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Preliminary Evidence of Users' Willingness to Pay for Safety

By Frank Berardino*

ABSTRACT

This paper reports the results of a survey on aviators' willingness to pay for safety enhancements. The study was designed to minimize the problems in prior studies due to the difficulties that consumers have in providing willingness to pay responses to small changes in risk specified as abstract statistical probabilities. Instead, pilots were asked how much they would be willing to pay for weather briefing services, because they have some appreciation of the risks involved for the value of the information provided in a weather briefing. A measure of the risk reduction associated with the use of a weather briefing in less-than-ideal weather conditions was obtained from another study.

The willingness to pay was divided by the change in safety associated with the use of a weather briefing to derive the pilots' implied value of a statistical life. The results show an estimated value of life which ranges from \$1.5 million to \$4.9 million per fatality avoided, which is considerably higher than the value used by FAA to evaluate the potential benefits of safety improvements.

I. INTRODUCTION

This paper reports the results of a survey undertaken on behalf of the National Air Transportation Association in 1985. The survey provides information on aviators' willingness to pay for safety enhancements. The study was designed to minimize the problems in previous survey-based studies due to the difficulties consumers have in providing willingness to pay responses to small changes in risk.

Based on users' willingness to pay and the reduction in risk due to the pilot weather briefing service, the implicit value of a human life is estimated to be between \$1.5 million and \$4.9 million. These values are in excess of current ones employed by the Federal Aviation Administration in policy analysis of the benefits and costs of safety enhancement programs. Another finding of the study is that whether or not aviation consumers are willing to pay for safety enhancements depends primarily upon their experience, and not on income. Also, there remains a small subset of aviators who will rationally choose not to purchase safety enhancements because of their willingness to accept risk.

These results are preliminary because the study addresses only a single safety enhancement program—weather briefings provided by flight service

stations—under a single set of weather conditions—“marginal visual flight rules.” Additional research would be desirable in order to test these findings in a broader context.

II. BACKGROUND

Policy analysts and product planners are often faced with trading-off the benefits and costs of safety enhancements. Such trade-offs inevitably become troublesome when they involve comparing the value of human life with the costs of safety enhancements.

Almost all economists would agree that the worth of something is equal to what someone is willing to pay for it. A problem occurs if the good or service at issue either is not priced in the market or is part of a larger unbundled product which cannot be easily identified by consumers. One example of an unbundled “product” would be the tensile strength of an airframe which can be varied by manufacturers above FAA established minimums. The greater the strength of the airframe, the safer the aircraft would be in the event of a crash. For the policy analyst the relevant questions are: how much safer would the airframe be, at different levels of tensile strength; and how much is the resulting safety enhancement worth to someone who might be in a fatal accident? The analyst would compare this to the added cost of the airframe.

Such decisions are important to both consumers and producers of safety enhancements. For example, when it was designing the Pinto automobile the Ford Motor Company used the average settlement in fatal product liability law suits, (\$225,000) to value human life.¹ As a result, Ford concluded that safety improvements to fuel tanks were not economically justified for the Pinto automobile. Had evidence been available on what consumers are willing to pay for safety, Ford might have reached a different conclusion.

The present paper examines the willingness of general aviation pilots to pay for weather briefings during less than ideal weather conditions. Weather briefings are currently provided free of charge by the Federal Aviation Administration through their Flight Service Station (FSS) facilities. A pilot can telephone an FSS facility and receive an en route briefing complete with interpretation of the weather by an FAA licensed briefer. A number of private firms also provide this service, mainly to corporate flight departments and to airlines. Unlike airlines and most flight departments, general aviation pilots, who fly under Part 91 of the Federal Aviation Regulations, are not specifically required to obtain a weather briefing.

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A. Rationale for the Study

The FAA is able to evaluate the approximate reduction in risk associated with the use of weather briefings in less than ideal weather conditions. A recent study³ found that the reduction in the risk of a fatal accident during less-than-ideal weather conditions can be reduced by between .0000015 and .0000055 per flight if the pilot receives a weather briefing. Using these statistics, it is possible to estimate the number of lives saved through the use of weather briefings, but this does not provide information on the dollar benefits of the briefings—the value of the lives saved.

III. PAST STUDIES

In the past, numerous studies of willingness to pay have been conducted using two basic approaches:

- *Surveys*: Consumers are polled to determine their willingness to pay to avoid a specified risk—e.g., the probability of a heart attack.
- *Statistical Studies of Worker Earnings*: Equations are estimated which explain the variation in wage levels; one of the explanatory variables is job-related risk.

There are shortcomings to both approaches. The survey approach suffers from the inability of many consumers to provide consistent answers to questions about abstract risks. For example, in the present case, many people simply would not be able to relate to changes in probabilities of fatal accidents on the order of one out of every 100,000 flights.

The statistical studies may suffer from aggregation biases. That is, if the wage studies are based on industry groups, there may be large variations in risk and other factors between companies in the industry and large variations in risk and other factors between occupational groups within a single company. Without access to company personnel records that could be used to differentiate job categories and related risks, the results of such studies may not be representative.

The present paper reports preliminary results of a willingness to pay survey which was conducted to avoid the difficulties consumers have in dealing with questions about risk specified in terms of abstract statistical probabilities. Instead, pilots were asked about their willingness to pay for weather briefing services. Because the pilots surveyed face these conditions regularly, and are trained to deal with them, they have some appreciation of the risks involved for the value of the information provided by the weather briefing.

In designing the study, the objective was to ask properly structured questions so that the pilots could reveal their willingness to pay based upon their real-life experiences, which would include:

- their internal evaluation of the risks of flying without a weather briefing,
- the value off flying under the specified conditions.

Also at issue in this study are the determinants of the users' willingness to pay. All other things being equal, one would suspect that users would be willing

to pay more for weather briefings and other safety enhancement items:

- The higher their income;
- The greater their experience in aviation in general, and with the weather conditions specified in particular;
- The greater their willingness to accept risk.

The following variables were available from the questionnaire to evaluate these effects:

- Income level,
- Exposure to marginal VFR conditions,
- Number of cross-country flights per year,
- Whether or not the respondent was a professional pilot,
- Whether or not the respondent had an instrument flight (IFR) rating.
- The willingness of the respondent to fly into marginal VFR conditions without weather briefing services.

IV. STRUCTURE OF THE INTERVIEW INSTRUMENT

325 pilots were surveyed by telephone regarding their use of FSS services. Of these, 224 of the pilots flew single engine piston aircraft exclusively, and approximately 103 pilots indicated they would fly in the less than ideal weather conditions at issue here.

The pilots were told that they were planning to fly 200 miles to a nearby city and had a need to be there that same day. The weather conditions were described as being:

- a marginal VFR (visual flight rule) day with 2000 foot ceiling, 4 miles visibility and a front expected to move through with a chance of thunderstorms.

They were then told there was no way to receive a weather briefing from the FSS service, but that alternatives were available at a price. They were then asked what they would be willing to pay given the circumstances described above.

The structure of these questions was designed to take into account the possible alternatives pilots would have including the substitution of automobile or other forms of transportation to make a trip that was necessary on that day. The circumstances are plausible because sometimes FSS services are unavailable because FAA telephone capacity is insufficient to handle peak demand situations. Virtually all pilots have faced at least some delays in receiving service and many have faced the situation posed in the survey.

V. FINDINGS

The average respondent to this survey was willing to pay \$7.30 per weather briefing during marginal VFR conditions. By dividing the user's willingness to pay for the service by the expected change in safety, it is possible to derive estimates of the implicit value of human life. Using the risk reduction estimates noted above, the value of human life implied by these findings is between \$1.5 million and \$4.9 million. By way of comparison, in its policy studies of safety enhancements, the FAA currently

employs a figure of \$650,000 per fatality avoided.³ The FAA figure is consistent with the implicit value of each statistical life in high-risk jobs.⁴ However, it is lower than Viscusi finds for blue-collar workers facing average risk where the value of a statistical life is close to \$3 million. For individuals in very safe occupations, he finds values of life of between \$6 million and \$10 million.⁵

The respondents to the present survey do not appear to fit comfortably into the demographic descriptions of the previous wage model studies, including those reported by Viscusi. In the wage studies, it is blue-collar, low-income individuals who face the greatest risk. In the present study, the average individual has an income of between \$30,000 and \$50,000—far in excess of the national average. Yet, these individuals voluntarily undertake risky flight operations. In fact, approximately 20 percent of the individuals surveyed said that they would not pay a positive price for the briefing service, even in marginal VFR conditions.

Table 1 reports the results of analysis of variance tests designed to distinguish between those who are willing to pay for the service and those who are not. As expected, the experience variables—defined as exposure to marginal VFR conditions, the number of cross-country flights per year, and whether or not the person is a professional pilot and has an IFR rating—all have a significant and positive impact on the willingness of respondents to pay a positive price for weather-briefing services in less-than-ideal weather conditions. However, neither the income nor the willingness to accept risk variable (willingness to fly without the service) has a significant impact.

Table 1
Differences Between Those Willing to Pay VS Those Not Willing to Pay

	t	Conclusion (Significance Level)
Willingness to Fly Without Service	0.55	No difference
Exposure to Marginal VFR	3.32	Difference (.01)
Income	0.65	No difference
Cross-country Flight per Year	1.48	Difference (0.1)
Professional Pilot	1.75	Difference (0.05)
IFR Rating	2.25	Difference (0.01)

These findings would appear to be consistent with those of Viscusi and O'Connor⁶ who describe a model of adaptive responses to worker willingness to accept job-related risk. Their findings indicate that experience plays a significant role in the willingness of workers to accept risk.

Experience is also a significant determinant of whether or not a respondent is able to provide economically rational responses to the willingness to pay questions. Specifically, a respondent was termed "irrational" if he or she:

- Was not willing to pay for a weather briefing in marginal VFR conditions, and
- Would not fly without the weather briefing.

Their responses indicated that they placed a value on the weather briefings in less-than-ideal weather conditions, but were unwilling to pay for them. Table 2 reports analysis of variance tests to distinguish between "rational" and "irrational" respondents. Notice that the experience variables all are significantly different from zero, while the income variable is not. No test is reported on the willingness of the pilots to fly without the service since by definition "irrational" respondents will not.

Table 2
Differences in Willingness to Pay Between "Rational" and "Irrational" Respondents

	t	Conclusion (Significance Level)
Exposure to Marginal VFR	4.57	Difference (.01)
Income	0.18	No difference
Cross-country Flights per Year	1.84	Difference (0.05)
Professional Pilot	1.78	Difference (0.05)
IFR Rating	2.34	Difference (0.01)

If we eliminate the irrational respondents from the sample, a quite different set of results occur. In testing these same variables to distinguish between rational individuals who are willing to pay for weather briefings in less-than-ideal weather conditions versus those who are not, we find that willingness to accept risk is the key variable. The findings in Table 3 indicate that neither exposure nor income play a role in determining whether the pilot is willing to pay for full weather briefings. These findings imply that approximately 5 percent of the rational respondents to the survey either:

- Are willing to accept greater risk than the remainder of the sample,
- Do not believe that weather briefings provide an enhancement to aviation safety substantial enough to pay for.

Table 3
Differences Between "Rational" Respondents Willing To Pay VS Those Not Willing to Pay

	t	Conclusion (Significance Level)
Willingness to Fly Without Service	4.16	Difference (.01)
Exposure to Marginal VFR	0.75	No difference
Income	0.02	No difference
Cross-country Flights per Year	0.04	No difference
Professional Pilot	0.17	No difference
IFR Rating	0.52	No difference

VI. CONCLUSIONS

These findings are generally consistent with the most recent wage models which are used to develop estimates of implicit values of statistical lives. The range in the value of human life found in this study—\$1.5 million-\$4.9 million—is well within the range of findings of the most recent wage studies. These findings indicate that the FAA may be using values that do not properly reflect the willingness of aviation users to pay for safety enhancements.

The findings in the present paper also support the adaptive response models that have been developed to explain variations in wages due to job-related risk. If the preliminary results of the present study hold for other aviation safety enhancements, they would imply that pilots with greater experience:

- Would be more likely to pay for safety enhancements than pilots with less experience;
- Would be more likely to be able to rationally trade-off risk and the costs of safety enhancements in the marketplace.

However, there remains a small subset of aviators who would be less willing to pay for aviation enhancements because they are willing to accept more risk than is typical of all aviators.

ENDNOTES

1. W. Kid Viscus: "Market Incentives for Safety," *Harvard Business Review*, July-August 1985, p. 135.
2. "FAA Office of Aviation Safety: Flight Service Station Privatization Evaluation Project." Chapter 77 (July 1985).
3. FAA APO Bulletin #84-3.
4. *Op. Cit.* p. 134.
5. *Op. Cit.* p. 134.
6. W. Kip Viscusi and Charles J. O'Connor: "Adaptive Responses to Chemical Labeling: Are Workers Bayesian Decision Makers?" *American Review*, Vol. 74 No. 5, pp. 942-956.