

The Impact of Digital Transformation on Enterprise Innovation

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Abstract: By adding cutting-edge technology and digital tools to enhance the effectiveness of data analysis and application, digital transformation generates a more fluid innovation opportunity and space for businesses to expedite the development of new products and services. In this process, limiting financing constraints and internal controls play a key role. Financing constraints can enable enterprises to obtain sufficient support, while strengthening internal controls can effectively manage investments in digital transformation, ensure efficient use of resources, reduce risks, and enhance investor confidence. Therefore, for companies to innovate in the digital revolution, scientific financial planning and internal control mechanisms are essential. Synthesizing the paper's results, financing constraints and internal control, which combined create a situation that is conducive to innovation and offer a strong support system for businesses to achieve sustainable development, have an immediate effect on how digital transformation affects organizational innovation.

Keywords: Enterprise innovation, Digital transformation, Financing constraints, Internal control.

1. Introduction

Digital transformation refers to the close integration of the digital economy with the real enterprise, using digital intelligence technology to penetrate into the business process and operation and management of the enterprise, comprehensively empowering and managing all aspects of the enterprise's production, marketing, management and services, and comprehensively managing to enhance the overall capability of the enterprise, so as to realize the value-added objectives of the enterprise's core strategy. The new strategy, digital advancement promotes the unimpeded flow and utilization of data between the market and enterprise departments, reforms the original production and business processes, and improves operational efficiency. The integrated use of digital information technology within the enterprise maximizes the productivity of other production to complete and optimizes the proportion and configuration of data and other factors of production to promote the optimization of the resource structure and enhance overall efficiency. Digital transformation not only optimizes the efficiency of resource allocation, but also injects new data elements, achieves resource savings through a reasonable combination of proportional structure, and creates new competitive advantages.

In this context, this paper will explore the relationship between digital transformation and enterprise innovation by choosing A-share listed companies in China from 2013 to 2022 as the research object to study the effect of digital transformation on the capacity for innovation of enterprises.

2. Theoretical Analysis and Hypothesis Formulation

In the new situation of the digital economy's development, transformative shifts are taking place in enterprise management. Enterprise digital transformation simplifies financial processing, optimizes internal data flow and preservation, reduces information non-pricing, optimizes the

digital governance system, and especially enhances R&D innovation. Digital transformation is essentially data-based, which can predict market demand, integrate human resources and intellectual capital, improve resource allocation efficiency and productivity, reduce R&D risks, material innovation inputs and share the process to implement effective control. Zheng Xiaobi, Wang Hongming [1,2] Therefore, this study puts forth hypothesis 1: Enterprise innovation is positively impacted by digital transformation.

Within the realm of the digital economy, the extensive application of digital information technologies like mobile internet, cloud computing and big data has significantly accelerated the rapid circulation of information. The information asymmetry between various business organizations has been successfully reduced by this acceleration. Chi Maomao, Lu Baochou [3,4] Enhanced information transparency plays a pivotal role in alleviating the financing limitations encountered by economic agents. This, in turn, enables them to secure substantial external investments at more favorable rates. Jiang, Fuxiu [5] Consequently, enterprises that have embraced digital transformation are well-positioned to meet the requirements of the digital economy. They are capable of attracting the attention and backing of external investors, increasing their chances of acquiring resources for innovation and technological advancements. This enables them to reduce information asymmetry, alleviate financial constraints associated with innovation initiatives, and elevate the standards of innovation within their operations. Therefore, this study puts forth hypothesis 2: Financing constraints can be effectively decreased by digital transformation, thus enhancing enterprise innovation.

An institutional system of enterprise risk assessment, management decision-making activity control, information and communication control, and supervision is internal control. A good control environment is the basis for continuous optimization of the organizational structure, clear distribution of authority, and reduction of principal-agent problems arising within the company. By expanding

information disclosure capabilities and motivation, lowering disclosure costs and uncertainty, reducing information asymmetry, enhancing external oversight, and improving decision-making, digital transformation can improve corporate governance. Li, Z. B. [6] Internal control can be improved in every way by digital transformation, including its effectiveness and flexibility, frequency of risk capture, identification, and dynamic management decisions, effectiveness of decision-making interactions with businesses, and quality of internal control. Therefore, this study puts forth hypothesis 3: Enterprise internal control can be effectively increased through digital transformation, fostering enterprise innovation.

3. SAMPLE Selection and Study Design

3.1. Sample and Data

The subject of the study object for this paper is A-share listed companies from 2013 to 2022. The sample is evaluated using the following standards: (1) excluding ST and *ST listed enterprises; (2) excluding samples with serious missing data; (3) excluding financial listed companies. Finally, 4473 sample enterprises are screened in this paper. Considering that the outliers may affect the empirical results, the upper and lower 1% Winsorize shrinkage tail is applied to all continuous variables. The CSMAR database provided the financial data for this study, and STATA 16 was used to carry out the regression analysis.

3.2. Variable definitions, As shown in table 1 below

Table 1. Variable definition table

Variable Types	Variables	Symbols	Definition
Explained variables	Enterprise innovation	Nov	R&D investment to operating revenue
Explanatory variable	Digital transformation	Dig	Guotaian Digital Transformation Degree Index
Intermediary variables	Financing constraints	Fin	Dividend Payout Level
	Internal control	Inter	Dibble Internal Control Index
Control variables	Enterprise Performance	ROA	Total Return on Assets
	Enterprise size	Size	Log of total assets
	Gearing ratio	Lev	Total liabilities / total assets
	Equity concentration	Top1	Shares held by the largest shareholder as a percentage of all shares
	Operating income growth rate	Growth	(Current year's operating revenue - Prior year's operating revenue)/Prior year's operating revenue

3.3. Model design

In this paper, Model 1 is created in order to examine Hypothesis 1. $Nov_{it} = \alpha + \beta_1 Dig_{it} + \beta_2 Size_{it} + \beta_3 Lev_{it} + \beta_4 Top1_{it} + \beta_5 Growth_{it} + \beta_6 ROA_{it} + \varepsilon_{it}$ (Model 1)

To test hypothesis 2, this paper will use stepwise regression to verify the existence of its mediating role. Model

3 is a regression model of the intermediary variable financing constraints and the explanatory variable digital transformation. Model 4 is a regression model of the explained variable enterprise innovation, the explanatory variable digital transformation, the intermediary variable digital transformation, the intermediary variable financing constraints, and several control variables.

$$Fin_{it} = \alpha + \beta_1 Dig_{it} + \varepsilon_{it} \quad (\text{Model 2})$$

$$Nov_{it} = \alpha + \beta_1 Dig_{it} + \beta_2 Fin_{it} + \beta_3 Size_{it} + \beta_4 Lev_{it} + \beta_5 Top1_{it} + \beta_6 Growth_{it} + \beta_7 ROA_{it} + \varepsilon_{it} \quad (\text{Model 3})$$

To test hypothesis 3, Model 4 and Model 5 are developed in this paper. Model 4 is a regression model

of the intermediary variable internal control and the explanatory variable digital transformation. Model 5 is a

regression model of the explained variable enterprise innovation, the explanatory variable digital transformation, the intermediary variable internal control and several control variables.

$$Inter_{it} = \alpha + \beta_1 Dig_{it} + \varepsilon_{it} \quad (\text{Model 4})$$

$$Nov_{it} = \alpha + \beta_1 Dig_{it} + \beta_2 Inter_{it} + \beta_3 Size_{it} + \beta_4 Lev_{it} + \beta_5 Top1_{it} + \beta_6 Growth_{it} + \beta_7 ROA_{it} + \varepsilon_{it} \quad (\text{Model 5})$$

4. Empirical Results and Analysis

4.1. Descriptive statistics

This paper presents a descriptive statistical analysis of the variables studied: digital transformation as an explanatory variable, indicators as a control variable and enterprise

innovation as an explained variable. The results obtained are summarized in Table 2 below:

4.2. Correlation analysis

This study aimed to examine the correlation between the explanatory variable of digital transformation, the control variable indicators, and the explained variable of enterprise

innovation. The relationship between these variables is shown in Table 3 below:

Table 2. Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max	Observations
Nov	5.662811	5.623639	0.02	32.95	25573
Inter	20.26763	1.363731	17.25059	24.28758	23629
Fin	21.45877	1.427118	18.76635	25.63989	23534
Dig	17.39765	14.12581	0.39	72.19	25573
Size	22.14423	1.303298	19.69779	26.22803	23629
Lev	0.3862784	0.189361	0.055794	0.840367	23629
Growth	-0.3072096	5.792547	-37.72238	23.05203	20372
Top1	0.3020098	0.16694	0	0.719871	25573
ROA	0.0548239	0.07177	-0.220648	0.281412	25573

Table 3. Correlation analysis

	Nov	Dig	Inter	Fin	Size	Lev	Growth	Top1	ROA
Nov	1								
Dig	0.666***	1							
Inter	0.132***	0.103***	1						
Fin	-0.351***	0.263***	0.790***	1					
Size	-0.240***	0.210***	0.864***	0.906***	1				
Lev	-0.297***	0.223***	0.343***	0.541***	0.529***	1			
Growth	0.01	0.022***	0.031***	-0	-0.01	-0.065***	1		
Top1	-0.194***	0.200***	0.178***	0.186***	0.169***	0.024***	0.059***	1	
ROA	0.051***	0.019***	0.042***	0.017**	-0.082***	-0.360***	0.359***	-0.019***	1

The table above demonstrates that

Nov and Dig have a 0.666 correlation coefficient, which is significant at the 1% level.

Nov and Inter have a 0.132 correlation coefficient, which is significant at the 1% level.

Nov and Fin have a -0.351 correlation coefficient, which is significant at the 1% level.

Nov and Size have a -0.240 correlation coefficient, which is significant at the 1% level.

Nov and Lev have a -0.297 correlation coefficient, which is significant at the 1% level.

Although there is a 0.01 link between Nov and growth, it is not noteworthy.

Nov and Top1 have a -0.194 correlation coefficient, which is significant at the 1% level.

Nov and ROA have a 0.051 correlation coefficient, which is significant at the 1% level.

4.3. Multicollinearity test

Multiple linear regression assumes that there is little association between the explanatory factors and the data in order to prevent biased analytical outcomes. The multiple cointegration test was therefore performed in this study prior to the multiple regression, and the test results are shown in Table 4 below:

Table 4. Multiple cointegration test

Variable	VIF	1/VIF
Lev	1.71	0.585167
Size	1.51	0.661662
ROA	1.35	0.740975
Growth	1.16	0.864238
Dig	1.1	0.913011
Top1	1.07	0.93513
Mean VIF		1.32

The expansion factors of the explanatory variables digital transformation Dig and several control variables, as can be seen from the above table, are all less than 5, demonstrating that the data utilized in this study are appropriate for the next level of empirical analysis and that there are no serious integration problems.

4.4. Basis regression and robustness test

In this paper, OLS, fixed effects, and random effects will be used to regress Model1 respectively. The specific regression results are shown in Table 5 below:

The regression coefficient of Dig is 0.2304, and the t-value is 121.27, which is strongly positive correlated at the 1% level,

according to the OLS regression results. It suggests that the level of enterprise innovation increases with the degree of digital transformation of listed enterprises.

The regression coefficient of Dig is 0.0906 and the t-value is 28.91, which is highly positively correlated at the 1% level, as can be observed from the FE regression findings. The regression coefficient of Dig, which has a t-value of 62.01 and is strongly positively associated at the 1% level, is 0.1576 according to the results of the RE regression. In general, it agrees with the OLS results. It shows that the regression model that underlies this study passes the robustness test and that Chinese listed enterprises' digital transformation has a strong positive influence on their ability to innovate.

4.5. Test of mediation mechanism

The validity of Hypothesis 2 will be examined in this

section by an analysis of the regression findings from Models 3 and 4. The regression results are shown in Table 6 below:

Table 5. Regression results

	OLS	FE	RE
	Nov	Nov	Nov
Dig	0.2304***	0.0906***	0.1576***
	-121.27	-28.91	-62.01
Size	-0.0337	0.3985***	0.0646**
	(-1.46)	-11	-2.17
Lev	-4.9951***	-2.7205***	-3.5272***
	(-29.03)	(-15.22)	(-21.02)
Growth	0.0059	-0.0019	-0.0021
	-1.31	(-0.75)	(-0.81)
Top1	-1.7790***	-1.1017***	-2.1737***
	(-10.38)	(-4.21)	(-9.91)
ROA	-4.7506***	-10.1718***	-9.4763***
	(-9.64)	(-29.35)	(-27.38)
cons	4.8788***	-3.1415***	4.0081***
	-10.15	(-3.94)	-6.23
R ²	0.499	0.126	
adj. R ²	0.498	-0.105	
F	3370.8871	388.0735	
N	20343	20343	20343

Table 6. Mediation mechanism test

	Mdoel2	Mdoel3	Mdoel4	Mdoel5
	Fin	Nov	Inter	Nov
Dig	-0.0082***	0.0915***	0.0114***	0.0908***
	(-11.32)	-29.65	-11.98	-28.98
Fin		-1.3545***		
		(-23.27)		
Inter				0.1149***
				-3.76
Size		1.5964***		0.5175***
		-25.47		-10.76
Lev		-2.0529***		-2.8310***
		(-11.51)		(-15.64)
Growth		-0.0093***		-0.0022
		(-3.66)		(-0.86)
Top1		-1.5338***		-1.0776***
		(-5.94)		(-4.12)
ROA		-7.6078***		-10.0533***
		(-21.22)		(-28.90)
cons	21.3196***	-0.809	20.0743***	-3.4231***
	-1689.81	(-1.02)	-1211.84	(-4.28)
R ²	0.007	0.155	0.007	0.127
adj. R ²	-0.22	-0.068	-0.219	-0.104
F	128.1666	420.5655	143.5288	334.9309
N	23534	20256	23629	20343

t statistics in parentheses

* p < 0.10, ** p < 0.05, *** p < 0.01

According to the Model 2 regression results, Dig's regression coefficient is -0.0082 and its t-value is -11.32, both of which are significant at the 1% level. In accordance with the regression results from Model 3, Compared to Fin, which has a regression coefficient of 1.3545 and a t-value of -23.27, which are both significant at the 1% level, Dig has a regression coefficient of 0.0915 and a t-value of 29.65. In conclusion, it demonstrates how beneficial digital transformation can be in reducing enterprises' financial

constraints and fostering innovation.

According to the Model 4 regression results, Dig's regression coefficient is 0.0114 and his t-value is 11.98, both of which are significant at the 1% level. The regression findings from Model 5 demonstrate that the regression coefficients of Dig and Inter are both significant at the 1% level, being 0.0908 and 0.1449, respectively, with a t-value of 28.98 and 3.76, respectively. Enterprises' internal control can be effectively increased through digital transformation, which

will increase their capacity for innovation.

5. Research Conclusions

Based on information asymmetry theory, principal-agent theory, and dynamic capability theory, in order to examine how the digital transformation has affected the entire enterprise innovation process, this study chooses A-share listed Chinese enterprises from the years 2013 to 2022 as its research subjects. Mitigating financing constraints and enhancing the efficacy of internal control measures are crucial approaches for fostering R&D innovation. On the one hand, enterprises have more external financing, and they have more funds to invest; on the other hand, it is a difficult problem for enterprises in facing where to invest the excess funds. As a way to further explore the mediating roles that internal control and financing constraints play in the link between the two, this study also chooses internal control and financing constraints for path analysis. The following study findings are deduced:

(1) Digital transformation enhances enterprise creativity and benefits the entire enterprise innovation process.

(2) Constraints on business financing that stand in the way of enterprise innovation are made easier by digital transformation.

(3) High-quality internal control serves as a catalyst for enterprise innovation, playing a mediating role in the relationship between digital transformation and enterprise innovation.

References

- [1] Zheng Xiaobi. (2017). "+Internet", "Internet+" and economic development: a supramarginal general equilibrium analysis. *Dynamics of economics*, 2017(06):32-44. Retrieved from <https://xueshu.baidu.com/usercenter/paper/show?paperid=1540deefccf4bfdad1d07d39542f93959>
- [2] Wang Hongming, Chen Yongchang, Yang Chen. (2022). Can digitalization improve innovation factor mismatch? Based on the perspective of inter-regional flow of innovation factors. *Securities Market News*, 1-10[2022-01-04]. Retrieved from <http://docs.static.szse.cn/www/aboutus/research/secuities/daily/W020220117393817658488.pdf>
- [3] Chi Maomao, Wang Junjing, Wang Weijun. (2022). Research on the influence mechanism of corporate innovation performance in the context of digital transformation - a mixed method based on nca and sem. *Scientology Research*, 2022,40(02):319-331. Retrieved from <http://journal08.magtechjournal.com/kxxyj/CN/Y2022/V40/I2/319>
- [4] Lu Baozhou, Yin Zhentao, Zhang Yan. (2021). An exploratory study on the process and mechanism of digital transformation of traditional enterprises. *Research Management*, 2022,43(04):83-93. Retrieved from https://mp.weixin.qq.com/s?__biz=MzA4MjQ0NDE2OA==&mid=2652793621&idx=1&sn=0caf3abe00489b1139378f5d909b1ed0&chksm=846f61f2b318e8e4ab833f027660fd20bfff24fc0313953f856e32190bcb5c75d4235c1052&scene=27
- [5] Jiang Fuxiu, Shi Bebe, Ma Yunbiao. Financial experience of information publishers and corporate financing constraints. *Economic Research*, 2016,51(06):83-97. Retrieved from <https://max.book118.com/html/2019/0309/7133101003002013.shtml>
- [6] Li Zhibin, Ruan Doudou, Zhang Tiesheng. Value creation mechanism of corporate social responsibility: A study based on the perspective of internal control. *Accounting Research*, 2020(11):112-124. Retrieved from https://xueshu.baidu.com/usercenter/paper/show?paperid=13610pk0c41j0ch0fd3c0pc0f5587577&site=xueshu_se