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Digital Transformation and Corporate Innovation Efficiency

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Abstract

Digital transformation is an important part of the development of China's digital economy. Based on the data of A-share listed manufacturing companies in Shanghai and Shenzhen Stock exchanges from 2010 to 2021, this paper studies the impact of digital transformation on enterprise innovation efficiency. The robustness test results show that digital transformation significantly improves the innovation efficiency of enterprises. Further research finds that digital transformation can improve the innovation efficiency of enterprises by increasing analyst attention, and this improvement effect mainly exists in enterprises with fierce industry competition, state-owned enterprises and enterprises with more government subsidies. This paper can increase the research results on the relationship between digital transformation and enterprise innovation efficiency, and enrich the relevant research.

Keywords

Digital Transformation; Innovation Efficiency; Analyst Attention.

1. Introduction

On May 25, 2022, the China Academy of Information and Communications Technology (CAICT) released the Research Report on the Policies of Major Countries and Regions to promote the Digital transformation of the manufacturing Industry, pointing out that the digital transformation of the manufacturing industry has become an important starting point for countries to enhance their competitiveness and foster new drivers of growth. China's manufacturing sector, with its huge scale, is the lifeblood and pillar of the national economy. On the one hand, the digital transformation of manufacturing industry can help enterprises get through business processes, break down departmental barriers, realize cross-department data interconnection, business communication, decentralization, give full play to the value of data, and truly enter the industry 3.0 stage; At the same time, it can further touch the core business of enterprises to achieve Industry 4.0 as the goal[1].

The sustainable development of enterprises cannot be separated from innovation, which is the core element for enterprises to maintain their competitiveness. Only through continuous innovation can enterprises cope with the rapidly changing market environment and adapt to the new era. The innovation level of domestic enterprises has been growing rapidly, but innovation efficiency has always been a difficult problem for enterprises, and the research on innovation efficiency in domestic academia is relatively few. In addition, understanding digital transformation from the internal perspective of enterprises is the integration of digitalization and enterprise business. Therefore, exploring the impact of digital transformation on enterprise innovation efficiency is not only to promote the R&D innovation of enterprises, but also to enhance the overall comprehensive operation ability of enterprises and increase enterprise value.

The possible marginal contribution of this paper is to empirically analyze how digital transformation affects the innovation efficiency of manufacturing enterprises and its internal mechanism, and to study the moderating effect of industry competition, enterprise nature and

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government subsidy on the impact of digital transformation on enterprise innovation efficiency from the perspective of internal and external environment of manufacturing enterprises.

This paper enriches the existing research on the internal mechanism and influencing factors of digital transformation and enterprise innovation efficiency, and provides a reference for the manufacturing industry to carry out digital transformation to promote high-quality development.

2. Literature Review and Theoretical Hypotheses

As early as 2000, Tapscott et al. published the book Digital Capital -- Harnessing the Power of Business Websites, which started the research on digital capital[2]. In today's digital age, data has become an emerging factor of production and has penetrated into all walks of life, supporting the existence of digital capital from the perspective of natural attributes. Based on this, data is both a resource and a capital, which can be used to produce goods or services, improve the economic benefits of enterprises, and create or enhance value for enterprises. Digital transformation is actually a process of integrating various elements of an enterprise with digital technology. The wide use of big data, Internet and other digital technologies promotes the deep integration of organization, production and management, endow enterprises with new vitality, and make enterprises recombine elements in productivity, production mode, management, market, customers and other aspects, thus promoting enterprises to increase economic benefits and improve the efficiency[3]. Combined with the national strategy of digital economy, this transformation should theoretically be able to improve the innovation efficiency of enterprises with the strategic orientation of "national policy + digital technology".

Digital transformation is a constantly developing concept. Today's digital transformation is not simply the traditional technology enhanced and supported by digitalization, but refers to the digital technology that can be used to achieve new innovation and creation in a certain field[4]. By combining digital technology with all aspects of production and operation, enterprises can effectively reduce costs, alleviate information asymmetry, and improve the efficiency of technological innovation, so as to promote the value creation of enterprises at a higher level[5]. Digital transformation has attracted more and more attention in existing research. Some scholars have studied the research situation of digital transformation in domestic academic circles through Cites pace visualization tool[6]. Guosheng Zhang et al. used the World Bank's survey data on Chinese enterprises to verify that digital empowerment can promote the technological innovation of enterprises by optimizing resources, reducing innovation costs and improving the level of labor force[7]. From the perspective of innovation value chain, Huiming Zhu et al. used two-stage DEA model to measure the technological innovation efficiency of manufacturing enterprises, and concluded that the overall technological innovation efficiency of manufacturing enterprises is low, but it is generally increasing year by year[8]. Fan He and Hongxia Liu found that digital transformation can promote the economic benefits of real enterprises' digital transformation by reducing costs, improving the efficiency of asset utilization and enhancing innovation ability[9]. Fei Wu et al. found that digital transformation can improve the stock liquidity level, thus further improving the performance of enterprises in the capital market[5]. Qun Yin and Yuxiu Tian used principal component analysis to construct an index system to reflect the degree of digital transformation, and then confirmed that digital transformation has a significant role in promoting the innovation and development efficiency of high-tech industries in the region by using DEA-BBC-Tobit series models[10]. Guangwen Hou and Chenxi Gao used questionnaire survey and empirical test method to verify that the information integration ability of digital transformation has a significant mediating effect on

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the impact of structural holes and network centrality on enterprise innovation performance[11].

To sum up, the existing literature on the relationship between digital technology and enterprise innovation mainly focuses on high-tech enterprises, and the main research direction is the impact of digital transformation on the level of technological innovation of enterprises, or the impact of digital capability on the innovation performance of enterprises with manufacturing industry as the main body. However, in terms of the actual national conditions, China's manufacturing industry has made great progress in innovation, but the innovation input and output efficiency of enterprises are still not improved. The overall digital transformation is in its infancy, and more than half of the manufacturing enterprises have not carried out digital transformation[12]. More than half of the manufacturing enterprises have not carried out digital transformation, which will improve data liquidity and transparency, realize data sharing between different departments, organizations and stakeholders, effectively reduce the degree of information asymmetry, and be more in line with market expectations[13]. A large amount of original data will be generated in the whole process of daily production and operation in enterprises. Before digital transformation, the effectiveness of information cannot be fully stimulated, and even the original data cannot be integrated into effective information, and enterprises cannot fully tap the potential value hidden in the information. Through digital technology, digital transformation can be summarized and integrated to form effective information, improve the efficiency of enterprise innovation, provide reliable and useful information for decision makers to make decisions, and enhance the long-term value of enterprises.

The innovation process is characterized by uncertainty, high risk and long time, which will increase the innovation cost of enterprises. Through digital transformation, enterprises can fully mine, collect and integrate data information resources, so that effective information is easier to obtain, the process of information circulation conversion is reduced, the accuracy of information is improved, the search cost of information is reduced, and the flow of resource elements is accelerated, so that enterprises can conduct trial-and-error innovation at a lower cost. At the same time, digital transformation can also discover the dynamic changes of the market, timely and accurately understand the market demand, reduce the cost of enterprise trial and error innovation, clarify the direction of innovation, improve the efficiency of capital allocation, so as to enhance the enthusiasm of enterprise research and development innovation[14]. Based on the above analysis, this paper puts forward the following core hypotheses:

Hypothesis 1: With other conditions unchanged, digital transformation can significantly improve the innovation efficiency of enterprises.

3. Research Design

3.1. Data Source

China started to implement the national informatization development strategy and the 11th five-Year Informatization Plan in 2006, which is the starting point for the country to carry out digital construction. Therefore, this paper selects the data of Shanghai and Shenzhen A-share manufacturing listed companies from 2010 to 2021 as the initial research sample, and does some preliminary processing on the data: Firstly, eliminate the samples of ST and delisting during the period; Secondly, excluding financial and insurance listed companies; Thirdly, in order to ensure the consistency of enterprise innovation efficiency evaluation, the sample companies with missing data of main variables are deleted; Fourthly, all continuous variables at the micro level are winsorized by 1% on both sides to reduce the influence of outliers. Finally, 21388 observations are obtained. The original data are from the CSMAR database, and the

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annual report data of relevant enterprises are from the official websites of major stock exchanges.

3.2. Variable Selection and Model Setting

3.2.1. Explained Variable

Enterprise innovation efficiency (Ie). The innovation behavior of enterprises is the whole process interspersed in the daily production and operation of enterprises, and its efficiency measurement should consider both innovation input and innovation output. The former can be measured by R&D input and the number of R&D employees, while the latter is mainly measured by the number of patent applications. Compared with the number of patents granted, the number of invention patents in patents can more clearly reflect the utilization efficiency of resources invested by enterprises for innovation from the perspective of enterprise initiative. Therefore, the innovation efficiency is measured by dividing the number of invention patent applications by R&D investment[15,16]. Considering that the number of invention patent applications or R&D investment of some sample companies is 0, the natural logarithm is taken after adding 1 to both of them, and the formula is as follows:

$$\text{Ie} = \frac{\ln(1+\text{number of invention patent applications})}{\ln(1+\text{research input})} \quad (1)$$

3.2.2. Explanatory Variable

Digital transformation (Dt). This paper refers to the feature lexicon of digital transformation proposed by Fei Wu and other scholars to build an index system of digital level[5]. The statistical digital transformation index data is right-biased, so it is log-processed to form the final digital transformation index.

3.2.3. Control Variables

Referring to the existing research on digital transformation and enterprise innovation efficiency, in order to improve the accuracy of the research, this paper adds other control variables that will affect enterprise innovation efficiency to control their influence. Including enterprise Size (Size), enterprise Age (Age), Growth ability (Growth), independence (Indep), liquidity (Liquid), Dual, ownership concentration (Share) and dummy variables of year and industry. See Table 1 for specific indicators.

Table 1. Variable definition table

Variable categories	Variable name	Symbols	Indicators
Explained variable	Innovation efficiency	Ie	(1)
Explanatory variables	Digital transformation	Dt	Ln(total word frequency +1)
Control variables	Enterprise size	Size	Ln(total assets)
	Age of business	Age	Age of the business
	Ability to grow	Growth	Growth rate of fixed assets
	Independence	Indep	Number of independent directors/total number of board members
	Liquidity	Liquid	Net cash flow from operating activities/total assets at year-end
	Combination of two roles	Dual	The combination of chairman and general manager is 1, and 0 otherwise
	Ownership concentration	Share	Percentage of shareholding of the largest shareholder
	Year	Year	Dummy variable
	Industry	Ind	Dummy variable

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3.2.4. Model Setting

In order to study the impact of digital transformation on enterprise innovation efficiency, this paper constructs the following regression model:

$$Iei,t = \alpha 0 + \alpha 1 Dti,t + \sum \alpha 2 Controls\text{i,t} + \varepsilon i \quad (2)$$

Where the explained variable Iei,t refers to the innovation efficiency of company i in year t, as shown in formula (1); The core explanatory variable Dti,t refers to the degree of digital transformation of company i in year t; Controls is the control variable representing the individual characteristics of the enterprise, as shown in Table 1 variable definition table; Is the random error term of the model. The coefficient of core explanatory variable Dti,t represents the impact of digital transformation on enterprise innovation efficiency.

4. Empirical Results and Analysis

4.1. Descriptive Statistics

Table 2. Descriptive statistics of main variables

Variables	variable	N	sd	mean	min	max
Innovation efficiency	Ie	20569	0.0460	0.0100	0	0.418
Digital Transformation	Dt	20569	1.243	1.138	0	6.140
Enterprise size	Size	20549	1.184	21.99	18.16	27.55
Age of business	Age	20303	0.374	2.816	0.280	4.160
Ability to grow	Growth	20567	450.2	3.442	- 1	64559
Independence	Indep	20569	0.0740	0.384	0.167	0.800
Liquidity	Liquid	20547	0.0730	0.0500	1.080	2.222
Two in one	Dual	20366	0.467	0.679	0	1
Ownership concentration	Share	19910	14.32	34.09	2.430	89.99

It can be seen from Table 2 that the average value of innovation efficiency of the explained variable is 0.01, the standard deviation is 0.0460, the minimum value is 0, and the maximum value is 0.418, indicating that the innovation efficiency of the sample listed companies is low, and there are large differences among companies, and the gap of innovation efficiency is large; The mean value of the explanatory variable digital transformation is 1.138, the standard deviation is 1.243, the minimum value is 0, and the maximum value is 6.140, indicating that the digital transformation degree of the overall manufacturing industry is not high, and there are large differences in the degree of digital transformation among different sample enterprises.

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4.2. Benchmark Regression

Table 3. Digital transformation and enterprise innovation efficiency

	(1)	(2)	(3)
	Ie	Ie	Ie
Dt	0.007 * * *	0.007 * * *	0.002 * * *
	(26.35)	(25.52)	(5.19)
size		0.000	0.001 * * *
		(0.82)	(5.14)
Age		0.009 * * *	0.002 * *
		(10.05)	(2.20)
Growth		0.000	0.000
		(1.61)	(0.79)
Indep		0.004	0.001
		(0.87)	(0.27)
Liquid		0.000	0.009 * *
		(0.10)	(2.11)
Dual		0.000	0.001
		(0.36)	(1.05)
Share		0.000 * * *	0.000
		(3.93)	(1.01)
_cons	0.002 * * *	0.024 * * *	0.029
	(4.40)	(3.60)	(1.30)
N	20569	19440	19440
Year	No	No	Yes
Ind	No	No	Yes
r	694.491	95.093	62.045
R^2	0.033	0.038	0.198

Note: (1) ***p<0.01, **p<0.05, *p<0.1; (2) t values are in parentheses; The following table is the same.

Table 3 reports the test results of the relationship between enterprise digital transformation and innovation efficiency. In the benchmark regression, Model (1) only uses ordinary least squares (OLS) to regression the explanatory variable of digital transformation (Dt). The data in the table show that the regression coefficient of digital transformation is 0.007, and it passes the significance test of 1%. Model (2) adds control variables on the basis of the existing conditions of M (1) model, and the relevant regression coefficient is 0.007, which passes the statistical significance test of 1%. Model.

(3) adds year and industry dummy variables on the basis of Model (2), and the results show that the regression coefficient of digital transformation is 0.002, which also passes the statistical significance test of 1%. Compared with the previous two models, the value of R2 has a significant increase. All these indicate that as the degree of digital transformation increases, the innovation efficiency of enterprises will increase accordingly, and there is a significant positive correlation between the two. Therefore, Hypothesis 1 is verified.

4.3. Endogeneity Problem

Considering that the model may have sample selection bias, this paper uses Heckman two- stage method to test. In the first stage, the explanatory variable digital transformation is first set as a dummy variable Dt_D, and the meaning of the dummy variable is judged according to whether Dt is greater than the sample median. At the same time, OtherDt, the proportion of other enterprises in the same industry with high degree of digital transformation, is added as an exogenous instrumental variable in the first stage, and the inverse Mills ratio (IMR) is calculated by using the regression results, and then IMR is added into the regression model of the second stage for calculation. The IMR coefficient in Model (2) of Table 4 is positive and passes the

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significance test of 5%, but the regression coefficient of Dt is still significantly positive at the level of 5%, which indicates that the main result of this paper on the positive correlation between digital transformation and enterprise innovation efficiency is robust.

4.4. Robustness Test

In order to ensure the robustness of the estimated results of the model, this paper uses the following methods to conduct the robustness test:

Firstly, we replace the index of explained variable. Based on the original index of the explained variable, this paper replaces the number of invention patent applications into the number of patent applications, and then puts the new explained variable into the model for calculation. The regression results are shown in Model (3) of Table 4.

Secondly, change the sample interval. The rapid development of China's digital economy after 2015 is more obvious, so the sample data from 2015 to 2021 are used to re-calculate the model. The regression results are shown in Model (4) of Table 4.

Thirdly, the sample enterprises that have not applied for invention patents are excluded. The business scope of the manufacturing industry is widely distributed. Considering that some enterprises in some industries have not applied for invention patents or the number of applications is small due to the business scope or the nature of main business during the sample period, this paper excludes the companies whose number of invention patent applications is 0 to further enhance the credibility of the results of this paper. The regression results are shown in Model (5) of Table 4.

Table 4. Endogeneity problem and robustness test

	(1)	(2)	(3)	(4)	(5)
	Heckman1	Heckman2	Ie2	Ie	Ie
Dt	0.0016 * *	0.0015 * *	0.005 * * *	0.001 * * *	0.004 * *
	(2.2268)	(2.0932)	(3.36)	(3.19)	(2.46)
Size	0.0016	0.0069 * *	0.028 * * *	0.002 * * *	0.027 * * *
	(1.3179)	(2.4119)	(16.98)	(5.77)	(14.93)
Age	0.0021	0.0050 * *	0.000	0.001	0.010 *
	(1.1305)	(2.1986)	(0.02)	(0.58)	(1.85)
Growth	0.0001	0.0000	0.001	0.000	0.001
	(0.7164)	(0.1440)	(1.01)	(0.94)	(0.74)
Indep	0.0006	0.0204	0.025	0.002	0.014
	(0.0655)	(1.5416)	(1.15)	(0.30)	(0.60)
Liquid	0.0089	0.0002	0.050 *	0.014 * *	0.054 *
	(1.4873)	(0.0237)	(1.77)	(2.54)	(1.74)
Dual	0.0006	0.0013	0.008 * *	0.001 *	0.007 *
	(0.4890)	(0.7791)	(2.07)	(1.66)	(1.73)
Share	0.0000	0.0000	0.000	0.000	0.000
	(0.4472)	(0.0102)	(0.24)	(0.03)	(0.45)
IMR		0.0593 * *			
		(2.4039)			
_cons	0.0339	0.1978 * *	0.334 * * *	0.043	0.320 * * *
	(0.9900)	(2.3296)	(6.53)	(0.98)	(5.68)
N	19334	19334	882	13398	881
Year	Yes	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes	Yes
R^2	0.1953	0.1917	0.362	0.191	0.344

Note: (1) ***p<0.01, **p<0.05, *p<0.1; (2) t values are in parentheses; The following table is the same.

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As shown in the table, the regression coefficients of the explanatory variables Dt corresponding to the three models are 0.005, 0.001 and 0.004 respectively, which are significantly positively correlated at the levels of 1%, 1% and 5% respectively, which is consistent with the expected results of this paper, indicating the robustness of the research results of this paper.

5. Further Analysis

5.1. Mechanism Test

It is obviously not enough to only study the positive correlation between the two without studying the influencing link. This part is to identify and test the influencing mechanism between the two[17]. Considering the limitations of the stepwise test method, this paper tests the mechanism by reducing the degree of information asymmetry, combining the stepwise test method and the Bootstrap test method, and the sampling times are set as 500.

Table 5. Test results of mediating effect of digital transformation on enterprise innovation efficiency

Variables	(1)	(2)
	AnaAttention	Ie
Dt	0.584 * * *	0.001 * * *
	(9.55)	(4.92)
AnaAttention		0.0001 * * *
		(3.79)
size	3.930 * * *	0.001 * * *
	(68.43)	(2.94)
Age	3.158 * * *	0.002 *
	(16.50)	(1.74)
Growth	0.088 * * *	0.000
	(3.56)	(0.69)
Indep	3.473 * * *	0.002
	(4.12)	(0.38)
Liquid	27.557 * * *	0.006
	(31.12)	(1.23)
Dual	1.248 * * *	0.001
	(9.21)	(1.30)
Share	0.010 * *	0.000
	(2.33)	(0.95)
_cons	67.267 * * *	0.020
	(15.11)	(0.89)
N	19440	19440
Year	Yes	Yes
Ind	Yes	Yes
r	106.221	61.475
R^2	0.297	0.199

Note: (1) ***p<0.01, **p<0.05, *p<0.1; (2) t values are in parentheses; The following table is the same.

Digital transformation can improve the transfer of information between enterprises and the outside world, and effectively reduce the degree of information asymmetry. This paper selects analyst attention (AnaAttention) as a mediating variable to test whether digital transformation can promote corporate innovation efficiency by reducing the degree of information asymmetry.

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The Dt coefficient of Model (1) in Table 5 is 0.584, which is significantly positively correlated at the level of 1%, indicating that for every unit increase in digital transformation, the analyst attention of manufacturing enterprises will increase by 0.584 units. It can be seen that digital transformation does reduce the degree of information asymmetry of enterprises. Model (2) of Table 5 regresses digital transformation indicators, analyst attention and control variables on enterprise innovation efficiency, and the coefficients of digital transformation and analyst attention are significantly positive correlated at the level of 1%. This shows that the degree of information asymmetry is indeed the mechanism for digital transformation to affect enterprise innovation efficiency. This conclusion supports Hypothesis 2.

Table 6. Mediating effect of operating cost and analyst attention: Bootstrap test

Explained variable	Explanatory variables	Mediating variables	Type of effect	Standard errors	Z statistic value	P-value	95% confidence interval
Ie	Dt	AnaAttention	Indirect effects	0.0000142	3.27	0.001	[0.0000185, 0.000074]
			Direct effect	0.0003803	18.03	0.000	[0.0061109,0.0076019]

5.2. Moderating Effect Test

5.2.1. The Degree of Industry Competition

Firstly, the degree of industry competition (HHI) is selected as the moderator variable. In Table 7, Model (1) regresses the explanatory variables of digital transformation (Dt), industrial competition (HHI) and their interaction term Dt*HHI, while Model (2) adds control variables, year and industry dummy variables on the basis of Model (1). It can be seen from the data in the table that the coefficients of the interaction term are − 0.011 and − 0.001 respectively, and they pass the significance test of 1% and 5% respectively, which indicates that the fiercer the industry competition is, the greater the impact of digital transformation on enterprise innovation efficiency is. In the fiercely competitive environment, enterprises are bound to face great pressure of survival and development. Only by taking advantage of the advantages of digital economy to innovate, improve the level of enterprise innovation and improve the efficiency of enterprise innovation, can enterprises optimize the allocation of resources in the fastest and optimal way, so as to obtain competitive advantages and win vitality.

5.2.2. The Nature of Property Rights

Secondly, the nature of property rights (SOE) is selected as the moderator variable. Model (3) and Model (4) of Table 7 divide the samples into state-owned enterprises and non-state-owned enterprises, and the coefficients are 0.0018 and 0.0015 respectively, which pass the significance test of 1%, indicating that the digital transformation of state-owned enterprises has a greater impact on enterprise innovation efficiency. Digital transformation is not only the transformation of R&D innovation, but also involves the transformation of governance structure. Compared with non-soes, the behavior of soes is determined by the will and interests of the state, and their profit- making purpose is mainly to regulate the economy. Therefore, the governance structure of soes is more complex, and the digital transformation will involve more.

5.2.3. Government Subsidies

In Table 7, Model (5) and Model (6), government subsidy (Gov) is selected as the moderator variable. Similarly to the degree of industry competition, the coefficients of the interaction term Dt*Gov of the two models are 0.002 and 0.001 respectively, which are significantly positive correlated at the level of 1% and 5% respectively, indicating that the digital transformation of enterprises receiving government subsidies has a more significant impact on their innovation

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efficiency. Enterprises that receive government subsidies will have more disposable resources, expand the space for innovation, and increase the development elasticity.

Table 7. Moderating effect test

	(1)	(2)	(3)	(4)	(5)	(6)
	Ie	Ie	State owned	Non-state-owned	Ie	Ie
Dt	0.011***	0.002***	0.0018***	0.0015***	0.006***	0.001***
	(37.03)	(5.55)	(2.97)	(4.45)	(13.28)	(2.94)
HHI	0.004	0.012				
	(0.91)	(1.18)				
Dt*HHI	0.011***	0.001**				
	(27.07)	(2.13)				
Gov					0.001***	0.000
					(3.66)	(1.41)
Dt*Gov					0.002***	0.001**
					(3.87)	(2.16)
Size		0.001***	0.000	0.002***		0.001
		(5.39)	(0.26)	(5.31)		(1.55)
Age		0.002**	0.008***	0.003**		0.002**
		(2.49)	(3.72)	(2.53)		(2.28)
Growth		0.000	0.000	0.000		0.000
		(0.83)	(0.48)	(1.00)		(0.91)
Indep		0.001	0.009	0.003		0.001
		(0.21)	(1.09)	(0.58)		(0.20)
Liquid		0.010**	0.014*	0.010**		0.007
		(2.39)	(1.72)	(2.01)		(1.28)
Dual		0.001	0.001	0.001		0.002**
		(0.99)	(0.28)	(1.24)		(2.36)
Share		0.000	0.000***	0.000		0.000
		(0.73)	(3.42)	(0.85)		(1.23)
_cons	0.003***	0.026	0.023	0.037***	0.010***	0.015
	(4.90)	(1.19)	(0.96)	(2.72)	(2.80)	(0.66)
N	21317	19954	5725	14230	13426	13088
Year	No	Yes	Yes	Yes	No	Yes
Ind	No	Yes	Yes	Yes	No	Yes
r	535.932	60.865	38.227	38.169	169.970	46.418
R^2	0.070	0.195	0.295	0.166	0.037	0.213

Note: (1) ***p<0.01, **p<0.05, *p<0.1; (2) t values are in parentheses; The following table is the same.

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6. Conclusion and Implications

In recent years, the state has vigorously launched digital economy policies and actively publicized the importance of enterprise innovation. Taking A-share listed companies in Shanghai and Shenzhen Stock exchanges from 2010 to 2021 as the research object, this paper empirically analyzes the impact of digital transformation on corporate innovation efficiency and its internal links through the research framework of "benchmark regression - robustness test - further analysis". Second, digital transformation can reduce the degree of information asymmetry between enterprises and the outside world by increasing the attention of analysts, thus significantly improving the innovation efficiency of enterprises; Third, the impact of digital transformation is more significant in enterprises with fierce industry competition, state-owned enterprises and enterprises with more government subsidies.

In the empirical process, this paper holds that the country has been promoting the development of digital economy for a long time, constantly introducing policies related to digital system to build a good and optimistic social environment for enterprises, and putting forward many preferential tax policies to help enterprises reduce the tax burden and provide abundant economic conditions for enterprise innovation. Therefore, enterprises should actively respond to the call of the country. Therefore, enterprises should seize the opportunity of The Times, join the array of digital transformation, promote the combination of enterprise digital technology and business operation, tap the potential value of information, and promote enterprises to improve innovation efficiency. While actively participating, enterprises should clarify their core competitiveness, analyze specific problems, and adopt appropriate and characteristic transformation paths for enterprises in different industries and different nences. The transformation direction responds to the innovation needs, so as to expand the core advantages of enterprises as much as possible, increase the value of enterprises, and promote the long-term development of enterprises.

Finally, enterprises should deeply apply and implement business in the process of digital transformation. For example, when enterprises carry out digital transformation, the data and business information of sales department, production department and R&D department can be reasonably exchanged and shared. Then the R&D department can grasp the market trend through sales data and clarify the R&D direction; When the production department obtains the information of the R&D department, it can weigh the production volume of products to avoid too much or too little production, and the production link is more reasonable. Things like that should be considered.

Only by integrating business with digital technology, the direction of digital transformation will be more reasonable, the possibility of successful transformation will be higher, and enterprises can better rationalize the allocation of resources.

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