

# The impact of e-commerce capabilities on agricultural firms' performance gains: the mediating role of organizational agility

Agricultural firms' performance gains

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## Abstract

**Purpose** – This study aimed to investigate the impact of e-commerce capabilities on agricultural firms' performance gains through organizational agility.

**Design/methodology/approach** – A survey was used to collect data from 280 managers of agricultural firms. The proposed model was tested via structural equation modeling.

**Findings** – The empirical results indicated that organizational agility plays a mediating role in conveying the positive influences of e-commerce capabilities on agricultural firms' performance gains. Specifically, managerial, talent and technical capabilities have different effects on market capitalization and operational adjustment agility, with talent capability performing the most important role. Market capitalization and operational adjustment agility have positive impacts on financial and nonfinancial performance gains, respectively.

**Originality/value** – This study provides a new framework to understand the relationships between e-commerce capabilities, organizational agility and agricultural firms' performance gains.

**Keywords** E-commerce capabilities, Organizational agility, Performance gains, Agricultural firms

**Paper type** Research paper

## 1. Introduction

While e-commerce is common in the retail and service sectors, it has not been widely adopted in the agricultural sector where businesses focus on growing, harvesting, packaging and shipping fruits and vegetables. The agricultural sector has unique characteristics that distinguish it from other industries. Specifically, market risks often occur due to the high degree of uncertainty in the agricultural supply chain (Zeng *et al.*, 2017), long industrial chains leading to difficulty in maintaining a stable level of quality in agricultural products (Lin *et al.*, 2019), agriculture production's reliance on the environment (Leong *et al.*, 2016) and the fragility and perishability of agricultural products which may increase due to high



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circulation costs (Cui *et al.*, 2017). All these characteristics can cause uncertainty and operational difficulties in the agricultural sector.

However, in this sector, e-commerce has the potential to eliminate middle layers in the value chain, reduce production and operational costs, lessen information asymmetry and improve the connection between agricultural production and market demand (Lin *et al.*, 2019). Such advantages are of vital importance as many agricultural firms struggle financially. For example, only 1% of agricultural firms in China are profitable (Zeng *et al.*, 2017). Therefore, there is a pressing need to examine the drivers of e-commerce adoption by agricultural firms as well as the process of creating performance gains through the use of e-commerce in agricultural firms after it is adopted. Most of the existing research studies in this domain focus on customer's adoption factors rather than assessing the value or the impact of e-commerce on firms (Picoto *et al.*, 2014; Krell *et al.*, 2016). To advance this line of research, we focus on the second need and examine the mechanisms that afford the translation of e-commerce capabilities into agricultural firms' performance gains.

E-commerce is regarded as being a universally available resource (imitable or mobile) as well as being unable to provide agricultural firms with a competitive advantage. However, the capabilities that reflect firms' ability to use e-commerce for managing business processes (i.e. e-commerce capabilities) are valuable, heterogeneous and immobile, which can provide a competitive advantage for agricultural firms (Zhang *et al.*, 2016a, b; Irfan *et al.*, 2019). For example, it has been posited that e-commerce can help agricultural firms integrate the production, supply and marketing of agricultural products, shorten the circulation link and expand the agricultural chain's value and increase market competitiveness (Zhu *et al.*, 2015).

Consequently, such capabilities and their efficacy in impacting firms' performance gains have not been ignored by current research. Nevertheless, the extant body of work in this domain has two limitations, which we intend to address in this study. First, previous studies have presented inconsistent conclusions regarding the impact of e-commerce capabilities on performance gains (Liu *et al.*, 2013). Some scholars have shown that e-commerce capabilities have a positive impact (Chen *et al.*, 2014), while others have found that e-commerce capabilities have no significant effect on firms' performance (Chae *et al.*, 2014). This inconsistency can be explained through understanding the mechanisms (e.g. mediation processes) that translate e-commerce capabilities into performance gains. Organizational agility captures a firm's ability to respond quickly to unexpected changes (Lu and Ramamurthy, 2011). It can help firms rapidly adjust their internal processes and capitalize on market opportunities to gain competitive advantage (Cheng *et al.*, 2020). Furthermore, when e-commerce is integrated into the market operation, e-commerce capabilities can help firms obtain and analyze information related to changes in the external environment, help firms improve business processes and thus achieve organizational agility (Ravichandran, 2018). Although organizational agility may play a mediating role in the impact of e-commerce capabilities on firms' performance gains, empirical evidence of its role as a mediator is scarce. Hence, we intend to explore it further in this paper. Second, existing studies have treated e-commerce capability as a unidimensional concept (Cui and Pan, 2015). This perspective ignores nuanced differences among various e-commerce capability facets. Thus, viewing e-commerce capability as a multidimensional concept can be beneficial and assist in exploring more specific effects of e-commerce capabilities on performance gains. This is the second objective we intend to address in this paper; it can also elucidate reasons for inconsistent findings in previous studies as averaging across e-commerce capability facets may mask important nuances.

To address the above described research gaps, we draw on the perspective of dynamic capability theory to develop a model that explains the impacts of e-commerce capabilities on agricultural firms' performance gains and the mediating role of organizational agility in the linkages between them. This paper makes three key contributions to current research. First, this study reveals the mechanism through which e-commerce capabilities influence

agricultural firms' performance gains, identifies the mediation role of organizational agility and provides a new way for agricultural firms to effectively develop e-commerce capabilities to obtain performance gains. Second, this study supplements the applicability of dynamic capacity theory and finds that e-commerce capabilities (i.e. low-order organizational capabilities) can promote organizational agility (i.e. high-order organizational capability). Third, this study considers both financial and nonfinancial performance gains as the reflection of agricultural firms' overall performance gains, expanding previous studies that only focused on one dimension.

## 2. Theoretical background

### 2.1 *Dynamic capability theory*

Dynamic capability theory argues that a firms' competitive advantage is dependent on a type of organizational capability, namely dynamic capability, which refers to a firm's ability to integrate, build and reconfigure internal and external competencies (Teece *et al.*, 1997; Li and Chan, 2019). Moreover, the theory also points out that dynamic capability has a hierarchical structure, including low- and high-order organizational capabilities (Liu *et al.*, 2013). Specifically, low-order organizational capability emphasizes the integration of knowledge in a specific field to achieve the firm's performance of a specific functional module (Wang *et al.*, 2012). High-order organizational capability covers a wide range of knowledge, mainly cross-level and cross-departmental knowledge, and emphasizes that firms can achieve specific goals through collaboration between various functional departments (Grewal and Slotegraaf, 2007). The literature on dynamic capability has indicated that low-order organizational capabilities can promote high-order organizational capabilities (Eisenhardt and Martin, 2000; Sambamurthy *et al.*, 2003; Pavlou and El Sawy, 2006).

In the existing literature, information technology (IT) capability is widely proposed as a critical type of low-order organizational capability that enables firms to mobilize and deploy IT-based resources for the enhancement of business strategies and work processes (Mikalef and Pateli, 2017). Organizational agility refers to the firm's ability to sense and quickly respond to changes in the environment (Cheng *et al.*, 2020). Organizational agility has been regarded as a high-order dynamic capability through the development of work routines and leveraging low-order operational capabilities (e.g. IT capability) that allow firms to align, enhance and reconfigure other capabilities and resources (Ghasemaghaei *et al.*, 2017; Ravichandran, 2018).

In the context of this study, e-commerce capabilities refer to a firm's ability "to interact with its customers and business partners and conduct businesses over the Internet" (Zhu, 2004). E-commerce capabilities enable firms to share information, increase effective communication, strengthen supply chain integration and accelerate decision-making, thus improving organizational agility and gaining competitive advantage (Kuang, 2011; Zhu *et al.*, 2020). E-commerce capabilities have been regarded as operational capabilities because they derive from e-commerce units of an organization (Benitez *et al.*, 2018). E-commerce capabilities are low-ordered and agility is high-ordered because dynamic capabilities are considered as high-order and operational capabilities are low-order (Wang *et al.*, 2012). Therefore, dynamic capability theory is an appropriate lens to understand the impact of e-commerce capabilities on organizational agility and subsequent agricultural firms' performance gains.

### 2.2 *Information technology and e-commerce capabilities*

IT capabilities are described as firms' ability to mobilize and deploy IT-based resources in combination with other resources and capabilities, which can help companies take advantage of opportunities and reconfigure resources to avoid adverse outcomes (Tallon *et al.*, 2019). Empirical research shows that companies with strong IT capabilities can create digital options in the form of digital processes and knowledge for firm operation, accelerate decision-making and increase effective communication, thus bringing excellent performance

gains (Irfan *et al.*, 2019; Li and Chan, 2019). An IT capability is not a simplistic, one-dimensional concept; rather, it is a complex construct composed of several dimensions. Prior research highlights that IT capabilities include organizational (e.g. IT management), physical (i.e. IT infrastructure) and human (e.g. IT skills or knowledge) elements and further divides IT capabilities into IT management, IT infrastructure and IT personnel capabilities (Kim *et al.*, 2012). Since then, the three dimensions of IT capabilities have been validated by other, related IT in different contexts. For example, big data analytics (BDA) capability consists of three primary dimensions (i.e. management, technology and talent capabilities) in a big data environment (Akter *et al.*, 2016; Wamba *et al.*, 2017).

E-commerce capabilities are a specific case or type of IT capabilities. In a similar spirit as the IT capabilities literature, we conducted a review of e-commerce capabilities, which presents us with three predominant dimensions: management, technical and talent capabilities and also identified in general IT capabilities and in specific BDA capabilities. For example, Zhuang and Lederer (2006) emphasized that the professional knowledge of e-commerce employees is the driving force in helping enterprises to use e-commerce resources to create business value. Eikebrokk and Olsen (2007) identified three competencies, e-business strategy, IT-business process integration and systems and infrastructure, as important elements of e-business capability and success in small and medium-sized enterprises (SMEs). Furthermore, Ordanini and Rubera (2010) pointed out that human resources' skills (i.e. technical and managerial) and other intangible capabilities, such as relationship assets (i.e. talent), are very important for the success of e-commerce applications. These dimensions of e-commerce capabilities and their relationships are also supported by Zhu *et al.* (2015), who identified technology, relationships and business as the core components of e-commerce processes.

Hence, drawing on the research study of Kim *et al.* (2012) and the e-commerce capabilities literature, we identified managerial, technical and talent capabilities as the three core dimensions of e-commerce capabilities. Managerial capability is the ability to handle routines in a structured manner to manage e-commerce resources in accordance with business needs and priorities (Kim *et al.*, 2012). Technical capability is the ability to provide technical solutions to problems in e-commerce operations in a fast and efficient manner, thereby ensuring the smooth business processes (Garrison *et al.*, 2015). Talent capability comprises employees' professional ability (i.e. skills and knowledge), which is fundamental for firms to use e-commerce to adjust operating procedures in response to market demand (Kim *et al.*, 2012). The three dimensions mainly reflect organizational, physical and human aspects of e-commerce, respectively. Their contributions to e-commerce capabilities do not exist in isolation but work with each other cooperatively.

### 2.3 Organizational agility

Organizational agility can help companies quickly adjust their structures, reconfigure resources and respond to market changes (Harsch and Festing, 2020). As such, it is a high-order capability built upon and afforded by low-level capabilities, which serve as its building blocks (Ghasemaghaei *et al.*, 2017). Therefore, organizational agility is an important component of a firm's ability to survive and develop in a turbulent environment, and it is afforded by low-level organizational capabilities. It is, thus, a reasonable mediating mechanism between capabilities and performance gains.

Agility may be particularly useful in the context of agricultural firms. Because the value chain of agricultural products is complex and involves many participants, there is a weak control, and the market environment is very unstable and dynamic. For instance, it is difficult to remain abreast of changing consumer preferences, from food protected by pesticides to organic foods, from sugary to healthier choices and from in-store to online shopping (Lagerkvist *et al.*, 2013). There are also frequent changes in market regulations, value chain models and competitors and collaborators (Trienekens, 2011), which make agility highly desirable and important for firms' survival.

Organizational agility can have two facets: market capitalizing and operational adjustment agility (Lu and Ramamurthy, 2011). Market capitalizing agility refers to a firm's ability to quickly respond to and capitalize on changes by continuously monitoring and quickly improving its products/services to address customer needs. This agility facet emphasizes a dynamic and growth-oriented entrepreneurial mindset about strategic direction, decision-making and judgment in uncertain conditions (Sambamurthy *et al.*, 2003). Operational adjustment agility involves the ability of a firm's internal business processes to physically and rapidly cope with market or demand changes. This agility highlights fluid translations of innovative initiatives in the face of change (Lu and Ramamurthy, 2011).

### 2.4 Firms' performance gains

Firms' performance gains are the degree to which a firm achieves its goals and the final result of its operation. In early studies of IT's impact on firms' performance gains, researchers believed that the value created by IT was reflected through financial indicators, such as a firm's profitability, market value and economic growth rate (Brynjolfsson, 1993). However, later research studies found that this evaluation system has some limitations. First, gaining value from IT is a long-term process with a time lag, and thus, it will not bring immediate financial benefits. Research has also shown that it takes two to three years to achieve IT productivity (Nwankpa and Datta, 2017). Second, the impact of IT use on firms' performance gains is reflected not only in financial performance gains but also in some unquantifiable values, such as operational efficiency improvement, new product development and customer satisfaction (Bozic and Dimovski, 2019). If these nonfinancial indicators are ignored, the value brought by IT will be underestimated. Therefore, this study divides the performance gains created by e-commerce into financial and nonfinancial performance gains. Financial performance gains reflect the profitability of firms, mainly measured by financial indicators, such as return on investment, sales volume and profit (Zhuang and Lederer, 2006). Nonfinancial performance gains mainly include less tangible performance aspects, such as product reliability, customer service, knowledge management and other aspects that capture performance aspects that cannot be directly monetized (Xu *et al.*, 2017).

### 3. The research model and hypotheses

Integrating discrete cosine transform (DCT) with the perspective of organizational agility, we propose the following model (Figure 1) that explains how key e-commerce capability facets help agricultural companies to become agile and, ultimately, help them perform efficiently.

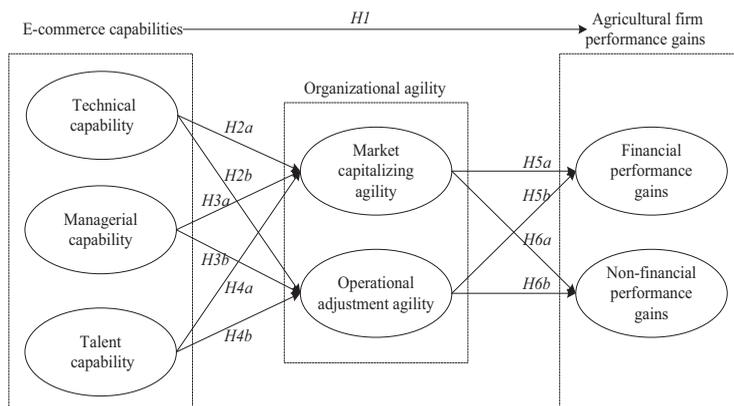


Figure 1. The research model

### 3.1 E-commerce capabilities and agricultural firms' performance gains

E-commerce capabilities can improve agricultural firms' connectivity and responsiveness by connecting various databases, which leads to superior firm performance gains. Specifically, e-commerce capabilities promote sharing among agricultural firms, customers and business partners, eliminate barriers to information flow and reduce information asymmetry by providing more accurate and timely information, thus increasing efficiency and reducing costs (Zhu, 2004; Wu *et al.*, 2019). In addition, e-commerce capabilities promote the extensive use of the Internet in business activities and facilitate decision-making and work efficiency among employees, thereby optimizing the operational system of agricultural firms (Zhu *et al.*, 2015). High-level e-commerce capabilities enable agricultural firms to better utilize the Internet to integrate information and resources, facilitate transactions and improve customer services (Yang *et al.*, 2015). Hence, we hypothesize that e-commerce capabilities can enable agricultural firms to improve performance gains, such as improving customer satisfaction, saving process cycles, reducing costs and improving asset returns:

*H1.* E-commerce capabilities are positively related to agricultural firms' performance gains.

### 3.2 E-commerce capability facets and organizational agility

E-commerce technical capability enables agricultural firms to easily and quickly change their operational processes to cope with both opportunities and threats in the market and improves the firm's ability to integrate new technologies that streamline operational procedures and processes (Garrison *et al.*, 2015). High levels of e-commerce technical capability in agricultural firms mean that the IT function can quickly develop, deploy and support system's components to adjust the production structure according to changes in market demand, improve the transmission of agricultural product information and support decision-making to adapt to the changing environment (Aker *et al.*, 2016). As such, this capability creates a flexible e-commerce infrastructure that caters to both facets of agility; it creates both internal and external flexibilities. Accordingly, we hypothesize that e-commerce technical capability can enable agricultural firms to quickly respond to market changes and rapidly adjust their internal operating processes to cope with market changes:

*H2a.* E-commerce technical capability is positively related to market capitalizing agility in agricultural firms.

*H2b.* E-commerce technical capability is positively related to operational adjustment agility in agricultural firms.

Managerial capability enables agricultural firms to effectively deploy IT solutions, assess market conditions and develop strategies that rely on e-commerce. It can also facilitate the effective and efficient integration of new technologies into existing business processes to increase the firm's flexibility (Bharadwaj, 2000). In a dynamic environment, high levels of e-commerce management capability can help agricultural firms adjust their agricultural production and marketing plans and respond to market changes caused by the characteristics of agricultural products and agriculture by leveraging e-commerce (Chen *et al.*, 2015). Indeed, managerial capability can improve organizational agility, in part, through the promotion of organizational learning and business strategy flexibility (Chen *et al.*, 2014). Given that e-commerce spans the whole supply chain, the flexibility gained can be both internal (i.e. related to operational processes, such as internal reporting and inventory management) and external (i.e. related to customer and supplier interactions, such as customer and supplier interfaces). As such, we hypothesize the following:

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*H3a.* Managerial capability is positively related to market capitalizing agility in agricultural firms.

*H3b.* Managerial capability is positively related to operational adjustment agility in agricultural firms.

With talent capability, employees can analyze data to design and redesign e-commerce strategies and operations according to observed firms' performance gains and changes in the external environment. When talent capability is high, employees can observe the environment and internal operations and develop e-commerce strategies that are consistent with the agricultural firm's overall strategy and fit the current state of the market. Indeed, talent capabilities afford fast responses to market changes and improve organizational agility (Luftman *et al.*, 2017). E-commerce talent capability can help agricultural firms assess changes in consumers' preferences quickly, create unique selling points, promote consumers' interest in agricultural products and facilitate consumers' purchasing decisions (Fosso *et al.*, 2017). This means that agricultural firms high in e-commerce talent capability can use their professional knowledge and skills to adjust operating procedures and cope with changes in market demands and the configuration of the market (e.g. new competitors, changes in the supply chain or changes in regulation) as well as react faster than competitors that are low in talent capability (Kim *et al.*, 2012). Therefore, we hypothesize the following:

*H4a.* Talent capability is positively related to market capitalizing agility in agricultural firms.

*H4b.* Talent capability is positively related to operational adjustment agility in agricultural firms.

### *3.3 Organizational agility and firms' performance gains*

Enabled by a specific capability, namely e-commerce capability, organizational agility is broader in scope. According to Grant (1995), broad capabilities tend to have stronger effects than specialized capabilities on firms' performance gains. Therefore, we argue that organizational agility directly impacts performance gains. Through this agility, agricultural firms can produce synergy between e-commerce technologies, business objectives and market demands. As such, it has been shown that market capitalizing and operational adjustment agility can improve firms' performance (Chakravarty *et al.*, 2013) through quickly perceiving and responding to customers' needs (Roberts and Grover, 2012). Organizational agility can help agricultural firms rapidly adjust operations (e.g. product-ordering modes, cold-chain logistics and the allocation of productive factors) to meet consumers' timeliness requirements for agricultural products and flexibly cope with various changes, thus increasing firms' performance gains (Zhou *et al.*, 2019).

A high level of market capitalizing agility can provide agricultural firms with a first-mover advantage by increasing agricultural product customization and reducing response times. It helps agricultural firms strengthen their competitive behavior and increase their chances of thriving in a competitive environment (Park *et al.*, 2017). However, market capitalizing agility can drive both financial and nonfinancial improvements. For example, a new e-commerce service that is sought after by customers (e.g. mobile and direct ordering of fruits or vegetables from the farm) can improve financial (e.g. profit) and nonfinancial aspects, such as customer satisfaction, retention and support. Similarly, a customer relationship management system that draws data from the same e-commerce site can facilitate not only more targeted marketing and increased profits but also better customer service, a nonfinancial performance gain. Therefore, we hypothesize the following:

- H5a.* Market capitalizing agility is positively related to financial performance gains in agricultural firms.
- H5b.* Market capitalizing agility is positively related to nonfinancial performance gains in agricultural firms.

Similarly, a high level of operational adjustment agility helps agricultural firms respond to customers' needs in a timely manner by building new partnerships, improving operational flexibility, reducing cost sharing and strengthening customer retention (Lu and Ramamurthy, 2011). In fact, operational adjustment agility helps generate new value propositions and improves internal operations to adapt to market changes, as well as seizes innovative opportunities (Sambamurthy *et al.*, 2003). It ensures that agricultural firms can quickly redesign existing processes and create new ones. This, too, can influence both financial and nonfinancial performance gains aspects. For example, automating the reporting of e-commerce transactions can allow fast maneuvers to be made that increase financial gains (e.g. dynamic pricing), in addition to increased responsiveness to customer issues (e.g. delayed shipments), which can lead to nonfinancial gains in customer satisfaction. Hence, we hypothesize the following:

- H6a.* Operational adjustment agility is positively related to financial performance gains in agricultural firms.
- H6b.* Operational adjustment agility is positively related to nonfinancial performance gains in agricultural firms.

#### 4. Theresearch design

##### 4.1 The sample and procedures

The data were collected in a survey administered to managers in a sample of agricultural firms in China. With the assistance of the Department of Agriculture, Environment and Rural Affairs, we obtained a list of 330 key agricultural firms located in provinces and cities with advanced e-commerce infrastructure, including Guangdong, Jiangsu, Zhejiang and Shanghai. A manager from each company was selected as a key informant. An e-mail message with a webpage survey and an official letter from the regional government were sent to organizational representatives to encourage participation. Within one week after the questionnaire was sent, we made telephone calls to remind them. A total of 311 questionnaires were returned. After removing 29 responses that were shorter than the time baseline (e.g. completing the questionnaire in less than 3 min), or contained illogical answers to questions (e.g. all the answers were the same), we obtained a sample of 280 valid responses. Characteristics of the sampled firms are presented in Table 1, while respondents' (managers) characteristics are given in Table 2.

##### 4.2 The survey

We used a web-based questionnaire with five-point Likert scales (from "strongly disagree" to "strongly agree") for data collection. The questionnaire collected descriptive information about the agricultural firm, such as size and experience with e-commerce initiatives, and descriptive information about the respondents (i.e. position in the firm, age, gender and education). It also captured the model's constructs (see items in Appendix). All measures were adapted from existing scales to fit the context of agricultural firms. The measurement of e-commerce talent capability was adapted from Akter *et al.* (2016), who used four first-order constructs to measure the second-order construct of talent capability. The four first-order constructs were measured by reflective 16 items, indicating that each item most likely reflects

**Table 1.** Firms' characteristics

Attributes	Options	Frequency	Percentage
Firm size [employees]	<200	50	17.9
	200–500	110	49.7
	501–1,000	90	32.1
	>1,000	30	10.7
Engagement in e-commerce [years]	<1	4	1.4
	1–3	56	20.0
	4–5	120	42.9
	6–10	80	28.6
	>10	20	7.1

Attributes	Options	Frequency	Percentage
Gender	Male	168	60.0
	Female	112	40.0
Age	20–29	48	17.1
	30–35	150	53.6
	36–40	60	21.4
	>40	22	7.9
Education	High school and below	3	1.1
	Junior college	25	8.9
	Undergraduate degree	222	79.3
	Master's degree and above	30	10.7
Occupation	Chief executive officer (CEO)	20	7.1
	Department head	145	51.8
	Department manager	115	41.1

**Table 2.** Respondents' characteristics

the same construct, and the explanatory of all the items with one construct is almost similar (Fornell and Larcker, 1981). Hence, we adapted from Akter *et al.* (2016) and chose one item best-matched with e-commerce from each first-order construct as the item of e-commerce talent capability in our study. Choosing one item from each first-order construct would reduce respondents' fatigue and increase the validity of the results if the survey was quite long (Zhang *et al.*, 2016a, b). Finally, we identified four items as indicators that reflect e-commerce talent capability. A forward–backward translation process was employed to ensure the content validity of the scales' translation to Chinese. Next, to ensure face validity and scale relevance and understandability, we invited 30 industry experts (i.e. executive-level managers of agricultural firms, obtained from a government database, who were not included in the main study) to pilot the questionnaire and provide feedback. Minor adjustments were applied based on their input.

## 5. Thedata analysis and hypotheses testing

### 5.1 The common method bias test

Given the use of self-reported cross-sectional data, we first used Harman's single-factor test to examine potential common method bias (CMB). We ran an exploratory unrotated factor analysis on all first-order construct items. The first factor explained 27.61% of the variance, which does not account for the majority of covariance of the variables. Hence, this test suggested that CMB is not a serious problem in this study. Second, following Liang *et al.* (2007), we included the partial least squares (PLS) model as a common method factor.

The results demonstrate that the method factor loadings ( $R^2$ ) were insignificant, and the indicators' substantive variances ( $RI^2$ ) were substantially greater than their method variances ( $R^2$ ). We, therefore, concluded that CMB is not a substantial problem in this study.

5.2 Reliability and validity tests

Scales were valid and reliable (see Table 3) with Cronbach's alpha values over 0.824, composite reliability values between 0.830 and 0.920 and average variance extracted (AVE) scores between 0.615 and 0.784. The results presented in Table 4 demonstrate adequate discriminant validity as the square root of the AVE of each variable is much higher than the inter-construct correlation of the variable.

5.3 Structural model testing

We used LISREL 8 for model estimation. Fit indices were adequate ( $\chi^2/df = 1.266$ , NFI = 0.841, CFI = 0.961, GFI = 0.907, AGFI = 0.886 and RMSEA = 0.029), and the path coefficients are shown in Figure 2. E-commerce capabilities were positively associated with agricultural firms' performance gains ( $\beta = 0.775, p < 0.001$ ), supporting H1. Technical capability was positively associated with market capitalizing agility ( $\beta = 0.201, p < 0.01$ ), supporting H2a but not with operational adjustment agility ( $\beta = 0.176, t = 1.788$ ), which did not support H2b. Managerial capability was positively associated with market capitalizing agility ( $\beta = 0.231, p < 0.001$ ) and operational adjustment agility ( $\beta = 0.241, p < 0.001$ ), supporting H3a and H3b, respectively. Talent capability was positively associated with market capitalizing ( $\beta = 0.418, p < 0.001$ ) and operational adjustment agility ( $\beta = 0.344, p < 0.001$ ), supporting H4a and H4b, respectively. Market capitalizing agility was positively associated with financial ( $\beta = 0.444, p < 0.001$ ) and nonfinancial performance gains ( $\beta = 0.393, p < 0.001$ ), supporting H5a and H5b, respectively. Finally, operational adjustment agility was also positively associated with financial ( $\beta = 0.332, p < 0.001$ ) and nonfinancial performance gains ( $\beta = 0.410, p < 0.001$ ), supporting H6a and H6b, respectively. All hypotheses, except H2b, were supported. Control variables (i.e. firm size and years of

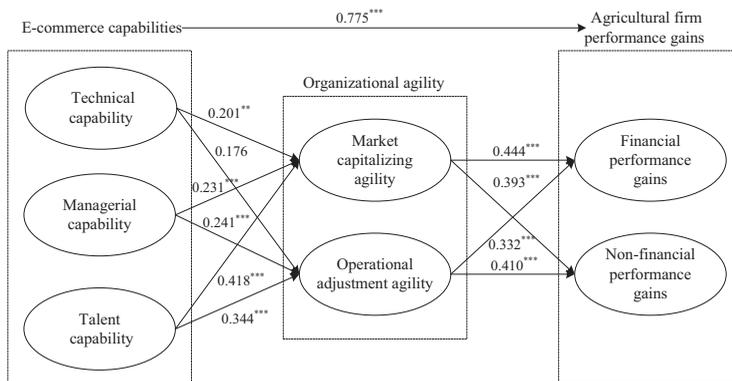
Table 3. Reliability and validity

Variables	AVE	CR	$\alpha$
Technical capability (TC)	0.784	0.843	0.838
Managerial capability (MC)	0.615	0.920	0.893
Talent capability (AC)	0.663	0.853	0.845
Market capitalizing agility (MCA)	0.718	0.891	0.882
Operational adjustment agility (OAA)	0.695	0.885	0.875
Financial performance gains (FPGs)	0.715	0.830	0.824
Nonfinancial performance gains (NFPGs)	0.682	0.915	0.886

Table 4. Correlations and discriminant validity

	TC	MC	AC	MCA	OAA	FPGs	NFPGs
TC	<i>0.817</i>						
MC	0.651	<i>0.804</i>					
AC	0.630	0.648	<i>0.800</i>				
MCA	0.588	0.568	0.675	<i>0.840</i>			
OAA	0.510	0.527	0.578	0.589	<i>0.809</i>		
FPGs	0.589	0.576	0.638	0.672	0.578	<i>0.813</i>	
NFPGs	0.556	0.568	0.646	0.626	0.643	0.699	<i>0.854</i>

Note(s): The "italics" value is the square root of the AVE of each variable



Note(s): \*\*\* $p < 0.001$ , \*\* $p < 0.01$

Figure 2.  
The structural model

experience with e-commerce) did not influence endogenous constructs (all  $p$ -values  $> 0.05$ ). The model explained 37.5% and 36.8% of the variance in market capitalizing and operational adjustment agility, respectively; and 44.5% and 47.5% of the variance in financial and nonfinancial performance gains, respectively.

#### 5.4 Post hoc tests

**5.4.1 Test of mediating effects.** We examined the mediating role of organizational agility in two ways. First, we used bootstrapping techniques with 5,000 resamples and 95% bias-corrected confidence intervals to test the mediating role. The results, reported in Tables 5 and 6, indicate that market capitalizing agility partially mediates the relationship between all capabilities and financial or nonfinancial performance gains, and operational adjustment agility partially mediates the relationship between all capabilities except technical capability and financial or nonfinancial performance gains. Then, we used the Sobel test to examine the mediating effect of organizational agility, and the results are shown in Table 7. These are consistent with the results of the bootstrapping test, further confirming the mediating role of market capitalizing and operational adjustment agility.

## 6. Discussion

We examined the role of e-commerce capabilities in building organizational agility in agricultural firms. Although previous studies have discussed e-commerce capabilities, there has been a rather inconsistent understanding in the literature (Cui and Pan, 2015; Zhu *et al.*, 2015). We enrich the existing research study by identifying three key dimensions of e-commerce capabilities, namely talent, managerial and technical capabilities, and revealing their different impacts on the two dimensions of organizational agility. Specifically, talent capability has stronger effects than managerial and technical capabilities. This demonstrates that professionals with e-commerce knowledge can help firms manage and maintain their data more efficiently and help firms respond faster to changes in the market. Therefore, talent capability can help firms seize market opportunities as well as arrange and adjust their internal operations, such as rapidly expanding or reducing the scales of production and services to adapt to market changes.

We note that managerial capability has a positive impact on market capitalizing and operational adjustment agility in agricultural firms. This finding is consistent with that of Tallon (2008), who found that IT management capability accelerates an enterprise's speed of response to market changes and positively affects operational adjustment agility.

**Table 5.**  
Results of mediating  
effects for financial  
performance gains as  
the dependent variable  
by bootstrapping  
testing

Variable	Market capitalizing agility				Operational adjustment agility									
	2.5% lower bound	Mediation test (ab) 97.5% upper bound	Zero included?	Full/partial mediation test (c) 2.5% lower bound	2.5% lower bound	Mediation test (ab) 97.5% upper bound	Zero included?	Full/partial mediation test (c) 2.5% lower bound	2.5% lower bound	97.5% upper bound	Zero included?	Type of mediation		
Technical capability	0.126	0.292	No	0.256	0.451	No	Partial	0.083	0.230	No	0.248	0.430	No	Partial
Managerial capability	0.127	0.292	No	0.194	0.379	No	Partial	0.756	0.246	No	0.380	0.591	No	Partial
Talent capability	0.116	0.312	No	0.317	0.537	No	Partial							

Variable	Market capitalizing agility				Operational adjustment agility				Type of mediation												
	Mediation test (ab)		Full/partial mediation test (c')		Mediation test (ab)		Full/partial mediation test (c')														
	2.5% lower bound	97.5% upper bound	Zero included?	2.5% lower bound	97.5% upper bound	Zero included?	2.5% lower bound	97.5% upper bound													
Technical capability	0.148	0.321	No	0.227	0.432	No	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Managerial capability	0.141	0.313	No	0.201	0.394	No	0.118	0.274	No	0.233	0.416	No	0.233	0.416	No	0.233	0.416	No	0.233	0.416	Partial
Talent capability	0.123	0.308	No	0.380	0.603	No	0.125	0.281	No	0.403	0.609	No	0.403	0.609	No	0.403	0.609	No	0.403	0.609	Partial

**Table 6.** Results of mediating effects for nonfinancial performance gains as the dependent variable by bootstrapping testing

**Table 7.**

Results of mediating effects by Sobel testing

Path	T-score	Standard error	p-value	Conclusion
TC → MCA → FPGs	5.631	0.041	0.000	Supported
TC → MCA → NFPGs	5.789	0.401	0.000	Supported
MC → MCA → FPGs	5.967	0.040	0.000	Supported
MC → MCA → NFPGs	6.636	0.036	0.000	Supported
MC → OAA → FPGs	4.757	0.036	0.000	Supported
MC → OAA → NFPGs	6.279	0.033	0.000	Supported
AC → MCA → FPGs	4.775	0.044	0.000	Supported
AC → MCA → NFPGs	4.775	0.044	0.000	Supported
AC → OAA → FPGs	3.965	0.306	0.000	Supported
AC → OAA → NFPGs	5.605	0.033	0.000	Supported

**Note(s):** TC: technical capability; MC: managerial capability; AC: talent capability; FPGs: financial performance gains; NFPGs: nonfinancial performance gains

Therefore, high managerial capability can help agricultural firms respond quickly to market changes as well as improve system development and project management by effectively executing plans and adjusting internal operations to respond to market demands.

Third, we also note that in agricultural firms, technical capability increases market capitalizing agility but has no effect on operational adjustment agility. These findings extend the research study of [Panda and Rath \(2016\)](#), who found that technical capability has a positive impact on market capitalizing and operational adjustment agility in financial firms. Technical capability has a driving effect on market capitalizing agility. It shows that agricultural firms with high technical capability can use advanced technology methods (e.g. big data analysis and cloud computing) to quickly capture and respond to changes in market demand and seize the opportunity to gain competitive advantage. We also find that technical capability has no significant influence on operational adjustment agility, but this could be a specific artifact of the sample. Alternately, there may be unique features of agricultural firms in China that weaken this link (e.g. barriers for operational adjustment). Specifically, agricultural characteristics (e.g. perishability, low standardization and seasonality) place high demands on e-commerce technical capability, but e-commerce in China's agricultural firms started late, and their technical level is relatively low. Thus, due to the constraints of low-level technology, it is difficult for agricultural firms to quickly and effectively improve or update their internal business processes. Further, exploring this null effect is a fruitful area for future research.

Fourth, market capitalizing and operational adjustment agility increase financial and nonfinancial performance gains of agricultural firms. Previous studies have focused on the impact of organizational agility on firms' financial performance gains ([Chakravarty et al., 2013](#)), ignoring the importance of nonfinancial performance gains. We extend previous research and find that there is no significant difference in the effect of the two dimensions of organizational agility on financial and nonfinancial performance gains. This indicates that in the changing market environment if firms want to improve nonfinancial performance gains (e.g. customer satisfaction, processing cycle or employees' sense of achievement) and increase financial performance gains (e.g. turnover of funds, return on assets or sales profit), they need to not only respond quickly to market changes and formulate new strategic plans but also adjust internal operations immediately to support the implementation of the new strategy.

Fifth, the results indicate that organizational agility partially mediates the effects of e-commerce capabilities and firms' performance gains. This finding is consistent with the leveraging effects of IT capabilities on dynamic capabilities, identified by [Pavlou and El Sawy \(2006\)](#). Organizational agility, as a type of dynamic capability, can adapt, integrate and reconfigure clusters of resources to match changes in the business environment.

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E-commerce capabilities can build a competitive advantage through organizational agility in a turbulent environment. The results also support the research study of Liu *et al.* (2013) by positing that the impacts of IT capabilities, as low-order capabilities, on firm performance are mediated by organizational agility, as high-order capabilities. From the view of the hierarchical structure of dynamic capability, the low-order capabilities can help a firm develop high-order ones, thereby gaining a competitive advantage. Hence, the finding reinforces the idea that e-commerce capabilities directly affect firms' performance gains as well as create and strengthen dynamic capabilities to achieve performance gains.

### 6.1 Theoretical contributions

The main theoretical contributions of this article include four aspects. First, while there is a growing body of research on e-commerce capabilities (Zhu and Kraemer, 2002; Wu *et al.*, 2011), studies of e-commerce issues in specific industries are relatively scarce, especially e-commerce in agricultural firms. E-commerce in agricultural firms has both the common features and attributes of traditional e-commerce and the particularity of the agricultural context. Therefore, we take e-commerce in agricultural firms as our research context and explore the mechanism through which e-commerce capabilities influence firms' performance gains. This relatively novel context expands the theoretical research scope of e-commerce and theories, such as the resource-based view of the firm and models of agility and firm performance, into this new domain.

Second, there is some evidence indicating that using e-commerce capabilities to achieve firms' performance gains is not always simple (Chen *et al.*, 2014). Some scholars even believe that e-commerce capabilities cannot directly bring about expected firms' performance gains (Chae *et al.*, 2014). It can be observed that the internal mechanism dealing with the impact of e-commerce capabilities on firms' performance gains is still unclear. To address this gap, this study operationalizes e-commerce capabilities in terms of three dimensions, including talent, managerial and technical capabilities, and explores the mediating role of organizational agility in the relationship between e-commerce capabilities and agricultural firms' performance gains. The finding not only demonstrates that e-commerce capabilities can influence agricultural firm performance gains by themselves but also clarify how they do so by enhancing organizational agility. Hence, this study contributes to our understanding of how the presence of e-commerce capabilities within an agricultural firm can improve outcomes.

Third, this study supplements dynamic capability theory by leveraging it to elaborate on how e-commerce affects an agricultural firm. Although research has begun to link firm-wide e-commerce capabilities to competitive advantage (Cui and Pan, 2015), there is still a limited understanding of e-commerce capabilities and how they relate to agility in agricultural firms. We classify organizational agility into two categories, market capitalizing and operational adjustment agility, and examine the impact of e-commerce capabilities on them. The results indicate that the three dimensions of e-commerce capabilities have different impacts on both types of organizational agility, indicating that e-commerce capabilities (i.e. low-order organizational capabilities) can influence to promote organizational agility (i.e. a high-order organizational capability). This finding enriches management studies of e-commerce and organizational agility by providing a better understanding of how e-commerce can enable organizational agility via building and enhancing essential e-commerce capabilities in agricultural firms.

Fourth, we identify two types of agricultural firms' performance gains: financial and nonfinancial. Prior studies have primarily focused on only one dimension (Ofir and Chris, 2014). We focus on both dimensions simultaneously, which provides a more comprehensive reflection of firms' overall performance. Hence, this study contributes to research on e-commerce business value by combining two dimensions of firms' performance. Future research can employ a similar, more comprehensive conceptualization of firms' performance.

### 6.2 Practical implications

The pragmatic implications mainly include two aspects. First, the results indicate that e-commerce capabilities play fundamental roles in improving agricultural firms' agility and enhancing performance outcomes. Therefore, agricultural firms should hire and retain skilled and experienced managers who should simultaneously develop adequate levels of e-commerce capabilities across the three key dimensions (i.e. talent, managerial and technical capabilities) to achieve superior performance. We also suggest that agricultural firms actively incorporate e-commerce with emerging digital technologies (e.g. cloud computing, big data and artificial intelligence), which enhance the firm's capability to explore and exploit the advanced features of e-commerce to support their business. We also found market capitalizing and operational adjustment agility to have similar impacts on financial and nonfinancial performance gains, which shows that both dimensions of organizational agility are very important to firms' performance. Therefore, when making plans, whether firms want to achieve short-term financial performance or long-term gains, managers need to invest in both market response and operational adjustment agility.

Second, the three dimensions of e-commerce capabilities have different effects on market capitalizing and operational adjustment agility in agricultural firms. This highlights the importance of the three key dimensions of e-commerce capability in using e-commerce to improve their ability to react to customer preferences and market changes to maintain a competitive advantage. Therefore, agricultural firms should rationally arrange investments in talent, managerial and technical resources according to the requirements of organization agility as well as promote the healthy development of e-commerce in agricultural firms. The findings also indicate that talent capability is most important for improving organizational agility. To improve talent capability, agricultural firms can strengthen employees' training to improve business skills, strengthen the construction of the enterprise culture, improve their employees' collective consciousness and organize interactive activities with customers to improve the ability of employees to maintain customer relations.

### 6.3 Conclusions, limitations and future research

This study finds that e-commerce capabilities can translate into financial and nonfinancial performance gains by increasing firm agility. As such, we call for more research into when and how e-commerce can help agricultural firms as well as the mechanisms that translate technology-related capabilities into performance gains. Several limitations in this study point to future research directions. First, this study is based on the Chinese context, so our research conclusions may not be applicable to other countries or cultures. Therefore, future research could perform a cross-cultural comparative analysis and test our model's effectiveness. Second, this study reveals a key mechanism that translates e-commerce capabilities into agricultural firms' performance gains. Other factors affecting agricultural firms' performance gains may not have been considered. Thus, future research could further explore factors that affect this mechanism (agility) and the conditions under which it functions. Future research could also integrate other broad organizational capabilities (e.g. innovation and collaboration capabilities) into our model. Third, the measurement of e-commerce talent capability was adapted from Akter *et al.* (2016), and we identified four items as indicators that reflect e-commerce talent capability. Nevertheless, other items may also explain e-commerce talent capability, so we call for future research to choose more items to explain e-commerce capability as comprehensively as possible. Finally, although the content of items in this research is related to agriculture, and the respondents worked for agricultural firms, the research model could be further revamped with potential factors reflecting the characteristics of agricultural firms. Future research is expected to fill this gap by capturing more characteristics of agricultural firms.

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**Appendix**  
**Measurement scales**

Variable	Item	Content	Source
Managerial capability (MC)	MC1	The effectiveness of e-commerce planning in our firm is better than that of other firms in our industry	Chen <i>et al.</i> (2015)
	MC2	E-commerce project management practices in our firm are better than those in other firms in our industry	
	MC3	Planning for security control, standard compliance and disaster recovery in our firm are better than those in other firms in our industry	
	MC4	System development practices in our firm are better than those in other firms in our industry	
	MC5	Consistency of e-commerce policies throughout our firm is better than that in other firms in our industry	
	MC6	E-commerce evaluation and control systems in our firm are better than those in other firms in our industry	
Technical capability (TC)	TC1	We have a process for e-commerce standardization	Garrison <i>et al.</i> (2015)
	TC2	We have the ability to quickly integrate new e-commerce into our existing infrastructure	
	TC3	The complexity of our current systems does not restrict our ability to implement new technology	
Talent capability (AC)	AC1	Our analytics personnel are very capable in the areas of data and network management and maintenance	Akter <i>et al.</i> (2016)
	AC2	Our analytics personnel are very knowledgeable about the critical factors for the success of our organization	
	AC3	Our analytics personnel are very knowledgeable about the business environment	
	AC4	Our analytics personnel work closely with customers and maintain productive user/client relationships	

(continued)

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Variable	Item	Content	Source
Market capitalizing agility (MCA)	MCA1	We are quick to make and implement appropriate decisions in the face of market/customer changes	Lu and Ramamurthy (2011)
	MCA2	We treat market-related changes and apparent chaos as opportunities to capitalize on them quickly	
	MCA3	We constantly look for ways to reinvent/reengineer our organization to better serve our marketplace	
Operational adjustment agility (OAA)	OAA1	Whenever there is a disruption in supply from our suppliers, we can quickly make the necessary alternate arrangements and internal adjustments	Xu <i>et al.</i> (2017)
	OAA2	We can quickly scale up or down our production/service levels to support fluctuations in the market demand	
	OAA3	We fulfill demands for rapid response and special requests of our customers whenever such demands arise; our customers have confidence in our ability	
Nonfinancial performance gains (NFPGs)	NFPGs1	The implementation of e-commerce has reduced our customers' reacting time	Xu <i>et al.</i> (2017)
	NFPGs2	The implementation of e-commerce has improved our customers' satisfaction	
	NFPGs3	The implementation of e-commerce has improved our internal process quality	
	NFPGs4	The implementation of e-commerce has reduced our process cycle time	
	NFPGs5	The implementation of e-commerce has reduced our process cost	
	NFPGs6	The implementation of e-commerce has improved the sharing of workers' knowledge	
	NFPGs7	The implementation of e-commerce has improved our employees' achievability and productivity	
Financial performance gains (FPGs)	FPGs1	The implementation of e-commerce has improved our inventory turnover rate	Xu <i>et al.</i> (2017)
	FPGs2	The implementation of e-commerce has improved our accounts receivable turnover rate	
	FPGs3	The implementation of e-commerce has reduced our sales cost rate	
	FPGs4	The implementation of e-commerce has improved our return on assets	
	FPGs5	The implementation of e-commerce has improved our sales profit rate	
	FPGs6	The implementation of e-commerce has improved our return on investment	

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