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Income and choice under risk[☆]Arnt O. Hopland^{a,*}, Egil Matsen^b, Bjarne Strøm^b^a Department of Business and Management Science and NoCeT, Norwegian School of Economics (NHH), Helleveien 30, N-5045 Bergen, Norway^b Department of Economics, Norwegian University of Science and Technology, N-7491 Trondheim, Norway

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ABSTRACT

This paper studies the relationship between income and risky choice in a field experiment where stakes are of first-order importance to the subjects' living standards. We combine observations of stopping decisions in a Norwegian game show with reliable data on each subject's income. Participants in the experiment are randomly drawn from an unusually large subject pool. Our results clearly indicate that people are risk-averse when making choices with large stakes, and that decision makers with high income are more willing to accept financial risk.

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1. Introduction

The relationship between the economic resources of a decision maker, such as wealth or income, and his attitudes towards risk is fundamental in theories of choice under uncertainty.¹ Such theories are, in turn, central in many economic models that influence economic policy. In spite of this, there are only a few empirical investigations of the relationship between risky choice and the affluence of the decision maker. An important reason for the limited amount of research is a lack of fully adequate data for the task. Ideally, the data should contain (i) observations of choices between well-defined risky options, (ii) a credible measure of the decision makers' income or wealth, (iii) choice outcomes that have

a substantial effect on the subjects' financial situation, and (iv) a representative subject pool.

This paper contributes to the empirical literature on choice under risk by collecting and analyzing a dataset that go a long way in meeting these four criteria. We combine choice data from a framed field experiment (according to the taxonomy of Harrison and List, 2004) with reliable data on each subject's income. The field experiment is the Norwegian game show *Millionsjansen* ("The Million Chance"). This game show meets the first criterion because contestants face a straightforward choice between taking home a sure prize or accepting a gamble with a simple probability distribution. We fulfill the second criterion by collecting tax register data on each contestant's income (and a measure of financial wealth) prior to their participation on the show. The financial outcomes in the experiment are of first-order importance to the subjects' living standards; hence, the third criterion is easily met. The average stake in the gambles we observe is 647,000 Norwegian kroner (\$85,000/€71,000 at the time of writing), with a median of 600,000. In comparison, the average annual pre-tax income of the contestants was 311,000 kroner before their participation in the lottery. Our experiment thus offers a rare opportunity to analyze how people's willingness to risk large amounts of real money depends on their income level. Finally, speaking to the fourth criterion, contestants are randomly drawn from a pool of candidates that constitutes a large share of the adult population. Although game show participants might be a somewhat special sample to investigate, the fact that they

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¹ According to expected utility theory, for instance, a central property of risk preferences is the relationship between the decision maker's wealth or income and his risk aversion. In applications of prospect theory, the reference point against which gains and losses are measured is often taken to be the decision maker's initial income or wealth.

are drawn from this large pool ensures that our subjects are representative along important dimensions.²

A larger dataset would allow us to estimate a full structural model, making it possible to recover the underlying fundamental preferences. However, given our modest sample size we would have to make strong assumptions to fully identify a structural model. Rather, we use a reduced form approach to estimate how the propensity to accept a given gamble depends on the decision maker's income and other characteristics, without making any choice-theoretic assumptions in our analysis. With the data we have available we find this to be a more credible and transparent approach than structural estimations.

We uncover three patterns in the data. First, people are, as expected, generally risk-averse in making high-stake choices: participants reject gambles with positive expected payoff when the risk becomes sufficiently high. Second, risk tolerance increases with income: the higher a subject's income is, the more likely he or she is to accept a given gamble. Third, in contrast with much of the earlier research on individual risk attitudes, we do not find statistically significant effects on choice of the gender or age of the decision maker.

1.1. Related literature

Previous empirical research on how risk attitudes vary with income or wealth can be divided into three different branches.³ The first branch uses data on individual asset holdings to analyze how portfolio composition varies with individual wealth. When combined with a theoretical portfolio choice model, this variation can be used to deduce the subjects' risk aversion. This approach is thus fundamentally structural. The results from these studies are somewhat mixed. Using cross-sectional data, [Friend and Blume \(1975\)](#) do not reject constant relative risk aversion across US households, while [Morin and Fernandez Suarez \(1983\)](#) and [Guisio and Paiella \(2008\)](#) find evidence of decreasing relative risk aversion across Canadian and Italian households, respectively.⁴ Moreover, the theoretical model on which these studies base their estimates has been seriously challenged by empirical research in finance (see, e.g., [Campbell, 2003](#)), calling into doubt the robustness of these findings. It thus seems worthwhile to supplement the asset holdings approach with more direct observations of risky financial choices, as we do in this paper.

A second type of study uses survey questions to measure risk attitudes. These analyses often include explorations of the relationship between income and/or wealth and risk attitudes among the respondents. Notable examples of such explorations include [Barsky et al. \(1997\)](#), [Donkers and Melenberg \(2001\)](#), and [Dohmen et al. \(2011\)](#). Again, the reported results are somewhat conflicting: using the expected utility model as their basis, [Barsky et al. \(1997\)](#) find a U-shaped pattern between risk preferences and income/wealth in their survey of US households; risk tolerance decreases for low income and wealth values and then increases. On the other hand, [Donkers and Melenberg \(2001\)](#) and [Dohmen](#)

[et al. \(2011\)](#) find a positive relationship between income/wealth and the willingness to take risks in surveys of Dutch and German households, respectively. A general concern about using surveys to elicit risk preferences is the tendency of surveys to rely on hypothetical choice situations. In particular, the financial stakes involved are usually imaginary, raising the question of whether the results can be generalized to the real world.⁵ In contrast, our field experiment involves choices with stakes that have a significant impact on the subjects' standards of living.

Finally, there are a few field experiments, prior to ours, that shed light on the relationship between financial resources and risk preferences.⁶ One important contribution comes from [Harrison et al. \(2007\)](#), who estimate risk attitudes using a controlled field experiment on a representative sample of Danes. They do not find any effect of household income on structural utility parameters across their subjects. We note that Harrison et al. use the household income category (high or low) as the measure of income for their subjects, whereas we have income data on each individual subject. Moreover, the financial stakes involved in their experiments are modest. Indeed, in a related paper ([Andersen et al., 2008a](#), p. 591), the same authors are careful to emphasize that they do not claim global validity for their estimates if stakes were reduced or increased substantially. In a related study on a representative sample of Dutch respondents, [von Gaudecker et al. \(2012\)](#) find an ambiguous association between structural utility risk parameters and the income and wealth category of respondents. Finally, our paper is related to the study by [Bombardini and Trebbi \(2012\)](#). Like us, they analyze choice data from a television show with high stakes and investigate how choices relate to, among other variables, the income of the decision maker. Bombardini and Trebbi estimate a highly structural model, assuming that preferences have constant relative risk aversion. Their estimate of this constant is clearly heterogeneous across their subjects, but they do not find that this parameter is related to the measure of individual income. Our approach differs from that of [Bombardini and Trebbi \(2012\)](#) in that we do not assume a specific functional form of preferences. In addition, Bombardini and Trebbi estimate the income of their subjects (based on occupation and city/region of residence), while we have actual income data on each individual.⁷

We are by no means the first to use data from television game shows to study risk preferences; see [Andersen et al. \(2008b\)](#) for a comprehensive survey of the early literature on estimating risk aversion in game shows.⁸ We believe, however, that our particular show has some important advantages compared to those previously studied: first, the weekly contestant in our show is randomly drawn from a large subject pool. In most other

² [Dohmen et al. \(2011\)](#) make a serious attempt to meet the generalizability concern by running a complementary experiment with a representative subject pool and real stakes. Their experiment confirms the validity of the risk willingness measure used in the survey, but they do not report whether the relationship between income/wealth and risk attitudes is comparable in the experiment and the survey. Moreover, although the financial stakes in their experiment are non-negligible, they are an order of magnitude smaller than in our natural experiment.

³ Experiments of risky choice conducted in the lab commonly use college students as subjects ([Harrison and List, 2004](#)), and may thus be of limited value in identifying the relationship between risk preferences and income or wealth. Field experiments such as ours attempt to overcome this drawback by using samples from populations with wider demographics.

⁴ Note also that having "average income" was one of the criteria for being selected to participate in the show analyzed by [Bombardini and Trebbi \(2012\)](#). As commented by the authors themselves (p. 1357), this limits the extent to which they can compare risk attitudes across income levels.

⁵ The strengths of game show data are well known, and these are shared by our experiment: choice options are well-defined, stakes are real and large, the tasks are repeated in the same manner from contestant to contestant, and samples are drawn from populations with a wider set of demographics than in the typical lab experiment.

² Note that we are not claiming full representativeness of our sample. In Section 3, we discuss sample properties, including selection issues, in detail.

³ Our literature review focuses on contributions that contain analyses of the relationship between risk preferences and income or wealth. We do not attempt to give a comprehensive survey of the large body of literature that estimates risk preferences because most of this research is silent on how their subjects' incomes affect the choices under investigation.

⁴ [Chiappori and Paiella \(2011\)](#) note that cross-sectional portfolio analyses suffer from an identification problem if true preferences are heterogeneous. To remedy this weakness, they use panel data from Italian households and find a small but significant negative correlation between wealth and risk aversion across households.

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