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Abstract

This paper shows data that illustrate the substantial variation among nonmedical schedules and the dramatic increase in their amount limits from 1972 through 1992. Coefficients of variation are analyzed for several data subsets. We find that the variation of schedules in the sample of all firms has increased throughout the 1972-1992 period for issue ages up to 30, but has declined for issue ages beyond 30 during the 1982-1992 period. For the non-New York and stock companies our statistical tests indicate an increase in the variability of schedules over the full period 1972 to 1992.

Key words and phrases: *mortality, underwriting, medical examinations, schedules, coefficient of variation*

1 Introduction

The practice of granting life insurance without a medical examination began in England when underwriting evidence consisted of personal interviews, opinions of associates and friends, and/or attending

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physicians' statements. Medical evidence began to be required in 1850, and a medical examination was considered essential until 1885. In 1886 cautious experiments to remove the medical examination on smaller policies began, albeit with substantial restrictions that were gradually lifted in view of favorable results.

The rationale for nonmedical limits[1] for insurance policies had been that the savings in medical exam expenses were sufficient to offset the additional mortality experienced in the absence of underwriting information from medical exams. A shortage of medical examiners in rural areas following World War I led a group of Canadian companies to begin nonmedical programs with restrictions on issue ages and amounts. The practice was well received in the field, the early experience was favorable, and the Canadian program was liberalized and expanded. Beginning in 1925 nonmedical underwriting spread rapidly through the American life insurance industry, and by 1935 86 percent of the 129 members of the American Life Convention had adopted nonmedical programs. Today nearly every life insurer in the United States and Canada accepts some nonmedically underwritten business, and it is estimated that 67 percent of new ordinary policies and 33 percent of new ordinary amounts are written nonmedically (Black and Skipper, 1994, Chapter 24, p. 671).

Because the insurer pays for medical evidence it uses in underwriting the application, there are initial expense savings when no medical examination is required. The actuarial mechanics of the construction of such schedules are well established: the present value over the policy life of the excess mortality experienced under nonmedical underwriting is equated to the expense savings at issue, and the equation is solved for the face amount that balances it.

Nonmedical limit schedules theoretically should depend on the cost of medical exams and the additional mortality experienced in their absence, suggesting that the schedules for different companies should not vary much. In practice, however, variation among companies enters via differing attitudes in areas such as mortality selection standards, persistency rates, returns on investments, target markets, degrees of accommodation to the writing agent, safety/profit margins in the premium structure, and stock versus mutual forms of insurer organization. This paper addresses questions raised by the existence of a large number of nonmedical limit schedules that exhibit substantial variation.

[1] A nonmedical limit for a new life insurance policy is the maximum amount of insurance that can be issued without the benefit of a medical or paramedical examination.

Changes in nonmedical limits over the last two decades have been characterized in Black and Skipper (1994, Chapter 24, p. 672) as "nonmedical limits exploded." Great increases in nonmedical limits represent the responses by companies to large increases in the cost of medical examinations over the period of this study. Companies have dealt with the cost increases in medical examinations by using less expensive paramedical exams and by making cost-effective use of blood and urine testing.

The extent to which nonmedical limit schedules vary is an empirical question. This paper seeks to determine both the degree of the current variation and the trend in variation over time: Is competition driving the schedules together, or are individual company differences forcing them apart? We show how nonmedical limits have developed, summarize the current situation, and explore the variations of schedules of different insurers.

2 Factors Impacting Nonmedical Limits

While this paper focuses on nonmedical limits, there is a continuum of underwriting approaches of which medically examined business and nonmedical business are the extremes. All variations are driven by the trade-off between expense savings and differential mortality costs. This dynamic trade-off is a function of the increase in the cost-effectiveness of underwriting tools, increases in medical exam costs, and continuing improvements in insured mortality. Paramedical underwriting provides the best example (Woodman, 1992). Paramedical underwriting has advanced to the point where separate mortality experiences are maintained for this approach. Blood and urine testing also offer protective values that are cost-effective at levels less than full nonmedical limits. Additionally, companies review periodically their use of other underwriting tools such as inspection reports, attending physicians' statements (APSs), personal health interviews (PHIs), and motor vehicle records (MVRs). These reviews may cause companies to revise the issue amounts at which they order such tools.

Inflation is one of the major forces that drew attention to the nonmedical area. The chairman of an extended discussion in 1970 on the impact of inflation on underwriting remarked: "There is evidence that the cost of medical underwriting has increased more rapidly than the health care index, so we can conclude that the major components of underwriting costs have increased more rapidly than the Consumer Price Index" (Taylor 1970). The *Statistical Abstracts of the United States*

Price Index	1972-1982	1982-1992	1972-1992
Consumer Prices	131%	45%	236%
Medical Care	148%	106%	410%
Physicians' Services	145%	94%	375%
Average Policy Size Issued	168%	154%	580%

provides the data for the percentage increases in related price indices shown below for the periods 1972-1982, 1982-1992, and 1972-1992. Data from the *Life Insurance Fact Book* show that the percentage increases in the average size policy issued have more than kept pace with these inflationary increases in the several price indices.

The onset of AIDS as a significant factor in underwriting occurred during the period 1982-1992. During this period AIDS dominated discussions of underwriting in the actuarial literature.[2] Company responses have included blood testing at much lower face amount levels in applicant cohorts where AIDS is a concern. Prior to 1985 blood testing generally was not requested until face amounts applied for exceeded $1 million. HIV/AIDS changed that dramatically. Blood/urine/saliva testing for HIV now begins at $25,000 to $100,000. Additionally, some observers feel that companies may have slowed increases in nonmedical limits and conformed their nonmedical schedules by issue ages to those of competitors to avoid being selected against by the HIV-infected.

3 Literature Review

This literature review concentrates on papers and discussions dealing with the factors impacting nonmedical limits. Outside the actuarial literature there is substantial additional underwriting material relevant to this subject, particularly in the publications of the Home Office Life Underwriters Association and the Institute of Home Office Underwriters.

[2]For the period up to December 31, 1991, during which information could affect company decisions on nonmedical limits for 1992, there were several papers and task force reports on AIDS (though not all focused on underwriting) that were published by the Society of Actuaries. These include the *Guide for Practicing Actuaries* (1988), Panjer (1989), Plumley (1989), Ramsay (1989 and 1990), the *Report of the Society of Actuaries Committee on HIV Research* (1990), and the *Report of the Task Force on the Financial Implications of AIDS* (1990).

The literature contains three themes. The first theme consists of historical examinations of nonmedical limits in ordinary (and industrial) life insurance. Parker (1921) reviews the Canadian experiment. Auden (1938) gives a brief history, an update on the practice of 114 companies, a review of the reasons for writing nonmedical business, and a report on the generally favorable mortality. Morton (1977) discusses nonmedical and paramedical underwriting in his review of underwriting principles and practices. Sankey (1990) and Black and Skipper (1994, Chapter 24, pp. 671–672) provide historic treatments for more recent periods.

The second theme, review and liberalization, consists of a long series of discussions in the actuarial and underwriting journals responding to questions by editors. Smith (1924) emphasizes the early success of the Canadian nonmedical program. Larus (1925) cautions against competition on nonmedical limits, while Parker (1925) feels that companies doing a nonmedical business contribute meaningfully to the information maintained by the Medical Impairment Bureau.

As liberalizations develop, the discussions focus on nonmedical mortality experience relative to that of medically examined business. Smith (1930) uses Canadian male select mortality as a benchmark; Shepherd (1930) benchmarks against American male select mortality. Both find the ratios of actual-to-expected mortality (A/E ratios) for nonmedical issues higher than the ratios for medically examined business; both find the A/E ratios for nonmedical issues in age groups beyond age 45 substantially higher than their medically examined counterparts. Smith and Cross (1930) indicate higher lapse rates on the nonmedical issues. Marshall (1932) provides data showing the favorable mortality experience of Connecticut Mutual. Discussions in *Record of the American Institute of Actuaries* (1934) identify issue age 40 as the supportable upper age for nonmedical schedules, providing several examples at older issue ages of substantially higher A/E ratios (relative to American male select mortality) for nonmedical issues than for those medically examined.

Auden (1938) cites reductions from upper age 45 to age 40 as the trend of the day, with nonmedical persistency still poor but nonmedical mortality satisfactory. He discusses the value of the forgone expense of the medical exam in offsetting additional mortality. Hunter (1940) inventories mortality studies (up to 1931 for three Canadian companies and five American companies) and adds New York Life data through 1939 to show generally favorable nonmedical experience. Discussions in *Record of the American Institute of Actuaries* (1942) center around the problems of obtaining medical examiners during World War II and the nonmedical liberalizations that would help reduce the load on examin-

ers (the consensus was "yes" to amounts, "no" to age extensions). The increase in the percentage of applications on a nonmedical basis that accompanied nonmedical schedule liberalizations is discussed, with one large company's percentage in 1942 going from 9 percent in July to 30 percent in October!

The central issue in *Record of the American Institute of Actuaries* (1946) is wartime mortality; all commentators on nonmedical limits come to the same general conclusion, viz. that nonmedical business still could be written satisfactorily at issue ages under 40 for amounts up to $5,000. The discussions in the *Transactions of the Society of Actuaries* (1950) indicate that the triggering incident for the announcement of nonmedical limit increases is a specific increase in medical examiner fees.

Merriam (1951) describes an increase in medical examiner fees of about one-third, with resulting extensions of nonmedical limits in the Metropolitan Life to the age groups 41-45 and 46-50. Mathews (1953) provides survey evidence from 108 companies that such extensions are not common—only 5 percent of the companies issue nonmedically above age 40. Morton (1954) reports that most Canadian companies continue some nonmedical issue amount to age 45, but provides discounted extra mortality costs that suggest only nominal amounts are feasible. Van Keuren (1956) indicates that Metropolitan Life, which introduced nonmedical issues above age 40 in 1951, has discontinued them because of unsatisfactory mortality experience and the necessity to obtain medical exams on 25 percent of nonmedical applicants.

Jacoby and Tookey (1959) both indicate pressure from physicians to increase the medical examination fees. They attribute this to doctors' aversion to paper work, the lagging of fees behind price levels, and resentment that insurers would attempt to fix doctors' fees. All discussants (*Transactions of the Society of Actuaries*, 1960) note increases of $25,000 to $30,000 up to age 30, but few increases thereafter.

Lew (1966) predicts increased use of bodily fluids testing to extend the use of nonmedical limits to older age groups. Gauer and van Keuren (1967) explore the use of technicians and early paramedical techniques. The difficulty of finding physicians willing to serve as medical examiners is noted. Many discussants note the use of medical information phoned-in and recorded. Keltie (1969) attributes the slowdown in mortality improvement on medically examined business to the spread of paramedical exams and alludes to reductions in the use of inspection reports and attending physicians' reports.

The third theme consists of the readings gathered by the Society of Actuaries under the rubric of *cost implications* in the *Professional Actu-*

arial Specialty Guide to Individual Underwriting (1993). Ormsby (1963) first examines the economics of underwriting in a paper that addresses the considerations involved in ordering inspection reports. He provides formulas for " ... converting changes in underwriting action attributable to information in the APS (attending physician's statement) into equivalent 'net' single premiums at issue so that a comparison can be made of these 'net' single premiums with the total cost of obtaining and processing the statement itself ..." The techniques outlined are applicable to the construction of nonmedical limit schedules.

Mast (1978) discusses each element of the nonmedical limit question. His paper determines the break-even amount as " ... the policy size at which the increased mortality costs resulting from the lack of a medical examination are approximately counterbalanced by the consequent savings in underwriting expenses." He mentions an asset share approach, and discusses the net single premium technique used by Ormsby: " ... the relationship between the expenses associated with obtaining a medical examination and the present value of the increased mortality cost per $1,000 is used to determine the break-even amount."

Reitano (1979) provides a consistent theory for evaluating the interplay between the cost of underwriting tools and the resulting mortality. He discusses two cases:

- The actuarial approach typically used in setting nonmedical limits, using the present value of the difference between medical and nonmedical mortality experience (the two table technique); and
- The underwriting approach for valuing underwriting tools (as in Ormsby), under which the value of the tool is the present value of the extra mortality costs that are saved by removing certain lives from the standard issue class (the single table method).

Bergstrom (1989, 1991) discusses the assumptions and calculations that provide estimates for the protective values of blood chemistry profile and urinalysis testing. The earlier study gives protective values for life insurance, the latter for major medical insurance. The reports show the techniques for expressing the results in terms of amount levels above which the testing is cost-justified and in terms of return on the investment (ROI) in the testing.

Mills (1991) provides a general model for such protective value studies, utilizing the axiom that " ... a particular underwriting procedure has positive economic value if its cost is less than the savings in mortality (or morbidity) made possible by its use." Mills provides an example for valuing the attending physician's statement in connection with disability income.

Woodman (1992) assesses the value of the paramedical examination using the tools and approach specified by Bergstrom. He provides comparisons between medical, paramedical, and nonmedical mortality experience; his further analysis indicates the age-at-issue groups and amount levels for which the several underwriting approaches are most appropriate.

4 Data Sources

The data used in the statistical analyses are the nonmedical limit amounts published in *Best's Flitcraft Compend (Life-Health)* for the editions dated 1973, 1983, and 1993. The data collection procedures used by A.M. Best Co. are such that the data relate to the years 1972, 1982, and 1992. It is these latter years that are used in the table headings and the text.

The nonmedical limit information, when available, is given in the policy analysis section (preceding the statistical sections) of the *Flitcraft Compend.* The availability of nonmedical schedules is shown in Table 1, which gives in the panel headings the number of companies contributing nonmedical limit schedules to each year of the study. The material available for analysis grew substantially from 1972 to 1982, then shrank in 1992 because the A.M. Best Company split the *Flitcraft Compend* into two sections, only one of which preserved the nonmedical data. As a result there are data on 113 companies for 1972, 164 companies for 1982, and 119 companies for 1992. Forty-eight companies provided data for all three years.

The basic data (not shown) consist of values for the nonmedical limits across each of the 15 issue age groups for each company plus additional values for independent variables representing specific characteristics of individual companies. The issue age groups used by different life insurers in practice are so similar that less than 20 forcings were needed to put the nonmedical schedules into the common format of 15 groups by age at issue.

Table 1
Characteristics of the Sample of All Firms Nonmedical Limits (000s)

Panel A: 1992 Sample (N = 119)															
Age at Issue	0-4	5-14	15	16-17	18-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70
Number of Companies*	115	115	118	118	118	118	118	118	118	115	107	52	36	18	10
Mean	222	225	224	220	208	209	209	180	140	86.6	66.3	25.4	17.5	5.50	1.63
Standard Deviation	153	155	137	138	134	134	134	99.8	89.2	65.1	65.3	53.6	50.1	18.3	7.42
Median	200	200	200	200	200	200	200	150	100	75	50	0	0	0	0
Mode	250	250	100	100	100	100	100	100	100	100	50	0	0	0	0
Maximum	1000	1000	1000	1000	1000	1000	1000	500	500	350	350	350	350	100	50
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Panel B: 1982 Sample (N = 164)															
Age at Issue	0-4	5-14	15	16-17	18-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70
Number of Companies*	162	162	163	164	164	164	164	162	162	150	82	37	22	16	10
Mean	134	139	139	141	141	145	144	108	70.6	40.1	25.2	15.8	14.4	8.50	5.57
Standard Deviation	84.5	82.5	81.3	81.0	80.9	86.4	86.9	85.2	82.5	75.4	75.9	72.2	72.3	47.5	42.4
Median	100	100	100	100	100	100	100	75	50	20	2	0	0	0	0
Mode	100	100	100	100	100	100	100	100	50	25	0	0	0	0	0
Maximum	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
Minimum	0	0	0	15	15	25	25	0	0	0	0	0	0	0	0
Panel C: 1972 Sample (N = 113)															
Age at Issue	0-4	5-14	15	16-17	18-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70
Number of Companies*	113	113	113	113	113	113	112	111	111	71	18	9	5	2	0
Mean	30.2	31.9	32.7	33.0	33.1	32.9	32.0	20.9	11.0	3.31	0.50	0.15	0.07	0.02	0
Standard Deviation	9.18	7.83	6.61	6.46	6.39	6.19	6.77	6.04	5.22	3.62	1.49	0.58	0.34	0.17	0
Median	30	30	30	35	35	30	30	20	10	3	0	0	0	0	0
Mode	30	30	30	30	30	30	30	20	10	5	0	0	0	0	0
Maximum	50	50	50	50	50	50	50	50	50	25	10	4	2.5	1.5	0
Minimum	5	10	10	10	10	10	0	0	0	0	0	0	0	0	0

* Number of companies with nonzero nonmedical limits

5 Methodology

For each age group for each of the years 1972, 1982, and 1992 these univariate statistics for the nonmedical limits are calculated: mean, median, mode, maximum, minimum, and standard deviation. We also count and display the number of companies that provide nonzero nonmedical limits to a particular age group. These characteristics are displayed in Table 1. The same statistics are provided in Table 2 for the 48 companies with data for all three years.

Because our interest is to determine the extent of current variation among issuers and the trend in variation over time, a test for stationarity of variance seems logical. Given the tremendous increase in nonmedical limits in the decade from 1972 to 1982, however, stationarity tests of the variance do not provide any insight as to the real divergences in behavior within the industry. Therefore, coefficients of variation are calculated for each age group for the years 1972, 1982, and 1992, and a series of nonparametric tests is performed on this statistic.

Statistical tests are used to determine: (i) whether variation within the industry has remained consistent for the two decades—this test was suggested in 1937 by Friedman (1991); and (ii) whether the variation has consistently increased or decreased over the two decades—this test was suggested in 1963 by Page (1991). Appendix A describes these tests for the entire sample, giving the null and alternative hypotheses, the calculated coefficients of variation, formulas for the test statistics, and the cut-off points for rejection at selected confidence levels. The Friedman and Page tests are performed on the entire sample and repeated again for those 48 companies for which data are available for both decades. This approach allows us to isolate any bias that may have been introduced by outliers or new entrants into the full sample.

The 48 firms for which data are available for 1972, 1982 and 1992 are also split into stock (22) and mutual (26) companies and New York (22) and non-New York (26) insurers. Similar tests are performed on these samples to determine whether there are any identifiable differences in behavior among these subgroups. The stock/mutual split is chosen to explore whether the philosophy or practices inherent in the form of company organization may influence the nonmedical limits. The non-New York/New York split is chosen to test whether the New York expense and commission limitations (and perhaps the extraterritoriality) would impact the nonmedical limits.

Table 2
Characteristics of the Sample of 48 Firms Nonmedical Limits (000s)

Panel A: 1992 Sample (N = 48)															
Age at Issue	0-4	5-14	15	16-17	18-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70
Number of Companies*	47	47	47	48	48	48	48	47	47	47	47	21	11	6	3
Mean	253	259	261	264	252	252	252	204	149	83.5	66.4	29.1	21.5	7.04	1.63
Standard Deviation	163	167	166	163	162	162	162	105	93.4	73.9	72.9	71.9	71.8	22.3	8.00
Median	250	250	250	250	250	250	250	200	100	50	50	0	0	0	0
Mode	250	250	250	250	250	250	250	100	100	50	50	0	0	0	0
Maximum	1000	1000	1000	1000	1000	1000	1000	500	500	350	350	350	350	100	50
Minimum	0	0	0	30	30	30	30	0	0	0	0	0	0	0	0
Panel B: 1982 Sample (N = 48)															
Age at Issue	0-4	5-14	15	16-17	18-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70
Number of Companies*	48	48	48	48	48	48	48	47	47	42	16	6	2	2	2
Mean	137	136	135	135	136	135	134	94.0	50.7	23.1	7.42	1.28	0.11	0.11	0.11
Standard Deviation	70.0	68.3	65.1	65.1	64.9	64.3	65.0	60.3	40.0	24.2	18.0	4.43	0.72	0.72	0.72
Median	100	100	100	100	125	125	120	75	50	15	0	0	0	0	0
Mode	100	100	100	100	100	100	100	100	50	10	0	0	0	0	0
Maximum	300	300	300	300	300	300	300	300	200	100	100	25	5	5	5
Minimum	30	30	30	30	30	30	30	0	0	0	0	0	0	0	0
Panel C: 1972 Sample (N = 48)															
Age at Issue	0-4	5-14	15	16-17	18-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70
Number of Companies*	48	48	48	48	48	48	48	47	47	27	3	2	1	1	0
Mean	29.7	31.6	32.8	33.2	33.2	33.1	32.1	19.8	9.96	2.96	0.21	0.16	0.03	0.03	0
Standard Deviation	9.31	7.52	5.92	5.60	5.60	5.61	6.09	5.62	3.43	3.20	0.92	0.69	0.22	0.22	0
Median	30	30	30	35	35	30	30	20	10	3	0	0	0	0	0
Mode	30	30	30	30	30	30	30	20	10	0	0	0	0	0	0
Maximum	50	50	50	50	50	50	50	40	25	12	5	4	1.5	1.5	0
Minimum	10	10	15	20	20	20	15	0	0	0	0	0	0	0	0

* Number of companies with nonzero nonmedical limits

6 Analysis and Findings

Panels A, B, and C of Table 1 show the descriptive statistics for all firms for the set of 15 age groups over 1972–1992. The data show the stunning increases in nonmedical limits, particularly over 1972–1982. The mean is consistently higher than the median and the mode, with few exceptions, suggesting that some companies offer significantly larger nonmedical limits than their competitors.

Panels A, B, and C of Table 2 show the descriptive statistics for the 48 companies. The same patterns of skewness, with the mean being higher than the median and the mode, emerge for 1992 and 1982, while the 1972 figures emulate a normal distribution.

Table 3 shows the percentage increase in the mean nonmedical limits for the periods 1972–1982, 1982–1992, and from 1972–1992. Percentage increases for 1972–1982 are substantial in every age category, especially beyond issue age 40. There are further increases in the mean nonmedical limits for every issue age category in the second decade. These increases are much smaller than those in the earlier decade but more evenly distributed along the age range.

Table 4 shows that the percentage of companies offering nonzero nonmedical limits at issue ages beyond age 40 has risen dramatically since 1972. This may reflect the lower mortality rates due to improved health care and the reduction of death rates from diseases significant to the elderly. The percentage of companies offering nonzero nonmedical insurance to groups below the age of 15 dropped slightly.

A comparison of the various coefficients of variation[3] suggests that the differences among companies increased over both decades for the first seven age groups (0–30) in the total sample, particularly in the decade from 1972 to 1982 (Table 5). For the next five age groups (31–55) the variation increased from 1972 to 1982, but the differences in nonmedical limits among companies decline markedly. For the last three age groups the variation among companies from 1972 to 1992 consistently declined. Much of the reduction in variation at the older ages can be attributed to those companies which went from zero to positive nonmedical limits in that age range. The data further suggest that positive socioeconomic factors for the older age groups in the decade from 1982 to 1992 may have overridden any differences in individual company underwriting costs. The greater variability in practice for the lower age groups, however, suggests that company policies differ more in targeting this age group.

[3]The coefficient of variation is the ratio of the standard deviation to the (nonzero) mean.

Table 3
Percentage Increases in Mean Non-Medical Limits: All Firms (in %)

Age Range	1972-82	1982-92	1972-92
0-4	347	66	640
5-14	336	62	605
15-15	325	61	585
16-17	327	56	567
18-20	326	48	528
21-25	344	43	535
26-30	353	44	553
31-35	417	67	761
36-40	545	97	1,173
41-45	1,118	115	2,516
46-50	4,980	161	13,160
51-55	10,500	60	16,833
56-60	21,186	17	24,900
61-65	42,900	(36)	27,400
66-70	∞	(71)	∞

For the entire sample the null hypothesis that variation among firms did not change from decade to decade is rejected at the 5 percent level using Friedman's nonparametric test (Table 6). The alternate hypothesis that the variation increased over time could neither be accepted nor rejected using Page's ordered test, while a second alternate hypothesis that the variation decreased over time failed to be accepted (Table 7). The analysis suggests that the divergent pattern in nonmedical limits for the younger age groups more than offsets the convergent patterns for the older age groups, but only to a small extent. There is no ordered pattern to this variation, however; neither the highest nor the lowest nonmedical limits fall in the same issue age category for the years 1972, 1982, and 1992.

The results are similar when the tests are performed only on the 48 firms for which data are available for both decades. The null hypothesis that variations among firms did not change from decade to decade fails to be rejected (Table 6 and Table 7). This is true even though the pattern

Table 4
Percentage of Companies Offering
Nonzero Nonmedical Privileges

Age				Percent Increase (in %)		
Range	1972	1982	1992	1972–82	1982–92	1972–92
0–4	100.0	98.8	96.6	(1.2)	(2.2)	(3.4)
5–14	100.0	98.8	96.6	(1.2)	(2.2)	(3.4)
15–15	100.0	99.4	99.2	(0.6)	(0.2)	(0.8)
16–17	100.0	100.0	99.2	0	(0.8)	(0.8)
18–20	100.0	100.0	99.2	0	(0.8)	(0.8)
21–25	100.0	100.0	99.2	0	(0.8)	(0.8)
26–30	99.1	100.0	99.2	0.9	(0.8)	0.1
31–35	98.2	98.8	99.2	0.6	0.4	1.0
36–40	98.2	98.8	99.2	0.6	0.4	1.0
41–45	62.8	91.5	96.6	45.7	5.6	53.8
46–50	15.9	50.0	89.9	214.5	79.8	465.4
51–55	8.0	22.6	43.7	182.5	93.4	446.3
56–60	4.4	13.4	30.3	204.5	126.1	588.6
61–65	1.7	9.8	15.1	444.4	54.1	738.9
66–70	0	6.1	8.4	∞	37.7	∞

in the coefficient of variation for the first seven age groups shows an increasing variation over time.

The null hypothesis fails to be rejected because there is a strong pattern of convergence in company practices in the age groups extending from 41 to 70. The increasing similarity in the behavior of these companies may have allowed other more independent firms to carve niches in these target markets, which would explain the ambivalence in the results for the entire sample.

Table 5
Coefficients of Variation for All Age Groups

Sample: All Firms															
Age	0-4	5-14	15	16-17	18-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70
1992	69.02	69.17	61.34	62.82	64.32	64.19	64.19	55.31	63.51	75.13	98.50	211.04	286.21	332.91	453.86
1982	63.00	59.59	58.35	57.51	57.35	59.38	60.10	78.89	116.88	188.10	300.59	457.71	500.98	558.50	762.51
1972	30.43	24.54	20.20	19.58	19.33	18.38	21.15	28.95	47.30	109.30	297.31	386.89	518.27	763.39	0
Sample: 48 Firms															
Age	0-4	5-14	15	16-17	18-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70
1992	64.55	64.40	63.59	61.83	64.23	64.23	64.23	51.23	62.82	88.49	109.89	247.35	334.40	316.56	492.25
1982	51.29	50.33	48.15	48.15	47.65	47.54	48.60	64.20	78.86	104.66	242.14	345.96	631.64	631.64	631.64
1972	31.35	23.83	18.03	16.86	16.86	16.95	18.97	28.40	34.47	108.35	442.35	428.64	692.82	692.82	0
Sample: Mutual Companies - 26 Firms															
Age	0-4	5-14	15	16-17	18-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70
1992	63.28	64.94	62.95	58.90	66.06	66.06	66.06	18.19	46.72	45.81	53.78	129.79	216.15	429.98	509.90
1982	44.72	45.03	45.03	45.03	45.03	74.42	45.98	65.86	57.50	90.57	261.28	269.03	509.90	509.90	509.90
1972	25.44	15.61	15.61	15.10	15.10	15.29	17.23	19.22	23.83	97.30	355.62	363.32	509.90	509.90	0
Sample: Stock Companies - 22 Firms															
Age	0-4	5-14	15	16-17	18-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70
1992	56.21	56.21	53.23	54.73	53.23	53.23	53.23	54.95	77.74	102.65	133.59	216.90	267.07	235.59	409.65
1982	60.07	56.91	52.80	52.80	51.54	51.54	52.15	65.28	97.72	119.65	210.28	431.80	458.26	458.26	458.26
1972	36.78	32.49	21.29	19.39	19.39	19.39	21.29	38.60	44.97	128.08	458.26	458.26	0	0	0
Sample: New York Companies - 22 Firms															
Age	0-4	5-14	15	16-17	18-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70
1992	65.02	63.02	63.02	56.59	62.48	62.48	62.48	51.75	67.61	73.49	88.90	150.74	191.76	248.84	342.88
1982	54.97	56.56	52.83	52.83	52.83	52.94	54.77	75.99	79.04	104.48	218.55	231.40	469.04	469.04	469.04
1972	23.14	17.01	17.01	17.01	17.01	17.27	19.73	19.35	36.54	120.77	325.86	333.01	469.04	469.04	0
Sample: Non-New York Companies - 26 Firms															
Age	0-4	5-14	15	16-17	18-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70
1992	49.92	49.92	48.78	51.20	52.47	52.47	52.47	49.53	60.06	93.39	124.77	236.58	331.10	340.63	500.00
1982	46.45	43.44	43.44	43.44	42.71	42.71	42.97	48.82	80.75	97.89	233.97	500.00	500.00	500.00	500.00
1972	36.00	28.82	19.14	17.09	17.09	17.09	18.96	34.13	33.35	95.74	500.00	500.00	0	0	0

Table 6
The Friedman Test

Sample	Friedman Test Statistic	Test Indication on Null at 5% Level
All Firms	6.93	Reject
48 Firms	2.53	Fail to reject
Mutual Companies (26)	3.63	Fail to reject
Stock Companies (22)	19.07	Reject
New York Companies (22)	3.73	Fail to reject
Non-New York Companies (26)	11.03	Reject

Note: H_0: $t_1 = t_2 = t_3$;

H_1: At least one of the t_is is different.

The 5% critical value is for this test is 5.99.

Table 7
The Page Test

Sample	Page Test Statistic	Test Indication on Null at 5% Level
All Firms	H_1: 190	Unclear
	H_2: 170	Fail to reject
48 Firms	H_1: 187	Fail to reject
	H_2: 173	Fail to reject
Mutual Companies (26)	H_1: 188.5	Fail to reject
	H_2: 171.5	Fail to reject
Stock Companies (22)	H_1: 195	Reject
	H_2: 170	Fail to reject
New York Companies (22)	H_1: 188	Fail to reject
	H_2: 170	Fail to reject
Non-New York Companies (26)	H_1: 196	Reject
	H_2: 164	Fail to reject

Note: H_0: $t_1 = t_2 = t_3$;

H_1: $t_1 < t_2 < t_3$;

H_2: $t_1 > t_2 > t_3$.

The 5% critical value is for this test is 190.

When the 48 firms are divided into New York carriers and non-New York insurers, the statistical tests provide interesting results. The tests indicate that the variation among New York carriers did not change over the two decades, while the null (no change) is strongly rejected for non-New York insurers (Table 6). Furthermore, Page's ordered test rejects the null in favor of the alternate that the variation among firms is increasing over time for the non-New York carriers (Table 7). The pattern in the coefficient of variation for the New York insurers remains similar to that for the sample of 48 firms.

When the sample of 48 firms is split on the basis of organization into stock and mutual firms, we again find interesting differences. For the stock companies, the null hypothesis that the variation in company practices did not change over time is strongly rejected in favor of the alternate (Table 6). Furthermore, Page's test rejects the null in favor of the alternate that the variation in company practices is increasing over time (Table 7). These variations are preponderant in the issue age groups from 0 to 30. Although the pattern of increasingly divergent practices exists at the lower age groups for the mutual companies, there seems to be convergence at the higher age groups. As a result, Friedman's test fails to reject the null of no changes. This result is further confirmed by Page's test—the null fails to be rejected in favor of either increasing or decreasing divergence in mutual company practices over time.

7 Conclusions

This study examines nonmedical limits for a sample of life insurance companies over a 20 year period to determine the extent of variability in company practices at several points in time and the change in variability over time. The study shows a greater variability in company practices for the lower age groups than for higher age groups. Part of this variability could be attributed to the fact that almost all companies offer nonmedical insurance in the lower age brackets. The number of companies offering nonmedical insurance at higher age brackets decreases sharply, particularly after age 50.

Analysis of data over time shows that the percentage of companies offering insurance at the higher age brackets has risen while the percentage at lower age brackets has dropped slightly. The number of companies offering nonmedical insurance to those below age 45 increased substantially in the first decade of our study, but decreased

slightly in the second decade. There is a continuous increase, however, in the number of firms offering nonmedical insurance at the higher age brackets. This fact could be attributed to improved mortality rates for the older population and to companies' increased interest in the senior citizen market.

When the entire sample is examined, statistical tests suggest an increase in variability of company nonmedical limit schedules. When the subsample of 48 firms for which data are available over both decades is examined, however, there appears to be no substantive change in the variability of nonmedical limits. One possible explanation for these results is that new firms entering or leaving the market attempt to carve special niches that contribute to the greater variability in nonmedical limits.

Interesting questions about nonmedical limits in practice abound. Do companies construct new nonmedical limit schedules analytically along the lines suggested earlier in this paper? Or do they forego such calculations and base their decisions in part on the schedules of other companies—particularly competitors? How do companies manage their agency operations with nonmedical limits less liberal than competitors? And where is the industry headed with respect to limits for nonmedical and paramedical acceptances and for blood/urine testing? Qualitative data are required to provide useful answers to these questions. Perhaps these data are best secured through a survey instrument addressed to the companies. The survey approach would have the additional benefit of providing a larger sample by avoiding the data limitations that a source such as the *Best's Flitcraft Compend (Life-Health)* necessarily imposes.

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Appendix

The Friedman and Page statistics are explained below for the sample of all firms; for more details on these statistics see Hettmansperger (1991). They are nonparametric tests and are performed on the coefficient of variation for the sample of all firms and for all the subsamples.

The first column of Table A1 recognizes that there are 15 issue age groups in the sample. In the remaining three columns the values of the coefficient of variation (CV) and the respective ranking of each year based on the CVs are provided. A value of three is given to the year with the highest value of the CV, and the other years are rank-ordered accordingly for each age group. The years 1972, 1982, and 1992 are represented by t_1, t_2, and t_3, respectively, in the tests below.

For the Friedman test, the null hypothesis and the alternative hypothesis are:

$$H_0: \quad t_1 = t_2 = t_3;$$

$$H_1: \quad \text{At least one of the } t_i\text{s is different.}$$

The test statistic is:

$$\begin{aligned} K^* &= \frac{12}{nk(k+1)} \sum_{j=1}^{k} (R_{.j})^2 - 3n(k+1) \\ &= \frac{12}{15 \times 3 \times 4} \times [(22)^2 + (36)^2 + (32)^2] - 3 \times 15 \times 4 \\ &= 6.93 \end{aligned}$$

Table A1
Coefficient of Variation
And Rank (in parentheses)

Age Group	Year 1972	1982	1992
1	30.4 (1)	63.0 (2)	69.0 (3)
2	24.5 (1)	59.6 (2)	69.2 (3)
3	20.2 (1)	58.3 (2)	61.3 (3)
4	19.6 (1)	57.5 (2)	62.8 (3)
5	19.3 (1)	57.3 (2)	64.3 (3)
6	18.8 (1)	59.4 (2)	64.2 (3)
7	21.1 (1)	60.1 (2)	64.2 (3)
8	28.9 (1)	78.9 (3)	55.3 (2)
9	47.3 (1)	116.9 (3)	63.5 (2)
10	109.3 (2)	188.1 (3)	75.1 (1)
11	297.3 (2)	300.6 (3)	98.5 (1)
12	386.9 (2)	457.7 (3)	211.0 (1)
13	518.3 (3)	501.0 (2)	286.2 (1)
14	767.4 (3)	558.5 (2)	332.9 (1)
15	0.0 (1)	762.5 (3)	453.9 (2)
$R_{.j}$	22	36	32

where k is the total number of years ($k = 3$); n is the number of issue age groups ($n = 15$); R_{ij} is the rank of the i-th observation in year j relative to the other $k - 1$ years; and

$$R_{.j} = \sum_{i=1}^{n} R_{ij} \quad j = 1, 2, \ldots, k.$$

The calculated value of K^* has a chi-square distribution with two degrees of freedom. The critical values at the 5 percent and 10 percent levels are 5.99 and 4.61, respectively. Thus, the hypothesis is rejected in favor of the alternative that the variations in the years 1972, 1982, and 1992 are not the same. (The hypothesis, however, fails to be rejected at the 1 percent level.)

Page's test for ordered alternatives asks whether the variable (in this case the coefficient of variation) is increasing over time or is decreasing

over time. The null hypothesis and the alternatives are:

$$\begin{aligned} H_0: &\quad t_1 = t_2 = t_3; \\ H_1: &\quad t_1 < t_2 < t_3; \\ H_2: &\quad t_1 > t_2 > t_3. \end{aligned}$$

The test statistic for H_1 is:

$$\begin{aligned} L &= \sum_{j=1}^{k} j \times R_{.j} \\ &= 1 \times 22 + 2 \times 36 + 3 \times 32 \\ &= 190. \end{aligned}$$

The value of the test statistic is equal to the critical value of 190 at the 5 percent confidence level. Therefore the hypothesis is neither accepted nor rejected in favor of the alternative H_1 that the coefficient of variation is increasing over time.

The test statistic for H_2 is:

$$\begin{aligned} L &= \sum_{j=1}^{k} (k - j + 1) \times R_{.j} \\ &= 3 \times 22 + 2 \times 36 + 1 \times 32 \\ &= 170. \end{aligned}$$

Because the calculated value of 170 is less than the critical value of 190, the hypothesis that the coefficient of variation remains constant over time fails to be rejected.