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# FARM-LEVEL INVESTMENT ANALYSIS: WHAT DISCOUNT RATE TO USE?

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# FARM-LEVEL INVESTMENT ANALYSIS: WHAT DISCOUNT RATE TO USE?

## Abstract

A discount rate is based on different aspects and differs across regions, economic sectors, investment projects, and decision makers. The choice of a discount rate requires a fundamental analysis and argumentation, in order to avoid an under- or overestimation of investment projects. Having conducted a farm-level experiment in the North-Rhine Westphalia (NRW, Germany), we estimated the current discount rates in German agriculture, as well as quantify the effects of different factors on discount rate.

## Keywords

Farm experiment, discounting, time value of money, Germany, North-Rhine Westphalia

## 1 Introduction

Investment decisions are essential for farms' success and thus constitute the core activity of farm-level decision making (e.g. SAUER and LATACZ-LOHMANN 2015). The choice of a discount rate is crucial for a proper investment analysis. A discount rate is individual-specific and constantly changes depending on the economic environment and its perception. Moreover, discount rate differs across investment projects due to different related risks and opportunity costs. In this study, we therefore aim to provide a recent estimation of the current discount rates using the example of German agriculture and a quantitative analysis of factors influencing discount rate. We conduct an online experiment among German farmers and analyze the effect of characteristics of the farmers and his/her farm, and hypothetical investment.

## 2 State of the art

The major factors affecting the discount rate identified in the literature are cost of capital (opportunity costs); debt-equity share; taxes; inflation; liquidity preferences; and risks and risks perception (e.g. BARRY and ELLINGER 2012). In addition, time horizon of investments, age, income, and economic knowledge of the decision maker were found to be significant in some experiments (e.g. STEINBERG et al 2009; LAHAV, ROSENBOIM and SHAVIT 2015).

The existing literature usually suggests to use some general economic values as a rough approximation of the true discount rate, e.g. risk-free rate (e.g. ODENING, MUSSHOF and BALMANN 2005), also adjusted with an average market risk premium (e.g. MUSSHOF 2012); ignoring therefore individual characteristics of the investor. Recent papers on investment in German agriculture assumed an annual discount rate in the range from 3.69% (WOLBERT-HAVERKAMP and MUSSHOF 2014) to 13.87% (MUSSHOF 2012). There are some studies estimating the discount rate of a certain social group, but they either refer to another social group than farmers (e.g. HARRISON, LAU and WILLIAMS 2002), or to another region than Germany (e.g. DUQUETTE, HIGGINS and HOROWITZ 2012), or are outdated.

## 3 Methodology

An experiment was chosen because (i) we aim to obtain the true discount rates; (ii) we hypothesize that individual characteristics of a farmer have a substantial influence on his discount rate; and (iii) this method has been used previously to estimate a discount rate.

During the experiment we asked for a minimum amount of money that the respondent would

like to get later, in order to refuse from a certain amount of money now. In order to increase the plausibility of the answers, we proceed in the following way. First, we explicitly say that only one respondent with the lowest announced amount of money gets it later, while the others get the initially offered amount of money now<sup>1</sup>. Hence, everyone has incentives to choose an amount of money close to his/her personal minimum; while asking for too little money increases the chance to be the one who actually gets the money later. Second, we precise the revealed discount rate further, conducting an experiment based on the Holt and Larry lottery (HOLT and LAURY 2002), where the suggested amounts of money are chosen close to the one announced in the first experiment. At the end of the experiment we ask for personal characteristics and data. The experiment runs anonymously online using the software LimeSurvey. All the collected data are used further to estimate a regression with the revealed discount rate as the dependent variable.

#### **4 Pre-test experiment among students**

Eight investment options were constructed for the pre-test experiment, differing by the amount of money (100€ and 1'500€), the time horizon (0.5 and 3 years), and the context: one investment option was framed as a gambling situation, hence being familiar for most students, and the other one – as an investment in a fund, which is rather unfamiliar for students. The experiment for students was available online for ten days starting from 26 August 2016. 123 students at the age between 19 and 31 years with and without economic background took part in the pre-test of the experiment, while only 43 students completed this experiment. The participants mentioned extensive amount of required time as one of the major reason for interrupting the experiment. Screening for inconsistent answers and implausible time spent for the experiment removed further six observations from the sample.

Out of 37 observations, the average mean of the annual discount rate across all the investment projects is 16.9% with a substantial difference between the investment projects (from 5.1% to 33.9%) that hints on importance of the characteristics of the investment project for the choice of a discount rate. In particular, the amount of money and the time horizon both have a strong negative effect on the discount rate, although the coefficients were found to be insignificant.

#### **5 Experiment among farmers**

Based on the results obtained during the pretest experiment among students, some adjustments were made before conducting the experiment among farmers. The major ones are listed below.

First of all, we reduced the required time for the experiment by reducing the number of investment options offered to every participant. In particular, we formulate nine combinations of money (10'000€, 100'000€, and 1'000'000€) and time (1, 5, and 10 years) and randomly assign one of them to every participant. We therefore also test more different amounts of money and time horizons, than in the pretest experiment, that might improve the results of the regression estimation. Second, every investment option is represented as both single cash flow and annuity cash flows, in order to check whether the schedule of cash flows influences the annual discount rate. Finally, we abandon differentiating between familiar and unfamiliar investment options, since the pretest experiment among students revealed no significant difference.

The survey among farmers is still ongoing supported by the Chamber of Agriculture NRW. The obtained results are of high interest for scholars, policy makers, investors, and farmers.

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<sup>1</sup> Our experiment doesn't imply any payments; all the amounts of money are fictitious. Further research might introduce a real financial incentive for participation in the experiment, in order to increase plausibility and response rate.

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