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SPDA – INTEREST-SENSITIVE CASH-FLOW ANALYSIS

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Panelists: SAMUEL H. COX
PETER B. DEAKINS
PAUL D. LAPORTE
Recorder: WARREN R. LUCKNER

The panel will discuss the results of the single premium deferred annuity (SPDA) persistency study, which was completed earlier this year, and will briefly identify further Society of Actuaries research being considered in the area of interest-sensitive cash flows.

MR. WARREN R. LUCKNER: I am a research actuary on the Society of Actuaries staff. The panel will discuss the results of the Single Premium Deferred Annuity Persistency Study, which was completed earlier this year. The panel also will identify some additional research in the area of interest-sensitive cash-flow analysis. Our panelists were all directly involved in the study and contributed significantly to its success.

Pete Deakins is with the Philadelphia office of Milliman and Robertson. Pete's expertise includes life insurance company and bank consulting, including individual life insurance and annuity and group annuity product development, pricing, asset segmentation, and asset and liability management. He is chairperson of the Project Oversight Group for the Society of Actuaries Interest-Sensitive Cash-Flow Research Project. Pete will discuss the significant results of the study and possible uses of the results.

Sam Cox is the A.J. Pasant Professor of Life Insurance and Financial Services at Michigan State University, where he teaches insurance, finance, and risk management. Sam and Steve Linney were the two academic researchers for the SPDA study. Sam will discuss the modeling of the sensitivity of withdrawal rates to surrender charges and interest rate spread.

Paul LaPorte is assistant vice president, financial research for the Life Insurance Marketing and Research Association (LIMRA). Paul directs a staff of professionals and technical specialists who research marketing costs and the compensation of marketing personnel. This includes directing studies related to product and persistency for LIMRA's member companies. Paul and Lucian Lombardi were the two LIMRA researchers for the SPDA study. Paul will discuss the highlights of the results of the study.

In late 1988, the Society of Actuaries Research Policy Committee identified interest sensitive cash-flow analysis as one of the priorities for research. Thus, they appointed a Project Oversight Group. Pete Deakins is the chairperson of that group; the other members are Ed Astrachan, Garth Bernard, Jim Merwald, Steve Smith and Jay Vadiveloo. During 1989, the Project Oversight Group defined in some detail a pilot study of SPDA persistency and solicited proposals for conducting that study. Four researchers were chosen to conduct the study: two academic researchers and two researchers from LIMRA. The study was funded by general Society of Actuaries research funds, contributions from the Financial Reporting and Product Development

Sections and LIMRA. Under the direction and management of the Society of Actuaries Project Oversight Group and the Society of Actuaries Research Management Committee, the researchers completed preliminary results that were published in *The Actuary*.

The Society of Actuaries Research Policy Committee recently approved proposals from LIMRA to conduct studies of universal life and flexible premium annuity persistency. LIMRA will again fund approximately two-thirds of the estimated cost of the study, and the Society of Actuaries Research Policy Committee has requested that the Financial Reporting and Product Development Sections again consider financial support. We, of course, welcome financial support from other sections, other groups and other interested individuals. We also welcome participation in those studies. Once the funding is secured for those studies, the Project Oversight Group will actively manage the work on the studies that are expected to be completed in 1994 for universal life and in 1995 for flexible premium annuity.

MR. PAUL D. LAPORTE: The primary purpose of this study was to determine the likelihood of a partial or a full withdrawal of SPDAs and also to determine the relationship to selected characteristics such as surrender charge and credited interest rate. However, the constraint we had was that it had to be information that was readily available to companies. So, characteristics like change in employment status, marital status, and income, which are very likely related to SPDA persistency, is information that we just didn't have. We also wanted to quantify the relationship in a tabular and parametric form for practical use in terms of product design, valuation, and investment management.

We looked at four withdrawal rates, partial and full, each on the basis of number of contracts withdrawn and also on the amount of cash value withdrawn. These were annualized rates; for example, if looking at a contract rate, the annualized rate would be the number of contracts that lapsed during a particular year divided by the exposure for that year. We excluded from the ratio any policies that terminated due to death, disability, or annuitization. Products included in the study were basically individual fixed SPDAs. These included some market-value adjusted annuities and CD annuities. Approximately one-third of the products that had interest guarantee periods greater than one year had a widows provision. We also included individually marketed group contracts where there was a master group contract and each individual had a certificate issued with full and partial surrender rights. The products we excluded were true employer-sponsored group annuities and also variable annuities. These included combination annuities where, in addition to variable accounts, there is a fixed account.

We reviewed eight contract characteristic factors. The first were both the amount and incidence of surrender charges. For the size of the contract or the cash value; the average cash value was a little under $24,000. The distribution channel, or who wrote the contract, is another characteristic. There were career agents, insurance brokers, stockbrokers, bank and savings and loan (S&L) employees, and some direct response. We analyzed withdrawals by the age and sex of the annuitant and the tax status, whether it was qualified or nonqualified. And for those products that were qualified, we determined whether they were IRAs, tax-deferred annuities (TDAs), 401(k)s, or keough's. As an aside, the IRAs had about three times less withdrawal

rates than 401(k)s and Keoghs, and TDAs were somewhere in the middle. Also, we looked at whether a contract had a free partial withdrawal or not. I believe about 85% of the contracts in the study did have free partial withdrawals. Finally, the credited interest rate is something. Sam will be talking more about, looking at the interest rate spread from the market interest rate.

This was a seriatim study not an aggregate study. I'll be giving you just a sampling of the analysis that we did. Twenty-four companies participated in the study. These included small, medium, and large companies and stock, mutual, and fraternal companies, as well as New York and non-New York companies. They had a total of 3.6. million contracts in force over the period that we were studying. We did a random sample of roughly 10% for the larger companies and for smaller companies slightly more than that. We had 387,000 contracts in the study, and that represented $8.3 billion of cash value in force. We looked at the period 1984-89. This was a cross-sectional study not a longitudinal study. That means when we did our random sampling, if a contract was included in 1986, for instance, determining whether that contract would be included in 1987 was an independent event. We took a random sample for each year.

Here are some sample characteristics. Sixty-five percent of the contracts had an interest guarantee period of one year or less. Ninety-four percent of these contracts still had a surrender charge in effect. Sixty-four percent were nonqualified and 36% were qualified.

The remaining 35% had an interest guarantee period of greater than one year. One-third of these had a three-year interest guarantee period and slightly over half had a five-year interest guarantee period. Ninety-five percent of those had a surrender charge, and they also had a higher proportion of nonqualified plans.

Focusing on the 65% of the sample that had an interest guarantee period of one year or less, 3.2% of the contracts had a full withdrawal during the year (Table 1). Some 3.4% had a partial withdrawal. Over 90% had no activity during a particular calendar year.

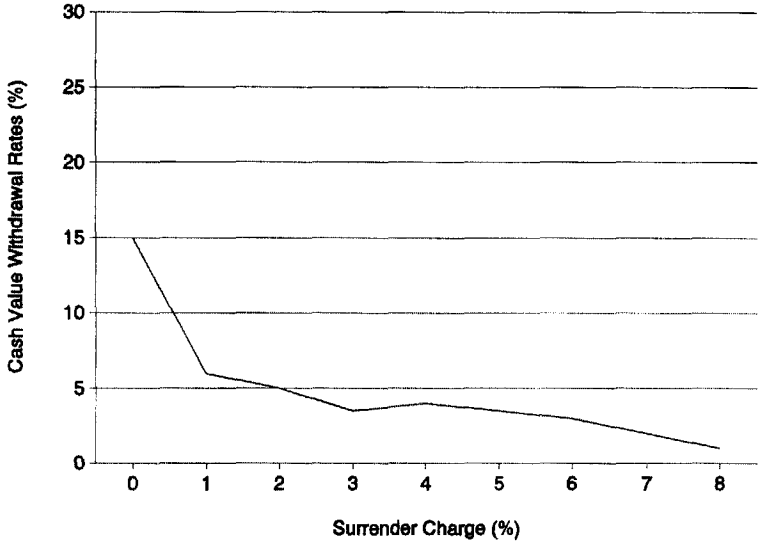
TABLE 1
Withdrawal Activity Interest Guarantee Period One Year or Less

Type of Withdrawal	Percent of Contracts
Full	3.2%
Partial	3.4
Annuitized	1.4
Death/Disability Claim	0.7
No Activity	91.3
Total	100.0%

The characteristic that was most related or correlated to withdrawal was the surrender charge. Looking at full withdrawal rates for cash values you can see in Chart 1 that when there was no surrender charge in effect, the withdrawal rate was slightly

over 15%. The withdrawal rate decreased as the surrender charge increased. At an 8% surrender charge, the withdrawal rate was 1.4%, a reduction of over 90%.

CHART 1
Full Withdrawal Rates by Surrender Charge



Another perspective is to study the withdrawal rate before and after expiration of the surrender charge (Chart 2). During the year of expiration the withdrawal rate was almost 20%. This is for all the contracts with a one-year or less interest guarantee period.

In the year of expiration, two-thirds of that year's withdrawals occurred during the first month after the surrender charge expires. And 90% of the withdrawals occurred during the first four months. The remaining 10% occurred in the last eight months of the year after the surrender charge expired.

A third way of looking at the withdrawal rate is by the distribution channel (Chart 3). Regardless of which type of agent sold the policy, the withdrawal rate was much lower when the surrender charge was applicable. When there was no surrender charge, the insurance broker and stockbroker had much higher withdrawal rates. When there was a surrender charge, policies sold by bank and S&L employees had the highest withdrawal rate. Lucian Lombardi did most of the work on this study. One of the analyses that he did was a multiple regression, controlling the effect of other characteristics and looking at one variable by itself and seeing what effect it has by itself.

CHART 2
Withdrawal Rates Before and After Expiration of Surrender Charges

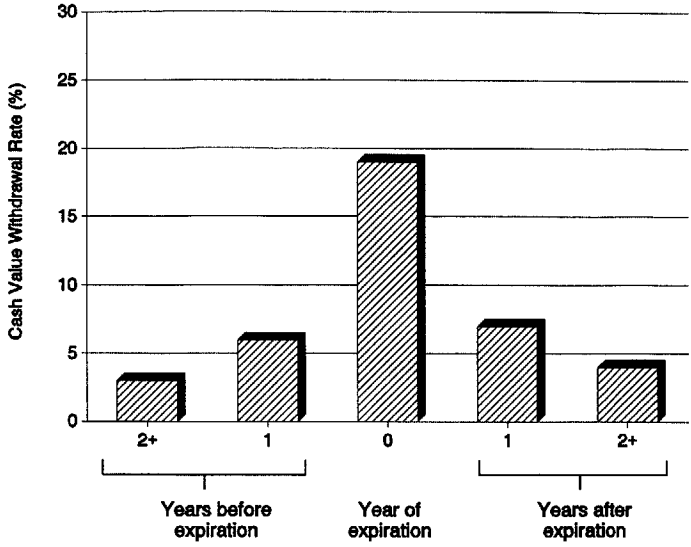
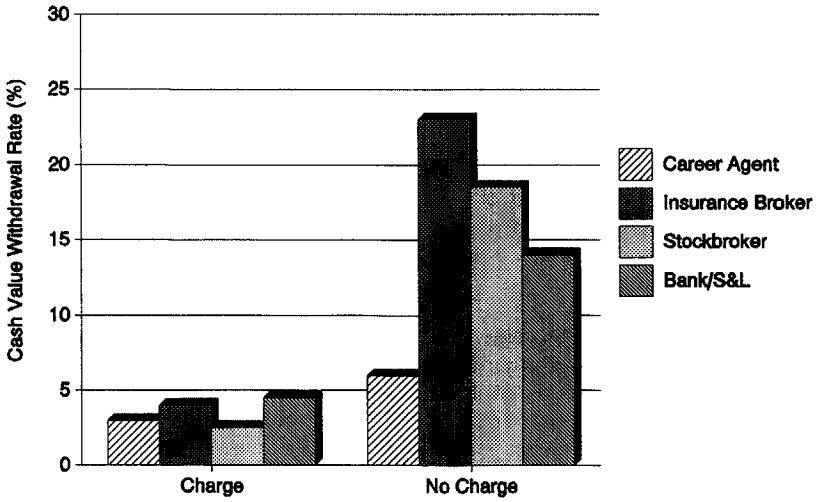
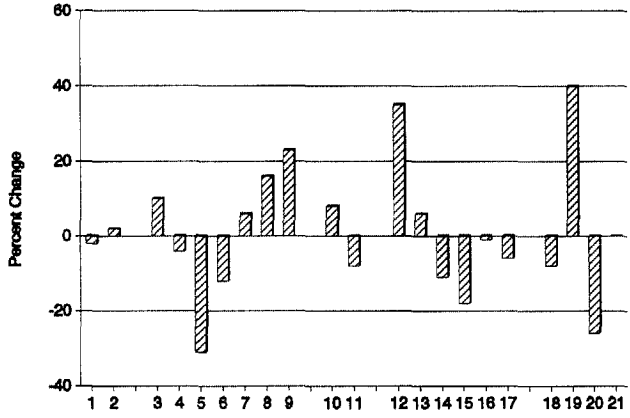


CHART 3
Full Withdrawal Rates by Distribution Channel



To understand this, review business sold through bank and S&L employees (Chart 4). When there was a surrender charge in effect they had the highest withdrawal rate. But Chart 4 suggests they didn't increase or decrease the likelihood of withdrawal. It is because of the market that they're in: they tend to sell to older individuals who have a higher likelihood of withdrawal and also have smaller cash values. Those two factors explain why bank employees tend to have higher withdrawal rates. But the fact that the contract was sold by a bank employee itself really had no positive or negative effect.

CHART 4
Full Withdrawal Activity
A Surrender Charge and One Year or Less Interest Guarantee



1 Nonqualified
2 Qualified

3 <40
4 40-49
5 50-59
6 60-64
7 65-69
8 70-74
9 75+

10 Male
11 Female

12 Under 5,000
13 5,000-9,999
14 10,000-19,999
15 20,000-29,999
16 30,000-49,999
17 50,000 and over

18 Career Agent
19 Insurance Broker
20 Stockbroker
21 Bank/S&L

Chart 5 is the same except it is for those contracts where there is no surrender charge. If the policy is qualified you will see higher withdrawl rates. Also, once the surrender charge is off, contracts sold by insurance brokers and stockbrokers had a very high likelihood of withdrawal.

Chart 6 looks at partial withdrawal rates when there is a surrender charge in effect and a one-year or less interest guarantee period. The staircase effect shows a definite increase in the likelihood of a partial withdrawal as the cash value increases. Also, as you would expect, if there is a partial withdrawal provision (which I mentioned about 85% of the policies had), there was a much higher likelihood of withdrawal.

Chart 7 shows a similar situation but the surrender charge is off. Again, for the older ages and the very large policies, there's a higher tendency for withdrawal.

CHART 5
Full Withdrawal Activity
No Surrender Charge and One Year or Less Interest Guarantee

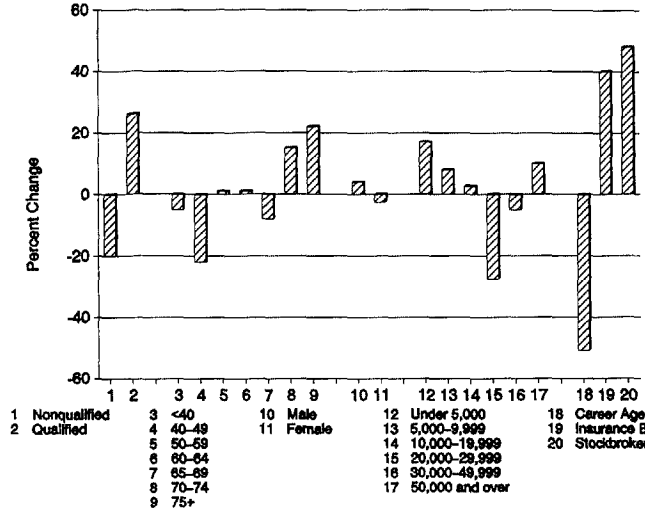


CHART 6
Partial Withdrawal Activity
A Surrender Charge and One Year or Less Interest Guarantee

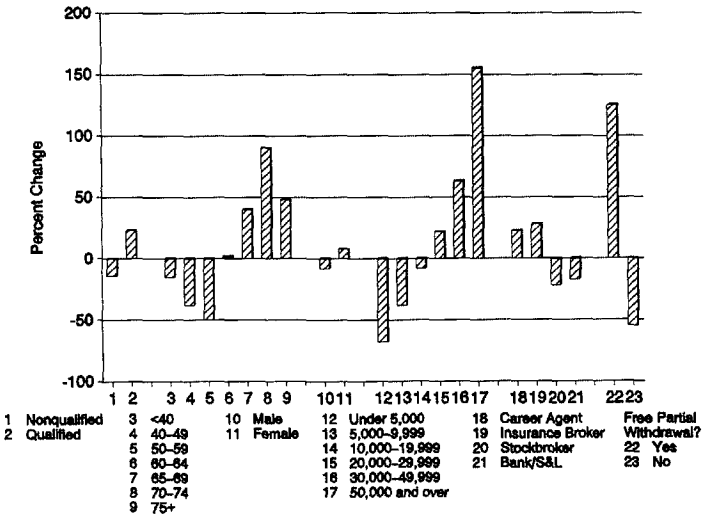
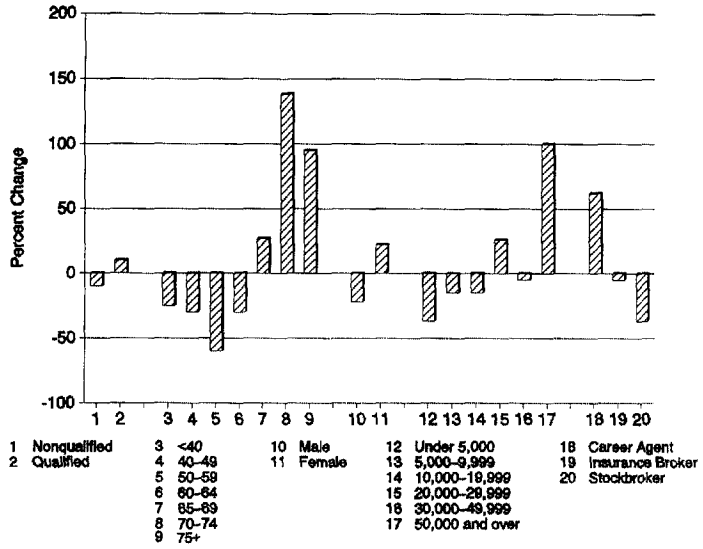


CHART 7
Partial Withdrawal Activity
No Surrender Charge and One Year or Less Interest Guarantee



Now to review those contracts that had an interest guarantee period of more than one year, which comprised 35% of the sample (Table 2). All of these rates are lower than they were for contracts with interest guarantee periods of less than one year.

TABLE 2
Withdrawal Activity Interest Guarantee Period Greater than One Year

Type of Withdrawal	Percent of Contracts
Full	2.7%
Partial	2.0
Annuitized	1.0
Death/Disability Claim	0.6
No Activity	93.7
Total	100.0%

Focusing on the 54% of the sample that had a five-year interest rate guarantee period, Table 3 looks at the cash value full withdrawal rates by contract year. The full withdrawal rate was very high in the sixth and seventh year, after the interest guarantee period expired. Also, many of these contracts had a five-year surrender charge, (probably a cliff surrender charge in many cases) which helps explain such a high withdrawal rate.

TABLE 3
Cash-Value Withdrawal Rate Five-Year Interest Guarantee Period

Contract Year	Full	Partial	Total
1	1.1	0.2	1.3
2	1.9	0.5	2.4
3	1.0	0.5	1.5
4	1.9	0.4	2.3
5	3.3	0.5	3.8
6	55.8	1.8	57.6
7	24.0	7.2	31.2

MR. SAMUEL H. COX: The goal of this part of the study was to measure the sensitivity of withdrawal rates to surrender charge and interest rate spread.

I'll just briefly go over the data, the definitions, and the models used to quantify the sensitivity of withdrawals. I'll describe the two models that we used in detail: the multiplicative hazards model and the New York Regulation 126 suggested model. Then, I'll summarize with conclusions.

The data consists of cells arranged by surrender charge and spread. There's a matrix of numbers. Each item in the matrix corresponds to a particular surrender charge or spread. The surrender charge is from the policy characteristics reported by the participating company. The cells are filled up by looking in each two-week period and calculating what the spread was for a particular policy, and what the surrender charge was for that two-week period.

Then, we put that policy's account value, or the associated withdrawal into a cell. For each cell we have an aggregate account value and number of policies subject to withdrawal. For each cell we have the actual account value withdrawn and the number of policies withdrawn. We're not following a particular contract through time. We've got a set of contracts and time periods, and we can look at each contract in a particular time period and see if it falls in that cell or not. If it does, we calculate the exposure to withdrawal and any withdrawal activity for that cell. That data were collected and then they were further broken out by other policy characteristics: one-year guarantee versus multi-year guarantee and qualified versus nonqualified. We collected the data both by number of contracts and dollars. The participating companies didn't report the spread. The spread was calculated by looking at the credited rate as reported by the company and we compared it to the five-year Treasury note rate for that same two-week period. So it's a surrogate for the spread; not the actual difference between the credited and competitive rates.

I'm now going to describe the models.

In the example below, T denotes the duration of a contract. The only decrement we're considering for a contract in this part of the analysis is withdrawal. We're ignoring mortality. The probability of withdrawal during the period is written in terms of the force of withdrawal and the spread; this should be the credited interest rate and not the guaranteed interest rate. The competitive rate is denoted by r and the

difference between the five-year Treasury bill or treasury note rate and the credited rate is the spread. The other variable is the surrender charge, and for this study, the surrender charge was set or had to take one of the eight values 0-7%. There were a few contracts that had different surrender charges but those contracts weren't included in this part of the study.

T = Duration of Contract (No mortality)

$S(t) = P(T > t)$

Measures of Withdrawal Activity:

a. Probability of Withdrawal During $(t, t + \Delta t)$

$$ {}_{\Delta t}q_t = \exp\left(-\int_t^{t+\Delta t} \mu(s)ds\right) $$

b. Force of Withdrawal at Time t

$$ \mu(t) = \lim_{\Delta t \to 0} \cdot \frac{P[t < T < t + \Delta t \mid T > t]}{\Delta t}. $$

c. Guaranteed Interest Rate r_g

d. Competitive Interest Rate r

e. $sp(t)$ spread $(t) = r(t) - r_g$

f. $sc(t)$ surr chg (t)

A step function, range is the eight rates:

$\{0, 0.01, 0.02, 0.03, 0.04, 0.05, 0.06, 0.07\}$.

The first model analyzed is the multiplicative hazards model. We considered a number of models. In the *Transactions* and *Records* from Society meetings and other sources, there's a number of proposed models to describe the withdrawal rate as a function of spread and surrender charge. We looked at many of them, and investigated the multiplicative hazards model and the New York Regulation 126 model in detail. The multiplicative hazards model is used in many economic and financial analyses. It's also in used in biology and medicine, and appears in the Society of Actuaries study note on survival models. This is a model based on expressing the force of withdrawal.

Multiplicative Hazards Model

$\mu(t) = \mu_0 \exp[\beta v(t)]$

where β is a vector of coefficients

and $v(t)$ is a vector of explanatory variables

$v_1(t)$ = surrender charge

$v_2(t)$ = spread

μ_0, β_1, β_2 determined by data

Assumption: Surrender charge and spread are constant during each of the two-week subintervals of the observation period.

Conclusion: $\mu(t)$ and ${}_{\Delta t}q_t$ depend only on the values of $sc(t)$ and $sp(t)$, and not on $sc(u)$ and $sp(u)$ for $u < t$.

In this case we'll have two explanatory variables, the surrender charge and spread, and three coefficients to determine in the model. That is, to fit this model to the data would be to specify μ_0, which is the base force of withdrawal, and the two coefficients, beta one and beta two, that explain the interaction of surrender charge and spread with the withdrawal rate. In applying this we assumed that during this two-week period the surrender charge and spread were constant. You can prove then that, in this setting, the force of withdrawal for that period and the corresponding probability of withdrawal depend on only the spread and surrender charge for only that time period, and not on how the policy got to that point. It is memoryless. The sensitivity for a particular two-week period just depends on the values of the parameters for that two-week period and not on the path the policy took to get to that period.

The New York Regulation 126 Model is based on the probability of withdrawal for a two-week period. You still have the same two independent variables -- surrender charge and spread. We're trying to calculate the probability as a function of the spread to some exponent multiplied by some coefficient plus a coefficient minus a coefficient times the surrender charge. We had some difficulty in applying this. One of the problems was because of our ad hoc definition of what spread was. When looking at graphs of the data it looked like there was some withdrawal activity that we would miss. First, we must have an exponent and that means the base of the exponent should be nonnegative. We would not want to use this model, or at least this part of the equation, when the spread was negative. So we'd want to make sure that we're throwing out terms where this is zero. When we did that we lost a lot of withdrawal activity. So we tried different numbers to move the spread. We adjusted our spread so that the model picked up most of the withdrawal activity. This was forced on us by the choice of the five-year Treasury note rate. We put this in and then tried to fit this model to the data as well.

New York Regulation 126 Model

$$ {}_{\Delta t}q_t = a + b\,\{\max[v_2(t) + 0.02, 0]\}^c - dv_1(t) $$

where

$v_1(t)$ = surrender charge

$v_2(t)$ = spread

Assuming spread and surrender charge constant over two-week periods, again find $\mu(t)$ and ${}_{\Delta t}q_t$ depend only on the values of surrender charge and spread at time t.

a = base probability of withdrawal during two-week period.

b, c measure effect of spread

d measures effect of surrender charge

Other models were considered, but data does not warrant an elaborate model.

For each model, we used some optimization technique to try to fit the parameters. For the multiplicative hazards model, the standard method of fitting that model to data is to maximize the log likelihood of the observation set.

Multiplicative Hazard Model Parameters

$\mu(t) = \mu_0 \exp\ [\beta v(t)]$

μ_0, β_1, β_2 maximize L:

$$L = \sum_{i,j} w_{i,j} \log\,[1 - \exp(-\Delta t \mu_{i,j})] - (w_{i,j} - E_{i,j})\,\Delta t \mu_{i,j}$$

i = surrender charge

j = spread

$w_{i,j}$ = withdrawals in cell i,j

$E_{i,j}$ = exposure in cell i,j

This is a straightforward technique. We calculate the log likelihood and then sum it over all the cells in the matrix. We have these values; withdrawals will be known, the exposure in each cell is known. We did this both for dollar amounts and number of contracts. And then we had the computer to search through values of μ_0, beta one and beta two until it found a maximum value. Those are the values we settled on. Table 4 shows what we came up with for the maximum likelihood estimates.

TABLE 4
Maximum Likelihood Estimates

Market	Initial Guarantee	Units	μ_0	β_1	β_2
Non Q	one year	N	0.117	-0.267	0.000
Non Q	one year	AV	0.137	-0.294	0.014
Non Q	Multi	N	0.345	-0.492	0.407
Non Q	Multi	AV	0.475	-0.546	0.464
qual	one year	N	0.177	-0.331	-0.141
qual	one year	AV	0.277	-0.434	-0.171
qual	Multi	N	0.216	-0.402	0.266
qual	Multi	AV	0.392	-0.489	0.377

We have three variables. N means that we used number of contracts. AV means we used the dollar amounts, the account values. We did this for both one-year and multi-year guarantees and for qualified and nonqualified contracts. These are the resulting optimal values. What can we conclude from this? The base level of withdrawal activity, μ_0, is higher by account value than by number of contracts in each case. Surrender charge has a stronger effect than spread. In each of these cases the coefficient for β_1 has a greater effect than β_2. Withdrawals decrease as surrender charge increases. That is, β_1 is negative, which we'd expect. Qualified one-year contracts have an anomaly. The coefficient of β_2 came out to be negative. We would expect (and it happened in all the other cases) that β_2 should be positive so that the withdrawal rates increase as spread increases.

With the New York model, there's no suggested way of fitting to data. We used least squares estimators.

There were some other methods but they were awkward to fit to data because of the problem of having an exponent in the spread and spreads sometimes being negative. We took just the predicted or expected predicted number of withdrawals and compared them to actual withdrawals.

New York Regulation 126 Parameters

Choose a, b, c, d to minimize

$$\sum_{i,j} (w_{i,j} - E_{i,j} q_{i,j})^2$$

$w_{i,j}$ = withdrawals, $E_{i,j}$ = exposure in cell i,j

$$q_{i,j} = a + b\,[\max(sp_j + 2.0,\ 0)]^c - dsc_i$$

We squared the difference and then asked the computer to find the values of a, b, c, and d which minimize over the whole matrix (Table 5).

TABLE 5
Least Square Estimates

			(values times 100)			
Market	Guarantee	Units	a	b	c	d
Non Q	one year	N	0.348	−0.007	28.65	0.043
Non Q	one year	AV	0.430	0.005	46.22	0.060
Non Q	Multi	N	0.347	0.091	70.27	0.068
Non Q	Multi	AV	0.657	0.212	55.56	0.138
Q	one year	N	0.419	−0.084	12.50	0.039
Q	one year	AV	0.520	−0.070	0.10	0.060
Q	Multi	N	0.370	0.120	56.30	0.073
Q	Multi	AV	0.590	0.210	45.70	0.123

The result was again that the base level of activity is higher by account value than number of contracts. The surrender charge has a greater effect than spread. Withdrawals as surrender charge decrease. The coefficient d is positive. Qualified one-year contracts still have the same anomaly. The qualified one-year contracts suggest something suspicious about their relationship to the spread. But all the other contracts had the proper relationship; that is, that withdrawals increase as spread increases.

What did we conclude from all this? First, that this is not a very good time to be looking at this relationship because most of the options in these contracts were out of the money. That is, it wasn't particularly enticing to exercise withdrawal options.

Most of the contracts had surrender charges of 5-7% during the observation period. Nevertheless, some conclusions can be drawn. Estimated rates are higher when measured by account value rather than number of contracts. The effect of surrender charge is as we would expect, and the effect of surrender charge dominates the effect of spread. And, as we'd expect, as the spread increases, withdrawals tend to increase (with the exception of the anomalies that were noted earlier).

MR. PETER B. DEAKINS: This data can be used on a practical day-to-day basis. I'll present the highlights of the study and the most useful conclusions. The four main areas in which the data will be helpful are pricing, valuation actuarial analyses, asset and liability management (which is closely related to valuation actuarial analyses), and in any kind of corporate planning or projections. Be very careful in interpreting the data. One thing you need to consider is the considerable extent to which company differences affect the data, which is somewhat difficult to do. We didn't distinguish the data in the study by company.

More important, consider the context. The most glaring example is in the conclusions that can be drawn about the interest sensitivity of surrenders. Given the time frame that we were in, where interest rates were gradually falling and nobody was ever significantly far below the market in their credited rate, the conclusion we drew was that noise from a variety of other factors was drowned out any impact or any conclusions you could draw about interest sensitivity. The context in which the study was performed -- the era of the data being the period of 1984-89 is very important to keep in mind.

Consider the size of the exposures. Statistically insignificant data sets are not shown. Where the results comes from a wide variety of information, drawing conclusions requires care.

The overwhelming conclusion of the study was that surrender charge was the dominant factor in determining what the lapse rates would be; so dominant that if you didn't adjust for surrender charges, the other variable had no discernible impact. Hence, all of the data are split in every case between with and without surrender charge.

There is definitely a distinction between a 1% surrender charge and a 0% surrender charge. Going from 2% to 1% has a much smaller impact than going from 1% to 0% surrender charges which indicates that a large part of the impact to policyholders is psychological rather than economic. Also, surrender rates are significantly higher in the year immediately following the expiration of the surrender charge than they are in the years after. That is particularly pronounced with the multi-year interest guarantee products. The surrender rate in the year after the surrender charge expired on a five-year guarantee product was 55% and in the following year it was 24%; it is not as dramatic in other cases.

Another interesting and surprising result of the study was the impact of multi-year interest guarantees. We expected that multi-year guarantee contracts would have a different type of experience than one-year guarantee contracts, but I don't think anybody expected that the differential would be quite as dramatic as it was. We saw rates as high as 55% in the year the surrender charge expired on five-year guarantee products. You have to consider the context of the data. It appears that there is a clear cut relationship between multi-year guarantee products and a higher surrender rate at the expiration of the surrender charge period when they coincide with the end of the guarantee. However, a factor to consider is the nature of the sale in business that has been sold in the last six or seven years with multi-year guarantees. In many cases, that business was sold as CD replacement business. So the nature of the sale clearly will have an impact on the surrender rates.

The other thing to consider when looking at those data is that we've been in a period of declining rates. When the renewal rates were declared on those policies they were generally between 1% and 4% lower than they had been initially. There is clearly a shock factor in the study data on top of the other factors. Unfortunately, the data didn't allow us to distill that factor; there wasn't enough experience from the period immediately after the surrender charge expired, and the guarantee expired on the multi-year guarantee products.

There wasn't sufficient data to study further the impact of interest changes. We've put the mechanism and a lot of the thought processes in place to evaluate that data as they become available when we next have a spike.

Another important result was that the distribution system has a substantial impact on surrender rates. This impact is minimal prior to the expiration of the surrender charge period, but stockbroker business and insurance broker business exhibited higher surrenders once the surrender charge expired. Career agency business exhibited significantly lower surrenders, relative to the other distribution systems, after the surrender charges expired. Company differentials are substantial, and, in evaluating these data, it's important to consider the nature of your company and of your markets, the reputation of your company, the nature of the sale, etc.

There are many factors that couldn't be built into the study that go into determining what surrender rates you can anticipate. I view the study as a starting point for any kind of analysis in your own company, not as an ending point.

There are several results that were of some interest. There was some differential in experience by size. It appeared that the larger policies were using their options in a more sophisticated manner; they generally had higher surrender rates when surrender charges expired and tended to use free partial withdrawal provisions more. There appears to be a correlation between size and sophistication. Paul alluded a little bit to the distribution by policy month. The most interesting result was how dramatically skewed surrenders are in the month immediately following the expiration of the surrender charge. During the surrender charge period, surrender charges were slightly skewed and there was no significant skewing the first year after the surrender charge period expires. There's a very dramatic difference in the utilization of partial withdrawals between contracts with and without free partial withdrawal provisions.

There is detailed information in the appendices which offer various breakdowns. The body of the study is an overview and discussion of key conclusions. There are interesting detailed results in the appendices which I find are useful.

MR. DANIEL H. STRASBURG: Are there any studies with which you could compare your results, that took place in a rising interest rate rising environment?

MR. LAPORTE: I know this is the first at LIMRA. We have a study on flexible premium annuities but we've never done one on SPDAs.

MR. DEAKINS: A major goal for us was to develop data that would give us significant information about how lapses and other cash-flow characteristics are affected by changes in interest rates. The most useful data would have been from the early

1980s, but unfortunately, because of the type of data that companies kept, and the number of companies in the market then, there just wasn't enough data for us to be able to do anything for the early 1980s. I think there was more than ten times as much business in force in the late 1980s as there was in the early 1980s. The data from the early 1980s are very sparse.

As the credited rates start getting substantially different from the rates available in the marketplace, you start to see significant changes in lapses. The data are very sparse, and there's not enough to draw any statistically valid conclusions. As far as I'm aware, there's hasn't been any solid, broad study of the issue as yet.

MR. ANDREW DAVID SMITH: Have you kept track of any information about the reasons for withdrawal?

MR. LAPORTE: Again, this was information that was readily available from the company. You would expect any change in employment status, marital status or income to be very correlated with withdrawal rates, but we didn't have that information available.

MR. DEAKINS: If or when we ever update the study, we'll have to be very careful with 1990-91 data. There has been a lot of noise in the industry in the last several years which we'll have to carefully adjust for in any later study that looks at 1990-91 data.

MR. LAPORTE: We didn't collect information on commissions and whether there was a trail commission. We have a large database and anyone interested in looking at it should give me a call. We may have already done some computer runs on the information that you're looking for. And if not, we have a small charge to crank it up again.

MR. B. JOHN MANISTRE: Concerning the one-year qualified anomaly, either there's something going on that is really unique or perhaps there's an error in the way the result was derived.

MR. COX: I asked Lucian Lombardi to look at those data to see if there weren't some errors in the data. We didn't find any.

MR. DEAKINS: At the levels that we've seen in the last five or six years, the anticipated impact of the interest rate spread is very small, and in the study it was outweighed by many noise factors. One of those is, exactly how do you measure what the market rate is? If you have spreads that are in the range of +2% to −2%, and you potentially have a deviation as high as 75-100 basis points in your measurement of the market rate, you've accounted for up to half of your spread right there. If you take the New York models that we see often in appraisal and valuation actuary work, you might see, for example, the market rate minus the credited rate squared times two. Even if you're 2% off the market, which would be pretty big for the time period we're looking at, you're only looking at a 4% or 8% anticipated differential, and that's assuming no surrender charge. Generally no one has been that far off the market. There has been little business that far off the market without a

surrender charge. During the surrender charge period, the anticipated impact of being that far off the market would be virtually nil.

MR. SMITH: One thing that could be valuable about this particular time period is that maybe you've got a handle on the base withdrawal rate. Do you have an idea, based on data in a relatively flat or gradually declining period, what level the base withdrawal assumption should be?

MR. LAPORTE: I think we saw about a 3% full withdrawal rate, and then another 3% from partial withdrawal.

MR. DEAKINS: The data is somewhat dependent on the type of contract; you have to look at your own company's market. However, we see very low rates as the base lapse rates. They rise as the surrender charge wears off, but not very much. It might be 2% at the very high surrender charge levels, and 6% or 7% when a surrender charge is 1% or 2%. There is modest fluctuation during the surrender charge period. No factor has a significant impact during the surrender charge period. During the postsurrender charge period, you see quite a bit of potential fluctuation. Surrender rates in the postsurrender charge period are as low as about 6% for agent sold business up to 60-70% surrender rates in the multi-year interest guarantee business in the year immediately following the surrender charge expiry if you had stockbrokers. So there's a large range once the surrender charge expires, but a narrow range during the surrender charge period.

MR. MELVIN C. MCFALL: Could you expand a little bit on the fact that lapse rates seem to be higher for the larger annuity policies during that environment? I might have expected the opposite because you'd think the larger policyowners would have the means to leave the money in the annuity rather than withdrawing it and that perhaps in a declining interest environment there wouldn't be more attractive options available.

MR. DEAKINS: I noted that there appears to be a strong correlation between sophistication and size. The large contracts actually had a lower surrender rate during the surrender charge period than the other contracts and a higher surrender rate after the surrender charge period. They were clearly the most economically motivated. This makes sense for a variety of reasons. First, they have more incentive to be economically motivated. Second, they have more incentive to pay attention to their contract. Third, you would assume that people with more money to put into an SPDA are more likely to be sophisticated. Finally, they're more likely to have been sold by a stockbroker. I think that you would find that most people would view stockbroker-sold business as being more sophisticated.

MR. McFALL: It was distribution-system related.

MR. LAPORTE: One of the things we did find is that stockbrokers were very attuned to whether there was a surrender charge in effect or not. Because as soon as that surrender charge went off the business lapsed.

MR. DEAKINS: Size has a modest impact. Stockbroker-sold business has a substantial impact. It's exactly as Paul said -- stockbroker-sold business has a much lower

surrender rate during the surrender charge period and much higher surrender activity after the surrender charge period. You see the same effect with the larger-sized business, but when you adjust out the stock brokerage, it's a much smaller impact. From the multivariate analysis, it appears that you get a similar effect from the large size business even when you leave out the impact of the large size business coming more from stockbroker-sold business.

MR. STEVE D. SCHULTZ: I found it interesting that a 1% versus a 0% surrender charge had a much bigger impact than going from 1% to 2%. It seems to me that a very sophisticated policyholder would convert his surrender charge into a spread. For example, if he's currently subject to a 4% surrender charge that wears off over the next four years he might view that as equivalent to a 1% spread. Did you see any evidence of that for the larger contract sizes?

MR. LAPORTE: No, but I think if we were in the situation where you had a long interest guarantee period and interest rates rose, the 1% surrender charge would have little effect. But given that we were in a declining interest rate environment, I don't think it would.

MR. DEAKINS: We didn't look at that much because it would have required breaking the data down finer than we were capable of doing, and would also have lost statistical significance. In the environment we've been in, you wouldn't see much of an impact; the large-sized business probably behaves similarly to other business between a 1% and 0% surrender charge relative to a 1% and 2% surrender charge. It would be in the rising interest environment that you would expect to see people starting to view the surrender charge more nationally as 0% versus 1% and 1% versus 2% as you described. What you described is the rational way to evaluate it, but I don't think that much of the surrender activity during the period of the study was economically motivated, trying to get a higher rate. We never got to see that phenomenon so we didn't have good data to evaluate it.

MR. LUCKNER: The report is going to be published in the 1991-92 *TSA Reports,* expected to be published in Spring 1993. Second, regarding the question of updating the study for future years, the Project Oversight Group and the Research Management Committee of the Society of Actuaries did consider what the next step would be in this interest-sensitive cash-flow research. An update of the SPDA study was one of the possibilities but it was felt that the universal life and flexible premium annuity studies were of higher priority. It is our intent to do something in the near future with SPDA data of 1990, 1991 and later years.

MR. DEAKINS: I believe we may be able to do something with the 1990-91 data. We didn't have an interest rate spike, but you can view the various troubled companies from 1990-91 as presenting an economic choice to the policyholders: trade off surrender charge versus a rate that, when you considered the risk inherent in the carrier, was probably below market. I'm not sure how we're going to mathematically formulate that, but the situation in 1990-91 was somewhat analogous to what a policyholder would face in a rising interest rate environment. At some point in the future, we may be able to use the 1990-91 data. Alternatively, it seems unlikely that interest rates will always be low; at some point in the future we're likely to have a spike to work with.