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How Prevalent are Friedman-Savage Utility Functions?*

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The modern literature on risk aversion and risk tolerance almost universally posits a monotonically concave, linear, or convex utility function. More than 50 years ago, however, Friedman and Savage (1948) theorized that individuals who both gamble and buy insurance may exhibit utility functions with both concave and convex segments. Despite its intuitive appeal, the Friedman-Savage hypothesis has not been widely tested on an empirical basis. Using a unique survey data set, this paper obtains evidence indicating that at least 18 to 20 percent of individuals evaluate risks in a manner consistent with Friedman-Savage preferences. **JEL: D010, D810.**

Introduction

Ever since Bernoulli solved the St. Petersburg paradox, it has been an article of faith among economists that marginal utility is decreasing in wealth, indicating a general aversion to risk. One of the oldest puzzles in the economic study of uncertainty arises from the observation that some individuals who buy insurance against potential losses also actively engage in gambling; whereas the former activity demonstrates risk aversion, the latter implies a love of risk.

One of the earliest explanations for this phenomenon, predating even the formal measurement of risk aversion by Pratt (1964) and Arrow (1965), is the suggestion by Milton Friedman and Leonard Savage (1948) that the risk preferences of individuals who gamble and yet simultaneously purchase insurance are governed by utility functions having both concave and convex segments.

Although the Friedman-Savage (FS) hypothesis is well-known, it has long been

under-appreciated. Textbooks covering attitudes toward risk generally neglect to mention the FS possibility (see, for example, the recent text by Gollier, 2001); an exception is the volume by Doherty (2000).

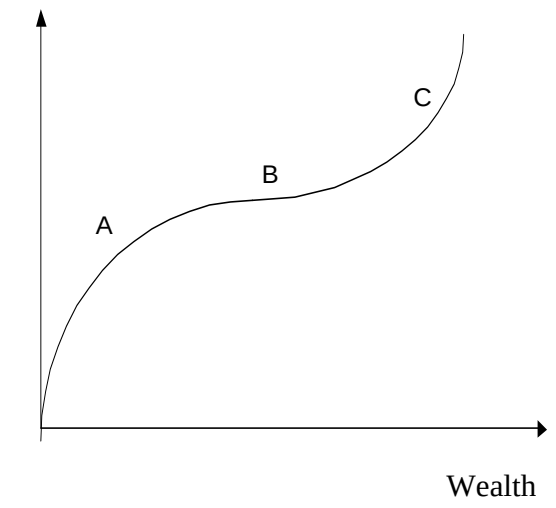
There is a sizable theoretical literature that debates the microeconomic foundations for FS preferences (Bailey et al. 1980; Gregory, 1980; Applebaum and Katz, 1981; Katz ,1983; Benishay, 1987; Dobbs, 1988; Myles, 1990), and the FS model has been invoked to explain various phenomena such as migration (Premus, 1979). Yet the empirical research attempting to establish the practical significance of the FS model has been extremely sparse. Pryor (1976) used aggregate historical data and found weak support for the FS hypothesis at the macro level. Brunk (1981) found that those who gamble do so primarily to increase their wealth (rather than for sheer pleasure), a rationale consistent with FS preferences. Hawley and Fujii (1993-94) found higher-income individuals to be more tolerant of financial risks, and interpreted this as evidence against the FS hypothesis.[1] Aside from these few studies, however, there is little empirical evidence concerning the FS model. As Benishay (1989, p. 518-519) notes, "it is very difficult to establish the number, or proportion in the population, of people behaving in accord with this [Friedman-Savage] hypothesis." Instead, most empirical estimates of risk preferences either assume that a particular functional form for utility (such as an isoelastic function) holds at all wealth levels, or simply measure a Pratt-Arrow coefficient of risk aversion at a specific level of wealth. Neither approach allows for the existence of FS-style irregularities.

The present note uses a unique survey data set constructed by the Center for Economic Research (CentER) at Tilburg University in the Netherlands to investigate the prevalence of FS utility functions. After a brief discussion of the methodology, the results and implications are examined.

Methodology

The central idea behind the Friedman-Savage hypothesis is that a utility function may display both concave and convex segments. Thus, the same individual may be averse to risk over some ranges of wealth, and risk-seeking over other ranges. A simple example of such a function (equivalent to Figure 2 in Friedman and Savage, 1948) is shown in Figure 1. Near point A, the utility function is concave to the origin, so the individual exhibits risk aversion and is inclined to buy insurance against potential losses; in the neighborhood of point C, the function is convex to the origin, so the individual is risk loving and thus inclined to place wagers. Consequently, there is an inflection point at B, where the individual exhibits risk neutrality. If point B is taken as a starting position, the individual exhibits risk aversion with respect to a loss, but would exhibit a love of risk if the potential gain from betting were sufficiently large. More generally, a Friedman-Savage function may have more than one inflection point; it is possible, for example, that the curve in Figure 1 would become concave again at a suitably high level of wealth.

Figure 1. A Friedman-Savage Utility Function



The most direct means of investigating the curvature of the utility function would be to observe each individual at various incremental levels of wealth. Unfortunately, no data set with sufficiently rich variation in endowed wealth is available for this purpose. We can, however, accomplish the same end by observing changes in reported certainty equivalents—the levels of guaranteed wealth that would yield utility comparable to the utility of undertaking a risk. In particular, if the risk premium—the bonus required by an individual to accept a risk—is uniformly positive (zero, negative), then the individual is strictly risk averse (risk neutral, risk loving). In contrast, any change in the sign of the risk premium implies that the individual exhibits FS preferences.

The 1993 and 1994 waves of the CentER Savings Survey (CSS) at Tilburg University are ideally suited for this purpose. In each of these years, more than 2,500 Dutch households were asked a sequence of survey questions regarding a gamble and its certainty equivalent, that were designed to elicit risk preferences. In particular, the 1993 wave initially asked the following:

> *Imagine you have won f200 in a game. You can now choose between keeping that f200, or having a lottery ticket with a certain chance to win a prize of f20,000. How high would that chance to win f20,000 need to be such that you would prefer the lottery ticket to keeping the f200 that you had already won?*[2]

Remarkably, the use of probability-equivalence questions was anticipated by Arrow (1965), but it is only in recent years that survey questions of this type have become widely popular vehicles for assessing attitudes toward risk. Data on risk preferences from the CentER Savings Survey have been analyzed by Warneryd (1996) and Donkers et al. (1999), while similar questions from other surveys have been used by Pennings and Smidts (2000), Guiso and Paiella (2001), Hartog et al. (2002), and Eisenhauer and Ventura (2003), among others. None of the prior studies, however, have used such data for the present purpose; indeed, point estimates indicating a love of risk have often been dismissed as mere outliers and subsequently excluded from analysis.

The answer to this particular question is the probability-equivalence parameter p defined by the expected utility equation

$$U(w+200) = (1-p)U(w) + pU(w+20{,}000) \quad (1)$$

where: U represents the utility function, w denotes the individual's riskless assets, and

all wealth is measured in Dutch florin. The expected wealth from accepting the gamble is calculated as $w + 20{,}000p$, and its certainty equivalent is $w + 200$. Thus, the risk premium is determined by the difference,

$$\pi = 20{,}000p - 200. \qquad (2)$$

Notice that $p < .01$ indicates a negative risk premium (or a love of risk), $p = .01$ indicates a zero risk premium (or risk neutrality), and $p > .01$ reflects a positive risk premium (or risk aversion).

In addition, the 1993 wave asked two other versions of the same question, first changing the *f*200 to *f*1,000 and then to *f*5,000, while the lottery prize remained *f*20,000. Thus, in the second and third iterations, risk neutrality is defined by $p = .05$ and $p = .25$, respectively. Notice that this sequence of questions anchors the minimum and maximum outcomes at w and $w + 20{,}000$ respectively, while shifting the certainty equivalent to successively higher wealth levels (such as those associated with points A, B, and C in Figure 1). Clearly, the points at which utility is evaluated in these three questions do not cover the entire spectrum of an individual's utility function. If, however, a respondent's answers to the three survey questions reveal a change from, say, risk aversion to a love of risk (as in Figure 1), then the individual must be classified as having FS preferences.

Likewise, the 1994 wave of the CSS posed three iterations of the same question, involving initial values of *f*100, *f*1,000, and *f*10,000 respectively, so that risk neutrality would be defined by $p = .005$, $p = .05$, and $p = .50$, respectively. This second wave of the survey provides an important check on the robustness of the 1993 results.[3] The second wave is additionally valuable because it represents a broader range of certainty-equivalents than the first wave, and is thus more likely to capture FS-type preference changes.

Results and Discussion

The results of the surveys are presented in Table 1. Among 2,910 respondents in 1993 and 2,534 in 1994 who provided answers to all three iterations, approximately 80 percent displayed risk aversion at every level of wealth that was considered in the survey. Those individuals are classified as strictly risk averse in Table 1. None of the respondents in either year were risk loving across all wealth levels, and only one percent of the 1993 sample exhibited strict risk neutrality throughout the entire range of wealth. The remaining 18.4 percent of the 1993 sample and 20.7 percent of the 1994 sample exhibited some combination of different risk attitudes at different certainty equivalents.[4] Thus, this simple survey technique suggests that at least 18 to 20 percent of the Dutch respondents revealed preferences consistent with the FS hypothesis. In addition, chi-squared tests conducted at the five percent level reveal that males and those classified by the CSS as high-income respondents (those with the highest non-experimental incomes) are significantly more likely than their counterparts to exhibit FS preferences.

Table 1: Prevalence of Risk Preferences

Preferences	1993 wave (percent)	1994 wave (percent)
Risk Averse	2,343 (80.5)	2,009 (79.3)
Risk Neutral	33 (1.1)	0 (0)
Risk Loving	0 (0)	0 (0)
Friedman-Savage	534 (18.4)	525 (20.7)
Total sample	2,910	2,534

Importantly, however, the proportions reported above should be considered conservative, lower-bound estimates. They reveal that at least one inflection point existed somewhere along the utility function for about one-fifth of each sample; but they do not necessarily imply an absence of inflection points among the remaining four-fifths. If, for example, some or all of the respondents who are identified as strictly risk averse eventually experience a desire for risk at wealth levels greater than those discussed in the survey, then these individuals have been misclassified by our test, and would more properly be deemed to have FS preferences if we could observe larger portions of their utility functions. Thus, the 18 to 20 percent figure most likely represents an under-estimate of the true prevalence of FS preferences.

Even so, this finding indicates that Friedman-Savage utility functions are empirically important and deserve further study. In particular, it suggests that risk neutral and/or risk-loving attitudes are operative at some wealth level among a sizable fraction of the population, and thus cannot simply be dismissed as outliers. In addition, this result highlights an important limitation of constructing point estimates of risk aversion or risk tolerance: because such estimates are valid only over an infinitesimally narrow range of wealth, they reflect what Pratt (1964) termed risk aversion "in the small" and may fail to accurately capture preferences over broader ranges. For the latter purpose, the development of more general measures of global risk aversion is required.

Endnotes

1. Although Friedman and Savage (1948) speculated that many utility functions would exhibit concavity at the highest levels of wealth, the Hawley-Fujii finding does not disprove the existence of FS functions in general—i.e., those having inflection points.

2. At the time of the survey, 20,000 guilders, or Dutch florin (*f*20,000), were worth approximately US$10,000.

3. There is always a danger that survey responses will be unrealistic portrayals of preferences, inconsistent with actual behaviors. However, the similarity of responses between 1993 and 1994 provides at least modest reassurance that the responses were not random but rather resulted from careful consideration of the proposed lotteries.

4. These combinations included risk aversion and risk neutrality, risk aversion and love of risk, and risk neutrality and love of risk.

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This issue of the BNE sees the return of a Book Note. Book Notes provide a short and intentionally provocative comment on a recent book so as to ignite debate and ultimately interest. The subjects of some Book Notes may be used as a full Book Review in a subsequent issue of the BNE.

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Book Note

The End of Poverty: How we can make it happen in our lifetime, published by Penguin Books in 2005, is the latest in a long series of important contributions by Columbia University's **Jeffrey Sachs**.

Books with grand titles often disappoint. However, and despite the grandest of titles, Jeffrey Sachs's recent book is not a disappointment, on any level. His is a remarkable book. In the space of about 400 pages Sachs provides us with a masterly rendition of some of the toughest questions faced by members of any generation. But throughout time there have been a plethora of excellent writers with urgent questions. Sachs's book is different as it makes a bold attempt at answering many of these thorny issues and generally comes up trumps.

The book, which is part professional autobiography and part manifesto-for-action, traces Sachs's own intellectual development as an economist and high-flying advisor. For example, entire chapters are devoted to his painstaking work in Bolivia, in Poland as well as in Russia and elsewhere. These chapters provide a first hand account of the experiences of someone who quite clearly has reveled in his role as an international economic policy trouble-shooter.

Whilst the autobiographical sections of the book are well worth a detailed read the real contribution is made in the more immediate discussions of the logistics of the war against poverty as perceived by Sachs. Sachs draws extensively on his experience as Mr. Kofi Annan's (UN General Secretary) Special Advisor on the Millennium Development Goals. Sachs's powerful writing style in these sections of the book is the closest one can get to a turbo-charged delivery as can be imagined

on paper. Whilst the writing is eloquent, the message is both urgent and powerful. Sachs is tenacious in his thirst for new insights to old questions. Few economists have looked at the problems of corruption, malnutrition, voicelessness and disease in quite the same way as Sachs has achieved. This work deserves to be very widely read, and most probably will.

Parviz Dabir-Alai

Book Review

Joseph Stiglitz and Bruce Greenwald. (2003) Towards a New Paradigm in Monetary Economics. Published by Cambridge University Press. PP328. ISBN 0 521 810345.

This book is the result of collaboration between two exceptionally well-known economists. Professor Stiglitz was Chairman of the President's Council of Economic Advisors and Senior Vice President of The World Bank. He is a Nobel Laureate from 2001 in recognition for his work in the economics of information. Professor Greenwald is also well-known for his contribution to the economics of corporate finance.

This book consists of sixteen chapters. Part I (Chapters 1 to 7) develops the theoretical foundation of their "new" paradigm, and Part II (Chapters 8 to 16) demonstrates how the new paradigm is applied to actual economic issues. For example, Chapter 13 of this book shows that the IMF made serious mistakes during the East Asia crisis because of its adherence to a traditional model that could not recognize the central role of credit and the institutions that provide this.

The most important assumption in this book is that asymmetric information is inevitable in the real economy, and credit is different from ordinary goods. The assumption of full information (with risk neutral economic agents), which is often used in traditional economic models to make discussion simpler and easier, is not always useful to understanding real economic challenges. As shown in this book, the assumption of imperfect information can explain the special character of credit markets and, therefore, importance of banking institutions supplying credit to the economy.

Economists generally understand the importance of asymmetric information to economic analysis, and the economics of information has been one of the active research topics since the 1970's. The authors successfully construct a "new" paradigm of monetary economics and provide a clear explanation on the implications of the imperfect information, by using only basic techniques, such as the mean-variance analysis.

The second feature of this book is that both macro monetary policy and bank regulatory policy are discussed in one theoretical framework. It is thought that the macro monetary policy which aims to achieve economic stabilization is an application of macroeconomics, while bank regulation is discussed as an application of microeconomics. Such a dichotomy is projected to government organizations. For instance, the Bank of Japan conducts macro monetary policy, and the Financial Services Agency is in charge of financial regulations. These two authorities often pursue their own targets without considering side effects of their policies. The authors are criticizing that such a dichotomy may produce serious problems at least when the economy experiences financial crisis. Of course, even

if the macro monetary policy makers should consider their influence on banks (and, in turn, bank regulators should also consider their influence on macro economy), it is still difficult to be too prescriptive about what exactly needs doing. To give authorities two or more purposes might be used as an excuse when they fail in an original duty.

The third feature of this book is that it challenges the established orthodoxy. For instance, the mainstream idea in bank regulation is that financial regulations other than capital-adequacy should be abandoned. However, the authors insist that the sole reliance on capital adequacy regulation is improper in a complicated world, and they propose the portfolio approach to regulation, by which the authors mean that the government must take a variety of actions that affect both the incentives and the constraints faced by banking institutions. However, even if we agree with the authors that the present method is poor, we need further investigation on what we have in our portfolio of regulatory tools and how we should use them.
Finally, readers should be careful not to misunderstand what the authors maintain. Take the authors' argument about the use of public funds as an example. In Chapter 9, they point out that the government-financed equity injection does not provide additional protection to the government and may even expose governments to higher losses. They also argue that the government equity injection may make the government-as-regulator's job more difficult. In Chapter 11, the authors support some countries that decided to inject more capital into the banking system whilst a financial crisis was in full flow.

In sum, the ideas presented in this book represent a significant change in thinking about macro monetary and bank regulatory policy. This book should stimulate debate and discussion, and will be a classic in monetary economics.

Nobuyoshi Yamori

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