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The drivers of eco-innovation and its impact on performance: Evidence from China

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ABSTRACT

This study sheds light on the driving forces of eco-innovation and the effects on firm performance. We focus on eco-innovation, which provides customer and business value, and contributes to sustainable development while decreasing environmental costs and impacts. The study uses data collected from 442 Chinese firms to investigate the relationship among the drivers, eco-innovation behavior, and firm performance. The results reveal that certain factors (i.e., technological capabilities, environmental organizational capabilities, a market-based instrument, competitive pressures, and customer green demand) contribute to the development of eco-innovation. Competitive pressure provides firms with the greatest incentive to adopt eco-innovation, followed by a market-based instrument, technological capabilities, customer green demand, and environmental organization capabilities. The market-based instrument is effective in inducing eco-innovation, while a command and control instrument does not. With regard to the adoption of eco-innovation, we show that eco-innovation behavior can significantly enhance a firm's environmental performance, and, through environmental performance, has an indirect positive impact on its economic performance. These findings support the "Porter hypothesis," and have several implications for both policy makers and business managers.

1. Introduction

The global environmental crisis, including the lack of resources, environment degradation, and pollution, has pushed countries all over the world to pay greater attention to sustainable development. At the same time, eco-innovation has become an inevitable choice for firms as a means to gain a competitive advantage and pursue sustainability under increasing environmental pressure. Compared to traditional innovation, eco-innovation has a so-called double externality problem, namely, innovation spillover in the research and innovation phases and environmental spillover in the adoption and diffusion phases (Rennings, 2000), which thereby reduce the incentives for its adoption. To further complicate the situation, the driving forces of eco-innovation, eco-innovation behavior, and performance remain unclear. Thus, there is a need for clarification as well as specific management and policy approaches that foster eco-innovation. In China, as an example, this situation is of a particularly critical nature as many environmental policies have been established to meet the soaring demands of the economy while seeking to create a low emission and sustainable environment.

A number of researchers in the field of innovation, management, environmental economics, stakeholder theory, and institutional theory have investigated the primary factors that drive eco-innovation. Insights from the field of innovation indicate that technology push and market demand pull are the most important factors in general (Horbach, 2008). Studies in the field of management suggest that corporate social responsibility internalizes environmental protection responsibility as part of a firm's strategy through increasing investments in eco-innovation (Bansal and Hunter, 2003; Kesidou and Demirel, 2012; Potoski and Prakash, 2003). Other scholars have concentrated on the importance of organizational capabilities, particularly environmental management systems (EMS) in stimulating eco-innovation (Horbach, 2008; Rehfeld et al., 2006; Wagner, 2008). The assumption is that implementation of EMS facilitates eco-innovation because it can enhance environmental awareness and increase operating efficiency within a firm. Studies close to the field of environmental economics, mainly from the micro level, analyze the impact of environmental regulation (e.g., standards, emissions charges, subsidies, and permits) on a firm's eco-innovation behavior

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(Brunnermeier and Cohen, 2003; Frondel et al., 2007; Kammerer, 2009). Several recent stakeholder theoretical studies state that stakeholder pressure is an important factor that triggers a company's adoption of eco-innovation. Moreover, numerous studies (Li, 2014; Zhu and Geng, 2013) applying institutional theory suggest institutional isomorphism promotes the reproduction of organizational innovation behaviors. All institutional pressures provide firms with important incentives to respond to environmental issues.

On the other hand, although a growing body of literature explores the relationship between environmental behavior and firm performance through both case studies and econometric analysis, the results remain inconsistent (Frondel et al., 2007: Porter and Van der Linde, 1995). The traditional economic propose that any environmental improvement effort make a firm to absorb an external cost and create an offsetting effect: namely, diminishing returns (Gray and Shadbegian, 1998). In contrast, the amendment school of thought, represented by Porter, assumes that environmental policies may encourage regulated firms to develop technological innovation activities and induce more advantages, which may result in higher profits at a later date (Porter and Van der Linde, 1995).

In recent years, the study of how innovation drivers affect eco-innovation behavior, and other related variables, has become increasingly important at the industry level. Many researchers have recognized the importance of the resource-based view and institutional theory in explaining a firm's eco-innovation behavior (e.g., Bansal and Roth, 2000; Chen, 2008; Li, 2014; Sarkis et al., 2010). The resource-based view proposes that firms respond to external change based on their own internal resources and abilities (Oliver, 1997). Institutional theory focuses on external pressures and social expectations to explain a firm's innovation behavior. Based on a combination of the two aforementioned distinct but complementary theories, this study extends the discussion about the drivers of eco-innovation behaviors. Following the theoretical framework, a large-scale survey is performed to explore the effects of the driving forces and eco-innovation behaviors on environmental and economic performance. In line with Sarkis et al. (2010) and DiMaggio and Powell (1983), two dimensions of internal resources (technological capabilities and environmental organizational capabilities) and three forms of institutional pressure, namely, coercive pressure, normative pressure, and mimetic pressure, are examined in terms of their individual influence on eco-innovation practices and performance. Specifically, this study addresses the following research questions: Do technological capabilities, environmental organizational capabilities, a command and control instrument, a market-based instrument, customer green demand, and competitive pressures work as the driving forces that trigger implementation of eco-innovation? If so, what are their specific effects? Which driver is the most effective to induce eco-innovation in firms? Can eco-innovation behaviors really achieve economic performance for firms?

To answer the aforementioned research questions, this study provides three contributions to the current eco-innovation literature. First, the theoretical framework mixes the resource-based view and institutional economics to examine the complexity of factors stimulating eco-innovation decisions as well as performance. Second, the examination of environmental regulation as two individual components (i.e., a command and control instrument and a market-based instrument) also leads to valuable insights and various implications for researchers and policymakers. Third, we test environmental performance as mediator between eco-innovation behaviors and economic performance.

The paper is structured as follows: Section 2 provides further details on our theoretical framework to develop hypotheses on the factors and outcomes of eco-innovation. Section 3 contains the survey data and methodology. Section 4 presents the main results of our study and leads to the discussion, followed by a conclusion and implications of the research in Section 5.

2. Theoretical framework and research hypotheses

The resource-based view suggests that a firm's resources need to be rare, valuable, imperfectly imitable, and non-substitutable to sustain a competitive advantage (Barney, 1991). These resources are important determinants of eco-innovation, and we refer to the two forms of critical internal resources identified by Sarkis et al. (2010), namely, technological capabilities and environmental organizational capabilities.

Technological capabilities play an important role in generating innovation (Baumol, 2002; Pavitt, 1984). These capabilities are comprised of tangible technologies, intangible experience, and the specialized knowledge the firm has to develop green products and processes. The process of eco-innovation is actually environmental knowledge accumulation, integration, and utilization. Firms with highly developed eco-innovation capabilities may make full use of knowledge spillover in its cluster network, learn from others to improve its eco-innovation ability, and achieve further eco-innovation success in the future. Baumol (2002) describes these path dependencies with the expression, “innovation breeds innovation.” In other words, firms that have been innovative in the past are more likely to adopt innovation in the present (De Marchi, 2012; Mondéjar-Jiménez et al., 2015). Therefore, we postulate that:

Hypothesis 1. Technological capabilities are positively associated with eco-innovation.

EMS can be understood as environmental organizational capabilities, which assist a firm in achieving successful implementation of eco-innovation (e.g., Blind, 2012; Rehfeld et al., 2006; Rennings et al., 2006; Wagner, 2008). EMS refer to the environmental programs and practices of a firm that comprise a systematic, comprehensive, planned, and documented approach, focusing on the reduction of the firm's environmental impact. More specifically, EMS build organizational capabilities and practices, such as pollution prevention, source reduction, recycling, and green product design, which help firms promote operating efficiency aimed at improved environmental quality in combination with decreased costs. That is, EMS, and in particular, certified EMS, directly facilitate the adoption of eco-innovation by mandating firms to establish environmental goals and management structures as well as programs by providing the critical environmental information (Melnyk et al., 2003). For example, since 1990, General Electric (GE) has launched EMS to achieve continuous improvement in environmental, health, and safety performance. EMS have become a part of the corporate culture of GE. Over the years, GE has provided environmental training for vendors and required them to comply with environmental regulations. Therefore, the concept of an eco-innovation management culture will be imperceptibly spread by the interaction process of firms and stakeholders. Thus, the capability to eco-innovate is thereby enhanced. Based on the findings of prior research, we propose the following:

Hypothesis 2. Environmental organizational capabilities are positively associated with eco-innovation.

Eco-innovation depends not only on internal drivers but also on many external pressures. Based on institutional theory, the external pressures encompass three types. The first is coercive pressure, associated with environmental regulation, and is typically exerted by the government. The second is normative pressure, and refers to a firm's need to increase its abilities to satisfy its stakeholders such as customers and suppliers. The third is mimetic pressure, and refers to