

## Article

# CEO Information Ability, Absorptive Capacity, and E-Commerce Adoption among Small, Medium, and Micro Enterprises in China

Jiafeng Gu 

Institute of Social Science Survey, Peking University, Beijing 100871, China; isssgujf@pku.edu.cn

**Abstract:** The purpose of this study was to explore the relationship between chief executive officer (CEO) characteristics, absorptive capacity, and e-commerce adoption in SMMEs. To achieve this objective, the study analyzed primary data gathered from 2675 small, medium, and micro enterprises (SMMEs) in China. A logistic regression model was employed to estimate how the CEO characteristics and absorptive capacity of SMMEs influenced their e-commerce adoption. The study revealed a significant positive relationship between CEO information ability, confidence, and e-commerce adoption. Additionally, this study confirmed a positive relationship between absorptive capacity and the adoption of e-commerce.

**Keywords:** CEO information ability; absorptive capacity; e-commerce; small, medium, and micro enterprises; China

## 1. Introduction

The rapid development of digital technology has profoundly changed the overall ecology of industry and commerce [1,2]. According to the “UNCTAD Estimates of Global E-Commerce 2018”, the total global e-commerce sales in 2018 reached USD 25.6 trillion, and the number of global “online shoppers” reached 1.45 billion [3]. In the context of the “Internet +,” e-commerce has become an important way for some small, medium, and micro enterprises (SMMEs) to implement a digital transformation and increase sales [4]. For the majority of SMMEs, the implementation of e-commerce strategies also involves some challenges, such as the need for additional investment and the backwardness of internal information construction [5,6]. Thus, the adoption rate of e-business by SMMEs is lower than that of large established businesses [7]. Additionally, the e-commerce adoption speed of SMMEs in developing countries is slower than that in developed countries [8]. The promotion of more SMMEs to adopt e-commerce and achieve commercial success remains an urgent problem in this field.

Previous literature shows divergent opinions regarding the factors affecting the adoption of e-commerce by SMMEs. Cooper and Zmud [9] divided the influencing factors into three, namely technological, organizational, and external factors, which were upheld by Fink [10]. Later, Damanpour and Damanpour [11] divided all possible influencing factors into two categories, namely the benefits and drawbacks of e-commerce adoption. Subsequent studies such as Archer et al. [12] and Govindaraju and Chandra [13] mainly followed this type of literature. Chief executive officers (CEOs), along with a group of well-experienced directors, lead corporate decision making, which undoubtedly includes decisions about e-commerce adoption [14,15]. The CEO is pivotal in small and medium enterprises (SMEs) [16]; however, research on the empirical link between CEO ability and e-commerce adoption by SMMEs is still lacking. Hence, this study proposed that there is a relationship between CEO information ability and e-commerce adoption by SMMEs.

Another gap explored in this study concerned the relationship between absorptive capacity and e-commerce adoption by SMMEs. Since Cohen and Levinthal [17] proposed



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the concept of absorptive capacity, due to its unique role in the organization's or an individual's acquisition, digestion, conversion, and application of new knowledge, absorptive capacity has always been an important area of research for scholars [18–20]. A study based on EU-27 firms showed that absorptive capacity is positively correlated with e-commerce adoption [21]. Previous studies showed that knowledge absorptive capacity is very important in the development of SMEs [22,23]. However, research exploring the absorptive capacity of SMMEs is relatively lacking [24], and the relationship between the absorptive capacity of SMMEs and their adoption of e-commerce is still a black box.

Thus, the present study aimed to explore CEO information ability, absorptive capacity, and e-commerce adoption among SMMEs. The research questions were as follows:

RQ1. What is the relationship between CEO information ability and e-commerce adoption among SMMEs?

RQ2. What is the relationship between absorptive capacity and e-commerce adoption among SMMEs?

By answering the above questions, this study aimed to contribute to the literature on knowledge management by exploring ways to promote the implementation of digital transformation and e-commerce strategies of SMMEs based on the CEO's information capability and firms' knowledge-absorption capabilities. Managers and firm owners may benefit from this study as it provided empirical evidence of two elements that may be helpful for the successful implementation of e-commerce strategies by SMMEs. The results of this study have both theoretical and practical implications. From a theoretical perspective, we discuss how two factors—CEO information ability and confidence—may influence the innovation of SMMEs, thus contributing to the knowledge-management literature. In addition, the results offer practical contributions. SMMEs may benefit from our research during the construction, management, and sharing of internal collective knowledge.

The remainder of this paper is organized as follows. The next section presents the literature background and the development of the hypotheses. Next, the methodological procedures are presented. Thereafter, the results are described. Then, the empirical results and limitations are discussed. Finally, some concluding remarks are given.

## 2. Literature Background and Hypotheses Development

The role of SMMEs is becoming increasingly pertinent in today's environment of economic development, and they have become an indispensable force in promoting economic development [25]. SMMEs comprise over 90% of all firms worldwide, accounting for up to 70% of the total employment and half of the gross domestic product (GDP) [26]. SMMEs are important economic drivers of the growth and development of developing economies [27]. In China, SMMEs contribute more than 60% of the national GDP [28]. In some cases, SMMEs are known as micro, small, and medium enterprises, written as MSMEs [29,30]. These two concepts are the same. In terms of the scope of the concept, SMMEs cover SMEs and micro and small enterprises (MSEs) [31,32]. To avoid conceptual confusion, the concept of SMMEs is uniformly adopted in the rest of this article, unless otherwise specified. However, the relevant literature on SMMEs includes MSMEs and SMEs. In this study, SMEs and MSEs were viewed as subsets of SMMEs.

For SMMEs, there is a general trend toward intelligent and digital development, which is conducive to the development of innovative business methods such as e-commerce [33,34]. The Internet not only brings marketing innovation to SMMEs, but also a tangible sales channel that integrates various new technologies and methods [35]. In this Internet age, one form of SMME empowerment is the adoption of e-commerce [13]. The use of e-commerce has often been cited as a significant factor in generating and sustaining SMME growth [36]. Since the introduction of the concept of e-commerce, there has not been a unified definition. Different researchers and organizations have proposed the definition and understanding of e-commerce from their perspectives, resulting in the diversity of e-commerce concepts [37]. In addition to e-commerce, e-business [38], e-services [39], electronic data interchange [40], and even the Web and the Internet have all been applied to similar SMME activities [41]. In

this study, e-commerce is defined as a business conducted using electronic data transmission via the World Wide Web, and the focus is business-to-customer (B2C) e-commerce, in contrast to business-to-business (B2B) e-commerce.

There are many advantages for SMMEs in adopting e-commerce. Regardless of how small a company is, it can reach buyers from all over the world through the Internet [42]. Online sales based on e-commerce platforms can effectively help SMMEs expand their markets and increase their market share [43]. Online sales based on e-commerce platforms can fully develop the advantages of SMMEs concerning flexibility in terms of price and output, and can better meet customer needs by providing personalized products or services [44]. The Internet has now become the main e-commerce infrastructure, and SMMEs must adapt or re-engineer their business processes to achieve a positive online sales performance [45]. However, when SMMEs adopt e-commerce, they face many challenges. Previous studies have divided e-commerce adoption barriers for SMMEs into four categories, namely technical; organizational; economic; and cultural, political, and legal factors [10,11]. The influencing factors are different for different regions. For example, in Indonesia, factors related to human resources and sources of information are the most significant barriers to e-commerce adoption by SMMEs [13]. To accelerate the adoption of e-commerce, it is necessary to strengthen the facilitating factors and eliminate the barriers, thus improving SMMEs' online sales capabilities.

A survey was conducted among 400 SMMEs in Pietermaritzburg and Durban, South Africa, and the following factors were identified as internal factors that influenced e-commerce adoption: owner/manager characteristics, firm characteristics, and internal IT capabilities [46]. Owner/manager characteristics have a significant influence on the adoption of e-commerce by SMMEs, which has been confirmed in previous studies. A survey of a representative sample of SMMEs in South Africa by Visagie [47] found that the key person in the SMME, the entrepreneur, is faced with a mammoth task. For SMMEs, the owner and founder are often the CEO and leader of the enterprise [48]. Therefore, according to management role theory, this article uniformly uses "CEO" instead of "owner and founder". The extant literature suggests that the CEO's ability is an important factor in determining the success of SMMEs. For example, in South Korea, the CEO's ability to discover new business opportunities has a positive effect on the performance of an SMME [49]. The adoption of e-commerce by an SMME may be directly related to the CEO's information ability. In this study, we followed this line of research by examining the effect of CEOs' information ability on e-commerce adoption by SMMEs.

A CEO's information ability refers to their ability to acquire, analyze, process, transmit, and transform information. CEOs with strong information ability are more likely to have information-based leadership; therefore, they are more likely to lead SMMEs to adopt e-commerce [50]. According to Ward and Zahavi's [51] information center hypothesis, CEOs with strong information capabilities are more likely to become information centers in SMMEs and to share information within the enterprise through e-commerce and other channels. Specifically, as Fudenberg and Tirole's [52] "signal-jamming" theory revealed, CEOs with a strong information ability may also choose to adopt e-commerce to signal to the employees and consumers that their information skills are superior, whereas less able CEOs may signal-jam others' inferences about their real information ability levels by not adopting e-commerce. This argument is similar to Holmström's [53] suggestion that a high-ability manager is willing to accept challenges; thus, they are more willing to adopt various innovative management and sales models, including e-commerce. If so, we can expect to observe a positive relationship between CEO information ability and e-commerce adoption by SMMEs.

A concept directly related to a CEO's information ability is CEO confidence, which refers to the evaluation of the ability to successfully cope with a specific situation [54]. In this study, CEO self-confidence refers specifically to the CEO's assessment of their ability to successfully cope with the use of e-commerce scenarios. According to the theory of organizational behavior, people are not purely rational; they also have an irrational

side [55]. Therefore, when CEOs make decisions, they will not only be affected by their own ability, but also by their psychology [56]. Since e-commerce projects usually have certain characteristics, such as a high risk and low success rate, the confidence of the CEO is an important factor that affects the risk management of SMMEs and whether the enterprise can adopt e-commerce [14,46]. Galasso and Simcoe [57] found that CEOs with a higher degree of confidence will prove their value by improving the innovation ability of the enterprise. Therefore, CEOs with a higher degree of confidence are more likely to adopt e-commerce. Flâm and Risa [58] also predicted a positive relationship, and showed that final achievements depended positively on initial confidence. Therefore, it is reasonable to propose that there is a positive relationship between CEO confidence and e-commerce adoption.

The CEO's information ability and confidence have complementary effects on the adoption of e-commerce by SMMEs. Then, for the development of e-commerce in SMMEs, the CEO's information ability and confidence are two sides of one coin. Thus, the following hypotheses were proposed:

**Hypothesis 1 (H1).** *There is a positive association between CEO information ability and e-commerce adoption by SMMEs.*

**Hypothesis 2 (H2).** *There is a positive association between CEO confidence and e-commerce adoption by SMMEs.*

In addition to owner/manager characteristics, firm characteristics and internal IT capabilities also have a significant impact on the adoption of e-commerce by SMMEs [46]. A concept that is closely related to a firm's characteristics and internal IT capabilities is its absorptive capacity [59]. Cohen and Levinthal [60] defined absorptive capacity as the ability to learn from external knowledge through the processes of knowledge recognition, digestion, and utilization. Absorptive capacity is critical for SMMEs to successfully implement digital transformation and innovation [61,62]. In SMME research, innovation capacity is generally used to measure absorptive capacity [63,64]. Research on innovation in SMMEs mainly focuses on product innovation [65,66], process innovation [67,68], and marketing innovation [69]. Thus, in this study, product, process, and marketing innovations were used to measure the absorptive capacity of SMMEs.

A study with data surveyed from 466 SMMEs in Italy showed that absorptive capacity was positively associated with the adaptation of information technology [70]. Across EU-27 firms, absorptive capacity was positively correlated with e-commerce adoption [21]. Another recent study showed a positive relationship between absorptive capacity and e-commerce adoption by SMMEs in Iraq [71]. This positive relationship was depicted by Rogers' [72] diffusion of innovation theory, and was confirmed by many subsequent studies [7,13,36,46]. As product, process, and marketing innovations are measurements of absorptive capacity, it is possible to infer that there is a positive association between these measurements and e-commerce adoption by SMMEs. Thus, the following hypotheses were proposed:

**Hypothesis 3 (H3).** *There is a positive association between product innovation and e-commerce adoption by SMMEs.*

**Hypothesis 4 (H4).** *There is a positive association between process innovation and e-commerce adoption by SMMEs.*

**Hypothesis 5 (H5).** *There is a positive association between marketing innovation and e-commerce adoption by SMMEs.*

### 3. Methodological Procedures

#### 3.1. Data Collection

The data used in this study were taken from the Enterprise Survey for Innovation and Entrepreneurship in China (ESIEC). The ESIEC aims to obtain microdata reflecting the innovation and entrepreneurship status of Chinese enterprises. The survey content includes six dimensions: entrepreneurial history, enterprise creation processes, basic enterprise information, enterprise innovation, inter-enterprise relations, and business environment. In 2018, the first baseline survey of the ESIEC was conducted based on the industrial and commercial enterprise registration database using a two-stage cluster sampling method. In the first stage, 117 counties were selected from six provinces—namely Liaoning, Shanghai, Zhejiang, Henan, Guangdong, and Gansu—by using probability proportionate to the size of the number of enterprises. At the second stage, a sample of 500 enterprises was randomly selected from each district and county. So, this was two-stage cluster sampling with the probability proportionate to the size of the number of enterprises at the first stage and a constant number of subjects per cluster at the second stage. Then, a total of 58,500 sample companies were selected. More than 900 student interviewers conducted the field survey using computer-assisted personal interviews. The interviewer used a tablet computer to enter the respondents' answers when visiting the sample company on-site, which allowed them to transmit the data back to the server via a wireless network. The survey included 6198 completed samples, accounting for 10.6% of the corporate sample. In this study, the definition of an SMME was adapted from Gilmore et al. [73] and Santoro et al. [74], in which firms with between 50 and 250, 50 and 250, and less than 10 employees were treated as medium, small, and micro enterprises, respectively. Among the 6198 companies in this survey, after deleting missing values, there were 2675 SMMEs, among which 1559 (58.28%) were micro, 893 (33.38%) were small, and 223 (8.34%) were medium enterprises.

#### 3.2. Measures

**Dependent variable.** The intensity of e-commerce adoption was examined by looking at the percentage of sales made online [21]. Online sales refer to the use of e-commerce in an open network environment where buyers and sellers conduct various business activities without meeting each other to realize consumers' online shopping, transactions, electronic payments, and various kinds of business-transaction activities [75]. Therefore, this study used online sales as an indicator of e-commerce adoption. Respondents were asked, "Did your company sell products via the Internet or on mobile phones in 2017?" They responded with "1" or "0" to indicate "yes" or "no", respectively. Therefore, this dependent variable was a categorical variable comprising 0 and 1.

**Independent variables.** The core explanatory variables included the information ability and self-confidence at the CEO level and the absorptive capacity at the enterprise level. In terms of an operational definition, the variables at the CEO level were obtained by interviewers through observation. This was based on previous related research [76,77]. The respondents' information ability to master data was scored from 1 to 5 according to the interviewer's observation, with 1 being very weak and 5 being very strong. In terms of the information ability of the respondents, a score of less than or equal to 3 was categorized as 0, meaning low information ability, while a score greater than 3 was categorized as 1, meaning high information ability. Therefore, the CEO's information ability was transformed into a categorical variable comprising 0 and 1. There are many ways to measure CEO confidence [54]. Generally, researchers choose suitable measures of CEO confidence based on different research needs [78]. Here, the researcher took the perspective of social psychology to study the confidence of the CEO [79]. The respondents' confidence level was scored from 1 to 5 based on the interviewer's observation, with 1 being very weak and 5 being very strong. In terms of the confidence level of the respondents, a score of less than or equal to 3 was categorized as 0, indicating low confidence, while a score greater than 3 was categorized as 1, indicating high confidence. Therefore, CEO confidence was transformed into a categorical variable comprising 0 and 1.

Product, process, and marketing innovations were used to measure the adaptability of SMMEs. The operational definition of the product innovation variable was as follows: Respondents were asked, “Did your company have any new products or services in 2007?” They were instructed to mark “1” if the answer was “yes” and “0” if the answer was “no”. The process innovation variable was defined as follows: Respondents were asked, “Did your company have process innovation in 2017?” They were instructed to mark “1” if the answer was “yes” and “0” if the answer was “no”. The marketing innovation variable was defined as follows: Respondents were asked, “Has your company advertised or promoted their product online from 2016 to 2017?” They were instructed to mark “1” if the answer was “yes” and “0” if the answer was “no”. These indicators and measurement methods were also used in a previous study [80].

Control variables. Control variables included CEO age (40 years old or below, between 41 and 65 years old, or over 65 years old), CEO gender (male or female), CEO Hukou household registration (agricultural or nonagricultural), CEO ethnicity (Han nationality, or non-Han nationality), CEO education (below undergraduate education or bachelor’s degree and above), servicepersons (yes or no), firm size (1–10, 11–50, or 51–205 employees), firm age (four years old and below or five to eight years old), and industry (construction or non-construction industry).

### 3.3. Methods

Multivariate logistic regression analysis is widely used in SMME research [81,82]. In e-commerce adoption research, multivariate logistic regression analysis can effectively predict the probability of e-commerce adoption [83]. In this study, multivariate logistic regression analysis was conducted to test each relationship using STATA statistical software (version 15.0, StataCorp). The statistical significance was set at  $P < 0.05$ , and all tests were two-tailed. The likelihood ratio test of the final multivariate logistic regression model against the null model and the  $\chi^2$  statistic, as the difference between the two loglikelihoods of the null and final models, was conducted. Once the  $p$ -value was 0.000, it could be concluded that the final model outperformed the null model [84].

The following logistic regression model was used to assess the impact of information ability and self-confidence at the CEO level and absorptive capacity at the enterprise level on the e-commerce adoption:

$$\text{Logit } P(Y = 1 | X) = \ln \frac{P(Y = 1 | X)}{1 - P(Y = 1 | X)} = \alpha_j + \beta X + e,$$

Here,  $Y$  is the online sales and is a categorical variable of 0 or 1. A value of 1 meant that a company already had online sales, and 0 meant that a company did not have online sales.  $X$  includes the CEO’s information ability, product innovation, process innovation, marketing innovation, and another nine control variables.

## 4. Results

The respondents’ e-commerce adoption is shown in Table 1. During the 2016–2017 period, 32.49% of the respondents reported online sales ( $n = 869$ ), while 67.51% did not ( $n = 1806$ ).

The results in the cross-contingency table showed that SMMEs with CEOs who had high information ability were more likely to adopt e-commerce than those with CEOs who had low information ability. SMMEs with CEOs who had high confidence were more likely to adopt e-commerce than those with CEOs who had low confidence. SMMEs with a high level of product innovation were more likely to adopt e-commerce than those with a low level of product innovation. These same results were found with regard to both process and marketing innovation. The CEO age, education, and serviceperson experience were found to influence the adoption of e-commerce by SMMEs, while CEO gender, Hukou household registration, and ethnicity did not. The probability of SMMEs adopting e-commerce did not vary depending on the size of the enterprise. Older companies were found to be more likely

to adopt e-commerce than younger companies. The probability of adopting e-commerce for construction companies was lower than that for non-construction companies.

**Table 1.** Distribution and chi-square of general characteristics.

Classification		Number of Participants ( <i>n</i> = 11,547)	Online Selling or Not		$\chi^2$ ( <i>p</i> )
			<i>n</i> (%)	Yes <i>n</i> (%)	
CEO information capacity	High	1864 (69.68)	673 (77.45)	1191 (65.95)	36.72 *** (0.000)
	Low	811 (30.32)	196 (22.55)	615 (34.05)	
CEO confidence	High	2216 (82.84)	771 (88.72)	1445 (80.01)	31.32 *** (0.000)
	Low	459 (17.16)	98 (11.28)	361 (19.99)	
Product innovation	Yes	1178 (44.04)	518 (59.61)	660 (36.54)	126.64 *** (0.000)
	No	1497 (55.96)	351 (40.39)	1146 (63.46)	
Process innovation	Yes	992 (37.08)	442 (50.86)	550 (30.45)	104.74 *** (0.000)
	No	1683 (62.92)	427 (49.14)	1256 (69.55)	
Promotion innovation	Yes	1318 (49.27)	707 (81.36)	611 (33.83)	530.19 *** (0.000)
	No	1357 (50.71)	162 (18.64)	1195 (66.17)	
CEO age	Young	1735 (64.86)	705 (81.13)	1084 (60.02)	58.5 *** (0.000)
	Middle-aged	921 (34.43)	216 (24.86)	705 (39.04)	
	Old	19 (0.71)	2 (0.23)	17 (0.94)	
CEO gender	Male	1972 (73.72)	633 (72.84)	1339 (74.14)	0.511 (0.475)
	Female	703 (26.29)	236 (27.16)	467 (25.86)	
CEO Hukou	Agriculture	1437 (53.72)	449 (51.67)	988 (54.71)	2.178 (0.14)
	Nonagriculture	1238 (46.28)	420 (48.33)	818 (45.29)	
CEO ethnicity	Han	2546 (95.18)	828 (95.28)	1718 (95.13)	0.031 (0.861)
	Non-Han	129 (4.82)	41 (4.72)	88 (4.87)	
CEO education	High	1332 (49.79)	504 (58.00)	828 (45.85)	34.647 *** (0.000)
	Low	1343 (50.21)	365 (42.00)	978 (54.15)	

Table 1. Cont.

Classification		Number of Participants ( <i>n</i> = 11,547)	Online Selling or Not		$\chi^2$ ( <i>p</i> )
			Yes <i>n</i> (%)	No <i>n</i> (%)	
Serviceperson experience	Yes	147 (0.06)	65 (7.48)	82 (4.54)	9.761 *** (0.002)
	No	2528 (99.94)	804 (92.52)	1724 (95.46)	
Firm size	Micro enterprises	1559 (58.28)	462 (53.16)	1097 (60.74)	0.427 (0.513)
	Small	893 (33.38)	310 (35.67)	583 (32.28)	
	Medium	223 (8.34)	97 (11.16)	126 (6.98)	
Firm age	Old	705 (26.36)	236 (27.16)	469 (25.97)	20.131 *** (0.000)
	Young	1970 (73.64)	633 (72.84)	1337 (74.03)	
Industry	Construction	181 (0.07)	39 (4.49)	142 (7.86)	10.592 *** (0.001)
	Others	2494 (99.93)	830 (95.51)	1664 (92.14)	
Online selling	Yes	869 (32.49)			
	No	1806 (67.51)			

Note: \*\*\*  $p < 0.01$ .

Table 2 presents a logistic model that reflects the relationship between the adoption of e-commerce, CEOs' information ability, absorptive capacity, and other control variables. McFadden's Pseudo  $R^2$  is an indicator to measure the degree of fit of the logistic regression model. When the value is between 0.2 and 0.4, the fit of the logistic regression model is relatively good, and the model can be accepted. McFadden's Pseudo  $R^2$  was 0.2078, which showed that this logistic regression model had a good degree of fit.

The association between e-commerce adoption and CEOs' information ability was significant. The higher the CEO's level of information ability, the greater the likelihood of their SMME's adoption of e-commerce (odds ratio (OR) = 1.315; 95% confidence interval (CI): 1.046–1.653). Thus, Hypothesis 1 was confirmed. Furthermore, the association between e-commerce adoption and CEOs' confidence was significant. The higher a CEO's confidence level, the greater the likelihood of SMMEs' adoption of e-commerce (OR = 1.422; 95% CI: 1.068–1.895). Thus, Hypothesis 2 was confirmed. Additionally, SMMEs with middle-aged CEOs were less likely to adopt e-commerce than those with young CEOs (OR = 0.79; 95% CI: 0.578–0.892). In another finding, SMMEs led by CEOs with a bachelor's degree or above were more likely to adopt e-commerce than those led by CEOs who had never attended college (OR = 1.257; 95% CI: 1.022–1.544). Meanwhile, SMMEs led by CEOs with serviceperson experience were more likely to adopt e-commerce than those led by CEOs without such experience (OR = 1.527; 95% CI: 1.028–2.269). However, other characteristics of the CEO such as gender, Hukou household registration, and ethnicity were not significantly related to SMMEs' adoption of e-commerce.



**Table 2.** Multivariable logistic regression analysis.

Characteristics	Odds Ratio	Drink_Y_18 95% CI	p-Value
CEO information capacity: High vs. others	1.315	1.046–1.653	0.019
CEO confidence: High vs. others	1.422	1.068–1.895	0.016
Product innovation: Yes vs. no	1.518	1.246–1.849	0.000
Process innovation: Yes vs. no	1.605	1.317–1.956	0.000
Promotion innovation: Yes vs. no	7.171	5.848–8.793	0.000
CEO age:			
Middle-aged vs. young	0.79	0.578–0.892	0.003
Old vs. young	0.283	0.057–1.396	0.121
CEO gender: Male vs. female	0.903	0.728–1.121	0.355
CEO Hukou: Agriculture vs. nonagriculture	0.952	0.779–1.164	0.631
CEO ethnicity: Han vs. non-Han	0.816	0.519–1.282	0.377
CEO education: High vs. low	1.257	1.022–1.544	0.030
Serviceperson experience: Yes vs. no	1.527	1.028–2.269	0.036
Firm size:			
Small vs. micro enterprises	1.162	0.947–1.529	0.151
Medium vs. micro enterprises	1.295	0.992–1.537	0.131
Firm age: Old vs. young	1.235	1.141–1.825	0.059
Industry: Construction vs. others	0.534	0.354–0.806	0.003
Constant	0.073	0.041–0.13	0.000
McFadden's Pseudo R <sup>2</sup>		0.2078	
Log-likelihood		−1336.102	
Chi-square		700.86 (0.000)	

Furthermore, SMMEs with high rather than low levels of product innovation were more likely to adopt e-commerce (OR = 1.518; 95% CI: 1.246–1.849). Thus, Hypothesis 3 was confirmed. Moreover, SMMEs with a high rather than a low level of process innovation were more likely to adopt e-commerce (OR = 1.605; 95% CI: 1.317–1.956). Thus, Hypothesis 4 was confirmed. Further to this, SMMEs with a high rather than a low level of process innovation were more likely to adopt e-commerce (OR = 7.171; 95% CI: 5.848–8.793). Thus, Hypothesis 5 was confirmed. The study also showed no significant relationship between enterprise size and the probability of SMMEs' adoption of e-commerce. However, construction companies were significantly less likely to adopt e-commerce than non-construction companies (OR = 0.534; 95% CI: 0.354–0.806). Also, older SMMEs were more likely to adopt e-commerce than younger ones (OR = 1.235; 90% CI: 1.141–1.825). However, this relationship was not significant, with a *p*-value of 0.059.

## 5. Discussion

### 5.1. Theoretical Implications

This study contributed to the extant literature in three ways. First, the study expanded the understanding of CEO characteristics in relation to the adoption of e-commerce by SMMEs. The study showed that CEOs' information ability and confidence were significant factors that stimulated e-commerce adoption by SMMEs. Although the existing literature suggested that owner/manager characteristics will have an impact on the adoption of e-commerce by SMMEs [36,47], recent studies have added the dimension of CEOs' ability when studying SMME behavior. For example, in South Korea, the CEO's ability to discover new business opportunities had a positive effect on the performance of an SMME [49]. This study extended this further by highlighting the positive relationship between CEOs' information ability, confidence, and e-commerce adoption by SMMEs. Based on previous studies [50] and the information center hypothesis [51], our intuition was that CEOs with superior information ability were more knowledgeable about their business and the critical value of information, and as a result, the probability of adopting e-commerce would increase. Confirming this prediction, the empirical evidence indicated a positive association between CEOs' information ability, confidence, and e-commerce adoption

by SMMEs, offering an alternative explanation for the complex and diverse association between owner/manager characteristics and the adoption of e-commerce.

Second, this study extended the e-commerce adoption theory of SMMEs by drawing insights using the absorptive capacity lens. Rogers' [72] diffusion of innovation theory points out that the process of transferring information to people or organizations over time can bring innovative applications. The empirical results of this study showed that there was a significant positive relationship between the absorptive capacity, including product, process, and marketing innovations, and e-commerce adoption by SMMEs. The results of this study were consistent with those of previous studies [21,71]. Additionally, this study also showed that for SMMEs to adopt e-commerce, the impact of marketing innovation (OR = 7.171) was far greater than that of product (OR = 1.518) and process innovations (OR = 1.605). This showed that when SMMEs adopt innovative marketing methods such as Internet marketing, they will generally adopt e-commerce. Therefore, this study extended the theoretical insights on the e-commerce adoption behavior of SMMEs, which also enriched the absorptive capacity theory and improved its application.

Third, this study put forward new empirical evidence concerning certain traditional ideas, and showed that they are not always valid. Traditional ideas are that a firm's size has a positive impact on technology adoption [85,86]. However, contrary to Cuervo and Menéndez's [21] conclusion that firm size is positively correlated with e-commerce adoption, the results of this study showed this was not significant. They also showed that in different countries and regions, the influence of enterprise size on e-commerce adoption may differ. In other words, the relationship between the two was sensitive to the regional context. This study also showed that the probability of SMMEs adopting e-commerce is sensitive to the industrial context. The contextual sensitivity of SMMEs' adoption of e-commerce requires an objective analysis of the specific environment in which they are located during the study of SMME behavior [87].

### *5.2. Practical Implications*

The practical impact of this research for the implementation of digital transformation by SMMEs is as follows: First, SMMEs should seize the opportunities brought by the digital wave, attach importance to Internet-based e-commerce activities, and actively adopt e-commerce to achieve business growth. Second, the CEOs of SMMEs must strive to improve their information ability and gain enough confidence to become information-based leaders that adapt to the information age, so that they can lead their enterprises in this age to make full use of new management tools such as e-commerce. Third, SMME enterprises should actively improve their employees' learning enthusiasm and their ability to evaluate, assimilate, and apply new knowledge. All these are conducive to digital transformation and the adoption of management tools, including SMME e-commerce. For the government, it is necessary to strengthen policy support for the digital transformation of SMMEs.

### *5.3. Limitations and Future Research*

Although this study obtained results with theoretical value and practical significance, it also had limitations that need to be considered in future studies. First, because this study used cross-sectional data, the relationships in the results were correlational, not causal. In the future, it will be necessary to use panel data for causality testing. Second, more indicators should be used to comprehensively measure CEOs' information ability in the future. Third, this study measured the knowledge-absorption capacity from the perspective of innovation; the dimension of human resources should be added in the future. Finally, this study focused on SMMEs in China, and there was no comparison with other countries. Data from SMMEs in Southeast Asian countries, such as South Korea and Japan, should be collected to conduct country-by-country comparative research in the future.

## 6. Conclusions

The objective of this study was to identify the relationship between CEO characteristics, absorptive capacity, and e-commerce adoption using cross-sectional data of 2675 SMMEs in China. The study confirmed the positive relationship between CEOs' information ability, confidence, and e-commerce adoption by SMMEs. This may be explained by the existing literature that suggests that confident and informative CEOs are better innovators and information-based leaders [50,57], although further research needs to be done in this area. This enriched and expanded the research on the owner/manager characteristics of e-commerce adopted by SMMEs. This study also confirmed the positive relationship between absorptive capacity and the adoption of e-commerce by SMMEs, which was in line with previous studies [21,70]. The findings offer important implications for the digital transformation of SMMEs using an absorptive-capacity lens. For SMMEs, enterprises with a strong absorptive capacity tend to have a higher innovation capacity; thus, they are more likely to adopt e-commerce.

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