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Opinion leadership and willingness to pay for residential photovoltaic systems

Yoshihiro Yamamoto

Department of Economics, Takasaki City University of Economics, Takasaki 370-0801, Japan

HIGHLIGHTS

- Interpersonal communication about the adoption of PV systems is analyzed.
- A questionnaire survey is conducted.
- Opinion leaders on PV-system adoption are identified.
- A relationship is confirmed between willingness to pay and opinion leadership.
- Subsidization is more essential than feed-in tariffs from this point of view.

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ABSTRACT

According to diffusion theory, opinion leaders play an important role in the diffusion of new technologies through interpersonal communication with potential adopters. This study investigates the role and utility of opinion leadership in photovoltaic (PV) system diffusion. Specifically, the study proposes, examines, and considers the implications of the hypothesis that there is a positive relationship between willingness to pay (WTP) for a PV system and opinion leadership on PV-system adoption. The investigation employed an internet-based questionnaire to assess the use of interpersonal communication in decision-making on adoption, to identify opinion leaders on adoption, and to characterize their WTP. The response pool consisted of 488 individuals who lived in a detached house, owned a residential PV system, and were responsible for making the decision to adopt the system. The results support the hypothesis. Considering that subsidization preferentially incentivizes households with greater WTP to adopt PV systems, this suggests that subsidization is more effective than purchases of PV power under feed-in tariffs in promoting the diffusion of residential PV systems through interpersonal communication.

1. Introduction

Governments seeking to diffuse photovoltaic (PV) systems widely throughout society typically offer incentives such as subsidization, tax credits, and feed-in tariffs (FIT) to promote widespread adoption. Such incentives, along with the reductions in the cost of PV systems that have accompanied the development of PV technology, increase the advantages of adopting PV systems for potential adopters. Generally, if the advantages that a new technology offers include economic advantages over existing technology, the rate of adoption will be rapid (Rogers, 2003, pp. 229–230). On the basis of this understanding, numerous studies have investigated the diffusion of PV systems, including Lesser and Su (2008), Parker (2008), and Rigter and Vidican (2010), among others. In the view of technology diffusion reflected in these studies, the key to successful diffusion is cost reduction through technological development and incentives provided by government. Many studies have furthermore investigated the diffusion of PV systems with regard to FIT; recent examples include Cherrington et al. (2013), Martin and Rice (2013), Antonelli and Desideri (2014) and Campoccia et al. (2014).

However, another perspective on technology diffusion also merits attention, one with implications for the diffusion of PV systems in particular. This perspective focuses not on the new technology to be diffused, but rather on the members of society who adopt it. Studies based on this understanding include Faiers and Neame (2006), Bollinger and Gillingham (2012), Zhai and Williams (2012), Rai and Robinson (2013), Noll et al. (2014) and Schelly (2014). Implicit in this view is the epidemic model, in which it is presumed that "the primary factor limiting diffusion is

E-mail address: ysyama@tcue.ac.jp

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information, and that the most important source of information about a new technology is people or firms who have tried it" (Jaffe et al., 2003, p. 489). From this viewpoint, communication between those who have already adopted and those who have not yet but are considering adopting must be understood to play an important role in diffusion. Furthermore, such communication is most likely to occur if those who have already adopted are regarded as opinion leaders who are often asked for information or advice.

In a seminal work on technology diffusion, Rogers (2003) offered a comprehensive analysis of the role played by opinion leadership and opinion leaders in the diffusion of innovations such as new ideas and technologies. According to Rogers, diffusion may be defined as "the process in which an innovation is communicated through certain channels over time among the members of a social system" (p. 5). Opinion leadership, in particular, is "the degree to which an individual is able informally to influence other individuals' attitudes or overt behavior in a desired way with relative frequency. Opinion leaders are individuals who lead in influencing others' opinions" (p. 300). From these definitions, it follows that for potential adopters in the process of decision-making on adoption, "one way to cope with the inherent uncertainty about an innovation's consequences is to try out the new idea on a partial basis…. A demonstration can be quite effective in speeding up the diffusion process, especially if the demonstrator is an opinion leader" (p. 177).

This view suggests that if opinion leaders adopt PV systems during an early phase of the diffusion of a new technology, the subsequent diffusion—through the mechanism of interpersonal communication—will be broader, more rapid, or both than it would be if they had not adopted. The assumption of interpersonal communication as the mechanism of opinion leadership furthermore suggests an alternative policy approach to incentives than currently employed to promote PV-system diffusion. If some condition marking a person as an opinion leader on PV-system adoption could be identified, a government might use it in designing an incentive program to encourage opinion leaders to adopt preferentially. Critically, the development of such an approach would depend on finding such a condition.

I hypothesize that there is a positive relationship between willingness to pay (WTP), that is, the maximum amount of money a person is willing to pay for a PV system, and the level of opinion leadership exerted by that person, and hence, that greater WTP can serve as a condition indicating higher opinion leadership. (WTP can be understood to represent how much a person values a PV system since he or she will not pay more than this value to obtain one.) The reasoning behind this hypothesis is that opinion leaders are more likely than others to recognize—and pay for—the high value that solar power generation by PV systems offers to society.

If this hypothesis is correct, then policymakers could increase the diffusion of PV systems with programs designed to incentivize those with greater WTP to adopt preferentially. This would be a relatively easy task since WTP involves monetary values that could tractably be reflected in an incentive program.

The present study offers an empirical investigation that supports the above hypothesis. In the investigation, the first question examined was whether or not interpersonal communication plays a role in decision-making on PV-system adoption; in a survey of households with installed PV systems, respondents were asked, first, whether or not they had received information or advice from those who had already adopted, and second, whether or not they were asked for information or advice from those who were considering adopting. When it was shown that interpersonal communication plays a role in decision-making on PV-system adoption, the investigation then turned to characterizing respondents with regard to opinion leadership and WTP. In particular, opinion leaders were identified as those who not only adopt the innovation—in this case, a PV system—earlier than others, but also are respected enough by other members of a social system to be asked for information or advice about the innovation.

The remainder of the paper is organized as follows. Section 2 presents as background a brief review of preceding studies, as well as a brief survey of the status of PV system diffusion and governmental policy with regard to diffusion in Japan. Section 2 also presents the methodology of the survey and an overview of the questionnaire; critically, this part explains how opinion leaders are identified. Section 3 presents the results and offers discussion regarding the use of interpersonal communication in PV-system diffusion, identification of opinion leaders, and WTP. Finally, Section 4 explores the policy implications of the results and concludes with suggestions for future research.

2. Methods

As background to the present study, which employs a questionnaire survey conducted in Japan, this section begins with a brief review of several preceding questionnaire-based studies, as well as a survey of the status of PV-system diffusion and governmental policy with regard to diffusion in Japan. (For more on PV-system diffusion in Japan, see also Mendonça, 2007, pp. 71–75.)

Critical to the survey employed in this study is the methodology of how opinion leaders are identified among respondents. The latter half of this section describes the procedure employed for identifying opinion leaders, which is predominantly based on the work of Rogers (2003). Finally, this section offers an overview of the survey, including a description of the respondents.

2.1. Literature review

Numerous studies have investigated the role of interpersonal communication in technology diffusion, among which Griliches (1957) and David (1966) are widely regarded as seminal. Other studies have addressed energy issues (Stern, 1992; Wilson and Dowlatabadi, 2007; Bollinger and Gillingham, 2012; Rai and Robinson, 2013). However, only a limited number of studies have focused on the diffusion of residential PV systems. Two of these in particular support the present study by showing the role of interpersonal communication in PV technology diffusion: Bollinger and Gillingham (2012), which provided a methodology for identifying peer effects and applied it to PV-system diffusion in California, and Rai and Robinson (2013), which quantified the effects of different information channels on aspiring PV adopters' decision-making.

Furthermore, the following studies provide context for the questionnaire survey-based approach taken in the present study. First, Labay and Kinnear (1981) investigated, by means of a questionnaire survey, differences in perceptions of the attributes of residential solar heating and hot water systems between adopters and non-adopters, with attention to demographic characteristics of respondents. Like the present study, Labay and Kinnear examined decision-making in the purchase of a new technology, if not PV systems, in view of differences between people. In contrast, the present study is concerned not with differences between adopters and non-adopters—Labay and Kinnear's concern—but rather with differences in level of opinion leadership among adopters.

Second, Jager (2006) also employed a questionnaire survey to investigate how people reach the decision to adopt a PV system. Jager examined the effects of information and support meetings organized by a municipality. The study shed light on social aspects of PV-system diffusion, showing that social motives, such as