Application of Digital Technology in Disruptive Innovation

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Abstract: This paper selects 74 Chinese automobile manufacturing enterprises as the sample data, and analyzes the relationship between digital technology and innovation capability from the perspective of the heterogeneous role of enterprise size. The research conclusion shows that digital technology can significantly improve the innovation capability, and the size of enterprises is significantly positively correlated with the innovation capability. Enterprise size has a moderating effect in the process of promoting the innovation capability of digital technology. When the enterprise size is larger, the digital technology has a stronger impact on innovation capability.

Keywords: digital technology, innovation capability, enterprise size

1. Introduction

In recent years, China's digital economy has made new breakthroughs. Driven by the country's great attention to the development of the digital economy and market demand, China's digital economy will continue to flourish; The China Business Industry Research Institute predicts that the scale of China's digital economy will increase to 51.7 trillion yuan in 2022. In recent years, digital technology has involved all walks of life in the country, and the digital economy has become a driving force for global economic growth.

Since entering the 21st century, China's automobile industry has developed rapidly, the concentration of the shape industry has been continuously improved, and the product technology level has been significantly improved. From the perspective of the automotive industry, which regards the automotive industry as the demand side of digital technology, digital technology runs through all aspects of manufacturing, production, marketing, management, operation and maintenance, and post-service in the automotive industry.

In recent years, scholars have made many researches on the relationship between "digital technology and enterprise innovation capability". On the one hand, enterprises can use the data integration and analysis advantages of digital technology [1] (Shi Bingzhan, Li Jiantong, 2020) to change the way of enterprise value creation and acquisition [2] (Nambisan S et al., 2019), achieve factor empowerment [3] (Qilei Liu et al., 2021), and thus enable production innovation[4](Abrel T et al., 2016). On the other hand, digital technology can improve the accuracy of information searching and analyzing[5](Zhu Qin, 2019), and eliminate the structural barriers of enterprise employees in obtaining information, opportunities and resources[6](Maomao Chi, 2020), so as to improve the accurate analysis of market demand (Qin Zhu, 2019).

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According to the resource-based view, enterprise innovation needs to rely on non-replicable and unique resources [7] (GRANT R M, 1996). The application of digital technology can help enterprises identify valuable information resources (Li Cai et al., 2019), integrate enterprise information and resources, reduce innovation risks, improve resource allocation efficiency, and enhance innovation performance. Therefore, it is of great significance to explore the relationship between digital technology and enterprise innovation capability.

2. Research hypotheses

2.1 Digital technology and enterprise innovation capabilities

How to use digital technology to obtain sustainable competitive advantage has become an important issue for high-quality development of enterprises in the digital economy era. Research has shown that the deep application of digital technology can drive enterprise innovation and improve market competitiveness. Therefore, enterprises can improve their performance [10] (MART Í NEZ-CARO E et al., 2020) and competitive advantage (AUTIO E, 2017) by using digital technology.

H1: Digital technology has a significant positive impact on the innovation capability of manufacturing enterprises.

2.2 Enterprise size and innovation capabilities

Xue Fengping [11] (2005) takes 114 large and medium-sized enterprises in Qingdao as an example to analyze the relationship between enterprise scale and technological innovation capability, and found that the larger the enterprise scale, the stronger the enterprise innovation capability. Hu Yidong [11] and Zhong Weijun (2011) found that the size of enterprises was positively correlated with innovation capabilities by using panel data of high-tech enterprises for three consecutive years.

H2: Enterprise size has a significant positive impact on the innovation capability of manufacturing enterprises.

2.3 The moderating effect of enterprise size between digital technology and enterprise innovation capacities

According to the resource-based theory, enterprise innovation requires a lot of resources, which are valuable, unique, and non replicable [7] (GRANT R M, 1996). These innovative resources need to be searched and obtained globally with the help of digital technology. However, the application of digital technology needs the support of large amounts of funds from enterprises. Generally, large enterprises have more sufficient funds, talents and other resources for R&D investment and the use of digital technology, and pay more attention to basic research in R&D. Therefore, the larger the enterprise, the stronger its capability to use digital technology, and the stronger its innovation capability.

According to the resource-base view, enterprise innovation requires a large number of resources, which are valuable, unique, and unreplicable [7] (GRANT R M, 1996), difficult to imitate and scarce innovation resources need to be searched and obtained globally with the help of the relevance and editable capability of digital technology, and the effective use of digital technology

requires a large amount of financial support from enterprises. Generally, large-size enterprises have sufficient funds, talent and other resources for R&D investment and the application of digital technology, and also pay more attention to basic research in research and development.

H3: Enterprise size has a moderating effect between digital technology and enterprise innovation capability.

3. Empirical analysis

3.1 Sample selection and data source

Based on the important position of the automobile manufacturing industry in the national economy, this paper mainly takes automobile manufacturing enterprises as the research sample, and the specific sample selection, screening and data collection process is as follows: (1) select Chinese A-share automobile manufacturing enterprises that have been listed before 2021 from CNKI patent database and CSMAR database; (2) exclude the enterprises whose listing was interrupted, suspended and had ST from 2011 to 2021; (3) exclude enterprises with missing key variables such as innovation performance, digital technology and enterprise scale. After the above processing of the sample, this paper finally gets the observation value of 72 enterprises.

3.2 Research and design

3.2.1 Dependent variable: Enterprise innovation capability (IC)

Referring to the research of FANG [14] (2014), the innovation capability is expressed by the logarithm of the number of invention patents authorized in t+1 year. It represents the transformation capability of the enterprise's innovation achievements. The more patents, the higher the enterprise's innovation output.

3.2.2 Independent variable: Digital technology (DT)

Drawing on the research of NAMBISAN [15] (2017) and Wang Haihua[8](2021), this paper measures digital technology through digital operations, digital products and digital platforms. If a business uses one of the digital operations, digital products or digital platforms, it is 1, if it uses two items, it is recorded as 2, if it uses three items, it is recorded as 3, otherwise it is 0. The data comes from the annual report disclosed by the enterprise, and the number of occurrences of digital technology-related expressions such as digital operations, digital products, and digital platforms in the company's annual report is manually reviewed, and if the number of occurrences is 1, the digital technology is assigned to 1; If the number of occurrences is 2, the numerical technique is assigned to 2; If the number of occurrences is 3, the numerical technique is assigned 3; If the number of occurrences is 0, the numeric technique is assigned to 0.

3.2.3 Moderating variable: Enterprise size (Size)

Use enterprise assets to measure enterprise size. This is because the more the total assets of an enterprise are, the larger the enterprise is, and the less the total assets are, which means the smaller the enterprise is. Specifically, this paper uses the logarithm of the total enterprise assets to measure enterprise size.

3.2.4 Control variable (Con)

Referring to the relevant studies, the controlling variables include: (1) the shareholding structure (OS): the proportion of the shares of the members of the board of directors to the total shares; (2) the asset-liability ratio (AIR): the proportion between the total liabilities and the total assets; (3) the year of establishment (AGE): the length of the period from the establishment time to the current year.

3.3 Model setting

This paper establishes a multiple regression model to test the relationship between digital technology, enterprise size and enterprise innovation capability. Model (1) reflects the relationship between digital technology and enterprise innovation capability, and model (2) reflects the relationship between enterprise scale and enterprise innovation capability.

$$IC = \beta_0 + \beta_1 DT + \beta_2 \sum Con_{i,t} + \varepsilon \quad (1)$$

$$IC = \beta_0 + \beta_1 Size + \beta_2 \sum Con_{i,t} + \varepsilon \quad (2)$$

Among them: IC is the enterprise innovation capability; DT is digital technology; Size is the enterprise size; Con is the control variable, including equity structure, asset liability ratio and establishment period; ε is the error term, β is a constant term, i represents an individual enterprise, and t represents a year.

3.4 Data analysis

3.4.1 Descriptive statistics and correlation analysis

The descriptive statistics and correlation analysis results of variables in this paper are shown in Table 1. There is a significant positive correlation between enterprise innovation capability and digital technology at the level of 1%, with a correlation coefficient of 0.390. Digital technology and enterprise scale are significantly positively correlated at the level of 1%, with a correlation coefficient of 0.0517.

Table 1 Descriptive statistics and correlation analysis

Variable	mean	Standarderror	crest value	least value	1	2	3	4	5	6
1.IC	4.581	1.537	8.310	1.390	1					
2. DT	0.972	0.934	3.000	0.000	0.390***	1				
3.Size	22.899	1.426	26.350	19.760	0.120	0.0517***	1			
4. ES	0.099	0.132	0.526	0.000	-0.004	0.082	0.359***	1		
5.AR	0.466	0.193	0.901	0.045	-0.009	0.211*	0.448***	0.150	1	
6. Years	21.610	7.613	37.000	6.000	-0.039	-0.100	-0.351***	-0.302**	-0.447***	1

N=72, *, * *, * * * indicates being significant at the 10%, 5%, and 1% levels, respectively

3.4.2 Regression analysis

The results of the regression analysis of the variables presented in this paper are shown in Table 2. The regression coefficient of the relationship between digital technology and enterprise

innovation capability is significantly positive (β =0.393, p <0.01), indicating a significant positive correlation between digital technology and manufacturing enterprise innovation capability; the relationship between enterprise size and enterprise innovation capability is significantly positive (β =0.580, p <0.01), indicating a significant positive correlation between enterprise size and innovation capability.

Table 2 Regression test of digital technology, enterprise size and innovation capability

variable	IC	IC
	model (1)	model (2)
constant term	2.842	-9.365
digital technique	0.393***	
	(3.593)	
size		0.580***
		(4.709)
ownership structure	0.031	0.072
	(0.247)	(0.595)
asset-liability ratio	0.220*	-0.001
	(1.799)	(-0.012)
Established years	0.060	-0.104
	(0.523)	(-0.919)
R^2	0.201	0.284
After the adjustment of R^2	0.153	0.241
F	4.219***	6.650***

N=72, *, * *, * * * indicates being significant at the 10%, 5%, and 1% levels, respectively

3.5 E. Heterogeneity analysis

3.5.1 Data processing

The average of the enterprise size of 72 sample data is 22.899. The enterprises with a scale of more than 22.899 are classified as sample 1; The enterprises with a scale of 22.899 or less are classified as sample 2. Then, correlation analysis and regression test were conducted for the two samples.

3.5.2 Sample test

The descriptive statistics and correlation analysis results of the two samples are shown in Table 3. In sample 1, there is a significant positive correlation between enterprise innovation capability and digital technology at the level of 5%, with a correlation coefficient of 0.410. In sample 2, digital technology and innovation capability are significantly positively correlated at the level of%, with a correlation coefficient of 0.356. The correlation coefficient in sample 1 is greater than that in sample 2. This shows that the larger the enterprise scale, the more significant the role of digital technology in promoting innovation capability.

Table 3 Regression test of digital technology, enterprise size and innovation capability

variable	IC	IC
	Sample 1 (large-size)	Sample 2 (large-size)
constant term	2.436	3.967
digital technique	0.410**	0.356**
	(2.352)	(2.209)
ownership structure	0.152	-0.001
	(0.835)	(-0.006)
asset-liability ratio	0.211	0.097
	(1.268)	(0.517)
Established years	0.93	-0.198
	(0.534)	(-1.228)
R^2	0.206	0.174
After the adjustment of R^2	0.097	0.073
F	1.885	1.732
variable	IC	IC
	Sample 1 (large-size)	Sample 2 (large-size)

N=72, *, * *, * * * indicates being significant at the 10%, 5%, and 1% levels, respectively

4. Conclusion

First, digital technology can significantly improve the innovation capability of enterprises. Confirmation the view of MARTINEZ-CARO E et al. The same is true for Chinese automobile manufacturers, which shows that the digital paths such as digital infrastructure, digital operation and digital products can promote the innovation capacity of Chinese automobile manufacturers.

Second, there is a significant positive correlation between enterprise size and enterprise innovation capability.

Third, enterprise scale has a moderating effect in the process of digital technology promoting enterprise innovation capability. In the context of large-scale enterprises, the effect of digital technology to promote innovation capability is more obvious. This shows that the larger the enterprise is, the wider and richer the digital application scenarios and scope will be, and enterprises will have more choices and opportunities to improve their innovation capabilities.

5. Limitations and Future Study Directions

From the perspective of heterogeneity of enterprise scale, this paper studies the impact of digital technology on the innovation ability of enterprises, which provides a basis for existing theoretical research, but there are still some research limitations and shortcomings:

A. In this paper, 100 listed companies in the automobile manufacturing industry were selected

as the research sample, and the sample size was relatively small. Applicability to other industries has yet to be tested. Future research will not be limited to this field, but the role of firm size heterogeneity in each field will be further explored to enhance the generalization of research conclusions.

B. This paper selects the number of patents obtained as the standard for measuring the innovation ability of enterprises, and does not distinguish between the number of authorized patents and the number of patents. In terms of enterprise scale, there is a singleness in using only the total assets of the enterprise as an indicator to measure the scale of the enterprise.

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