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How Green Management Influences Product Innovation in China: The Role of Institutional Benefits

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Abstract Does being green facilitate product innovation? This study examines whether green management in firms operating in China fosters radical product innovation to a greater extent than it does incremental product innovation and investigates the underlying institutional mechanisms involved in the relationship between green management and product innovation. The findings show that green management is more likely to lead to radical product innovation than to incremental product innovation. Moreover, government support as a formal institutional benefit more strongly mediates the effect of green management on radical product innovation than its effect on incremental product innovation; whereas social legitimacy as an informal institutional benefit more strongly mediates the effect of green management on incremental product innovation than its effect on radical product innovation. These findings provide important implications for explaining how

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firms employ green management to facilitate product innovation.

> Did you ever stop to notice, this crying Earth, these weeping shores?—Michael Jackson, "Earth"

Introduction

Being green has become an important consideration for firms due to growing public concern with environmental issues, which in turn has stimulated growing interest among scholars in examining green management. A variety of environmental topics have been examined, including green orientation (Hong et al. 2009), environmental corporate social responsibility (Ambec and Lanoie 2008), environmental social responsibility (Siegel 2009), environmental orientation (Fraj-Andres et al. 2009), and environmental management (Florida and Davison 2001; Molina-Azorín et al. 2009). In line with this stream of research, we examine *how green management affects a firm's product innovation from an institutional perspective*, based on the research gaps we identify below.

First, the extant literature has focused primarily on how corporate green practice directly affects firm performance (Ambec and Lanoie 2008; McWilliams and Siegel 2000; Orlitzky et al. 2003; Peng and Lin 2008), treating the mechanisms involved in this relationship as a black box. Based on an extensive review of green management practices, Molina-Azorín et al. (2009) suggest that green

management may not directly contribute to performance; it is, therefore, necessary to examine intermediate outcomes, such as product innovation (see also Ambec and Lanoie 2008; Haanaes et al. 2013). *Product innovation* refers to the introduction by a firm of a new product to a target market (Zhou et al. 2005; Shu et al. 2012) and it is the outcome from the new product development activities (Nakata and Sivakumar 1996). The significance of product innovation is well documented. As Sorescu and Spanjol (2008) show, in the packaged goods industry a break-through innovation increases firm value on average by $4.2 million. Although the green management literature has studied how to "green up" new product programs (Chen 2008; Chen and Chang 2013; Dangelico and Pujari 2010), the question of how green management influences product innovation has not been directly addressed.

Second, the mechanisms through which green management influences product innovation may be different in emerging economies from those in developed societies (Rojsek 2001; Brik et al. 2011). In developed countries, firms most likely green themselves up when they have accumulated enough resources and market share for their existing businesses (Sharma 2000). On the contrary, since firms in emerging economies such as China normally lack needed resources (Rettab et al. 2009), green management has become an important response to institutional pressures to gain certain institutional benefits such as tax abatements and supports. Although the institutional perspective is gaining prominence in explaining green management (Bansal and Roth 2000; Jennings and Zandbergen 1995), previous studies have paid limited attention to the exact role of institutional factors. Organizational strategies and behaviors are restricted and shaped by formal and informal institutions in which they are embedded (North 1990; Scott 1995). In responding to external institutions, organizations attempt to acquire resources, reduce uncertainty, and achieve and maintain legitimacy (Suchman 1995). However, institutions differ greatly across countries, especially between developed and emerging economies. While formal institutions are relatively well established in developed countries, emerging economies often lack stable factor markets and credible legal frameworks (Peng 2003). These institutional voids could lead to a range of scenarios in terms of the role of institutional benefits in the green management–innovation link (Peng 2003; Sheng et al. 2011).

To address these two research gaps, we build on institutional theory (North 1990; Scott 1995) to examine how green management affects firm-level innovation (radical versus incremental product innovation). We define *green management* as a firm's systematic managerial practices for addressing environmental issues through environmental protection and minimizing "the negative environmental impact of the firm's products throughout their life cycle"

(Klassen and McLaughlin 1996, p. 1199; Florida and Davison 2001; Haden et al. 2009). The core idea of green management is to protect the natural environment and employ production and operational technologies that minimize their environmental impact (Peng and Lin 2008). Depending on the degree of novelty, product innovation can be radical or incremental (Chandy and Tellis 1998; Garcia and Calantone 2002). *Radical innovation* consists of introducing new products that represent significant leaps in technological development and (or) customer value, whereas *incremental innovation* involves relatively minor changes in or modifications of existing product technologies and (or) customer value (Chandy and Tellis 1998; Zhou et al. 2005). Because radical and incremental innovations require different levels of investment and R&D effort, green management may have differential effects on these two types of innovation. Since product innovation reflects the performance of new product development activities, the examination of the effect of green management on product innovation could be meaningful for understanding how green management impacts firm performance.

We further examine how institutional benefits mediate the effect of green management on product innovation. Based on institutional theory, being green is originally initiated not at the firm level but rather through pressure from external institutions, such as the government, the public, and laws and regulations (Bansal and Roth 2000; Buysse and Verbeke 2003). As a response to these external pressures, firms adopt green practices to gain government support and social legitimacy. *Government support* refers to the extent to which a particular company gains assistance such as favorable policies, incentives, and programs from the government and its administrative bureaus (Li and Atuahene-Gima 2001; Sheng et al. 2011). Because of severe environmental problems, the Chinese government has abandoned the traditional "getting rich first and clean up later" mindset, established the Ministry of Environmental Protection in 2008, and amended the Environmental Protection Law in 2014, aiming to develop the environment protection industry into a national pillar industry (The Chinese State Council 2013). *Social legitimacy* refers to the social judgment of acceptance, appropriateness, and desirability on the part of the public and social communities (Suchman 1995). In China, the public's fear of environmental pollution continues to grow (PewResearchCenter 2013). In 2013, 47 % of the interviewed Chinese indicated that air pollution is a fatal problem, compared with 36 % in 2012; 40 % said water pollution is a key concern in 2013, compared with 33 % in 2012. The public and social communities exert growing green pressures on both the government and businesses. Figure 1 shows our conceptual framework.
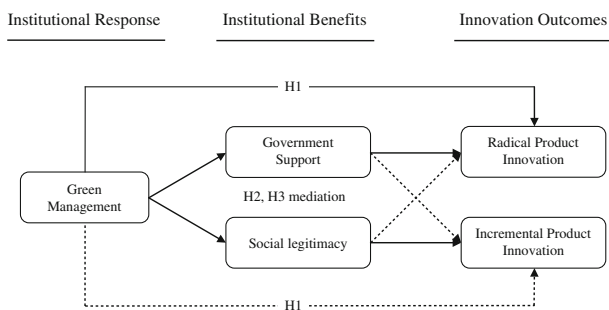
Fig. 1 Conceptual framework Note: *Dotted arrows* indicate weaker effects

This study contributes to the extant literature in three significant ways. First, we enrich scholarly understanding of how green management differentially affects radical and incremental product innovation. Second, the study reveals the mediating mechanisms of institutional benefits in links between green management and product innovation. Third, our study reveals the differential mediating roles of formal and informal institutional benefits. Overall, our study shows that formal and informal institutions play a complementary role in enabling green management to foster product innovation in China.

Theoretical Background

Green Management

Green management includes two major types of practices: (1) environmental management to protect the natural environment and resources, and (2) operational effectiveness in resource and energy consumption (Chabowski et al. 2011; Klassen and McLaughlin 1996; Peng and Lin 2008). While green practice may accompany every generation of humankind, the emphasis on green management is marked by the World Commission on Environment and Development (1987), which calls for sustainable development and specifies the meaning of sustainability. In response, firms increasingly integrate environment-related issues into their business strategies to enhance brand image, renew product portfolios, and increase productivity (Buysse and Verbeke 2003; Chen 2008; Florida and Davison 2001; Leonidou et al. 2013).

While early research suggests that going green might increase costs (Palmer et al. 1995), more recent studies posit that green management contributes to stronger firm performance by cutting costs and increasing potential revenue (Ambec and Lanoie 2008; Leonidou et al. 2013; Marcus and Fremeth 2009; Peng and Lin 2008). As Ambec and Lanoie (2008, p. 46–47) suggest, green management

should *enhance* firm revenue through "(a) better access to certain markets; (b) differentiating products, and (c) selling pollution-control technology" as well as by *reducing* costs in four categories: "(a) risk management and relations with external stakeholders; (b) cost of material, energy, and services; (c) cost of capital; and (d) cost of labor." More specifically, green management reduces the cost of capital through providing more direct access to capital markets, easier credit from banks, and more positive shareholder reactions. It also reduces the cost of labor through cutting the costs associated with illnesses, absenteeism, recruitment, and turnover.

Institutional Theory

Among the various theoretical perspectives that examine green management (Connelly et al. 2011), institutional theory is gaining prominence. Bansal and Roth (2000) suggest that four motivations for going green are legislation, stakeholder pressures, economic opportunities, and ethical concerns. Chabowski et al. (2011) similarly posit that legal, ethical, and discretionary intentions are three major drivers of going green in organizations. The legal intention reflects the basic level of going green by upholding, maintaining, and supporting the rule of law in business activities. The ethical intention places greater emphasis on ethical issues related to stakeholders, such as the public, government, and employees. The discretionary intention indicates that firms actively adopt green concepts beyond legal and ethical expectations, such as voluntary regulatory cooperation, employee volunteer programs, and charitable donations to support green activities. As such, institutional pressure is one major driver of going green in firms.

Institutional theory emphasizes the interplay between institutions and organizations: institutions could be formal (such as laws, regulations, and rules) or informal (including norms, cultures, and ethics); companies have to make strategic decisions and pursue their interests within both formal and informal institutional constraints (North 1990; Scott 1995). Since the government is in charge of law legislation and enforcement, and promulgates regulations and rules, it represents one of the major formal institutions. Informal institutions such as norms, cultures, and ethics are largely embedded in social interactions and upheld by the public and social communities.

Organizations respond to formal and informal institutions through the process of institutionalization, which occurs primarily through three mechanisms (DiMaggio and Powell 1983): coercive isomorphism (pressure from regulators and resources providers), mimetic isomorphism (imitation of other organizations to reduce cognitive uncertainty), and normative isomorphism (pressures arising

from social factors such as the public, the community, and trade associations). Therefore, the government represents an important formal institution and its impact is felt largely through coercive isomorphism; the public and social communities represent informal institutions, which affect organizations through mimetic and normative isomorphism. By complying with formal and informal constraints, firms are able to gain institutional benefits, such as securing necessary resources and obtaining social legitimacy (DiMaggio and Powell 1983; Jansen et al. 2006).

In China, *government support* and *social legitimacy* are probably the two most important institutional benefits. As a formal institutional benefit, government support provides firms with access to scarce resources and preferential treatment, because the Chinese government still exercises considerable control over economic activities (Li and Atuahene-Gima 2001; Sheng et al. 2011). Initiated and implemented by the government and its administrative bureaus, government support takes a variety of forms, including tax abatements, subsidies, and specific programs and policies designed to promote certain behaviors and activities (Guellec and van Pottelsberghe de la Potterie 1997; Li and Atuahene-Gima 2001). Due to the institutional voids that are typical of emerging markets (Khanna et al. 2005), government support serves as an important formal institutional benefit (Sheng et al. 2011).

As an informal institutional benefit, social legitimacy enables firms to gain network power and minimize pressure from external accountability since business conduct in China is heavily rooted in social relations and personal connections (i.e., *guanxi*) (Li et al. 2008; Su et al. 2007; Shu et al. 2012). Social legitimacy reflects "a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions" (Suchman 1995, p. 574). Social legitimacy is sociotropic insofar as the public and external communities judge whether an organizational activity is acceptable or not. Companies with high social legitimacy are more likely to build a strong brand image and gain social confidence (Sheng et al. 2011).

Hypotheses

Green Management and Product Innovation

We predict that green management will positively affect product innovation, and that such impact will be stronger for radical product innovation than for incremental product innovation. First, firms must address environmental issues to satisfy demand from their major stakeholders (Buysse and Verbeke 2003; Porter and Van der Linde 1995). Public

demand for green products provides demonstration effects which "can spur innovation by increasing the competitive advantage of greener products in the market, which can then be followed by larger commercialization and diffusion" (Ambec and Lanoie 2008, p. 48). In China, over 75 % of respondents to a survey asserted that they would definitely or very likely buy green products (DuPont Industrial Biosciences 2012) and 95 % of Chinese consumers would be willing to pay premiums for green products (Xue 2014). These innovative consumers of green products could further generate product diffusions to other consumers. Accordingly, firms must develop radical new products or modify and improve existing market offerings to satisfy demand for green products.

Second, green management could spur product innovation through providing more opportunities to innovate. Because green management prioritizes the environmental concerns of external constituencies, firms pay close attention to government policies, the voices of customers, and the public interest (Luo and Du 2012). The rich information flow from outside sources broadens firms' R&D activities, enabling them to engage in out-of-the-box thinking when undertaking innovative product development. Recently, Bao et al. (2012) found that market knowledge search breadth is positively related to new product innovativeness and that this positive effect increases as search breadth increases. Klingebiel and Rammer (2014) provide empirical evidence that acquiring resources from a wide variety of providers could encourage firms to embrace new product development projects with unproven futures, i.e., radical new products. In an era of sustainable consumption (Chan et al. 2008), consumers have become more mindful of themselves, their communities, and nature throughout the consumption process. Such demand trends provide firms with great opportunities to create and introduce new products.

Third, going green involves more than merely implementing minor changes in firms' operational processes, practices, and decision-making activities related to product innovations (Harris and Crane 2002). Often, green management requires firms to adopt or build completely new operational systems and pushes firms to rethink their entire product development processes (Porter and Van der Linde 1995). As Peng and Lin (2008) posit, to cope with green demand from a variety of stakeholders, green-oriented firms must alter their core business disciplines of marketing, management, and operations. These major changes facilitate "developing new environmentally friendly products from inception (e.g., biodegradable, recyclable) rather than adopting 'end-of-pipe' solutions for existing products" (Leonidou et al. 2013, p. 154). Therefore, green management is more likely to generate radical innovation than incremental innovation.

H1 Green management is more positively associated with radical product innovation than with incremental product innovation.

Mediating Role of Institutional Benefits

Green management involves interactions with actors, including "regulators, non-governmental organizations, and the public," in a broad social arena (Reinhardt 1998, p. 53). When firms proactively institutionalize themselves through green management, they may gain benefits from external institutions "because audiences are most likely to supply resources to organizations that appear desirable, proper, or appropriate" (Suchman 1995, p. 574). In the following discussion, we examine how government support as a formal institutional benefit and social legitimacy as an informal institutional benefit mediate the relationship between green management and product innovation.

Firms can gain government support when aligning their strategies and behaviors with the government's expectations and regulations (Li and Atuahene-Gima 2001; Shu et al. forthcoming). For example, on April 24, 2014, China issued amendments to the Environmental Protection Law that explicitly aims to advance green development; and the Chinese State Council is keen on growing the environmental protection industry into a national pillar industry through increasing support in the form of tax breaks and subsidies (The Chinese State Council 2013). For companies, green management shows cooperation with the government by respecting national law, improving the work environment, maximizing resource utilization, and reducing environmental harm. In return, the government will grant favorable policies and exclusive resources to companies that adopt green management practices. If a firm becomes a green exemplar of the sort that the government advocates, it can have more opportunities to communicate with and lobby the government to gain more unique and exclusive support (Guellec and van Pottelsberghe de la Potterie 1997). As Shu et al. (forthcoming) show, such support could be exclusive resources that enable a firm to more effectively innovate.

Social legitimacy reflects the extent to which an organization behaves congruently with a society's values, norms, and expectations (Suchman 1995). Because green management demonstrates that a firm respects and endeavors to meet the standards of social norms, various stakeholders (suppliers, customers, insurers, employees, etc.) will view the firm as a good citizen. As a response to institutional pressures, green management practices, therefore "emphasize the importance of obtaining legitimacy for purposes of demonstrating social worthiness" to social constituencies (Oliver 1991, p. 150). Once perceived as legitimate, firms could offset uncertainties in new product development and their new products should be more readily accepted by the market

(Suchman 1995). Dougherty and Heller (1994) emphasize the importance of legitimacy for product innovation in established firms, and Rao et al. (2008) find that both external legitimacy through partnering with prominent firms and internal legitimacy through hiring a reputed executive could enhance the benefits of product innovation.

We further postulate that government support and social legitimacy affect radical and incremental innovation differently. Government support is more likely to mediate the relationship between green management and radical innovation. First, given China's objective of becoming an "innovation-oriented society" by 2020 and a world leader in science and technology by 2050, the central and local governments invest heavily in promoting radical and indigenous innovation, i.e., innovations the property rights for which are controlled by the Chinese organizations or citizens (Cao et al. 2006; Hout and Ghemawat 2010). In recent years, the Chinese government has endeavored to advance its science and technology through two major conduits. On the one hand, the government has the goal of investing heavily in R&D activities (1.5 % of its GDP in 2006 to 2.5 % by 2020) in sunrise areas such as clean energy, nanotechnology, quantum physics, and new-generation nuclear reactors, aiming to develop breakthrough innovations (Hout and Ghemawat 2010, p. 96). On the other hand, the government requests that multinational corporations share their cutting-edge technologies with the Chinese firms as a condition of operating in China. Such a request demonstrates the Chinese government's preference for breakthrough technologies and its aim of leapfrogging its home-grown technologies into leading positions in the world (Cao et al. 2006). As such, government support stimulates Chinese firms to focus more on radical than on incremental innovation.

Second, government support provides firms with access to scarce, low-cost resources without necessarily requiring equivalent monetary payback (Sheng et al. 2011; Shu et al. forthcoming). Rather, the government normally requires firms to achieve a certain number of patents, develop technological advances, or explore areas of national strategic importance. To fulfill such requirements, firms must explore and experiment in new areas (Guellec and van Pottelsberghe de la Potterie 1997), leading to more radical product innovation. For example, to develop the solar photovoltaic power industry, the Chinese government launched the Township Electrification Program in 2002 and the Chinese Renewable Energy Law in 2006, which stimulated this industry to become the solar cell manufacturing leader in 2007 (Huo and Zhang 2012). The patenting filing figures for the Chinese photovoltaic power industry in 2006 and 2007 exceeded even those of the US and Japan, two global industrial leaders (France Innovation Scientifique & Transfert, FRINNOV 2009). Therefore, we predict that:

H2 Government support mediates the effects of green management on radical product innovation more strongly than on incremental product innovation.

Social legitimacy likely plays a more salient role in incremental product innovation than in radical product innovation. First, social legitimacy encourages steady but minor improvements. Legitimacy functions as a taken-for-granted belief system and as such emphasizes the inevitability and permanence of social practices (Suchman 1995; Reast et al. 2013). Introducing radically new products may challenge the status quo of the target market, such as altering customer preferences and attracting more competitive responses or public objections. To comply with the inevitability and permanence of social practices, firms are more likely to develop incremental innovations because such products fit existing norms and values.

Second, diverse social constituencies may view innovative products differently. Ashforth and Gibbs (1990, p. 177) explain that "there are often ambiguities and inconsistencies in their transmission—in the laws and traditions that ratify values, the editorializing of the media, and the pressure campaigns of interest groups." The co-existence of competing interests and belief systems often requires compromise in developing new products (Driessen and Hillebrand 2012). For example, clients may prefer low-cost products that function efficiently, whereas nongovernmental organizations may prioritize environmentally friendly production procedures. To meet the expectations of various stakeholders, firms need to discover solutions that acknowledge a range of voices. As Driessen and Hillebrand (2012) show, when developing new green products, tensions originate from a range of stakeholders (customers, suppliers, special interest groups, the public, etc.), demanding that firms implement coordination mechanisms and prioritization principles. As a result, firms have to make compromises in terms of new product development and such compromises may lead to more incremental changes in existing products and services. Therefore,

H3 Social legitimacy mediates the effects of green management on incremental product innovation more strongly than on radical product innovation.

Methods

Sampling and Data Collection

We collected data from companies in China. China has achieved remarkable economic growth over the past three decades, yet it also has become one of the world's most polluted countries. According to the World Bank, 16 of the world's 20 most polluted cities are in China and the total cost of air and water pollution in China reached about 5.8 % of GDP in 2007 (López et al. 2008). To solve this problem, China established the Ministry of Environmental Protection in 2008 to focus on issues related to environmental protection and restoration. Currently, a wide range of industries in China are undergoing "a green revolution" and the society generally is adopting "a green mindset" (McKinsey 2009). Meanwhile, China has become a leading innovation powerhouse according to recent data on patent applications and R&D investment (World Intellectual Property Organization 2013). Therefore, we are particularly interested in assessing the role of green management on product innovation in China.

Since China has several geographical segments, we used a stratified sampling procedure. First, we categorized 31 Chinese provinces into three categories according to their 2009 GDP rankings. For each category, we randomly selected 500 firms to form our sampling frame, totalling 1,500 firms. The firm list and contact information were provided by local governments and administrative bureaus. Second, we employed professional interviewers to make phone calls to these firms to reach senior managers. After explaining the academic research purpose and confidentiality policy, 490 firms agreed to participate in the research. Next, we sent trained interviewers to these firms and conducted structured on-site interviews. The interviews lasted, on average, about one hour. Through these efforts we eventually obtained 303 paired responses (from one senior manager and one middle manager per firm). The overall response rate reached 20.2 % (303/1500), which is acceptable for survey-based research (Kriauciunas et al. 2011).

The on-site interviews were conducted from August 2010 through January 2011. The face-to-face interview procedure allowed us to assess the suitability of the respondents for the study. It also offered respondents an opportunity to ask for clarifications of the issues under study. In order to maintain cross-cultural equivalence (Douglas and Craig 2006), we employed the translation/back-translation procedure to improve the validity of the Chinese-version questionnaire. Before finalizing the survey, we refined the measures through in-depth interviews with 20 managers from 10 firms to ensure their relevance and clearance in the Chinese context.

We interviewed top managers who had played important roles in their firms, especially in driving product innovation. To increase the response rate, we promised to offer a summary of research results. After each of the top managers finished the Top Managers' Questionnaire, we persuaded them to select one middle-level manager from the same firm who is in charge of product innovations or technology management to answer the Middle-Level Managers' Questionnaire. In order to minimize social-desirability bias, we requested that interviewers inform

every respondent that there are no right or wrong answers and that their responses would remain strictly confidential and never be shared with their colleagues. Also, informants were asked to recall situations in their firms during the recent three-year period while responding to the interview questions (Li and Atuahene-Gima 2001).

Among the top-manager respondents, 19.26 % were CEOs/chairmen and the rest were from top management teams. Middle managers came from engineering (37.95 %), marketing and sales (32.34 %), manufacturing (22.11 %), and other functional departments (7.60 %). The average work experience of informants is 8.19 years. These results indicate that our informants were knowledgeable about the issues under investigation. Overall, the final sample covers 303 firms in 23 provinces in China, among which 21.10 % were large firms (with more than 2,000 employees), 29.10 % middle-sized firms (with between 300 and 2,000 employees), and 39.80 % small firms (with under 300 employees); 36.60 % were state-owned enterprises (SOEs), 20.80 % were foreign-invested firms, and the rest were private firms (42.60 %).

We employed two methods to check for potential non-response bias. First, the *t*-tests indicated no statistically significant differences between the sample and the population with respect to firm size or firm age. Second, we also compared the means of firm size and firm age between the responding firms and non-responding firms in the sample. No significant differences were found. The results of these tests indicate that non-response bias was not a potentially serious problem. Therefore, our sample data adequately represents the characteristics of firms in China.

Measures

We adapted our measures from existing studies whenever possible, and created new ones when existing measures were not available. Every measure, except those for most control variables, used a Likert-type response of 1 ("strongly disagree") to 7 ("strongly agree"). The measures of focal constructs are reported in the Appendix.

Green Management

Because no well-developed, widely accepted scale of green management is available, we developed our scale based on related environmental management studies in areas such as strategic green orientation (Hong et al. 2009), green management adoption (Peng and Lin 2008), environmental strategy (Buysse and Verbeke 2003), environmental strategy focus (Banerjee 2002), and environmental orientation (Fraj-Andres et al. 2009). A six-item scale was developed to reflect how firms protect the environment and minimize the negative impacts of a product during its entire lifecycle

by following the well-accepted practice of developing new scales (Gerbing and Anderson 1988). More specifically, we measured green management by asking respondents to evaluate how well their firms had protected the environment, respected natural laws, maintained an ethical working environment, utilized resources wisely and responsibly, economized in the usage of raw materials, and recycled their products. The construct was measured using answers from the Top Managers' Questionnaire.

Mediators

We adapted a scale developed by Li and Atuahene-Gima (2001) and also recently used by Sheng et al. (2011) to measure *government support*. *Legitimacy* has been measured using one of the three options: code adoption, organizational linkages, and media perception (Schneiberg and Clemens 2006), while Vergne (2011) develops a new perception-based measure. Thus, our study referred to the legitimacy framework of Scott (1995) and adapted Vergne's (2011) scale to measure *social legitimacy*. Our measure contains four items which reflect the degree of acceptance the focal firm gained from external social institutions, such as the public and the community.

Since government support and social legitimacy could influence both strategic-level and operational-level issues, we averaged the answers from top and middle managers to measure these two variables. We followed the procedure of James et al. (1984) to assess inter-rater reliability. The results show that the scales for government support and social legitimacy exhibited very high inter-rater agreement of .908 and .938, respectively.

Product Innovation

We adopted the scale of De Luca and Atuahene-Gima (2007) to measure radical innovation and adopted the scale of Jansen et al. (2006) to measure incremental innovation. Because new product development is usually organized through different project teams, middle-level managers have more detailed information and deeper knowledge about their product innovation projects than top managers. Therefore, we used the answers from the middle managers to measure product innovations.

Control Variables

We controlled for a number of factors. Younger and smaller firms might have a greater propensity to innovate (Zimmerman and Zeitz 2002), so we controlled for *firm age* (natural logarithm of firm operating years) and *firm size* (natural logarithm of number of employees). *State ownership* might influence firm operation and strategies in China

(Zhou et al. 2008), so we included a dummy variable to represent SOEs and non-SOEs (1 and 0). Because firm innovativeness varies across industries (Sheng et al. 2011), we controlled for industrial effects with two dummy variables: *high-technology versus non-high-technology industry* (1, 0) and *manufacturing versus non-manufacturing industry* (1, 0). Industrial characteristics also affect innovation (Zhou et al. 2005), so we controlled for *industry competitiveness* with one item ("Please select the most appropriate description of your industry: not competitive, limited competitive, moderately competitive, very competitive, and extremely competitive") and *industry development stage* by asking respondents to select one from the following four stages: introduction, development, maturity, and decline.

Factor Analysis

Since our study developed two new measures, we conducted two exploratory factor analyses (EFA) implemented through SPSS to assess the factor structures of these two measures: green management and social legitimacy. Originally, green management was constructed using six items and the EFA based on principle component analysis showed that these six items were loaded on a single factor which explained 66.75 % of the variance. But the reliability analysis showed that, by deleting one item, reliability could be improved (see the Appendix), so we dropped that item. We used a similar procedure to assess the social legitimacy measure and dropped one item for better measurement reliability.

Then, we conducted a confirmatory factor analysis to further assess the measures in our study. We used structural equation modeling (SEM) to assess the unidimensionality and convergent validity of the reflective measures. Following Shook et al. (2004) recommendation, we evaluated the models with three fit indices: DELTA2, the relative noncentrality index (RNI), and the comparative fit index (CFI). The confirmatory factor analysis of the five-factor model fitted the data well ($\chi^2 = 236.625$, $df = 103$, $p < .001$, DELTA2 $= .959$, RNI $= .959$, CFI $= .959$). In the measurement model, all items were significantly loaded on the variables that they were supposed to measure (see the Appendix). The composite reliability for each construct was greater than .70. These results revealed support for unidimensionality and convergent validity. To examine discriminant validity, we followed Fornell and Larcker (1981) and compared the variance shared between the constructs with the average variance extracted (AVE). The square roots of the AVE

of these variables were shown in the diagonal and the correlation coefficients between all the variables were below the diagonal in Table 1. The discriminant validity of a measure is adequate when the diagonal element is greater than each of the off-diagonal elements in the corresponding rows and columns. The results shown in Table 1 satisfied those requirements.

Common Method Bias

We adopted procedural and statistical methods to mitigate and assess the potential influence of common method bias (CMV; Podsakoff et al. 2003). First, as described in the data collection section, we collected data from two informants in each firm—one top manager and one middle manager. Because the information pertaining to the independent and dependent variables came from multiple informants, CMV is reduced considerably. Second, we used the marker variable (MV) method to assess CMV. We included an MV that is unrelated to at least one variable to represent the potential CMV (Lindell and Whitney 2001). The MV used was *shared vision*, which represents a commonly accepted view of organizational learning and the answers were taken from the top managers. The lowest positive correlation ($r = .005$ in Table 1) between shared vision and other variables was employed to adjust the construct correlations and statistical significance. The results in Table 1 showed that none of the significant correlations turned insignificant following the adjustment. Therefore, common method bias was unlikely to be a serious concern.

Results

We used SEM to test the hypotheses because SEM can estimate our mediating models simultaneously. For H1, we used structural model comparison to assess whether green management influences radical and incremental product innovation differently (Arbuckle 2012). We followed Baron and Kenny's (1986) procedure to examine the mediation effects in H2 and H3: (1) the dependent variable must be significantly impacted by the independent variable; (2) the mediator must be significantly impacted by the independent variable; (3) the dependent variable has to be significantly impacted by the mediator; and (4) when the mediator enters the step (1) model, full mediation will be supported if the originally significant influence of the independent variable on the dependent variable becomes insignificant; while partial mediation requires the significance level of the impact from the independent variable to the dependent variable to decrease substantially.

Table 1 Means, standard deviations, correlations, and average variance extracted (n = 303)

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. Green management	5.398	.963	**.799**	.297**	.465**	.289**	.088	-.077	.106	-.032	.103	-.088	.020	-.061
2. Government support	4.649	1.017	.301**	**.871**	.445**	.318**	.066	-.007	.137**	.080	.113*	-.077	-.047	-.026
3. Social legitimacy	5.172	.931	.468**	.448**	**.938**	.337**	.192**	.002	.249**	-.011	.198**	.006	-.017	-.054
4. Radical innovation	4.492	1.186	.293**	.321**	.341**	**.846**	.239**	-.036	.127*	-.106	.234**	-.017	-.035	-.038
5. Incremental innovation	4.985	1.029	.093	.071	.196**	.243**	**.794**	-.058	-.095	-.102	.089	.061	-.024	.134**
6. Firm age	1.201	.342	-.072	-.002	.007	-.031	-.053		.513**	.258**	-.012	-.007	.128*	.335**
7. Firms size	2.784	.860	.110	.141*	.253**	.131*	-.090	.515**		.151**	.080	.033	.118*	.247**
8. Firm ownership (1 = state owned)	.366	.483	-.027	.085	-.006	-.101	-.096	.262**	.155**		-.161**	-.188**	-.131*	.124*
9. Industry (1 = Hightech)	.416	.494	.107	.117*	.203**	.238**	.094	-.007	.085	-.155**		.093	.001	-.145**
10. Industry (1 = Manufacturing)	.578	.495	-.083	-.072	.011	-.012	.066	-.002	.038	-.182**	.098		.211**	-.005
11. Industry competitiveness	3.612	.782	.025	-.042	-.012	-.030	-.019	.132*	.122*	-.125*	.006	.215**		.152**
12. Industry development stage	2.578	.508	-.056	-.021	-.049	-.033	.138*	.338***	.251**	.128*	-.139*	.000	.156**	
13. Shared vision	5.142	1.224	.577**	.299**	.367**	.246**	.116*	.008	.085	.008	.061	-.069	.072	.005

Zero-order correlations are below the diagonal while the adjusted correlations for potential common method variance are above the diagonal Lindell and Whitney (2001). Diagonal value (in bold) is the square root of the average variance extracted (AVE)

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$ (2-tailed)

For H1, we first ran an unconstrained model (Model 1 in Table 2) and the results for Model 1 showed that green management was positively associated with both radical ($b = .303$, $p < .001$) and incremental product innovation ($b = .173$, $p < .05$). We then controlled these two coefficients to be equal and re-ran the estimation in the constrained structural model. The results indicated that the constrained model fitted to the data worse than the unconstrained model [$\Delta\chi^2(1) = 3.851$, $p < .05$], suggesting that the regression weight between green management and radical product innovation was significantly stronger than that between green management and incremental product innovation (Savalei and Kolenikov 2008). Thus, H1 was supported.

H2 and H3 were tested by estimating four models as shown in Table 2 based on the four conditions in Baron and Kenny (1986): (1) Model 1 delineates the direct effects of green management on radical and incremental product innovation, (2) Model 2 reflects the effects of green management on government support and social legitimacy, (3) Model 3 represents the effects of government support and social legitimacy on radical and incremental product innovation, respectively, and (4) Model 4 shows the indirect effects of green management via government support and social legitimacy on radical and incremental product innovation.

First, the results from Model 1 shown in Table 2 satisfied condition 1 of Baron and Kenny's procedure. Second, the results in Model 2 revealed that green management was positively and significantly related to government support ($b = .362$, $p < .001$) and social legitimacy ($b = .476$, $p < .001$), so condition 2 was satisfied. Third, the results for Model 3 showed that social legitimacy had a significant relationship with both radical ($b = .194$, $p < .01$) and incremental innovation ($b = .252$, $p < .001$), but green management impacted only radical innovation significantly ($b = .253$, $p < .001$), not incremental innovation ($b = .038$, $p > .10$). Finally, the results in Model 4 showed that when the effects of two mediators (government support and social legitimacy) were considered in the structural model, the originally significant relationship between green management and radical innovation became less significant ($b = .172$, $p < .05$) and the originally significant relationship between green management and incremental innovation became non-significant ($b = .057$, $p > .10$). In sum, the results shown in Table 2 on the whole suggested that government support only partially mediated the relationship between green management and radical innovation, in support of H2. Social legitimacy not only partially mediated the relationship between green management and radical innovation, but it also fully mediated the link between green management and incremental innovation, in support of H3.

Table 2 Standardized structural equation parameter estimates (t-value)

Models	Model 1		Model 2		Model 3		Model 4			
Endogenous variables	Radical innovation	Incremental innovation	Government support	Social legitimacy	Radical innovation	Incremental innovation	Government support	Social legitimacy	Radical innovation	Incremental innovation
Green management	.303*** (4.700)	.173* (2.553)	.362*** (5.704)	.476*** (7.556)			.361*** (5.699)	.470*** (7.581)	.172* (2.328)	.057 (.698)
Government support					.253*** (4.061)	.038 (.576)			.217*** (3.322)	.024 (.337)
Social legitimacy					.194** (3.061)	.252*** (3.493)			.121+ (1.708)	.227** (2.817)
Controls										
Firm age	-.026 (-.383)	-.012 (-.160)	-.080 (-1.173)	-.080 (-1.280)	-.011 (-.159)	.004 (.057)	-.080 (-1.174)	-.079 (-1.260)	.001 (.010)	.006 (.086)
Firm size	.095 (1.446)	-.170* (-2.297)	.119+ (1.817)	.262*** (4.311)	.040 (.583)	-.232*** (-2.934)	.119+ (1.817)	.261*** (4.298)	.039 (.576)	-.231** (-3.006)
Firm ownership (1 = state owned)	-.074 (-1.246)	-.082 (-1.243)	.086 (1.463)	.014 (.267)	-.100+ (-1.700)	-.090 (-1.369)	.086 (1.464)	.014 (.266)	-.095 (-1.635)	-.087 (-1.339)
Industry (1 = hightech)	.203*** (3.449)	.117+ (1.815)	.148** (2.801)	.062 (1.086)	.171** (2.886)	.082 (1.258)	.062 (1.089)	.147** (2.781)	.173** (2.981)	.082 (1.285)
Industry (1 = Manufacturing)	-.036 (-.622)	.084 (1.296)	-.042 (-.723)	.031 (.576)	-.046 (-.789)	.074 (1.154)	-.042 (-.718)	.032 (.594)	-.031 (-.541)	.077 (1.210)
Industry competitiveness	-.066 (-1.134)	-.071 (-1.110)	-.047 (-.815)	-.034 (-.640)	-.043 (-.754)	-.061 (-.954)	-.047 (-.815)	-.035 (-.665)	-.052 (-.917)	-.061 (-.967)
Industry development stage	.034 (.563)	.249*** (3.537)	.024 (.403)	-.055 (-.995)	.036 (.601)	.262*** (3.754)	.024 (.398)	-.055 (-.982)	.036 (.606)	.261*** (3.770)
R square	.153	.150	.157	.296	.184	.145	.157	.298	.209	.160
Model fit	Model 1: $\chi^2(217) = 554.232$, $p < .001$, DELTA2 = .905, RNI = .904, CFI = .904, RMSEA = .072. Model 2: $\chi^2(217) = 491.871$, $p < .001$, DELTA2 = .923, RNI = .922, CFI = .922, RMSEA = .065. Model 3: $\chi^2(215) = 532.821$, $p < .001$, DELTA2 = .911, RNI = .909, CFI = .909, RMSEA = .070. Model 4: $\chi^2(211) = 432.477$, $p < .001$, DELTA2 = .938, RNI = .937, CFI = .937, RMSEA = .059.									

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$ (two-tailed)

Effects of Controls

Several findings from control variables also emerged. First, firm size negatively impacted incremental innovation; when firms grew larger they seemed to gain more government support and greater social legitimacy. Second, firms in high-tech industries tended to introduce more product innovations and gain more government support. Finally, when an industry reached its later stages (maturity and decline), firms in that industry tended to introduce more incremental innovation.

Sensitivity Analysis

We conducted a sensitivity analysis to assess the appropriateness of averaging responses from top and middle managers. First, we calculated the scores of government support and social legitimacy from the responses of top and middle managers, respectively. Thus, we had a pair of scores for government support: government support based on responses of top managers (Government Support Top) and government support based on responses of middle managers (Government Support Middle). We also had a pair of scores for social legitimacy (Social Legitimacy Top and Social Legitimacy Middle). Second, we followed Baron and Kenny's (1986) procedure to conduct mediation analyses based on these two pairs of mediating variables. The findings showed results that were similar to those presented in Table 2.[1]

Discussion

This study examines whether green management practices influence Chinese firms' radical product innovation more strongly than it does incremental innovation, and also investigated the underlying institutional mechanisms. The findings show that green management has a stronger relationship with radical innovation than with incremental innovation. Moreover, government support as a formal institutional benefit more strongly mediates the effect of green management on radical innovation than its effect on incremental innovation; whereas social legitimacy as an informal institutional benefit more strongly mediates the effect of green management on incremental innovation than its effect on radical innovation. These results provide strong support for our predictions and generate important theoretical and managerial implications.

Theoretical Contributions

Our findings contribute to the literature in three major ways. First, we enrich the green management literature by examining how green management affects product innovation. Prior studies have focused mainly on the financial consequences of green management, overlooking intermediate outcomes such as product innovation (Ambec and Lanoie 2008; McWilliams and Siegel 2000). Our findings show that green management positively affects product innovation; in particular, green management is more strongly related to radical innovation than to incremental innovation. This refreshes the perspective on what green management can bring to firms. By paying great attention to environmental protection and the voices of various external stakeholders, green management provides ample opportunities for innovating (Haanaes et al. 2013; Luo and Du 2012). Because green management often requires firms to reconsider and rebuild their business operations in dramatically new ways, it stimulates more radical innovations than incremental innovations (Leonidou et al. 2013).

Second, our study reveals the underlying institutional mechanisms through which green management promotes product innovation. Prior studies suggest that firms could take advantage of opportunities embedded in environmental issues by proactively making changes to support environmental protection (Buysse and Verbeke 2003). But the underlying mechanisms through which green management influences firm performance or product innovation have not been examined. By regarding green management as a response to institutions that address environmental issues, our study posits that green management could generate formal and informal institutional benefits and that such benefits could channel the influences of green management on product innovation. As our findings show, government support mainly mediates the link between green management and radical innovation, but not the effect on incremental innovation; in contrast, social legitimacy partially mediates the influence of green management on radical innovation yet fully mediates the impact on incremental innovation.

Third, our study contributes to institutional theory by showing the distinct roles of formal and informal institutions. Although the extant literature has relied on institutional theory to reveal how firms comply with institutions on environmental issues through the process of institutionalization (North 1990; Scott 1995), the benefits that firms could gain from institutionalization—not to mention the role of these institutional benefits in generating product innovation—have not yet been adequately examined. Since government support—an institutional benefit gained from formal institutions—is initiated for specific purposes (e.g., to advance science and technology) (Sheng et al. 2011), firms may pursue more fundamental advancements in

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[1] The results of the sensitive analysis are available from the first author by request.

technology, and in turn generate more radical product innovations. On the other hand, because social legitimacy demands conformity to social institutions which evolve gradually (Johnson et al. 2006; Reast et al. 2013; Suchman 1995), it encourages firms to generate incremental product innovations. Overall, our study advances the development of the institution-based view of strategy (Peng et al. 2009) by showing that formal and informal institutions have complementary effects.

Managerial and Policy Implications

Although a few firms have taken initiatives to adopt green management, many more firms are hesitating to make such changes because they are concerned about whether green management might hurt business performance. Our study should increase confidence in firms that have already installed green management and offers some grounds to reduce their concerns. First, being green could indeed enhance firm product innovation. Our study shows that green management could lead to more radical product innovation than incremental product innovation. Therefore, green practice is a viable option for firms seeking to develop radical innovation. Second, green management could generate formal and informal institutional benefits. Formal support from the government provides a reliable source of unique and exclusive resources, and informal social legitimacy generates a socially accepted image for the firm. Moreover, government support stimulates radical innovation, whereas social legitimacy facilitates incremental innovation. Thus, firms could rely on these two institutional benefits to materialize the outcomes of going green.

Our study also provides important implications for policymakers. Organizations in emerging economies on average hesitate to launch green initiatives due to insufficient institutional support, a weak and ineffectual legal system for guarding against unethical practices, and under-developed communication channels through which to promote green practices (Brik et al. 2011; Rettab et al. 2009). Our research shows, however, that even in emerging markets green management practices could produce more radical than incremental innovation. As radical innovations have the potential to engender long-term success in organizations as well as the larger society, policymakers could employ more stringent environmental regulations to pressure organizations to take more green management initiatives in the hope of creating more radical innovations. Moreover, along with environmental regulations, the government could provide strong support for firms who have already greened themselves up. By relying on exclusive and abundant government support, firms could pursue more radical innovations through bold initiatives and endeavors.

Limitations and Future Research Directions

This study should be understood in light of several limitations which future investigations should try to overcome. First, our study might suffer from the cross-sectional nature of our data. Although we planned and executed our study with great care and employed several methods to avoid potential common method bias, the cross-sectional data could not test the cause-and-effect relationships in our proposed model, which calls for longitudinal designs. Second, we examined institutional benefits only; further studies could consider potential institutional hurdles such as government intervention. Third, we just considered one type of legitimacy—social legitimacy. Future research could examine the potential effects of pragmatic and cognitive legitimacy on product innovation. Differing from social legitimacy, pragmatic legitimacy "rests on the self-interested calculations of an organization's most immediate audiences" (Suchman 1995, p. 578), who are in position to determine the practical outcomes of the organization's activities. Cognitive legitimacy, on the other hand, is a perception based on taken-for-granted assumptions that an organization's practices are consistent with those assumptions. Therefore, whereas social legitimacy stresses social acceptance, pragmatic legitimacy emphasizes self-interest-directed outcomes and cognitive legitimacy reflects social identification. Thus, these three types of legitimacy may impact product innovation differently.

Conclusion

Going green has become increasingly important, yet its influence on firm product innovation awaits further scholarly investigation. Our study finds the direct and indirect effects of green management on product innovation. Survey data from both top and middle managers show that (1) green management has a stronger effect on generating radical than incremental innovation; (2) government support more strongly mediates the effect of green management on radical innovation than its effect on incremental innovation; and (3) social legitimacy more strongly mediates the effect of green management on incremental innovation than its effect on radical innovation. Overall, our study contributes to the environmental management literature by revealing the underlying institutional mechanisms that enable green management to influence radical and incremental product innovation.

Appendix 1

See Appendix Table 3.

Table 3 Measurement scales

Constructs	SFL[a]
Green management [New scale; Composite reliability = .898; from top managers]	
In the past three years, our company has	
Protected the environment	.807
Respected the natural laws	.704
Maintained an ethical working environment	.829
Utilized resources wisely and responsibly	.892
Economized the usage of raw materials	.725
Recycled our products	*
Government support [Li and Atuahene-Gima (2001); Composite reliability = .926, the average of responses of top and middle managers]	
In the past three years, the government has	
Has provided necessary technology information and support to our firm	.741
Has provided support for our firm to seek for financial resources	.823
Has provided support to import technology and equipments when we needed	.839
Has provided direct financial support to our firm such as tax reduction and subsidiary	.785
Has provided necessary legal support for our firm to enter a new market	*
Social legitimacy [Developed based on Scott (1995) and Suchman (1995); Composite reliability = .957; the average of responses of top and middle managers]	
In the past three years, what our company has done	
Has been accepted by the community	*
Has been accepted by the public	.879
Has been accepted by the financial agencies (such as the state-owned banks)	.866
Has been accepted by the public stakeholders, such as environment protection agencies	.930
Radical product innovation [De Luca and Atuahene-Gima (2007); Composite reliability = .881; from middle managers]	
In the past three years, our company has	
Introduced new to the industry products	.782
Introduced breakthrough product innovations	.937
Introduced new products based on revolutionary technology.	.710
Introduced new products that cannot be substituted by products based on old technology	*
Incremental product innovation [Jansen et al. (2006); Composite reliability = .773; from middle managers]	
In the past three years, our company has	
Introduced new products with minor improvements based on existing technology	.819
Introduced new products with minor adaptations based on existing knowledge	.767
Introduced new products with slight improvements based on our previous technology	*

[a] *SFL* standardized factor loading

* Items dropped due to low loading (< .07)

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