
Measuring Risk Aversion

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Abstract

The purpose of the survey is to summarize, discuss, and interpret published research concerning the risk aversion of decision makers who maximize expected utility. In doing this, two points are emphasized. First, any measure of risk aversion is specific to the particular outcome variable over which the measure is defined or estimated, and second when outcome variables are related, then their risk aversion measures are also related. These two points are used to show that a substantial portion of the reported variation in magnitudes and slopes of risk aversion measures from the research of the past forty years results from differences in the outcome variables, and when these differences are adjusted for, those findings are a quite consistent body of evidence.

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1

Introduction

The measurement of a decision maker's propensity to accept or reject risk is an important and well researched topic. The purpose of this survey is to summarize, discuss, and interpret published research on this topic for decision makers who maximize expected utility. Expected utility was made a prominent tool of economic analysis in the 1940s by Von Neumann and Morgenstern (1944). Risk aversion and the size and nature of a decision maker's reaction to risk was extensively discussed by Friedman and Savage (1948, 1952). It was not until the work of Arrow (1965, 1971) and Pratt (1964), who define measures of risk aversion, however, that the quantification of the propensity to take risks for *single dimension* outcome variables could begin.¹ The focus in this review is on the information that has been provided concerning the Arrow-Pratt measure of relative risk aversion, although absolute risk

¹The work presented here focuses on utility functions with outcomes that are of a single dimension. When more than one component is used to describe the outcome, such as the level of consumption in two time periods, or both the measure of health and wealth of the decision maker, then measuring the propensity to take risk becomes a more complicated matter. Except for a very brief mention in Section 4 when discussing consumption, this aspect of risk aversion is not discussed here.

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aversion, partial risk aversion, risk tolerance and other measures are also briefly discussed.

More than forty years have passed since measures of risk aversion were first defined by Arrow (1965, 1971) and by Pratt (1964). During these years theoretical analysis has presented a large number of theorems that use assumptions concerning the level and slope of risk aversion in order to predict choices made by decision makers. These predictions are then compared with the observed decisions. When the predicted decisions match those that are observed, the assumptions leading to the predictions are supported, and when the predictions are the opposite of what is observed, the assumptions are rejected. In this way certain properties of the various risk aversion measures, such as decreasing absolute risk aversion for wealth, have become well accepted, while other properties such as increasing absolute risk aversion for wealth have been rejected.

During this same forty year time period, various empirical studies have attempted to directly determine which levels and slopes for risk aversion are consistent with the observed choices of a variety of decision makers. The evidence provided from this analysis has varied widely, and presents seemingly contradictory results concerning the slope and magnitude of risk aversion. Examining, interpreting and consolidating this evidence, and comparing it with the findings obtained in theoretical analysis is one of the main tasks of this work.

The risk taking propensity of a number of different groups of decision makers has been studied. Included are investors who allocate wealth among assets, consumers who choose consumption levels across time, agricultural producers who make various choices so as to maximize expected utility from net income or profit, and other such groups. Within each of these groups of decision makers, the particular decisions examined are also quite varied. As a result, each study selects an outcome variable that is consistent with the purposes of the study, and it is often the case that this outcome variable is not identical to that chosen by another. Hence a large number of different outcome variables have been employed in the discussion of the risk aversion of decision makers. These outcome variables include wealth, income, consumption, return, rate of return, net income, payoff and profit.

In addition to a variety of differently named outcome variables, in many instances different definitions or measures are employed for a particular outcome variable even though the name used remains the same. This makes the number of different outcome variables that have been examined even larger. For instance, one study of portfolio choice may use wealth as the outcome variable and in that study the taxation of investment income is ignored. Another study examines exactly the same decision, and considers the outcome variable to be final wealth, but explicitly models the taxation of investment gains. Even though the outcome variable is referred to as wealth in each of the studies, in the one case this variable is before-tax wealth, and in the other it is wealth after taxes are paid on investment income. Such differences in the way an outcome variable is defined or measured, even though they seem to be minor, can lead to significantly different estimates of the risk aversion measure, or require that different conditions be imposed on that measure.

When outcome variables differ, but are related to one another in a known way, the relationship between the outcome variables determines the relationship between their risk aversion measures. In many cases the relationship between outcome variables is implied by their definitions, and the definitions themselves can be used to indicate how the risk aversion measures are related to one another. Such is the case for the wealth and after-tax wealth outcome variables that were just mentioned.

Similar variation in outcome variables occurs in empirical analysis. Different measures are used for an outcome variable in the various studies. In one study, the wealth attributed to a decision maker making portfolio or other choices may include the value of owned housing, the value of life insurance, or the value of human capital, while another study may exclude these components when measuring wealth. Data availability sometimes determines what is included and what is excluded when measuring a particular outcome variable. This variation in the way the outcome variable is measured leads to predictable differences in the estimated magnitudes and slopes for risk aversion that are obtained. Once the variation is recognized, adjustments can be made so that the results are more easily compared across studies.

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This variation in the outcome variables has led to different estimates of, and conditions imposed on, the slope and magnitude of risk aversion measures. It is important to recognize that for each of the studies, theoretical or empirical, the reported information directly pertains only to the risk taking propensity for the particular outcome variable examined. Furthermore, this information cannot usually be used to make statements concerning the risk taking propensity for other outcome variables without making adjustments. The literature is filled with examples where this point has been ignored, and the evidence from one study has been inappropriately used as information concerning risk aversion for a different outcome variable. Many studies publish tables which list the estimated values for relative risk aversion for different outcome variables when those values are not comparable. Great care must be exercised in using the findings concerning the magnitude and slope of risk aversion presented in any particular analysis.

The fundamental point made in the analysis here is that even though information concerning risk aversion in a particular study is always for the specific outcome variable employed in that study, the manner in which the various outcome variables are related to one another determines how their respective risk aversion measures are related. Thus, information concerning the relationship between outcome variables can be used to adjust the risk aversion information obtained for the one, so that this same information also applies to another. One of the contributions of this study is a detailed discussion of how to go about the task of making such adjustments.

This adjustment of risk preference information so that the various separate bodies of information can be more easily compared also allows one to consolidate the wide array of information concerning risk aversion. An important step in this process is to choose one outcome variable to which all others can be related and compared, a reference outcome variable. Wealth, as the term is used by Arrow (1965, 1971) and Pratt (1964), is selected as this reference outcome variable, and an attempt is made to relate all other outcome variables to Arrow-Pratt (A-P) wealth. Doing this allows the reported information on risk aversion for other outcome variables to be appropriately adjusted so that each of the studies provides information concerning risk aversion for

(A-P) wealth. By adjusting all information to this common scale, results across studies can be more easily summarized and directly compared, and the body of information concerning risk aversion can be examined as a whole rather than as individual parts.

Casual inspection of the findings concerning the magnitude and slope of risk aversion obtained during the past forty years indicates that both the magnitude and the slope of risk aversion varies widely across groups of decision makers, and even varies with the decisions that are made. Estimates of the magnitude of relative risk aversion range widely from near zero to values approaching one hundred, and whether the slope of the risk aversion measure is positive, negative or zero is an unsettled question for many measures, including relative risk aversion. The review here attempts to show that a substantial part of this variation is due to the differences in the outcome variables used in the analysis. After adjusting and consolidating the information, the situation is quite different. Evidence concerning the risk taking characteristics of representative decision makers of various types, making a variety of decisions, is quite consistent. Representative farmers choosing production strategies, representative investors choosing portfolio composition, and representative consumers optimally deciding on consumption over time are quite similar in their propensities to accept risk.

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