be consistently applied, and in several respects is illogical." The authors' arguments may be summarized as follows:

1. Calculations of premium—surplus relationships are inaccurate for an individual company which is a member of a group.
2. The appropriate premium—surplus relationship is dependent upon the nature of the firm's operations and its historical performance.
3. It is difficult to obtain a satisfactory premium—surplus relationship that satisfies all interested parties because stockholders will prefer a high premium—surplus relationship while policyholders and regulators will prefer a low ratio.
4. Different relationships will apply to stock and mutual companies.

I generally agree with these arguments. However, they do not suggest to me that the premium—surplus relationship is not useful. Rather, they only suggest that the relationship should be calculated and applied with care and discretion. I believe the relationship is particularly useful to assess, as I have pointed out, whether or not the Industry is generally over-capitalized.

Finally, I believe the authors have presented an interesting review of the whole subject of premium—surplus relationships and think they have made a valuable contribution in setting the subject into historical perspective. I hope the authors' paper will stimulate actuarial research into this important area of insurance companies' financial structures.

DISCUSSION BY DAVID J. GRADY

Messrs. Beckman and Tremelling have addressed themselves to a question which is of fundamental importance to the insurance industry. The determination of the appropriate relationship between net written premium and policyholders' surplus could provide a key to the problems of pricing, profitability and capacity.

The authors provide a brief summary of the current rules-of-thumb by which regulatory authorities test the adequacy of policyholders' surplus. They point out that the formulas employed today are not the result of

recent intensive studies but are merely liberalizations of the two-for-one rule developed nearly forty years ago. These modifications of the original formula assume that the two-for-one rule is soundly based but that in some unspecified way, aside from the fact that it appears to be too stringent, it is inappropriate for current needs. Since this rule is the foundation for the prevailing regulatory procedures, I should like to reinforce the authors' conclusions concerning its applicability with some additional comments.

The two-for-one rule was introduced in the late 1930's by Roger Kenney who was at that time Chief Examiner for the New York Insurance Department. "After making a thorough study of the difficulties into which certain casualty companies had fallen in the early 1930's—difficulties brought on by sharply mounting loss ratios accompanied by an equally sharp decline in the securities markets—he came to the conclusion that in the great majority of cases the venturesome area was entered when a company's premium volume began to exceed $2.00 for every dollar of policyholders' surplus, including any 'free' (or general contingency) reserves."[1]

Although the details of this important study do not appear to be readily available, certain conclusions emerge from Mr. Kenney's statements concerning it.

(1) The approach was a negative one. Apparently, Mr. Kenney's study consisted of examining only insolvent companies, noting a common characteristic of a "great majority of cases", and deducing a law for application to the insurance industry in general. The statistical and logical fallacies of such a procedure are obvious; however, it is sufficient to emphasize that no effort was made to investigate the surplus needs of soundly-managed, solvent companies. In fact, when it was pointed out that a number of reputable companies remained solvent in spite of having been in "violation of the tenets of the Kenney Theory" for decades, Mr. Kenney's response was, "It was more by the grace of God than by any good judgment on their part that they survived at all!"[2]

(2) No attempt was made to relate surplus levels to the standard variables which create the need for surplus, although Mr. Kenney makes frequent appeal to them.

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[1] Roger Kenney, *Fundamentals of Fire and Casualty Insurance Strength* (The Kenney Insurance Studies, Dedham, Massachusetts, 1967), fourth edition, p. 97.

[2] *Ibid.*, page 28.

(3) The study postulated written premium to be the measure of insurer's risk. Although risk may be implicit in the stochastic nature of the pricing process, it is by no means identical with written premium. In essence, written premium is the sum of expected losses (with appropriate loadings for expenses, profit and contingencies) while insurer's risk is generally defined to be adverse deviation from these expected values.

(4) The study did not attempt to distinguish among different types of insurers nor among insurers with vastly differing portfolios. Even superficial analysis reveals that an insurance portfolio consisting of property damage liability coverage on private passenger automobiles should require far less surplus than a group of product liability policies producing the same premium volume.

Since the current premium-to-surplus ratios are merely extensions of this early formula, they have fallen heir to each of the faults of the original study. The major virtue of the variety of premium-to-surplus formulas in use today is that they are simple to apply. Their chief disadvantage is that they are only tenuously related to the actual problem.

I believe that development of the other major conclusion advanced by Messrs. Beckman and Tremelling may be summarized as follows:

(1) Standard and Poor's 500 Stock Index is highly correlated with the total policyholders' surplus for all stock companies combined. Therefore, this stock index is an excellent predictor of future levels of policyholders' surplus.

(2) "The single series, Standard and Poor's 500 Stock year-end closing average, explains 64% of the annual variation (i.e., yearly percent change) in policyholders' surplus."

(3) "Risk (i.e., the variation in rate of return) from insurance operations is minimal when compared to the risk resulting from stockmarket appreciation or depreciation."

(4) The stock market is the major factor affecting policyholders' surplus. Therefore, the major portion of the insurer's risk (investment risk) "could be minimized by eliminating investments in the stock market and investing all assets into bonds."

At first glance this conclusion seems entirely reasonable. However, its possible consequences for the insurance industry are somewhat alarming. These potential effects include far stricter regulation of investments, denial of the right to participate in the stock market, and reduction of the profit and contingencies allowance in the premium dollar to more appropriately reflect the "relatively minimal" underwriting risk. Therefore, I would like to comment briefly on the methodology which the authors use to achieve this conclusion.

(1) The authors indicate that the correlation between Standard and Poor's 500 Stock Index and policyholders' surplus is 98%. Chart I provides a graph of the regression line and a visual confirmation of this apparently remarkable correlation. However, the two sets of data under consideration are actually time series containing distinct autocorrelation. The 98% correlation is somewhat less striking when contrasted with the relatively simple relationship between surplus and the passage of time: the correlation between policyholders' surplus and calendar year is 94%.

(2) The contention that Standard and Poor's 500 Stock Index explains 64% of the annual variation in policyholders' surplus appears to be the result of calculating R^2, the sum of squares due to regression divided by the total sum of squares corrected for the mean. Although the authors have satisfied the book definition of R^2, their casual use of the word "explains" may cause the unwary reader to believe that a deterministic relationship exists between stock market results and policyholders' surplus. Actually, when the word "explains" is used with respect to the fit of a statistical regression model, it is subject to a very narrow technical definition. Regression analysis may reveal association between two variables, but association may be due to a variety of causes. In particular, association may be the result of factors which act jointly on the correlated variables. For example, both the stock market and policyholders' surplus have been subject to considerable growth over time, and they are both influenced adversely by the occurrence of natural or economic catastrophes. In general, simple correlation is not sufficient to prove causation.

An analysis of this data is hindered even further by its heterogeneity. The problem of heterogeneity may be illustrated by an investigation of the following argument:

(a) At least a portion of policyholders' surplus may be considered to be directly invested in the stock market.

(b) The volatility of the market has a direct influence on this portion of policyholders' surplus.

(c) Regression analysis shows that 64% of the annual variation in the total policyholders' surplus may be explained by a leading market indicator.

(d) Therefore, 64% represents the impact which direct investment in the stock market has had on the volatility of total policyholders' surplus.

Apart from the previously indicated weaknesses in this argument, it leads to serious consideration of the portion of policyholders' surplus devoted to common stock. Exhibit I summarizes the commitment of the policyholders' surplus to the stock market by the stock insurance industry over the past 25 years. Exhibit II indicates the percentage of policyholders' surplus invested in common stock of a type similar to that comprising the S&P Index (Industrials, Utilities and Railroads) for the same time period. The exhibits reveal a dramatically increasing commitment of policyholders' surplus to the stock market. This varying participation in the market destroys the homogeneity of the data and introduces a third variable which must be tested. How much has R^2 been strengthened by the increasing commitment of increasing surplus to an increasingly volatile market?

(3) Risk is generally defined to be adverse deviation from expected values. The authors' definition of risk as "variation in rate of return" not only allows them to include several sizeable investment *gains* in their computations but to use the squares of these favorable deviations as contributions to the investment risk.

(4) The industry data used by the authors to support their conclusion contains an unfortunate bias. The law of large numbers tends to act on the pooled results of several hundred stock companies in a manner which gives a somewhat diminished view of underwriting risk.

Although the preceding four points have led me to question whether the stock market is the major factor affecting policyholders' surplus, it is unquestionably a major factor. Certainly, the optimal employment of the assets underlying policyholders' surplus is dependent not only upon risk but upon expected return.

In conclusion I agree with the authors that the myriad of interacting variables makes the problem of policyholders' surplus enormously complex. Unfortunately, premium-to-surplus ratios are easy to condemn but difficult to replace. The authors are to be commended for their pioneering paper on a fascinating and fundamental subject.

CHART I
RELATIONSHIP BETWEEN POLICYHOLDERS' SURPLUS AND THE STANDARD & POOR'S INDEX

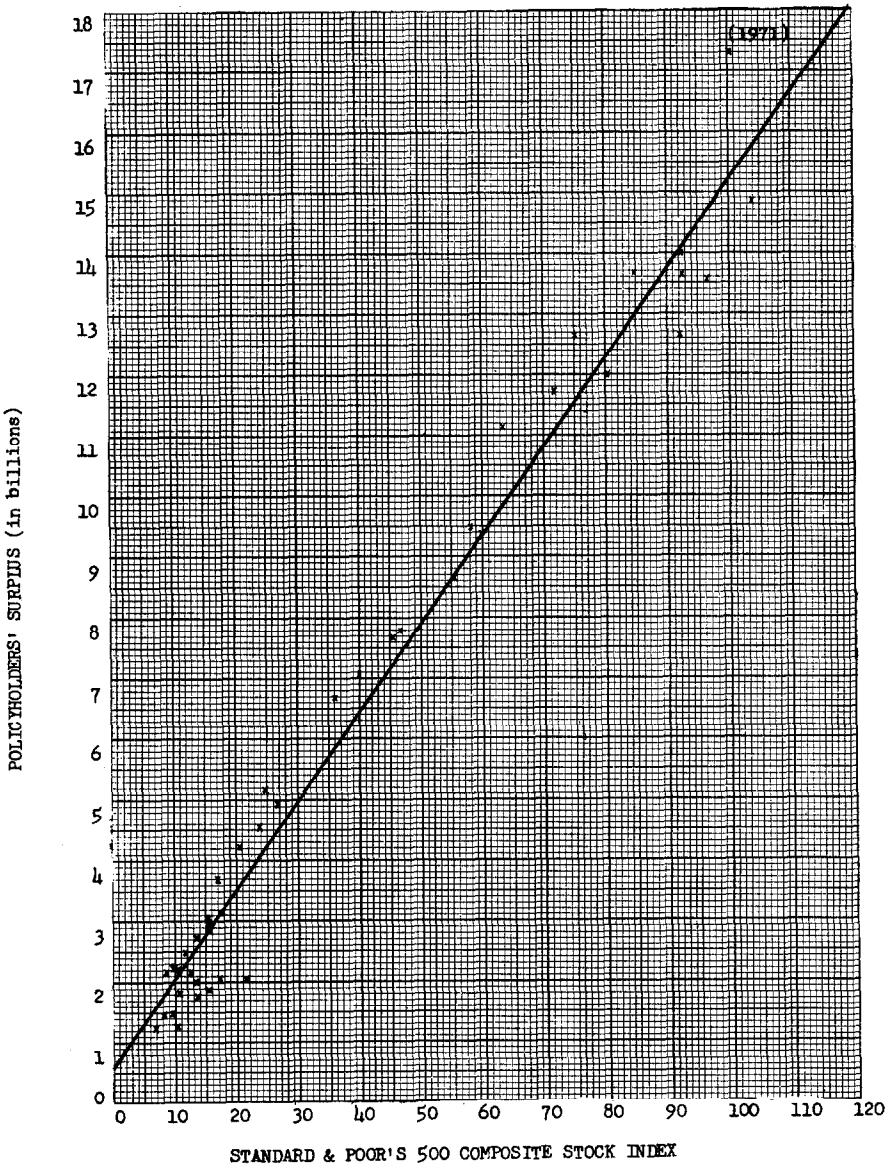

EXHIBIT I
STOCK INSURANCE INDUSTRY PARTICIPATION IN COMMON AND PREFERRED STOCKS
(Amounts in thousands of dollars)

Year	Policyholders' Surplus	Admitted Assets in Common Stock		Admitted Assets in Preferred Stock		Admitted Assets in Common and Preferred Stock	
		Amount	% of Surplus	Amount	% of Surplus	Amount	% of Surplus
1947	2,904,943	1,673,656	57.6	546,606	18.8	2,220,262	76.4
1948	3,066,252	1,718,626	56.0	537,936	17.5	2,256,562	73.6
1949	3,707,539	2,157,148	58.2	591,825	16.0	2,748,973	74.1
1950	4,216,861	2,570,988	61.0	615,454	14.6	3,186,442	75.6
1951	4,542,504	2,919,785	64.3	650,255	14.3	3,570,040	78.6
1952	4,963,904	3,230,418	65.1	715,896	14.4	3,946,314	79.5
1953	5,191,529	3,307,838	63.7	751,154	14.5	4,058,992	78.2
1954	6,697,464	4,589,309	68.5	791,773	11.8	5,381,082	80.3
1955	7,693,594	5,479,911	71.2	791,670	10.3	6,271,581	81.5
1956	7,800,261	5,798,328	74.3	707,684	9.1	6,506,012	83.4
1957	7,073,013	5,257,042	74.3	718,895	10.2	5,975,937	84.5
1958	8,619,370	6,772,003	78.6	709,345	8.2	7,481,348	86.8
1959	9,381,140	7,480,660	79.7	700,091	7.5	8,180,751	87.2
1960	9,494,889	7,631,322	80.4	681,514	7.2	8,312,836	87.6
1961	11,719,406	9,769,815	83.4	661,968	5.6	10,431,783	89.0
1962	11,146,292	9,120,573	81.8	694,770	6.2	9,815,343	88.1
1963	12,642,213	10,709,980	84.7	717,257	5.7	11,427,237	90.4
1964	13,690,544	12,014,739	87.8	733,832	5.4	12,748,571	93.1
1965	13,659,762	12,345,297	90.4	798,523	5.8	13,143,820	96.2
1966	12,006,722	10,952,508	91.2	833,593	6.9	11,786,101	98.2
1967	13,580,010	12,843,063	94.6	936,639	6.9	13,779,702	101.5
1968	14,886,618	14,318,753	96.2	1,050,194	7.1	15,368,947	103.2
1969	12,698,941	13,076,170	103.0	988,968	7.8	14,065,138	110.8
1970	14,014,350	13,653,545	97.4	1,234,258	8.8	14,887,803	106.2
1971	17,308,207	17,188,251	99.3	1,565,616	9.0	18,753,867	108.4
Average % Participation, 1947-1970			77.7		10.0		87.7
Average % Participation, 1947-1971			78.5		10.0		88.5

Source: Best's Aggregates & Averages, 1948-1972

EXHIBIT II
STOCK INSURANCE INDUSTRY PARTICIPATION IN COMMON STOCKS REPRESENTATIVE OF STANDARD & POOR'S 500 COMPOSITE STOCK INDEX
(Amounts in thousands of dollars)

Year	Policyholders' Surplus	Admitted Assets Invested in Common Stock of				Percentage of Policyholders' Surplus
		Railroads	Utilities	Miscellaneous	Total	
1947	2,904,943	59,502	132,661	767,493	959,656	33.0
1948	3,066,252	61,847	150,247	780,242	992,336	32.4
1949	3,707,539	58,517	250,895	957,894	1,267,306	34.2
1950	4,216,861	72,601	295,039	1,264,723	1,632,363	38.7
1951	4,542,504	67,334	375,423	1,447,398	1,890,155	41.6
1952	4,963,904	86,078	471,799	1,542,193	2,100,070	42.3
1953	5,191,529	77,291	536,383	1,487,964	2,101,638	40.5
1954	6,697,464	108,092	714,941	2,108,676	2,931,709	43.8
1955	7,693,594	118,924	815,782	2,687,060	3,621,766	47.1
1956	7,800,261	111,247	860,353	2,846,089	3,817,689	48.9
1957	7,073,013	76,559	896,324	2,461,387	3,434,270	48.6
1958	8,619,370	92,102	1,230,592	3,332,358	4,655,052	54.0
1959	9,381,140	78,116	1,269,857	3,649,494	4,997,467	53.3
1960	9,494,889	70,343	1,517,477	3,613,260	5,201,080	54.8
1961	11,719,406	76,121	1,923,186	4,504,045	6,503,352	55.5
1962	11,146,292	74,256	1,865,507	3,993,683	5,933,446	53.2
1963	12,642,213	90,469	2,011,528	4,804,167	6,906,164	54.6
1964	13,690,544	97,858	2,270,932	5,575,821	7,944,611	58.0
1965	13,659,762	107,030	2,198,618	6,230,966	8,536,614	62.5
1966	12,006,722	93,540	2,047,510	5,567,071	7,708,121	64.2
1967	13,580,010	103,892	2,037,292	7,124,219	9,265,403	68.2
1968	14,886,618	114,520	2,087,785	7,892,931	10,095,236	67.8
1969	12,698,941	65,753	1,611,400	7,378,017	9,055,170	71.3
1970	14,014,350	66,293	1,643,471	7,106,353	8,816,117	62.9
1971	17,308,207	77,334	1,748,015	9,385,074	11,210,423	64.8
Average Percentage Participation, 1947-1970						51.3
Average Percentage Participation, 1947-1971						51.8

Source: Best's Aggregates & Averages, 1948-1972