African Journal of Business Management Vol. 5(22), pp. 9154-9163,30 September, 2011
Available online at http://www.academicjournals.org/AJBM
DOI: 10.5897/AJBM11.273
ISSN 1993-8233 ©2011 Academic Journals

Full Length Research Paper

Determinants of green innovation adoption for small and medium-size enterprises (SMES)

Ming-Horng Weng[1]* and Chieh-Yu Lin[2]

[1]Far East University, No. 49, Zhonghua Rd., Xinshi Dist., Tainan City 74448, Taiwan.
[2]Chang Jung Christian University, 396, Sec.1, Chang Jung Rd., Kway Jen, Tainan, 71101, Taiwan.

Accepted 21 June, 2011

The main purpose of this paper is to develop a model that analyzes factors influencing the adoption of green innovations for the small and medium-size enterprises (SMEs). From the perspective of technical innovation, the determinant factors consist of technological, organizational and environmental dimensions. A questionnaire survey on small and medium-size enterprises was conducted to test proposed research hypotheses. Based on the survey results, we found that technological characteristics of green innovations, organizational characteristics, governmental supports, customer pressure and regulatory pressure have significantly influences on green innovation adoption for SMEs while the influence of environmental uncertainty is not significant. Practical implications of research findings are discussed.

Key words: Green innovation adoption, small and medium-size enterprises (SMEs), determinants of innovation, technical innovation.

INTROUDCTION

For the purpose of sustainable development, an increasing number of companies all over the world are constantly under pressure to develop environmentally responsible and friendly operations, and regard commitment to the natural environment as an important variable within the current competitive scenarios. They are attentive to the concept of enhancing their competitiveness through improvements in the environmental performance, addressing the environmental concerns of their customers, and mitigating the environmental impact of their production and service activities. Many researchers have proposed various explanations as to what factors influence firms' adoption of green innovations (Gadenne et al., 2009; Henriques and Sadorsky, 1999; Lin and Ho, 2011). Stakeholder pressure, environmental regulation, company size, managers' characteristics, human resources and industrial sector are relevant variables frequently appeared in related research (Etzion, 2007; Gonzalez-Benito and Gonzalez-Benito, 2006). The main purpose of this paper is to study the factors that affect the adoption of green innovations for small and medium-size enterprises (SMEs) from the perspectives of technical innovation and stakeholder pressure.

Applying environmental criteria into corporate operations requires exploring new resource combinations and deploying existing resources in new ways (Hart, 1995; Lin and Ho, 2011). Green innovation adoption involves implementing new or modified processes, techniques and systems to reduce environmental harms. As innovation is the use of new technical and administrative knowledge, the adoption of green practices can be regarded as an innovation process. Several researchers (Henriques and Sadorsky, 2007; Lin and Ho, 2011; Rothenberg and Zyglidopoulos, 2007) analyze environmental issues from the perspective of innovation. Most of them provide an insight into the influences of certain organizational and environmental factors on green innovation. For example, Del Brio and Junquera (2003) argued that financial resources, management style, human resources, manufacturing activity, technological approach, innovative capacity, and external cooperation are relevant factors influencing green innovation adoption for small and medium-sized enterprises. Henriques and Sardosky (2007) argued that total quality management and external stakeholder pressure would increase the likelihood that Canadian manufacturing companies implement cleaner technical innovations. In a study of the printing industry,

*Corresponding author. E-mail: weng.minghorng@gmail.com. Tel: 886-6-5979566. Fax: 886-6-5966247.

Rothenberg and Zyglidopoulos (2007) found that the adoption of green innovations was positively associated with the dynamism of the company's task on the environment. However, little empirical study analyzes how technological, organizational and environmental factors simultaneously influence the adoption of green innovations. Lin and Ho (2011) have found that the adoption of green practices for logistics companies was influenced by technological organizational and environmental factors. In addition to stakeholder pressure, organizational and external environmental factors are two factors commonly considered in the studies of green innovation (Etzion, 2007; Gonzalez-Benito and Gonzalez-Benito, 2006). Scarce attention has been paid to the influences of technological characteristics on green innovation (Lin and Ho, 2011).

Literature on technical innovation suggests that the nature of technology, the capabilities of the organization and the external environment are three general characteristics affecting the adoption of new technologies (Chau and Tam, 1997; Tornatzky and Fleischer, 1990). Characteristics of a new technology such as compatibility, complexity and relative advantage may affect its adoption (Jeyaraj et al., 2006; Lin and Ho, 2011; Rogers, 2003; Tornatzky and Klein, 1982). Boiral (2002) argues that characteristics of environmental knowledge are relevant in environmental management. Therefore, technological characteristics should be taken into account when analyzing the adoption of green innovations for the SMEs. To fill the research gap, this paper studies the influences of technological, organizational, and environmental factors on the adoption of green innovations. Also, this study investigates the influences of stakeholder pressure on the adoption of green innovations because stakeholder pressure is a prominent factor influencing a company's environmental strategy (Buysse and Verbeke, 2003; Sharma and Henriques, 2005). Traditional green innovation adoption frameworks have repeatedly shown the strong explanatory power of stakeholder pressure. Drawing on theories of technical innovation and stakeholder pressure, this paper attempts to contribute a new model to research on green innovation adoption. An understanding of the influencing factors is essential for practitioners to best implement green innovations and for researchers to best understand the issues that need to be addressed.

This paper will focus on the green innovation adoption of SMEs in China. SMEs have played a relevant role in China's economic development. Due to the global trend of environmental protection, SMEs in China have begun to take environmental issues into consideration. Company size has been repeatedly taken as a relevant organizational characteristic influencing companies' technical innovation (Kimberly and Evanisko, 1981) as well as environmental activities (Del Brio and Junquera, 2003; Etzion, 2007; Gonzalez-Benito and Gonzalez-Benito, 2006). In general, large companies tend to adopt green innovations more easily than small ones because they have sufficient resources and strong infrastructures. Small companies, in contrast, may suffer from the lack of financial resources and professionals, which results in difficulties in adopting green innovations. Some researchers have analyzed the green behavior of SMEs (for example, Gadenne et al., 2009; Roberts et al., 2006; Simpson et al., 2004). Much remains to be learned empirically about the factors influencing green innovation adoption for SMEs.

THEORETICAL BACKGROUND

Adopting green practices can be seen as a technical innovation process (Lin and Ho, 2011). Innovation consists of any practice that is new to organizations, including equipments, products, processes, policies and projects. Technical innovation pertains to products, services and production technologies; it is related to basic activities and concerned with either product or process (Kimberly and Evanisko, 1981; Damanpour, 1991). Several researchers have proposed a number of factors influencing the adoption of innovations. Kimberly and Evanisko (1981) indicate that organizational and contextual factors influence the adoption of innovations. The determinants influencing organizational adoption of innovations include perceived innovation characteristics, adopter's organizational characteristics and environmental influences. The availability and quality of internal resources and external knowledge, the knowledge transfer activities, and the political and legal environment are relevant for the adoption of technical innovations. In general, the adoption of technical innovations is affected by technological, organizational and external environmental context (Scupola, 2003; Tornatzky and Fleischer, 1990). Some researchers have also argued that these factors will influence green innovation adoption. In a study of Chinese logistics industry, Lin and Ho (2011) suggest that the adoption of green practices for logistics companies is influenced by technological organizational and environmental factors. In their model, the technological factors include relative advantage, compatibility and complexity of green practices; the organizational factors include organizational support, quality of human resources and company size; and the environmental factors include stakeholder pressure, governmental support and environmental uncertainty. Because these proposed factors have not yet been utilized in analyzing green behaviors of SMEs, we will investigate the factors influencing green innovation adoption for SMEs based on Lin and Ho's (2011) model.

Technological factors

Several technological characteristics of an innovation can

affect its adoption, including complexity, compatibility, relative advantage, triability, observability, ease of use, perceived usefulness, information intensity, uncertainty and so on (Tornatzky and Klein, 1982). The perceived technological characteristics of an innovation are considered as cognitive beliefs reflected in an attitude towards the innovation. Based on Lin and Ho's (2011) model, this study focuses mainly on complexity, compatibility and relative advantage because these three characteristics have consistently been found to be more important in influencing adoption behavior than the other characteristics (Lin and Ho, 2011; Rogers, 2003; Sia et al., 2004; Tornatzky and Klein, 1982).

Complexity is the degree to which a technical innovation is perceived to be relatively difficult to understand and use. It will increase the difficulty in knowledge transfer and innovation diffusion (Rogers, 2003), and is usually hypothesized to be negatively related to innovation adoption (Tornatzky and Klein, 1982). Green innovations incorporate both tacit and explicit knowledge. The tacit knowledge may be inherent in identifying sources of pollution, reacting quickly to accidental spills, and proposing preventive solutions (Boiral, 2002). It leads to the ambiguity of the innovations. Ambiguity is a major barrier to the transfer of best innovation within a firm (Szulanski, 1996). A technology will be more complex while it reveals a higher level of ambiguity (Simonin, 1999). An organization is apt to advance technical innovation when knowledge is shared easily within the organization. Efficient knowledge sharing can lead to better innovative capabilities in terms of higher order learning, and consequently can improve organizational performance including environmental management effectiveness (Etzion, 2007). A technology with high complexity contains a lot of tacit knowledge that requires laborious efforts to learn and diffuse (Tornatzky and Fleischer, 1990). The difficulty in learning and sharing tacit technological knowledge makes it relatively difficult to adopt a complex technology. Therefore, the adoption of green innovations for SMEs is expected to be negatively associated with the perceived complexity of the innovations, and the following hypothesis is proposed:

H_1: There is a negative association between perceived green innovation's complexity and green innovation adoption for SMEs.

Compatibility is the degree to which an innovation is perceived as being consistent with the existing values, experiences and needs of the firms (Rogers, 2003). How the new technology fits with the knowledge that a company already possesses and accumulates is also an important factor that influences technical innovation (Chau and Tam, 1997; Tornatzky and Fleischer, 1990). To lessen possible objection against the diffusion of a new technology, a company will be more likely to adopt the new technology that is more compatible with the company's current operational knowledge (Torantzky and Klein, 1982). Compatibility is also relevant to green innovation adoption, because several green innovations are additions to companies' current technologies; adoption of green innovations is not a single event but can be described as a process of knowledge accumulation and integration. Green innovations that are more compatible to a company's current technologies will be more easily to be diffused within the organization. Dupuy (1997), in a study of Ontario organic chemical industry, found support for the notion that innovations that are additions to existing technology, such as abatement equipment, are most likely to diffuse earlier than technologies that are more difficult to incorporate into the production process. Fit between previous experiences and environmental actions may generate a greater environmental effectiveness (Etzion, 2007). Therefore, the adoption of green innovations for SMEs is expected to be positively associated with the perceived compatibility of the innovations, and the following hypothesis is proposed:

H_2: There is a positive association between perceived green innovation's compatibility and green innovation adoption for SMEs.

Relative advantage is the perception that an innovation is more advantageous than its substitute idea. The perceived benefits may be measured in economic and social terms like convenience and satisfaction. Companies are more likely to adopt a technology which is able to provide better performance and higher economic gains than the other technologies. Relative advantage is positively related to the adoption of innovation (Rogers, 2003; Tornatzky and Klein, 1982). Potential organizational benefits of green innovations include reduced energy and natural resource consumption, reduced waste and pollutant emission, improved environmental and financial performance and greater responsiveness to social environmental expectation (Etzion, 2007; Hart, 1995). In a study of the Spanish pulp and paper industry, Del Rio Gonzalez (2005) suggests that economic and financial advantages are important technological characteristics that influence the adoption of clean technologies. The perceived net benefits that the green innovation offers will serve as motivations for companies to adopt the technology. Therefore, the adoption of green innovations for SMEs is expected to be positively associated with the perceived relative advantage of the innovations, and the following hypothesis is proposed:

H_3: There is a positive association between perceived green innovation's relative advantage and green innovation adoption for SMEs.

Organizational factors

The organizational context implies the processes and attributes that constrain or facilitate technical innovation.

Several studies have discussed the influences of a variety of organizational characteristic variables such as quality of human resources, top management's leadership skills, organizational support, organizational culture and organizational size on technical innovation (Kimberly and Evanisko, 1981; Tornatzky and Fleischer, 1990) and environmental strategy (Etzion, 2007; Gonzalez-Benito and Gonzalez-Benito, 2006). In general, sufficient organizational resources and qualified organizational capabilities are two relevant organizational characteristics advancing technical innovation (Damanpour, 1991; Jeyaraj et al., 2006) as well as environmental performance (Hart, 1995; Russo and Fouts, 1997). The availability of resources, management support, organizational learning capabilities and human resources will influence the adoption of green innovations (Lee, 2008; Lin and Ho, 2011; Zhu et al., 2008). This study focuses mainly on the quality of human resources, organizational support, and company size because they are organizational resource-related variables widely analyzed in research on technical innovation and environmental management (Lin and Ho, 2011).

Qualified human resources are helpful to adopt innovations because of their competent learning and innovative capabilities. The quality of human resources is an essential factor influencing technical innovation (Tornatzky and Fleischer, 1990). Adopting green innovations is a complex process requiring cross-disciplinary coordination and significant changes in the existing operation process (Russo and Fouts, 1997). It is intensive in human resources and depends on the development and training of tacit skills through the employees' involvement (Hart, 1995; Del Brio and Junquera, 2003). The recipient's lack of absorptive capacity is one of the major barriers to the transfer of technical knowledge within a firm (Szulanski, 1996). To overcome knowledge barriers to adopting green innovations, employees need extensive specialized training to learn the principles underlying the innovation. Employees with competent learning capabilities will be apt to increase their absorptive capacity through training programs that can advance green innovation adoption. Also, companies will have higher innovative capacity because of employees' improved innovative and learning capabilities. As the degree to which an organization is receptive to new ideas will influence its propensity to adopt new technologies, a company with higher innovative capacity will be more likely to successfully implement an advanced environmental strategy (Christmann, 2000). Therefore, companies that have qualified human resources will benefit adopting green innovations. A positive association between the adoption of green innovations and the quality of human resources is expected for SMEs, and the following hypothesis is proposed:

H_4: There is a positive association between the quality of human resources and green innovation adoption for SMEs.

Providing incentive for innovation adoption and ensuring the availability of financial and technical resources for innovation have positive effects on the adoption of technical innovation (Jeyaraj et al., 2006). Organizational support is the extent to which a company helps employees using a particular technology or system. For the development of environmental management, organizational support is essential because the employees will be motivated to implement green behavior and the resources required for adopting green innovations will be more easily available. Also, the top management plays an essential role in organizational support. Many green innovations require the collaboration and coordination of different departments and divisions during adoption. To ensure successful adoption, green initiatives are usually endorsed and encouraged from the top management (Gonzalez-Benito and Gonzalez-Benito, 2006). The central task of top management is to obtain resources and assemble them into organizational capabilities so that the company is able to adopt green innovations to achieve environmental competitive advantage (Zhu et al., 2008). Therefore, the adoption of green innovations for SMEs is expected to be positively associated with the organizational support, and the following hypothesis is proposed:

H_5: There is a positive association between organizational support and green innovation adoption for SMEs.

Environmental factors

Rather than the natural environment, the environmental factors in this study refer to the standard conceptualization of external environment in the organizational behavior literature. The external environment in which a company conducts its business is another important factor affecting innovative and green behavior. Certain environmental variables such as environmental uncertainty, environmental munificence, governmental support, industry type, competition and network relations are often discussed in the literature of technical innovation (Jeyaraj et al., 2006; Tornatzky and Fleischer, 1990) and environmental management (Etzion, 2007; Gonzalez-Benito and Gonzalez-Benito, 2006). Environmental uncertainty and external resource availability are consistently regarded as two primary environmental factors influencing technical innovation and environmental strategy (Aragon-Correa and Sharma, 2003; Jeyaraj et al., 2006; Rothenberg and Zyglidopoulos, 2007; Tornatsky and Fleischer, 1990). The government plays an important role in supporting resources for innovation adoption (Lee, 2008; Li and Atuahene-Gima, 2002; Scupola, 2003). Based on Lin and Ho's (2011) model, this study focuses mainly on the influences of environmental uncertainty, governmental support, and stakeholder pressures.

Environmental uncertainty refers to frequent and unpredictable changes in customer preferences, technological development and competitive behavior perceived by the managers. It has been viewed as the most relevant environmental characteristic that affects a firm's decision making (Li and Atuahene-Gima, 2002). Managers facing uncertain business environments tend to be more proactive and use more innovative strategies than managers in less turbulent environments. Under high environmental uncertainty, companies will attempt to gather and process information frequently and rapidly to address environmental changes (Gupta and Govindrajan, 1991), and also tend to pay more efforts on innovation and increase the rate of technical innovation to maintain a competitive advantage (Damanpour, 1991; Kimberly and Evanisko, 1981; Zhu and Weyant, 2003), because adopting green innovations can be regarded as a technical innovation process that can improve a company's environmental performance, the adoption of green innovations is expected to be positively associated with the perceived environmental uncertainty. Companies are more likely to invest in resources and adopt environmental innovations to generate the capacity to improve environmental performance in uncertain environments (Aragon-Correa and Sharma, 2003; Rothenberg and Zyglidopoulos, 2007). Therefore, the following hypothesis is proposed:

H_6: There is a positive association between perceived environmental uncertainty and green innovation adoption for SMEs.

Governmental support is a relevant environmental factor influencing technical innovation. The governments can advance technical innovation through several encouraging policies such as providing financial incentive, technical resources, pilot projects and tax breaks (Tornatzky and Fleischer, 1990; Scupola, 2003). Adopting green innovations relies to some extent on the availability of external resources. Munificence of resources in the business environment increases the degree to which a company engages in environmental management (Aragon-Correa and Sharma, 2003; Rothenberg and Zyglidopoulos, 2007). The government can raise the munificence by providing governmental subsidies or tax incentives for alternative energy technologies, bank financing at lower rates for environmentally friendly technologies, and lower insurance premiums for lower environmental risks (Aragon-Correa and Sharma, 2003). Lee (2008), in a study of Korean SMEs, also suggests that governmental support in green initiatives has a positive influence on the company's willingness to participate in the green supply chain. Therefore, a positive association between the adoption of green innovations and governmental support is expected for SMEs, and the following hypothesis is proposed:

H_7: There is a positive association between governmental support and green innovation adoption for SMEs.

Stakeholders can be seen as one part of the organizational environment (Etzion, 2007) and play an important role in organizational environment. They are widely considered in research on environmental issues. Stakeholders are individuals or groups who affect a company's activities and are also affected by the company's activities. Stakeholder pressure is regarded as the most prominent factor influencing a company's environmental strategy (Buysse and Verbeke, 2003; Gonzalez-Benito and Gonzalez-Benito, 2006; Sharma and Henriques, 2005). According to the stakeholder theory, organizations carry out activities to satisfy their main stakeholders. Among various stakeholders, customers and regulators are viewed as a company's most important stakeholders (Christmann, 2004; Etzion, 2007). A body of research reveals the positive relationships between firms' environmental activities and customer and regulatory pressure (Christmann, 2004; Lee, 2008; Wong and Fryxell, 2004). Therefore, the adoption of green innovations for SMEs will positively associate with customer and regulatory pressure, and the following hypotheses are proposed:

H_8: There is a positive association between the customer pressure and green innovation adoption for SMEs.
H_9: There is a positive association between the regulatory pressure and green innovation adoption for SMEs.

RESEARCH METHODS

Sample and data collection

The hypotheses were tested using data collected by means of mailing questionnaires to SMEs in China. As the largest emerging economy, China has been undergoing rapid economic growth since 1980s. The samples were selected from SMEs operated in Dongguan, an industrialized city in Guangdong Province, China.

One thousand samples were randomly drawn from a list of SMEs in China. These companies were contacted via telephone to confirm the names of respondents and their mailing addresses. Questionnaires were mailed to the sampled companies' senior managers who are familiar with the company's environmental activities. Two weeks after the questionnaires were mailed, follow-ups to the sampled companies were conducted to remind them of the importance of their responses and thank them for their assistance. Of the total sampling firms, 267 completed and returned questionnaires. The overall response rate is 26.7%; because of incomplete information, 23 unusable questionnaires were excluded, and 244 respondents were analyzed in the study.

The wave analysis which assumed that, late respondents tend to be more similar to non-respondents than early respondents in mail surveys (Armstrong and Overton, 1977), was used to evaluate the non-response bias. Comparisons of respondents who responded readily to the survey with those who responded after the follow-up step revealed that the non-response bias was not significant in the study.

Measures

In the study, measures of dependent and independent variables are

adopted from Lin and Ho's (2011) study. Green innovation adoption refers to the decision of a company to use the green innovations to respond to environmental issues. The green innovations include consolidating shipments, disposing waste responsibly, purchasing ecological products, reducing energy consumption, reducing solid/water waste and emissions, using cleaner production methods and using recyclable packaging/containers (Lin and Ho, 2011). Each sampled company was asked to score the degree of adoption of green innovations according to a seven-point scale anchored by "not at all" and "to a great extent".

According to Lin and Ho's (2011) study, all the determinant factors were measured using 7-point Likert scales anchored by "strongly disagree" and "strongly agree". Table 1 shows the measurement items of each factor. Complexity was measured by the degree to which the green innovations would be learned and used easily (Rogers, 2003; Sia et al., 2004). Compatibility was measured by the degrees of perceived fitness between the green innovation and the company's existing operation systems (Chau and Tam, 1997; Rogers, 2003; Sia et al. 2004). Relative advantage was measured by the degree to which the green innovation could increase environmental and economic performance (Rogers, 2003; Sia et al., 2004). The quality of human resources was measured according to the learning and innovative capabilities of employees (Scupola, 2003; Tornatzky and Fleischer, 1990). Organizational support was measured according to the degrees of the company's resource supports and leaders' attitudes toward environment issues (Tornatzky and Fleischer, 1990). The environmental uncertainty was measured according to the degrees of changes in competitors' innovative abilities, customers' requirement and the development of new technologies (Buchko, 1994; Zhu and Weyant, 2003). Governmental support was measured by whether the government provides financial and technical supports for adopting green innovations (Lee, 2008; Scupola, 2003). Customer pressure and regulatory pressure were measured by asking the respondents to score the environmental pressure exerted by customers and regulators, respectively (Gonzalez-Benito and Gonzalez-Benito, 2006).

The measurement items were submitted to factor analysis. The result of factor analysis confirms the construct validity of this study. According to the reliability coefficients, the smallest value of Cronbach's alpha for this study is 0.7981, which implies that the sampling results are reliable (Nunnally, 1978). Since the single informant technique in data collection is subjected to the potential for common method bias by artificially inflating observed relationships between variables, the bias was checked using Harman's single factor test (Podsakoff et al., 2003). If common method bias exists, a single factor will emerge from a factor analysis of all survey items, or one general factor that accounts for most of the variance in an unrotated factor structure will result. The analysis revealed more than one factors with eigenvalues greater than 1.0, and the first factor accounted for only about 35% of the variance. The results indicated that common method bias was not a problem in the study.

RESULTS AND DISCUSSIONS

The study used the regression analysis to verify whether SMEs' green innovation adoption is influenced by the proposed technological, organizational and environmental factors. Table 2 shows the standardized results of regression analysis. The hypotheses related to technological factors, H_1, H_2 and H_3, are all supported. The hypotheses related to organizational factors, H_4 and H_5 are all supported. Regarding the environmental factors, hypotheses H_7, H_8 and H_9 are supported. But, the hypothesis H_6 about environmental uncertainty is not supported. The significant results suggest that complexity, compatibility and benefits of green innovations will affect the adoption behavior. SMEs will be apt to adopt a green innovation when they perceive that the green innovation is simple and easy to learn and use, compatible to their existing business operations, and helpful for improving environmental and economic performance. Therefore, to reduce perceived complexity and increase perceived compatibility of green innovations, the SMEs should attempt to accumulate more environmental knowledge and increase the explicitness of green innovations. During the process of accumulating environmental knowledge, the SMEs can have more related experiences that are helpful for reducing the perceived complexity of green innovations, and adjust their values and operations towards environmental-friendly that advance the compatibility between companies' existing systems and new green innovations. Increasing the explicitness of green innovations is helpful for the transfer and learning of related knowledge within an organization, and helps the SMEs appreciating the compatibility of the green innovations. The SMEs are able to select a green innovation that is more consistent with their existing system. Furthermore, to advance green innovation implementation, providers of environmental technologies and systems should put more effort to make their customers appreciate the relative advantage of the green innovations. The SMEs will be more likely to adopt the green innovations when they perceive the benefits of the green innovation, including improved environmental and economic performance.

Regarding the organizational factors, both the organizational support and the quality of human resources exhibit significantly positive influences on SMEs' green innovation adoption behavior. The present result also provides further evidence on the importance of organizational support, especially top management support, in green innovation. Green innovation adoption processes usually add complexity to production or delivery processes and require the commitment of organizational resources. Learning and innovative capabilities of employees and the availability of resources are relevant for the adoption of green innovations. Organizational support gives employees motivation and resources to adopt environmental innovations. The SMEs should provide an amount of learning and training programs and build knowledge management systems to advance green innovation adoption.

The significant results that governmental support and regulatory pressure affect green innovation adoption behavior suggest that the government plays an important role in advancing SMEs' green innovation adoption. In general, a body of research has concluded that governmental regulation is a main driver for environmental management. In addition to setting up environmental regulations, the present result reveals that the government

Table 1. Measurement Items for Determinant Factors.

Determinant factor	Factor loading	Cronbach's α
Technological factor		0.8764
Complexity of technology		
Learning the green practice is difficult	0.847	
Understanding the green practice is difficult	0.816	
Sharing the knowledge of the green practice is difficult	0.735	
Using the green practice needs many experiences	0.691	0.8901
Compatibility of technology		
The green practice is compatible with our existing operations	0.807	
Integrating the green practice with company's existing system is easy	0.744	
The green practice is consistent with our company's values	0.692	0.8536
Relative advantage of technology		
The green practice can provide better environmental performance	0.806	
The green practice can provide higher economic benefits	0.759	
The green practice can enhance our company's reputation	0.713	0.8804
Organizational factor		0.9097
Quality of human resources		
Employees can share knowledge with each others	0.813	
Employees can learn new technologies easily	0.767	
Employees can easily use new technologies to solve problems	0.724	
Employees can provide new ideas for our company	0.651	0.9104
Organizational support		
Top management encourages employees to learn green practices	0.842	
Our company provides resources for employees to learn green practices	0.816	
Our Company provides rewards for employees' green behavior	0.714	
Top management can help employees when they face green problems	0.683	0.9048
Environmental factor		0.8613
Environmental uncertainty		
Predicting competitors' behavior is difficult	0.807	
The advance in new technologies is quickly	0.753	
Predicting customers' preferences is difficult	0.721	
Customers' preferences vary frequently	0.651	0.7981
Governmental support		
Government provides financial support for adopting green practices	0.841	
Government provides technical assistance for adopting green practices	0.809	
Government helps training manpower with green skills	0.734	0.8718
Customer pressure		
Our customers require us to improve environmental performance	0.817	
Caring for the environment is an important consideration for our customers	0.721	0.8209
Regulatory pressure		
Government sets environmental regulations for business operations	0.832	
Industrial associations require us to conform to environmental regulations.	0.719	0.8451
		Total Cronbach's α = 0.8706

Table 2. Standardized regression results for the adoption of green innovations.

Dependent variable: Adoption of green innovations		
Predictor	**Standardized coefficient β**	***t***
Technological factor		
Complexity of technology	-0.126	-2.104*
Compatibility of technology	0.183	3.182**
Relative advantage of technology	0.191	4.003**
Organizational factor		
Quality of human resources	0.173	2.935**
Organizational support	0.211	4.306**
Environmental factor		
Environmental uncertainty	-0.072	-1.081
Governmental support	0.198	3.621**
Customer pressure	0.118	1.924*
Regulatory pressure	0.185	2.943**
R^2	0.608	
Adj. R^2	0.591	
F	36.02**	
* $p<0.05$; ** $p<0.01$		

should put more effort in encouraging and guiding SMEs to adopt green innovations. Green process innovation is driven by both regulatory push and pull effects (Lin and Ho, 2011). Most SMEs may suffer from the lack of financial and technical resources and qualified professionals. Governmental support is essential for SMEs in developing environmental management (Del Brio and Junquera, 2003; Lee, 2008; Noci and Vergandi, 1999). Providing economic incentive, reducing long-term uncertainties, stimulating industry-generated information and providing flexibility are the essentials of governmental policies that have the ability to advance green innovation (Norberg-Bohm, 1999). Well-designed environmental policies can stretch firms beyond current innovations and grant them flexibility to meet the environmental goals. In addition, the present result provides further evidence on the importance of customer pressure in green innovation adoption.

The finding reveals a non-significantly negative relationship between environmental uncertainty and green innovation adoption. A similar result was also found in Lin and Ho's (2011) study. While most environmental approaches could produce positive economic returns only in the long term (Etzion, 2007), environmental uncertainty may affect the type and amount of resources needed in the resource portfolio, the capabilities necessary to outperform rivals, and the leveraging strategies required to gain and maintain a competitive advantage (Sirmon et al., 2007). Most SMEs with limited resources will be difficult to develop long processes of competence accumulation and allocate resources to environmental initiatives (Del Brio and Junquera, 2003). They may tend to develop a short term mentality concerning their return on investments and avoid prolonged technological experimentation along different technological paths. Environmental technology investments will be delayed until other productive process changes are being made (Rothenberg and Zyglidopoulos, 2007). Therefore, when SMEs perceive a high degree of uncertainty in their business environment, they may put more resources on improving their primary business activities rather than on improving their environmental performance. As a result, the government should provide more resources for the SMEs to help them adopt green innovations.

Conclusions

This study conducts a questionnaire survey on exploring the factors influencing green practice adoption for SMEs in China. According to the research results, the adoption of green innovations for Chinese SMEs is significantly influenced by the complexity, compatibility and relative advantage of green innovations, quality of human resources, organizational support, governmental support, customer pressure and regulatory pressure. The influences of environmental uncertainty on SMEs' green behavior are not significant. Therefore, to advance green innovation adoption, the SMEs can increase the explicitness and compatibility of green innovations, improve learning and innovative capabilities of employees and make organizational resources easily available for the firm. In addition to being a regulator, the government should provide sufficient financial, technical and educational resources for the SMEs to adopt green innovations.

Over the past decades, a growing literature stream focuses on understanding organizational adoption of green innovations for SMEs. So far, little research analyzes the determinants of green innovation adoption for SMEs from the perspective of technical innovation. Most previous studies focused exclusively on organizational and environmental factors and stakeholder pressure, and ignored the influences of technological characteristics of green innovations. A major contribution of this study is to investigate the influences of technological, organizational and environmental factors on green innovation adoption for SMEs. This study provides evidence that the proposed technological, organizational and environmental factors have significant influences on green innovation adoption for SMEs. As a result, future research on environmental issues of SMEs can take these three characteristics simultaneously into account. Other possible technological, organizational and environmental factors can also be taken into considerations in future studies.

The research findings obtained by data collected in China may be limited in their generalizability. Different countries may lead to conclusions different from the present study. Future studies can use the proposed model in other countries. In addition, the unavailability of objective measurements of green innovation adoption behaviors for the SMEs in China resulted to a reliance on subjective responses of the samples. This study may suffer from the respondent bias. Participants may modify their responses to be socially acceptable or rational. Future research can attempt to investigate SMEs' green innovation adoption behaviors by collecting objective data.

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