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Does the Digital Transformation of an Organization Improve the Quality of Internal Controls?

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Abstract. To explore the relationship and path mechanism between enterprise digital transformation and enterprise internal control quality, this paper selects A-share listed companies in Shanghai and Shenzhen from 2012 to 2021 as the research samples, adopts the text mining method to construct the degree of enterprise digitization metrics, empirically analyses the impact of the degree of enterprise digital transformation on the quality of enterprise internal control, and explores the path mechanism between the two from the perspective of the five elements of internal control. The results show that enterprise digital transformation can improve the quality of internal control. The results found that enterprise digital transformation can improve the quality of internal control of enterprises; that is, the two are significantly positively correlated; from the perspective of the five elements of internal control, enterprise digital transformation mainly improves the quality of enterprise internal control by improving the efficiency and ability of enterprise risk assessment, practical control activities, and improving the efficiency of information and communication; further research found that the better the degree of enterprise digital transformation, the worse the effect of financing constraints, and the worse the quality of enterprise internal control. The worse the effect, the better the quality of enterprise internal control. Heterogeneity analysis found that the magnitude of the degree of enterprise digital transformation on the quality of enterprise internal control is more remarkable in cities with low agency costs, low levels of the regional digital economy, technology-intensive enterprises, and manufacturing enterprises. The above conclusions have particular reference value for scientifically promoting the digital transformation and development of China's small and medium-sized enterprises and effectively promoting improving internal control.

Keywords: Enterprise Digital Transformation; Internal Control Quality; Financing Constraints.

1. Introduction

With the continuous development and application of digital technology, enterprise digital transformation has become an inevitable trend of modern enterprise development. Digital transformation is an inevitable trend in the development of today's enterprises, which can help enterprises improve efficiency, reduce costs, improve competitiveness, and bring more business opportunities. Digital transformation is not only a technical means but also a way of thinking and management, which brings excellent business value to enterprises. However, with the deepening of digital transformation, enterprises face more internal control problems. The development of digital technology increases the complexity and difficulty of enterprise internal control, and enterprises need to constantly explore internal control methods in the digital era to ensure the accuracy and integrity of the enterprise's financial reporting and to prevent risks such as internal fraud and external attacks.

Recently, our government has introduced a series of policies to promote enterprise digital transformation. The government has increased its support for the digital transformation of enterprises through the establishment of special funds, tax incentives, and other policies; provided a favorable environment for the digital transformation of enterprises through the construction of digital infrastructure; improved the technological level of the digital transformation of enterprises through the support of the research and development of critical technologies and the establishment of technological innovation alliances; and increased the support for the digital transformation of enterprises through the formulation of talent policies. The report of the 20th Party Congress proposes "accelerating the development of the digital economy and promoting the deep integration of the digital economy and the real economy," which points out the direction of the integration of the digital

economy and the real economy in China. Enterprises, as the main body of digital transformation, should sincerely implement the "deep integration of the digital economy and the real economy" pointed out in the report of the 20th CPC National Congress, actively embrace digital transformation, accelerate digital transformation, and digitally enable the high-quality development of the real economy. At the same time, the government should strengthen policy guidance and support and provide a favorable environment and conditions for the digital transformation of enterprises under the joint efforts of the government, enterprises, and all parties in society.

At present, scholars at home and abroad have conducted much research on the concept of enterprise digital transformation, influencing factors, the role of the results and the role of the mechanism, and the influence of internal control factors, etc., has accumulated a particular literature base, to a certain extent, for the study of the impact of the relationship between the enterprise digital transformation and the internal control of the theoretical basis and practical basis. Scholars, such as Luo Yanmei (2022) et al., have yet to study the direct relationship between the two. The study shows that the digital transformation of manufacturing enterprises significantly improves the quality of internal control and analyses the four paths from the digitalization of production, digitalization of products, digitalization of services, and digitalization of management. That is, there is a positive relationship between digital transformation and internal control for enterprises, which establishes an excellent theoretical foundation for the research of this paper.

In summary, this paper selects A-share listed companies in Shanghai and Shenzhen from 2012 to 2021 as the research sample. It conducts an empirical study in order to explore the logical relationship and path mechanism between digital transformation and the quality of internal control of enterprises and further analyses the mediating relationship of financing constraints between the two and the extent of the impact between the digital transformation of enterprises and the quality of internal control under the influence of different heterogeneous factors.

The main contributions of this paper are: first, the current research on enterprise digital transformation is mainly focused on the results of digital transformation and the role of the mechanism, and a clear relationship between digital transformation and the quality of internal control and the impact of the path of the literature is still relatively small, and this paper focuses on the relationship between the digital transformation of enterprises and the impact of the enterprise's internal control and found that the digital transformation of the enterprise helps to improve the quality of the enterprise's internal control. This paper focuses on the relationship between digital transformation and internal control of enterprises and finds that digital transformation helps to improve the quality of internal control of enterprises, which enriches the research literature on digital transformation and internal control to a certain extent; secondly, this paper focuses on analyzing and arguing the utility of the path of digital transformation to improve the quality of internal control of enterprises from the perspective of the five elements of internal control. It presents the ideas and initiatives for small and medium-sized enterprises facing digital transformation. Third, this paper also explores the mechanism of financing constraints in the relationship between digital transformation and the quality of corporate internal control. Fourthly, this paper tests the whole sample regarding agency costs, regional digital economy level, factor intensity, and manufacturing firms to explore the degree of influence between enterprise digital transformation and internal control quality under the influence of different heterogeneous factors.

2. Literature Review and Research Hypothesis

2.1. Literature Review

1) Enterprise Digital Transformation

In recent years, enterprise digital transformation has become the focus of contemporary scholars' research, and the existing literature related to enterprise digital transformation is mainly researched from concept definition, influencing factors, economic consequences, and transformation paths.

This paper focuses on the economic consequences and transformation paths of digital transformation of enterprises, and the research mainly involves corporate performance, surplus management, the corporate division of labor, productivity, corporate valuation, corporate governance, audit pricing, capital market performance, risk-taking, accounting information, readability of annual reports, and corporate sustainability. Most of the scholars' research focuses on its impact on corporate performance, involving corporate performance, financial performance, operational performance, market performance, and innovation performance.

The empirical results of most scholars' studies indicate that enterprise digital transformation has a positive effect on enterprise performance, and that enterprise digital transformation has a positive effect on enterprise performance through cost reduction0[2][3].The digital transformation of the enterprise is a positive contribution to the performance of the enterprise through cost reduction, human resource utilisation efficiency enhancement0[2] internal learning orientation and external network relationship embedding[5] The results of most scholars' studies show that digital transformation positively contributes to enterprise performance, It significantly promotes the degree of supply chain integration[2][4] The results show that digital transformation has a positive impact on enterprise performance through cost reduction[5][6][7] Leveraging government policies such as financial subsidies and support[6] and reducing the gross profit margin of products and the sales expense ratio[8] and reduce the sales expense rate, etc., which in turn improve enterprise performance. Some scholars have suggested a negative correlation between enterprise digital transformation and enterprise performance. For example, Anna Xiao (2022) argues that the digitization of manufacturing enterprises significantly negatively impacts enterprise performance and verifies that digital transformation can improve enterprise performance by reducing costs and lowering asset turnover.[9] In addition, scholars focus on a specific industry or a type of enterprise to analyze the impact of enterprise digital transformation on enterprise performance, such as small and medium-sized enterprises (SMEs), private enterprises, high-tech enterprises, textile enterprises, real enterprises, manufacturing enterprises, and agriculture, logistics industry, etc.

In addition to the significant impact of digital transformation on enterprise performance, it also affects market performance, financial performance, etc. For example, Lina Liang et al. (2022) pointed out that digital transformation not only has a significant positive impact on enterprise market performance but also has a significant negative impact on the short-term financial performance of enterprises, and there is a "U"-shaped relationship between digital transformation and long-term financial performance of enterprises.[10]It is further shown that digital transformation can reduce the cost of enterprises (production cost[11][12],financing costs[11][13],transaction costs[14]), expand market share[12] increase the efficiency of management[11][13] increasing the output of technological innovation[11] Reducing financial risk[15] and thus improve financial performance, and due to increased transaction costs and increased investment in technological innovation[11] and high hidden costs[16] and dependence on high investment and management costs[17] and economic policy uncertainty[15][18] which in turn inhibit the enhancement of firms' financial performance or make it decline. Qi Yudong and Cai Chengwei (2020) found that digitization can promote enterprise business model innovation. However, it will also change the enterprise's original business processes, triggering holistic dislocation and increasing enterprise management costs. The two paths positively and negatively offset each other, thus not significantly impacting the enterprise's financial performance.[19] In addition, Liu et al. (2023)[20] suggested that digital transformation of distribution enterprises significantly promotes the improvement of business performance; Duan Huayou et al. (2022)[21] studied that digital transformation significantly improves the level of innovation performance of enterprises.

In addition to studying the relationship between enterprise digital transformation and performance, some scholars have also studied the relationship between digital transformation and other factors of enterprise development. Among them, there is a positive contribution of enterprise digital transformation to most of the factors involved in the research factors, such as enterprise total factor productivity[22], company valuation[23], corporate governance level[24] corporate governance level,

enterprise risk-taking level[25][26] Comparability of accounting information[27][28] corporate sustainability[29] the more readable a company's annual report is[30] and stock liquidity[30]. Some elements, such as surplus management, correlate negatively[31]. In addition, some scholars have different research conclusions on the same element. Such as the impact of enterprise digital transformation on audit pricing[31][33]and share price crash risk[34][35].

2). Factors affecting the quality of internal controls

The current research on the quality of internal control has been going on for a long time; many scholars have conducted theoretical and empirical research from various perspectives. This paper reviews the literature related to the factors affecting the quality of internal control.

Literature has been published on a comprehensive and in-depth study of the factors influencing the quality of internal control in terms of the enterprise's asset size, financial status, operational status, level of corporate governance, organizational structure, stage of development, and corporate culture.

Positive influences mainly include intense product market competition, degree of financial marketization, degree of marketization and legal system and media attention, corporate culture, hiring of Big 4 accounting firms, government audits, internal control audits, institutional investor research, non-state shareholders, short-selling mechanism, major shareholders' short-selling behaviors, information technology backgrounds of the directors, absence of controlling shareholders, average educational qualifications of the executive team, corporate life cycle, etc. In contrast, the average age and tenure of the executive team, government intervention, and clan identity of the chairman and general manager show negative correlations with internal control quality. The degree of party organization governance involvement has an inverted U-shaped relationship with internal control effectiveness.

3). Enterprise digital transformation and internal controls

In recent years, enterprise digital transformation has been the focus of scholars' research, which has had different impacts on various aspects of enterprise development, and internal control, as an important perspective for evaluating enterprise development over the years, has also been the focus of scholars' research. More scholars in the study of the relationship between enterprise digital transformation and various perspectives of enterprise development, the internal control as the intermediary effect between the two or the impact of the mechanism for elaboration, such as some scholars believe that enterprise digital transformation can strengthen the quality of internal control to enhance the comparability of accounting information.[28][29]

In contrast, there still needs to be more research literature that directly investigates the relationship between digital transformation and the internal control quality of enterprises and the mechanism path of how it affects them. For example, Zhang Qincheng and Yang Mingzeng (2022) and Wang Song and Liu Zhuoya (2023) found that digital transformation promotes internal control quality by improving the efficiency of internal control operation[36][37] Cheng, Leah and Hu, Xiuqun (2022) found that digital development of enterprises mainly improves the quality of internal control by improving the internal environment of the enterprise, improving risk management and enhancing the information and communication capabilities of the enterprise.[38]Eunice Wang and Jiacai Zhang empirically examined that the enhancement effect of digital transformation on the quality of internal control is mainly achieved by improving corporate agency problems and enhancing external media monitoring.[39]Wu, Jingtai, and Dong, Yue (2023) found that digital transformation improves corporate disclosure quality by reducing surplus management and enhancing the quality of internal control.[40]

In summary, the existing literature has studied in detail the economic consequences of digital transformation and the transformation path, and the influence factors of internal control, which provides a good foundation for the study of this paper and provides indirect support for further in-depth and improved research on the relationship between the digital transformation of enterprises affecting the quality of internal control of enterprises, as well as the mechanism of its influence. Based

on this, this paper explores the enhancement effect of enterprise digital transformation on the quality of enterprise internal control from the new perspective of enterprise digital transformation affecting internal control. It combines existing research with an in-depth analysis of the influence mechanism and the conditions of the role. In today's extensive development of enterprise digital transformation construction, studying the impact of enterprise digital transformation on the quality of internal control as soon as possible will help enterprises to analyze the impact and economic effect of digital transformation from the internal control level, help further to improve the quality of the development of listed companies, and promote more enterprises to enter and improve digital transformation better and faster.

2.2. Research Hypotheses

At present, there is an existing research literature on the relationship between enterprise digital transformation and internal control and the impact of the mechanism of theoretical analysis and research hypotheses. Most scholars, from the perspective of the five elements of internal control of enterprises, carry out specific analyses and elaboration. Scholars from the enterprise digitalization path carry out theoretical research.

The digital transformation of enterprises makes cloud computing, big data, the Internet of Things, and other advanced digital technologies and traditional industries gradually achieve in-depth integration and promotes the systematic reshaping of enterprise management, which will bring disruptive innovations to the enterprise management model, which will inevitably bring a significant impact on the internal control of enterprises, prompting the internal control of enterprises to produce the whole element, the whole process, and the whole system of change, and have far-reaching impact on the quality of the internal control of enterprises. It will have a far-reaching impact on the quality of internal control of enterprises. Internal control is an essential operation and management measure for enterprises to prevent the risk of violating laws and regulations, ensure the truth and integrity of financial information, and promote enterprises' sustainable development.COSO's internal control framework believes the internal control system consists of five elements: internal environment, risk assessment, control activities, information and communication, and internal supervision. In this paper, we will use the five elements of internal control to analyze the impact of digital transformation on the quality of internal control in enterprises and to elaborate both positively and negatively. Digital transformation will comprehensively affect the elements of internal control. Theoretically, digital transformation may either improve internal control quality or negatively affect internal control quality. The role of digital transformation in companies on the quality of internal control is mainly reflected in the following aspects:

First, the digital transformation of enterprises has improved the internal environment of enterprises and, thus, the quality of their internal controls. Internal control is the core corporate governance system, and the internal environment is the basis for enterprises to implement internal control. In the process of enterprise digital transformation, on the one hand, the use of emerging technologies and innovation not only reduces internal and external communication costs but significantly optimizes the efficiency of capital use under the constraints of limited funds.[31] On the one hand, the use and innovation of emerging technologies not only reduce internal and external communication costs but also significantly optimize the efficiency of capital use under limited capital constraints, also breaking the traditional organizational structure with the decentralized and disintermediated features of the digital environment it constitutes, and the mobile Internet, big data and other technologies enable top managers to learn the frontline information such as the sales side and the logistic network in a timely, accurate and comprehensive manner. The organizational hierarchy becomes more flat and networked, which can achieve a high degree of information sharing and resource synergy and enhance the organizational adaptive capacity to the external environment changes. Adaptability, which makes the internal control system capture the dynamic information of environmental changes promptly, process the information promptly to adjust the control objectives and control system to achieve the dynamic optimization of the internal control system, improve the efficiency of the self-repair of the internal

control, and reduce the defects of internal control.[41]On the other hand, with the role of digital technology, the transparency of information between enterprises and between enterprises and the market has been enhanced. The previous situation of "information silos" has been broken through, alleviating the information asymmetry between the principal and the agent of the enterprise, thus improving the environment of internal corporate governance.[38]These changes will optimize the control environment and thus improve the quality of internal controls.

Secondly, the digital transformation of enterprises has improved the efficiency and capability of enterprise risk assessment and, thus, the quality of internal control. Risk assessment is a prerequisite for practical control activities. Obtaining sufficient and appropriate information promptly and effectively identifying risk factors is the basis for practical risk assessment.[36]On the one hand, risk management methods in digitally transformed enterprises are qualitative and quantitative.[38]Through digital transformation, business managers can understand the business situation and business risks in real-time, identify, grasp, and analyze changes in corporate information and related risks on time with the help of intelligent, automated digital technology, establish an effective prediction model to accurately assess the probability of occurrence of each risk factor and possible losses, and be able to correctly classify the level of risk to help decision makers to implement the optimal response to the predestination. At the same time, it can use enterprise historical data to accurately assess the risk and timely and effectively deal with it, reduce the risk of decision-making and management in the process of enterprise production and operation activities, enhance the predictability and responsiveness of the product market, and realize the matching of resources and risks. Compared with traditional risk assessment techniques, risk assessment is more efficient.[42]Digital transformation promotes the smoother operation of enterprises' internal management activities, thus improving the effectiveness of internal control. As a result, digital technology can serve risk assessment and improve the efficiency and capability of risk assessment, thus improving the quality of internal control.

Third, the digital transformation of enterprises improves the quality of internal control through effective control activities, thus improving the quality of internal control. Digital transformation to promote the improvement of internal control operation efficiency is an important path to strengthen the quality of internal control.[43]In the process of internal control management, enterprises have improved the efficiency of authority management through digital transformation and the use of voice recognition, face recognition, identity verification and other artificial intelligence technologies, got rid of the constraints of some control activities in terms of time and location through cloud computing, mobile Internet and other digital technologies, made digital technology a new type of hold-up tool, realised the intelligence of control activities, enhanced the timeliness and Flexibility, and with the help of big data, cloud computing and artificial intelligence and other digital technologies, the data related to control activities is very easy to achieve cloud backup, and can achieve centralised processing of all data and information or be programmed to be processed, and real-time transmission to the risk assessment system for intelligent risk assessment, effectively improving the safety and standardisation of control activities, so that the operational assessment of the staff, the operational norms and the job responsibilities have scientific standards, so that the internal control system can really achieve level-by-level management, compliance and implementation, to achieve the purpose of upward and downward effect, digital technology obviously change the way of enterprise operation and management, so as to improve the efficiency of the implementation of corporate goals. It can be seen that digital technology can realize the intelligence of control activities, improve the efficiency and effectiveness of control activities, and effectively control internal control activities, which contributes to the overall improvement of the quality of internal control.[36][37]

Fourth, the digital transformation of enterprises has improved the quality of internal control by enhancing the efficiency of information and communication. The traditional enterprise information transfer and communication form is relatively single and lacks efficiency due to time and space limitations. The application of digital technology, across the barriers, so that the "instant transmission" of information and "instant communication" between individuals has become a reality,

significantly improving communication efficiency.[36]This is divided into two aspects: internal information communication and external information communication. Within the enterprise, the application of digital technology enhances the links between employees, between employees and departments, and between employees and things, and the data center constructed with the help of digital technology can efficiently collect and store the enterprise's data and achieve data sharing through the cloud platform, thus breaking the "departmental wall" within the enterprise, and eliminating the "information silo." "Information silos" and improve the efficiency of collaborative work within the enterprise.[45]Digital technology improves the organizational efficiency of enterprises, accelerates the flow of information between organizations, replaces some essential repetitive work at the same time, makes the complex work in the joint role of people and digital technology more efficient, reasonable and accurate completion, technology sharing speed up, information exchange increases, which will significantly enhance the efficiency of information transfer, and ultimately improve the quality of internal control.[37]Outside the enterprise, digital technology improves the efficiency of information collection, transmission, processing, and application, realizes the timely acquisition and rapid transmission of information related to production and operation, and forms a distributed information structure and a shared network platform.[38]It provides a richer and more open channel for communication between enterprises and external stakeholders, enabling enterprises to grasp external information in real-time and promoting information communication and exchange, and interaction within and outside the enterprise.[36]Thus, digital transformation can improve the effectiveness of information and communication within the enterprise and between the internal and external, thus improving the quality of internal control.

Fifth, the digital transformation of enterprises improves the quality of internal controls by strengthening internal oversight mechanisms. Digital transformation will lead to significant changes in enterprises' core competitive business processes and the integration of digital technologies into business processes. Through digital technology's transformation of business processes, internal oversight procedures can be integrated into all aspects of business processes, making real-time tracking, dynamic regulation, and comprehensive monitoring possible.[36]The development of digital technology has made it easier to strengthen the supervision of institutional investors, media, analysts, and other external subjects through the Internet technology platform. The business decision-making process of enterprises has become more transparent, which further enhances the supervisory power under internal control, helps to compress the space for management's opportunistic behaviors, and reduces agency problems.[44]In addition, the application of digital technology improves the speed of information processing and reduces the problem of information asymmetry in the enterprise. In the supervision process, the results can be compared in real-time with the supervision objectives and the differences to achieve the timely identification and comprehensive diagnosis of the degree of internal control monitoring and deficiencies and to carry out intelligent identification and repair of internal control deficiencies. Therefore, digital transformation can enrich the way and content of internal supervision, increase the channels of internal supervision, and realize the intelligence of internal supervision so as to strengthen the role of the internal supervision mechanism and thus improve the quality of internal control.[36]

In addition, Zhang Qincheng (2022) suggests that a series of changes in the digital transformation of enterprises will also hurt the quality of internal control, which will make the control environment complex and changeable, increase the difficulty of risk assessment, increase the content and complexity of control activities, bring more information security issues, and increase the difficulty of internal supervision.[36]

In summary, the five elements of internal control, as the core elements of the internal control system, the digital transformation of enterprises may both improve the quality of internal control and negatively affect the quality of internal control, and the relationship between the digital transformation of enterprises and the quality of internal control is not logically conclusive and thus needs to be urgently tested empirically. To this end, this paper proposes the following hypotheses:

H1: Digital transformation of enterprises improves the quality of their internal controls.

H2: The digital transformation of an organization improves the quality of its internal controls by improving the internal environment of the organization.

H3: An organization's digital transformation improves the quality of internal controls by increasing the efficiency and capability of risk assessment.

H4: Digital transformation of enterprises improves the quality of their internal controls through practical control activities.

H5: Digital transformation of enterprises improves the quality of their internal controls by increasing the efficiency of information and communication.

H6: Digital transformation of enterprises improves the quality of their internal controls by strengthening internal oversight mechanisms.

3. Research Design

3.1. Sample Selection and Data Sources

This paper selects A-share listed companies in Shanghai and Shenzhen from 2012 to 2021 as the research sample. Before 2011, fewer traditional Chinese companies implemented new technologies such as artificial intelligence, blockchain, cloud computing, and big data. After 2011, with the rapid development of China's mobile Internet, Chinese Internet companies have opened up their platform strategies, fuelling digital transformation. For this reason, this paper takes 2012 as the starting year of the sample. In addition, this paper processes the samples as follows: (1) excluding the samples of financial industries; (2) excluding the samples of ST, *ST, and PT categories; and (3) excluding the samples with missing data. After the above processing, 24,219 research samples are obtained. To avoid the bias and influence of extreme values on the test results, this paper applies 1% Winsor treatment to all continuous variables and obtains 28,205 research samples. The enterprise digital transformation index is derived from the Cathay Pacific Economic and Financial Research Database (CSMAR), the internal control index (*IC*) is derived from the Dibble-China Listed Company Internal Control Index, and the data of control variables are all from the CSMAR database.

3.2. Model Design and Variable Descriptions

This paper constructs the following empirical test model, using an econometric approach based on multiple regression analysis to test the relationship between digital transformation and internal control of enterprises:

$$IC = \beta_0 + \beta_1 Digital + \beta_2 Controls + Year + Industry + \varepsilon \quad (1)$$

If the research hypotheses of this paper are valid, then this paper expects that the regression coefficient of digital transformation of enterprises (*Digital*) should be significantly positive.

1). Explained Variables.

Internal Control Index (*IC*). Derived from the Dibble-China Index of Disclosure of Internal Controls of Listed Companies, which also lists five subcomponents for measuring the IC: the Internal Environment Index (*InterEn*), the Risk Assessment Index (*Risk*), the Control Activity Index (*Control*), the Information and Communication Index (*Information*), and the Internal Supervision Index (*InterSuper*).

2). Explanatory Variables.

Enterprise digital transformation (*Digital*). This variable is selected based on the research methodology of Wu Fei et al. for measuring digital transformation indicators, and the data is obtained from the CSMAR database of enterprise digital transformation index.

Digital transformation relies on enterprises' layout and development of key core technologies. In contrast, technologies such as artificial intelligence, blockchain, cloud computing, and big data are the basic architectures of core technologies (Qi, I.D. and Xiao; X., 2020). With this in mind, recent studies have constructed enterprise-level digital transformation indicators through a word frequency analysis method of semantic feature recognition of company annual report texts with manually defined digital keywords (Wu Fei et al., 2021; Yuan Chun et al., 2021). Drawing on these studies, this paper uses total digitized vocabulary word frequency and total sentence frequency to construct corporate digital transformation variables. Digital is the ratio of the sum of digitized vocabulary frequency in the text of the annual report to the total vocabulary of the segment of that text. In addition, considering that sentences are the essential element in linguistic expression, the reliability of analytical conclusions is relatively higher when sentences are used as the basic unit of analysis in the text analysis process (Ivers, 1991). This paper also counts the percentage of the total number of sentences containing words related to digital transformation as a proxy measure of corporate digital transformation. Specifically, *Digital111* is the ratio of the sum of the number of sentences containing digital words to the total number of sentences in the text of the annual report. The larger the values of *Digital1* and *Digital2* are, the more digital the firm is.

3). Control variables.

Table 1. Variable Definition Table

Variable Type	Variable Name	Variable Code	Variable Interpretation
Explaned Variable	Internal Control	*IC*	Dibble - Internal Control Index of Listed Companies in China
Explanatory Variable	Enterprise Digital Transformation	*Digital*	CSMAR database of enterprise digital transformation indices
Control variable	Enterprise Size	*Size*	ln total business assets
	Gearing	*Lev*	Total liabilities/total assets
	Cash flow levels	*Cfo*	Net cash flows from operating activities of the enterprise / divided by total assets
	Net interest rate on Assets	*Roa*	Net profit/total assets
	Enterprise Growth Capacity	*Growth*	(Current year's operating income - previous year's operating income)/previous year's operating income
	Number of years listed	*Lnage*	ln (current year - year of listing + 1)
	Shareholding Concentration	*Ownconl*	Shareholding ratio of the largest shareholder
	Big 4 audited or not	*Inter4*	1 if audited by an international Big 4 in the year, 0 otherwise
	Board Size	*Board*	ln total number of board members
	Proportion of independent directors	*Indep*	Number of independent directors divided by the total number of board members
	competition intensity	*Hhi*	Herfindahl index
	Vintages	*Year*	Year fixed effects
	Sector	*Industry*	2012 SEC Industry Classification Standards, Industry Fixed Effects

To improve the precision of the study, a series of control variables have been added to this paper. Concerning the existing studies, the control variables selected for inclusion are as follows: firm size (*Size*), gearing ratio (*Lev*), cash flow level (*Cfo*), net asset margin (*Roa*), firm growth capacity (*Growth*), number of years on the stock market (*Lnage*), shareholding concentration (*Ownconl*), whether or not the Big four audits (*Inter4*), Board size (*Board*), proportion of independent directors

(*Indep*), and competitive intensity (*Hhi*). The paper also controls for firm, year, and industry fixed effects. The specific variables are defined as followTable 1.

4. Empirical Findings and Research Analyses

4.1. Descriptive Statistics

The descriptive statistics of the main variables are shown in Table 2. The mean value of internal control (*IC*) is 0.361. The median is 0.371, the standard deviation is 0.061, the minimum value is 0.160, the maximum value is 0.470, and the data shows a negatively skewed distribution, which means that on the whole, the company's internal control status is good, but there is a significant gap in the status of internal control among different companies; in terms of the five grading indices for measuring internal control (*IC*), InterEn, Risk, Control, Information and Communication, and Internal Oversight. In terms of the five graded indices to measure internal control (*IC*), the Internal Environment Index (*InterEn*), Risk Assessment Index (*Risk*), Control Activity Index (*Contro*l), Information and Communication Index (*Information*), and Internal Supervision Index (*InterSuper*) all show negatively skewed distributions. The mean value of Digital is 1.415, the median is 1.099, the standard deviation is 1.393, the minimum value is 0, and the maximum value is 5.056. The data shows a favorable skewed distribution, which means that overall, the enterprise's digital transformation is in good condition. However, there is a significant gap in the degree of digital transformation among different companies.

Table 2. Descriptive statistics for each variable

VarName	Obs	Mean	Median	SD	Min	Max
IC	28205	0.361	0.371	0.061	0.160	0.470
InterEn	28205	0.074	0.075	0.031	0.000	0.160
Risk	28205	0.055	0.056	0.017	0.000	0.090
Control	28205	0.085	0.088	0.027	0.000	0.130
Information	28205	0.026	0.027	0.011	0.000	0.050
InterSuper	28205	0.121	0.135	0.038	0.000	0.160
Digital	28205	1.415	1.099	1.393	0.000	5.056
Size	28205	36.943	35.000	15.952	1.000	76.000
Lev	28205	22.269	22.086	1.296	19.863	26.269
Cfo	28205	0.430	0.422	0.206	0.057	0.910
Roa	28205	0.046	0.046	0.068	-0.159	0.241
Growth	28205	0.032	0.034	0.070	-0.329	0.192
Lnage	28199	0.169	0.103	0.419	-0.590	2.636
Ownconl	28205	2.207	2.303	0.770	0.693	3.332
Inter4	28205	33.823	31.500	14.762	8.448	74.020
Board	28205	0.058	0.000	0.234	0.000	1.000
Indep	28203	2.121	2.197	0.199	1.609	2.708
Hhi	28203	37.693	36.360	5.393	33.330	57.140

4.2. Benchmark Regression

Table 3 reports the core test results of the relationship "digital transformation of enterprises - internal control." In the benchmark regression, multiple linear regression is used. Model (1) presents the results of the regression between firms' digital transformation and internal control, where the

regression coefficient of firms' digital transformation (*Digital*) is 0.0002 and passes the 1% statistical significance test. Model (2)-Model (6) shows the regression relationship between the digital transformation of enterprises and five hierarchical measures of internal control, in which the internal environment index (*InterEn*), risk assessment index (*Risk*), and digital transformation of enterprises (*Digital*) are positively correlated at the 10% level of significance; the control activities index (*Control*), information and communication index (*Information*) are positively correlated with Digital at the 1% level of significance, and *InterSuper* is negatively correlated with *Digital* at the 5% level of significance.

Table 3. Results of baseline regression analyses

VARIABLES	Explaned variable					
	(1)	(2)	(3)	(4)	(5)	(6)
	IC	*InterEn*	*Risk*	*Control*	*Information*	*InterSuper*
Digital	0.0016***	0.0001	0.0003***	0.0006***	0.0007***	-0.0000
	(3.9776)	(0.4182)	(2.7205)	(3.2393)	(8.5316)	(-0.1208)
Size	0.0071***	0.0020***	0.0016***	0.0008***	0.0012***	0.0017***
	(13.2676)	(8.7837)	(10.7270)	(3.6941)	(10.9545)	(5.6436)
Lev	-0.0193***	-0.0103***	-0.0007	-0.0094***	0.0024***	-0.0022
	(-6.3457)	(-8.4975)	(-0.8187)	(-7.5703)	(4.2440)	(-1.2775)
Cfo	0.0085	0.0056**	0.0034**	0.0053**	-0.0026**	-0.0032
	(1.3863)	(2.0756)	(2.2728)	(1.9798)	(-2.3716)	(-0.9671)
Roa	0.0653***	0.0205***	-0.0027*	0.0059**	-0.0024**	0.0454***
	(9.4531)	(7.1525)	(-1.6879)	(1.9733)	(-2.0033)	(11.0712)
Growth	-0.0031***	-0.0011***	-0.0003	0.0002	0.0014***	-0.0032***
	(-3.6638)	(-2.7879)	(-1.4818)	(0.4999)	(9.6238)	(-5.8428)
Lnage	-0.0042***	-0.0017***	-0.0008***	-0.0028***	-0.0019***	0.0028***
	(-6.2576)	(-5.5667)	(-4.2905)	(-9.5620)	(-13.6331)	(7.6991)
Ownconl	0.0001**	0.0000***	-0.0000	-0.0000***	-0.0000***	0.0001***
	(2.0102)	(3.1673)	(-0.2779)	(-2.7840)	(-5.3898)	(5.7150)
Inter4	0.0086***	0.0049***	0.0022***	0.0006	-0.0006	0.0016
	(4.0284)	(5.1399)	(3.6995)	(0.7694)	(-1.2475)	(1.5508)
Board	0.0146***	0.0117***	0.0010	-0.0016	-0.0018***	0.0057***
	(4.8817)	(8.8957)	(1.2393)	(-1.2996)	(-3.0291)	(3.6159)
Indep	0.0004***	0.0003***	0.0000	-0.0000	0.0000	0.0001*
	(3.9905)	(7.5901)	(0.4809)	(-0.9297)	(0.2193)	(1.8141)
Hhi	-0.0025	0.0007	-0.0010	0.0038	0.0005	-0.0068*
	(-0.3917)	(0.2566)	(-0.6826)	(1.2431)	(0.4367)	(-1.7891)
Constant	0.0866***	0.0449***	-0.0175***	0.0631***	0.0045	-0.0155**
	(6.0813)	(6.4369)	(-4.3026)	(10.7341)	(1.5665)	(-2.0807)
Observations	28,182	28,182	28,182	28,182	28,182	28,182
R-squared	0.269	0.367	0.521	0.149	0.234	0.433

t-statisticsinparentheses

***p<0.01,**p<0.05,*p<0.1

This means that a higher degree of enterprise digital transformation will significantly improve the quality of enterprise internal control, which validates hypothesis H1. In this enterprise, digital transformation successfully validates hypotheses H3, H4, and H5 mainly by significantly improving the Risk Assessment Index, the Control Activity Index, and the Information and Communication Index. In contrast, H2 and H6 are not validated.

4.3. Robustness Tests and Endogeneity Treatment

1). Substitution of explanatory variables

In order to test the robustness of the findings, for one thing, this paper replaces the explanatory variable, the continuous variable enterprise digital transformation (*Digital*), with a dummy variable 0-1 variable (*digital*), which is averaged by industry, and assigned a value of 1 if more significant than the average, and 0 if less than the average. According to the above hypothesis testing steps, the regression still uses the industry year double fixed effect model to ensure that the control variables remain unchanged. The results are shown in Table 4. As shown in Table 4, the regression coefficients of the 0-1 variable (*digital*) in the model (1) are still cheerful at the 1% level of significance, which indicates that the research conclusions are still robust after replacing the measurement methods of the variables, and again verifies that hypothesis H1 is valid. Secondly, this paper selects Yuan Chun and other scholars (2021) to replace the digital transformation indicators with the processing of data related to digital transformation indicators. The regression results are as follows in Table 4.The regression coefficients are still cheerful at the 1% level of significance, as shown in column (2) of Table 4, which indicates that the research conclusions are still robust after replacing the indicators of the explanatory variables, and again verifies that Hypothesis H1 is valid.

2). Narrowing the sample

This paper initially selected 2012-2021 Shanghai and Shenzhen A-share listed companies as the research sample; in order to test the robustness of the research conclusions, this paper narrows the sample scope to 2016-2021 by the above hypothesis testing steps under the premise of ensuring that the control variables remain unchanged, the regression is still using the industry, year double fixed-effects model. The results are as Table 4 shows: the regression coefficient of enterprise digital transformation (*Digital*) in the model (3) is significantly positive at the 1% level, which indicates that the research conclusions are still robust after narrowing the sample scope of the measurement method, and once again verifies that Hypothesis H1 is valid.

3). Independent variables lagged by one period

Results of the main regression analysis Table 4 show that enterprises carrying out digital transformation can effectively improve the quality of enterprise internal control. However, considering the endogeneity issue, the quality of enterprise internal control may also, to a certain extent, inversely affect the degree of enterprise digital transformation, i.e., the two are causally related to each other, triggering biased regression results. In addition, although this paper looks at factors that may impact the quality of corporate internal control, there may still be unobservable factors that affect the empirical results. Therefore, to mitigate the endogeneity problem that leads to biased results, reference is made to the existing literature, and the regression is conducted with one-period lagged digital transformation (*L.Digital*) as the explanatory variable. The regression results are shown in Table 4. Model (4) shows that the results still show the regression coefficient of *L. Digital* is significantly positive at the 1% level, indicating that the implementation of digital transformation in the lagged period still promotes the improvement of the quality of internal control of the enterprise, and Hypothesis H1 still holds.

4). PSM regression

Considering the sample selection bias problem, this paper adopts the PSM propensity score method to match the sample so that the enterprises that carry out digital transformation and those that do not

have digital transformation have similar individual characteristics to ensure that the average treatment effect can be accurately estimated.

Table 4. Robustness test & Endogeneity test

VARIABLES	Explained Variable (*IC*)				
	(1)	(2)	(3)	(4)	(5)
	Replacement of dummy variables (*digital*)	Replacement of Yuen Chun Digital Indicator	Reduced sample size	Lag one phase	PSM
Digital		0.0018***	0.0015***		0.0014***
		(3.2746)	(3.7886)		(2.8525)
L. Digital				0.0015***	
				(3.5626)	
digital	0.0019**				
	(2.4800)				
Size	0.0073***	0.0073***	0.0057***	0.0067***	0.0071***
	(13.5833)	(13.4446)	(10.5472)	(11.9831)	(10.3350)
Lev	-0.0192***	-0.0192***	-0.0185***	-0.0180***	-0.0203***
	(-6.2808)	(-6.2553)	(-5.9658)	(-5.6130)	(-5.2948)
Cfo	0.0071	0.0078	0.0116*	0.0179***	0.0061
	(1.1505)	(1.2718)	(1.7848)	(2.7054)	(0.7591)
Roa	0.0651***	0.0648***	0.0582***	0.0703***	0.0710***
	(9.2504)	(9.1668)	(8.1205)	(9.5576)	(7.5390)
Growth	-0.0030***	-0.0030***	-0.0013	-0.0028***	-0.0028**
	(-3.5235)	(-3.5437)	(-1.4507)	(-2.9569)	(-2.5017)
Lnage	-0.0043***	-0.0042***	-0.0037***	-0.0029***	-0.0037***
	(-6.3400)	(-6.2403)	(-5.5551)	(-3.5916)	(-4.3752)
Ownconl	0.0001*	0.0001*	0.0000	0.0001**	0.0001**
	(1.9045)	(1.9402)	(0.7534)	(2.1091)	(2.4813)
Inter4	0.0083***	0.0084***	0.0121***	0.0123***	0.0072***
	(3.9198)	(3.9366)	(5.7805)	(5.5486)	(2.7727)
Board	0.0149***	0.0149***	0.0120***	0.0148***	0.0149***
	(4.9539)	(4.9256)	(3.9973)	(4.7754)	(4.0506)
Indep	0.0004***	0.0004***	0.0004***	0.0004***	0.0004***
	(4.1290)	(4.0703)	(3.8743)	(3.8764)	(3.5226)
Hhi	-0.0030	-0.0034	0.0094	-0.0017	-0.0041
	(-0.4627)	(-0.5265)	(1.2562)	(-0.2519)	(-0.5027)
Constant	0.0810***	0.0830***	0.2058***	0.1666***	0.0863***
	(5.7298)	(5.8624)	(14.4480)	(11.2969)	(4.8975)
Observations	27,741	27,616	19,139	23,335	15,109
R-squared	0.269	0.268	0.116	0.181	0.261

t-statisticsinparentheses

***p<0.01,**p<0.05,*p<0.1

Dummy variables for the digital transformation of enterprises are set, and the portion of the degree of digital transformation that is more significant than the sub-industry mean is taken as 1, indicating that the enterprise carries out digital transformation. The remaining portion is taken as 0. Among them, the enterprise's internal control (*IC*) quality is taken as the explanatory variable. The size of the enterprise, the balance sheet ratio, the level of cash flow, the net asset interest rate, the enterprise's growth ability, the number of years of listing, the concentration of equity, and whether or not the Big Four international audits, board size, proportion of independent directors, and competitive intensity as the characteristic variables for 1:1 nearest-neighbor matching and score matching, and the matched samples are regressed again. After matching, the balance test results show that most of the covariates are no longer significantly different between the treatment and control groups. The results are shown in Table 4 Model (5). The regression coefficients are still significantly positively correlated at the 1% level, suggesting that the conclusions of this paper are still robust after accounting for the sample self-selection problem.

4.4. Further analysis

1)Mechanism test

This paper also explores whether financing constraints affect the relationship between firms' digital transformation and internal control quality. Wang Jingyong and other scholars (2022) empirically show that SMEs carrying out digital transformation can effectively reduce financing constraints;[45] Li Li and Zhang Di (2019) showed that the higher the quality of internal control, the lower the degree of corporate financing constraints. [46] Therefore, this paper selects financing constraints as the mediating variable. That is, it is assumed that enterprises' digital transformation improves the quality of internal control by alleviating financing constraints. The financing constraint is adopted as the KZ index, and the data is obtained from the Cathay Pacific database (CSMAR). Table 6 reports the test results of the mediating effect of financing constraints between internal control quality and firms' digital transformation. The mediating effect of financing constraints between firms' digital transformation and internal control is tested using stepwise regression, and the results are as follows. Table 5 of (1), (2), and (3) are shown. It can be seen that the regression coefficients between financing constraints and the quality of corporate internal control are negatively correlated at the 5% significant level, which means that the worse the financing constraints are, the better the degree of corporate internal control quality is. This indicates that financing constraints mediate the relationship between enterprise digital transformation and internal control; that is, the better the degree of enterprise digital transformation, the worse the effect of financing constraints, and the better the quality of enterprise internal control.

2) Heterogeneity analysis

In the previous tests, this paper verifies the impact of firms' digital transformation on firms' internal control quality based on a full-sample perspective. It confirms the impact of the two after robustness tests. However, there may be asymmetric effects of corporate digital transformation on internal control quality under different firm attribute differences, and exploring such cases can help develop differentiated policy directions. Therefore, this paper conducts a sub-sample test of the entire sample with agency costs, regional digital economy level, firms' factor intensity, and whether they are manufacturing firms. The results of the heterogeneity analysis are shown below.

a) Agency Cost

This paper chooses the overhead ratio to represent the firm's agency cost. Management expense ratio = management expense/operating income. This paper takes the continuous variable management expense ratio (*Mfee*) as the median. The original value is assigned as one if it is greater than the median and 0 if smaller. According to Table 6 among the models (1) and (2), the results show that the effect of the degree of digital transformation of the firm on the quality of the firm's internal control is positively correlated at the 1% significant level and the magnitude of the effect is greater for firms with low agency costs. This phenomenon may be because when firms with low agency costs undergo

digital transformation due to fewer agency problems, digital transformation is more about efficiency, innovation, and growth than solving internal control problems.

Table 5. Mechanism test results

VARIABLES	(1)	(2)	(3)
	IC	*KZ*	*IC*
KZ			-0.0009***
			(-2.9886)
Digital	0.0016***	-0.0236**	0.0016***
	(3.9776)	(-2.1240)	(3.9257)
Size	0.0071***	-0.3534***	0.0068***
	(13.2676)	(-22.7890)	(12.4364)
Lev	-0.0193***	6.4532***	-0.0134***
	(-6.3457)	(76.7314)	(-3.6414)
Cfo	0.0085	-14.9089***	-0.0051
	(1.3863)	(-90.3898)	(-0.6701)
Roa	0.0653***	-4.5342***	0.0611***
	(9.4531)	(-24.4165)	(8.7689)
Growth	-0.0031***	-0.2089***	-0.0033***
	(-3.6638)	(-8.5034)	(-3.8689)
Lnage	-0.0042***	0.4410***	-0.0038***
	(-6.2576)	(21.9986)	(-5.5367)
Ownconl	0.0001**	-0.0052***	0.0001*
	(2.0102)	(-5.6730)	(1.8696)
Inter4	0.0086***	0.2217***	0.0088***
	(4.0284)	(3.9773)	(4.1138)
Board	0.0146***	-0.0499	0.0145***
	(4.8817)	(-0.6342)	(4.8660)
Indep	0.0004***	0.0050*	0.0004***
	(3.9905)	(1.9426)	(4.0353)
Hhi	-0.0025	-0.2576	-0.0027
	(-0.3917)	(-1.5707)	(-0.4284)
Constant	0.0866***	7.4042***	0.0933***
	(6.0813)	(17.4106)	(6.5082)
Observations	28,182	28,182	28,182
R-squared	0.269	0.736	0.269

t-statisticsinparentheses

***p<0.01,**p<0.05,*p<0.1

However, internal control risks are higher for firms with higher agency costs due to more severe agency problems. Such firms need to focus on internal control improvements in addition to pursuing efficiency and innovation when digitally transforming in order to reduce the risks associated with

agency costs. Therefore, the degree of digital transformation of enterprises with low agency costs has a more significant impact on internal controls, as high agency cost enterprises need digital transformation more to address internal control issues. In contrast, low-agency-cost enterprises focus more on business development and innovation.

b) Regional level of digital economy

Table 6. Results of heterogeneity analysis 1

VARIABLES	Agency Cost		Regional level of digital economy	
	(1)	(2)	(3)	(4)
	Higher	Lower	Higher	lower
Digital	0.0921**	0.2084***	0.1231***	0.1346***
	(1.9880)	(4.6251)	(2.5805)	(3.0628)
Size	0.5608***	0.6105***	0.6942***	0.5944***
	(9.3111)	(11.2924)	(10.7663)	(11.7682)
Lev	-2.8163***	-1.9241***	-2.1522***	-2.3016***
	(-8.9981)	(-5.9586)	(-6.1472)	(-8.0296)
Cfo	1.9898**	0.9973	1.2011	1.4436**
	(2.5212)	(1.4389)	(1.4838)	(2.1089)
Roa	2.7565***	1.5587**	1.6455***	3.8292***
	(5.4291)	(2.5185)	(3.2143)	(6.5960)
Growth	0.0009	-0.0093***	-0.0843***	-0.0060**
	(0.1828)	(-3.6601)	(-2.7238)	(-2.5460)
Lnage	-0.3573***	-0.3041***	-0.3486***	-0.3485***
	(-4.5706)	(-4.2067)	(-4.0605)	(-5.1080)
Ownconl	0.0099***	0.0024	0.0060	0.0063*
	(2.6728)	(0.6966)	(1.5198)	(1.9302)
Inter4	1.2353***	0.7390***	0.6406**	1.1617***
	(4.4022)	(3.6866)	(2.2499)	(5.6973)
Board	1.5893***	1.1951***	1.4107***	1.3754***
	(4.8708)	(3.9998)	(4.0695)	(4.7727)
Indep	0.0378***	0.0490***	0.0428***	0.0417***
	(3.4327)	(4.9958)	(3.5963)	(4.4329)
Hhi	-0.1127	-0.8606	1.2394	-1.6484**
	(-0.1256)	(-1.0265)	(1.2526)	(-2.1018)
Constant	12.3088***	10.5423***	8.9398***	11.5722***
	(7.6306)	(7.5091)	(5.1065)	(8.7623)
Observations	11,970	12,233	9,257	14,946
R-squared	0.232	0.280	0.234	0.265

t-statisticsinparentheses

***p<0.01,**p<0.05,*p<0.1

This paper is based on the white paper "China Regional Digital Development Index Report" published by CCTC Kelida Planning and Design Institute in 2021, which lists the top 30 cities in the regional digital development index, according to the division of the enterprise's office address, assigning the value of 1 to Market and the rest of the value of 0. The regression results of the sub-sample are shown in Table 6. The results from model (3) and model (4) show that the impact of the degree of digital transformation of enterprises on the quality of internal control of enterprises is more positively correlated at the 1% significance level in cities that are not ranked in the top 30. This phenomenon may be because external pressures such as government, regulators, or market competition may prompt enterprises to pay more attention to improving internal control quality. At the same time, the digital transformation of enterprises may bring about more significant improvement in the efficiency of resource allocation. Hence, enterprises in these cities need to use digital transformation to help them manage and control their business, reduce the risk of internal control, and improve the enterprise's overall competitiveness.

c) Factor-intensive perspective of the enterprise

Based on the factor-intensity perspective, we expect digital development to substantially increase the degree of servicing in capital- or technology-intensive firms. In this paper, the sample is divided into three categories according to the following order of precedence: capital-intensive firms (net fixed assets to total assets > median, assigned *Company* as 1), technology-intensive firms (R&D expenditures to main business revenues > median, assigned *Company* as 2), and labor-intensive firms (non-1 non-2 assigned *Company* as 3). From Table 8 the results of models (5), (6), and (7) in Table 8, it can be seen that the coefficients of the impact of the degree of digital transformation on the quality of internal control in all three types of firms are significantly positive, i.e., capital-intensive is significant at the 1% level, technology-intensive is significant at the 5% level, and labor-intensive is significant at the 10% level. In comparison, the spillover effect of digital development on the quality of internal control is more substantial for capital-intensive firms. This may be because the core assets of capital-intensive firms are usually physical assets, such as plant and equipment. The value of these assets largely depends on their utilization, maintenance, and management. The more significant effect of digital transformation on internal control is that these enterprises usually involve complex funding processes and financial transactions. Digital transformation can improve funding processes' automation, monitoring, and auditing capabilities, strengthen internal control and risk management, and reduce potential errors and risks. In contrast, the core assets of technology-intensive firms are usually intangible assets such as intellectual property rights and technical secrets, the value of which depends mainly on the firm's R&D and innovation capabilities. While digital transformation can also improve productivity, management efficiency, and financing efficiency for technology-intensive firms, these advantages are relatively weak. Thus, digital transformation is more effective for internal control in capital-intensive firms.

d) Whether manufacturing enterprises

In different industries, the degree of development of enterprises' digital transformation varies. More literature has been explored and found that the degree of digital transformation of manufacturing enterprises relative to other industries is higher. Therefore, this paper expects that the degree of digital transformation of enterprises on the quality of internal control of enterprises in the manufacturing industry is more significant. The definition of the manufacturing industry is assigned a value of 1, and the non-manufacturing industry is assigned a value of 0. The results of the sub-sample regression are as follows: Table 7 The regression coefficients between enterprise digital transformation and internal control quality are more significant and positively correlated at a 1% significance level for manufacturing enterprises. In contrast, the regression coefficients of the explanatory variables are not significant for the samples of other industries, as shown in models (8) and (9) of Table 7. This suggests that the contribution of digital transformation to internal control quality is reflected in the manufacturing sector. This phenomenon may be because digital transformation can help manufacturing enterprises optimize production processes, improve quality management to monitor and manage product quality in real-time, as well as achieve information sharing and collaboration

between internal and external supply chains to improve the transparency and efficiency of the supply chain; at the same time, enterprises can use big data and data analytics technology to achieve in-depth analysis of production and sales data to understand the market demand, and to better At the same time, enterprises can use big data and data analysis technology to understand market demand through in-depth analyses of production and sales data, and better identify, assess and manage supply chain risks, quality risks, and other risks, thus improving the quality and efficiency of internal control and promoting the sustainable development and competitiveness of enterprises.

Table 7. Heterogeneity regression results 2

VARIABLES	Factor intensity of enterprises			Whether manufacturing enterprises	
	(5)	(6)	(7)	(8)	(9)
	Capital-intensive	Technology-intensive	Labour-intensive	YES	NOT
Digital	0.1695***	0.1637**	0.1066*	0.1859***	0.0677
	(3.7649)	(2.4324)	(1.6953)	(5.8307)	(1.4594)
Size	0.6391***	0.6004***	0.6231***	0.5671***	0.6241***
	(11.5187)	(7.2039)	(8.2290)	(12.3323)	(9.4792)
Lev	-2.4825***	-2.0590***	-2.1452***	-2.0770***	-1.6480***
	(-8.0363)	(-4.4392)	(-4.9653)	(-8.1393)	(-4.2471)
Cfo	1.3273*	0.0888	2.0650**	0.8692	0.6876
	(1.7974)	(0.0808)	(2.0426)	(1.3952)	(0.7125)
Roa	2.4514***	3.7914***	2.2605***	3.5384***	2.8016***
	(4.4899)	(4.3048)	(3.2240)	(6.4956)	(5.1084)
Growth	-0.0066***	0.0045	-0.0466	-0.0086**	-0.0048*
	(-2.8347)	(0.2760)	(-1.4516)	(-1.9975)	(-1.7073)
Lnage	-0.3346***	-0.3661***	-0.3359***	-0.3318***	-0.4678***
	(-4.4496)	(-3.3620)	(-3.2547)	(-5.5454)	(-4.7347)
Ownconl	0.0065*	0.0080	0.0054	0.0021	0.0068
	(1.8275)	(1.5703)	(1.0897)	(0.7412)	(1.4582)
Inter4	0.9226***	0.8843**	0.9782***	0.7041***	1.5700***
	(4.0871)	(2.4808)	(3.1275)	(3.5756)	(5.6044)
Board	0.9456***	1.4704***	2.0510***	1.8525***	-0.1966
	(3.0614)	(3.2260)	(4.6842)	(7.2082)	(-0.4862)
Indep	0.0316***	0.0538***	0.0529***	0.0568***	0.0025
	(3.0655)	(3.5407)	(3.6555)	(6.6736)	(0.1789)
Hhi	-1.5944*	1.5742	-1.1175	-0.6655	-1.1326***
	(-1.7736)	(1.2141)	(-0.9648)	(-1.5419)	(-3.5633)
Constant	12.0944***	10.1980***	8.7975***	11.6383***	16.1433***
	(8.2940)	(4.5926)	(4.2582)	(10.8996)	(10.3931)
Observations	12,038	5,733	6,432	17,712	6,491
R-squared	0.257	0.257	0.257	0.246	0.234

t-statisticsinparentheses

***p<0.01,**p<0.05,*p<0.1

5. Conclusion and Insights

This paper selects A-share listed companies in Shanghai and Shenzhen from 2012 to 2021 as the research sample, empirically examines the relationship between enterprise digital transformation and enterprise internal control, and draws the following conclusions: firstly, enterprise digital transformation improves the quality of enterprise internal control, i.e., there is a significant positive correlation between the two; secondly, from the point of view of the five elements of internal control, enterprise digital transformation improves the quality of internal control of the enterprise mainly by improving the efficiency and capability of risk assessment, practical control activities, and improving the efficiency of information and communication to improve the quality of corporate internal control. Third, the paper conducts robustness tests by replacing explanatory variables and reducing the sample size. The findings remain the same, as they use lagged one-period and PSM tests to deal with endogeneity issues. This suggests that enterprise digital transformation can improve internal control quality while being affected by external macro-environmental factors and enterprise micro-characteristic factors. Fourth, the mediation effect test finds that the better the degree of corporate digital transformation, the worse the effect of financing constraints, and the better the quality of corporate internal control. Fifth, the heterogeneity analysis finds that the magnitude of enterprise digital transformation on the quality of internal control of enterprises is more significant in cities with low agency costs and low levels of regional digital economy, technology-intensive enterprises, and manufacturing enterprises.

Based on the above conclusions, the paper makes the following recommendations:

From the social point of view, the government should actively guide the development of the digital economy, accelerate the construction of digital information infrastructure, and provide an excellent social environment for the company's digital transformation, as well as recognize the close relationship between the company's digital transformation and the characteristics of the industry and the development of the region and formulating supporting incentive policies in conjunction with the relevant circumstances, to better realize the quality of the internal control that is enhanced by the digital transformation. Secondly, the regulatory authorities should focus on the advantages of digital technology, with the help of digital technology, to supervise the information disclosure work of enterprises. They can also incorporate the digital transformation of enterprises into the appraisal system to promote the implementation of digital transformation.

Investors can actively use efficient and convenient digital technology to make up for their shortcomings in information search and promptly grasp enterprises' disclosure information. At the same time, based on traditional information access channels such as financial reports and analysts' reports, they should promptly monitor enterprises' accounting information with the help of digital media technology and make joint efforts with enterprises and regulators to enhance the efficiency of capital market operation. In addition, digital transformation requires a large amount of capital investment, and the cycle is long and slow to show results; financing constraints can become a stumbling block in corporate transformation. Financial institutions should combine the financing needs of transforming companies, innovate financial products, improve financial support for digital transformation companies, alleviate the financing constraints they face, and promote digital transformation. Give full play to the enhancement effect on the quality of internal control.

From the point of view of the enterprise itself, enterprises need to recognize and grasp the development opportunities of digital transformation. They can start from the perspective of the five elements of internal control, discover and find the deficiencies and shortcomings in the digital transformation process of enterprises, and gradually improve the internal control deficiencies and enhance the core competitiveness of enterprises. Specifically, first, enterprises should make full use of the new generation of digital technology to call for massive data in real time, access to adequate information to achieve a high degree of information sharing and resource synergy, to achieve the dynamic optimization of the internal control system, improve the efficiency of the internal control self-repair, reduce internal control deficiencies, and further improve the internal control system to

create a collaborative control of the internal environment. In addition, grasp the gradually increasing information transparency between enterprises and between enterprises and the market and use it to optimize the operating costs of enterprises and the efficiency of capital use. Secondly, enterprise managers should identify, grasp, and analyze changes in corporate information and related risks with the help of new-generation digital technology, establish risk prediction models, accurately identify risk points, and formulate optimal coping strategies using artificial intelligence to enhance the efficiency of risk assessment and coping. Thirdly, through digital transformation, enterprises have realized the intelligence of control activities, enhancing the timeliness and flexibility of control activities. With the help of digital technology, the data related to control activities can be backed up in the cloud, processed centrally or programmed, and transmitted in real-time to the risk assessment system for intelligent risk assessment, which effectively improves the security and standardization of control activities, thus improving the efficiency of the implementation of corporate goals. Fourthly, enterprises should fully use the "instant transmission" of information and "instant communication" between individuals achieved by digital technology, which significantly improves communication efficiency. Digital transformation can enrich the way and content of internal supervision, increase the channels of internal supervision, and realize the intelligence of internal supervision to strengthen the role of the internal supervision mechanism and then improve the quality of internal control. Fifth, enterprises should integrate digital technology into business processes, internal oversight procedures implanted in the entire process of business processes, real-time tracking, and comprehensive monitoring have become possible, reducing the probability of error or fraud and strengthening the internal oversight mechanism. Of course, enterprises in the digital transformation process need to improve the understanding and skill level of employees and management further on digital transformation.

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