A Study on the Impact Pathways of Digital Transformation on Corporate Value

Hongyuan Ma

Liaoning University, Shenyang 210000, China;

13520034918@163.com

Abstract. With the development of the digital economy, digital transformation has become one of the important means of developing new quality productive forces and also one of the important ways for enterprises to pursue the enhancement of their value. This paper takes the listed companies on China's A-shares market from 2010 to 2020 as the research sample to empirically test the impact of digital transformation on corporate value and its mechanism. The paper first conducts an empirical study on the relationship between digital transformation and corporate value, and then discusses the impact mechanism through heterogeneity, robustness methods, and further discussions. The results show that digital transformation can significantly promote the improvement of corporate value levels. The scale of enterprises and their marketing channels play a partial mediating role in the impact of digitalization on corporate value. Heterogeneity analysis found that the positive impact of digital transformation on the value creation of young enterprises, enterprises in the eastern region, and non-state-owned enterprises is more significant. This study reveals the mechanism by which digital transformation affects corporate value and also provides policy implications for the government to formulate relevant policies to empower enterprises with digital transformation.

Keywords: digital transformation; digital economy; enterprise value; digital technology.

1. Introduction

The current digital economy is booming, and a new economic model that regards data as a key production factor has begun to emerge. Digital technology serves as a core driving force for economic development, and effectively leveraging digital technology can provide a solid foundation for digital transformation. The report of the 20th National Congress of the Communist Party of China emphasizes the need to "accelerate the development of the digital economy, promote the deep integration of the digital economy and the real economy, and create internationally competitive digital industry clusters." As the main carriers of the real economy, enterprises have been significantly impacted by a series of policy shocks, affecting the majority of traditional businesses. As the first "pioneers" successfully transformed, an increasing number of enterprises have chosen the path of digital transformation. According to the "2024 China Enterprise Digital Transformation Index Report," 59% of surveyed enterprises plan to increase investment in digital transformation projects in the coming year. This reflects a growing willingness among enterprises to enhance their competitiveness through digital transformation. The "2024 China Small and Medium-sized Enterprises Digital Transformation Report" indicates that 46% of small and medium-sized enterprises have improved the competitiveness of their products and services through digital transformation, 42.1% have enhanced business efficiency, and 35.6% have reduced operational costs. These data highlight the significant benefits and high value of digital transformation for enterprises. However, the "2024 China Enterprise Digital Transformation Report" also reveals that some enterprises face practical issues such as "inability to transform," "unwillingness to transform," and "fear of transformation." This further underscores the practical significance of researching enterprise digital transformation.

Digital economy, digital industry, and digital transformation have become popular topics in academia. Early research on digital transformation focused on the publishing industry. Huang Shengmin et al. (2002) were among the first to study the impact of digital transformation on China's broadcasting and television sector, including content changes, role shifts, and regulatory disruptions and reconstructions. As the concept of the digital economy emerged, academic research on enterprise

digital transformation has become increasingly rich. The Enterprise Digital Transformation Summit (2019) proposed that cloud service platforms would provide solutions for enterprise digital transformation. Sun Yuping (2021) argued that enterprise digital transformation follows a progressive hierarchy of "point-line-surface-body." In this context, it is essential to comprehensively understand the series of impacts that digital transformation brings to enterprises, including total factor productivity (Zhao Chenyu et al., 2021) and supply chain efficiency (Zhang Shushan et al., 2023). It is evident that these impacts play a crucial role in corporate value. As the most accurate indicator of overall corporate equity, corporate value is of significant reference value for the long-term development of enterprises. Therefore, the impact of digital transformation on corporate value and its pathways is an important topic with theoretical value, practical significance, and policy implications.

Based on the theoretical analysis and supporting literature in related fields, this paper uses A-share listed companies in China from 2010 to 2020 as the research sample. By employing text analysis techniques to measure the degree of enterprise digital transformation, it explores the impact of digital transformation on corporate value and its mechanisms. Subsequently, robustness checks were conducted to ensure the reliability of the conclusions. Heterogeneity analyses were performed from the perspectives of enterprise age, region, and ownership, revealing the micro-level differences in the impact of digital transformation on corporate value. Based on the above analysis, this paper proposes and attempts to answer the following three questions: First, does digital transformation positively impact corporate value? Second, through what channels does it promote the enhancement of corporate value? Third, is there heterogeneity at different levels? Answering these questions has important theoretical value and practical significance, as it contributes to a deeper understanding of the mechanisms behind the enhancement of corporate value in the wave of digital transformation and provides a solid foundation for the digitalization of industries in the context of Chinese-style modernization, thereby supporting high-quality economic development.

The subsequent arrangement of this paper is as follows: The second section reviews and summarizes the current relevant literature at home and abroad; the third section sets up the model and explains the variables; the fourth section conducts empirical analysis to test the hypotheses and perform related checks; the fifth section further analyzes the findings; and the sixth section concludes with an outlook.

This paper proposes the following three hypotheses:

H1: Digital transformation has a positive effect on enhancing corporate value.

H2: Digital transformation enhances corporate value by expanding enterprise scale.

H3: Digital transformation increases corporate value by expanding marketing channels and revenue.

2. Literature References

2.1. Research on Digital Transformation

Digital transformation is the process by which enterprises integrate new-generation Information and Communications Technology (ICT) into various business domains, thereby continuously creating value and enhancing their competitiveness within the industry. However, there is no completely unified standard in the academic community for measuring digital transformation. Peter et al. (2021) qualitatively divide digital transformation into three stages: datafication, digitalization, and digital transformation. He Fan and Liu Hongxia (2019) proposed assigning a value to the state of enterprise digital transformation by introducing a "0-1" dummy variable to determine whether the enterprise has undergone digital transformation in that year. Wu Fei et al. (2021) collected and organized the annual reports of listed companies, characterizing the degree of enterprise digital transformation through word frequency statistics. Yuan Chun et al. (2021) established a digital dictionary based on national policy work reports and then constructed an indicator of the degree of enterprise digitalization using text analysis methods from the field of machine learning. This paper integrates the measurement methods of digital transformation by the aforementioned scholars and constructs a measurement

definition of enterprise digital transformation through comprehensive text analysis of the annual reports of listed companies.

What factors influence enterprise digital transformation? From a macroeconomic perspective, the role of the government is significant. The high cost of technology required for digital transformation often leaves most enterprises trapped in low profits and high financing constraints, hence government fiscal technology expenditure can promote the process of enterprise digital transformation (Wu Fei et al., 2021); the intelligent manufacturing policy "Intelligent Manufacturing Development Plan (2016-2020)" significantly enhances enterprise digital transformation, especially R&D in digital technology (Qu Yongyi et al., 2024). In addition, government macro tools such as interest rate marketization (Tang Song et al., 2022) and tax incentives (Cheng Qiongwen et al., 2022) can all impact enterprise digital transformation. From a meso-market analysis, the "visible hand" of the effective market has played a huge role. Sun Jing et al. (2024) found that new types of information consumption, which are mainly carried by digital technology, have given rise to a "reverse pressure" mechanism, thereby effectively accelerating the pace of enterprise digital transformation. Digital market behaviors such as digital mergers and acquisitions (Tang Haodan and Jiang Dian Chun, 2021) and the rise in labor costs (Zhao Chenyu and Li Bingyu, 2024) are strong supports for enterprise digital transformation. From a micro enterprise level, factors such as the CEO's composite functional background (Mao Ju et al., 2022), heterogeneous institutional investors within the enterprise (Li Huamin et al., 2021), and executive information technology background (Wu Yuhui et al., 2022) also have varying degrees of impact on the overall state of enterprise digital transformation.

The deep integration of digital technology and traditional industries has given birth to new forms, new industries, new models, and new drivers. "Integration of the digital and real economies" has become one of the specific manifestations of the current vigorous development of the digital economy. Both domestic and international scholars have analyzed and demonstrated the economic consequences of digital transformation. Foreign scholars Bob Hinings et al. (2018) proposed that digital transformation brings innovation effects. Eller et al. (2020) found that enterprise digital transformation has a significant impact on the financial performance of small and medium-sized enterprises. Wu et al. (2019) believed that digital transformation can improve enterprise production efficiency. In addition, enterprise digital transformation can greatly enhance enterprise performance and innovation vitality (Peng and Tao, 2022), and digital transformation can also use produced consumer data to improve and optimize production processes, thereby enhancing enterprise business models (Li F, 2017). However, some scholars have also found the drawbacks of digital transformation. Syuntyurenko (2020) pointed out that it is precisely the overdevelopment of current digital technology that has triggered global technological unemployment and social unrest, and Evan et al. (2021) supplemented that the digital economy revolution has caused some enterprises to transform in chaos and structural distortion.

Domestically, regarding the impact of digital transformation, Ni Kejin and Liu Xiuyan (2021) found that digital transformation enables enterprises to achieve intelligent operations, develop data value, reduce costs and improve efficiency, thereby promoting enterprise expansion and growth. Jin Yu et al. (2022) proposed that digital transformation can achieve enterprise green innovation through "resource effects," "governance effects," and "multiplier effects." Digital transformation has brought new opportunities and realized the vision of "dividing the cake well," increasing the share of labor income (Fang Mingyue et al., 2022). Du Mingwei et al. (2022) analyzed the impact of enterprise digital transformation on the quality of China's export products from the perspective of international trade.

2.2. Research on the Impact of Digital Transformation on Corporate Value

Corporate Value refers to the market evaluation of a company's tangible and intangible assets. As an important strategic requirement for national development in contemporary times, corporate digital transformation has an extremely profound impact on the creation of corporate value. Amidst the tide of the "digital revolution," the vast majority of companies have spontaneously boarded the "train of

the times." The academic community has conducted extensive research on the factors affecting corporate value. Li Zheng (2006) demonstrated through empirical analysis that corporate social responsibility (CSR) can burden companies and thus have a negative impact on corporate value. However, Wang Linlin et al. (2022) found that CSR can increase corporate value by improving efficiency and reducing risks. In addition, a series of factors such as the application of blockchain technology (Zhang Huan et al., 2023) and the concentration of cross-border e-commerce customers (Su Yumin et al., 2024) can all impact corporate value. Whether it is the controversial factor of CSR or other factors, their essence is closely linked to the digital technology level and the degree of digital transformation of the company. The impact factor of digital transformation occupies a significant portion of the influence on corporate value. Corporate digital transformation requires extensive research on technologies such as Artificial Intelligence (AI), Block Chain, Cloud, and Big data, thereby enabling "ABCD" technologies to deeply empower corporate operations, significantly reducing the burden of corporate social responsibility and long-term operational costs. Therefore, this paper focuses on exploring the impact of digital transformation on corporate value.

The impact of digital transformation on corporate value has received widespread attention in the academic community. It can be divided into two parts: external factors and internal factors. Externally, Sun Qiong et al. (2022) analyzed from the perspective of the hypocrisy theory that corporate digital transformation can boost stakeholders' and investors' confidence in the company's fulfillment of social responsibility and long-term development, thereby increasing stock prices and enhancing corporate value. Huang Dayu and Xie Huobao (2022) proposed that digital transformation can optimize market expectations and improve information asymmetry, thereby enhancing potential corporate value. Corporate digital transformation also promotes cooperation models with other companies and the market, integrates and utilizes external information, and improves the scenario system and work efficiency between enterprises (Porter M E et al., 2014). Internally, digital transformation can positively affect corporate value through a series of paths such as optimizing business processes (Cenamor et al., 2017), reducing transaction and production costs (Li Zhihong, 2023), improving production efficiency (Bai Xiyan and Lu Chan, 2023) and resource allocation efficiency (Quinton et al., 2016), and enhancing synergistic effects (Zhang Yinghui and Li Siyi, 2023).

2.3. Literature Review

Currently, there is a substantial body of academic research on digital transformation and corporate value separately; however, the analysis of the impact pathways of digital transformation on corporate value is not comprehensive enough and requires further study and deepening.

In light of this, building upon existing research, this paper attempts to further analyze the mechanisms and reliability of the impact of digital transformation on corporate value. Specifically, the marginal contributions of this paper are mainly reflected in two aspects: First, this paper empirically examines the impact of digital transformation on corporate value and, in addition, conducts empirical analysis on the heterogeneity issues of enterprise age, region, and ownership, providing more reliable evidence to promote the digital transformation of Chinese enterprises and the "Digital China" strategy. Second, it pioneers the exploration of the mechanisms by which digital transformation drives the appreciation of corporate value, empirically testing two impact channels: the expansion of enterprise scale and the increase in enterprise marketing channels. Providing empirical evidence for the impact of digital transformation on corporate value will help enterprises adopt the correct strategies in practicing digital transformation, thereby providing a solid material foundation for the high-quality economic development of enterprises.

3. Research design

3.1. Variable measurement and description

3.1.1 Dependent Variable

Firm Value (*firm_value*). The existing literature measures firm value using metrics such as return on total assets, book-to-market ratio, return on equity, Tobin's Q, and price-to-earnings ratio. This paper utilizes Tobin's Q (TobinQ), as adopted by Liu Xing and Li Xiaorong (2012), to measure firm value. The larger the value of this indicator, the higher the firm value is indicated to be.

$$firm\_value = \frac{pricepershare \times NumberofShare + pricepershare \times Numberofnonshares}{TotalAssets}$$

3.1.2 Core Explanatory Variable

Digital Transformation (*digital*). The measurement of digital transformation often involves constructing a dictionary through text analysis and processing annual report texts with word segmentation to calculate the digital transformation index. This paper draws on Wu Fei's (2021) methodology of statistically analyzing the frequency of 76 digital-related terms across five dimensions: artificial intelligence technology, big data technology, cloud computing technology, blockchain technology, and the application of digital technology. The higher the value of this indicator, the greater the degree of digital transformation of the company is indicated to be.

3.1.3 Control Variables

To avoid the potential omitted variable bias that may skew the regression results in the empirical process, this paper introduces a set of control variables at other levels of the enterprise to account for factors that could affect firm value. These include the asset-liability ratio (*AL_ratio*), intangible asset ratio (*IA_ratio*), the ratio of shares held by the largest shareholder (*SH_ratio*), net profit (*profit*), and sales expense ratio (*SE_ratio*). Furthermore, to control for the potential impact of enterprise factors and time factors on the empirical results, this paper controls for fixed effects of the enterprise (*id*) and year (*time*).

Table 1 Description of main variables

Variable type	variable name	variable symbol	calculation method
Dependent Variable	enterprise value	firm_value	(Market capitalization of outstanding shares + number of shares not outstanding * Net assets per share + book value of liabilities)/total assets
Core Explanatory Variable	Digital Transformation	digital	Total word frequency for digital transformation plus 1 taken as natural logarithm
intermediary variable	scale of operations	size	Natural logarithm of total assets at year-end
	revenues	Income	Income from principal activities
	gearing	AL_ratio	Ratio of total liabilities to total assets
	Intangible assets ratio	IA_ratio	Intangible assets/total assets
control variable	Shareholding ratio of the largest shareholder	SH_ratio	Shares held by Top1 largest shareholder Percentage of all shares
	net profit	profit	Total profit of the enterprise for the period less Amount after income tax
	sales expense ratio	SE_ratio	Selling expenses/operating income

3.2. Empirical Model

3.2.1 Benchmark Regression Model

To examine the impact of digital transformation on firm value, this paper constructs a fixed-effects regression model for the regression as follows:

$$firm\_value_{it} = \beta_0 + \beta_1 \cdot digital_{it} + \lambda \cdot X_{it} + \mu_i + \nu_t + \varepsilon_{it} \quad (1)$$

Where the subscripts i and t represent the firm and year, respectively; $firm\_value_{it}$ is the proxy variable for the dependent variable, $digital_{it}$ is the proxy variable for the explanatory variable; X_{it} is the set of relevant control variables; β_0 denotes the constant term; β_1 is the parameter for the core explanatory variable, if $\beta_1 > 0$, it indicates that the digital transformation of the firm positively promotes the enhancement of firm value, that is, the digital transformation of the firm can increase firm value; if $\beta_1 < 0$, it indicates that the digital transformation of the firm negatively affects firm value, that is, the digital transformation of the firm will cause a decrease in firm value; μ_i and ν_t represent the individual and year fixed effects, respectively, and ε_{it} is the random error term.

3.2.2 Mediation Effects Model

In order to examine the mechanism process of enterprise profit and enterprise size in the enterprise digital transformation on enterprise value enhancement, this paper draws on the mediation effect proposed by Wen Zhonglin (2004), Wen Zhonglin and Ye Baojuan (2014), as well as the "two-step" mediation effect theory proposed by Jiang Boat (2022). M_{it} for the mediating variables, this paper constructs the mediation effect model as follows.

$$firm\_value_{it} = \gamma_0 + \gamma_1 digital_{it} + \sum X_{it} + \sum \nu_t + \sum \mu_i + \varepsilon_{it} \quad (2)$$

$$M_{it} = \beta_0 + \beta_1 digital_{it} + \sum X_{it} + \sum \nu_t + \sum \mu_i + \varepsilon_{it} \quad (3)$$

3.3. Data sources and descriptive statistics

This paper selects A-share listed companies from 2010 to 2020 as the research subjects and processes the data as follows: (1) cleaning the data to remove all potentially duplicate records; (2) excluding samples of companies that have been specially treated (ST) or specially transferred (ST*); (3) excluding samples of companies with severe data missingness. The data used in this paper are all sourced from the GTA Information (CSMAR) database, and Stata 17.0 is employed for the analysis of the relevant data. Ultimately, this paper obtains an unbalanced panel data set, containing 3,699 firms and 26,233 observations.

The descriptive statistical results of the main variables are shown in Table 2. The firm value (firm_value) has a maximum value of 122.2, a minimum value of 0.674, a mean of 2.103, and a standard deviation of 2.275. It is not difficult to find that there is a significant difference between firms, indicating that the sample selected in this paper has a high degree of representativeness. The digital transformation indicator (digital) has a maximum value of 80.04, a minimum value of 23.00, a mean of 36.07, and a standard deviation of 10.49, showing a large variation. The levels of digital transformation development among different companies vary greatly, and the issue of imbalance is quite prominent. The descriptive statistical results of the other variables are roughly similar to existing studies and are within a reasonable range. In addition, this paper also conducts a VIF test on the relevant variables. The test results show that the VIF values are all much less than 10, and which can indicate that there is no multicollinearity problem between the relevant variables.

Table 2 Descriptive statistics

variant	variable name	sample size	average value	(statistics) standard deviation	minimum value	maximum values
firm value	enterprise value	26,233	2.103	2.275	0.674	122.2
digital	Digital Transformation Index	24,775	36.07	10.49	23.00	80.04
profit	net profit	26,233	5.680e+08	3.300e+09	-1.710e+10	1.510e+11
AL ratio	gearing	26,233	0.408	0.204	0.00708	0.995
IA ratio	Intangible assets ratio	26,233	0.0484	0.0620	0	0.938
SH ratio	Shareholding ratio of the largest shareholder	26,233	34.84	14.98	0.290	89.99
SE ratio	sales expense ratio	26,233	0.0754	0.0963	0	2.333

4. Imperical Test

4.1. Benchmark Regression Analysis

Table 3 reports the empirical test results of the relationship between "digital transformation - firm value". The Hausman test rejects the null hypothesis, indicating that a fixed effects model is appropriate. In the benchmark regression, this paper adopts a progressive regression strategy. Column (1) presents the test results without the inclusion of any control variables, controlling only for time-fixed effects, and passes the 1% significance test. The coefficient for corporate digital transformation (digital) is 0.010, indicating that corporate digital transformation has a positive impact on the enhancement of firm value. Column (2) controls only for firm-level fixed effects and passes the 5% significance test, with the digital transformation coefficient being 0.005. Column (3) adds a set of control variables to the basis of column (2), including time-fixed effects and firm-level fixed effects, and passes the 1% significance test. The relevant regression coefficients are somewhat reduced (0.025), possibly due to the absorption of some factors affecting firm value after the inclusion of a series of control variables. However, its significance remains unchanged (t-value of 9.57). This indicates that the higher the degree of corporate digital transformation, the more it will significantly enhance firm value. There is a significant positive correlation between the two, and hypothesis H1 is validated.

Table 3 Benchmark regression

VARIABLES	(1) firm_value	(2) firm_value	(3) firm_value
digital	0.010***	0.005**	0.025***
	(7.71)	(2.00)	(9.57)
AL_ratio			0.658**
			(2.31)
IA_ratio			0.905**
			(2.08)
SH_ratio			-0.017***
			(-6.25)
profit			0.000***
			(4.19)
SE_ratio			-0.703***
			(-2.76)
Observations	23,615	24,387	23,240
R-squared	0.007	0.623	0.620
Year FE	YES	NO	YES
Firm FE	NO	YES	YES

Note: t-values in parentheses, ***, ** and * indicate significant at 1%, 5% and 10% confidence levels, respectively, as below.

4.2. Robustness Check

The aforementioned benchmark regression has preliminarily tested the hypotheses of this paper. To further verify the reliability of the benchmark regression model's test results, considering the impact of time lags, models, explanatory variables, control variables, and other factors, this paper conducts an empirical test on the results of the benchmark regression by replacing the core explanatory variable.

The indicator of corporate digital transformation is a spectral concept. To more finely examine the relationship between "digital transformation - firm value," this paper replaces the core explanatory variable with corporate digital application scores and corporate digital achievement scores, and conducts regression analysis again to test the robustness of the model. The results are presented in Tables 4 and 5.

4.2.1 Substituting the Explanatory Variable with Corporate Digital Application Score

The Corporate Digital Application Score is a derived calculation that takes into account three secondary indicators: technological innovation, process innovation, and business innovation. This paper re-examines the regression results of the model by substituting the core explanatory variable with the Corporate Digital Application Score. Empirical studies (Table 4) find that when using the digital application score as the explanatory variable, its regression coefficient (0.004) is significantly positive at the 1% level. This result indicates that corporate digital transformation has a significant positive impact on firm value, and this impact remains significant after the substitution of the explanatory variable, thereby validating the robustness of the model.

Table 4 Replacement of explanatory variables1

VARIABLES	(1) firm_value
Digital Application Score	0.004***
	(3.74)
AL_ratio	0.640**
	(2.23)
IA_ratio	0.833*
	(1.90)
Income	-0.000*
	(-1.67)
size	-0.439***
	(-6.47)
SH_ratio	-0.019***
	(-6.96)
profit	0.000***
	(4.25)
SE_ratio	-0.652**
	(-2.57)
Observations	23,240
R-squared	0.618
Year FE	YES
Firm FE	YES

4.2.2 Substituting the Explanatory Variable with Corporate Digital Achievement Score

The Corporate Digital Achievement Score is a derived calculation that takes into account six secondary indicators: digital innovation standards, digital innovation papers, digital invention patents, digital innovation qualifications, and national-level digital innovation awards. When the explanatory variable is replaced with the Corporate Digital Achievement Score, its impact on firm value (firm_value) remains significantly positive at the 1% level (0.021). This regression coefficient is also close to that of Model (3) in Table 3. Therefore, we can conclude that corporate digital transformation can promote the enhancement of its value, and this promotional effect is robust, providing evidence to support the core conclusions of this paper.

Table 5 Replacement of explanatory variables2

VARIABLES	(1) firm_value
Scoring of digitized results	0.021***
	(10.17)
AL_ratio	0.685**
	(2.40)
IA_ratio	0.784*
	(1.80)
Income	-0.000*
	(-1.88)
size	-0.512***
	(-6.95)
SH_ratio	-0.017***
	(-6.63)
profit	0.000***
	(4.25)
SE_ratio	-0.752***
	(-2.94)
Observations	23,240
R-squared	0.620
Year FE	YES
Firm FE	YES

5. Further Discussion

5.1. Mechanism Test

The aforementioned studies provide rich empirical data support for a profound understanding of the impact of digital transformation on firm value. It is worth noting that the previous text only provided an overall portrayal of "corporate digital transformation - firm value" without analyzing the mechanisms within the "black box." Therefore, in this section, an attempt is made to further explore the impact mechanism of digital transformation on firm value from two influence channels: firm size and marketing channels.

This paper selects two sets of mediator variables. The first set of variables is firm size, which characterizes a concrete and digital representation of enterprise growth after digital transformation. The second set of variables is enterprise marketing channels, which characterize the impact of digital transformation on the volume and channels of enterprise revenue.

The reason for choosing these two sets of mediator variables is twofold. First, as in the classical economics theory of "economies of scale," after digital transformation, enterprises will continue to grow under the dual promotion of "artificial intelligence +" and "data elements ×," and the scale of enterprises will gradually increase. Second, digital transformation can empower the platform economy of enterprises, and mobile applications have become one of the important channels for enterprises. This also lays a solid foundation for enterprises to achieve a dual-track marketing model of "online + offline." At the same time, their digital transformation often enables enterprises to more accurately collect, analyze the needs, preferences, and behavioral patterns of their users, which can bring higher operating income to enterprises.

As shown in Table 6, Column (1), the regression coefficient of enterprise digital transformation (digital) on firm size (Size) is positive and highly significant at the 1% level, meaning that enterprises after digital transformation can better achieve intelligent operations, thereby achieving cost reduction and efficiency enhancement. This provides a solid material basis for enterprises to expand reproduction. In addition, enterprises will expand their scale due to "cost drivers" and "growth drivers" for investment in different locations (Ni Kejin and Liu Xiuyan, 2021). Both drivers are also benefits that digital transformation can bring to enterprises. In Column (2), the coefficient of enterprise digital transformation is 0.025, significantly positive at the 1% level. The impact of firm size on firm value has been extensively and maturely studied in academia. Li Jingming and Wang Rongjian (2013) proposed that the larger the scale of an enterprise, the more financial flexibility it can reserve, thereby contributing to the enhancement of firm value. In summary, a positive path of "enterprise digital transformation → (increase in) firm size → (enhancement of) firm value" is formed. Therefore, Hypothesis H2 is established.

Table 6 Intermediation effect regression results1

VARIABLES	(1) size	(2) firm_value
digital	0.042***	0.025***
	(52.85)	(9.57)
AL_ratio	1.415***	0.658**
	(30.28)	(2.31)
IA_ratio	0.128	0.905**
	(0.74)	(2.08)
Income	0.000***	
	(4.81)	
SH_ratio	-0.013***	-0.017***
	(-13.40)	(-6.25)
profit	0.000***	0.000***
	(2.97)	(4.19)
SE_ratio	-0.007	-0.703***
	(-0.08)	(-2.76)
Observations	23,240	23,240
R-squared	0.915	0.620
Year FE	YES	YES
Firm FE	YES	YES

In Table 7, this paper shifts to the identification test of the mechanism path of "enterprise marketing channels and marketing revenue." The study shows that corporate digital transformation, as indicated in Column (1), has a positive regression coefficient that is highly significant at the 1% level, implying that enterprises after digital transformation can significantly enhance their marketing channels and marketing revenue (the coefficient of digital transformation (digital) in Column (1) is significantly positive at the 1% level, with a t-value of 3.25). In Column (2), the coefficient of corporate digital transformation is 0.025, significantly positive at the 1% level. There is a relatively comprehensive study in academia on the impact of enterprise marketing channels and marketing revenue on enterprise value. Zhang Di and Tian Xu (2021) conducted a case study on Shanghai Jahwa (SHJH) and found that after the enterprise carried out channel innovation, it achieved multi-channel and omni-channel value evolution. At the terminal of its marketing channels, it satisfied customer value and partner value, further realizing the enhancement of enterprise value. Based on the above research discussions, corporate digital transformation can expand the marketing channels of enterprises and increase marketing revenue. When an enterprise has more marketing channels and larger marketing

revenue, its benefit level is significantly improved, thereby promoting a substantial increase in enterprise value. Therefore, Hypothesis H3 is established.

Table 7 Intermediation effect regression results2

VARIABLES	(1) Income	(2) firm_value
digital	84015968.240***	0.025***
	(3.25)	(9.57)
AL_ratio	2.291e+09	0.658**
	(1.17)	(2.31)
IA_ratio	5.126e+09**	0.905**
	(2.08)	(2.08)
size	4.332e+09***	
	(6.76)	
SH_ratio	3386412.984	-0.017***
	(0.22)	(-6.25)
profit	5.293***	0.000***
	(4.92)	(4.19)
SE_ratio	-1.514e+09	-0.703***
	(-1.15)	(-2.76)
Observations	23,240	23,240
R-squared	0.970	0.620
Year FE	YES	YES
Firm FE	YES	YES

5.2. Heterogeneity Analysis

New Structural Economics categorizes China's industries into five types: catch-up, leading, transforming, leapfrogging, and strategic. These five industries clearly demonstrate the vast differences among various enterprises in our country. With the development of the digital economy as an entirely new economic form, the heterogeneity in digital transformation caused by disparities in digital technology is also increasingly reflected across different countries and regions, which is inevitable for enterprises. Therefore, neglecting the characteristic attributes of enterprises in research may lead to the generalization of conclusions, which is not conducive to forming scientifically rigorous research findings. Based on the above considerations, this section focuses on the differences in enterprise attribute characteristics to conduct heterogeneity tests. This paper specifically explores the heterogeneity of the impact of digital transformation on enterprise value from three perspectives: enterprise age (divided into young and mature enterprises based on the median age of enterprises), geographical region of the enterprise (eastern region or central and western regions), and property rights attributes of the enterprise (state-owned enterprises or private enterprises), with the results shown in Tables 8-10.

5.2.1 Heterogeneity Test Based on Enterprise Age

The regression test in Table 8 conducted a heterogeneity identification test for the age attribute of enterprises. According to Song Chang and Liu Sihui (2011), who divided Chinese A-share listed companies into three different stages of the life cycle: growth, maturity, and decline, it is also pointed out that enterprises at different development stages require differentiated analysis. Therefore, this paper uses 17 years of enterprise age as the dividing standard. Enterprises older than 17 years are classified as mature enterprises, and those younger than 17 years are considered young enterprises. Columns (1)-(2) conducted group processing based on different enterprise ages and performed

benchmark tests on them separately. It was found that the regression coefficient for the explanatory variable of mature enterprises is 0.023, while that for young enterprises is 0.038, passing the heteroscedasticity test between groups. This indicates a significant difference between mature and young enterprises, and the role of digital transformation is more prominent in young enterprises. It can be concluded that young enterprises show a more pronounced effect on the enhancement of enterprise value during the process of digital transformation.

There are roughly two reasons for this. First, young enterprises are often subject to stricter financing constraints compared to mature enterprises, which often prompts young enterprises to apply digital technology driven by innovation to achieve deep integration of the digital and physical realms. Additionally, young enterprises are generally more adept at using digital channels to interact with customers, directly communicating with customers through social media, mobile applications, etc., collecting feedback, and quickly responding to customer needs. This helps to enhance customer loyalty and increase brand value, thereby contributing more to the appreciation and enhancement of enterprise value.

Table 8 Heterogeneity test: firm age attributes

VARIABLES	(1) firm_value mature enterprise	(2) firm_value young enterprise
digital	0.023***	0.038***
	(4.50)	(11.05)
AL_ratio	0.713	0.609***
	(1.15)	(4.29)
IA_ratio	1.008	1.206**
	(1.12)	(2.48)
SH_ratio	-0.014***	-0.018***
	(-2.93)	(-7.32)
profit	0.000***	0.000**
	(6.44)	(2.56)
SE_ratio	-0.723*	-0.299
	(-1.84)	(-0.69)
Observations	12,634	10,269
R-squared	0.669	0.511
Company FE	YES	YES
Year FE	YES	YES

5.2.2 Heterogeneity Test Based on the Geographical Region of Enterprises

The regression test in Table 9 focused on conducting a heterogeneity identification test for the differences in the geographical regional attributes of enterprises. In regional economics, the choice of enterprise location has always been a key focus of research. Since the reform and opening up, the economic differences between the eastern and central-western regions of China have widened, reflecting heterogeneity at the enterprise level as well. The urban hierarchy system points out that the type of enterprises a city hosts determines its status and level (Liang Qi et al., 2013). At the same time, the level and hierarchy of a city also have a reverse effect on the development of enterprises. Therefore, this paper divides the geographical regions of enterprises into the eastern region and the central-western region. Columns (1)-(2) conducted group processing based on the heterogeneity of enterprise geographical regions and performed benchmark tests on them separately. It was found that the regression coefficient for the explanatory variable of enterprises in the eastern region is 0.028, while that for enterprises in the central-western region is 0.015, and the heteroscedasticity test

between groups was passed. This confirms significant differences between enterprises in the eastern and central-western regions, with digital transformation playing a more prominent role in enterprises in the eastern region. It can be concluded that the role of digital transformation in enhancing enterprise value is more pronounced in the eastern region than in the central-western region.

The paper suggests the following reasons for the above conclusion. The eastern region has a more developed economy and a more mature market environment, with enterprises generally having stronger financial strength and market resources, providing a solid foundation for the digital transformation of enterprises. The "hard and soft infrastructure" in the eastern region is more developed compared to the central-western region, which also provides prerequisites for the market to play its optimal role in resource allocation and for the government to play its guiding role effectively. In such an economic environment, the demonstration effect in the eastern region can be established. This has produced a positive demonstration effect on enterprises in other regions, promoting the process of digital transformation of enterprises in the eastern region to be faster and better than those in the central-western region.

Table 9 Heterogeneity test: firms' regional attributes

VARIABLES	(1) firm_value eastern part	(2) firm_value Central and Western region
digital	0.028***	0.015***
	(8.60)	(4.87)
AL_ratio	0.688*	0.704***
	(1.83)	(3.95)
IA_ratio	1.211*	0.375
	(1.91)	(1.07)
SH_ratio	-0.019***	-0.011***
	(-5.21)	(-5.20)
profit	0.000***	0.000***
	(3.73)	(5.66)
SE_ratio	-0.921***	-0.015
	(-2.94)	(-0.03)
Observations	17,342	5,898
R-squared	0.626	0.576
Company FE	YES	YES
Year FE	YES	YES

5.2.3 Heterogeneity Test Based on the Property Rights Attributes of Enterprises

Considering that the impact of digital transformation on enterprise value may vary across different property rights attributes of enterprises, this paper categorizes listed companies in China into state-owned enterprises (SOEs) and non-state-owned enterprises (non-SOEs). The regression results are presented in columns (1) and (2) of Table 10. It is found that the regression coefficient for the explanatory variable of state-owned enterprises is 0.009, while that for non-state-owned enterprises is 0.036, and the test for heteroscedasticity between groups was passed. This confirms significant differences between state-owned and non-state-owned enterprises, with digital transformation having a more pronounced effect on non-state-owned enterprises. It can be concluded that under the impetus of digital transformation, non-state-owned enterprises perform better and can more significantly enhance the level of enterprise value.

Table 10 Heterogeneity test: property rights attributes of enterprises

VARIABLES	(1) firm_value state-owned enterprises	(2) firm_value non-state-owned enterprises
digital	0.009***	0.036***
	(3.80)	(9.59)
AL_ratio	-0.036	0.832***
	(-0.26)	(4.15)
IA_ratio	0.268	1.100
	(0.88)	(1.57)
SH_ratio	-0.008***	-0.022***
	(-4.81)	(-6.53)
profit	0.000***	0.000***
	(3.12)	(9.16)
SE_ratio	-0.670*	-0.546*
	(-1.77)	(-1.94)
Observations	8,063	14,386
R-squared	0.609	0.669
Company FE	YES	YES
Year FE	YES	YES

6. Conclusion

6.1. Research Conclusions

This paper conducts an empirical study based on the data of listed companies on China's Shanghai and Shenzhen A-shares from 2010 to 2020, revealing the mechanism by which digital transformation affects enterprise value, as well as the mediating effects of enterprise size and enterprise influence channels. At the same time, robustness tests were passed, and heterogeneity studies at different dimensional levels were conducted, leading to the following main research conclusions:

(1) The study examines samples with accuracy and representativeness and finds that digital transformation has a positive promoting effect on enterprise value, which is highly significant. This conclusion still holds after endogeneity and robustness tests.

(2) Enterprise size has a partial mediating effect on the impact of digital transformation on enterprise value; the enterprise's marketing channels also have a partial mediating effect in the aforementioned mechanism, which has been tested using the "two-step method."

(3) The value creation effect of digital transformation is more significant in young enterprises, enterprises in the eastern region, and non-state-owned enterprises. For mature enterprises, enterprises in the central and western regions, and state-owned enterprises, the bonus effect they obtain from digital transformation is relatively low. This research conclusion provides a reference for enterprises to seek their own development paths and for national and government policies aimed at high-quality development of the digital economy and the formulation of policies for Digital China. It expands the research boundaries of enterprise lifecycle theory, regional economic development theory, and property rights theory, among other issues.

6.2. Strategic Recommendations

Based on the research conducted in this paper and an analysis of the current macro environment, in order to help enterprises fully leverage the multiplier effect of digital transformation on the enhancement of enterprise value, the following three strategic recommendations are proposed:

Firstly, clarify the digital transformation strategy and build a data-driven culture. The Third Plenary Session of the 20th Central Committee of the Party proposed to accelerate the construction of systems and mechanisms that promote the development of the digital economy and to improve the policy system for digital industrialization and industrial digitalization. It is evident that the development of the digital economy has been elevated to an unprecedented level, and digital transformation has become a key lever in advancing the construction of Digital China. For enterprises, digital transformation is no longer an option but a necessary answer concerning their survival and development. However, the process of digital transformation must not blindly follow trends. Enterprises should first clarify their development prospects, comparative advantages, and market positioning. At the same time, they should determine the specific areas of their digital transformation, whether to focus on creating customer experiences, improving service levels, or to concentrate on product innovation and enhancing product value-added? Only by clarifying the enterprise's transformation strategy can the benefits of digital transformation be fully realized. With the official implementation of the "Interim Provisions on Accounting Treatment of Enterprise Data Resources" on January 1, 2024, it signifies the formalization and legalization of data as a core asset. This also indicates that data elements, as the main driving force to accelerate the pace of enterprise digital transformation, are of self-evident importance. Enterprises should encourage data analysis capabilities from management to employees, establish decision-making mechanisms based on data, and create a positive corporate atmosphere, making the entire enterprise imbued with a data-driven culture.

Secondly, upgrade new types of infrastructure and deepen the implementation of digital technology. In the digital age, applying emerging technologies such as the Internet, big data, and artificial intelligence to traditional infrastructure to form integrated infrastructure has become the much-discussed "new infrastructure" initiative. These flexible and powerful new types of infrastructure are the cornerstone of enterprise digital transformation. Enterprises should align with their own strategic development goals, apply R&D to technologies suitable for their comparative advantages, and serve their own industry sectors, thereby achieving a deep integration of digital transformation technology with the enterprise's own advantageous businesses. At the same time, corporate leadership should avoid falling into the trap of "theoretical discussions without practical application." The practical application of digital technology can be achieved through a process of "digital planning — business identification — business blueprint — project marketing — system selection." By adopting a "learning by doing" approach, enterprises can ensure continuous progress in the digital transformation process, promoting the creation of faster, higher, and more sustainable value.

Thirdly, optimize business processes and cultivate digital talent. The dimension of digital transformation is not only about the development and application of technology but also includes the improvement and optimization of business processes. Enterprises should base themselves on Business Process Management (BPM) and Service-Oriented Architecture (SOA) to achieve the digitalization of workflows and operations themselves, as well as automated, structured, and controlled processes. With the aid of digital transformation means, eliminate redundant process links, break down information barriers between departments, and achieve the automation and intelligence of business processes. Since digital transformation itself has a high technical barrier, the cultivation of technical talent is important. For the long-term enhancement of enterprise value, enterprises can adopt school-enterprise cooperation to provide talents who understand both business and technology. In addition, enterprises can establish incentive mechanisms to encourage employees to try and innovate new digital solutions, creating a positive atmosphere of innovation and providing a broad space for talent growth and development.

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