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Informational cascades and technology adoption: Evidence from Greek and German organic growers

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ABSTRACT

The present study aims to empirically analyze the effect of social interactions and conversion subsidies on the adoption rates of organic farming practices in two samples of olive and cereal growers in Greece and Germany, respectively. To this end we construct two alternative indicators to capture informational cascades created in rural areas. The first indicator is based on demographic characteristics while the other one on profitability considerations since farmers are likely to imitate the behavior of more successful farmers. Building upon the theoretical findings of Foster and Rosenweig (1995), Munshi (2004), Bandiera and Rasul (2006) and Weber (2012), we find that informational cascades are indeed important in revising farmers' perceptions and adoption behavior in both rural areas of Europe. Our results show that conversion subsidies can enhance social network effects internalizing informational externalities even in areas where adoption rates are considerable. This finding is independent of the crop and the country under consideration underlying the importance of informational cascades for technology adoption.

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Introduction

During the last decades, organic farming production has significantly grown within the European agricultural sector. This growth in organic production is partly due to the recent CAP reforms directed at promoting organic practices across the EU. The redirection of European agricultural policy discussions towards the promotion of organic farming is primarily based on the belief that organic technology carries the potential of a sustainable development. Indeed, unlike conventional agricultural technologies, organic farming represents an agricultural production system that can promote consumers' health by improving food security and quality with minimum adverse environmental impacts. In this context, organic farming can constitute a viable alternative production practice that can contribute to an economically and ecologically sustainable development. Nevertheless, the main question to be answered is what constitutes the most effective way to promote organic farming in the EU. Apparently, the answer depends on the key determinants that affect the adoption decisions of farmers.

Since Griliches' (1957) seminal paper on hybrid corn, there has been an extensive research on the determinants of technology adoption in agriculture.[2] Most of this comprehensive work attributes farmers' adoption decisions mainly to socio-economic, demographical and environmental factors. Nevertheless, more recent contributions challenge this perception arguing that these factors fail to explain accurately the diffusion patterns of new technologies (Feder et al., 1985; Besley and Case, 1993; Wozniak, 1993; Rogers, 1995). The reasoning behind this view is that socio-economic, demographical, and environmental characteristics are conditional on a farmer's information on the new technology. Thus, information accumulation is of particular importance when the determinants of adoption decisions are in question.

Although early work on this field has well established the theoretical links between information accumulation and technology adoption,[3] more recent contributions point to the importance of technology characteristics in the adoption process. According to this view, the distinct features of a new technology may raise barriers to technology adoption. Evenson and Westphal (1995) were the first to summarize these characteristics under the notions of *tacitness* and

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[2] Excellent surveys of the existing literature on technological adoption models are provided by Feder and Umali (1993) and Sunding and Zilberman (2001). In addition, Besley and Case (1993) provide a detailed review of some possible empirical models for studying technology adoption in agriculture.

[3] Stigler (1961), Nelson and Phelps (1966), Schultz (1972), Huffman (1977), Rahm and Huffman (1984), and Lin (1991) were the first to establish the theoretical links between information accumulation and technology adoption.

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circumstantial sensitivity of the new technology. Techniques of production are tacit if they are not fully embodied in a set of artifacts like a collection of machines, seeds, manuals or blueprints. Producers may employ differently the tacit elements of the new technology using ostensibly identical production techniques. Moreover, the performance characteristics of a particular production technology might be sensitive to the circumstances under which it is used. Non-tradable inputs (most obviously land) vary in characteristics in ways that affect the performance of different technologies. For instance, two farmers under the same circumstances may employ pest control techniques using the same set of inputs. Nevertheless, they may actually employ two distinct techniques due to differences in their understanding of the tacit elements of the technology. In addition, the application of pest control will depend on local circumstances such as soil, and climate conditions which differ among locations.

To overcome the tacit and circumstantial barriers to adoption, there must be investments in learning. There are two types of learning. Farmers might engage themselves in *learning-by-doing*, experimenting with the new technology to reveal the tacit elements of the technology or to determine its sensitivity to local conditions. Alternatively, farmers might *learn-from-others*, either from other producers, or from locally based researchers and extension agents. The two types of learning have different implications for policy and for the character of agricultural growth. When producers learn from their own experimentation, they actually undertake an investment that yields uncertain returns. When producers learn from each other, not only is there risky investment, but that investment generates informational spillovers. These notions are related to what Rogers (1995) defines as the *hardware* and *software* aspects of a new technology. The former is the tool or the physical object that embodies the technology (*e.g.*, tractor) whereas the later is the information base needed to use it efficiently. To pass on software knowledge, potential users need to be able to communicate directly with current users who have accumulated experience with the new technology.

Among the different types of learning, learning-from-others (also called *social learning*) has attracted the interest of many researchers. Social learning essentially describes a process of information accumulation by which an individual producer learns from his neighbors' experiences with the new technology. Foster and Rosenweig (1995) were the first to explore how learning-from-others can affect adoption choices studying the adoption of HYV in rural India. Munshi (2004) showed that individual producers may benefit less from informational spillovers if the performance of the new technology depends on current users' skills. Bandiera and Rasul (2006) and Maertens (2009) went one step further underlining the important role of informational spillovers in the adoption of farm technologies, while Conley and Udry (2010) found that farmers adapt their behavior following the information they gather from most successful neighbors. On the other hand, Moser and Barrett (2006) revealed that formal informational channels (*i.e.*, extension personnel) act as substitutes to social learning processes in rural Madagascar. Finally, Weber (2012) attempted to disentangle the effect of correlated unobservable variables with the social learning process using a unique dataset from Peruvian coffee producers.

Although, both theoretical arguments and empirical evidence underline the importance of social learning in agricultural technology adoption, current CAP reforms have been limited to promoting organic farming in the EU mainly via subsidy-driven policy schemes (summarized in EU Regulations 1257/1999 and 834/2007). Analyzing these policy schemes, Lampkin and Padel (1994) and Pietola and Oude Lansink (2001) found that conversion subsidies have significantly expanded organic farming throughout Europe at least in the early years. Indeed, financial incentives such as direct subsidies are common and effective means of overcoming farmers' adverse perceptions. Nevertheless, these types of incentives are costly. Given that adoption depends primarily on farmers' perceptions, a less costly way to promote organic adoption is the provision of informational incentives that revise producers' perceptions about the profit-effectiveness of new organic technologies. Although fixed initial costs are incurred, informational incentives may be less costly in the long-run. While both information and subsidy policies speed up adoption and diffusion of new technologies, subsidy policies may yield welfare losses in the form of income transfers from other sectors of the economy (Stoneman and David, 1986). Moreover, market services and information sources might be more effective than subsidies in encouraging organic adoption throughout the EU (Lohr and Salomonsson, 2000).

In light of the above and building upon the theoretical developments of Foster and Rosenweig (1995), Munshi (2004), Bandiera and Rasul (2006) and, Weber (2012), the objective of this paper is to empirically evaluate the effects of social learning and financial incentives on á farmer's decision to adopt organic farming. To capture empirically the effects of social learning on individual adoption decisions, we suggest two alternative indices based on Rogers' (1995) definition of social networks in rural areas as well as on profitability considerations. In addition, in order to analyze whether the effect of subsidies depends on the strength of social networks and vice versa we introduce nonlinearities in our model under the form of interaction terms. Our empirical model utilizes two different samples of olive and cereal growers in Greece and Germany, respectively. Both olive and cereal production constitute significant portions of the total crop production in the regions under consideration emphasizing the importance of our empirical findings. Moreover, using different datasets from two case countries enables us to examine whether the cause-effect results (*i.e.*, informational cascades) are limited to a specific crop or country. Empirical results suggest that indeed informational spillovers are more important factors than conversion subsidies fostering the adoption of organic farming technology in both Greece and Germany. In particular, the results indicate that the marginal effect of an additional homophylic adopter is four times as large as the effect of an increase of 1000 euros in the amount of subsidies.

In Section ''Social learning, learning-by-doing and subsidies'' we discuss the relationship between subsidies, social learning, and learning from others. Next we present the empirical model and discuss the econometric specification and the data used. In Section '' Empirical results'' we present the estimation results, while in the last section we discuss some important policy recommendations implied by our findings.

Social learning, learning-by-doing and subsidies

Information accumulation and financial incentives along with their interactions are likely to affect significantly farmers' adoption decisions. Although the channels through which financial incentives (such as subsidies) can affect adoption are rather clear, the determinants of information accumulation are quite complicated. Investments in learning and informational campaigns enhance information accumulation which in turn remove the barriers to technology adoption. Investments in learning can take two forms, *i.e.*, learning-by-doing and learning from others (also called social learning). When farmers are experimenting with the new technology they engage themselves in learning-by-doing. This expertise is a form of human capital. The more the farmer uses a technology, the better he learns its distinct characteristics, and the more productive he gets (Jovanovic and Nyark, 1996). In addition, the better he learns the elements of the technology, the more likely he is to adopt it.

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