Working Paper

Will enterprise digital transformation affect diversification strategy?

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ABSTRACT

This paper empirically examines the impact of enterprise digital transformation on the level of enterprise diversification. It is found that the digital transformation of enterprises has significantly improved the level of enterprise diversification, and the conclusion has passed a series of robustness tests and endogenous tests. Through mechanism analysis, we find that the promotion of enterprise digital transformation on enterprise diversification is mainly realized through market power channel and firm risk channel. That is, the pursuit of establishing market power and monopoly profits based on digital transformation and the decentralization strategy to deal with the risks associated with digital transformation are important reasons for enterprises to adopt diversification strategy under the background of digital transformation. Although the organization
costs channel, transaction cost channel, block holder control channel, industry type and information asymmetry channel have some influence on the main effect of this paper, they are not the main channel because they have not passed the inter group regression coefficient difference test statistically.

**Keywords:** Digitization, diversification, organization costs, transaction costs.

1| **INTRODUCTION**

The impact of information technology on the world has deepened day by day. A series of emerging information technologies and digital technologies, including big data and the Internet, have developed rapidly, which has had a far-reaching impact on the development of the global economy. Digital transformation has become an important engine of global economic growth. Worldwide, enterprises in various countries gradually take digital technology as an important strategic measure of enterprise development, and upgrade and transform the organizational structure and business process through information technology. With the rapid development of digitization, it is very important to understand the impact of enterprise digital transformation on enterprise strategic choice. It will not only help to further understand the enterprise strategy itself and future development trend, but also help to have an insight into the overall macro and global economic trend and development. It will be possible to provide strong policy suggestions for relevant managers. Therefore, it has important practical significance.

For many years, enterprise diversification has been the focus of research. However, few people have studied the impact of digitization on enterprise diversification. First, the improvement of digitization helps enterprises reduce organizational costs, further improve information processing efficiency, and finally promote the expansion of organizational scale (Malone et al., 1987), which will promote the diversified development of enterprises; Second, the technological advantages brought by the digital transformation of enterprises may help enterprises to adopt diversified strategies to obtain monopoly profits; Third, enterprise digital decision-making may help to
improve the accuracy and breadth of decision-making of external major shareholders, and then help to improve the level of diversification. Fourth, due to the foresight and complexity of digital enterprises, enterprise digital transformation itself may aggravate the enterprise risk level, which may promote enterprises to adopt diversification strategies and reduce enterprise risks.

On the other hand, the development of digitization also makes the information communication between enterprises and the outside world more border, reduces the transaction cost of enterprises, is conducive to promoting the specialized development of enterprises, and thus relatively reduces the diversification level of enterprises. In addition, the implementation of the enterprise digital transformation strategy strengthens internal control, which will help to prevent the generation of enterprise agency problems, which will curb the management's behavior of making profits for itself by adopting diversification strategy to build an empire. Overall, the impact of enterprise digital transformation on diversification needs further empirical test.

The marginal contribution of this paper lies in:

（1）At the theoretical level, this paper expands the theoretical boundary between diversified research field and digital research field. Firstly, this paper expands the research on the economic consequences of enterprise digitization, and empirically analyzes the impact of enterprise digitization transformation on enterprise diversification strategy for the first time. Secondly, this paper analyzes the different impact of enterprise digital transformation on the choice of enterprise diversification strategy under different level of transaction cost, organization costs, market power, blockholder control, information asymmetry and firm risk. Thirdly, this paper analyzes the different impact of enterprise digital transformation on enterprise diversification strategy in manufacturing and service industries.

（2）At the practical level, examining the impact of enterprise digital transformation on enterprise diversification strategy from a micro perspective will help enterprise managers and relevant policy makers have an insight into the future development direction of enterprises and
deeply understand the economic consequences of digital transformation.

2 | RELATED LITERATURE AND HYPOTHESIS DEVELOPMENT

Economies of scale and synergy are important reasons for enterprises to adopt diversification strategy (Penrose, 1959; Teece, 1980, 1981, 1982). However, due to the limitation of enterprise spatial distribution and geographical factors, it poses a challenge to enterprise management and increases the cost of enterprise management (Coase, 1937). Previous studies have shown that diversification strategy will lead to the dispersion of business interests (Tallman and Li, 1996). The dispersion of business interests further increases the requirements for information processing capacity, which will also aggravate the operating costs of enterprises (Morrison and Roth, 1992; Tallman and Li, 1996). Transaction costs theory holds that the key to the boundary of enterprise diversification level is to balance the economic benefits brought by diversification to offset the resulting organization costs. (Jones and Hill, 1988).

2.1 TRANSACTION COST AND ORGANIZATION COST CHANNEL

2.1.1 ORGANIZATION COST CHANNEL

Digital transformation can reduce the organization costs of enterprises: first, information technologies such as digital information management system can improve the organization's information processing ability and efficiency, facilitate the cooperation and communication between various divisions of the enterprise, realize low-cost recording and tracking of all matters in all links of supply, production and marketing, and optimize the coordination and linkage of all production links of the enterprise. Thus, the accuracy and precision of enterprise management decision-making are improved. It reduces the organization costs (Fernandez and Nieto, 2006). Second, the development of digital technology is conducive to the real-time and transparent recording of enterprise personnel management, production R & D, financial management and all important links, effectively reduces and compresses the possibility of agents engaging in default activities, thus reducing the agency cost of enterprises (Chen and Kamal, 2016). Therefore, the
organization costs will decrease with the improvement of enterprise digitization, and the enterprise
digital transformation will be conducive to the choice of enterprise diversification strategy.

2.1.2 TRANSACTION COST CHANNEL

On the other hand, digital transformation also provides potential for enterprises to adopt
professional strategies, which can reduce the transaction costs faced by enterprises: first, the
development of digital technology can accelerate the collection, storage and analysis of information,
help enterprises contact a wider range of business partners, and understand the potential capabilities,
credit Transaction history and other information are helpful for enterprises to identify better
counterparties, Reduces search costs for enterprises (Malone et al., 1987) second, digital
technology deepens the communication between enterprises, makes the key subject information of
transactions between enterprises more transparent, and reduces the negotiation cost in the process
of signing enterprise contracts. Third, various technologies of digital mobile Internet and industrial
Internet can ensure that the client can track the agent in time after signing the contract , This will
lead to a significant reduction in the regulatory cost of enterprises under digitization (Clemons,
1993) in addition, the timely contact between enterprises and real-time tracking of materials
brought by digital technology ensure that even if the contract is not listed, the transaction details
can be flexibly adjusted between enterprises and counterparties according to immediate needs, so
as to reduce the production related costs caused by incomplete contracts. Fourth, highly transparent
transaction records under digital technology , the opponent will bear higher reputation loss in case
of default, which further reduces the possibility of default. To sum up, the transaction costs will be
reduced with the improvement of enterprise digitization, and the enterprise digital transformation
will be conducive to the professional development of enterprises. Since the relationship between
enterprise specialization and diversified development is often an opposite group, we believe that
the development of enterprise specialization will weaken the possibility of enterprise diversified
development.

To sum up, whether enterprise digital transformation can improve the choice of enterprise
diversification strategy through economies from internalizing transactions is affected by two forces and depends on the size and direction of the two forces.

2.2 MARKET POWER CHANNEL

The traditional method of industrial economics holds that the operation of enterprises in multiple products, markets and businesses is in the pursuit of market monopoly power and associated benefits. Therefore, in the case of vertical integration, companies with a monopoly position at a certain stage of the value chain can use the market to foreclose and extend their monopoly to the adjacent stages of the value chain (chemow, 1998). The development of vertical integration forces competitors to take the way of vertical integration to check and balance, thus increasing entry barriers. Generally speaking, large diversified companies can exercise market power in three ways: 1 Predatory pricing. 2 Reciprocal buying. 3 Mutual forbearance. The digital transformation of enterprises is likely to strengthen the technological monopoly power of enterprises and further consolidate the monopoly position of enterprises, which leads enterprises to adopt relevant diversification strategies to obtain monopoly profits.

2.3 BLOCKHOLDER CONTROL CHANNEL

Research on corporate diversification shows that block holders tend to promote diversification. According to hautz et al. (2013), ownership concentration is positively correlated with product diversification. Nguyen (2018) believes that the existence of block holders encourages the diversification of Vietnamese enterprise. Gu et al. (2018) believe that the non controlling shareholders of Chinese enterprises have strong supervision and incentive, which stimulates diversification. We believe that enterprise digital transformation has greatly improved the information and decision-making accuracy required for enterprise strategic decision-making, and may improve the accuracy and accuracy of decision-making of major shareholders, so as to improve the degree of enterprise diversification.

2.4 INFORMATION ASYMMETRY CHANNEL
External monitoring mechanisms play a key role in monitoring management performance and help alleviate diversification decisions that lead to the decline of enterprise value (Denis et al., 1997). Companies with higher levels of information disclosure generally have a lower level of diversification (Gu et al., 2018). Information symmetry tends to prevent diversified opportunistic management decisions and curb the emergence of agency problems. We believe that the digital transformation of enterprises involves the storage and packaging of information, which may greatly enrich the enterprise information environment, so as to strengthen the enterprise information disclosure, inhibit the generation of agency problems, and prevent managers from arbitrarily adopting diversification strategies for reasons such as Empire construction, so as to reduce the degree of enterprise diversification.

2.5 FIRM RISK CHANNEL

Pandya and Rao (1998) found that diversified companies have lower risk and higher performance. Hitt et al. (1997) proved that diversified companies tend to perform better than non-diversified companies and have lower performance risk. Digitization is often closely related to the application of new technologies. The volatility of the company's performance can be attributed to the application of new technologies. Therefore, the digital transformation of enterprises may be transformed into the volatility of corporate performance, so as to encourage the diversification of companies to reduce risks.

Based on the above discussion, organization cost channel, market power channel, blockholder control channel and firm risk channel indicate that enterprise diversification transformation may improve the degree of enterprise diversification, while transaction cost channel and information asymmetry channel indicate that enterprise diversification transformation may reduce the degree of enterprise diversification. Then whether the enterprise diversification transformation can improve the enterprise diversification level depends on the size and direction of the comprehensive action of the above multiple forces.

Based on this, the following assumptions H1 and H2 are put forward:
H1: When the net effect of enterprise digital transformation on enterprise diversification is positive, enterprise digital transformation promotes the diversified development of enterprises.

H2: When the net effect of enterprise digital transformation on enterprise diversification is negative, enterprise digital transformation inhibits the diversified development of enterprises.

3] SAMPLE DESCRIPTION AND VARIABLE MEASUREMENT

3.1 Data source and sample selection

This study collects relevant data from the databases of the China Stock Market & Accounting Research Database (CSMAR) and Chinese Research Data Services (CNRDS) and uses the main financial indicators and data listed on the Chinese A-share market from 2004 to 2020 as the initial sample. In the data collection process, we tried our best to ensure that the sample size was maximized. We eliminated the insufficient and missing data of related variables. The final sample included 32907 company annual observations, representing 3709 unique companies.

Table 1 lists sample screening and sample distribution.

Table 1 Sample screening and Sample distribution

Panel A: Sample screening

| Initial sample                      | 46736 |
|------------------------------------|-------|
| Excluding:                         |       |
| Samples with missing and abnormal data | 13829 |
| Final sample                       | 32907 |

Panel B: Sample distribution by year

| Year | n   | % Total |
|------|-----|---------|
| 2004 | 431 | 1.31    |
| 2005 | 732 | 2.22    |
| 2006 | 888 | 2.70    |
| 2007 | 995 | 3.02    |
| 2008 | 1,126 | 3.42 |
| 2009 | 1,218 | 3.70 |
| 2010 | 1,409 | 4.28 |
| 2011 | 1,769 | 5.38 |
| Year | Total Sales | Entropy |
|------|-------------|---------|
| 2012 | 2,178       | 6.62    |
| 2013 | 2,248       | 6.83    |
| 2014 | 2,247       | 6.83    |
| 2015 | 2,407       | 7.31    |
| 2016 | 2,643       | 8.03    |
| 2017 | 2,851       | 8.66    |
| 2018 | 3,190       | 9.69    |
| 2019 | 3,276       | 9.96    |
| 2020 | 3,299       | 10.03   |
| Total| 32,907      |         |

3.2 | Variable description

3.2.1 Level of firm diversification

We use two of the most commonly used measures of portfolio diversity to capture a firm’s level of diversification: Total entropy, Herfindahl index. Each measure is calculated using annual data from CSMAR. This study takes the classification standard of the industry classification guidelines of listed companies issued by China Securities Regulatory Commission as the main basis for the cross industry operation of listed companies.

Total entropy captures the extent of diversity across a firm’s activities (Jacquemin and Berry, 1979; Palepu, 1985). It is calculated as

$$\text{Total entropy} = \sum_{i=1}^{N} S_i \ln(1/S_i)$$

where $S_i$ is the share of a firm’s total sales in industry $i$ and $N$ is the number of industries in which the firm operates. Total entropy equals zero for a single business firm and it rises with the extent of diversity.

The Herfindahl index of diversity is calculated as

$$\text{Herfindahl index} = \sum_{i=1}^{N} (S_i)^2$$

where $S_i$ is the share of a firm’s total sales in industry $i$ and $N$ is the number of industries in which the firm operates. Since lower values of the Herfindahl index indicate higher levels of diversification, we take a negative number for this value for comparative analysis. This measure equals -1 for a single business firm and it rises with the level of diversification.
3.2.2 Digitization

The quantitative measurement of enterprise digital transformation is a hot issue concerned by all parties. Enterprise digital transformation needs the help of cutting-edge digital technology and hardware system to promote the digitization of enterprise production process and means of production. First, the enterprise will focus on updating and upgrading the original technology and manufacturing system by relying on the "digital core technology drive". Among them, artificial intelligence, blockchain, cloud computing, big data and other technologies constitute the core underlying technology framework. The promotion of core and bottom technology focuses on the deep embedding of digital technology, mainly focusing on the digitization of core technologies and processes in various links such as internal management, production and operation of the enterprise; In addition, enterprise digital transformation is to form final output, product innovation and service innovation in the market. With the deepening of digital transformation, it will involve the core products and businesses of enterprises and form new performance growth points. At this level, technology pays more attention to the effective integration of digital and business environment. Based on, in the structural framework of enterprise digital transformation, this research is divided into two levels: "bottom technology application" and "technology practical application": the "bottom technology application" includes four main technical components; In "technology practice application", focus on the application of specific digital services.

We believe that as a major strategy for enterprise development in the period of enterprise digital transformation, it will be easier to be reflected in the enterprise annual report, which is summary, guiding and forward-looking. The use of words in the annual report can reflect the strategic choice characteristics and future vision of the enterprise, and to a large extent reflect the business philosophy and future development path of the enterprise. Therefore, it is scientific to
measure the degree of digital transformation from the perspective of word frequency statistics involving "enterprise digital transformation" in the annual reports of listed enterprises.

This paper collects and arranges the annual reports of all A-share listed enterprises in Shanghai and Shenzhen through the python crawler function, and extracts all text contents through the Java pdfbox library as the data pool for subsequent feature word screening. Based on a series of classic literature, relevant important policy documents and research reports with the theme of digital transformation, this paper combs the key words of digital transformation, and finally confirms the characteristic words of digital transformation; The Related words are classified into "bottom technology application" and "technology practical application" to form a feature thesaurus. On this basis, the expressions of negative words such as "None" and "no" before deleting the keyword, and the "digital transformation" keywords unrelated to the company itself (including the introduction of company shareholders, customers, suppliers and company executives) have been deleted. Finally, based on the data pool formed by the annual report text extraction of Listed Enterprises Based on python, search, match and count the word frequency according to the characteristic words, and then classify and collect the word frequency in the key technical direction to form the final aggregated word frequency, so as to build the index system of enterprise digital transformation. Because this kind of data has the typical characteristics of "skew distribution", this paper processes it logarithmically to obtain the overall index describing the digital transformation of enterprises. In the robustness test, this paper subdivides the caliber according to the composition difference and application status of the technology, and carries out the regression test again. See Appendix B for thesaurus.

3.2.3 control variables.

Firm performance

The company's performance is measured by the company's return on assets (ROA). ROA is a widely used performance measurement index. Relevant studies have shown that there is an important correlation between corporate performance and a number of other key indicators. (Keats
and Hitt, 1988). For the same reason, we controlled the growth rate of the company's operating revenue, which is equal to (the company's operating revenue of the current year / the company's operating revenue of the previous year) - 1)

**Capital structure**

The research of O'Brien et al. (2014) based on agency theory shows that the company's capital structure will have an impact on diversification. Therefore, we use the proportion of the company's year-end liabilities to total assets to control this variable.

**Ownership structure**

Fox et al. (1994) research shows that the company's ownership structure will affect the diversification strategy. Therefore, we control the shareholding ratio of the management (the total shareholding of the management divided by the circulating share capital), the shareholding ratio of major shareholders (the number of shares held by the first major shareholder / the total number of shares), and the duality (if the chairman and general manager of the company are the same person, it is 1, otherwise it is 0). In addition, due to China's special ownership system, we also control whether the enterprise type is a state-owned enterprise or a private enterprise.

**Industry competitiveness**

Industrial competitiveness has been proved to be closely related to the degree of economies of scale and the degree of market power in the industry. Enterprises in highly competitive industries often show a lower level of diversification. (Christensen and Montgomery, 1981). This paper uses the huffindahl index, that is, the sum of the square of the proportion of the company's operating revenue in the operating revenue of all companies in the industry, to measure this variable.

**Industry capital intensity**

High industry capital intensity shows that production has a high degree of economies of scale, and high sunk costs form exit barriers, which affect the level of enterprise diversification. (Porter, 1980). We use the ratio of industry net fixed assets to industry employees to measure this variable.

**Firm size**
Firm size is a key index reflecting economies of scale and market power. Relevant studies show that there is a correlation between enterprise scale and diversification level (Grant, Jammime, and Thomas, 1988). We use the logarithm of the company's total assets to measure this variable.

**FirmAge**

The research of Xie et al (2014) shows that corporate age will have an impact on diversification. Therefore, we control the logarithm of corporate age (current year - year of establishment + 1).

### 3.3| The benchmark model

To examine the relation between Digitization on diversification, we estimate the following equations:

\[
Total \ entropy_{it} \left( \text{Herfindahl index}_{it} \right) = \beta_0 + \beta_1 \text{Digitization}_{it} + \sum \beta_j (\text{Control variables})_{it} + \sum \text{Firm}_{it} + \sum \text{Year} + \varepsilon_{it}
\]

*Total entropy* and *Herfindahl index* refer to the diversification of company *i* in year *t*.

Year and firm fixed effects are included to control for time- and firm-invariant factors.

The variables of interest, Digitization<sub>*t*</sub>, measure the degree of digitization. A larger \( \beta_1 \) represents a greater impact of digitization on diversification. All variables are defined in Appendix A.

### 4| EMPIRICAL RESULTS

#### 4.1| Descriptive statistics and correlation analysis

Table 2-1 reports descriptive statistics of main variables for the 2004–2020 sample. Table 2-2 reports the Pearson correlation coefficients between variables. The correlation coefficients between independent variables and control variables were less than 0.5, so there is no evidence of severe multicollinearity among the variables.

| Table 2-1 Descriptive statistics results |
|-------------------------------|------|-----|-----|-----|
| VARIABLES                      | (1)  | (2) | (3) | (4) | (5) |
| N                               |      |     |     |     |     |
| mean                           |      |     |     |     |     |
| sd                              |      |     |     |     |     |
| min                             |      |     |     |     |     |
| max                             |      |     |     |     |     |
| Variables       | Total entropy | Herfindahl index | Digitization \(_{ij}\) | Growth \(_{ij}\) | Roa \(_{ij}\) | Leverage \(_{ij}\) | Mshare \(_{ij}\) | FirmAge \(_{ij}\) | Size \(_{ij}\) | Tophold \(_{ij}\) | Dual \(_{ij}\) | SOE \(_{ij}\) | HHI \(_{ij}\) | CI \(_{ij}\) |
|----------------|---------------|------------------|--------------------------|----------------|--------------|-----------------|----------------|----------------|----------------|----------------|---------------|---------------|---------------|--------------|
| Total entropy  | 1.000         |                  |                          |                |              |                 |                |                |                |                |                |                |                |              |
| Herfindahl index | 0.979a       | 1.000            |                          |                |              |                 |                |                |                |                |                |                |                |              |
| Digitization \(_{ij}\) | 0.109a       | 0.095a           | 1.000                    |                |              |                 |                |                |                |                |                |                |                |              |
| Growth \(_{ij}\) | 0.008         | 0.008            | -0.005                   | 1.000          |              |                 |                |                |                |                |                |                |                |              |
| Roa \(_{ij}\)   | -             | -                | -0.001                   | 0.001          | 1.000        |                 |                |                |                |                |                |                |                |              |
| Leverage \(_{ij}\) | -0.000       | -0.001           | -                        | 0.000          | -0.070a      | 1.000           |                |                |                |                |                |                |                |              |
| Mshare \(_{ij}\) | -             | -                | 0.131a                   | -0.003         | 0.063a       | -0.011c         | 1.000          |                |                |                |                |                |                |              |
| FirmAge \(_{ij}\) | 0.118a        | 0.115a           | 0.145a                   | 0.004          | -0.041a      | 0.008           | -0.113a        | 0.113a         |                |                |                |                |                |              |
| Size \(_{ij}\)   | 0.250a        | 0.194a           | 0.137a                   | -0.002         | 0.019a       | -0.036a         | 0.165a         | 0.197a         |                |                |                |                |                |              |
| Tophold \(_{ij}\) | -             | -                | 0.006                    | 0.062a         | -0.010c      | 0.066a          | 0.156a         | -0.039a        |                |                |                |                |                |              |
| Dual \(_{ij}\)   | 0.053a        | 0.052a           | 0.122a                   | 0.013b         | 0.002        | 0.188a          | -              |                |                |                |                |                |                |              |
| SOE \(_{ij}\)    | 0.061a        | 0.055a           | -                        | -0.027a        | 0.004        | -0.188a         | -0.039a        | 0.343a         |                |                |                |                |                |              |
| HHI \(_{ij}\)    | 0.130a        | 0.117a           | 0.184a                   | -0.006         | -0.027a      | 0.013b          | -0.039a        | 0.055a         |                |                |                |                |                |              |
| CI \(_{ij}\)     | 0.004         | 0.003            | -                        | -0.001         | 0.000        | -0.073a         | 0.049a         | 0.010c         |                |                |                |                |                |              |

Table 2-2 The correlation matrix of the explanatory variables
This table reports pairwise Pearson correlation coefficients between the variables. a, b, and c indicate significance at the 1%, 5%, and 10% levels, respectively.
4.2 Multivariate analysis

4.2.1 Test of Hypothesis 1 and 2

According to the regression results in Table 3(1)-(4), enterprise digital transformation is positively correlated with the choice of diversification strategy, and significantly exists at the 1% confidence level, indicating that the role of enterprise digital transformation in reducing enterprise organization costs is dominant, and finally promotes the choice of enterprise diversification strategy. Hypothesis 1 is true, but hypothesis 2 is not true.

| Model | (1) | (2) | (3) | (4) |
|-------|-----|-----|-----|-----|
| **VARIABLES** | **Digitization** | **Total entropy** | **Total entropy** | **Herfindahl index** | **Herfindahl index** |
| **Digitization** | 0.0262*** | 0.0192*** | 0.0133*** | 0.0099*** |
| | (5.7459) | (4.1779) | (5.2502) | (3.8461) |
| **Growth** | 0.0000*** | 0.0000*** | | |
| | (17.8535) | (20.7382) | |
| **Roa** | -0.0170 | -0.0111* | | |
| | (-1.5612) | (-1.7079) | |
| **Lev** | 0.0002 | -0.0000 | | |
| | (1.4556) | (-0.0618) | |
| **Maghold** | -0.0207 | -0.0118 | | |
| | (-1.6156) | (-1.4970) | |
| **FirmAge** | 0.1463*** | 0.0969*** | | |
| | (3.4809) | (4.1371) | |
| **Size** | 0.0496*** | 0.0236*** | | |
| | (6.6697) | (5.6840) | |
| **Tophold** | -0.1326*** | -0.0770*** | | |
| | (-2.5823) | (-2.6676) | |
| **Dual** | 0.0018 | 0.0009 | | |
| | (0.2116) | (0.1905) | |
| **Soe** | 0.0283 | 0.0135 | | |
| | (1.3520) | (1.1969) | |
| **HHI** | -0.0236 | -0.0011 | | |
| | (-0.2991) | (-0.0262) | |
| **CI** | -0.0230** | -0.0126** | | |
| | (-2.2117) | (-2.4296) | |
| **_cons** | 0.4343*** | -0.8540*** | -0.7593*** | -1.4254*** |
| | (21.9201) | (-5.0108) | (-69.7993) | (-14.8964) |
This table reports the estimated results from the regressions of Digitization on diversification, t statistic based on the robust standard error is in parentheses.***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

### 4.3 Robustness tests

1. In order to control the deviation of missing variables, we further added two control variables, industry R & D density $RD_{it}$ (proportion of industry R & D expenditure in total industry revenue) and industry export density $ED_{it}$ (proportion of industry export revenue in total industry revenue). Due to a large number of missing data in these two variables (sample size reduced from 32907 to 15799) Moreover, the regression results do not have a significant impact on the model. In order to prevent sample selection bias, the relevant regression results are placed in the robustness test part, as shown in columns (1) - (2) of table 4-1. The main regression results are consistent with the benchmark regression.

2. In order to increase the reliability of the research, this paper uses Tobit model to regress the main variables in this paper. It is worth mentioning that Tobit model can not control the firm fixed effect, so we only control the industry fixed effect. According to the results in table 4-1 (3) - (4) and Table 4-2 (1) - (2), the main regression results are consistent with the benchmark regression.

3. We classify and regress several main components of digital technology keywords. According to the regression results in table 4-3 (1) - (5) and table 4-4 (1) - (5), we find that all technology categories are positively correlated with enterprise diversification strategy, and cloud computing, digital technology application and big data are significantly positively
correlated with enterprise diversification strategy choice. These three types of digital technologies play a leading role in the choice of enterprise diversification strategy. We believe that the reason is that these three types of technologies are more mature and more available than artificial intelligence and blockchain technology, thus playing a key role in reducing organization costs and promoting the choice of enterprise diversification strategy.

Table 4-1 Robustness tests of Digitization on diversification

| VARIABLES       | (1)       | (2)       | (3)       | (4)       |
|-----------------|----------|----------|----------|----------|
|                 | FE       | Tobit    | FE       | Tobit    |
| Digitization    |          |          |          |          |
| Digitization    | 0.0223***| 0.0134***| 0.0369***| 0.0202***|
|                 | (4.0267) | (4.1337) | (8.4606) | (8.3238) |
| Growth          | -0.0004***| -0.0001  | -0.0001  | -0.0000  |
|                 | (-2.6623)| (-1.2330)| (-0.2109)| (-0.1786)|
| Roa             | -0.0748  | -0.0352  | -0.1333***| -0.0753***|
|                 | (-1.5968)| (-1.2181)| (-3.4960)| (-3.4829)|
| Lev             | -0.0011  | -0.0044  | -0.0227**| -0.0128**|
|                 | (-0.9562)| (-0.6212)| (-2.1037)| (-2.0835)|
| Mshare          | -0.0579  | -0.0398  | -0.1217***| -0.0764***|
|                 | (-1.3241)| (-1.4741)| (-4.2595)| (-4.7382)|
| FirmAge         | 0.0893   | 0.0612*  | 0.2257***| 0.1225***|
|                 | (1.6196) | (1.9179) | (7.9568) | (7.8526) |
| Size            | 0.0656***| 0.0369***| 0.0938***| 0.0496***|
|                 | (4.8514) | (4.6929) | (15.1502)| (14.4115)|
| Tophold         | -0.1920**| -0.1229***| -0.3885***| -0.2128***|
|                 | (-2.3777)| (-2.6287)| (-8.7346)| (-8.6187)|
| Dual            | -0.0060  | -0.0033  | -0.0153  | -0.0081  |
|                 | (-0.5757)| (-0.5447)| (-1.6067)| (-1.5329)|
| Soe             | -0.0033  | 0.0036   | 0.0277   | 0.0070   |
|                 | (-0.1210)| (0.2395) | (1.4432) | (0.6700) |
| HHI             | -0.0710  | -0.0115  | -0.1611  | -0.0868  |
|                 | (-0.5818)| (-0.1621)| (-1.5075)| (-1.4558)|
| ED              | -0.0689  | -0.0260  | -0.0720* | -0.0239  |
|                 | (-1.5290)| (-0.8166)| (-1.7675)| (-1.0280)|
| CI              | -1.2141  | -0.7694  | -0.7427  | -0.8505  |
|                 | (-0.8103)| (-0.9484)| (-0.5251)| (-1.0677)|
| RD              | -0.0043  | -0.0020  | -0.0052  | -0.0031  |
|                 | (-1.2017)| (-1.0503)| (-1.3095)| (-1.3861)|
| cons            | -1.1757***| -1.6801***| -2.4358***| -2.2848***|
|                 | (-3.8044)| (-9.3665)| (-9.4489)| (-16.2085)|
This table reports the estimated results from the regressions of robust test of Digitization on diversification. For the fixed effect model, t statistic based on the robust standard error is in parentheses, and for the Tobit model, z statistic based on the robust standard error is in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 4-2 Robustness tests of Digitization on diversification

| Model | 1 | 2 |
|-------|---|---|
| VARIABLES | Total entropy | Herfindahl index |
| Digitization_{it} | 0.0250*** | 0.0134*** |
| | (7.9482) | (7.8781) |
| Growth_{it} | 0.0000 | 0.0000 |
| | (0.7843) | (1.0721) |
| Roa_{it} | -0.0304** | -0.0195** |
| | (-2.1847) | (-2.4944) |
| Lev_{it} | 0.0000 | -0.0001 |
| | (0.0246) | (-0.3300) |
| Maghold_{it} | -0.1867*** | -0.1049*** |
| | (-8.1719) | (-8.3631) |
| FirmAge_{it} | 0.2263*** | 0.1255*** |
| | (11.3728) | (11.7760) |
| Size_{it} | 0.0696*** | 0.0351*** |
| | (19.7119) | (18.2885) |
| Tophold_{it} | -0.2482*** | -0.1328*** |
| | (-8.9707) | (-8.8070) |
| Dual_{it} | -0.0052 | -0.0032 |
| | (-0.7486) | (-0.8376) |
| Soe_{it} | 0.0393*** | 0.0167*** |
| | (3.5966) | (2.8312) |
| HHI_{it} | -0.0052 | -0.0093 |
| | (-0.1015) | (-0.3364) |
| CI_{it} | -0.0346 | -0.0207 |
| | (-1.3111) | (-1.3994) |
| _cons | -1.5443*** | -1.7734*** |
| | (-9.8034) | (-21.0577) |
This table reports the estimated results from the regressions of robust test of Digitization on diversification. For the Tobit model, z statistic based on the robust standard error is in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 4-3 Robustness tests of considering digital technology differences

| Model     | (1)       | (2)       | (3)       | (4)       | (5)       |
|-----------|-----------|-----------|-----------|-----------|-----------|
| CC_{it}   | 0.0133**  |           |           |           |           |
|           | (1.9799)  |           |           |           |           |
| DTA_{it}  |           | 0.0234*** |           |           |           |
|           |           | (4.2210)  |           |           |           |
| AI_{it}   |           |           | 0.0017    |           |           |
|           |           |           | (0.2139)  |           |           |
| BT_{it}   |           |           |           | 0.0138    |           |
|           |           |           |           | (0.9351)  |           |
| DT_{it}   |           |           |           |           | 0.0171***|
|           |           |           |           |           | (2.6032)  |
| Growth_{it}| 0.0000*** | 0.0000*** | 0.0000*** | 0.0000*** | 0.0000*** |
|           | (18.2321) | (18.5449) | (18.3843) | (18.3618) | (17.9109) |
| Roa_{it}  | -0.0168   | -0.0169   | -0.0169   | -0.0167   | -0.0166   |
|           | (-1.5422) | (-1.5470) | (-1.5345) | (-1.5266) | (-1.5160) |
| Lev_{it}  | 0.0002*   | 0.0002    | 0.0002*   | 0.0002*   | 0.0002    |
|           | (1.6792)  | (1.5614)  | (1.7657)  | (1.7594)  | (1.5984)  |
| Maghold_{it} | -0.0204  | -0.0212   | -0.0207   | -0.0205   | -0.0203   |
|           | (-1.5875) | (-1.6413) | (-1.6069) | (-1.6013) | (-1.6118) |
| FirmAge_{it} | 0.1453*** | 0.1472*** | 0.1466*** | 0.1466*** | 0.1459*** |
|           | (3.4475)  | (3.5045)  | (3.4748)  | (3.4809)  | (3.4693)  |
| Size_{it} | 0.0520*** | 0.0509*** | 0.0531*** | 0.0529*** | 0.0509*** |
|           | (7.0014)  | (6.8737)  | (7.1577)  | (7.1419)  | (6.8451)  |
| Tophold_{it} | -0.1386*** | -0.1375*** | -0.1414*** | -0.1410*** | -0.1357*** |
|           | (-2.6891) | (-2.6698) | (-2.7395) | (-2.7312) | (-2.6391) |
| Dual_{it} | 0.0019    | 0.0021    | 0.0020    | 0.0019    | 0.0016    |
|           | (0.2286)  | (0.2530)  | (0.2424)  | (0.2265)  | (0.1882)  |
| Soe_{it}  | 0.0276    | 0.0290    | 0.0282    | 0.0280    | 0.0281    |
|           | (1.3159)  | (1.3849)  | (1.3415)  | (1.3298)  | (1.3383)  |
| HHI_{it}  | -0.0289   | -0.0229   | -0.0313   | -0.0325   | -0.0311   |
|           | (-0.3668) | (-0.2911) | (-0.3971) | (-0.4121) | (-0.3948) |
| CI_{it}   | -0.0241** | -0.0239** | -0.0246** | -0.0244** | -0.0239** |
|           | (-2.3164) | (-2.3132) | (-2.3535) | (-2.3396) | (-2.2748) |
| _cons     | -0.8960***| -0.8805***| -0.9179***| -0.9147***| -0.8750***|
|           | (-5.2539) | (-5.1843) | (-5.3833) | (-5.3806) | (-5.1225) |
This table reports the estimated results from the regressions of Digitization on diversification. t statistic based on the robust standard error is in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

| Model       | (1) Herfindahl index | (2) Herfindahl index | (3) Herfindahl index | (4) Herfindahl index | (5) Herfindahl index |
|-------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| **CC_{it}** | 0.0078*** (2.0422)   | 0.0116*** (3.8487)   | 0.0020 (0.4459)      | 0.0093 (1.1208)      | 0.0086** (2.3854)    |
| **DTA_{it}**| 0.0000*** (20.6039)  | 0.0000*** (20.7424)  | 0.0000*** (20.5433)  | 0.0000*** (20.5173)  | 0.0000*** (20.6134)  |
| **AI_{it}** | -0.0110* (-1.6945)   | -0.0111* (-1.6952)   | -0.0110* (-1.6824)   | -0.0110* (-1.6766)   | -0.0109* (-1.6683)   |
| **BT_{it}** | 0.0000 (0.1860)      | 0.0000 (0.0638)      | 0.0000 (0.2861)      | 0.0000 (0.2918)      | 0.0000 (0.1018)      |
| **Maghold_{it}** | -0.0116 (-1.4705) | -0.0120 (-1.5183) | -0.0118 (-1.4895) | -0.0116 (-1.4835) | -0.0116 (-1.4928) |
| **FirmAge_{it}** | 0.0963*** (4.1026) | 0.0974*** (4.1595) | 0.0969*** (4.1288) | 0.0970*** (4.1395) | 0.0967*** (4.1263) |
| **Size_{it}** | 0.0248*** (5.9995) | 0.0243*** (5.8734) | 0.0253*** (6.1358) | 0.0253*** (6.1301) | 0.0243*** (5.8710) |
| **Tophold_{it}** | -0.0799*** (-2.7605) | -0.0796*** (-2.7489) | -0.0813*** (-2.8053) | -0.0812*** (-2.8018) | -0.0787*** (-2.7233) |
| **Dual_{it}** | 0.0010 (0.2037) | 0.0011 (0.2273) | 0.0010 (0.2154) | 0.0010 (0.1990) | 0.0010 (0.1706) |
| **Soe_{it}** | 0.0131 (1.1598) | 0.0138 (1.2284) | 0.0134 (1.1897) | 0.0133 (1.1753) | 0.0134 (1.1849) |
| **HHI_{it}** | -0.0037 (-0.0862) | -0.0009 (-0.0214) | -0.0051 (-0.1189) | -0.0058 (-0.1378) | -0.0050 (-0.1176) |
This table reports the estimated results from the regressions of Digitization on diversification, t statistic based on the robust standard error is in parentheses.***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

5| ADDRESSING ENDOGENEITY CONCERNS

There may also be endogenous problems in this paper. Based on this, considering that enterprise digital transformation is a positive response to the continuous maturity of "ABCD" technology, it is an excellent quasi natural experiment for enterprises to gradually promote their own digital transformation in batches. This paper selects the multi-stage dual difference model (did) to further overcome the endogenous problem: by making two differences between the treatment group and the control group before and after the implementation of the digital transformation strategy, it can effectively eliminate the internal differences between individuals and the errors caused by the time trend unrelated to the experimental group. We can get the "net effect" of enterprise digital transformation on enterprise diversification. Accordingly, this paper constructs the following double difference model: The model of the difference-in-differences regression is specified as follows:

\[ Total\ entropy_{i,t} \cdot (Herfindahl\ index_{i,t}) = \beta_0 + \beta_1 (du_{i,t} \times dt_{i,t}) + \sum \beta_j (Control\ variables)_{i,j} + \sum Firm_{i,t} + \sum Year + \epsilon_{i,t} \]

Where, \( du \) is an individual dummy variable, \( du = 1 \) represents the group of enterprises undergoing digital transformation during the sample period, \( du = 0 \) represents the group of
enterprises that have not undergone digital transformation. Further set the period dummy variable $dt$. If the company carries out digital transformation in the current year and subsequent years, it will be assigned as 1, otherwise it will be 0. $\beta_1$ reflects the change of enterprise diversification before and after the enterprise promotes the digital transformation, and is the parameter to be evaluated of the key variable in this paper. It should be pointed out that the double difference samples need to have sufficient observation values in several years before and after the policy change. Therefore, the samples selected in this paper are samples with a period of at least five consecutive years, so as to ensure that there is sufficient observation period after the difference as much as possible. At the same time, this paper will eliminate those samples that have been showing digital transformation keywords during the whole sample period. In addition, the model controls the fixed effect of firms.

According to the regression results in Table 5 (1) - (2), we find that the variables ($du_{it} \times dt_{it}$) are still positively correlated with the enterprise diversification strategy, and significantly exist at the 5% confidence level, indicating that this study does not need to worry about the impact of endogenous problems on the conclusion of this paper. In addition, according to the regression results listed in Table 5 (3) - (4), we can see that the regression results of relevant variables are not significant three years ($du_{it} \times Before_{3it}$), two years ($du_{it} \times Before_{3it}$), one year ($du_{it} \times Before_{1it}$) before the implementation of the policy. One year ($du_{it} \times After_{1it}$), two years ($du_{it} \times After_{2it}$) and three years ($du_{it} \times After_{3it}$) after the implementation of the policy, the relevant results are positive and basically significant, which further illustrates the reliability of the benchmark regression results.

### Table 5 Difference-in-differences (DID) regressions.

| Model | DID |
|-------|-----|
|       |     |
|                | (1)             | (2)             | (3)             | (4)             |
|----------------|-----------------|-----------------|-----------------|-----------------|
|                | Total entropy   | Herfindahl index| Total entropy   | Herfindahl index|
| $du_{it} \times dt_{it}$ | 0.0245**        | 0.0116**        | 0.0025          | 0.0011          |
|                | (2.3478)        | (2.0093)        | (0.2780)        | (0.2199)        |
| $du_{it} \times Before_{3it}$ | -0.0002         | -0.0003         | -0.0223         | -0.0648         |
|                | (0.5350)        | (0.5451)        | (2.3478)        | (2.0093)        |
| $du_{it} \times Before_{2it}$ | 0.0050          | 0.0029          | (1.1733)        | (1.1650)        |
|                | (0.0114)        | (0.0064)        | (2.2914)        | (2.2649)        |
| $du_{it} \times After_{1it}$ | 0.0235**        | 0.0131**        | (1.5909)        | (1.8374)        |
|                | (2.0093)        | (1.1650)        | (2.0093)        | (1.1650)        |
| $du_{it} \times After_{2it}$ | 0.0165          | 0.0108*         | (1.5909)        | (1.8374)        |
|                | (1.1414)        | (1.3685)        | (1.5909)        | (1.8374)        |
| $du_{it} \times After_{3it}$ | 0.0233**        | 0.0121**        | (1.1414)        | (1.3685)        |
|                | (2.0093)        | (1.1650)        | (2.0093)        | (1.1650)        |
| Growth$_{it}$ | 0.0000***       | 0.0000***       | 0.0000***       | 0.0000***       |
|               | (17.2911)       | (20.2095)       | (17.7345)       | (20.1354)       |
| Roa$_{it}$    | -0.0116         | -0.0079         | -0.0118         | -0.0080         |
|               | (-1.1321)       | (-1.2781)       | (-1.1524)       | (-1.2982)       |
| Lev$_{it}$    | 0.0002          | -0.0000         | 0.0002          | -0.0000         |
|               | (1.1414)        | (-0.4227)       | (1.2276)        | (-0.3685)       |
| Maghold$_{it}$| -0.0236         | -0.0134         | -0.0233         | -0.0132         |
|               | (-1.5166)       | (-1.4156)       | (-1.4882)       | (-1.3872)       |
| FirmAge$_{it}$| 0.1531***       | 0.0990***       | 0.1543***       | 0.0994***       |
|               | (3.4942)        | (4.0387)        | (3.5177)        | (4.0545)        |
| Size$_{it}$   | 0.0507***       | 0.0234***       | 0.0514***       | 0.0237***       |
|               | (6.5207)        | (5.3970)        | (6.6124)        | (5.4715)        |
| Tophold$_{it}$| -0.1078**       | -0.0623**       | -0.1101**       | -0.0633**       |
|               | (-2.0009)       | (-2.0558)       | (-2.0422)       | (-2.0887)       |
| Dual$_{it}$   | -0.0012         | -0.0010         | -0.0009         | -0.0009         |
|               | (-0.1286)       | (-0.1938)       | (-0.1022)       | (-0.1705)       |
| Soe$_{it}$    | 0.0275          | 0.0130          | 0.0279          | 0.0132          |
|               | (1.2402)        | (1.0966)        | (1.2526)        | (1.1115)        |
| HHI$_{it}$    | -0.0153         | 0.0040          | -0.0169         | 0.0035          |
|               | (-0.1811)       | (0.0879)        | (-0.2003)       | (0.0780)        |
| Cl$_{it}$     | -0.0229**       | -0.0126**       | -0.0243**       | -0.0132**       |
|               | (-2.2113)       | (-2.4145)       | (-2.3430)       | (-2.5324)       |
| -cons         | -0.8943***      | -1.4253***      | -0.9125***      | -1.4326***      |
|               | (-5.0552)       | (-14.3042)      | (-5.1567)       | (-14.3983)      |
| Firm FE       | Yes            | Yes            | Yes            | Yes            |
| Year FE       | Yes            | Yes            | Yes            | Yes            |
| Observations | 27033 | 27033 | 27033 | 27033 |
|--------------|-------|-------|-------|-------|
| adj. R2      | 0.047 | 0.042 | 0.046 | 0.042 |

The table reports the estimated results from the difference-in-difference regressions, t statistic based on the robust standard error is in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

6| ORGANIZATION COSTS CHANNEL

As mentioned above, the impact of enterprise digital transformation on enterprise diversification depends on whether enterprise digital transformation plays a leading role in reducing transaction costs or reducing enterprise organization costs. If digitization plays a dominant role in reducing organization costs, then, the improvement of enterprise digitization level should be more conducive to those enterprises with high organization costs, which will play a more significant role in promoting the diversification of such enterprises. This paper intends to further explore whether there is heterogeneity in the promotion effect of enterprise digitization on enterprise diversification in enterprises with different organization costs. In order to verify the above speculation, this paper uses the following two indicators to measure the internal control cost of enterprises.

(1) Proportion of administrative expenses. This index directly reflects the organization costs of enterprises. Specifically, according to the sample median of the proportion of enterprise management expenses in operating revenue, we conduct sub sample regression. According to the regression results in Table 6 (1) - (4), we find that the promotion effect of enterprise digitization on enterprise diversification is more significant in the group with higher management expenses, however, the coefficient difference between groups was not statistically significant by the suest test, which cannot verifies the above discussion.
(2) Enterprise growth. According to the enterprise life cycle theory, enterprises in the early stage of growth usually have simple organizational structure and low organization costs; In contrast, when the enterprise is in the mature or declining stage, the organizational structure is complex and the organization costs increases gradually. Therefore, enterprise growth can reflect the organization costs faced by enterprises to a certain extent. The higher the growth, the lower the organization costs. This paper carries out grouping regression according to the median growth rate of operating revenue. According to the regression results in columns (1) - (4) of table 7, the promotion effect of enterprise digitization on enterprise diversification is more significant in the group with low enterprise growth rate, however, the coefficient difference between groups was not statistically significant by the sue test, which cannot verifies the above discussion.

| Table 6 Digitization on diversification in high management cost group and low management cost group |
|-----------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| Model | FE | High organization cost | Low organization cost | High organization cost | Low organization cost |
|       |     | High management cost group | low management cost group | High management cost group | low management cost group |
|       |     | (1) | (2) | (3) | (4) |
| Digitization<sub>i</sub> | 0.0178*** | 0.0139** | 0.0097*** | 0.0075* |
|       | (3.0063) | (2.0302) | (2.9204) | (1.9289) |
| Growth<sub>i</sub> | 0.0000*** | 0.0000* | 0.0000*** | 0.0000 |
|       | (17.2142) | (1.6882) | (17.8639) | (1.6056) |
| Roa<sub>i</sub> | -0.0053 | -0.0062 | -0.0038 | -0.0098 |
|       | (-0.5733) | (-0.2270) | (-0.6768) | (-0.6546) |
| Lev<sub>i</sub> | 0.0001 | -0.0018 | -0.0000 | -0.0049 |
|       | (0.6970) | (-0.0898) | (-0.4804) | (-0.4420) |
| Maghold<sub>i</sub> | -0.0181 | -0.0731 | -0.0105 | -0.0416 |
|       | (-1.0255) | (-1.0339) | (-1.0170) | (-1.0793) |
### Table 7 Digitization on diversification in high growth rate group and low growth rate group

| Model                      | Low organization cost | High organization cost | Low organization cost | High organization cost |
|----------------------------|-----------------------|------------------------|-----------------------|------------------------|
|                            | High growth rate group| low growth rate group  | High growth rate group| low growth rate group  |
|                            | (1)                   | (2)                    | (3)                   | (4)                    |
| Total entropy              | Total entropy         | Herfindahl index       | Herfindahl index      |                        |
| **Digitization**, j        | 0.0181***             | 0.0205***              | 0.0092***             | 0.0105***              |
|                           | (3.3841)              | (3.5353)               | (3.0750)              | (3.2418)               |
| **Growth**, j              | -0.0000               | -0.0677***             | 0.0000                | -0.0414***             |
|                           | (-0.3653)             | (-3.6040)              | (1.3470)              | (-3.8201)              |
| **Roa**, j                 | -0.0244               | -0.0157                | -0.0180               | -0.0132*               |
|                           | (-0.4933)             | (-1.3024)              | (-0.6109)             | (-1.8575)              |
| **Lev**, j                 | -0.0015               | 0.0002                 | -0.0020               | -0.0000                |
|                           | (-0.1436)             | (1.2958)               | (-0.3285)             | (-0.4571)              |
| **Maghold**, j             | -0.0174*              | -0.1003*               | -0.0091               | -0.0684**              |

_t statistic based on the robust standard error is in parentheses.***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively._
7| TRANSACTION COST CHANNEL

Enterprise digital transformation can reduce the transaction costs of enterprises, so whether the impact of enterprise digital transformation on the choice of enterprise diversification strategy is heterogeneous under different degrees of transaction costs. We believe that when the transaction costs of enterprises is low, the space for reducing the transaction costs by digitization is limited. At this time, the effect of digitization on reducing the organization costs will be more obvious, and thus the effect on improving the diversification level of enterprises will be more significant. Because it is difficult to measure enterprise.
transaction costs directly, this paper measures enterprise transaction costs from enterprise and region levels respectively.

(1) At the enterprise level, this study uses enterprise asset specificity to reflect transaction costs. Enterprises with higher asset specificity face higher lock-in costs because they are often at a disadvantage in the transactions with competitors and face higher transaction costs (Williamson, 2007). In this paper, the proportion of intangible assets in total assets is used to measure the asset specificity of enterprises (Collis and Montgomery, 1997). According to the quartile of the proportion of intangible assets in total assets, sub sample regression is carried out. According to the regression results in Table 8 (1) - (4), we find that the promotion of enterprise digitization on the level of enterprise diversification is more significant in the group with relatively low proportion of intangible assets, however, the coefficient difference between groups was not statistically significant by the suest test, which cannot verifies the above discussion.

(2) At the regional level, this paper studies the marketization level to reflect the transaction costs. In areas with low marketization level, the trading environment is poor, the probability of default among market subjects is higher, and the transaction costs faced by enterprises is often higher. This paper uses the marketization index of the province where the enterprise is located to measure the median of the regional marketization level for sub sample regression. According to the regression results in Table 9 (1) - (4), we find that the promotion effect of enterprise digitization on the level of enterprise diversification is more significant in the group with higher marketization degree, however, the coefficient difference between groups was not statistically significant by the suest test, which cannot verifies the above discussion.
Table 8 Digitization on diversification in high intangible asset ratio group and low intangible asset ratio group

| Model | High transaction costs | Low transaction costs | High transaction costs | Low transaction costs |
|-------|------------------------|-----------------------|------------------------|-----------------------|
|       | high intangible asset ratio group | low intangible asset ratio group | high intangible asset ratio group | low intangible asset ratio group |
|       | Total entropy | Total entropy | Herfindahl index | Herfindahl index |
|       | (1) | (2) | (3) | (4) |
| Digitization_{it} | 0.0163** | 0.0243*** | 0.0102** | 0.0133*** |
|       | (2.0548) | (3.0981) | (2.1749) | (3.0427) |
| Growth_{it} | 0.0000*** | 0.0000 | 0.0000*** | 0.0000 |
|       | (7.4326) | (0.7766) | (9.4542) | (0.3084) |
| Roa_{it} | -0.0310 | 0.0019 | -0.0181 | -0.0003 |
|       | (-1.2702) | (0.0886) | (-1.1321) | (-0.0265) |
| Lev_{it} | -0.0003 | 0.0000 | 0.0001 | -0.0001 |
|       | (-0.0245) | (0.0094) | (0.0184) | (-0.8382) |
| Maghold_{it} | -0.1297* | -0.0232 | -0.0866* | -0.0242 |
|       | (-1.7067) | (-0.3638) | (-1.9500) | (-0.6514) |
| FirmAge_{it} | 0.0516 | 0.1080 | 0.0278 | 0.0861* |
|       | (0.5895) | (1.1594) | (0.5630) | (1.7479) |
| Size_{it} | 0.0648*** | 0.0077 | 0.0358*** | -0.0017 |
|       | (4.0956) | (0.7174) | (4.1118) | (-0.2815) |
| Tophold_{it} | 0.0141 | -0.0463 | -0.0029 | -0.0091 |
|       | (0.1425) | (-0.5237) | (-0.0509) | (-0.1895) |
| Dual_{it} | -0.0266* | 0.0088 | -0.0111 | 0.0043 |
|       | (-1.7083) | (0.5814) | (-1.2073) | (0.5169) |
| Soe_{it} | 0.0982*** | -0.0191 | 0.0447** | -0.0172 |
|       | (2.6847) | (-0.4456) | (2.2717) | (-0.7754) |
| HHI_{it} | -0.2091 | -0.1434 | -0.1545* | -0.0505 |
|       | (-1.4006) | (-0.8149) | (-1.8198) | (-0.5512) |
| CI_{it} | -0.0347*** | 0.4063*** | -0.0175*** | 0.2073** |
|       | (-7.1379) | (2.6690) | (-6.5033) | (2.5003) |
| _cons | -1.0043*** | 0.0898 | -1.5335*** | -0.8817*** |
|       | (-2.7772) | (0.2998) | (-7.4183) | (-5.4062) |
| Firm FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |
| Observations | 8239 | 8236 | 8239 | 8236 |
| adj. R2 | 0.065 | 0.025 | 0.064 | 0.016 |
| SUEST test | chi2( 1) = 0.37 | chi2( 1) = 0.01 |
|            | Prob > chi2 = 0.5437 | Prob > chi2 = 0.9263 |
t statistic based on the robust standard error is in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 9 Digitization on diversification in high regional marketization degree group and low regional marketization degree group

| Model | Low transaction costs | High transaction costs | Low transaction costs | High transaction costs |
|-------|-----------------------|------------------------|-----------------------|------------------------|
|       | high regional          | low regional           | high regional          | low regional           |
|       | marketization degree group | marketization degree group | marketization degree group | marketization degree group |
|       | (1)                    | (2)                    | (3)                    | (4)                    |
| **Digitization** | 0.0213*** | 0.0163** | 0.0111*** | 0.0077* |
|       | (3.3609)               | (2.1982)               | (3.1526)               | (1.8178)               |
| **Growth** | 0.0001               | 0.0000***             | 0.0000                | 0.0000***             |
|       | (0.8735)               | (14.7872)             | (0.6196)               | (15.0794)             |
| **Roa** | -0.0615*             | -0.0110               | -0.0370*              | -0.0076               |
|       | (-1.7390)             | (-1.0218)             | (-1.7833)             | (-1.1915)             |
| **Lev** | -0.0064            | 0.0004***            | -0.0052               | 0.0001                |
|       | (-0.9408)             | (2.7893)              | (-1.2925)             | (1.6381)              |
| **Maghold** | -0.0523          | -0.0212              | -0.0320               | -0.0118               |
|       | (-0.9019)             | (-1.5121)             | (-0.9902)             | (-1.3842)             |
| **FirmAge** | 0.2144***         | 0.0361               | 0.1324***             | 0.0438                |
|       | (3.8137)              | (0.5239)              | (4.2334)              | (1.1251)              |
| **Size** | 0.0343***         | 0.0649***            | 0.0160**              | 0.0309***             |
|       | (2.6257)              | (6.2984)              | (2.2063)              | (5.3040)              |
| **Tophold** | -0.1302          | -0.1263*             | -0.0831*              | -0.0616               |
|       | (-1.5830)             | (-1.8435)             | (-1.8211)             | (-1.5589)             |
| **Dual** | 0.0012              | -0.0065              | 0.0005                | -0.0030               |
|       | (0.0919)              | (-0.5030)             | (0.0615)              | (-0.4045)             |
| **Soe** | -0.0016              | 0.0430               | -0.0065               | 0.0219                |
|       | (-0.0374)             | (1.6124)              | (-0.3007)             | (1.4869)              |
| **HHI** | 0.0050              | -0.1091              | 0.0085                | -0.0374               |
|       | (0.0397)              | (-1.1035)             | (0.1234)              | (-0.6834)             |
| **Cl** | 0.0260              | -0.0829              | 0.0127                | -0.0874               |
|       | (0.1921)              | (-0.3786)             | (0.1683)              | (-0.7251)             |
| **cons** | -0.6712**          | -0.9314***           | -1.3299***            | -1.4645***            |
|       | (-2.3348)             | (-3.7996)             | (-8.3678)             | (-10.4098)            |

| Firm FE | Yes | Yes | Yes | Yes |
|---------|-----|-----|-----|-----|
| Year FE | Yes | Yes | Yes | Yes |
| Observations | 13641 | 15967 | 13641 | 15967 |
| adj. R2   | 0.058 | 0.050 | 0.059 | 0.039 |
t statistic based on the robust standard error is in parentheses.***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

8| THE IMPACT OF THE INDUSTRY TYPE

Manufacturing and services. On the one hand, the impact of digitization on the level of enterprise diversification is affected by the degree of transformation. In the early stage of digital transformation, digital technology has not been integrated with enterprise production and operation, so the impact of digitization on enterprise diversification is difficult to be reflected; With the in-depth development of digital transformation, digital technology will be gradually integrated with enterprise production and operation, and the impact of digitization on enterprise organization cost will be gradually reflected. On the whole, the digital transformation process of service industry precedes that of manufacturing industry. Therefore, the role of digitization in promoting the diversification level of enterprises may be more significant in service enterprises. According to the regression results in table 10 (1) - (4), we find that the promotion effect of enterprise digital transformation on enterprise diversification is more significant in the service industry, however, the coefficient difference between groups was not statistically significant by the suuest test, which cannot verifies the above discussion.

| Table 10 Digitization on diversification in Manufacturing and Service industry |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| Model           | FE              | Model           | FE              | Model           | FE              | Model           | FE              |
| Service industry| Service industry| Service industry| Service industry| Manufacturing    | Manufacturing    | 
| Total entropy   | Total entropy   | Herfindahl index| Herfindahl index| 
| Digitization,t  | Digitization,t  |                 |                 |                 |                 |                 |
| 0.0263***       | 0.0133**        | 0.0138***       | 0.0076**        |
| (3.1710)        | (2.4663)        | (2.9758)        | (2.4611)        |
| Variable       | Estimate 1 | Estimate 2 | Estimate 3 | Estimate 4 |
|----------------|------------|------------|------------|------------|
| growth         | 0.0000***  | -0.0002**  | 0.0000***  | -0.0001**  |
| (10.7885)      | (-2.4651)  | (14.0006)  | (-2.5313)  |
| roa            | 0.0219     | -0.0615*** | 0.0064     | -0.0354*** |
| (0.9019)       | (-3.5320)  | (0.4467)   | (-3.7447)  |
| lev            | 0.0005     | -0.0088**  | 0.0002     | -0.0057**  |
| (0.3184)       | (-2.1327)  | (-0.2344)  | (-2.3569)  |
| maghold        | -0.0094*   | -0.1156*** | -0.0042    | -0.0724**  |
| (-1.7405)      | (-2.2039)  | (-1.3462)  | (-2.4568)  |
| firmage        | 0.1692**   | 0.1226**   | 0.1067**   | 0.0834***  |
| (1.9744)       | (2.2891)   | (2.7285)   |            |
| size           | 0.0321***  | 0.0607***  | 0.0112*    | 0.0316***  |
| (2.6216)       | (5.8598)   | (1.6721)   | (5.3890)   |
| tophold        | -0.0183    | -0.2045*** | -0.0022    | -0.1184*** |
| (-0.1926)      | (-3.0272)  | (-0.0422)  | (-3.0992)  |
| dual           | -0.0033    | 0.0042     | -0.0021    | 0.0021     |
| (-0.2033)      | (0.4084)   | (-0.2298)  | (0.3496)   |
| soe            | 0.0230     | 0.0266     | 0.0091     | 0.0145     |
| (0.6089)       | (0.9919)   | (0.4536)   | (0.9913)   |
| hhi            | -0.0436    | -0.1397    | -0.0010    | -0.0627    |
| (-0.3069)      | (-1.3489)  | (-0.0127)  | (-1.0675)  |
| c1             | -0.0218**  | 4.4860**   | -0.0114**  | 2.2333**   |
| (-2.0275)      | (2.4812)   | (-2.1433)  | (2.2226)   |
| _cons          | -0.5292*   | -1.0141*** | -1.1906*** | -1.5517*** |
| (-1.7321)      | (-4.3142)  | (-7.1322)  | (-11.6420) |

| Firm FE | Yes | Yes | Yes | Yes |
|---------|-----|-----|-----|-----|
| Year FE | Yes | Yes | Yes | Yes |
| Observations | 9750 | 19554 | 9750 | 19554 |
| adj. R2  | 0.046 | 0.063 | 0.037 | 0.061 |
| SUEST test | chi2(1) = 2.00 | chi2(1) = 1.48 |
| Prob > chi2 | 0.1571 | 0.2238 |

The t statistic based on the robust standard error is in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

9) MARKET POWER CHANNEL

We use the HHI index to measure industry concentration ($HHI_{it}$, The square sum of the company's Total asset in the proportion of all companies in the industry in year t). We performed grouping regression according to the annual median of industry concentration, according to the regression results in Table 11 (1) - (4), we find that the impact of enterprise digital transformation on enterprise diversification is more significant in the group with high market concentration, and the coefficient difference between groups passed the suest test. It
shows that the pursuit of market monopoly power and interests is an important reason for the diversification level of enterprises caused by enterprise digital transformation.

Table 11 Digitization on diversification in High market concentration group and Low market concentration group

| Model | High market concentration group | Low market concentration group | High market concentration group | Low market concentration group |
|-------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|
|       | Total entropy                    | Total entropy                  | Herfindahl index                | Herfindahl index                |
| Digitization,ij | 0.0306***                     | 0.0123*                       | 0.0149***                      | 0.0069*                       |
|       | (4.9386)                        | (1.9238)                      | (4.4045)                       | (1.9239)                      |
| Growth,ij | 0.0000***                     | 0.0000                        | 0.0000***                      | 0.0000                        |
|       | (17.4014)                       | (0.7323)                      | (19.6982)                      | (0.2809)                      |
| Roa,ij | -0.0020                        | -0.0834**                     | -0.0028                        | -0.0470**                     |
|       | (-0.2536)                       | (-2.2808)                     | (-0.5923)                      | (-2.2689)                     |
| Lev,ij | 0.0003**                       | 0.0018                        | 0.0001                         | -0.0005                       |
|       | (2.0271)                        | (0.2165)                      | (0.7882)                       | (-0.1088)                     |
| Maghold,ij | -0.0194*                      | -0.0343                       | -0.0102                        | -0.0221                       |
|       | (-1.7216)                       | (-0.7605)                     | (-1.6099)                      | (-0.8317)                     |
| G FirmAge,ij | 0.1631***                    | 0.1428**                      | 0.0975***                      | 0.1013***                     |
|       | (2.8157)                        | (2.2203)                      | (3.0367)                       | (2.8081)                      |
| Size,ij | 0.0592***                      | 0.0463***                     | 0.0288***                      | 0.0222***                     |
|       | (5.5448)                        | (4.4367)                      | (4.8454)                       | (3.8342)                      |
| Tophold,ij | -0.1157                       | -0.2231***                    | -0.0567                        | -0.1392***                    |
|       | (-1.6405)                       | (-2.8349)                     | (-1.4707)                      | (-3.0924)                     |
| Dual,ij | -0.0018                        | 0.0100                        | 0.0018                         | 0.0038                        |
|       | (-0.1501)                       | (0.8636)                      | (0.2719)                       | (0.5713)                      |
| Soe,ij | 0.0408                         | 0.0158                        | 0.0214                         | 0.0058                        |
|       | (1.4217)                        | (0.5164)                      | (1.4202)                       | (0.3516)                      |
| HHI,ij | 0.0300                         | -0.0112                       | 0.0184                         | 0.0539                        |
|       | (0.3869)                        | (-0.0302)                     | (0.4375)                       | (0.2580)                      |
| Cl,ij | -0.0239**                      | 4.5160***                     | -0.0133**                      | 2.3363**                      |
|       | (-2.3374)                       | (2.7473)                      | (-2.5522)                      | (2.5425)                      |
| _cons | -1.1346***                     | -0.7472***                    | -1.5609***                     | -1.3859***                    |
|       | (-4.6755)                       | (-3.0520)                     | (-11.3817)                     | (-10.2149)                    |
| Firm FE | Yes                            | Yes                           | Yes                            | Yes                           |
| Year FE | Yes                            | Yes                           | Yes                            | Yes                           |
| Observations | 16145                          | 16762                          | 16145                          | 16762                          |
| adj. R2 | 0.061                          | 0.049                         | 0.053                          | 0.048                          |
| SUEST | chi2( 1) = 4.98                | chi2( 1) = 2.94               |                                |                               |
| test  | Prob > chi2 = 0.0256            | Prob > chi2 = 0.0863           |                                |                               |
t statistic based on the robust standard error is in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

10| **BLOCKHOLDER CONTROL CHANNEL**

To test whether digital transformation increases diversification through block holders’ intervention, Following Gu et al. (2018), we proxy block holder ownership, we add a direct proxy for block holders’ ownership, BlockHolding\(_{it}\), which is the total holding of block holders. We conducted group regression according to the annual median block holders shareholding. According to the regression results in columns (1) - (4) of table 12, the difference of correlation coefficient between groups did not pass the suest test, indicating that this channel hypothesis is not tenable.

**Table 12 Digitization on diversification in High block holders shareholding group and Low block holders shareholding group**

| Model       | FE  | High block holders shareholding group | Low block holders shareholding group |
|-------------|-----|--------------------------------------|--------------------------------------|
|             |     | (1)                                  | (2)                                  | (3)                                  | (4)                                  |
|             |     | Total entropy                        | Total entropy                        | Herfindahl index                     | Herfindahl index                     |
| Digitization\(_{it}\) |     | 0.0175***               | 0.0193***               | 0.0100***               | 0.0085***               |
|             |     | (2.7564)                      | (3.2449)                      | (2.7381)                      | (2.5978)                      |
| Growth\(_{it}\)   |     | 0.0000**              | 0.0000***              | 0.0000                  | 0.0000***              |
|             |     | (2.2601)                      | (15.4420)                     | (1.5664)                     | (17.5738)                     |
| Roa\(_{it}\)     |     | -0.0404                     | -0.0108                     | -0.0231                    | -0.0085                     |
|             |     | (-1.3488)                    | (-1.2305)                    | (-1.4129)                   | (-1.5874)                    |
| Lev\(_{it}\)     |     | 0.0335*                      | 0.0003**                      | 0.0175                    | 0.0000                      |
|             |     | (1.7189)                     | (2.0184)                     | (1.4773)                   | (0.5798)                     |
| Maghold\(_{it}\) |     | -0.0161*                     | 0.0461                       | -0.0086                    | 0.0335                      |
|             |     | (-1.6972)                    | (0.7023)                     | (-1.4603)                  | (0.9320)                     |
| FirnAge\(_{it}\) |     | 0.0961                      | 0.2054***                    | 0.0721**                   | 0.1278***                    |
|             |     | (1.6306)                     | (3.1665)                     | (2.1148)                   | (3.5795)                     |
| Size\(_{it}\)    |     | 0.0458***                    | 0.0628***                    | 0.0231***                  | 0.0311***                    |
|             |     | (3.9179)                     | (6.2189)                     | (3.3475)                   | (5.6658)                     |
| Tophold\(_{it}\) |     | -0.2938***                   | -0.0804                      | -0.1863***                 | -0.0374                      |
|   | (-3.1838) | (-1.0667) | (-3.5358) | (-0.9093) |
|---|-----------|-----------|-----------|-----------|
| $Dual_{it}$ | 0.0042 | -0.0047 | 0.0003 | -0.0022 |
|                  | (0.3363) | (-0.4384) | (0.0455) | (-0.3642) |
| $Soe_{it}$ | -0.0133 | 0.0710** | -0.0081 | 0.0363** |
|                  | (-0.4927) | (2.1161) | (-0.5210) | (2.0595) |
| $HHI_{it}$ | -0.0008 | -0.0738 | 0.0201 | -0.0432 |
|                  | (-0.0062) | (-0.7534) | (0.2970) | (-0.8335) |
| $CI_{jt}$ | -0.0361*** | -0.0164 | -0.0167*** | -0.0101* |
|                  | (-4.5874) | (-1.5947) | (-3.7062) | (-1.7271) |
| _cons | -0.6251** | -1.2917*** | -1.3342*** | -1.6693*** |
|                  | (-2.3964) | (-5.5165) | (-8.7545) | (-12.9310) |

|   | Yes | Yes | Yes | Yes |
|---|-----|-----|-----|-----|
| **Firm FE** | Yes | Yes | Yes | Yes |
| **Year FE** | Yes | Yes | Yes | Yes |
| **Observations** | 13936 | 18971 | 13936 | 18971 |
| **adj. R2** | 0.054 | 0.047 | 0.053 | 0.041 |
| **SUEST** | chi2( 1) = 0.04 | chi2( 1) = 0.09 |
| **test** | Prob > chi2 = 0.8399 | Prob > chi2 = 0.7661 |

* t statistic based on the robust standard error is in parentheses.***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

11| INFORMATION ASYMMETRY CHANNEL

The presence of external monitoring systems, including analysts’ coverage and external auditors, is attributable to a more transparent information environment for outsiders (see Choi & Lee, 2013; Zuckerman, 2000).

To verify whether information asymmetry the key channel affecting the main effect of this paper, we follow the literature and use two proxies for information asymmetry that have been widely adopted: the number of analysts following a firm ($^\text{Analyst}_{it}$); the number of analysts’ reports covering a firm ($^\text{Report}_{jt}$).

Firstly, we conducted grouping regression according to the annual median concerned by analyst focus. According to the regression results in table 13 (1) - (4), the difference of regression coefficient between groups failed to pass the suest test. Then, we conducted grouping regression according to the annual median of interest in the research report. According to the
regression results in table 14 (1) - (4), the difference of regression coefficient between groups failed to pass the suest test. To sum up, this channel assumption is not tenable.

Table 13 Digitization on diversification in High analyst focus group and Low analyst focus group

| Model  | FE | High analyst focus | Low analyst focus group | High analyst focus group | Low analyst focus group |
|-------|----|--------------------|-------------------------|--------------------------|-------------------------|
|       |    | (1)                | (2)                     | (3)                      | (4)                      |
|       |    | Total entropy      | Total entropy           | Herfindahl index         | Herfindahl index         |
| Digitalization, | FE | 0.0160***          | 0.0219***               | 0.0072**                 | 0.0130***               |
|       |    | (2.9054)           | (3.5003)                | (2.4776)                 | (3.6374)                |
| Growth, | FE | 0.0000***          | 0.0000***               | 0.0000***                | 0.0000***               |
|       |    | (2.7876)           | (19.3594)               | (3.6069)                 | (19.8761)               |
| Roa, |    | -0.0937            | -0.0067                 | -0.0481                  | -0.0057                 |
|       |    | (-1.4774)          | (-0.8675)               | (-1.3273)                | (-1.2012)               |
| Leve |    | 0.1035**           | 0.0001                  | 0.0564**                 | -0.0000                |
|       |    | (2.3152)           | (0.9177)                | (2.2671)                 | (-0.4766)               |
| Maghold, |    | -0.0129*           | -0.0194                 | -0.0073                  | -0.0148                |
|       |    | (-1.7781)          | (-0.5083)               | (-1.5938)                | (-0.6691)               |
| FirmAge, |    | 0.0913*            | 0.1687***               | 0.0660***                | 0.1044***               |
|       |    | (1.6664)           | (2.7652)                | (2.1672)                 | (3.0378)                |
| Size, |    | 0.0641***          | 0.0494***               | 0.0359***                | 0.0238***               |
|       |    | (5.0416)           | (5.3340)                | (5.0231)                 | (4.5628)                |
| Tophold, |    | -0.1087            | -0.1138*                | -0.0636                  | -0.0659*                |
|       |    | (-1.3697)          | (-1.7597)               | (-1.4748)                | (-1.7703)               |
| Dual, |    | -0.0016            | 0.0030                  | -0.0021                  | 0.0019                 |
|       |    | (-0.1326)          | (0.3023)                | (-0.2972)                | (0.3150)                |
| Soe, |    | -0.0209            | 0.0093                  | -0.0075                  | 0.0017                 |
|       |    | (-0.6261)          | (0.3963)                | (-0.4137)                | (0.1334)                |
| HHI, |    | -0.1815            | 0.0515                  | -0.0627                  | 0.0298                 |
|       |    | (-1.5791)          | (0.5285)                | (-1.0207)                | (0.5666)                |
| C1, |    | -0.0213            | -0.0265**               | -0.0102                  | -0.0159**               |
|       |    | (-1.4173)          | (-2.0766)               | (-1.4632)                | (-1.9767)               |
| _cons |    | -1.1546***         | -0.8726***              | -1.6833***               | -1.4288***              |
|       |    | (-3.9588)          | (-3.9225)               | (-10.2465)               | (-11.3284)              |
| Firm FE |    | Yes                | Yes                     | Yes                      | Yes                     |
| Year FE |    | Yes                | Yes                     | Yes                      | Yes                     |
| Observations |    | 15534              | 17373                   | 15534                    | 17373                   |
| adj. R2 |    | 0.068              | 0.042                   | 0.065                    | 0.039                   |
| SUEST |    | chi2( 1) = 0.43    | chi2( 1) = 1.36         |                         |                         |
Table 14 Digitization on diversification in High research report Concern Group and Low Research Report Concern Group

| Model                  | High research report Concern Group | Low Research Report Concern Group | High research report Concern Group | Low Research Report Concern Group |
|------------------------|------------------------------------|----------------------------------|------------------------------------|-----------------------------------|
|                        | (1)                                | (2)                              | (3)                                | (4)                              |
|                        | Total entropy                      | Total entropy                    | Herfindahl index                   | Herfindahl index                   |
| Digitization$_{it}$   | 0.0167***                          | 0.0205***                        | 0.0077***                          | 0.0122***                         |
|                        | (3.0135)                           | (3.2754)                         | (2.6415)                           | (3.3861)                          |
| Growth$_{it}$          | 0.0000***                          | 0.0000***                        | 0.0000***                          | 0.0000***                         |
|                        | (2.5902)                           | (19.0926)                        | (3.3581)                           | (19.8156)                         |
| Roa$_{it}$             | -0.1263*                           | -0.0064                          | -0.0663*                           | -0.0054                           |
|                        | (-1.9247)                          | (-0.8197)                        | (-1.7919)                          | (-1.1508)                         |
| Lev$_{it}$             | 0.0853*                            | 0.0001                           | 0.0493*                            | -0.0000                           |
|                        | (1.8904)                           | (1.1322)                         | (1.9543)                           | (-0.3079)                         |
| Maghold$_{it}$         | -0.0119*                           | -0.0190                          | -0.0067                            | -0.0151                           |
|                        | (-1.7213)                          | (-0.5116)                        | (-1.5521)                          | (-0.6966)                         |
| FirmAge$_{it}$         | 0.1110**                           | 0.1567**                         | 0.0749**                           | 0.0984***                         |
|                        | (1.9990)                           | (2.5381)                         | (2.4402)                           | (2.8419)                          |
| Size$_{it}$            | 0.0598***                          | 0.0520***                        | 0.0332***                          | 0.0251***                         |
|                        | (4.6455)                           | (5.5540)                         | (4.5709)                           | (4.7480)                          |
| Tophold$_{it}$         | -0.0773                            | -0.1231*                         | -0.0487                            | -0.0698*                          |
|                        | (-0.9579)                          | (-1.9180)                        | (-1.1218)                          | (-1.8866)                         |
| Dual$_{it}$            | 0.0022                             | 0.0030                           | 0.0001                             | 0.0023                            |
|                        | (0.1811)                           | (0.2949)                         | (0.0208)                           | (0.3896)                          |
| Soe$_{it}$             | -0.0292                            | 0.0086                           | -0.0136                            | 0.0017                            |
|                        | (-0.8925)                          | (0.3695)                         | (-0.7639)                          | (0.1331)                          |
| HHI$_{it}$             | -0.1493                            | 0.0191                           | -0.0461                            | 0.0141                            |
|                        | (-1.2840)                          | (0.2053)                         | (-0.7421)                          | (0.2784)                          |
| CI$_{it}$              | -0.0212                            | -0.0283**                        | -0.0103                            | -0.0168**                         |
|                        | (-1.4362)                          | (-2.2426)                        | (-1.5048)                          | (-2.1404)                         |
| _cons                  | -1.1031***                         | -0.8925***                       | -1.6409***                         | -1.4394***                        |
|                        | (-3.6901)                          | (-3.9532)                        | (-9.7907)                          | (-11.2427)                        |
| Firm FE                | Yes                                | Yes                              | Yes                                | Yes                               |
| Year FE                | Yes                                | Yes                              | Yes                                | Yes                               |
| Observations           | 15657                              | 17250                            | 15657                              | 17250                             |
| adj. R2                | 0.063                              | 0.044                            | 0.060                              | 0.040                             |
| SUEST                  | chi2( 1) = 0.19                    | chi2( 1) = 0.82                  | chi2( 1) = 0.3665                  |
| test                   | Prob > chi2 = 0.6623               | Prob > chi2 = 0.3665              |

Prob > chi2 based on the robust standard error is in parentheses.***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.
t statistic based on the robust standard error is in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

**12| FIRM RISK CHANNEL**

We take every three years as an observation period to calculate the standard deviation \( (\text{risk}^{1}_{i,t}) \) and range \( (\text{risk}^{2}_{i,t}) \) of the industry adjusted ROA respectively. When the enterprise risk is higher than the median of the sample, the value of the dummy variable \( H - \text{risk} - l(2)_{i,t} \) is 1, otherwise it is 0. We include the \( H - \text{risk} - l(2)_{i,t} \) and the interaction terms of standardized digital transformation and standardized \( H - \text{risk} - l(2)_{i,t} \) proxies into the baseline regression model. According to the regression results in columns (1) - (2) of table 14, we find that the regression coefficient of the \( \text{Digitization}_{i,t} \times H - \text{risk} - l(2)_{i,t} \) is significantly positive, indicating that the digital transformation of enterprises in high-risk group can better promote the development of enterprise diversification. The regression results in table 15 are consistent with the benchmark regression, which further illustrates the robustness of the conclusion. In addition, we use enterprise risk as the outcome variable to analyze the relationship between enterprise digital transformation and enterprise risk. According to the regression results in columns (1) - (2) of table 16, we find that there is a significant positive correlation between enterprise digital transformation and enterprise risk. Based on the above analysis results, we believe that the digital transformation of enterprises is often accompanied by high firm risks. In order to reduce firm risks, firm will adopt diversified development strategy. This channel assumption is established.

| Table 14 Digitization on diversification considers the firm risk |
|---------------------------------------------------------------|
| \( risk^{1}_{i,t} \)       | \( risk^{2}_{i,t} \)       |
| (1) Total entropy          | Herfindahl index       |
| \( \text{Digitization}_{i,t} \) | 0.0168***         | 0.0092***         |
|                            | (3.4323)             | (3.3038)             |
| Variable                  | (1)            | (2)            |
|--------------------------|----------------|----------------|
| Digitization$_{i,t}$     | 0.0167***      | 0.0092***      |
| H - risk$_{i,t}$         | (3.4254)       | (3.2974)       |
| Growth$_{i,t}$           | 0.0000***      | 0.0000***      |
| (17.0733)                | (19.2448)      |
| Roa$_{i,t}$              | -0.0117        | -0.0077        |
| (-1.1591)                | (-1.2985)      |
| Lev$_{i,t}$              | 0.0001         | -0.0000        |
| (0.9125)                 | (-0.4626)      |
| Maghold$_{i,t}$          | -0.0177        | -0.0098        |
| (-1.5848)                | (-1.4631)      |
| FirmAge$_{i,t}$          | 0.1703***      | 0.1064***      |
| (3.3343)                 | (3.6947)       |
| Size$_{i,t}$             | 0.0434***      | 0.0211***      |
| (5.5969)                 | (4.7957)       |
| Tophold$_{i,t}$          | -0.1013*       | -0.0597***     |
| (-1.8873)                | (-1.9672)      |
| Dual$_{i,t}$             | -0.0027        | -0.0026        |
| (-0.3069)                | (-0.5034)      |
| Soe$_{i,t}$              | 0.0370*        | 0.0163         |
| (1.7414)                 | (1.4105)       |
| HHI$_{i,t}$              | 0.0231         | 0.0033         |
| (0.2660)                 | (0.0694)       |
| CI$_{i,t}$               | -0.0219**      | -0.0123**      |
| (-2.1477)                | (-2.3912)      |
| _cons                    | -0.7993***     | -1.3982***     |
| (-4.2405)                | (-13.2066)     |

Firm FE: Yes
Year FE: Yes
Observations: 29269
adj. R$^2$: 0.041

Table 15 Digitization on diversification considers the firm risk

$t$ statistic based on the robust standard error is in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.
| Variable          | (1)            | (2)            |
|-------------------|----------------|----------------|
| Digitization_{it} | 0.0023***      | 0.0042***      |
| Growth_{it}       | 0.0000***      | 0.0000***      |
| Roa_{it}          | -0.0164**      | -0.0298**      |
| Lev_{it}          | 0.0001         | 0.0001         |

Table 16 Digitization on diversification considers the firm risk.
|                | (0.5171) | (0.5333) |
|----------------|----------|----------|
| Maghold<sub>i</sub> | -0.0036  | -0.0065  |
|                | (-0.7318) | (-0.6967) |
| FirmAge<sub>i</sub>  | 0.0397*** | 0.0750*** |
|                | (5.6464) | (5.6588) |
| Size<sub>i</sub>    | -0.0187*** | -0.0355*** |
|                | (-14.8347) | (-14.7968) |
| Tophold<sub>i</sub> | -0.0255*** | -0.0471*** |
|                | (-3.6589) | (-3.5598) |
| Dual<sub>i</sub>    | 0.0015   | 0.0027   |
|                | (0.9374) | (0.9086) |
| Soe<sub>i</sub>     | -0.0026  | -0.0050  |
|                | (-0.9719) | (-1.0022) |
| HHI<sub>jj</sub>    | 0.0383*** | 0.0751*** |
|                | (3.2656) | (3.3616) |
| CI<sub>jj</sub>     | -0.0051** | -0.0097** |
|                | (-2.0352) | (-2.0378) |
| _cons           | 0.3477*** | 0.6602*** |
|                | (12.8793) | (12.8950) |

**Firm FE** | Yes | Yes |
**Year FE**  | Yes | Yes |
**Observations** | 30891 | 30891 |
**adj. R²**   | 0.139 | 0.140 |

* t statistic based on the robust standard error is in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

### 13] CONCLUSIONS AND DISCUSSIONS

Based on the micro enterprise perspective, this paper discusses the impact of digital transformation on enterprise diversification from both theoretical and empirical aspects for the first time. It is an important research paper in the field of digital research and enterprise diversification. The study found that digital transformation can significantly promote the level of enterprise diversification, and the main conclusions of the study passed the robustness test and endogenous test. Through mechanism analysis, we find that the promotion of enterprise digital transformation on enterprise diversification is mainly realized through market power channel and firm risk channel. That is, the pursuit of establishing market power and monopoly
profits based on digital transformation and the decentralization strategy to deal with the risks 
associated with digital transformation are important reasons for enterprises to adopt 
diversification strategy under the background of digital transformation. Although the 
orGANization costs channel, transaction cost channel, blockholder control channel, industry type 
and information asymmetry channel have some influence on the main effect of this paper, they 
are not the main channel because they have not passed the inter group regression coefficient 
difference test statistically.

APPENDIX A. VARIABLE DEFINITIONS

This table contains the definitions of variables used in our analysis.

| Variable           | Definition                                                                 |
|--------------------|-----------------------------------------------------------------------------|
| Total entropy      | \( Total \ entropy = \sum_{i=1}^{N} S_i \ln(1/S_i) \)                        |
|                    | where \( S_i \) is the share of a firm’s total sales in industry \( i \) and \( N \) is the number of industries in which the firm operates. |
| Herfindahl index   | \( \text{Herfindahl index} = \sum_{i=1}^{N} (S_i)^2 \)                     |
|                    | where \( S_i \) is the share of a firm’s total sales in industry \( i \) and \( N \) is the number of industries in which the firm operates. We take a negative number for this value for comparative analysis. |
| \( DTA_{it} \)     | The Natural logarithm of 1 plus the total word frequency of digital keywords of company \( i \) in year \( t \) |
| \( AI_{it} \)      | The Natural logarithm of 1 plus Artificial intelligence technology keyword word frequency of company \( i \) in year \( t \) |
| \( BT_{it} \)      | The Natural logarithm of 1 plus Blockchain technology keyword word frequency of company \( i \) in year \( t \) |
| \( CC_{it} \)      | The Natural logarithm of 1 plus Cloud computing technology keyword word frequency of company \( i \) in year \( t \) |
| \( DT_{it} \)      | The Natural logarithm of 1 plus Big data technology keyword word frequency of company \( i \) in year \( t \) |
| \( Growth_{it} \)  | current year's operating revenue / previous year's operating revenue       |
| **Variable** | **Description** |
|--------------|----------------|
| $Mshare_{it}$ | Total shares held by the management divided by the outstanding share capital of company $i$ in year $t$. |
| $CI_{jt}$ | This variable is measured by the ratio of industry $j$ net fixed assets to industry $j$ employees in year $t$. |
| $HHI_{jt}$ | The square sum of the company $i$'s operating income in the proportion of all companies in the industry in year $t$. |
| $Soe_{it}$ | The value of state-owned holding enterprise is 1, and that of other enterprises is 0. |
| $Size_{it}$ | Natural logarithm of total assets of company $i$ in year $t$. |
| $Lev_{it}$ | Asset liability ratio = Total liabilities/total assets of company $i$ in year $t$. |
| $Roa_{it}$ | Return on total assets = Net profit/total assets of company $i$ in year $t$. |
| $Tophold_{it}$ | Shareholding ratio of the largest shareholder of company $i$ in year $t$. |
| $Dual_{it}$ | The dummy variable of management power of $i$ company in year $t$, equal to 1 when the chairman and CEO are concurrently serving, otherwise it is 0. |
| $Maghold_{it}$ | The dummy variable of the management shareholding ratio of $i$ company in year $t$; when the management shareholding ratio is greater than the annual industry median, it is 1, otherwise it is 0. |
| $FirmAge_{it}$ | Natural logarithm (current year - year of establishment + 1) of the company $i$ in year $t$. |
| $HHI2_{it}$ | The square sum of the company $i$'s Total asset in the proportion of all companies in the industry in year $t$. |
| $BlockHolding_{it}$ | The total holding of block holders. |
| $Analyst_{it}$ | Number of analysts following the firm. It is calculated by taking the natural logarithm of 1 plus the number of analysts following the firm at the end of a fiscal year. |
| $Report_{it}$ | Number of research reports covering the firm. It is calculated by taking the natural logarithm of 1 plus the number of research reports issued by securities companies covering the firm in one fiscal year. |

### APPENDIX B. DIGITIZATION DEFINITIONS

**Digitization bag of words**

**Panel A. Bag of words (English Version)**

| **type**       | **Bag of words**                                                                 |
|----------------|---------------------------------------------------------------------------------|
| Bottom technology intelligence | Artificial intelligence, business intelligence, image understanding, investment decision support systems, intelligent data analysis, intelligent robots, machine learning, deep learning, semantic search, biometric technology, face |
| Type                          | Bag of words                                                                 |
|-------------------------------|-----------------------------------------------------------------------------|
| Big data technology           | Big data, data mining, text mining, data visualization, heterogeneous data, credit investigation, augmented reality, mixed reality, virtual reality |
| Cloud computing technology    | Cloud computing, stream computing, graph computing, memory computing, multi-party secure computing, brain-inspired computing, green computing, cognitive computing, fusion architecture, billion-level concurrency, EB-level storage, Internet of Things, cyber-physical systems |
| Blockchain technology        | Blockchain, digital currency, distributed computing, differential privacy technology, smart financial contract |
| Digital technology application | Mobile Internetwork, Industrial Internet, Mobile Internet, Internet Medical, E-commerce, Mobile Payment, Third Party Payment, NFC Payment, Smart Energy, B2B, B2C, C2B, C2C, O2O, Network Connection, Smart Wear, Smart Agriculture, Smart Transportation, Smart healthcare, smart customer service, smart home, smart investment advisory, smart cultural tourism, smart environmental protection, smart grid, smart marketing, digital marketing, unmanned retail, Internet finance, digital finance, Fintech, financial technology, quantitative finance, open banking |

**Panel B. Bag of words (Chinese Version)**

| Type                          | Bag of words                                                                 |
|-------------------------------|-----------------------------------------------------------------------------|
| 底层技术运用                  | 人工智能、商业智能、图像理解、投资决策辅助系统、智能数据分析、智能机器人、机器学习、深度学习、语义搜索、生物识别技术、人脸识别、语音识别、身份验证、自动驾驶、自然语言处理 |
| 大数据技术                  | 大数据、数据挖掘、文本挖掘、数据可视化、异构数据、征信、增强现实、混合现实、虚拟现实 |
| 云计算技术                  | 云计算、流计算、图计算、内存计算、多方安全计算、类脑计算、绿色计算、认知计算、融合架构、亿级并发、EB级存储、物联网、信息物理系统 |
| 区块链技术                  | 区块链、数字货币、分布式计算、差分隐私技术、智能金融合约 |
| 技术实践应用                | 移动互联网、工业互联网、移动互联、互联网医疗、电子商务、移动支付、第三方支付、NFC支付、智能能源、B2B、B2C、C2B、C2C、O2O、网联、智能穿戴、智慧农业、智能交通、智能医疗、智能客服、智能家居、智能投顾、智能文旅、智能环保、智能电网、智能营销、数字营销、无人零售、互联网金融、数字金融、Fintech、金融科技、量化金融、开放银行 |

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