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Understanding the role of social capital in adoption decisions: An application to irrigation technology

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ABSTRACT

Recently, social capital has gained importance in explaining technology adoption decisions by farmers. In this paper, we examine the impact of social capital on the adoption of irrigation technology and irrigation scheduling among wine producers in Central Chile. We propose three hypotheses: that trust and networks affect positively the adoption of both technologies (H1 and H2) and that trust is positively related to networks (H3). First, we identify seven different components of social capital: general trust, trust in institutions, trust in water communities, norms, formal networks, informal networks, and size of networks. Second, we estimate two Partial Least Squares models using as endogenous variables irrigation technology adoption and adoption of irrigation scheduling. Both models tested confirm the relevance of our interpretation of the use of social capital and its implications in understanding producers' behaviour towards adoption of technologies. The three hypotheses tested positive. Trust in institutions, and formal and informal networks have a positive impact on the adoption of both technologies. General trust has a positive relationship with formal and informal networks. Human capital also has a strong relationship with networks, which allows us to argue that networks are the main catalysts of social capital. As expected, physical and human capital have a positive and significant relationship with adoption. Our results support that extension efforts should consider social networks, not just economic or individual-level predictors, in promoting agricultural innovations.

1. Introduction

Understanding producers' decisions regarding technology adoption has been a major area of agricultural research for several decades. In 1984, Feder & Slade published a widely recognized study of the factors that predict agricultural innovation and adoption to increase productivity, essential to economic growth and development (Doss, 2006; Baerenklau and Knapp, 2007). A standard utility model is commonly used in explaining technology adoption where farmer characteristics (human capital) and farm structure (physical capital) are the main factors affecting the utility of the technology (e.g. Foster and Rosenzweig, 2010; Abdulai et al., 2011; Abdulai and Huffman, 2014; Wossen et al., 2015). Although such studies consider human and physical capital, they address the individual level only, ignoring that individual decisions are embedded within a more complex system corresponding to a community whose shared common interests, activities and concerns lead to individual decisions (Oreszczyn et al., 2010) and shape institutions that must accommodate the physical, economic, and cultural environment of those individuals (Ostrom, 1993). At this point, to build a social capital framework, we break the system concept into individual factors who make decisions as part of their interactions in a social process and within a social environment (Pannell et al., 2006; Aguilar-GAllegos et al., 2015). We will elaborate further on this factor.

Lyda Hanifan first mentioned the concept of social capital in 1916 (Lollo, 2012), but only since the 1990s has it been linked to development and economic growth. As stated by Putnam (1993), social capital enables the formulation of new strategies for development. Although there is no consensus on its definition (Chou, 2006; Sabatini, 2006; Ng'ang'a et al., 2016), social capital is generally explained in the literature as being characterized by networks, norms and trust in social interrelationships that facilitate cooperation and coordination of people to achieve desired goals and mutual benefit (Narayan and Cassidy, 2001; Putnam, 1993). The conceptual vagueness is intensified by the lack of agreement on how to measure social capital (Sabatini, 2006). As social ties, trust and norms are not directly observable (Krishna, 2004), it is necessary to use indirect indicators for measurement (Sabatini, 2006).

Notwithstanding the difficulties in defining social capital, several studies put forward the idea that its main contribution is to facilitate information flows among individuals, which may encourage adoption processes (Läpple and Van Rensburg, 2011; Ramirez, 2013; Micheels

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and Nolan, 2016). According to Micheels and Nolan (2016) the number of adopted technologies has a positive correlation with the farmer social capital. Pannell et al. (2006) refer to adoption as a learning process that occurs through the collection of information and the acquisition of practical skills. Eastwood et al. (2012), going further, also refer to the social nature of learning, considering the adoption of technology to be the tip of the iceberg and that, after adoption, there will be changes in management practices as well as adoption of additional technologies, signaling trust and networks as the main sources of this dynamic. Although this interaction has visible merits, it also can have undesirable effects, such as when bad performance of the technology adopted by some farmers leads to wider rejection of the technology within the community. Moreover, according to Adrianzen (2009), there is a trend among rural households to react more drastically to a bad performance of a new technology than to one that performs well.

As stated above, we argue that social capital components play a relevant role in the adoption decision-making process. However, there is not clear conception on how the social capital components interact to define the behaviour of the producer. Understanding these interactions may shed light on the factors of social capital that can drive decision-making processes towards a specific behaviour. From this statement, two questions arise. What is the relationship of social capital and the behaviour of farmers regarding the use of a technology; and how are social capital components related to each other? As a case study we use irrigation technology adoption and the adoption of irrigation scheduling among medium to small vineyard producers in Chile. We understand irrigation technology not only as the implementation within the farm's irrigation system but also as the adoption of the knowhow to irrigate properly by establishing the time and frequency of irrigation. The adoption of better irrigation practices can benefit the producer by allowing for a higher yield and quality of the products and saving water resources that have been becoming scarcer in the recent years. Henceforth, in this paper we refer to the first process as *irrigation technology adoption* and the second process as *adoption of scheduling*. Although both processes are related, they can be treated as independent decisions and, therefore, we test separate models for irrigation technology adoption and the adoption of scheduling. Having described our study objective and the research context, we now present a literature review on social capital, after which we introduce our research framework and formulate the hypotheses.

2. Background on social and human capital

The factors determining the adoption or non-adoption of a certain technology in agriculture continue to draw research attention. Profitability of the technology to be adopted is usually considered as the key factor (Foster and Rosenzweig, 2010; Wossen et al., 2015), in which economic aspects, such as the availability of labour, crop price, price of resources or access to credit, are also ranked among the most relevant (Arellanes and Lee, 2003; Baumüller, 2012; Noltze, 2012; Genius et al., 2013; Abdulai and Huffman, 2014). Besides economic factors, other determinants are also considered. Traditional studies on technology adoption use socio-economic characteristics like age, gender and experience of the farmer, educational level, household size or income, to represent human capital (Arellanes and Lee, 2003; Foster and Rosenzweig, 2010; Abdulai et al., 2011; Genius et al., 2013; Handschuch et al., 2013; Ramirez, 2013; Abdulai and Huffman, 2014), and farm characteristics like farm size, land ownership, soil quality, machinery, type of crops or livestock as proxies for physical capital (Isham, 2002; Arellanes and Lee, 2003; Abdulai et al., 2011; Baumüller, 2012; Noltze, 2012; Handschuch et al., 2013; Ramirez, 2013). In addition to these established variables, several authors have emphasized social and institutional variables, thereby effectively turning the focus to social capital in addition to human and physical capital (Isham, 2002; Arellanes and Lee, 2003; Foster and Rosenzweig, 2010; Noltze, 2012; Abdulai and Huffman, 2014; Wossen et al., 2015; Aguilar-Gallegos et al., 2015).

As already mentioned, social capital has been conceptualized in various ways in the literature. It has been described as a valuable asset (Bolino et al., 2002), often created as a by-product of social activities (Putnam, 1993; Beugelsdijk and Smulders, 2003). Narayan and Cassidy (2001), Putnam (1993) and Woolcock (1998) define social capital as social interrelationships that facilitate cooperation and coordination of people to achieve desired goals and mutual benefit through norms, trust and networks. For Bourdieu (1980), social capital is a function inherent in the social structure and relationships among actors. In a more structured form, van Rijn et al. (2012) distinguish between cognitive and structural social capital, in which cognitive social capital is associated with norms, values and trust, while structural social capital is associated with either vertical or horizontal networks, in other words intra-community ties (Woolcock and Narayan, 2000; van Rijn et al., 2012). Social norms are hierarchical and not spontaneously developed (Fukuyama, 2001), and they influence the individual's preferences for respecting constraints. Norms combined with trust enable collective action (van Rijn et al., 2012). In contrast, structural social capital is associated with networks or inter-community ties, known as bonding social capital (Woolcock and Narayan, 2000), that could be horizontal and include informal ties that bridge different communities or organizations, such as family and friends, formal or open networks, or vertical relationships.

Evidence shows that social capital leads to an increase in economic growth and facilitates economic and community development (Narayan and Cassidy, 2001; Knack and Keefer, 1997; Woolcock and Narayan, 2000). Hence, creating and strengthening social capital has been seen as relevant for local economies. Factors like homogeneity, such as belonging to the same ethnic group and having the same language or religion (Chou, 2006), reinforce social capital because they lead to similarity in interests and values (Lollo, 2012). According to Lollo (2012), a second important determinant of social capital is clear rules and a sufficient flow of information expressed by an explicit hierarchy that, in the socio-technological landscape, is not influenced directly by the individuals but drives changes (Hermans et al., 2013). In other words, being a member of the group is necessary for the individual's creation of social capital (Lollo, 2012). Further determinants for building social capital are the frequency and repetition of interactions as well as opportunity and motivation for participation in a group (Lollo, 2012) and at least a basic level of education (Cramb, 2004).

The benefits of social capital are numerous. Generally speaking, social capital promotes collective work, reduces transaction costs and increases transaction ability (Isham, 2002; Fukuyama, 2001; Sabatini, 2006; Chalupnicek, 2010; van Rijn et al., 2012). Strong network ties lead to more effective and efficient work, along with an effective way to cope with risk. van Rijn et al. (2012) and Ng'ang'a et al. (2016) found that due to the reduction in transaction costs, social capital aids farmers in coping with risk, in which social capital can be seen as a mutual insurance. Trust enables exchange and responsibility among individuals to protect themselves against risks and shocks. The main advantage of social capital is seen in the information flow provided by networks and trust (Bolino et al., 2002; Bouma et al., 2008; Eastwood et al., 2012). According to Fisher (2013), trust constitutes the catalyst that promotes the transformation of information into usable knowledge. Networks, in contrast, provide the environment for the exchange of information as they can “bridge the gap between supply of new technologies and the firms who may adopt” (Micheels and Nolan, 2016). Not only does the amount of information increase and become more accessible (Adler and Kwon, 2002), but the information in the network is also filtered, concentrated and legitimated (Burt, 1997; Chalupnicek, 2010). Adopters can be distinguished by not only having more information, but also because they actively collect more information (Läpple and Van Rensburg, 2011). The main sources of information are extension agents and other farmers (Isham, 2002; Eastwood et al., 2012). Although