296,784	-177,216
7	73	438,000	6	365,874	-72,126
8	67	402,000	8	589,600	187,600
9	59	354,000	7	614,264	260,264
10	52	312,000	8	826,208	514,208
11	44	264,000	7	842,975	578,975
12	37	222,000	7	975,597	753,597
13	30	180,000	6	961,800	781,800
14	24	144,000	6	1,100,520	956,520
15	18	108,000	4	815,196	707,196
16	14	84,000	4	860,848	776,848
17	10	60,000	3	681,792	621,792
18	7	42,000	2	479,980	437,980
19	5	30,000	1	253,429	223,429
20	4	24,000	1	267,621	243,621

*Includes only payments to homeowners; excludes accruing interest.

Both fixed-rate and variable-rate reverse mortgages have their own advantages and disadvantages. A fixed interest rate allows the lender to predict the future loan balance accurately. This may make it easier to estimate the risks associated with length of residency and home appreciation. However, a fixed loan rate subjects the lender to a C-3 interest change risk; that is, the value of the loan on the lender's balance sheet can be depressed by a change in the general interest rate environment. On the other hand, a variable interest rate tied to a recognized index can avoid the C-3 type of risk but

TABLE 3

DEMONSTRATION OF NEGATIVE CASH FLOW FROM ORIGINATING 100 REVERSE MORTGAGES EVERY YEAR

(1) Year	(2) Number of Homeowners Receiving Cash during Year	(3) Total Cash Amount Loaned during Year*	(4) Number of Loans Terminating in Year	(5) Total Amount Received from Loans Repaid during Year	(6) Cash Flow
1	100	$ 600,000	4	$ 25,340	$ −574,660
2	196	1,176,000	7	65,342	−1,110,658
3	289	1,734,000	11	149,602	−1,584,398
4	378	2,268,000	16	297,632	−1,970,368
5	462	2,772,000	21	492,837	−2,279,163
6	541	3,246,000	27	789,621	−2,456,379
7	614	3,684,000	33	1,155,495	−2,528,505
8	681	4,086,000	41	1,745,095	−2,340,905
9	740	4,440,000	48	2,359,359	−2,080,641
10	792	4,752,000	56	3,185,567	−1,566,433
11	836	5,016,000	63	4,028,542	−987,458
12	873	5,238,000	70	5,004,139	−233,861
13	903	5,418,000	76	5,965,939	547,939
14	927	5,562,000	82	7,066,459	1,504,459
15	945	5,670,000	86	7,881,655	2,211,655
16	959	5,754,000	90	8,742,503	2,988,503
17	969	5,814,000	93	9,424,295	3,610,295
18	976	5,856,000	95	9,904,275	4,048,275
19	981	5,886,000	96	10,157,704	4,271,704
20	985	5,910,000	97	10,425,325	4,515,325

*Includes only payments to homeowners; excludes accruing interest.

creates uncertainty in the future loan balance. This uncertainty arises because the interest is capitalized as additions to the loan balance rather than paid as accrued.

A fixed-rate reverse mortgage could be viewed as the lender selling a futures or option contract for additional loans at the same interest rate for many years in the future. The extent to which a reverse mortgage is regarded to have the features of a futures contract, as opposed to the features of an option contract, depends upon the actuary's judgment about the degree of discretion the homeowners have in taking further loans, keeping in mind that these homeowners are generally in need of cash and want to stay in their homes. Similarly, the homeowners have the option to pay off the loan provided they can find the money to do so.

C. General Home Appreciation Risk

If only the home's current value is used to determine the amount of monthly loan, the resulting amount will be too small to interest many older homeowners in mortgaging their property. Yet, assumption of a general home appreciation rate introduces another risk for the lender. If homes in general do not appreciate as much as expected, the time when the loan balance exceeds the estimated selling price (the crossover point) occurs sooner. Figure 2 demonstrates how this happens. Suppose the actuary assumes 5.6 percent annual appreciation in the estimated selling price of the home. Figure 2 shows that the crossover point occurs in the seventeenth year. If, however, the selling price actually grows at a 3 percent annual appreciation rate, the crossover point occurs in the thirteenth year. More homeowners are still living in their homes at the crossover point than expected, not because of extended residency but because a lower home value advances the crossover point. Thus, the lender has more loans than originally expected that are not fully recoverable. To make matters even worse for the lender, each loan repaid after the crossover point involves more loss to the lender than originally predicted (the shaded area in Figure 2).

FIGURE 2

DEMONSTRATION OF GENERAL HOME APPRECIATION RISK

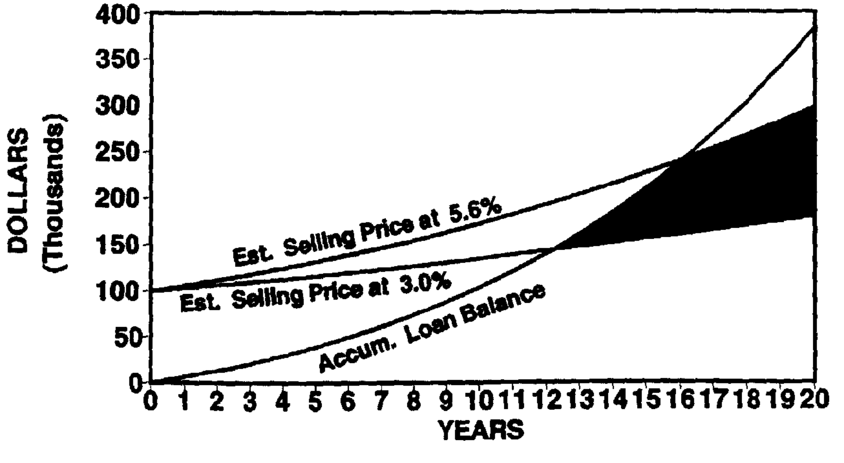


Table 4 contains the data illustrated in Figure 2. Columns 2, 3, 4, 5, and 6 are identical to the corresponding columns in Table 1. Column 7 is calculated like column 4 except the annual appreciation rate is 3 percent instead of 5.6 percent. Column 8 is calculated like column 5 except the lower home

TABLE 4

DEMONSTRATION OF GENERAL HOME APPRECIATION RISK
REVERSE MORTGAGES FOR 100 HOMEOWNERS AGE 75 WITH $100,000 HOMES
SELLING EXPENSES EQUAL 10% OF ESTIMATED SELLING PRICE

			5.6% Annual Appreciation			3% Annual Appreciation		
(1) End of Year	(2) Number of Homeowners Still in Their Homes at End of Year	(3) Accumulated Loan Balance per Home	(4) Estimated Selling Price of a Home	(5) Amount Received If One Loan Is Repaid This Year	(6) Unfunded Excess of Loan Balance over Home Value for Loans Repaid This Year	(7) Estimated Selling Price of a Home	(8) Amount Received If One Loan Is Repaid This Year	(9) Unfunded Excess of Loan Balance over Home Value for Loans Repaid This Year
1	96	$ 6,335	$105,600	$ 6,335	$ 0	$103,000	$ 6,335	$ 0
2	93	13,334	111,514	13,334	0	106,090	13,334	0
3	89	21,065	117,758	21,065	0	109,273	21,065	0
4	84	29,606	124,353	29,606	0	112,551	29,606	0
5	79	39,041	131,317	39,041	0	115,927	39,041	0
6	73	49,464	138,670	49,464	0	119,405	49,464	0
7	67	60,979	146,436	60,979	0	122,987	60,979	0
8	59	73,700	154,636	73,700	0	126,677	73,700	0
9	52	87,752	163,296	87,752	0	130,477	87,752	0
10	44	103,276	172,440	103,276	0	134,392	103,276	0
11	37	120,425	182,097	120,425	0	138,423	120,425	0
12	30	139,371	192,295	139,371	0	142,576	128,318	77,371
13	24	160,300	203,063	160,300	0	146,853	132,168	168,792
14	18	183,420	214,435	183,420	0	151,259	136,133	283,722
15	14	208,962	226,443	203,799	20,652	155,797	140,217	274,980
16	10	237,178	239,124	215,212	87,864	160,471	144,424	371,016
17	7	268,349	252,515	227,264	123,255	165,285	148,757	358,776
18	5	302,784	266,655	239,990	125,588	170,243	153,219	299,130
19	4	340,825	281,588	253,429	87,396	175,351	157,816	183,009
20	3	382,848	297,357	267,621	115,227	180,611	162,550	220,298
21	2	429,273	314,009	282,608	146,665	186,029	167,426	261,847
22	1	480,558	331,594	298,435	182,123	191,610	172,449	308,109
23	1	537,214	350,163	315,147	0	197,359	177,623	0
24	0	599,803	369,772	332,795	267,008	203,279	182,951	416,852
25	0	668,945	390,479	351,431	0	209,378	188,440	0
Total					$1,155,778			$3,223,902

values in column 7 are used. Column 9 is calculated like column 6 but uses the amounts in column 8. The lower home appreciation rate results in \$2,068,124 of additional unrecoverable loan amounts. Ignoring interest, this is more than 20 percent of the total value of the 100 homes at origination of the reverse mortgages. Discounted at the loan rate, the difference is 4 percent of the total value of the 100 homes at loan origination, or 153 basis points per dollar of repayable loan balance each year. Thus, the risk associated with assuming a general home appreciation rate can be sizable.

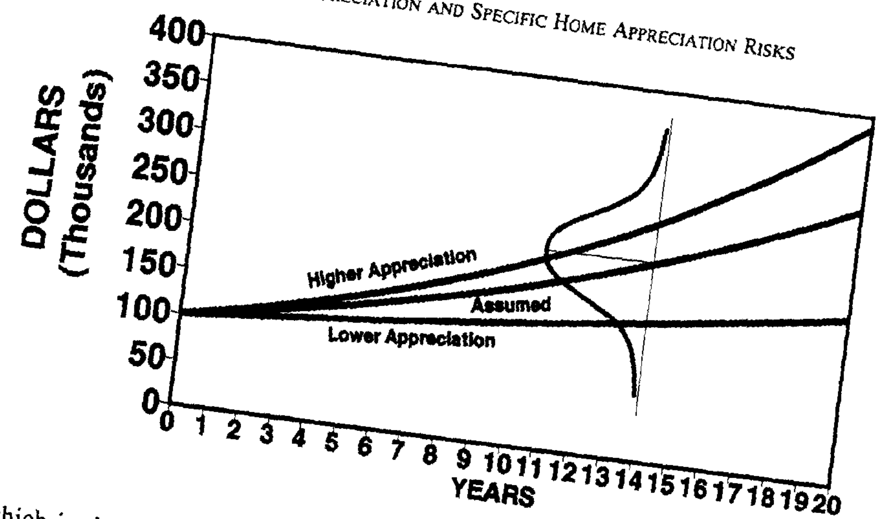
D. Specific Home Appreciation Risk

Even if homes in general appreciate as much as the lender predicts, the lender still faces the risk that the particular homes on which it has loans will not appreciate at the general rate. This shortfall may be the result of a local phenomenon, such as the fall in home prices in the Houston, Texas, area in the mid-1980s when oil prices collapsed. It could also be the result of specific causes, such as deterioration of the neighborhood, lack of proper maintenance of the property, or uninsured loss of the property by fire or natural catastrophe. Whatever the cause, reduced appreciation on a single home would create a situation much like that described under "General Home Appreciation Risk," but for one home instead of a large group of homes. The specific home appreciation risk boils down to how many of the lender's homes will appreciate less than the general appreciation rate assumed and the extent to which they fall short.

At any given time, each home in the lender's reverse mortgage portfolio will be expected, according to the general home appreciation assumption, to have increased to a multiple of the home's value at loan origination. Even though the lender's portfolio of homes may have increased to the expected value, values of individual homes in the portfolio will vary from their expected values. This dispersion of individual home values about their expected values determines the specific home appreciation risk. In this case, however, the expected values have their own uncertainty because of the general home appreciation risk. Figure 3 displays this relationship. The lender assumed the portfolio of homes would appreciate at a certain rate, which is shown as the middle curve in Figure 3. The portfolio may actually appreciate at a higher or a lower rate, shown by the top and bottom curves in Figure 3. The general home appreciation risk is the possibility of actual portfolio average appreciation being less than the middle curve. Even when the portfolio appreciates as expected, there will be a dispersion of individual home values,

FIGURE 3

GENERAL HOME APPRECIATION AND SPECIFIC HOME APPRECIATION RISKS



which is shown in Figure 3 as a distribution whose mean equals the middle curve.

For most product designs, some loss from the specific home appreciation risk is virtually certain. Even if actual general home appreciation equals the lender's assumption, total unfunded excesses increase when individual homes fail to appreciate as planned. This is demonstrated in Table 5 when some homes do not appreciate even though the overall appreciation rate of all homes matches the lender's assumption. In Table 5, 80 percent of homes appreciate at 7 percent, and the other 20 percent of homes remain unchanged at $100,000, resulting in average yearly appreciation rates of 5.6 percent to 6.7 percent for the block of mortgages. The calculations in Table 5 are analogous to those in Table 4, except that 7 percent and 0 percent annual appreciation rates are used where appropriate. The total unfunded excess of loan balance over home value in Table 5 is $1,356,439, which is $200,661 more than the unfunded excess if every home appreciates at 5.6 percent in all years (see column 6 of Table 1). This equals 0.9 percent on a present value basis, or 33 basis points per dollar of repayable loan balance each year. This greater excess occurs because the lender does not fully benefit from the higher appreciation rate if the lender receives no more than the loan balance. Table 5 illustrates the problem that the specific home appreciation risk presents to the lender in many tenure reverse mortgage designs. The homeowner gets most of the benefit if there is extra appreciation, while the lender pays most of the cost if there is a shortfall in appreciation. Thus, it is important that individual homes be underwritten carefully.

E. Expense Risk

The market for reverse mortgages is believed to be potentially large but thinly spread and ill-informed. The means of finding and presenting information to homeowners who would enter into a reverse mortgage is not well defined. Likewise, older homeowners often are unwilling even to consider mortgaging their home until their need for spendable cash becomes great; therefore, solicitation of the same prospects over an extended time may be necessary. A lender should expect to have to experiment with various marketing organizations and advertising methods. This experimentation and communication will require a considerable investment with a risk of not recovering it. In addition, administrative, systems and legal expenses may not be well understood and can differ significantly from those used in pricing insurance policies. Such expenses include:

1. Filing and negotiating with state and federal insurance and banking regulators
2. Licensing
3. Creating forms, documents, and contracts specific to this new type of product
4. Developing administrative systems
5. Paying inspection fees, title insurance and closing costs
6. Selling the home or settling the mortgage when the homeowner dies or moves
7. Developing leads and then converting them to sales of mortgages
8. Complying with state and federal disclosure laws.

III. RISK MANAGEMENT

The objective of risk management for a reverse mortgage program is to maintain adequate total yields and to protect principal. As previously described, several of these five risks can reduce yield by moving the crossover point sooner, either for a specific home or for the lender's entire portfolio of reverse mortgages. It can be argued that there may be some interdependence among the risks. For example, in an environment of low home appreciation in general, more people may find that it is not worthwhile to maintain

TABLE 5

DEMONSTRATION OF SPECIFIC HOME APPRECIATION RISK
80% OF HOMES APPRECIATE AT 7% PER YEAR AND 20% OF HOMES REMAIN UNCHANGED IN VALUE
REVERSE MORTGAGES FOR 100 HOMEOWNERS AGE 75 WITH $100,000 HOMES
SELLING EXPENSES EQUAL 10% OF ESTIMATED SELLING PRICE

			7% Annual Appreciation			Homes Still Worth $100,000			
(1) End of Year	(2) Number of Homeowners Still in Their Homes at End of Year	(3) Accumulated Loan Balance per Home	(4) Estimated Selling Price of a Home	(5) Amount Received If One Loan Is Repaid This Year	(6) Unfunded Excess of Loan Balance over Home Value for Loans Repaid This Year	(7) Estimated Selling Price of a Home	(8) Amount Received If One Loan Is Repaid This Year	(9) Unfunded Excess of Loan Balance over Home Value for Loans Repaid This Year	(10) 80%/20% Weighted Unfunded Excess of Loan Balance over Home Value
1..........	96	$ 6,335	$107,000	$ 6,335	$ 0	$100,000	$ 6,335	$ 0	$ 0
2..........	93	13,334	114,490	13,334	0	100,000	13,334	0	0
3..........	89	21,065	122,504	21,065	0	100,000	21,065	0	0
4..........	84	29,606	131,080	29,606	0	100,000	29,606	0	0
5..........	79	39,041	140,255	39,041	0	100,000	39,041	0	0
6..........	73	49,464	150,073	49,464	0	100,000	49,464	0	0
7..........	67	60,979	160,578	60,979	0	100,000	60,979	0	0
8..........	59	73,700	171,819	73,700	0	100,000	73,700	0	0
9..........	52	87,752	183,846	87,752	0	100,000	87,752	0	0
10..........	44	103,276	196,715	103,276	0	100,000	90,000	106,208	21,242
11..........	37	120,425	210,485	120,425	0	100,000	90,000	212,975	42,595
12..........	30	139,371	225,219	139,371	0	100,000	90,000	345,597	69,119
13..........	24	160,300	240,985	160,300	0	100,000	90,000	421,800	84,360
14..........	18	183,420	257,853	183,420	0	100,000	90,000	560,520	112,104
15..........	14	208,962	275,903	208,962	0	100,000	90,000	475,848	95,170
16..........	10	237,178	295,216	237,178	0	100,000	90,000	588,712	117,742
17..........	7	268,349	315,882	268,349	0	100,000	90,000	535,047	107,009
18..........	5	302,784	337,993	302,784	0	100,000	90,000	425,586	85,117
19..........	4	340,825	361,653	325,488	15,337	100,000	90,000	250,825	62,435
20..........	3	382,848	386,968	348,271	34,577	100,000	90,000	292,848	86,231
21..........	2	429,273	414,056	372,650	56,623	100,000	90,000	339,273	113,153
22..........	1	480,558	443,040	398,736	81,822	100,000	90,000	390,558	143,569
23..........	1	537,214	474,053	426,648	0	100,000	90,000	0	0
24..........	0	599,803	507,237	456,513	143,290	100,000	90,000	509,803	216,593
25..........	0	668,945	542,743	488,469	0	100,000	90,000	0	0
Total........									$1,356,439

their homes. This reduced maintenance would create a greater cost from the specific home appreciation risk. However, because these interdependencies are probably small, it is a reasonable simplifying assumption to treat the five risks as independent when the actuary evaluates them and designs ways to manage the risks. To a large extent, the degree of independence and even the existence of the risks depend upon the actuary's design of the product and administration of the reverse mortgage.

One way to manage the risks is to estimate the cost of each and to charge for them by some sort of fee. In addition, it is possible to design the reverse mortgage to eliminate or minimize selected risks by means of conservatism, diversification, sharing the risk with the homeowner, hedging, and asset-liability matching. Conversely, poor product and administrative design of a reverse mortgage can create risks and incentives for antiselection and loss.

A. Charging for the Risks

Through scenario testing similar to that demonstrated in Tables 1, 4, and 5, the actuary can estimate the costs of the risks. Then the reverse mortgage can be designed to charge for the risks using some combination of up-front fee, annual fee or shared-appreciation fee. An up-front fee would be very much like the "points" associated with a regular mortgage, in which the borrower pays a few percentage points of the amount borrowed. Because of the fundamental difference in the loan balance pattern between a reverse mortgage and a regular mortgage, the up-front fee in a reverse mortgage is generally expressed in terms of percentage points of the home's initial value.

An annual fee could be assessed as a certain number of basis points of the current outstanding loan balance at each anniversary of the reverse mortgage. Because of the way the loan balance of a reverse mortgage grows, the annual fee per loan would be small in early years when most reverse mortgages are still in force, but would grow larger in later years, while the number of loans in force declines. Thus, an annual basis-points fee may not result in as much spreading of the fee among all homeowners as desired. A fixed-dollar annual fee would provide more spreading than a basis points annual fee but still less than an up-front fee.

A third type of charge is shared appreciation. In a shared-appreciation reverse mortgage, a portion or all of each year's increase in the home's value belongs to the lender, although the lender does not actually receive any cash for the appreciation until the reverse mortgage is repaid. In effect, the shared appreciation is a form of additional capitalized interest on the loan. With this type of fee, those homeowners whose homes appreciate more bear a much larger cost than those whose homes appreciate less. Similarly, those homeowners who terminate their loans early pay a relatively much higher cost than those who stay in their homes longer. Garnett and Guttentag [5] provide a good description of shared-appreciation reverse mortgages. In a 100 percent shared-appreciation reverse mortgage, the lender would receive principal repayment and accumulated interest (usually at a fixed rate) plus the entire increase in the home's value from the date of origination to the date the loan is repaid. Table 6 demonstrates how a 100 percent shared-appreciation reverse mortgage would work. The basic data in Table 6 are the same as in Table 1. Column 2 is the estimated selling price of a home if the annual appreciation rate is 5.6 percent. Column 3 shows the value of the home in excess of \$100,000, all of which belongs to the lender as the shared-appreciation fee. However, the lender may be unable to collect all this amount in the later years because of the nonrecourse guarantee. Column 4 is the "traditional" part of the loan balance, consisting of the accumulation at a 10 percent nominal annual interest rate compounded monthly of the monthly amounts loaned to the homeowner (same as column 2 in Table 1). Column 5 is the sum of the principal, interest and shared appreciation without regard to the nonrecourse guarantee limit. Finally, column 6 is the actual amount the lender receives if the loan is repaid in a given year. Comparison of columns 5 and 6 illustrates how the lender is unable to collect all the loan balance beginning in the ninth year (under the specific situation pictured in Table 6). By the fifteenth year of this example, the lender is unable to collect any more than in a reverse mortgage without shared appreciation, because the accumulated principal and interest exceed 90 percent of the estimated selling price of the home (compare column 6 of Table 6 with column 4 of Table 1).

The shared-appreciation fee can make the finance charge of reverse mortgages extremely high both for homeowners whose homes enjoy greater appreciation than average and for those who move out of their homes or die within ten years or so. Column 7 of Table 6 displays the annual percentage rate the lender earned on the loan if the loan were repaid that year. Because the lender receives both interest and the shared-appreciation fee, the annual percentage rate is very high for loans that terminate when the lender can collect all the home appreciation. Shared appreciation is not well understood by many customers. As a result, some have become disgruntled after they entered into a shared-appreciation reverse mortgage and then realized how much appreciation the lender was receiving relative to the amount of money

TABLE 6

DEMONSTRATION OF A 100% SHARED-APPRECIATION REVERSE MORTGAGE
HOMEOWNER AGE 75 WITH $100,000 HOME
5.6% ANNUAL HOME APPRECIATION AND 10% INTEREST RATE*
SELLING EXPENSES EQUAL 10% OF ESTIMATED SELLING PRICE

(1) End of Year	(2) Estimated Selling Price of a Home	(3) Shared Appreciation Owed to Lender	(4) Accumulated Principal and Interest	(5) Total Loan Balance (Sum of Prior Two Columns)	(6) Amount Lender Receives If Loan Repaid This Year	(7) Annual Percentage Rate* Earned by Lender If Loan Repaid This Year
1	$105,600	$ 5,600	$ 6,335	$ 11,935	$ 11,935	122.5%
2	111,514	11,514	13,334	24,848	24,848	65.2
3	117,758	17,758	21,065	38,823	38,823	45.8
4	124,353	24,353	29,606	53,959	53,959	36.1
5	131,317	31,317	39,041	70,358	70,358	30.3
6	138,670	38,670	49,464	88,134	88,134	26.4
7	146,436	46,436	60,979	107,415	107,415	23.6
8	154,636	54,636	73,700	128,336	128,336	21.5
9	163,296	63,296	87,752	151,048	146,966	19.4
10	172,440	72,440	103,276	175,716	155,196	16.7
11	182,097	82,097	120,425	202,522	163,887	14.6
12	192,295	92,295	139,371	231,666	173,066	12.9
13	203,063	103,063	160,300	263,363	182,757	11.6
14	214,435	114,435	183,420	297,855	192,992	10.6
15	226,443	126,443	208,962	335,405	203,799	9.7

*Nominal annual rate compounded monthly.

they borrowed. This has been especially true when homes have appreciated at high rates. Table 7 displays this by illustrating the results when the home appreciates 10 percent annually. (Table 7 is calculated just like Table 6 except the annual appreciation rate is 10 percent instead of 5.6 percent.) There have been several areas in the U.S. where homes have appreciated 10 percent a year or more over long periods, notably California and the Washington, D.C. area. As Table 7 shows, the annual percentage rate earned is extremely high for loans terminating within the first few years, and even though the annual percentage rate declines, the actual dollar amount of the shared-appreciation fee continuously increases to $166,991 in the fifteenth year. (This shared appreciation fee of $166,991 equals the difference between the amount the lender receives if the loan is repaid, which is $375,953, shown in column 6, and the accumulated principal and interest of $208,962, shown in column 4.)

Figure 4 displays a comparison of the loan balance of a reverse mortgage using an up-front fee with one using a shared-appreciation fee. The up-front

TABLE 7

DEMONSTRATION OF A 100% SHARED-APPRECIATION REVERSE MORTGAGE
HOMEOWNER AGE 75 WITH $100,000 HOME
10% ANNUAL HOME APPRECIATION AND 10% INTEREST RATE*
SELLING EXPENSES EQUAL 10% OF ESTIMATED SELLING PRICE

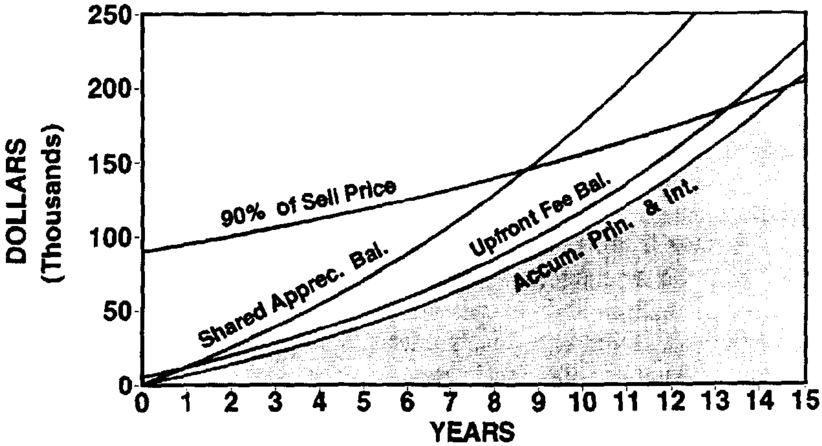
(1) End of Year	(2) Estimated Selling Price of a Home	(3) Shared Appreciation Owed to Lender	(4) Accumulated Principal and Interest	(5) Total Loan Balance (Sum of Prior Two Columns)	(6) Amount Lender Receives If Loan Repaid This Year	(7) Annual Percentage Rate* Earned by Lender If Loan Repaid This Year
1......	$110,000	$ 10,000	$ 6,335	$ 16,335	$ 16,335	176.5%
2......	121,000	21,000	13,334	34,334	34,334	92.0
3......	133,100	33,100	21,065	54,165	54,165	63.9
4......	146,410	46,410	29,606	76,016	76,016	49.9
5......	161,051	61,051	39,041	100,092	100,092	41.5
6......	177,156	77,156	49,464	126,620	126,620	35.9
7......	194,872	94,872	60,979	155,851	155,851	31.9
8......	214,359	114,359	73,700	188,495	188,495	29.0
9......	235,795	135,795	87,752	223,547	212,216	25.8
10......	259,374	159,374	103,276	262,650	233,437	23.0
11......	285,312	185,312	120,425	305,737	256,781	20.9
12......	313,843	213,843	139,371	353,214	282,459	19.3
13......	345,227	245,227	160,300	405,527	310,704	18.0
14......	379,750	279,750	183,420	463,170	341,775	16.9
15......	417,725	317,725	208,962	526,687	375,953	16.0

*Nominal annual rate compounded monthly.

fee demonstrated is 5 percent of the home's initial value, and the shared-appreciation balance assumes 5.6 percent annual home appreciation. Even though these two fees do not have the same present value, Figure 4 illustrates how the two fee patterns would differ. The shaded area represents accumulated principal and interest, which would be the amount owed if no fee were involved. Reverse mortgages terminating during the first year would owe more under an up-front fee than under a shared-appreciation fee for the specific fee arrangements pictured in Figure 4. However, Figure 4 shows that the shared-appreciation fee balance at 5.6 percent annual appreciation exceeds the 5 percent up-front fee balance in the second year, and that relationship continues until the fourteenth year, when the amount owed equals 90 percent of the selling price under both arrangements. Even with a 10 percent up-front fee, the same pattern would hold and the shared-appreciation fee balance would exceed the up-front fee balance within a few years after loan origination.

FIGURE 4

COMPARISON OF UP-FRONT FEE AND SHARED-APPRECIATION FEE



The loan balance under a reverse mortgage using an annual-basis-points fee or a fixed annual fee would have a pattern similar to but steeper than the loan balance of a reverse mortgage with an equivalent up-front fee. In cases in which the two fee patterns have the same value to the lender, the loan balance with the annual fee would start lower but become higher than the loan balance with the up-front fee. After both loan balances reach 90 percent of the home's selling price, the amount owed under both fee patterns would be the same.

A shared-appreciation fee offers some significant advantages to the lender. First, the only limit on the lender's profit potential is the appreciation of the homes' values. Second, shared appreciation reduces or eliminates the cost of the specific home appreciation risk, if the lender can get a general mix of homes that on average meet or exceed the lender's general appreciation assumption. Because the lender now receives more than the expected loan balance on homes that appreciate, profits from homes with higher appreciation rates can offset the negative results of those homes that do not appreciate as well as expected.

On the other hand, a shared-appreciation fee also has definite disadvantages to the lender. Older homeowners are hesitant to enter into a loan in which the cost not only is unknown but also depends upon a contingency as unpredictable as the specific appreciation of one's home. This makes the marketing of a shared-appreciation reverse mortgage more difficult than one with an up-front or annual fee. Moreover, customer relations can be a real problem when customers realize that the effective interest rates are very high.

In addition, the appraisal of the home's value can be a source of conflict. Because all increase in the value of the home goes to the lender, an understated appraisal at loan origination increases the shared-appreciation fee and thereby increases the profit and margins for the lender. On the other hand, the customer has a great incentive to argue for a higher appraisal, because it would increase the monthly amount received from the lender. Thus, disagreements are likely and add conflict to the sales process. Likewise, at loan termination the lender receives the maximum amount of money when the appraised value is as high as possible, while the borrower is benefited by a lower appraisal. Even in a fair appraisal, the borrower often perceives that the lender has taken too much fee. For this reason, the federal reverse mortgage demonstration, as well as some state laws, have limited the amount of shared appreciation that the lender can receive [14].

B. Methods of Minimizing the Risks

Several options are available to the actuary to eliminate or minimize the risks of length of residency, interest rate, general home appreciation, and specific home appreciation: conservatism, diversification, sharing the risk with the homeowner, hedging, and asset-liability matching. An obvious example of conservatism is to reduce the monthly loan payment to the homeowner. A sufficiently low monthly amount could be determined that would nearly eliminate the four risks. Although this might be very advantageous from a risk perspective, the disadvantage would be the product's lack of marketability. For this reason, the actuary must accept some risk, but charge an appropriate fee for taking that risk. With a higher fee, more risk can be accepted; however, there is a point of diminishing return. Once the loan balance exceeds the home's value, the fee begins to lose value because the fee is charged by adding it to the loan balance. If a larger fee is charged, a larger percentage of the terminating loans pay a reduced fee or no fee at all, because a larger percentage of the loans terminate after their loan balances exceed the homes' values.

A second way to minimize risks is diversification. The lender should make reverse mortgages on homes in several regional areas to reduce the specific home appreciation risk. By having the portfolio of reverse mortgages represent a diversity of locations, the lender is less exposed to the effect of a particular area of the country having depressed housing prices from economic or demographic changes. Appropriate diversification of the location of the reverse mortgages can help the lender achieve its specific home appreciation assumption.

Other diversification techniques that any prudent investor in real estate would practice should be followed, such as diversification of the types of structures. The lender would not limit its reverse mortgages to condominiums, for example, in case their prices were to decline because of a significant reduction in demand for this type of housing.

A third way to minimize risks is through sharing the risk with the homeowner. The shared-appreciation fee is a good example of sharing the specific home appreciation risk with the homeowner. By its nature, a shared-appreciation fee charges a larger fee on homes with higher appreciation, which offsets the lower fee from homes that appreciate less than expected. Another way to minimize the specific home appreciation risk is to design the reverse mortgage so that the homeowner who has a home with the best potential for appreciation finds it in his or her own best interest to purchase the lender's reverse mortgage rather than a competitor's reverse mortgage. This could be done, for example, by guaranteeing that the homeowner gets to keep the home equity that results from the home appreciating more than a certain amount. Theoretically, it would cost the lender to allow the homeowner to keep that home equity; however, in practice such a technique might save the lender money by creating an incentive for the homeowner to take better care of the home and thereby reducing the specific home appreciation risk. Thus, through sharing some of the risks and rewards with the homeowner, the lender reduces its specific home appreciation risk because the homeowner would have to lose all of his or her appreciation incentive before the lender loses any of its loan balance.

As mentioned earlier, the use of a variable interest rate is another example of sharing the risks and rewards with the homeowner. If interest rates are low, the homeowner will be rewarded with more remaining equity, and the lender will be rewarded by having relatively less loan losses. On the other hand, if interest rates are high, the homeowner loses equity and the lender has higher-than-expected loan losses.

A fourth way to minimize risks is hedging and/or asset-liability matching. The most straightforward case would be a company with indexed liabilities obtaining improved asset-liability matching by selling a reverse mortgage with an interest rate tied to the same index. Because an interest rate change on a liability is offset by the same change in an asset, the company is hedged against changes in the interest rate environment. A less direct approach would be to use statistical analysis to determine whether other interrelationships exist within the company's portfolio of assets and liabilities that would indicate strategies whereby risks can be reduced. Ibbotson and Siegel [7], for example, demonstrate that real estate has near-zero correlations with stocks and long-term corporate bonds and very high correlation with inflation. They also discuss the relatively low standard deviation of annual changes in residential housing prices. Because risk charges and option costs increase with volatility, the actuary can use such information to measure the relative size of the various risks in a reverse mortgage and to help devise strategies to hedge these risks. The methods lenders use to deal with investment risks are generally proprietary; however, the same asset-liability matching techniques used to manage the C-3 risk would be applicable to reverse mortgages.

In evaluating the risks and the extent to which they will be controlled, the actuary must use scenario testing. The risks should be studied independently and in combination. Careful testing is necessary because the risks have interrelated effects on the product and its profitability. Use of averages alone can produce very deceptive results.

IV. SPECIAL UNDERWRITING HAZARDS

Without minimizing the importance of asset-liability management, the authors are convinced that the greatest risk arises from antiselection by intermediaries and borrowers. There is not a long evolution of protective administrative procedures for reverse mortgages. Thus, those actuaries who are accustomed to dealing with life insurance must discipline themselves to review every procedure and feature of a reverse mortgage product to ensure it includes the proper incentives and protective procedures. Some of the more unusual hazards are described below.

First, there is the danger of home values being overstated. Because the amount of the monthly loan depends upon the home's value, the homeowner, and possibly even the sales representative and loan originator, will be seeking the highest appraisal possible. Real estate appraisal is not an exact science, and the accuracy of appraised values can vary greatly among appraisers. Even for a given appraiser the accuracy of appraised values can vary greatly among various property types (single-family dwellings, condominiums, planned unit developments (PUDs), owner-occupied rental property). As the recent

S&L failures have demonstrated, erroneous appraisals and incautious lending can have disastrous financial consequences. Because of the long time lag between loan origination and the time when mistaken assumptions are recognized, it is critical that the lender carefully control the appraisal process using audits and other quality control mechanisms. This risk is especially hazardous for an insured program in which the loan originator both acts as the sales representative and also selects the appraisers.

Second, because the nonrecourse guarantee limits the lender to only the home's value for repayment of the loan, the lender is at risk that the homeowner may fail to properly maintain the property. Homes that are allowed to deteriorate will not appreciate in value as much as homes in general and will therefore produce unexpected excesses of loan balance over home value. The lender needs to develop a method of confirming that the homeowner is adequately maintaining the home and may even need to assume the maintenance in order to conserve property value.

A third peril is the possibility that the homeowner will not maintain adequate homeowners insurance, either through carelessness, forgetfulness, or lack of money. An uninsured loss of the home by fire or natural disaster can leave the lender with a loan unrecoverable except for the value of the land. It is critical that the lender implement procedures to control this risk. The lender may even find itself forced to pay the insurance premium to protect its interest in the property. Other alternatives available to the lender would include wording the mortgage so that the nonrecourse guarantee does not apply if an uninsured loss occurs and escrowing the insurance premiums out of the monthly loan payments.

Fourth, a reverse mortgage presents the lender with the unique risk that the homeowner's heirs will challenge the mortgage after the homeowner's death. They may claim not to have known about the reverse mortgage and say that they had been led to believe that they would inherit a debt-free home. Considering the age of a reverse mortgage mortgagor, heirs could claim that their parent was not legally competent to enter into such a complicated agreement. Obviously, the lender must try to prevent this occurrence, both to reduce litigation expenses and to increase customer satisfaction.

Finally, the lender should evaluate the risks associated with various property types. Certain types of properties, such as condominiums, may be harder to sell in a reasonable time than the typical single-family home. The lender must consider carefully which property types will be accepted for reverse mortgages.

V. SPECIAL PRICING CONSIDERATIONS

In the preceding discussion, we described several kinds of risk and treated them as independent. Actually, these and other risks can, to a large extent, be created or eliminated, made independent or dependent, and limited or increased through product design. Reverse mortgages present the product designer with many opportunities to select or invent particular product or administrative features, either wisely or unwisely, with the marketplace demanding relatively few absolutely standard features. For example, one designer could choose to pay for underwriting and loan loss costs through an initial sign-up fee or loan, while another could choose to have no sign-up fee and pay for these costs entirely through a higher loan interest rate. These two approaches will undoubtedly create different marketing approaches, but they also create different risks. The second approach creates a prepayment risk that is absent in the first approach. The second designer has created a whole class of worry (general interest rate decrease and subsequent refinancing and loss of the loan before costs are repaid) that does not exist for the first designer. As an example of an administrative risk, consider a designer who plans to use outside sellers for the product, pays a commission for closed loans, and relies on the seller to do the appraisals. That designer has just created a character/honesty risk for the company where none existed before. As described earlier, incentives for the homeowner to self-select or to maintain the home can also be an important method of defining and limiting risk.

Because each company differs in its areas of investment expertise and types of assets and liabilities, the actuary should tailor the product design to best fit the company profile. Another key investment consideration is risk tolerance. A total shared-appreciation reverse mortgage has more opportunity for high profits and more risk of loss than a reverse mortgage with more predictable charges.

Developing a reverse mortgage involves creating a new product that is at the intersection of insurance, banking, and investment. The actuary's job is largely one of selecting the best set of features from an almost infinite universe and then explaining the financial underpinnings of the plan to the disparate corporate audience representing the three disciplines. For example, in the selection of a profit standard, investment professionals generally prefer basis points, insurance actuaries prefer present values, and some managers may think in terms of undiscounted margins. For that reason, the risk costs in Tables 1, 4, and 5 are expressed in all three terms.

A simple example of the pricing process is a reverse mortgage based on the following assumptions:

- It is designed to have only the three risks illustrated in Tables 1, 4, and 5.
- The risks are independent, and their costs are exactly equal to those in the tables.
- The profit standard is 100 basis points.
- Expenses are equivalent to 150 basis points.
- All charges to the homeowner take the form of an ongoing basis point fee, which becomes part of the interest rate charged to the homeowner.
- The cost of funds equals a given interest rate I.

Then the pricing might be done using the excess spread approach [6].

	Interest Rate
Cost-of-Funds	I %
Length of Residency Risk	0.64
General Home Appreciation Risk	1.53
Specific Home Appreciation Risk	0.33
Expenses	1.50
Profit	1.00
Total	I + 5.00%

If the cost of funds is 10 percent, the rate charged to the homeowner is 15.00 percent. The actuary should be cautious with this approach because the costs of risks and expenses vary with the interest rate charged. An approach that takes into account interest sensitivity is discussed by DiVenti and Herzog [3]. Their stochastic simulation approach explicitly takes into account many of the possible risks in calculating the amount of money available to a homeowner for a given interest rate.

Whatever methodology is used for pricing, it is critical that the actuary not price by considering only averages. Much of the risk costs arise from the inevitable deviation of individual home values from their expected values, even if the assumed averages are accurate.

VI. RESERVES

From the previous discussion, it is obvious that a reverse mortgage is a product in which early profits may turn to later losses. The chance of loss during the first several years of a reverse mortgage lending operation is minuscule. Later, as loan balances begin to exceed home values, losses on individual loans can accrue. For this reason, reserves should be actuarially determined so profits emerge in a reasonable manner and the solvency of the lender is protected.

Consider an example of a reverse mortgage using up-front fees to charge for the loss risks mentioned earlier. Expenses (sales, appraisal, title insurance, and so on) almost all occur by the time the mortgage is closed; however, the Financial Accounting Standards Board requires that these expenses be amortized over the expected life of the mortgage (*SFAS 91* [4]). This creates some early reported profits in line with generally accepted accounting principles. However, much larger reported profits would come from up-front risk fees if no offsetting reserves were created. Because these risk fees were explicitly charged to cover later expected losses, it would be totally inappropriate to allow them to pass into profits when they are charged to homeowners. Instead, the actuary should use the risk fees to set up a reserve that accumulates with interest and is decremented as loans are repaid.

Although the late emergence of loss in reverse mortgages is similar to the pattern in life insurance policies, the loss is a financial risk (that the value of the home, for whatever reason, may be less than the loan balance when the homeowner leaves the home) rather than a mortality risk. Thus, reserves for reverse mortgages would not be life insurance reserves but rather would correspond to loan-loss reserves established by a lender for questionable loans or other amounts whose recoverability is uncertain.

Such reserves could be calculated by using the principles of a prospective reserving method. For example, a reserve per home for a reverse mortgage with only up-front fees could be calculated as follows.

Let

w = First age such that the probability of a homeowner still living in the home is zero

x = Homeowner's age at loan origination

${}_0HV$ = Home value at loan origination

${}_tLB_x$ = Accumulated loan balance at the end of year t for a homeowner age x at loan origination (for example, column 2 in Table 1)

${}_tAR_x$ = Amount received if the loan is repaid at the end of year t for a homeowner age x at loan origination (for example, column 4 in Table 1)

${}_tL_x$ = Greater of $({}_tLB_x - {}_tAR_x)$ and zero

${}_jp_{[x]+t}$ = Probability at time t that homeowners, age x at loan origination, will still be in their homes at the end of year $t+j$

$q_{[x]+t}$ = Probability at time t that homeowners, age x at loan origination, will terminate their loans within one year, either by death, move-out or repayment

${}_tVL_x$ = Loan reserve, per \$1 of home value at loan origination, at the end of year t for a homeowner age x at loan origination.

Assuming end-of-the-year terminations, the reserve for that particular reverse mortgage at the end of year t would be:

$$({}_tVL_x)({}_0HV) = \sum_{j=0}^{w-x-t} {}_jp_{[x]+t}\, q_{[x]+t+j}\, v^{j+1}\, {}_{t+j+1}L_x$$

The above formula is a general one.

As a special case, the following one explicitly recognizes, in addition to the length-of-residency risk, the specific home appreciation risk by using an appreciation distribution function. The formula assumes that each home's full value at loan origination is used to purchase the reverse mortgage, that there is no general home appreciation risk, that there are no expenses involved in selling homes, and that the reverse mortgage product has only up-front fees and no shared-appreciation feature.

Let

${}_tUHV$ = Expected home value at the end of year t per \$1 of home value at loan origination

${}_tULB_x$ = Accumulated loan balance at the end of year t per \$1 of home value at loan origination for a homeowner age x at loan origination.

The ratio of an individual home's actual value to its expected appreciated value at the end of year t could range from zero to (theoretically) an infinitely large number. However, define a limit to that ratio as ${}_tR_x$, where ${}_tR_x = {}_tULB_x / {}_tUHV$.

For each year t, partition the range from zero to ${}_tR_x$ into n_t subintervals. A large enough number of subintervals will produce a partition fine enough to ensure a sufficiently good estimate of loss. Then let $r_t(i)$ be a point from the i-th subinterval. Typically, $r_t(i)$ would be the midpoint of the ratios in that subinterval; however, letting $r_t(i)$ be the smallest ratio in each subinterval would introduce some conservatism because this would produce larger reserves. Finally, define

$a_t[r_t(i)]$ = The probability that, at the end of year t, the ratio of an actual individual home value to its expected appreciated value falls into the subinterval represented by $r_t(i)$.

For any year t,

$$\sum_{i=1}^{n_t} a_t[r_t(i)] \leq 1.$$

Assuming end-of-the-year terminations, the loan reserve, per \$1 of home value at loan origination, at the end of year t for a homeowner age x at loan origination would be:

$$_tVL_x = \sum_{j=0}^{w-x-t} ({}_jp_{[x]+t}\, q_{[x]+t+j}\, v^{j+1}) \cdot \left\{ \sum_{i=1}^{n_{t+j+1}} ({}_{t+j+1}ULB_x - [r_{t+j+1}(i)]_{t+j+1}UHV)\, a_{t+j+1}[r_{t+j+1}(i)] \right\}$$

The above formula could be expanded to recognize explicitly the general home appreciation risk if the appreciation distribution function included both general and specific home appreciation risks. An empirical distribution function including both risks could be developed based on a stochastic simulation like the one discussed by DiVenti and Herzog [3]. Each reverse mortgage product design will need its own reserve formula that reflects the product's specific repayment provisions and guarantees, such as shared appreciation, equity conservation, and selling expenses borne by the lender.

Table 8 displays reserves calculated using the above formula for a block of 100 reverse mortgages for which each home is worth \$100,000 and each homeowner is age 75. For simplicity, $a_t[r_t(i)]$, $r_t(i)$, and n_t are assumed to be independent of time, and $r_t(i)$ has only two values, 0.5 and 1.0, with a 50 percent probability of each value. The valuation interest rate in Table 8 is 10 percent nominal annual compounded monthly, the same as the loan interest rate. The values of ${}_jp_{[x]+t}$, $q_{[x]+t+j}$, ${}_t$UHV, and ${}_tULB_x$ are derived from columns 2, 3, and 5 of Table 1. A reverse mortgage with ongoing fees would have a lower reserve because of the deduction of the present value of future fees.

Although the numbers in Table 8 are merely illustrative, they demonstrate that significant reserves can arise from a relatively small number of reverse mortgages. These reserves are a function of the loan balance patterns typical

TABLE 8

DEMONSTRATION OF LOAN RESERVES FOR REVERSE MORTGAGES FOR 100 HOMEOWNERS AGE 75 WITH $100,000 HOMES AT LOAN ORIGINATION VALUATION AND LOAN INTEREST RATES EQUAL 10% NOMINAL ANNUAL COMPOUNDED MONTHLY

(1) End of Year	(2) ${}_tVL_x$	(3) Home Value at Loan Origination of Loans Still Active at End of Year	(4) Total Loan Reserve
Origination	0.03275	$10,000,000	$ 327,500
1	0.03769	9,600,000	361,824
2	0.04298	9,300,000	399,714
3	0.04961	8,900,000	441,529
4	0.05807	8,400,000	487,788
5	0.06821	7,900,000	538,859
6	0.08155	7,300,000	595,315
7	0.09815	6,700,000	657,605
8	0.12314	5,900,000	726,526
9	0.15434	5,200,000	802,568
10	0.20150	4,400,000	886,600
11	0.26472	3,700,000	979,464
12	0.36067	3,000,000	1,082,010
13	0.47804	2,400,000	1,147,296
14	0.62882	1,800,000	1,131,876
15	0.78134	1,400,000	1,093,876
16	0.97708	1,000,000	977,080
17	1.20357	700,000	842,499
18	1.45027	500,000	725,135
19	1.67858	400,000	671,432
20	1.93970	300,000	581,910
21	2.24538	200,000	449,076
22	2.64238	100,000	264,238
23	2.91907	100,000	291,907
24	0	0	0

of most reverse mortgages and the large sums generally involved in each mortgage. This is one more reason why a company entering the reverse mortgage business needs to be well capitalized.

The actuary will want to select a valuation interest rate appropriate for both the lender's situation and the loan interest rate charged. The actuary should also use an appropriate margin of conservatism in selecting assumptions, such as the home appreciation rate, so that reserves will be adequate for adverse deviations from expected results. As with pricing, a stochastic modeling approach that takes into account all the risks together may be easier than reserving for each risk separately and taking into account their interdependencies.

Proper reserving in reverse mortgages is critical, because most homeowners with reverse mortgages depend upon the money from the lender to pay for daily living expenses. For this reason, the bankruptcy of a lender involved in reverse mortgage lending would have serious personal consequences to the borrowers. In addition, the failure of one lender could undermine the whole concept of reverse mortgages, because older homeowners would be even more skeptical of every lender and would fear that they too might become unfortunate victims.

VII. CONCLUSION

Reverse mortgages are a new field but represent a class of investments that could involve tens of billions of dollars of loans in the future. In this paper we have attempted to identify the actuarial considerations that go into the design, pricing and reserving of such a product. Reverse mortgages have a unique set of design considerations and require sophisticated pricing, marketing, administrative, and asset management strategies to ensure the profitability of the product and the future solvency of the lender.

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DISCUSSION OF PRECEDING PAPER

ALBERT E. EASTON:

Thanks are due to the authors for this complete exploration of the risks inherent in reverse mortgages. The concept of a reverse mortgage is not a natural one, but one probably originating primarily from tax considerations. If there were no tax considerations, the cash flows inherent in a reverse mortgage would be available from a life annuity purchased either with the proceeds of a sale/leaseback or an interest-only mortgage.

Life annuities are taxed more heavily in the later years of life under the provisions of the 1986 Tax Reform Act (after the "investment in contract" is recovered). For that reason, the taxes are highest just when inflation has most seriously eroded the value of fixed-income payments. Fixed-income annuities are often no longer suitable support vehicles for the elderly—hence the reverse mortgage.

At present, it seems most likely that the tax consequences of reverse mortgages are:

1. No tax on income, even when payments (that is, "borrowings") under the reverse mortgage exceed the original investment in the house
2. Exclusion of capital gains tax at death under Section 1014 ("stepped-up" basis)
3. Deduction of accrued interest if the mortgage is repaid before death and if the house was the principal residence, offsetting capital gains recognized if the house is sold. (Many elderly persons also will qualify to exclude $125,000 of capital gains under Section 121.)

Reverse mortgages have not yet been common enough to have attracted any specific tax regulatory attention. If they become common, some or all of the tax advantages may be restricted.

The authors propose a level-income reverse mortgage in which future appreciation in home value is anticipated and paid in early years. This model has the advantage of making early income payments more attractive, but has the disadvantage of producing a declining inflation-adjusted income. Also, it would seem to be far less attractive to the lending agency than a loan that is adjusted upward every few years based on a new appraisal. Such an increasing income mortgage also reduces two of the most significant risks—general and specific home appreciation—and should reduce the charges for these risks.

Developments in reverse mortgages will be interesting over the next few years. They may fill a significant need in our economic structure.

THOMAS N. HERZOG:

I thank the authors for an excellent job of describing the basic characteristics of reverse mortgages. They filled many holes in my earlier work [2]. The current paper focuses, as did my earlier work, on providing cash payments to older homeowners.

Benjamin [1] has extended these concepts. His idea is to develop a unified scheme that uses the value of the house to provide care in the home followed by care in a residential or nursing home. In other words, Benjamin [1] proposes that the value of the house be used to pay for all the future living expenses of the older homeowner regardless of whether he/she spends the rest of his/her life in the house. Benjamin's ideas are for residents of Great Britain. Of course, there are major differences in the health care systems and the real estate markets of Great Britain and the U.S. I propose the extension of Benjamin's ideas to the U.S. as a potential actuarial research problem.

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MARK W. GRIFFIN:

The authors are to be congratulated for an excellent description of a very interesting financial innovation. The paper also is timely, because reverse mortgages will undoubtedly become much more popular in the years ahead due to their compelling social purpose and the aging of the population.

The paper clearly shows that, from the lender's perspective, the risk of incomplete repayment of the loan depends on the length of tenancy and the rate of appreciation, or depreciation, of the home's value. In asset parlance, the lender's (investor's) risk of not receiving timely payment of principal or interest is known as credit risk. Credit risk is often referred to as C-1 risk by actuaries. The risk of incomplete repayment therefore can be thought of as the credit risk of a reverse mortgage. The skills of an actuary seem well suited for measuring the credit risk of a reverse mortgage and for determining what risk premium is necessary to compensate the lender for the expected credit losses. However, the actuary must remember that a reverse mortgage is, from the lender's perspective, an investment, and investments can have risks other than credit risk. This discussion focuses on the interest rate risk of reverse mortgages.

Both an asset and a liability are needed to study interest rate risk. Therefore, as the authors state, it is necessary to analyze reverse mortgages in an asset/liability framework. From the lender's perspective, which is the perspective throughout this discussion, the reverse mortgage begins as a commitment to lend certain amounts at certain terms, over an uncertain period of time. As money is lent, the reverse mortgage becomes an asset. To analyze the interest rate risk of a fixed-rate reverse mortgage, consider the following:

Asset: Fixed-rate reverse mortgage with a rate of 9 percent. $10,000 is loaned at the beginning of each year for 10 years. At the end of 10 years, the house is sold for an amount in excess of the $165,603 accumulated loan value.

Liability: A "policy" in which an installment of $10,000 is paid at the beginning of each year for 10 years. The installments accumulate at 8 percent and are repaid to the policyholder at the end of 10 years, the maturity of the policy. The maturity amount is $156,455.

The example is very simplified because there is no credit risk and no expenses and the liability appears tailor-made for the asset. In this theoretically perfect example, the lender would appear to have a certain profit at the end of 10 years of $9,148 ($165,603 − 156,455).

However, under most fixed-rate reverse mortgages, the homeowner is under no obligation to continue to borrow more money as time passes. In fact, it is possible that if prevailing interest rates fall noticeably, other lenders may be offering fixed-rate reverse mortgages at lower rates. If the amount of the original reverse mortgage were small relative to the current value of the home, the borrower might be able to take out a new reverse mortgage at the new lower fixed rate. Also, the borrower might be able to repay the first reverse mortgage by receiving a larger initial payment under the new reverse mortgage, subject to the value of the property.

If interest rates did fall significantly, it is very hard to predict what proportion of borrowers might "reborrow" in this fashion. On one hand, borrowers would tend to be elderly and not inclined to look for such a financial arbitrage. On the other hand, a financial intermediary or heir of the borrower may have an interest in such a transaction.

Also, many of today's or tomorrow's older homeowners have taken advantage of a fixed insurance policy loan rate in the rising interest rates of the 1970s, or they have refinanced traditional mortgages during the falling interest rates of the 1980s. Like traditional mortgage refinancing, any up-front fees that might be incurred by reborrowing will affect the economics of such a transaction.

To consider the financial effect on the lender of reborrowing, let us consider the "New York 7" interest rate scenarios, and use the simple assumption that when interest rates have fallen 2 percent, reborrowing will occur. The following table shows the effect on the terminal profit that such reborrowing would have. The calculations assume that after reborrowing has occurred, installments are lent at prevailing market rates over the remaining term of the policy.

Scenario Number	Interest Rate Behavior	Terminal Asset Value	Terminal Profit*
1	No change	$165,603	$9,148
2	Rates go up 3% immediately and stay there	165,603	$9,148
3	Rates go down 3% immediately and stay there	139,716	−16,739
4	Rates go up 5% over 10 years	165,603	9,148
5	Rates go down 5% over 10 years	149,357	−7,098
6	Rates go up 5% over 5 years and then down 5% over 5 years	165,603	9,148
7	Rates go down 5% over 5 years and then up 5% over 5 years	143,242	−13,213

*Terminal liability value is $156,455 in all scenarios.

For example, in scenario 5 in which rates go down 5 percent over 10 years, reborrowing is assumed to occur 4 years from the policy date, when "rates" have fallen 2 percent. At that point, the accumulated balance of the loan, $49,847, plus the $10,000 installment paid at that time, is assumed to be lent, or "reinvested," at 7 percent for the remaining 6 years of the policy. Prevailing reinvestment rates are assumed to be 9 percent, the original reverse mortgage rate, minus the 2 percent change in "interest" rates. The $10,000 installment received 5 years after policy issue is lent at 6.5 percent for the remaining 5 years of the policy, and so on.

The point of this simplified analysis is to demonstrate in a rough fashion the degree of possible interest rate risk arising from the reborrowing risk in fixed-rate reverse mortgages. Interest rate risk can be considerable even when the fixed-rate reverse mortgage is paired with the most suitable liability that can be contrived. A more complete asset/liability analysis would include: a distribution by age of borrowers, actual amounts that would be loaned, expenses, a complete set of interest rate scenarios, a distribution of home appreciation rates, age-specific tenure rates, a realistic set of liabilities, and a number of reborrowing assumptions.

There are two possible ways of addressing the interest rate risk problem. The first is to try to find a liability in which the asset's behavior can be reflected. It is difficult to imagine that such an approach could work in the situation of a fixed-rate reverse mortgage. The "policy" chosen for our simple analysis assumes that installments that will yield 8 percent continue to be paid even when prevailing interest rates have risen substantially from levels at which 8 percent was attractive. To suit the asset under consideration, the lender would have to have the ability to terminate the policy when prevailing interest rates had fallen! Incorporating some degree of interest-sensitive policyholder behavior would amplify the interest rate risk problem. Therefore, the liability-side approach seems very difficult at best.

The second possible approach would be to try to offset the reborrowing option in the fixed-rate reverse mortgage through the purchase of options. This also would be very challenging because the option is in effect for an unknown time, and the extent to which people would reborrow also is uncertain. The amount and timing uncertainty does not mean that hedging the reborrowing risk through the purchase of options is inappropriate; it just makes the outcome less precise. The terms of the fixed-rate reverse mortgage may be attractive enough to the lender that a sufficient amount of hedging through option purchases can be afforded.

In light of the uncertainty posed by reborrowing risk, it is difficult to see how fixed-rate reverse mortgages would be suitable in an asset/liability framework.

Even for traditional fixed-rate investors, such as insurance companies, there is no reason to ignore floating-rate reverse mortgages as potentially attractive investments. By charging the borrower a floating rate of interest, the lender eliminates the risk of interest-rate-sensitive reborrowing. As the authors note, charging a floating rate does create more uncertainty in the future loan balance. However, if in fact there is some positive correlation between short-term interest rates and inflation rates, and between inflation rates and house appreciation rates, a floating-rate reverse mortgage may have less credit risk than the fixed-rate version.

To understand how a floating-rate reverse mortgage can be of interest to a fixed-rate investor, it is necessary to understand the concept of an interest rate swap. In an interest rate swap, two parties agree to exchange payments periodically over a specific time (1 to 10 years). Typically one party's payment rate is fixed over the term of the agreement, and the other party's rate floats with respect to some well-defined interest rate index. The payment is calculated by multiplying the rate by the agreed-upon notional amount. For example, consider the following example:

Party A:	Pays a fixed rate of 8.0%
Party B:	Pays 3-month LIBOR (London Interbank Offered Rate, an index of floating rate returns)
Term:	7 years
Notional amount:	\$1,000,000
Frequency:	quarterly

Suppose the 3-month LIBOR at the time of agreement was 5.0 percent. The payment by Party B to Party A after 3 months would be $1,000,000 \times 0.05 \times 0.25 = \$12,500$. The payment by Party A to Party B would be $1,000,000 \times 0.8 \times 0.25 = \$20,000$. Usually only the net payment is exchanged. The calculation is based on the 3-month LIBOR level set at the beginning of the period but paid in arrears. This continues every quarter for 7 years. There is no exchange of the notional amount at the end of the 7 years. When viewed in isolation, each party appears to be taking interest rate risk. However, in most situations both parties will have other different transactions on their books offsetting the exposure of this particular swap. The parties have some degree of credit risk should their counterparty be unable to make net payments when required.

The swap market has grown quickly in the last 10 years and now totals more than \$4 trillion of notional amount. A community of swap dealers, comprising investment dealers and banks, has grown with the market. End-users of swaps include bond issuers, banks and insurance companies. The common floating rate indexes are LIBOR and prime, which are generally not familiar to the average person. Prime would probably be the most common index for reverse mortgages.

Suppose that a floating-rate reverse mortgage could be originated in which the investor received, net of expenses and an adequate margin for credit risk, on a quarterly basis, prime plus 1 percent. At the time of the origination, the investor could pay prime as the floating leg of a swap and receive 5-year Treasuries plus 0.5 percent as the fixed leg of a 5-year interest rate swap. Therefore, a 5-year fixed-rate return of 5-year Treasuries plus 1.5 percent could be achieved. The notional amount schedule can be tailored to the expected outstanding amount of the first loan over the 5-year period. The notional amount schedule also can be designed to increase at later times to reflect subsequent loans. The investor may be an insurance company trying to find a 5-year fixed-rate investment to fund a GIC, SPDA, or other insurance product.

In assessing the attractiveness of a floating rate-reverse mortgage swapped to give a fixed rate of return, the following would have to be considered:

1. Other 5-year fixed-rate investments available
2. The nature and magnitude of the credit risk of the reverse mortgage and swap combination, versus alternative investments
3. The reverse mortgage is a commitment to make a series of investments. The terms upon which future investments could be swapped, although they can be studied historically and generally put between certain bounds, are unknown.

Through the swap market, the investor will have the flexibility, at the point at which each floating-rate reverse mortgage payment is made, to decide over what time to fix the rate for that investment. At the end of the fixed period, the decision is made again based on the then-current needs of the investor. However, after originating the reverse mortgage, the investor will have the obligation to lend certain amounts over a fairly long horizon, and therefore, the potential implications on future investment and liquidity needs should be carefully considered.

The reverse mortgage is an excellent example of a financial instrument requiring many types of risk analysis and management. It is hoped that the actuarial profession will rise to the challenge.

(AUTHORS' REVIEW OF DISCUSSIONS)

WILLIAM A. PHILLIPS AND STEPHEN B. GWIN:

We thank each one who discussed our paper and contributed additional ideas.

Mr. Easton has raised two important points in his discussion. He has described the tax issues surrounding reverse mortgages and immediate annuities both succinctly and well. Different tax laws could easily create an environment in which an immediate annuity/mortgage combination would be the standard format for reverse mortgages, and such is the case in Great Britain. We also agree with Mr. Easton's point that a rising income over time would be appropriate, in view of inflation; however, at present, most reverse mortgage purchasers seem mainly interested in current income. Both issues suggest that reverse mortgages are at the beginning of the evolutionary trail.

Mr. Herzog has identified a promising research area by linking the primary source of older homeowners' funding (their homes, through reverse mortgages) with a burgeoning need, long-term care. Anyone developing methods to fund long-term care with reverse mortgages should be aware that regulators and others have already voiced concerns about possible conflicts of interest, if marketing organizations sell both reverse mortgages and long-term-care insurance.

Mr. Griffin has made some very perceptive comments about the advantages and disadvantages of fixed-rate versus variable-rate reverse mortgages. It may not be necessary for a lender to use swaps with a variable-rate reverse mortgage if the lender also has variable liabilities that match. Appropriate product design can provide some protection against the "reborrowing" risk that Mr. Griffin mentions. As we described in Section V, "Special Pricing Considerations," up-front fees in effect create a surrender charge that would deter reborrowing in many cases. Mr. Griffin probably would not be surprised that the authors designed a reverse mortgage with a variable loan rate and up-front fees.