The Geneva Papers on Risk and Insurance Vol. 25 No. 2 (April 2000) 288–295

To Insure or not to Insure? Considerations on Irrational Strategies to Take Out Insurance

by Michael Theil*

In earlier work by Slovic *et al.* (*Journal of Risk and Insurance*, 1977 pp. 237–258) studying insurance decisions under laboratory conditions, subjects showed a clear and repeated preference to purchase insurance against high-probability, low-loss events rather than the opposite. This result comes as a surprise as the primary objects for insurance are most commonly risks with some large loss potential but occurring only rarely. In subsequent studies, the reported effect was somewhat reduced but a convincing explanation for this odd behavior was not offered. The present study analyses preceding work with respect to its research design and presents an alternative problem solution.

1. Introduction

Empirical work on insurance decisions has brought quite a number of puzzling results. The findings of some early experiments by Slovic *et al.* (1977) point to a particularly surprising phenomenon: in this study, people exhibited a strong and stable preference to insure against high-probability, low-loss events, quite the opposite to what insurance theory as well as evidence from insurance practice would suggest. Preference patterns like these raise fundamental questions about risk attitudes and the traditional concept of insurance.

This issue has induced several attempts at re-examination. In most instances, subjects tended to prefer to insure against small, likely losses, although not to the same extent as in Slovic *et al.* The reported effect remained, perhaps reduced, but it was by no means eliminated.

Recent work (Loubergé and Outreville, 1994) claims that the format of the original questionnaire has caused this particular behaviour. However, only one group of subjects preferred to insure against low-probability, high-loss events, while others remained largely indifferent to exposures with varying probabilities and sizes of loss, thereby suggesting that other factors, which are still unknown, may play a role in this matter.

The present work adds to these findings, studying the impact of different probability statements. To this end, we first describe the basic features of the original work by Slovic *et al.* (section 2). Then (section 3) we give an outline of some analysis that re-examined the preference to insure against small, probable losses. Finally (section 4) we present a study of our own, and discuss the contrasting results in section 5.

2. The problem: the basic experiment by Slovic *et al.*

Motivated by Kunreuther's (1976) findings that people are reluctant to take out insurance against natural hazards, Slovic *et al.* (1977) set out to investigate the process of insurance

* Dr. Michael Theil, Department of Risk Management and Insurance, Vienna University of Economics and Business Administration, A-1090 Vienna.

decision-making more thoroughly. Unlike Kunreuther, who interviewed homeowners in earthquake- and flood-prone areas, they intended to create experiments that replicated high loss potentials. At the same time, the laboratory setting was to allow to control for the core factors of choice under risk.

The experimental situation finally created by Slovic *et al.* consisted of a set of (imaginary) urns, containing different proportions of blue and red balls. Drawing a blue ball incurred a loss, unless the subject had purchased insurance at some fixed premium.

Obviously, all probability/loss pairs in their experiment have the same expected value, which itself equals the insurance premium charged. Subjects were told that they could only lose in this sort of game, either by suffering a loss or by buying insurance. They should figure out what insurance to buy to end up with the fewest negative points.

In short, the experiment found strong and persistent preference to insure against high-probability, low-loss risks.

The relevance of these findings for insurance theory and practice is exceptional for several reasons. First, the results are in marked contrast to what one would expect from insurance theory as well as intuitively. Insurance is a particularly useful instrument for protecting against incidents that occur rarely but have a large loss potential. For high-probability, low-loss events, other risk-management tools may be more effective. Low-loss risks are also often self-retained, for instance in case that an insurance contract includes deductibles, but also in many other everyday situations. Therefore, if the experiment by Slovic *et al.* captures risk preferences correctly, we would most probably see some very different strategies for managing risk in reality. As this is not the case, it is interesting to learn more about the process that provoked the decision behaviour found by Slovic *et al*.

As a second point, the kind of insurance offered in this and in subsequent studies is in fact very simple: it provides full cover without any limits or deductibles. Moreover, the stakes are well defined, as the potential loss along with the associated probability is clearly stated. One

Table 1:
Urn game: probability and loss representations

Urn #	Probability/loss	Ball colour		Insurance premium
		Blue	Red	
1	# of balls	1	999	
	# of points	−1000	0	1
2	# of balls	5	995	
	# of points	−200	0	1
3	# of balls	10	990	
	# of points	−100	0	1
4	# of balls	50	950	
	# of points	−2-	0	1
5	# of balls	100	900	
	# of points	−10	0	1
6	# of balls	250	750	
	# of points	−4	0	1

Source: Slovic *et al*., 1977.

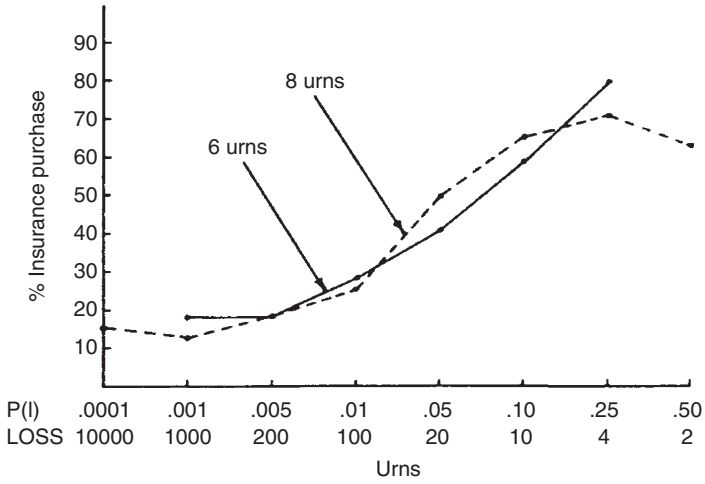

Figure 1: Percentage of subjects purchasing insurance for urns varying in probability and amount of loss: six- and eight-urn games

might therefore consider such an insurance problem easier to understand for decision-makers than situations with deductibles, varying sums insured, the possibility of underinsurance or the like. If such odd decisions are encountered in comparatively uncomplicated situations, it seems reasonable to analyse the determinants of these decisions more closely before proceeding to more complex decision settings.

Thirdly, the results by Slovic *et al*. have received quite a lot of attention among scientists, not only immediately after their first appearance, but also in recent years. Subsequent studies were generally driven by serious doubts concerning the validity of the original results. However, although they were successful in identifying some problems with the original experiment, the observed effects were never completely eliminated nor were the reasons fully explained.

While the latter point perhaps addresses scientists rather than insurance practitioners, further analysis of insurance decisions is relevant for the industry as well. All over Europe in recent years there have been significant changes in insurance markets. With broadening product ranges and increasing competition, knowledge about the customer's understanding of insurance and consequential preferences has become a crucial factor in success. Further analysis of the question at issue may add to this body of knowledge.

3. Subsequent studies

Other authors soon picked up the findings by Slovic *et al.* However, Schoemaker and Kunreuther (1979), although re-examining several aspects of the original work, present their decisions in a different format, so that their results cannot be compared directly to those by the first authors. Nevertheless, risk-taking attitudes generally seemed to prevail. Hershey and Schoemaker (1980a) used similar decision alternatives as Slovic *et al*., but analyse the impact of varying gain/loss frames (reflection effect) rather than insurance decisions.

Part of the Hershey and Schoemaker (1980b) study deals with decision problems that largely correspond to those in the original survey. Some differences in the format of the questionnaire concern the representation of losses and premiums (monetary units rather than undefined points) and one decision alternative. However, their results are in marked contrast to those of Slovic *et al.* earlier. Reasoning about the possible causes, Hershey and Schoemaker believe that either the different loss and premium format or a portfolio representation of risks account for the observed differences.

The latter idea is later picked up by Loubergé and Outreville (1994). They set out to determine whether particular characteristics of the questionnaire are responsible for the different results in the studies by Slovic *et al.* and Hershey and Schoemaker. Specifically, they assume that the grouping of questions induced the risk-taking behaviour in the original study.

To investigate their hypothesis, they presented one and the same questionnaire in two different versions, one with grouped questions with increasing probability and decreasing magnitude of loss as in Slovic *et al.*, the other with the questions singled out and mixed probability/loss amount pairs.

For the version with single insurance decisions, the subjects answered as expected, that is, they preferred to insure against low-probability, high-loss events. On the other hand, when questions were grouped as in the original study, subjects exhibited quite different insurance preferences: For all risks, the insurance alternative seemed to be almost equally attractive; between 40 and 60 per cent of subjects decided to take out insurance; there was no clear tendency to buy insurance for either low-probability or very likely losses, respectively.

Note that these results are in contrast to both the Slovic *et al*. and the Hershey and Schoemaker studies, which resulted in opposing preferences for insurance, while in the present case, subjects did not show a clear tendency towards either preference pattern. The only exception was found for a group of students comparatively familiar with various aspects of the economics of risk and uncertainty. In this group, there were no serious differences between the two versions of the questionnaire. The results generally replicated those of Hershey and Schoemaker.

The findings suggest that some influence on risk preferences may be attributed to the format of the questionnaire. However, the study by Loubergé and Outreville clearly fails to replicate the results by Hershey and Schoemaker, indicating that other factors have to be considered.

4. Re-examination

In laboratory work, the experimental design generally has considerable influence on the results obtained. As discussed above, the relatively simple problem set in the current line of research should allow the number of potential factors to be reduced to a minimum, making closer examination possible.

The *grouping* of questions has been the central question of the work by Loubergé and Outreville. It seems as if the problem presentation has some influence on the results (no clear tendency to insure specific types of risk). However, Slovic *et al*. had also examined this possibility (with different urns from those in their original questionnaire), yet with hardly any effect on the reported preference to insure against high-probability, low-loss events.

For the *probability format*, the studies by Slovic *et al.* and Loubergé and Outreville choose an urn representation. Hershey and Schoemaker are not specific about their design. Although urns are often used to explain probabilities in elementary textbooks, they are certainly not the most common idea when thinking of insurance.

While Slovic *et al.* use undefined points for *loss and premium* sizes, both other studies apply monetary units, which is certainly closer to the reality of insurance decisions. Loss and premium sizes – understood as mere numbers – differ between the studies reported here. Hershey and Schoemaker conclude from their results that this had no effect on the observed behaviour.

Strictly speaking, *subjects*, generally recruited from among students, were different in all the studies. However, more detailed results by Slovic *et al.* and by Hershey and Schoemaker – in accordance with Plott (1982) – suggest that the results are indifferent to subject pool variations.

The *decision context* was some more or less abstract insurance problem in all studies. Different *instructions* seem to have been used, presumably with different languages on top of it. Both may result in different, yet hard to control, internal problem representations.

There is a lot of evidence in the literature (for instance Lichtenstein and Newman, 1967; Budescu, Weinberg and Wallsten, 1988; Boehm, 1989; Jablonowski, 1994; Schulenburg, 1994) that the understanding and encoding of verbal and mathematical probability statements are considerable sources of bias. Therefore, it seems promising to approach the problem of irrational insurance preferences as reported by Slovic *et al.* from this angle, i.e. to drop the urn representation of probabilities used in previous studies. Therefore, in the present experiment, probabilities are stated as the average number of losses per thousand, a representation often used in an insurance context.

The questions in our questionnaire are grouped, i.e. subjects had to decide on alternatives ordered by increasing probability (decreasing magnitude) and presented simultaneously.

The insurance premium was held constant and was equal to the expected loss in the first round. Later, subjects also had to judge insurance alternatives, where the premium was higher (commercial insurance) or lower (subsidized insurance) than the expected loss, similar to the study by Slovic *et al.* Considering the different currencies involved, the losses at stake were set higher than in previous studies.

The questionnaire was presented to 118 students at the Wirtschaftsuniversität Wien. About two-thirds were at the very beginning of their course of studies participating in an elementary cost accounting course, and another third were on an introductory course in risk management and insurance. The members of both groups can be assumed largely unfamiliar with such decision problems. In addition to subjects' risk preferences, information was obtained on age and sex. Neither personal characteristic had a significant effect on decision behaviour, that is, the decisions at whatever premium level were not systematically related to the students' age, sex or progress in their course of studies.

Table 2:
Percentage preferring insurance: results for grouped problems

Risk	Loss	Probability	% preferring insurance
1	100,000	0.001	59.8
2	20,000	0.005	59.0
3	10,000	0.01	57.3
4	2,000	0.05	41.9
5	1,000	0.1	36.8
6	400	0.25	28.2

Source: author.

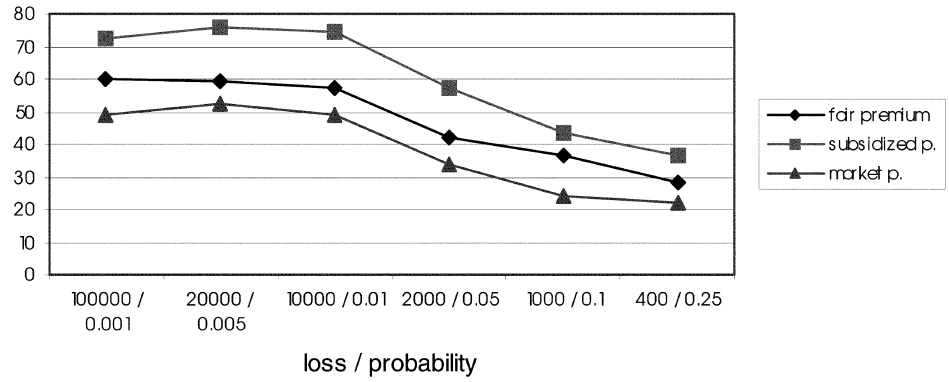

Figure 2: Percentage of subjects preferring insurance; fair, subsidized and market premiums

In contrast to previous results, the subjects in the present study exhibited a clear preference to insure against high, unlikely losses. Moreover, the aggregate pattern of choice is practically the same for all three premium levels: When the insurance premium is set higher than the fair premium, the subjects are less inclined to take out insurance, but the insurance-buying propensity declines the smaller, but more probable losses are, in much the same way as for a fair premium. Similar considerations apply when a subsidized insurance premium, i.e. lower than the expected value, is charged.

Note that Loubergé and Outreville obtained a similar result only for students with some background in the economics of insurance. The present results, however, suggest that decisions were independent of subjects' state of knowledge.

5. Discussion

There are now three similar experiments with quite different results. The studies use a specific set of decision alternatives and vary in only a few features of their design. As discussed above, the following elements are of central interest: the format of probabilities, the format of losses and premium, and the presentation of questions singly or in grouped form. The attempts to re-examine the study by Slovic *et al*. also indicate that there is doubt about its validity: Hershey and Schoemaker think that a more realistic design would have led to other results, while Loubergé and Outreville believe that the grouping of questions induced the specific pattern of choice. However, a straightforward explanation has not yet been found.

This question can be approached as follows. The relative similarity of three of the studies allows three variables to be extracted that describe the experimental design. These variables match the elements already discussed: probability format (urn format versus numerical representation), loss and premium format (points versus monetary units) and grouped versus single problems. These variables can be related to the set of results, whether or not insurance was taken out for a specific risk. As the studies have only the fair premium setting in common, comparisons cannot be drawn with scenarios with market or subsidized insurance.

Altogether, four groups that have been examined under comparable conditions were incorporated in this analysis: one subgroup of the Slovic *et al*. study ($n_1 = 109$), one group from Laval University ($n_2 = 192$) and one from the University of Geneva ($n_3 = 72$), both part

of the Loubergé and Outreville study, and one group from the Wirtschaftsuniversität Wien ($n_4 = 118$). Altogether 491 subjects decided upon six insurance questions each, which adds up to a total of more than 2,900 single decisions.

The information obtained was coded into binary variables representing insurance decisions on the one hand and experimental design (grouping, loss and premium format, probability format) on the other. Possible interdependencies between insurance decisions and experimental design variables were further analysed by applying the Bravais–Pearson contingency measure (also referred to as phi-coefficient for binary variables). The results are summarized in Table 3.

The null hypothesis, assuming independence of variables is rejected at the 0.01 level for most insurance decisions with respect to the variables loss and premium format and probability format. It is not rejected for risk #4, which does not come as a surprise, as we have seen earlier that the curves of the different studies intersect at some intermediate risk level. The null hypothesis is also not rejected with respect to the grouped questions variable in any case. Coefficients relatively close to 0, as in the present case, may indicate that, although there is a significant interdependence, this relationship is not necessarily linear but they do not affect the interpretation of results any further.

Overall, the present analysis suggests that the insurance decisions in the experiments discussed are affected by the specific format of probabilities on the one hand and of losses and premiums on the other rather than by the grouped or single presentation of problems. Therefore, picking up the argument by Hershey and Schoemaker that the Slovic *et al.* study uses a design which is comparatively unusual for insurance problems, the present results also suggest that the specific preference for insuring against small, probable losses is the product of the experimental design and is therefore an artefact.

The present work also shows that the results of even quite simplified experiments depend to a large extent on elementary problems such as the format of probabilities or losses. As such, this analysis is also of practical value. For real-life insurance decisions, the estimation of potential loss frequencies or of the possible magnitude of loss is by no means as straightforward as in the experimental settings discussed here. As a consequence one should

Table 3:
Correlation between the decision to take out insurance and the representation of alternatives

	Correlation		
Risk	**Grouped questions**	**Loss/premium format**	**Probability format**
1	−0.007	0.238**	0.224**
2	−0.031	0.247**	0.204**
3	−0.018	0.176**	0.607**
4	−0.065	0.041	−0.36
5	−0.035	−0.097**	−0.135**
6	0.072	−0.328**	−0.235**

Source: author.
**significant at the 0.01 level; risk 1: highest loss/lowest probability; risk 6: lowest loss/highest probability.

not expect potential policyholders to make (theoretically) sound decisions when problem characteristics such as probability or loss size are vague or hard to understand. This assumption is also supported by several practical observations on insurance decision-making, for instance concerning varying limits in liability insurance or different preferences for property damage insurance and related business interruption coverage.

REFERENCES

BOEHM, B., 1989, "Risk Management Practices: The Six Basic Steps", in Boehm, B. (ed.), *Software Risk Management*. Washington, D.C.: IEEE Computer Society Press.

BUDESCU, D., WEINBERG, S. and WALLSTEN, T., 1988, "Decisions Based on Numerically and Verbally Expressed Uncertainties", *Journal of Experimental Psychology – Human Perception and Performance*, 14(2), pp. 281–294.

HERSHEY, J. and SCHOEMAKER, P., 1980a, "Prospect Theory's Reflection Hypothesis: A Critical Examination", *Journal of Organizational Behavior and Human Performance*, 25(3), pp. 395–418.

HERSHEY, J. and SCHOEMAKER, P., 1980b, "Risk Taking and Problem Context in the Domain of Losses: An Expected Utility Analysis", *Journal of Risk and Insurance*, 47(1), pp.111–132.

JABLONOWSKI, M., 1994, "Communicating Risk: Words or Numbers*?", Risk Management,* 41(12), December, pp. 47–50.

KUNREUTHER, H., 1976, "Limited Knowledge and Insurance Protection", *Public Policy*, 24(2), pp. 227–261.

LICHTENSTEIN, S. and NEWMAN, R., 1967, "Empirical Scaling of Common Verbal Phrases Associated with Numerical Probabilities", *Psychonomic Science*, 9, pp. 563–564.

LOUBERGÉ, H. and OUTREVILLE, J.-F., 1994, "Experimental Investigations on Risk-Taking in the Domain of Losses", in Hesberg, D., Nell, M. and Schott, W. (eds), *Risiko, Versicherung, Markt, Festschrift für Walter Karten zur Vollendung des 60. Lebensjahres*. Karlsruhe: Verlag Versicherungswirtschaft. pp. 53–67.

PLOTT, C.,1982, "Industrial Organization Theory and Experimental Economics", *Journal of Economic Literature*, 20, pp. 1485–1527.

SCHOEMAKER, P. and KUNREUTHER, H., 1979, "An Experimental Study of Insurance Decisions", *Journal of Risk and Insurance*, 46(4), pp. 603–618.

SCHULENBURG, J.M., 1994, "Wie wahr ist der Schein? Die Wahrscheinlichkeit", in Hesberg, D., Nell, M. and Schott, W. (eds), *Risiko, Versicherung, Markt, Festschrift für Walter Karten zur Vollendung des 60. Lebensjahres*. Karlsruhe: Verlag Versicherungswirtschaft. pp. 39–52.

SLOVIC, P., FISCHHOFF, B., LICHTENSTEIN, S., CORRIGAN, B. and COMBS, B., 1977, "Preference for Insuring Against Probable Small Losses: Insurance Implications", *Journal of Risk and Insurance*, 44(2), pp. 237–258.