TOWARDS STATISTICALLY BASED FIDELITY RATES

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BACKGROUND

Fidelity rates have been established in the past primarily by the use of "informed judgment," in accordance with the position of fidelity-surety underwriters that statistical ratemaking methods were not applicable to the bonding lines. During the last several years, this position has been modified somewhat as underwriters have recognized the increasing similarities between fidelity bonding and casualty insurance; the rate structure, however, has yet to reflect the shift of opinion. The replacement of individual and schedule bonds by blanket coverages, particularly in the bank and commerical fields, with the accompanying shift in underwriting attention from the principal to the obligee, is probably the fundamental cause of this change in position, but there have been other more direct pressures towards statistically sounder fidelity rates.

Foremost among these has been the increasingly critical attitude of the various state regulatory authorities towards the manual rules and rates presently used by the members and subscribers of the Surety Association of America, which completed its assumption of the duties of the Towner Rating Bureau in 1949. Although the authorities have recommended various changes in the surety lines, the bulk of their criticism has been directed at rating and ratemaking procedures in the fidelity lines. Two examples of this criticism of the Association's methods and manuals are especially noteworthy:

1. *The "Virginia rate case."*
2. *The 1951 and 1957 Convention Examinations of the Surety Association.*

Another pressure towards a sounder ratemaking basis for the fidelity lines has been the deteriorating experience of bank and commercial bonds. A member of the Association prepared an exhibit showing a 2.1% underwriting loss for the period 1951-1956 for fidelity classifications excluding official bonds; experience in the two succeeding years has not been particularly enheartening. With the current attitude of the various insurance departments, a rate increase based on "informed judgment" alone would probably be difficult to support, and many underwriters thus appear willing to examine some sort of statistical ratemaking method for the fidelity lines. Presumably, the selected method would also provide a means of testing rate adequacy or redundancy in the future.

A final pressure may be found in the forces of competition on the Association companies. Under this rather ambiguous "catch-all" may

be mentioned several ills of the business, particularly in the commercial blanket bond field:

1. The premium for commercial blanket bonds is presently determined by classifying the insured's employees as "A," "B," or "C," entering the rate tables to find the premium for the number of class "A" employees, and adding a constant charge for each "B" employee. Because of the lack of rigid distinction between "A" and non-"A" employees, it is normal that no two Association companies will arrive at the same premium for a given bond, with the result that the two companies find themselves in effect "cutting" rates; in addition, it is known that "C" employees cause losses, even though no premium is collected for them. It appears impossible to accommodate any substitute for the "A-B-C" method to current manual rates because of inconsistencies in the rate tables.
2. Fidelity, especially commercial coverage, is a "salesman's" line. A relatively low commission scale combined with a low medium premium produces dollar commissions which apparently do not provide the incentive necessary for producers to "sell" the line. It should be remembered in this connection that the bulk of the fidelity business is written by Association members, all of whom are stock companies.
3. Underwriters are continually disturbed by the tendency for domestic companies to write primary areas of coverage only, with the relatively loss-free excess areas covered abroad.
4. It is apparently standard practice for independents to file rates lower than Association rates as soon as the latter are published. Since the Association rates themselves are not statistically based, it is rather difficult to attack the independent filings as inadequate.
5. Departures from average rates to recognize inherent differences in hazard between insureds are limited. The commercial classification system groups insureds as either "classified" or "unclassified"; for the former, specific class discounts or surcharges are applied to basic rates, while for the latter the basic rate table applies. Currently, about half of the total premium volume is derived from "unclassified" insureds. In addition, there is no provision in the manual rules for debit rating. As a result, underwriters find themselves unable to accept many "unclassified" risks whom they would be perfectly willing to cover at a rate higher than that provided by the basic table, and forced to cancel coverage which they would be happy to carry at an increased rate.

Although a statistically based ratemaking method obviously would not provide an immediate answer to all these problems, some under-

writers feel that it might be a good beginning towards a final solution of most of them.

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The manual rates underlying many of these difficulties are not statistically based, in the usual sense of the term; rather, they have evolved over a period of time. Commercial blanket bond rates were originally adapted from individual and schedule bond rates, and were further modified to reflect changes in coverage, particularly that from an aggregate limit of liability in collusion cases, as is now found in the Primary Commercial Blanket Bond, to an individual employee limit, as is now found in the Blanket Position Bond. The general philosophy behind the rates is apparently that the rate per unit of penalty for the same exposure properly decreases as penalty increases, and, similarly, that the rate per unit of exposure for a constant penalty should decrease as exposure increases. It is evident that these conditions relate both to a percentage expense savings as premium size increases (i.e., to premium discount) and to a diminishing pure premium for each higher increment of penalty. While it would be preferable to divorce these two conditions from each other for the purpose of testing rate level, there is nothing basically wrong with correcting rates for both simultaneously as long as the graduation for increments of the variables is logical and consistent.

In the Association's present manual, there is a fairly constant relationship between the rates for Blanket Position and Primary Commercial Blanket Bonds of the same penalty and exposure, but the graduation of rates within the various tables is not consistent. Three examples of inconsistencies in commercial rates will serve to point up the inadequacies of the rate tables:

1. For both Blanket Position and Primary Commercial Blanket Bonds, the cost of adding a sixth employee under a $100,000 bond is no greater than that for the same employee under a $25,000 bond. In fact, for bonds of $25,000 or more under either bond form, each employee from the sixth through the twenty-fifth may be added for an identical price, regardless of bond size. However, with a $100,000 Position bond, although each additional employee from the sixth through the twenty-fifth costs $17.21, each employee from the twenty-sixth through the fiftieth will cost $17.90. Similarly, under a $500,000 Primary bond, the cost is only $15.17 for coverage for each of the sixth through the twenty-fifth covered employees, while each of the twenty-sixth through the fiftieth employees costs from $25.52 to $25.96, and each of the fifty-first through the hundredth results in an additional $17.01 charge.
2. The owner of an amusement park may secure a schedule bond totaling $25,000 at a rate of $9.00 per $1000 for his non-admin-

istrative employees, or a $500,000 schedule bond for these same employees at a rate of $3.00 per $1000. If the same man should also wish similar coverage for the employees of his baseball club, he would find that he could purchase the $25,000 schedule for only $5.00 per $1000, while the $500,000 cover would carry a rate of $4.00 per $1000.

3. An industrial insurance company wishes to bond five of its agents and considers that $15,000 individual bonds would satisfy its needs. Since the total bond is $75,000, the rate will be $50 per $1000 per man, and the total premium will be $3750. After some reflection, the company decides instead to purchase individual bonds of $20,000 and learns that, since the rate has decreased to $30 per $1000 per man, the bonding company will have to provide the additional $25,000 coverage at a savings of $750 over the cost of the smaller bond.

In summary, the current tables fail to provide equal proportionate increases in premium for either an increasing penalty with a constant exposure or an increasing exposure with a constant penalty. Although a part of this lack may be accounted for by the provision for premium discount, the majority is apparently the result of continuing adjustments to rates by the use of "informed judgment." As a result, it is virtually impossible to modify the existing tables to accommodate a statistical ratemaking system or a different exposure base without producing drastic, and unsupported, premium changes for a large number of insureds.

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It appears, then, that the climate of opinion is now favorable to the development of some sort of statistical ratemaking methods for fidelity insurance. Moreover, given the inconsistencies of the present manual rates, a thorough revamping of existing procedures seems preferable to a further modification of the current rules and rates. These conclusions rest, however, on the assumption that statistical methods can advantageously be applied to fidelity experience; when the study to be discussed in this paper was begun, it seemed that, since the validity of this assumption had apparently never been established, a first task should be to test fidelity experience for similarity to the loss patterns in those lines in which statistical ratemaking methods are used. In addition, because of the varying liability assumed under fidelity bonds of different penalty, a rating system analogous to that used in the liability lines seemed appropriate for fidelity business; a study of loss distribution by size of loss would perhaps provide a statistical foundation for concrete recommendations to that effect. Accordingly, a study of losses in one company's current closed claim file was undertaken, and the primary object of this paper is to report the findings of that study and the recommendations drawn from these findings.

THE LOSS STUDY

Because of the importance of salvage to the ultimate cost of fidelity losses, original plans provided for an analysis of the distribution by size of paid losses net as to salvage collected. An examination of the age of the available closed claims revealed that the bulk of these claims dated from the period 1954-1957, so that many, and particularly those for the larger amounts, were still in salvage; to eliminate this possible cause of distortion, the plan of the study was modified to allow for the use of gross losses. A pilot study was first made of commercial claims, and the analysis was then extended to the other fidelity sub-lines (bank, public official, and federal official) and fiduciary, which, although technically a surety sub-line, is close in coverage to fidelity. The distribution of number of losses by sub-line was as follows:

Sub-line	*Number of losses*	*Percentage of total*
Bank	1684	17.7
Commercial	7048	74.3
Official	472	5.0
Fiduciary	288	3.0
Total	9492	100.0

These claims accounted for over $15 million of loss to the insured obligees.

As the data for each claim were recorded, the penalty of the bond under which the loss was payable was checked; if it appeared that the paid loss had been limited to the bond penalty, the original claim file was examined to determine, insofar as possible, the actual loss sustained by the insured, and this latter amount was substituted in the data for the actual paid loss. Losses reported in the study thus represent an estimate of the amounts which would have been paid under open penalty bonds. Two limitations to the accuracy of these estimates should be noted:

1. Some claim files were, of course, not available, and the paid loss figures were retained for these claims.
2. In many cases, it was evident that the insured had proven his loss only up to the penalty of the bond. In some of these cases, an estimate of the actual amount in default could be formed by a review of the claim correspondence; in others, the proof of loss was accepted as the only source of loss data.

Although these inadequacies create some downward pressure on the total loss incurred, the claims to which they applied were generally under small penalty bonds ($2500 or less), and it is doubtful that they result in any considerable distortion in the size-of-loss distribution.

In the final tabulation, claim data were grouped by size of loss (excluding loss expense), using intervals selected to provide statistics

readily comparable with current rate manuals. For the interested reader, the tabulated data are given in the first Appendix to this paper. It should be borne in mind when reviewing the data and the remarks on them which follow that the hazards covered under important bond forms vary by sub-line, and hence that the loss data do not result from strictly homogeneous exposures. The simplest fidelity coverage is to be found in the commercial blanket bond, which normally insures against loss arising from employee dishonesty. Bond forms for public officials and fiduciaries usually guarantee also the faithful performance of the principal in the exercise of his duties; financial blanket bonds cover non-employee, as well as employee, dishonesty and unexplainable disappearance of valuables. It is lamentable that no clear distinction is made in rating between the fundamental employee dishonesty coverage and the supplemental coverages; a desire for clarity would dictate that rates for each coverage be established independently. Since, however, rates are not so published, losses arising from all covered hazards have been included in the data, and the figures should be regarded as an indication, rather than as an accurate representation, of the overall fidelity loss pattern.

As a first step in summarizing the data, the cumulative percentage distribution of numbers of losses in the various size-of-loss brackets was calculated for each sub-line and for all sub-lines combined. These distributions appear in Table 1, from which it is evident that most gross losses were relatively small in amount; it thus appears that fidelity shares with casualty lines a preponderance of low-cost losses. Unfortunately, there was no convenient way of relating loss frequencies to exposures, and it is thus impossible to comment on the stability of loss costs in terms of exposures. Nonetheless, it seems fair to conclude that the distribution of losses by size indicates that statistical ratemaking methods may be employed in the fidelity lines with advantage.

TABLE 1.—CUMULATIVE DISTRIBUTION OF NUMBER OF FIDELITY LOSSES BY SIZE OF LOSS

Amount less than	*Bank*	*Commercial*	*Official*	*Fiduciary*	*Total*
$ 100	31%	28%	24%	8%	27%
200	53	44	35	16	44
500	70	66	53	28	65
1,000	81	79	67	51	78
2,500	89	91	83	80	90
5,000	94	96	90	93	95
10,000	96	99	96	98	98
25,000	98	100–	99	100–	99
50,000	99		99		100–
100,000	100–		100–		

A second analysis of the data involved computing, for each representative bond penalty, the amount of loss which would have been paid had all bonds been of the same penalty, and then comparing these amounts to the total open penalty loss. Because of the disturbing effect on the comparison caused by an extremely large public official loss, that loss was netted of salvage before making the final calculations. Ratios of losses for each penalty to open penalty loss, incorporating this adjustment, are shown in Table 2; the method of computation of these ratios was perfectly straightforward, and its description has been relegated to Appendix II.

TABLE 2.—RATIO OF LOSS UNDER ASSUMED FIXED PENALTY BOND TO OPEN PENALTY (UNLIMITED) LOSS

Penalty	*Bank*	*Commercial*	*Official*	*Fiduciary*	*Total*
100	2.9%	8.2%	2.6%	5.4%	5.7%
200	4.7	14.1	4.7	10.4	9.8
500	8.6	26.3	9.7	23.7	18.5
1,000	12.6	38.7	15.6	40.4	27.5
2,500	20.0	57.5	25.8	66.9	41.8
5,000	27.2	71.0	35.5	82.9	52.9
10,000	36.4	81.5	44.2	93.3	62.7
25,000	52.0	92.4	54.7	99.8	75.0
50,000	64.7	97.5	63.2	100.0	82.8
100,000	76.0	99.8	71.4		88.7
200,000	85.7	100.0	78.8		92.9
250,000	87.8		82.0		93.9
500,000	93.2		97.9		97.5
750,000	98.4		100.0		99.5
1,000,000	100.0				100.0

Lastly, the data of Table 2 were compared with relativities between manual rates for bonds of various penalties. The results of this comparison may be examined in Table 3. Because it was necessary to use indices in making these comparisons, the ratios should be considered only as indicative of a pattern, especially at penalties close to the index. Nonetheless, if we assume that, over the years, the premium fund produced by current fidelity rates has been just adequate to pay losses and expenses and leave a reasonable margin, we must conclude from Table 3 that these rates have been inadequate for small-penalty bonds, and considerably redundant for large-penalty bonds. This conclusion is based on the loss-paying portion of the rate only; if we also consider the expense portion of the rate, including both an estimated minimum expense per item written and a decreasing expense percentage as premium increases, the inadequacy for small bonds and redundancy for large bonds in current rates are further enlarged.

TABLE 3.—RATIO OF PENALTY RELATIVITY UNDERLYING PRESENT RATES* TO RELATIVITY INDICATED BY LOSS STUDY

		Commercial		Official		Fiduciary
Penalty	*Bank Blanket*	*Schedule*	*Blanket*	*Individual*	*Blanket*	*Individual*
100	—	49%	—	—	—	—
200	—	53	—	—	—	—
500	—	72	—	—	—	—
1,000	—	91	—	66%	—	74%
2,500	—	100	100%	100	100%	100
5,000	89%	162	111	145	99	125
10,000	100	259	148	233	123	191
25,000	89	518	267	471	202	402
50,000	92	—	323	817	223	773
100,000	107	—	434	1445	272	—
200,000	137	—	—	—	279	—
250,000	153	—	—	—	—	—
500,000	187	—	—	—	—	—
750,000	209	—	—	—	—	—
1,000,000	230	—	—	—	—	—

* "Basic" or "general" rates for the following exposures and forms for blanket and schedule bonds:

Bank—Form 24 for a bank with 40 employees and $10,000,000 deposits. Rates for penalties less than $25,000 were extrapolated from rates for small banks.

Commercial—Schedule and Blanket Position Bond covering 40 "A" employees.

Public Official—Honesty Blanket Position Bond covering 40 "A" employees.

A PROPOSAL

Although under present manual rules the exact method of calculating bond premiums varies by sub-line, in general premiums for blanket bonds are determined by first entering a rate table at a point dependent upon number of exposures and bond penalty and then modifying the tabular rate for classification or bond form. For individual and schedule bonds, a rate per unit of penalty, either level or "stepped" as penalty increases, is extended by the aggregate bond penalty. The data of Table 2 suggest a rating method analogous to that used in the liability lines; certainly the adoption of such a method would bring about a desirable uniformity and simplicity in calculating fidelity premiums, and it is therefore proposed that all fidelity bonds be rated as follows:

1. Rates would be published, by class of business, for a unit exposure at a basic penalty.
2. For penalties above and below the basic penalty, rate differentials to the basic penalty would be published.

3. The classification rate for the basic penalty would be extended by the appropriate penalty differential to arrive at the unit rate for a bond of given penalty in that classification.
4. This rate would then be extended by the exposures to produce the manual premium for the bond.
5. Manual premium would be modified by experience rating for risks large enough to present credible experience, and by premium discount for risks developing an annual premium large enough to warrant expense gradation. By the same reasoning, minimum premiums would incorporate both a loss and an expense constant.

This rating method simplifies consistent graduation of the rate structure for bonds of different penalties and exposures, and, since its values would be statistically based, allows checking of this graduation from time to time. In addition, the method provides a convenient vehicle for solutions to many of the problems of the business mentioned earlier.

In order to effect the proposal, however, much work remains, and at least the following problems will have to be considered and solved:

1. A fundamental task is to establish a classification system, containing preferably a small number of classes, which groups principals by the loss hazard each presents. Fidelity losses may result from contact with, or control over, either cash and securities, goods, or both; the extent of the hazard may be measured both by the amount of the tangibles exposed and, perhaps more importantly, by the ability of the dishonest principal to shield his activities through access to the general books of account and to unit records such as cash registers and vouchers. The classification system should reflect these and other like considerations, rather than merely the type of business in which the principal is engaged. In connection with the development of a classification system, it would be desirable to segregate the hazards insured against, as discussed in the second section of this paper.
2. An exposure base must be selected. Considering the standard criteria which an efficient base must meet, some form of payroll base appears the most satisfactory approximation for bank and commercial risks; bond penalty is possibly the only satisfactory base for fiduciary and public official bonds as they are presently written.
3. A basic penalty must be chosen. The loss study indicates that $2500 or $5000 woud be most suitable.
4. Differentials must be established for penalties higher than the basic unit. It is likely that more than one set of differentials will be required, in order to recognize differences in the high-cost hazard presented by the various classes of business. For

example, in the commercial field outside employees produce a large number of low-cost, and relatively few high-cost, cases; the basic rate for this class would be higher than average, and the increased penalty factor should correspondingly be low. Executive officers, on the other hand, produce few small claims, but present a considerable hazard to "jumbo" losses; the basic rate would accordingly be quite low, and the increased penalty factor should be high enough to produce sufficient premium dollars to cover the exposure.

5. The general method of making the loss-paying portion of the rate must be settled upon, and a statistical plan must be designed to implement the method. In the past, statistical ratemaking has come to be associated with relatively frequent rate revisions; for the fidelity lines, frequent rate revisions appear highly impractical. On the other hand, there must be a way of revising rates when prospective costs indicate that current rates are either inadequate or redundant. A possible solution would be to test observed frequency and claim costs with those underlying rates, and to revise rates only when there was a significant variation from the expected value of either factor.

More difficult to resolve than the traditionally necessary compromise between rate stability and responsiveness will be the problem of designing an adequate treatment of salvage in determining loss costs. It will be seen in Table 4 that the portion of losses on which some salvage is collected is substantial, and that this portion varies both by loss size and by sub-line. Because salvage collection may be either made soon after loss payment or deferred as installments, it is obvious that the amount collected will be a function of time; in addition, it appears that ultimate recovery is also dependent on loss size.

TABLE 4.—RATIO OF NUMBER OF LOSSES FOR WHICH SALVAGE WAS COLLECTED TO TOTAL NUMBER OF LOSSES, BY SIZE OF GROSS LOSS.

Size of loss	*Bank*	*Commercial*	*Official*	*Fiduciary*
1– 99	10%	22%	30%	22%
100– 199	10	35	45	37
200– 499	18	46	58	60
500– 999	24	55	67	59
1,000– 2,499	43	58	71	60
2,500– 4,999	51	56	64	63
5,000– 9,999	56	55	58	62
10,000–24,999	51	34	39	60
25,000–49,999	77	14	33	—
50,000–99,999	91	14	50	—
100,000 & over	71	—	50	—
	21	41	55	55

These considerations prompt the suggestion of treating salvage in ratemaking by an average value approach, so that recent loss experience could be used in the basic data. Probably it would be best to net losses by immediate salvage, and then further discount them by the average value, for the size and kind of loss, of future expected salvage collections. Since future salvage collections will always be partly dependent upon economic conditions, great care will be required in designing the actual mechanics of an average value approach.

6. The method of providing for expenses and margin in basic rates must be determined.
7. To recognize loss characteristics of individual risks, a sound experience rating plan, closely related to the manual ratemaking procedure, must be established; similarly, to recognize expense gradation by size of risk, a premium discount plan must be selected which is in keeping with the manual provisions for expense.

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I have attempted to indicate above, for any interested members of the Society, some of the problems which will have to be solved in placing fidelity rates on a statistical basis. Relatively little actuarial work has been concentrated on fidelity and surety rates; considering the scarcity of actuaries and the problems constantly raised in the casualty lines, a good reason for this lack of attention may be found in the fact that fidelity accounts for about 0.5%, and surety only an additional 1.0%, of direct premiums written in the industry. The present situation of fidelity rates, however, affords an excellent opportunity for the application of those techniques which are the stock-in-trade of the casualty actuary, and it is hoped that some members of the Society may be interested enough to direct a portion of their energies towards the solution of the problems mentioned in this paper. In the belief that further background material may be of help to those interested, I have appended a brief bibliography. Readers will note that most of these sources are valuable primarily as indicators of opinion from various sides, and that, with the exception of the "Linder Study," little is available which would be of use in statistical ratemaking.

APPENDIX I.—BASIC LOSS DATA

BANK

Size of loss	*Number of Claims*	*Loss incurred*	*Loss expense*	*Salvage claim count*	*Salvage collected*	*Salvage expense*
1– 99	528	22,701	181	52	2,107	—
100– 199	361	43,692	1,848	35	2,789	69
200– 499	281	86,750	471	51	9,255	141
500– 999	186	120,996	2,446	44	18,282	154
1,000– 2,499	141	215,110	4,902	61	64,221	977
2,500– 4,999	77	262,564	7,000	39	84,028	443
5,000– 9,999	36	249,465	4,887	20	31,415	1,404
10,000– 14,999	21	263,616	4,332	13	63,079	1,280
15,000– 19,999	11	184,625	1,190	4	10,842	54
20,000– 24,999	7	158,276	2,697	3	20,530	674
25,000– 49,999	17	583,744	12,900	13	200,487	5,773
50,000– 74,999	8	474,302	20,463	7	43,798	—
75,000– 99,999	3	265,181	7,463	3	62,951	2,132
100,000–199,999	5	761,555	4,212	3	75,056	20
200,000–249,999	—	—	—	—	—	—
250,000–499,999	1	258,190	2,638	1	101,400	—
500,000–999,999	1	826,539	—	1	311	—
1,000,000 & over	—	—	—	—	—	—
Totals	1,684	4,777,306	77,660	350	790,551	13,121

COMMERCIAL

1– 99	1,959	95,135	2,200	425	17,773	1,251
100– 199	1,151	162,759	2,922	398	38,070	4,121
200– 499	1,527	484,474	10,549	705	127,416	10,131
500– 999	949	663,748	11,676	517	171,484	16,248
1,000– 2,499	838	1,289,469	22,596	489	267,285	19,891
2,500– 4,999	350	1,192,778	14,496	197	181,888	11,291
5,000– 9,999	169	1,096,552	13,626	93	119,542	9,068
10,000– 14,999	47	587,646	14,303	19	40,719	2,477
15,000– 19,999	21	363,013	152	4	4,607	300
20,000– 24,999	8	179,980	311	3	19,544	1,926
25,000– 49,999	21	702,810	3,323	3	25,742	75
50,000– 74,999	4	231,893	409	—	—	—
75,000– 99,999	3	242,774	395	1	10,500	1,500
100,000–199,999	1	112,000	—	—	—	—
200,000–249,999	—	—	—	—	—	—
250,000–499,999	—	—	—	—	—	—
500,000–999,999	—	—	—	—	—	—
1,000,000 & over	—	—	—	—	—	—
Totals	7,048	7,405,031	96,958	2,854	1,024,570	78,279

APPENDIX I.—BASIC LOSS DATA—*(Continued)*

OFFICIAL

Size of loss	*Number of Claims*	*Loss incurred*	*Loss expense*	*Salvage claim count*	*Salvage collected*	*Salvage expense*
1– 99	111	5,036	61	33	1,695	44
100– 199	53	7,244	255	24	2,478	131
200– 499	84	28,765	1,342	49	10,378	683
500– 999	69	49,403	1,782	46	21,943	4,490
1,000– 2,499	73	109,929	2,406	52	29,932	2,267
2,500– 4,999	36	127,744	1,841	23	30,107	3,945
5,000– 9,999	26	166,620	7,848	15	26,089	2,671
10,000– 14,999	8	97,119	1,512	3	10,303	1,179
15,000– 19,999	3	50,117	730	2	13,885	1,122
20,000– 24,999	2	42,786	505	—	—	—
25,000– 49,999	3	108,011	298	1	9,817	411
50,000– 74,999	2	129,239	3,868	1	11,083	6,509
75,000– 99,999	—	—	—	—	—	—
100,000–199,999	1	115,000	13	—	—	—
200,000–249,999	—	—	—	—	—	—
250,000–499,999	—	—	—	—	—	—
500,000–999,999	—	—	—	—	—	—
1,000,000 & over	1	1,571,364	509	1	1,039,167	1,399
Totals	472	2,608,377	22,970	250	1,206,877	24,851

FIDUCIARY

1– 99	23	803	912	5	367	—
100– 199	22	3,037	498	8	896	15
200– 499	35	12,050	1,282	21	4,911	266
500– 999	68	48,407	3,510	40	15,303	1,343
1,000– 2,499	83	131,501	7,908	50	37,434	2,885
2,500– 4,999	38	128,616	5,960	24	31,116	1,296
5,000– 9,999	13	87,540	5,067	8	23,590	1,358
10,000– 14,999	3	35,380	272	2	5,204	185
15,000– 19,999	2	32,066	1,094	1	3,303	1,116
20,000– 24,999	—	—	—	—	—	—
25,000– 49,999	1	26,262	1,692	—	7,529	—
50,000– 74,999	—	—	—	—	—	—
75,000– 99,999	—	—	—	—	—	—
100,000–199,999	—	—	—	—	—	—
200,000–249,999	—	—	—	—	—	—
250,000–499,999	—	—	—	—	—	—
500,000–999,999	—	—	—	—	—	—
1,000,000 & over	—	—	—	—	—	—
Totals	288	505,662	28,195	159	129,653	8,464

APPENDIX II.—CALCULATION OF RATIO OF LOSS AT ASSUMED FIXED PENALTY TO OPEN PENALTY (UNLIMITED) LOSS

The total loss incurred under the assumption that all bonds in force were of penalty p_i equals the sum of (1) all losses for amounts less than p_i and (2) the product of p_i and the number of losses for amounts equal to or greater than p_i. Upon dividing this sum by the total open penalty loss, the desired ratio is obtained. Symbolically, the ratio

$$\frac{lp_i}{L} = \frac{\sum_{t=1}^{i-1} l_t + p_i \sum_{t=i}^{\infty} n_t}{\sum_{t=1}^{\infty} l_t}$$

where, for the *i*-th size-of-loss bracket,

p_i = lower boundary
n_i = number of losses
l_i = amount of loss

and the infinity symbol merely denotes that the summation is carried to the end of the data table.

As an example, the beginning of the calculation for bank bonds is shown below.

(1) p	(2) Σl	(3) Σn	(4) $p \Sigma n$	(5) $\Sigma l + p \Sigma n$	(6) $\frac{lp_i}{L}$
0	—	1,684	—	—	.000
100	22,701	1,156	115,600	138,301	.029
200	66,393	795	159,000	225,393	.047
.	.	.	.	.	.
.	.	.	.	.	.
1,000,000	4,777,306	—	—	4,777,306	1.000

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