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Booij, A.S.

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1 Introduction

Well known economic measures such as inflation, unemployment and growth are all estimated on the basis of assumptions that are not innocuous. Should inflation measures be based on past or current bundles of goods? The former may give an overstatement and the latter an understatement of the welfare effect of price changes. Should unemployment rates be based on registry records of individuals that have applied for benefits, or should it be based on peoples' statements in labor surveys? The first method generally gives much lower rates than the second because not all people that think of themselves as being unemployed register themselves as such. In France this difference led to considerable debate when the national bureau of statistics changed the unemployment definition (EUBusiness 2007). Likewise, growth measures are sensitive to which goods are defined as intermediary goods and which as final goods, because expenditure on intermediary goods should be deducted from total expenditure to arrive at the total value added. Differences in growth rate measures are not inconsequential because the performance of governments is often judged on them, and governments use growth measures and forecasts to determine planned expenditure.

Economic quantities that do not appear on the foreground as much as these measures but that are of great interest to (micro) economists, are measures of risk attitudes. Risk attitudes can be thought of as the preferences that govern people's choices between risky or uncertain alternatives. Risky alternatives are probability distributions over outcomes, also called prospects, with all probabilities and outcomes known to the individual. Uncertainty designates the more general situation where not all probabilities or outcomes are known.

Risk attitudes play a central role in nearly every model of individual decision making used in economics where risk or uncertainty are involved, be it in a model of lifecycle consumption-smoothing decisions, of the choice of portfolio composition, insurance, education choice, or bidding strategies in auction theory. Hence, a good understanding of

risk attitudes is important, at least in theory, for predicting behavior in these different settings.

The first and major part of this thesis consists of three papers that concern the measurement of risk attitudes, and in particular the sensitivity to some of the assumptions made to measure them. In the second part we consider an empirical application where risk attitudes appear as one of the determinants of behavior. For simplicity, we will only consider decision making under risk, with money taken as outcomes.

Since its axiomatization by Von Neumann and Morgenstern in 1947, economists have used the expected utility model to describe behavior under risk. In this classical model the value of a prospect is given by the probability weighted sum of utilities of the outcomes. Risk attitudes are then fully determined by the curvature of the utility function of wealth. More precisely, in the expected utility model risk aversion (preferring the expected value of a prospect to the prospect itself) follows from diminishing marginal utility of wealth, and the "degree" of risk aversion increases if utility becomes more concave, that is if marginal utility diminishes more rapidly. This may be individual specific. For an individual agent utility curvature can be measured from observed risky choices. The obtained measure can then, in principle, be used to predict or explain behavior in other risky choice situations. This approach is not valid, however, if individuals do not behave according to the expected utility model, i.e. if one (or more) of the models' assumptions fails descriptively. The first part of this thesis investigates what happens to the obtained measures of utility curvature when we depart from the classical assumptions.

In chapter 2, we consider what happens to the obtained measure of utility curvature if it is assumed that individuals can not borrow from future income, which is implicitly assumed in the expected utility model. It turns out that this assumption is relevant when individuals are impatient and their income profile is flat. Then additional income is not fully integrated with wealth because its effect is spread over only a short period. This reduces the measured degree of risk aversion. This point is illustrated by an empirical application where risk aversion is measured using the hypothetical valuation of a series of lotteries by a representative sample individuals.

In chapters 3 and 4 we depart from expected utility in a different way. There we assume that behavior under risk is described by the more general prospect theory (Kahneman and

Tversky 1979; Tversky and Kahneman 1992). According to this theory, risk attitudes are not only driven by utility curvature, but also by the subjective weighting of (cumulative) probabilities and loss aversion, which is the psychological overweighting of losses compared to gains with respect to a flexible reference point. Using a non-parametric measurement method that is invariant to this departure from classical assumptions, lab experiments with students reveal that utility curvature is far more linear than traditional measurements suggest. In chapter 3 we use the same tool to extend this finding to a representative sample of the population, which gives indirect evidence of the presence of the non-linear weighting of probabilities.

Chapter 4 provides complementary evidence for this result. There we estimate a fully parametric version of the prospect theory model, jointly estimating utility and probability weighting at the aggregate level. This approach confirms the approximate linearity of utility for small stakes and presents in-sample evidence of probability weighting for a representative subject pool. Because chapters 3 and 4 are written as independent papers, both provide a review of the empirical literature and a description of the data. Hence, the reader is forewarned that there is some repetition in the exposition put forward in these chapters.

The second part of this thesis diverges from the first. There a particular application is presented where risk attitudes are associated with student-borrowing behavior in the Netherlands. An even stronger association, however, is observed with de degree of knowledge the students have with the loan-conditions, which are the rules set out by the government for student borrowing. This association vanishes if students' knowledge is manipulated by a randomly assigned information treatment, which gives an example of how the relaxation of the classical exogeneity assumption made in regression analysis may lead to a very different picture of causal effects. Moreover, the direct policy implication of the study is that students' lack of knowledge about the borrowing conditions is not constraining their borrowing behavior, questioning the need for an information campaign.

In summary, this thesis consists of two parts. In part I we consider three papers that fall under the heading of the measurement sensitivity of risk aversion. Chapter 2 starts with an analysis of how different assumptions about consumption smoothing over time can influence the estimate of risk aversion. Chapter 3 departs from the classical theory in a

different way, by assuming loss aversion and allowing for the non-linear weighting of probabilities. Chapter 4 extends these results by providing measures of the probability weights. The last chapter is categorized in part II that deals with the measurement sensitivity of causal effects in education. There we investigate the interpretation of students' ignorance with - and an associated low take-up of - student loans in the Netherlands.