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Measuring time preferences: Comparing methods and evaluating the magnitude effect

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ABSTRACT

The discount rate is of great importance for all decisions in an intertemporal context. This study experimentally investigates the time preferences of German farmers and students by comparing two methods of discount rate elicitation. The first method is based on the elicitation of time preference and risk attitude using two multiple price lists. Afterward, the discount rate is estimated by taking the risk attitude into account. The second method also uses a multiple price list approach; however, in contrast to the first method, probability discounting is applied for eliciting time preference. In this case, the individual risk attitude is not elicited separately, and no assumptions regarding the shape of the utility function are necessary. Both methods are conducted in two magnitude treatments, using €100 and €300 as a baseline. The results reveal that the ascertained discount rates of both methods are different for farmers in both magnitude treatments and for students in the €300 treatment. This result contradicts previous findings on the comparison of these two methods. Furthermore, only the method based on the measurement of time preference and risk attitude separately reveals significant responsiveness to the magnitude of the experimental payout.

1. Introduction

The understanding of many economic decisions is decisively dependent on time preference, which is the exchange ratio between future and current welfare. At the societal level, the weighting between future and current consumption determines, for instance, the investment in environmental preservation (Laury et al., 2012). At the individual level, investment projects with future returns have to be related to the temporally differentiated investment costs (Laury et al., 2012). Due to its relevance, time preference is investigated in several research studies (Andreoni and Sprenger, 2012; Benhabib et al., 2010; Andersen et al., 2008; Coller and Williams, 1999), with some specifically targeting farmer preferences (Liebenehm and Waibel, 2014; Bocquého et al., 2013). The discount rate of farmers is especially relevant since they make decisions with long maturities and a high proportion of sunk costs; e.g., the cultivation of perennial crops or the use of specific livestock buildings (Herberich and List, 2012; Moschini and Hennessy, 2001).

While time preference can be estimated using field data (Hausman, 1979), most research effort is spent on the experimental elicitation of time preference as discount rates (Andreoni et al., 2015). Nevertheless, the time preference elicited by experiments varies between different investigations. Frederick et al. (2002) provided an overview of various studies investigating time preference, which revealed a range of discount rates from −6% to a measurement of rate approaching infinity. One explanation for these differences in the measured discount rate is the use of a range of different experimental measurement approaches due to a lack of consensus on the appropriate method (Andreoni et al., 2015). Furthermore, differences in measured time preferences may originate from behavioral effects, for instance, the so-called magnitude effect; i.e., decreasing discount rates caused by increasing amounts of experimentally offered goods (Bocquého et al., 2013; Frederick et al., 2002; Pender, 1996).

With regard to the different time preferences reported in various studies, such as those mentioned above, other research studies focused on underlying assumptions to determine time preferences. While early research on time preference assumed linear preferences in wealth; i.e., risk neutrality (Coller and Williams, 1999), recent studies have challenged this assumption (Andersen et al., 2008), as evidence for risk-averse behavior has been found in many studies (Laury et al., 2012; Andersen et al., 2006; Holt and Laury, 2002). Therefore, Andersen et al. (2008) concluded that there may be an erroneous determination of discount rates if a risk-neutral decision-maker is assumed *a priori*. Consequently,

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Andersen et al. (2008) measured the discount rates by using the method of Coller and Williams (1999) and measured the risk attitude in the same way as Holt and Laury (2002), and then estimated the individual discount rate and risk attitude of the experiment participants jointly. Another experimental method for the determination of discount rates was demonstrated by Laury et al. (2012). They did not elicit the risk attitude of the participants separately, but rather implicitly included it in the discount rate elicitation. The discount rate is elicited using a single experimental task; therefore, the elicitation of discount rates is simplified, and possible sources of errors, such as the assumption regarding the curvature of a utility function, can be avoided. Interestingly, Laury et al. (2012) found no significant difference between the discount rate elicited with their method and the discount rate estimated with the method of Andersen et al. (2008). Like most economic experiments (Anderson and Stafford, 2009; Anderhub et al., 2001; Coller and Williams, 1999), Laury et al. (2012) used students as experiment participants.

With this in mind, the aim of the present study was to clarify whether the methods of time preference elicitation and estimation by both Andersen et al. (2008) and Laury et al. (2012) lead to comparable results for entrepreneurs. Therefore, we investigated the time preference of German farmers, as an example for entrepreneurs, using both experimental methods in a within-subject design. For farmers, time preference has never before been compared using these two experimental methods. Furthermore, we investigated using a within-subject design to find whether the two elicitation methods reveal similar discount rates when they are applied to German students. Using the control group of students enables a ceteris paribus comparison of German farmers and students since the time preference is captured with the identical experimental procedure. Moreover, we examined a potential magnitude effect in a within-subject comparison by using different amounts of money to obtain the discount rate of farmers. To test the robustness of the results regarding the magnitude effect, we used the same monetary amounts for eliciting the discount rates of students as well. For these purposes, the discount rates are elicited experimentally and estimated afterward using structural maximum likelihood methods. Thus, the present study is an extension of the existing literature with regard to three aspects. Firstly, we tested whether the two methods by Andersen et al. (2008) and Laury et al. (2012) lead to comparable results when they are applied to farmers. Secondly, we measured discount rates of German students using the methods of Andersen et al. (2008) and Laury et al. (2012) to verify the results of Laury et al. (2012) for American students. Thirdly, we investigated a magnitude effect for both methods with both groups of participants. As for the method of Andersen et al. (2008), a magnitude effect has been investigated for the Danish population (Andersen et al., 2013), but to our knowledge, there has been no investigation of a magnitude effect for the Laury et al. (2012) method.

In Section 2, hypotheses are derived from the existing literature, and in Section 3 the experimental design is presented. Subsequently, Section 4 contains the theoretical considerations of the data analysis, and in Section 5, descriptive statistics are presented and the validity of the hypotheses is tested. Finally, the article ends with conclusions and future research perspectives in Section 6.

2. Hypotheses

The transfer of insights derived from a student sample to entrepreneurs in general, and to farmers more specifically, is not easily achieved. Barr and Hitt (1986) illustrated that the validity of experiments with students in behavioral research is controversial, and showed that managers act systematically unlike students in salary and selection decisions (e.g., the evaluation of applicants). One possible reason for these differences is provided by Andersen et al. (2010), who described the characteristics of students, including age and level of education, as more homogeneous compared to entrepreneurs. Harrison and List (2008) as well as Khera and Benson (1970) pointed out that the behavior of students cannot be generalized to entrepreneurs due to the different levels of experience of these two groups. Such differences in decision-making behavior also hold true for farmers and students, as Maart-Noelck and Musshoff (2014) revealed with regard to the risk attitude. Thus, it can be postulated that results derived from experiments with students are not directly applicable to entrepreneurs, such as farmers. Therefore, we attempted to verify whether the results obtained by Laury et al. (2012) with students also held true for farmers. Laury et al. (2012) compared the discount rate estimated with their own method to the discount rate estimated with the Andersen et al. (2008) method. They revealed that the estimated discount rates of both methods show similar results in a within-subject experiment with 103 American students. However, Laury et al. (2012) also indicated that their results should be validated with consideration to other populations. Moreover, to provide a control group for farmers, we also elicited the discount rates of German students by applying the method of Laury et al. (2012) and the method of Andersen et al. (2008). Thus, our first hypotheses are formulated as follows:

H1a: With German farmers as an example of entrepreneurs, the discount rate estimates do not differ between the methods of Andersen et al. (2008) and Laury et al. (2012).

H1b: For German students, the discount rate estimates do not differ between the methods of Andersen et al. (2008) and Laury et al. (2012).

In the literature, an influence of the value used for eliciting discount rates is described.[1] This so-called "magnitude effect" indicated that the discount rate decreases with increasing amounts of experimentally offered goods (Frederick et al., 2002). Andersen et al. (2013) provided an extensive overview regarding previous findings of the magnitude effect. In relation to farmers, Pender (1996) confirmed these results and showed that for farmers and agricultural workers in India, the discount rate substantially decreases with a larger expected quantity of rice offered. However, a closer examination of the studies cited by Andersen et al. (2013) revealed evidence of a lack of magnitude effect investigations using elicitation methods that contain uncertain payments comparable to the probability discounting method of Laury et al. (2012). The type of payment used most often in different experimental settings is fixed payments, as used in the Coller and Williams (1999) method. For instance, Holcomb and Nelson (1992) conducted an experiment in which participants have the choice between monetary amounts they could receive immediately ($5 or $17) and greater monetary amounts that could be received one day later. However, the participants have to decide between amounts that are certain. Kirby (1997) carried out auctions for delayed payments with magnitudes of either $10 or $20. The results revealed a decreasing discount rate with increasing values offered in the auctions. To measure the discount rates of 27 students, a fill-in-the-blank elicitation method was used by Benhabib et al. (2010). Participants were asked to state a monetary amount that would make them feel indifferent about receiving the money earlier or later. The later amounts were given, and varied between the guaranteed amounts of $10 and $100. Their findings were consistent with the magnitude effect. Andersen et al. (2013) used the

[1] We focus in the following on references using incentivized experiments, while there can also be found a large number of studies using hypothetical tasks.

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