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Research note

Internal governance and member investment behavior in energy cooperatives: An experimental approach

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ABSTRACT

Cooperatives may become increasingly important as suppliers of electricity from renewable resources. Numerous governance models exist for establishing a renewable energy cooperative. Since members self-select into the organization, causal links between methods of internal governance and member characteristics are difficult to identify. We demonstrate how economic experiments can address this problem. In a simple social-dilemma game, we study the impact of heterogeneity in wealth on investment in a jointly owned enterprise under two different governance models. We do not find that member heterogeneity or governance model affect investment levels. A participant's endowment appears to be the most important factor explaining variation in investment. Good knowledge of cooperative governance has a positive impact on investment in the game and good knowledge of game theory has a negative impact on investment in the game. Future research should investigate the effect of the distribution of control rights on the performance of cooperative enterprises.

1. Introduction

Cooperatives play a significant role in the global economy, and approximately one billion people are members of a cooperative (ICA, 2015). In some sectors, such as agriculture, cooperatives are responsible for the lion's share of the market (Bijman et al., 2012; Hanisch et al., 2013). Cooperatives succeed by pooling resources of their members while maintaining members' economic independence. By economizing on information and monitoring costs, cooperatives may be able to outperform long-term contracting in hierarchical organizations or short-term market contracting (Bonus, 1986; Ménard, 2004).

A number of generic governance models have emerged to address problems with heterogeneity in members' interests, wealth, and time horizons, and considerable diversity can be found in the internal methods of cooperative governance (Bijman et al., 2014; Chaddad and Cook, 2004). Internal governance can be defined as the sum of mechanisms an enterprise establishes within its boundaries to organize and control responsibilities and authority of its management, governing bodies, and owners. Differences in these mechanisms might emerge from transaction and ownership costs that firms seek to minimize under competition (Williamson, 1981; Hansmann, 1996). A growing body of literature is concerned with understanding the effect of different governance models on behavior and performance of agricultural cooperatives (Iliopoulos, 2015). However, relatively little is known about the energy sector, in which cooperatives are growing fast in number and size in many Western countries (Yildiz et al., 2015). Energy cooperatives may emerge from citizen initiatives and participatory processes in the context of electricity infrastructure planning and development (Schweizer et al., 2014). They are often formed by actors from diverse socio-economic backgrounds, and establishing an effective governance model becomes particularly important (Yildiz et al., 2015).

Empirical studies on the effect of internal governance on performance often find it difficult to identify a causal relationship because members self-select into the organization, and performance may be either an outcome or a cause of changes in governance. In addition, it might be difficult to identify the causal effect of factors such as heterogeneity in wealth from observational data if

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these data are correlated with other factors. Especially in energy cooperatives, members might be motivated by concerns for the environment or regional economic development, which might also affect the way in which members organize their enterprise. In this case, the effects of members' characteristics and internal governance on performance cannot be easily separated. Natural field experiments within or between firms help to address this dilemma but still face several practical and ethical challenges (Bandiera et al., 2011).

In this paper, we argue that economic experiments can provide insights that complement other research methods. In experiments, factors such as heterogeneity in wealth can be exogenously manipulated, and their effect on outcomes can be identified. Our study is closely related to the economic experiment of Fehr et al. (2008), who found that joint ownership may be more efficient than individual ownership. We modify their experiment to investigate how variations in wealth may impact behavior under two different models of joint ownership. In the first model participants' profits depend on the total amount invested. In the second model, additional returns are realized from one's own investment. Our paper demonstrates how economic experiments can contribute to the analysis of internal governance in cooperative enterprises. In the next section, we introduce the experimental design and procedures. We then present the results, which are discussed in the final section.

2. The experiment

2.1. Theoretical background and context

Our experiment is based on a social-dilemma game, which we define as a game in which individually rational and selfish behavior leads to socially undesirable outcomes. Specifically, we use a slightly modified and framed version of an n-player linear voluntary contribution mechanism public-goods game (Isaac et al., 1984). In every round r, a player i can invest from an initial endowment e_{ir}. Profits π_{ir} are determined by the amount invested x_{ir} and the total amount invested by the $j\ (=n-1)$ other players $\sum_{j\neq i}^{n-1} x_{jr}$:

$$\pi_{ir} = \frac{a\left(\sum_{j\neq i}^{n-1} x_{jr} + x_{ir}\right)}{n} + e_{ir} - x_{ir} + bx_{ir}$$

where a is a constant that satisfies $1 < a < n$. We introduce b to allow for a special profit based on player i's investments independent of the other players' investments, where b must satisfy $0 < a/n + b < 1$. From these conditions, it follows that in a finitely repeated game, investing the smallest possible amount is a dominant strategy for rational and selfish players. Minimal investment of all n players is a unique Nash equilibrium.

From a member's perspective, investing into a cooperative is similar. Traditionally, profits and losses in cooperatives have been distributed according to patronage rather than on the basis of shares in equity capital. In other cases, profits and losses can be distributed evenly among members, or members can be forced to provide equity in proportion to patronage. Hence, members do not have an incentive to invest more than the minimum amount. In the past, many cooperatives (e.g., those in the dairy industry) have failed to raise equity for investing into modern equipment and to exploit economies of scale; thus, different governance models have emerged to either attract outside investors or to make investments more attractive for members by acknowledging heterogeneity in wealth and interests (Chaddad and Cook, 2004; Iliopoulos, 2015). Specifically, in the so-called member-investor model (Chaddad and Cook, 2004), members receive a larger share of profits contingent on amounts invested, and members are free to choose how much to invest.

Choosing an effective governance model is also an important question for energy cooperatives which are formed under the joint objective of producing, trading, or distributing electricity from renewable resources and those marked by a relatively high degree of heterogeneity in member characteristics (Yildiz, 2014; Yildiz et al., 2015). Energy cooperatives differ substantially in terms of their integration along the electricity and heat value chains. Some cooperatives solely engage in the trade of electricity; some generate from renewable resources and feed electricity into the grid; some operate local heat grids and in a few cases even electricity distribution grids (Yildiz et al., 2015). Requirements for internal governance differ according to these functions. In contrast to agricultural cooperatives, members' motives to join are also more diverse. A recent survey of energy cooperatives by the German Raiffeisen and Cooperative Association found that in addition to dividends, the promotion of renewable energy and regional value creation are also mentioned as main motivations (DGRV, 2014; cf. Wieg, 2014).

The diversity in motivations is also reflected in the numerous business models that exist for financial participation of citizens in renewable energy projects in general and for cooperatives in particular. Notably, some cooperatives pay dividends of four or five percent on members' shares, whereas others do not pay dividends so that surpluses can be invested in new projects or used to support community projects, such as childcare centers. At the same time, heterogeneity exists in the amount members invest within and between enterprises and in the rules regarding minimum investments (DGRV, 2014; Yildiz, 2014).

We use this context in our experiment for framing the investment decision in the game as a decision to invest into a jointly-owned energy cooperative in Berlin, Germany. We conducted the experiment with graduate students of Environmental and Agricultural Economics Master programs at Humboldt-Universität zu Berlin, Germany. Because of their academic background and a recent political referendum in the city of Berlin on transforming the city's electricity grid and power generation capacities from an investor-oriented model to a cooperative (cf. Kunze and Becker, 2015), subjects were familiar with the decision context. This familiarity is important to our study because "it is not the case that abstract, context-free experiments provide more general findings if the context itself is relevant to the performance of subjects" (Harrison and List, 2004, p. 1022).

2.2. Experimental design

We manipulate two factors in the experiment: (1) the marginal per-capita return (MPCR) from one's own investment and (2) heterogeneity in endowments. In one half of treatments, constants are set to $a = 0.65$ and $b = 0$ with a MPCR $= 0.65$, which is similar to a traditional cooperative model (cf. Chaddad and Cook, 2004). In the other half, constants are $a = 0.5$ and $b = 0.3$ with a MPCR $= 0.8$, which is similar to a member-investor model. Endowments are varied in three levels. Each of the $n = 2$ players is endowed with either $e = 50, 100$, or 150 experimental coins. Investments (x) must be at least 10 coins and can be raised in increments of 10 coins up to the total endowment. We combine both factors in a full factorial within-subjects design with $r = 6$ (cf. Table 1).

The public-goods game is a standard experiment that has been widely studied in the lab (see Ledyard (1995) or Zelmer (2003) for summaries of empirical findings), and both factors (variation in the MPCR and endowment heterogeneity) have been previously investigated (e.g., Chan et al., 1996, 1999; Cherry et al., 2005). In a quantitative meta-analysis, Zelmer (2003) finds that increasing the MPCR has a large and statistically significant positive effect on