

## Can Firm Digitization Process Improve its Competitiveness?--Based on Resource, Information and Risk Perspectives

Zhu Guanping<sup>1</sup>, Guo Debing<sup>2\*</sup>, Sun Mingchen<sup>1</sup>

<sup>1</sup>School of Finance, Jiangxi University of Finance and Economics, Nanchang, China

<sup>2</sup>School of Business, Guilin Tourism University, Guilin, China

\*Corresponding Author: Guo Debing

School of Business, Guilin Tourism University, Guilin, China

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**Abstract:** Digitization process, as an important means to achieve high-quality economic development, has an important impact for entering the international market. In order to investigate whether the digitization process can improve corporate competitiveness, this paper empirically examines the impact mechanism of digitization process on corporate competitiveness using a sample of A-share listed companies in Shanghai and Shenzhen from 2010 to 2021. The study finds that firms' digitization process can significantly enhance their competitiveness. This finding remains valid after controlling for endogeneity, dynamic effects, and sample selection bias. In terms of the impact mechanism, firm digitization process can promote their competitiveness through the channels of increasing the trade credit financing, improving the information disclosure quality, and reducing the firm default risk.

**Keywords:** Digitization process, corporate competitiveness, trade credit financing, information disclosure quality, firm default risk.

## 1. INTRODUCTION

With the occurrence of overcapacity in the real economy, how to improve corporate competitiveness is getting more and more attention from the academic and practical sectors. Especially under the multiple adverse impacts of the epidemic outbreak at the end of 2019, the intensification of trade frictions between China and the United States, and the deepening of market competition, how to further improve corporate competitiveness is more relevant to whether firms can achieve high-quality economic development. Corporate competitiveness refers to the competitive advantages that firms can show in terms of resources, capabilities and technology relative to their competitors.

The natural resource view believes that the future competitive advantage of firms come from the promotion of environmentally sustainable resources and capabilities (Hart and Dowell, 2011). Firms that can effectively address pollution prevention, product cleanliness and green products will be more able to win the favor of consumers. Higher order theory suggests that different firms have different executives with knowledge, capabilities and resources, implying that there is also variability in firm competitiveness (Hambrick and Mason, 1984). Compared to firms with a low proportion of female executives, an appropriate increase in the proportion of female among executives can help reduce business risks and enhance the competitive advantage of firms (Huang and Kisgen, 2013). Innovation-driven theory considers technology innovation not only as an internal driver for the improvement of firms' own competitiveness, but also as a new driving force and engine for achieving sustained national economic growth (Şener and Saridoğan, 2011). Scholars studying digital transformation consider digitization, as a strategic act, reflect its superiority in resources, capabilities, and technology (Tiwana *et al.*, 2010).

Firm digitization refers to the digitization of firms at all levels of production, sales, and management through the use of digital technologies such as big data, artificial intelligence, blockchain, and the Internet (Hirsch-Kreinsen, 2016).

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According to McKinsey & Company research data shows firms that excel in data analysis drive 6.5 times more customer retention than the average competitor; 5.8 times more customer satisfaction; 9 times more customer loyalty; and 18.8 times more profit generated by customers. In terms of academic research, the prior literature based on theoretical frameworks, such as organization theory, corporate governance and development economics, on the one hand, has analyzed the positive impact of digitization on organizational structure upgrading, organizational boundaries and adaptive change (Hess *et al.*, 2016; Zhou, 2013), on the other hand, also studied the impact of digitization on the improvement of business environment, the construction of innovation system and the capacity of public services (Rachinger *et al.*, 2018; Lindgren *et al.*, 2019). Overall, the previous literature generally recognizes the positive economic effects that can be brought to firms by promoting digitization processes.

However, a small number of scholars believe that digitization processes may not improve firm performance and enhance corporate competitiveness. Although the firm digitization process affects firm performance through two paths (sales and management activities), the opposite effects of the two paths lead to the insignificant impact of digitization process on firm performance. In addition, the 2019 China Corporate Digital Transformation Research Report published by the Dun & Bradstreet Group also shows that although about 40% of firms in China have started their digital transformation, only 10% have made milestone progress, and 80% of firms are still dissatisfied with the effect of data application and fail to generate value. Throughout the existing literature, no unified research conclusion has been formed on whether firms can promote their competitiveness by promoting the digitization process. Though the existing literature generally acknowledges that digital transformation can bring positive economic effects, the question of how digitization process affects corporate competitiveness still lacks quantitative assessment. Therefore, this paper focuses on the following two questions: Firstly, can firms promote its competitiveness by strengthening the digitization process? Secondly, what is the impact path of firm digitization on corporate competitiveness?

The research contributions of this paper are mainly reflected in the following aspects. Firstly, this paper enriches the impact factors of corporate competitiveness. Though the existing literature mainly explores the issue of how to enhance corporate competitiveness based on the perspectives of natural resources view, higher order theory and innovation-driven theory, this paper examines the impact factor of corporate competitiveness from the digitization perspective. Secondly, this paper examines the logic behind the fact, namely that the digitization process is partly responsible for the increase corporate competitiveness by affecting the increase in trade credit financing, the improvement in information disclosure quality and the reduction in firm default risk. Finally, the findings of this paper can also provide a theoretical basis for the government to promote the development of digital economy and firms to strengthen their competitiveness.

## 2. THE IMPACT MECHANISM ANALYSIS

How to improve corporate competitiveness has been the goal sought by firms, but scholars currently study how to improve corporate competitiveness mainly from the perspective of natural resource view, higher order theory and innovation-driven theory, and less explore its impact on corporate competitiveness from the digitization process perspective. In this paper, we argue that firm digitization process can enhance corporate competitiveness by influencing three ways: resources (increasing trade credit financing), information (improving information disclosure quality) and risk (reducing firm default risk). Therefore, this paper will explain the impact mechanism of firm digitization on corporate competitiveness through three channels: trade credit financing, information disclosure quality and firm default risk.

### 2.1 Resource Perspective: Increasing Trade Credit Financing

The digitization process can improve the trade credit financing of firms, thereby enhancing the corporate competitiveness. At present, financing is still an important issue for firms, especially small and medium-sized micro firms are facing the problem of difficult and expensive financing. Although financial resources are fundamental resources to support the growth and development of firms, firms prefer to seek inter-firm trade credit financing to alleviate financing constraints (Seifert *et al.*, 2013). Unlike bank credit guarantees and mortgages, business-to-business trade credit financing relies more on the creditworthiness of the borrower. In the era of digital artificial intelligence, various soft information of firms is more accessible, and especially firms with faster digitization process are more able to form "digital matching" relationships with upstream suppliers and downstream sellers, and thus obtain trade credit financing (Zhang *et al.*, 2023). In addition, compared with low-digitization firms, firms with higher digitization processes also tend to have more obvious advantages in resource allocation efficiency, information asymmetry and financial stability (Eling and Lehmann, 2018), which make credit providers more willing to provide trade credit financing to them, and thus promote the corporate competitiveness.

### 2.2 Information Perspective: Improving Information Disclosure Quality

The digitization process can improve the quality of corporate information disclosure, thereby enhancing the corporate competitiveness. The information disclosure act, as an important channel for investors, creditors and other stakeholders in the external market to access corporate information, helps reduce information asymmetry behavior. In

term of internal view, firms with higher digitization process can rely on digital technologies such as big data, blockchain and cloud computing to reduce information asymmetry with investors, creditors and stakeholders, and achieve information sharing by virtue of the accuracy, diversity and openness of their data, thus winning more financing for firms (Li *et al.*, 2023). From the perspective of external supervision, market participants are able to tap into various financial and non-financial information of firms more conveniently, quickly and accurately in the digital economy. Meanwhile, this digital technology convenience will force firms with higher digitization process to reduce the disclosure of illegal and irregular behaviors, and improve the quality of information disclosure. In turn, high-quality information disclosure not only helps to restrain managers' opportunistic and rent-seeking behaviors, but also prevents firms from under-innovating and enhances their stability and competitiveness (Camisón-Haba *et al.*, 2022).

### 2.3 Risk Perspective: Reducing Firm Default Risk

The digitization process can reduce the firm default risk, thereby enhancing the corporate competitiveness. Firm default risk refers to the possibility that an firm will not be able to repay its debts and interest. The occurrence of debt default can, in a minor case, crisis the current survival and development of firm, or in a major case, trigger a chain reaction of debt defaults and lead to the outbreak of systemic financial risks. Previous studies have shown that the main reasons for the occurrence of corporate default risk are corporate financialization, agency problems, and financing constraints (Hu *et al.*, 2021; Lundqvist and Vilhelmsson, 2018). The core connotation of digitization lies in the use of digital technology to upgrade all aspects of corporate production, operation and management. This can not only improve the quality of corporate internal control and restrain management's agency problems, opportunism and over-investment (Zhou and Ge, 2023), but also improve the quality of information disclosure and reduce the information asymmetry, and thus access to more external finance. Higher firm default risk, on the one hand, brings about harsher external monitoring and auditing risks, leading to impaired effectiveness of decision making (Franz *et al.*, 2014). On the other hand, it also brings about disadvantages such as stock price collapse risk, higher audit costs and lack of R&D innovation, thus weakening the corporate competitiveness.

## 3. DATA SELECTION AND RESEARCH DESIGN

### 3.1 Data Selection

This paper takes the listed companies in Shanghai and Shenzhen A-shares from 2010-2021 as the samples, and screens the samples according to the following principles: ① excluding the listed companies in finance and insurance; ② excluding the listed companies marked with ST; ③ excluding the listed companies with missing data. Through the above processing, the final sample of 33,719 annual observations is obtained. All data in this paper are obtained from CSMAR database. In addition, to mitigate the extreme impact, all continuous variables are treated with 1% and 99% Windsor shrinkage techniques.

### 3.2 Research Design

(1) In order to examine whether firm digitization process can enhance corporate competitiveness, the following model is constructed:

$$COM_{it} = \beta_0 + \beta_1 Dig_{it} + \beta_2 Size_{it} + \beta_3 Lev_{it} + \beta_4 Dual_{it} + \beta_5 Bal_{it} + \beta_6 Cash_{it} + \beta_7 IDR_{it} + \beta_8 Fin_{it} + \beta_9 SOE_{it} + \beta_{10} Abroad_{it} + \beta_{11} Mag_{it} + \beta_{12} MFR_{it} + Industry + Year + \mu \quad (1)$$

$COM_{i,t}$  is the value of corporate competitiveness of the  $i$  firm in period  $t$ . There are two main approaches from the existing literature about the measurement of corporate competitiveness. Firstly, prior research uses the ratio of firm operating income to industry operating income as a measure. Secondly, considering that the concept of "competitiveness" is a comprehensive index, it must be measured from the internal causes and external performance of enterprises, i.e., using the entropy method to obtain a comprehensive index of corporate competitiveness. Based on this, this paper adopts both methods to measure the corporate competitiveness. On the one hand, this paper uses the ratio of firm operating income to industry operating income as the variables of corporate competitiveness (COM1). The larger the value is, the more competitive the firm is in the industry. On the other hand, following to the entropy method, the sum of the entropy values of the scale factor (natural logarithm of operating revenue), the efficiency factor (return on net assets), the operating factor (natural logarithm of accounts receivable turnover), and the operational safety factor (current ratio) are used to measure corporate competitiveness (COM2).

Dig is the explanatory variable firm digitization. The current measurement on corporate digitization is mainly carved by using annual report text analysis method. Specifically, firstly, the annual reports of all listed companies are obtained by Python crawler function, while later the text is crawled and digitized word frequencies are formed from five parts: big data technology, artificial intelligence technology, blockchain technology, cloud computing technology and digital technology application. Finally, based on the summation of the digitized word frequencies of the five aspects, the corporate digitization index is thus constructed. In this paper, we continue to follow the previous digitization portrayal criteria and use the word frequencies of "digitization" in five parts of listed companies' annual reports, including big data

technology, artificial intelligence technology, blockchain technology, cloud computing technology and digital technology application, as the proxy variables for firm digitization.

Size, Lev, Dual, Bal, Cash, IDR, Fin, SOE, Abroad, Mage and MFR are control variables for firm size, firm debt level, power concentration, equity checks and balances, cash flow level, board independence, financial competence, state-owned of enterprise, overseas business ability, managerial age and managerial agent motivation. The control variables are calculated in Table 1. In addition, to avoid the influence of industry and year on the empirical results, this paper also controls for industry and year effects.  $\beta_1$  is the parameter to be estimated and  $u$  is the error term.

(2) To examine whether firm digitization can have contributed to the improvement of corporate competitiveness by improving the channels of resources, information and risk, the following model was constructed:

$$COM_{it} = \beta_0 + \beta_1 Dig_{it} + \beta CVs + Industry + Year + \mu \tag{2}$$

$$MV_{it} = \beta_0 + \beta_1 Dig_{it} + \beta CVs + Industry + Year + \mu \tag{3}$$

$$COM_{it} = \beta_0 + \beta_1 Dig_{it} + \beta_2 MV_{it} + \beta CVs + Industry + Year + \mu \tag{4}$$

Where, COM is the corporate competitiveness, Dig is the firm digitization process, CVs are control variables, and MV are the mediating variables of resource, information and risk, respectively. Following to previous research: (i) Resources are measured as trade credit financing (the sum of accounts payable, notes payable and accounts receivable in advance divided by assets). The more trade credit financing a firm obtains, the more the firm has sufficient funds to purchase other human, material and other factor resources. (ii) Information is measured by DiBo internal control information disclosure index from China data. The more information disclosed about the firm's internal control, the more it can alleviate the information asymmetry between principals and agents, and thus gain the favor of external investors. (iii) Risk is measured by Morton's firm default risk (Hu *et al.*, 2021), the most important manifestation of firm risk comes from default risk, and then triggers a series of chain reactions such as firm operation, reputation and bankruptcy risk.

**Table 1: Names, symbols and definitions of related variables**

Variable category	Variable name	Variable symbols	Calculation formula
Dependent variable	Corporate competitiveness	COM1	The ratio of firm operating income to industry operating income
		COM2	The sum of the entropy values
Independent variable	Digitization process	Dig	Natural logarithm of the frequency of digitized words published in the annual report after adding 1
Intermediate variables	Trade credit financing	Resource	The sum of accounts payable, notes payable and accounts receivable in advance divided by assets
	Information disclosure index	Information	DiBo internal control information disclosure index
	Firm default risk	Risk	The measured by Morton's firm default risk
Control variables	Firm size	Size	Natural logarithm of firm assets
	Firm debt level	Lev	Firm liabilities divided by firm Asset
	Power concentration	Dual	If the chairman and general manager are the same person, take the value of 1, otherwise 0
	Equity checks and balances	Bal	The percentage of shares held by the 2nd-5th largest shareholder divided by the first largest shareholder
	Cash flow level	Cash	Net cash flow from operating activities divided by total assets
	Board Independence	IDR	Number of independent directors divided by the number of director size
	Financial competence	Fin	If the director and supervisor has financial background, take the value of 1, otherwise 0
	State-owned of enterprise	SOE	If it is a state-owned enterprise, take the value of 1, otherwise 0
	Overseas business ability	Abroad	If the director and supervisor have overseas background, take the value of 1, otherwise 0
	Managerial age	Mage	The average age of directors and supervisors
	Managerial agent motivation	MFR	Administrative expenses divided by operating income

## 4. ANALYSIS OF EMPIRICAL RESULTS

### 4.1 Description Analysis

Table 2 reports the descriptive statistics results of this paper. As can be seen from Table 2, the maximum and minimum values of both measures of corporate competitiveness exhibit large extreme differences, indicating that corporate competitiveness has some variability among listed companies. The mean value of firm digital process is 1.2702, the minimum value is 0, and the maximum value is 4.9767, which indicates that there is also some variability in digital promotion among listed companies. As for the control variables, the mean value of corporate debt level is 0.4144, indicating that overall, about 41.44% of the total assets of listed companies are in the scale of debt; the mean value of cash flow level is 0.0474, indicating that the cash generated from operations of each firm is about 4.74% of the assets; the mean value of overseas business ability is 0.4943, indicating that the executives with overseas residency or study background in director and supervisor are 49.43%.

**Table 2: Descriptive statistics results**

Variables	N	Mean	Std	Min	P25	Median	P75	Max
COM1	33719	0.5022	1.7895	0.0009	0.0086	0.0281	0.1615	13.509
COM2	33719	18.353	1.2302	15.679	17.495	18.207	19.060	21.874
Dig	33719	1.2702	1.3712	0.0000	0.0000	0.6931	2.1972	4.9767
Size	33719	22.065	1.2677	19.661	21.144	21.886	22.786	26.026
Lev	33719	0.4144	0.2091	0.0490	0.2458	0.4044	0.5667	0.9413
Dual	33719	0.2866	0.4521	0.0000	0.0000	0.0000	1.0000	1.0000
Bal	33719	0.7454	0.6133	0.0287	0.2642	0.5858	1.0654	2.8355
Cash	33719	0.0474	0.0688	-0.1647	0.0091	0.0469	0.0874	0.2409
IDR	33719	0.3753	0.0531	0.3333	0.3333	0.3571	0.4286	0.5714
Fin	33719	0.6129	0.4871	0.0000	0.0000	1.0000	1.0000	1.0000
SOE	33719	0.3452	0.4754	0.0000	0.0000	0.0000	1.0000	1.0000
Abroad	33719	0.4943	0.4999	0.0000	0.0000	0.0000	1.0000	1.0000
Mage	33719	49.062	3.2112	41.230	46.880	49.140	51.290	56.500
MFR	33719	0.0915	0.0763	0.0085	0.0445	0.0726	0.1125	0.5029

**Note:** Since the value of COM1 is too small, it is expanded by 100 times.

### 4.2 Main Regression Analysis

Table 3 reports the main regression results of this paper. Table 3(1) and (3) show that the coefficients of firm digitization on corporate competitiveness are 0.072 and 0.103 at 1% significant level, respectively, indicating that firm digitization contributes to corporate competitiveness. Table 3(2) and (4) show the coefficients of corporate digitization on corporate competitiveness still pass the significance test at the 1% level, and the estimated coefficient are still positive, indicating that firm digitization can significantly improve corporate competitiveness. Meanwhile, firm size, cash flow level, proportion of independent directors, overseas business ability and management age are positively related to corporate competitiveness. Management agent motivation is negatively related to corporate competitiveness.

**Table 3: Main regression results**

Variables	COM1		COM2	
	(1)	(2)	(3)	(4)
Dig	0.072 <sup>***</sup> (12.37)	0.027 <sup>***</sup> (4.92)	0.103 <sup>***</sup> (17.61)	0.031 <sup>***</sup> (13.44)
Size	—	0.412 <sup>***</sup> (35.33)	—	0.765 <sup>***</sup> (26.70)
Lev	—	-0.075 <sup>*</sup> (-1.85)	—	0.071 <sup>***</sup> (4.21)
Dual	—	0.069 <sup>***</sup> (4.90)	—	-0.019 <sup>***</sup> (-3.57)
Bal	—	0.027 <sup>**</sup> (2.35)	—	-0.029 <sup>***</sup> (-7.13)
Cash	—	0.228 <sup>**</sup> (2.08)	—	1.496 <sup>***</sup> (34.86)
IDR	—	1.544 <sup>***</sup> (8.02)	—	0.091 <sup>**</sup> (1.98)
Fin	—	0.045 <sup>***</sup> (3.31)	—	-0.019 <sup>***</sup> (-3.49)

SOE	—	-0.034** (-1.97)	—	0.069*** (10.79)
Abroad	—	0.143*** (9.52)	—	0.029*** (5.32)
Mage	—	0.036*** (13.37)	—	0.008*** (9.50)
MFR	—	-1.455*** (-12.97)	—	-4.014*** (-68.96)
Cons	2.518*** (16.02)	-8.497*** (-24.56)	17.793*** (32.41)	1.241*** (18.27)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Obs	33719	33719	33719	33719
F value	7149.08***	312.58***	142.66***	4622.38***
Adj.R2	0.340	0.442	0.110	0.868

**Note:** \*\*\*, \*\*, \* indicate significant at the 1%, 5%, and 10% levels, respectively. The t-values of robustness standard errors are in parentheses.

### 4.3 Long-Term Behavior or Short-Term Effects

The above results suggest that the firm digitization can significantly improve corporate competitiveness, so a natural question is whether the behavior is a short-term effect or a long-term one. To explore this question and also to address the problem of reverse causality in endogeneity, this paper analyzes firm digitization with lags of one to three periods. Table 4 reports the regression results for three lags of corporate digitization. As can be seen from the results in Table 4, whether COM1 or COM2 is used to measure corporate competitiveness, the regression results of firm digitization lags on corporate competitiveness remain positively correlated at the 1% level. This result not only shows that there is no reverse causality in terms of firm digitization on corporate competitiveness, but also shows that the digitization process has a long-term effect on corporate competitiveness.

**Table 4: Long-term behavior or short-term effects results**

	COM1			COM2		
	Lag1	Lag2	Lag3	Lag1	Lag2	Lag3
Dig	0.024*** (3.97)	0.022*** (3.31)	0.019*** (2.61)	0.032*** (12.67)	0.032*** (11.22)	0.030*** (9.68)
CVS	Yes	Yes	Yes	Yes	Yes	Yes
Cons	-8.851*** (-24.07)	-9.035*** (-23.17)	-9.145*** (-21.88)	1.253*** (17.02)	1.311*** (16.41)	1.274*** (14.82)
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Obs	29224	25479	22040	29224	25479	22040
F value	334.28***	306.35***	259.40***	4104.13***	3627.91***	2766.61***
Adj.R2	0.446	0.443	0.448	0.869	0.869	0.869

**Note:** \*\*\*, \*\*, \* indicate significant at the 1%, 5%, and 10% levels, respectively.

### 4.4 Robustness Tests

#### (1) Endogenous Problems

For time series, the more common instrumental variables come from the lags of the explanatory variables. On the one hand, the lags of firm digitization process are highly correlated with the current period's digitization process. On the other hand, corporate competitiveness in the current period is unlikely to affect digitization process in the previous period, which makes the lag of firm digitization process a good externality. Table 5 reports the regressions results with one period lag of firm digitization process. From the results in the first paragraph, it is clear that firm digitization process lagged one period has a high positive correlation with the current digitization, which validates the requirement that firm digitization process with lag one period has a high correlation with the current digitization process. Further observing the results of the second stage, it can be found that the coefficients of corporate digitization process on corporate competitiveness are 0.013 and 0.027 at 1% significant level, respectively, which indicates that firms digitization process can enhance corporate competitiveness after considering endogeneity issues.

**Table 5: Endogenous test results**

	Dig	COM1	Dig	COM2
	1 <sup>st</sup>	2 <sup>nd</sup>	1 <sup>st</sup>	2 <sup>nd</sup>
Dig	—	0.013 <sup>***</sup> (2.81)	—	0.027 <sup>***</sup> (10.69)
L.Dig	0.898 <sup>***</sup> (364.89)	—	0.898 <sup>***</sup> (364.89)	—
CVS	Yes	Yes	Yes	Yes
Cons	-0.051 (-0.57)	-10.059 <sup>***</sup> (-25.12)	-0.051 (-0.57)	2.158 <sup>***</sup> (29.56)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Obs	29224	29224	29224	29224
F value	1367.57 <sup>***</sup>	1315.01 <sup>***</sup>	6371.22 <sup>***</sup>	1154.89 <sup>***</sup>
Adj.R2	0.795	0.113	0.795	0.840

**Note:** <sup>\*\*\*</sup>, <sup>\*\*</sup>, <sup>\*</sup> indicate significant at the 1%, 5%, and 10% levels, respectively. The t-values of robustness standard errors are in parentheses.

**(2) Quantile Regression Test**

This paper further employs quantile regression to test its robustness. On the one hand, it is to remove the suspicion that the sample may hold only at a certain quantile and not necessarily at other quartiles. On the other hand, it is also possible to observe at which quantile the digitization process has the strongest effect on corporate competitiveness. Table 6 reports the quantile test results for Q25, Q50 and Q75. From the results in Table 6, it can be seen that the coefficients of the impact of firm digitization process on corporate competitiveness are significantly positive at the 1% level. In summary, the ability of firms that firm digitization will significantly improve their competitiveness is again verified.

**Table 6: Quantile regression results**

	COM1			COM2		
	Q25	Q50	Q75	Q25	Q50	Q75
Dig	0.002 <sup>***</sup> (12.62)	0.002 <sup>***</sup> (8.56)	0.002 <sup>***</sup> (2.92)	0.025 <sup>***</sup> (12.17)	0.025 <sup>***</sup> (10.09)	0.026 <sup>***</sup> (8.65)
CVS	Yes	Yes	Yes	Yes	Yes	Yes
Cons	0.041 (1.08)	0.333 <sup>***</sup> (5.30)	0.844 <sup>***</sup> (4.94)	1.046 <sup>***</sup> (11.93)	0.935 <sup>***</sup> (13.94)	1.223 <sup>***</sup> (14.95)
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo.R2	0.117	0.214	0.361	0.632	0.656	0.674

**Note:** <sup>\*\*\*</sup>, <sup>\*\*</sup>, <sup>\*</sup> indicate significant at the 1%, 5%, and 10% levels, respectively.

**(3) Other Robustness Tests**

To ensure that the findings of this paper are reliable, the following robustness tests are also done in this paper. (1) Propensity score matching method. Considering the problem of sample self-selection preference in this paper, the sample is tested by the propensity score matching method. Specifically, dummy variables are set based on the digitized median, while control variables such as firm size, debt service level and power concentration are used as covariates. (2) Substitution of digitization. Following prior research, we use the sample firms whether undergo digital transformation, and take a value of 1 when the word "digital" is involved in the firm's annual report, or 0 otherwise. (3) Substitution of corporate competitiveness. Corporate competitiveness is measured using the ratio of total profit, total tax and interest expense to assets. (4) Excluding the effect of large cities. If the fintech industry is more developed in the city, it will have a facilitating effect on the firm digital advancement. To exclude the heterogeneous influence of large cities, the sample of municipalities directly under the central government is further excluded, and then re-regressed. (5) Excluding the interference of epidemic. Considering the outbreak of the epidemic after 2020, it may make firms profit fall and unable to advance their digital development, thereby affecting their competitiveness. Samples are regressed again after excluding the data after 2020. All the above test results show that firm can significantly improve their competitiveness by promoting digitization.

## 5. IMPACT MECHANISM TEST

### 5.1 Trade Credit Financing Transmission Test

Table 7 reports the impact of digitization process on corporate competitiveness from the resource (trade credit financing) perspective. The regression results in Table 7 show that the coefficient of firm digitization process on trade credit financing is significant at the 1% level of 0.010, indicating that firm digitization improvement can significantly increase trade credit financing of firms. Meanwhile, the coefficients of trade credit financing on corporate competitiveness (COM1 and COM2) are 0.646 and 0.929 respectively at 1% significant level in Table 7(2) and (4), indicating that the more trade credit financing a firm receives, the more beneficial it is to the corporate competitiveness. Furthermore, Tables 7(2) and (4) also show that the coefficients of firm digitization on the two enterprise competitiveness are significantly positive at the 1% level, indicating that trade credit financing plays a partially mediating effect in the digitization process on corporate competitiveness. In summary, the regression results in this paper support the mediated transmission path of digitization process → trade credit financing → corporate competitiveness.

**Table 7: Trade credit financing transmission regression results**

Variables	The first test of mediating effects		The second test of mediating effects	
	Resource	COM1	Resource	COM2
	(1)	(2)	(3)	(4)
Dig	0.010 <sup>***</sup> (24.94)	0.020 <sup>***</sup> (3.58)	0.010 <sup>***</sup> (24.94)	0.021 <sup>***</sup> (9.42)
Resource	—	0.646 <sup>***</sup> (7.00)	—	0.929 <sup>***</sup> (31.01)
CVS	Yes	Yes	Yes	Yes
Cons	0.165 <sup>***</sup> (12.07)	-8.604 <sup>***</sup> (-24.81)	0.165 <sup>***</sup> (12.07)	1.087 <sup>***</sup> (16.25)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Obs	33719	33719	33719	33719
F value	459.40 <sup>***</sup>	398.65 <sup>***</sup>	459.40 <sup>***</sup>	4766.61 <sup>***</sup>
Adj.R2	0.412	0.443	0.412	0.872

Note: <sup>\*\*\*</sup>, <sup>\*\*</sup>, <sup>\*</sup> indicate significant at the 1%, 5%, and 10% levels, respectively.

### 5.2 Information Disclosure Quality Transmission Test

Table 8 reports the impact of the digitization process on corporate competitiveness from the information (information disclosure quality) perspective. From the regression results in Table 8, it is clear that the coefficient of firm digitization process on information disclosure quality is significant at the 1% level of 0.252, indicating that the promotion of digitization by firms can significantly improve information disclosure quality. Meanwhile, the coefficients of information disclosure quality on the two corporate competitiveness in Table 8(2) and (4) are 0.007 and 0.011 at the 1% level respectively, indicating that the higher the quality of information disclosed by firms, the more beneficial to the corporate competitiveness. In addition, Tables 8(2) and (4) also show that the coefficients of corporate digitization on COM1 and COM2 are also significantly positive at the 1% level, indicating that the information disclosure quality plays a partially mediating effect in the process of firm digitization on corporate competitiveness. In summary, the regression results of this paper support the mediated transmission path of digitization process → information disclosure quality → corporate competitiveness.

**Table 8: Information disclosure quality transmission regression results**

Variables	The first test of mediating effects		The second test of mediating effects	
	Information	COM1	Information	COM2
	(1)	(2)	(3)	(4)
Dig	0.252 <sup>***</sup> (7.99)	0.077 <sup>***</sup> (12.10)	0.252 <sup>***</sup> (7.99)	0.126 <sup>***</sup> (27.16)
Information	—	0.007 <sup>***</sup> (5.26)	—	0.011 <sup>***</sup> (13.94)
CVS	Yes	Yes	Yes	Yes
Cons	8.491 <sup>***</sup> (8.45)	-2.232 <sup>***</sup> (-8.12)	8.491 <sup>***</sup> (8.45)	1.256 <sup>***</sup> (17.20)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Obs	29654	29654	29654	29654
F value	309.56 <sup>***</sup>	133.38 <sup>***</sup>	309.56 <sup>***</sup>	4053.48 <sup>***</sup>
Adj.R2	0.345	0.405	0.345	0.842

Note: <sup>\*\*\*</sup>, <sup>\*\*</sup>, <sup>\*</sup> indicate significant at the 1%, 5%, and 10% levels, respectively.



### 5.3 Firm Default Risk Transmission Test

Table 9 reports the impact of digitization process on corporate competitiveness from the risk (firm default risk) perspective. From the results in Table 9, it is clear that the coefficient of firm digitization process on firm default risk is significant at the 1% level of -0.008, indicating that the promotion of digitization by firms can significantly reduce the firm default risk. Meanwhile, the coefficients of firm default risk on COM1 and COM2 in Table 9(2) and (4) are -0.158 and -0.026, respectively, the former significant at the 1% level and the latter significant at the 10 level, indicating that the lower the firm default risk, the more favorable it is to the corporate competitiveness. Furthermore, Tables 9(2) and (4) also show that the coefficients of firm digitization on the two corporate competitiveness (COM1 and COM2) are also significantly positive at the 1% level, indicating that firm default risk plays a partially mediating effect in the process of firm digitization on corporate competitiveness. In summary, the regression results in this paper support the mediated transmission path of digitization process → firm default risk → corporate competitiveness.

**Table 9: Firm default risk transmission regression results**

Variables	The first test of mediating effects		The second test of mediating effects	
	Risk (1)	COM1 (2)	Risk (3)	COM2 (4)
Dig	-0.008*** (-9.40)	0.025*** (4.64)	-0.008*** (-9.40)	0.031*** (13.30)
Risk	—	-0.158*** (-2.76)	—	-0.026* (-1.92)
CVS	Yes	Yes	Yes	Yes
Cons	-1.278*** (-37.19)	-8.699*** (-23.27)	-1.278*** (-37.19)	1.207*** (17.50)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Obs	33719	33719	33719	33719
F value	378.79***	303.57***	378.79***	4550.35***
Adj.R2	0.441	0.442	0.441	0.868

Note: \*\*\*, \*\*, \* indicate significant at the 1%, 5%, and 10% levels, respectively.

## 6. CONCLUSION AND INSIGHTS

This paper empirically investigates the impact of firm digitization process on corporate competitiveness and its impact mechanism, using a sample of A-share listed companies in Shanghai and Shenzhen from 2010-2021. The study shows that the firm digitization process can significantly improve corporate competitiveness. In terms of the impact mechanism, the firm digitization process can achieve their competitiveness through the channels of increasing trade credit financing, improving information disclosure quality and reducing corporate default risk. In other words, the stronger the digitization process is, the more competitive advantages in terms of resources (increased business credit financing), information (improved quality of information disclosure) and risk (reduced risk of corporate default), thereby leading to stronger corporate competitiveness.

Based on the findings of this paper, the following recommendations are to be made.

Firstly, attach importance to the concept of digitization process. Although firms may face painful periods and operational risks when promoting the digitization process, digitization, as a hard-core reform that integrates innovation, is a necessary weapon to cope with changes, respond to the current situation, and enhance modern governance. Focusing on the digitization process, on the one hand, a firm requires executives to emancipate their minds and achieve a change of concept. They must attach importance digitization with a world, strategic and future perspective, and realize networking, intelligence and informatization in production, by using digital technology tools such as big data, artificial intelligence, Internet of Things and block chain. On the other hand, executives are also required to dare to break the rules and explore boldly to accelerate the formation of standardized, synergized and modernized operation systems, thereby help the continuous improvement of corporate competitiveness.

Secondly, promote solidly the digital reform. Firms must keep pace with the times and market requirements to be bigger, better and stronger. In management, all the managed elements, modules and results can be digitalized. In production, firm should pursue the combination of "intelligence" and "machine", reshape digital technologies such as artificial intelligence into process reengineering and Six Sigma, use digital transformation to promote corporate value chain and so on. In sales, firm should pursue the combination of "production" and "consumption", adhere to the market

demand as the guide, grasp the various differences in consumer demand through digitization, reduce product inventory, and achieve a perfect fit between products and consumers.

Thirdly, strengthen digital privacy protection. In the era of digital economy, the use of big data, Internet of Things and Internet technology has made firms more accurate and efficient in collecting, processing and analyzing information of consumer groups. However, digital security issues such as information leakage, theft and misuse have also emerged. In the past, the main reasons for customer information leakage were outdated firewalls in the field of enterprise security, and lack of firm self-developed customer information protection applications. Therefore, it is necessary to update the firewall and other software in the security field in a timely manner to reduce the probability of hackers attacking customer information. Meanwhile, it also need to enhance the protection level of customer information data, increase the development of independent and innovative security prevention technology by firms, and reduce the use of second-hand artificial intelligence, cloud computing and digital platforms, etc.

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