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A Study of the Impact of Financial Resource Mismatches on the Digital Transformation of Enterprises

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Abstract

In order to explore the link between financial resource mismatch and enterprise digital transformation and the internal mechanism, this paper selects the A-share listed companies in Shanghai and Shenzhen from 2008 to 2022 as a sample, and the study shows that financial resource mismatch in China significantly inhibits the digital transformation of Chinese enterprises, and the conclusion still holds after a series of endogenous robustness tests; the test of the mechanism of action reveals that the mismatch of financial resources negatively affects the digital transformation of enterprises by exacerbating their inefficient investment. The findings reveal the impact of financial resource mismatch on enterprises' digital transformation as well as the intrinsic mechanism of its action, broaden the research perspective of financial resource mismatch and micro enterprises, and provide Chinese evidence to reveal that enterprises' digital transformation is hindered and slow to develop.

Keywords: financial resource mismatch, digital transformation, inefficient investment

1. Introduction

Digital is the "oil" of the future society (Li, 2020). As one of the keys to the deep integration of the digital economy and the real economy, the digital transformation of enterprises improves their competitiveness and contributes to their sustainable development. China's digital economy has been developing at a steady, rapid and reasonable pace, and from the "Report on the Development of China's Digital Economy" released by the China Academy of Information and Communications Technology (CAICT) for two consecutive years, we can find that the development of the digital economy has shown a trend of optimization and enhancement in terms of quantity, quality, and rate, and the tertiary industry, as a gas pedal, has become a key driver for the growth of total factor productivity in the digital economy. In particular, the tertiary industry, as an "accelerator", has become the key force driving the growth of the total factor productivity of the digital economy. Micro enterprises, as components of the real economy, should follow the development of the times and be closely connected with the development of the digital economy. However, at the end of 2022, the Report on the Development of the Digital Economy pointed out that some enterprises have the problems of "inefficiency" and "delay" in digital transformation: "inefficiency" is manifested in the "ineffective" digital transformation capability of enterprises, and "delayed" digital transformation is caused by the "ineffective" digital transformation capability of enterprises, and the "delayed" digital transformation capability of enterprises. Inefficiency" is manifested in the weak ability of enterprises in digital transformation, resulting in "not being able to turn"; "delay" is manifested in the high cost of transformation and long time-consuming transformation, leading to the phenomenon of "not willing to turn" and "not daring to turn" phenomenon (Liu, 2021). Therefore, in this context, it is particularly important and urgent to explore the deep-rooted reasons for the "inefficiency" and "delay" of enterprise digital transformation, which is the concern of many policy makers, operators and investors.

Digital transformation is an enterprise digital technological innovation activity, and it is imperative to address the issues of slow, difficult, and failed digital transformation in enterprises in a good and positive way. Throughout the world, in countries where technology ranks at the front end, a good financial system may have played a role in the modernization, systematization, and technological development of their economies, empowering that part of the world to become a major economy in the world (Sylla, 2002). Among the many studies about the digital transformation of enterprises, the content standing in the perspective of financial resource allocation has not yet been covered by research, and the efficacy of finance, as the core of the contemporary economy, in driving

economic innovation and transformation cannot be underestimated. Financial resources as a strategic resource, if there is a mismatch, its impact can not be ignored. Hsieh (2009) used relevant data for comparison, found that the resource mismatch between Chinese manufacturing enterprises to the enterprise total factor productivity and socio-economic output to bring about a 30%-50% shortfall, and even lead to the development of inefficiency or ineffectiveness (Wei, 2023). Based on the fact that enterprise digital transformation requires financial matching as well as support, and that enterprises have limited own funds, and that when funds are introduced from the outside, indirect financing dominated by banks is the main focus, if there is a mismatch of financial resources in this process, will it have an impact on enterprise digital transformation? The inefficient or even irrational allocation of financial resources that exists among industries and micro-enterprises is of no benefit to enterprise development as well as the construction of a modernized and powerful nation. Whether the misallocation of financial resources will have an impact on the digital transformation of enterprises in the process of the development of the era in which the importance of digital intelligence is rising is unclear.

Based on this, this paper investigates the impact of financial resource mismatch on the digital transformation of enterprises by using the relevant data of China's A-share listed companies in Shanghai and Shenzhen from 2008 to 2022. The results show that financial resource mismatch significantly inhibits the digital transformation of enterprises; in the mechanism test, it is found that financial resource mismatch inhibits the digital transformation of enterprises by increasing their inefficient investment.

The potential marginal contributions compared to previous articles of this paper are as follows:

First, it expands the scope of research on the impact factors of enterprise digital transformation, and expands the perspective different from that of most existing literature on the study of the economic consequences of digital transformation. This study links financial resource mismatch with enterprise digital transformation, firstly sorting out its inherent theoretical logic, then empirically examining the causal relationship between the two as well as the influence mechanism, and ultimately revealing the obstacles arising from financial resource mismatch to the process of enterprise digital transformation, thus providing a useful addition to eliminating the obstacles to the advancement of enterprise digital transformation. It finally reveals the obstacles arising from the mismatch of financial resources to the digital transformation process of enterprises, thus providing a useful supplement for the elimination of obstacles to the advancement of digital transformation of enterprises.

Secondly, from the perspective of inefficient investment, it digs deeper into the mechanism path of financial resource mismatch affecting the digital transformation of enterprises, and explores the impact of the source of financial resources on small and micro enterprises, which helps enterprises to identify and solve problems in a timely manner, and promotes the sustained and healthy development of enterprises.

The following parts of this paper are as follows: the second part summarizes the previous research and theoretical analysis, and puts forward the hypotheses; the third part is the research design part; the fourth part is the empirical results and discussion; the fifth part is the endogeneity and robustness test; the sixth part is the mechanism test; and the seventh part is the conclusions, policy insights and suggestions.

2. Extant Literature and Hypothesis Development

2.1 Extant Literature

In the real environment, digital transformation is a necessary way for enterprises to be able to survive and keep pace with the times (vial et al., 2021). Digital technology, as an important driving force for the transformation of old and new kinetic energy, has made it possible to use Internet technology to transform traditional industries and enhance the competitiveness of emerging enterprises (Lyytinen et al., 2016), and at the same time, it has become a major development strategy for most countries; it can create new kinetic energy for the development of the real economy (Gölzer et al., 2017). The current research on the factors influencing the digital transformation of enterprises is broadly divided into external factors and internal factors. Under external factors, China's government has successively introduced relevant policies to guide and support the development of enterprise digital transformation, including government subsidies, credit support, and the cultivation of technical talents and so on (Wade et al., 2015). In terms of internal factors, the "directors and supervisors" executive team, as the actual managers of the company, will inevitably have an impact on the digital transformation of the enterprise (Kane et al., 2015; Gobble et al., 2018); a positive and competitive internal development environment is crucial for the enterprise to carry out digital transformation (Holmström et al., 2018; Hess et al., 2016; Björkdahld et al., 2020). Financial resource mismatch is an important manifestation of resource misallocation, i.e., there is irrational allocation of financial resources among different regions and industries. Since the reform and opening up for more than forty years, China's development has shown a climbing speed that has attracted the world's attention, but with it there exists an incongruity and mismatch: China's financial system is still difficult to

provide efficient, high-quality and high-level services for the real economy (Bai, 2022).

2.2 Hypothesis Development

At present, digital transformation has become a core competitive advantage for reshaping enterprises. On the one hand, it can drive enterprises to improve quality as well as increase operational efficiency to a large extent, both abroad and domestically, there are studies pointing out that enterprises with a high degree of digital transformation have higher productivity (Bharadwaj, 2013), and are more capable of promoting the transformation of the old and new kinetic energy of the enterprise to lead China's economy to achieve new growth. The digital paradigm in digital transformation includes a large number of digital technologies that can empower enterprises, such as the Internet of Things, big data, artificial intelligence, etc. (Rindfleisch, 2017), which will bring about a complete realignment of organizations and strategies (Urbinati, 2018; Garzoni, 2020); and it can also make it possible for enterprises to have access to the data to lead the development of the value, which can then be used to create new opportunities (Garzoni, 2020), can provide enterprises with in-depth analysis of customer needs and meet customers' individualized needs while improving core competitiveness for the enterprise itself and opening up brand-new profit-making channels, so as to achieve the goal of enhancing the total factor productivity of enterprises. On the other hand, the current development of the times are all pointing to digitalization, enterprises are at the head of the flood tide, towards digitalization is the inevitable rather than accidental development of the times, the market environment is changing rapidly, enterprises in order not to be eliminated, choose to strengthen their own competitiveness and improve the total factor productivity of the digital transformation has become the "road to self-help", digital technology can help enterprises to adapt to the changing and dynamic environment, and to improve their core competitiveness and total factor productivity. Digital technology can empower enterprises with diverse dynamic capabilities to adapt to the changing and turbulent environment (Bharadwaj, 2013).

However, digital transformation is not an easy task, although the aforementioned digital transformation will bring disruption to the organization and strategy of the enterprise, but the digital transformation can not be directly "copied", "copy", the need for enterprises to carry out according to their own business and customer needs. Digital innovation and technological development, then the cost and effort of enterprises to be able to carry out digital transformation should not be underestimated. Research has shown that digital transformation is an iterative organizational process (Garzoni et al., 2020), including value-added and pioneering changes to the enterprise enabled by digital transformation (Barann et al., 2019), optimization of automated business processes (Lombardi, 2019), and adjustments to management tools and organizational structures (Athey, 2017; Jian et al., 2020; Tan et al., 2022), etc., and these transformations make daily operations and project management, etc., more efficient, thus making the whole enterprise more competitive (Rodic, 2017). This process requires enterprises to invest a large amount of capital, and the source of funds for enterprises, mainly through direct financing and indirect financing, direct financing is manifested in the form of financing without going through financial institutions such as the issuance of securities or enterprise content financing, and indirect financing is manifested in the form of bank credits and so on, which are mediated by financial institutions. The Statistical Report on the Stock of Social Financing in 2022 shows that the balance of RMB loans issued to the real economy accounted for 61.7% of the stock of social financing in the same period, which shows that the current bank-led indirect financing is still an important source of financial resources for the real economy, and if the allocation of financial resources is difficult to be distributed in accordance with the requirements of the maximum value of the production efficiency of each industry, then a mismatch of financial resources will be formed.

Financial resources as scarce resources, if it is difficult to flow to high-quality and efficient enterprises or sectors, then the efficiency of financial resource allocation will be difficult to ensure (Williamson, 1979). In the real context, the existence of financial resources mismatch is unavoidable, but the degree of mismatch is significantly different. At present, China's credit market is still dominated by state-owned banks, and low-cost bank loans mainly flow to state-owned enterprises. Obviously, abundant cash stock can reduce the risks and negative impacts brought by cash fluctuations, which not only helps enterprises to meet their daily production and operation needs, but also provides a good incubation environment for them to expand reproduction and develop and improve other businesses, such as digital transformation. However, when low-cost bank loans can easily flow to SOEs, problems such as overinvestment, principal-agent, overcapacity, and lack of R&D vitality may arise (Shao, 2010; Baqaee et al., 2020), and even great potential for financial leakage, i.e., large firms that are easy to finance may secondarily allocate the cheap funds they obtain to SMEs (Lu et al., 2004). Bai et al. (2022) found that in a credit mismatch environment, enterprises with excess bank borrowing are more likely to tend to engage in entrusted lending activities, and also found that when enterprises engage in entrusted lending behaviors, although it may bring additional revenue to the enterprise, it also significantly harms the enterprise's

own main business in the future, which in turn spills over to the real economy and leads to impaired development (Lu et al., 2004). To put it in another way, if enterprises maintain their original crude production methods and invest sufficient funds with relatively low capital costs in short-term projects in pursuit of short-term gains, then the time-consuming and risky digital transformation is a project that will be cut short for them, which is also detrimental to the high-quality, high-level sustainable development of enterprises. When the financial resources allocated to an enterprise are less than its normal business needs, on the one hand, it directly affects its innovation and R&D investment, internal structural upgrading and other activities, and on the other hand, it will also force this part of the enterprise to obtain funds through other abnormal channels, such as financial leakage and rent-seeking behavior. Although this can alleviate the financial needs of enterprises to a certain extent, compared with the formal channels, this will make enterprises consume a lot of non-essential human and financial resources, and even form a squeeze on the funds of other normal business (Murphy, 1993). Enterprises lack sufficient financial resources from formal financial institutions and have no time to put their energy, human and financial resources into projects that are conducive to the long-term, high-quality development of the enterprise, which will inevitably have an impact on the enterprise's ability to strengthen its competitiveness in the era of digitalization - digital transformation.

Synthesizing the above analysis, this paper proposes the following hypotheses:

H1: Financial resource mismatch will inhibit enterprises from undertaking digital transformation to a certain extent.

Investment activities are an important source of value creation for enterprises. However, when the enterprise chooses an investment project with a net present value (NPV) of less than 0 or gives up an investment project with a net present value (NPV) of more than 0, i.e., overinvestment and underinvestment occur, and investment is inefficient, and the current research refers to this phenomenon as inefficient investment. Inefficient investment will detract from the value of the enterprise, adversely affect the enterprise's own business activities, damage the enterprise's total factor productivity, and reduce the enterprise's sustainable development capability. In the past decade or so, the proportion of non-state-owned enterprises receiving bank loans was less than a quarter, and the remaining part of bank loans went to state-owned enterprises, however, when standing in the perspective of efficiency, non-state-owned enterprises are far better than state-owned enterprises in terms of the return on capital as well as the quality of investment. Originally, some of the state-owned enterprises have easy access to relatively inexpensive financial resources, bear certain social responsibilities, and are subject to more intervention in investment choices, and thus are prone to investment inefficiency due to blind expansion of investment; while enterprises that do not have access to the "deserved" financial resources due to discrimination or other reasons have investment quality guaranteed, but if they do not have access to financial resources due to discrimination or other reasons, their investment quality may be lower than that of state-owned enterprises. Although the quality of investment is guaranteed, if the mismatch of financial resources does not occur or the degree of mismatch only exists in the friction of the market environment, the quality and efficiency of investment of this part of the enterprise will be more efficient, and will avoid more underinvestment problems. Digital transformation requires firms to put in a lot of human and financial resources, so do firms have the energy to tilt their resources towards a time-consuming and risky project when inefficient investment would make them deviate from maximizing firm value.

Based on the above analysis, this paper proposes the following hypothesis:

H2: Misallocation of financial resources can lead to lower levels of digital transformation by exacerbating firms' inefficient investments and hence their digital transformation.

3. Research Design

3.1 Date Sources

In this paper, all the data of Shanghai and Shenzhen A-share listed companies from 2008-2022 are selected as the original research samples and pre-processed as follows: firstly, samples in the financial industry, ST, *ST and samples with a large degree of missing basic data are excluded; then, extreme values outside the 1%-99% of the continuous variables at the company level are Winsorized; and finally 33,860 observations are obtained. Among them, the digital transformation data used in the main hypothesis comes from the text analysis data of the company's annual report, and the rest of the data are from the CSMAR database.

3.2 Description of Variables

3.2.1 Explained Variable

Digital Transformation (Digit). In this paper, we refer to the method of Wu et al. (2021) to measure the degree of

digital transformation of enterprises based on the word frequency of "digitization" related words in the annual reports published by listed companies. Firstly, we use python crawler technology and Java PDFbox to analyze the text of annual reports of listed companies; secondly, we compare the text of the annual reports with the thesaurus of the key words related to "digitalization", and conduct searching, crawling, and statistical analysis; lastly, we count the total number of the word frequency occurrences. In order to ensure the feasibility of the study and prevent the "right skew" of this kind of data, the sum of the above word frequencies is added to one and then taken as the logarithm as the proxy variable of digital transformation in this paper.

3.2.2 Core Explanatory Variable

Financial resource mismatch (Fm). Referring to Shao Ting (2010), this paper adopts the deviation of firms' cost of capital from the average cost of capital of the industry in which they operate as a proxy variable for measuring financial resource mismatch. Namely:

$$financial\ resource\ mismatch = [interest\ expense/(debts - accounts\ payable) - Industry\ average\ interest\ rate] / Industry\ average\ interest\ rate$$

The results of the above calculations are taken as absolute values, and the larger the value, the more serious the degree of financial resource mismatch. In addition, in order to distinguish between over-allocation and under-allocation of financial resources, this paper makes the following treatment: when Fm<0, the cost of capital for enterprises to obtain funds is lower than the average cost of capital in the industry, which indicates that it is easier for enterprises to finance their behaviors; when Fm>0, the cost of capital for enterprises to obtain funds is higher than the average cost of capital in the industry, i.e., the enterprises' ability of obtaining financial resources is weaker (Shao, 2010).

3.2.3 Control Variables

Referring to previous scholars' studies and synthesizing the availability of data, the methodology of previous research designs, and the relevance to the article's research topic, this paper selects the following as control variables: at the enterprise level, this paper controls for basic enterprise characteristics such as enterprise size (Size), age of the enterprise going public (Age), size of the board of directors (Board), and the proportion of independent directors on the board of directors (Indep). Meanwhile, with reference to the study of Liu, Xilu et al. (2023), given that firms with excellent performance and surging momentum have more resources and needs for digital transformation, we control for firm value (Roa) and firm growth (Growth); at the industry level, this paper controls for the fixed effects of industry and year by adding industry dummy variables (Ind) and year dummy variables (Year). See Table 1 for a description of the specific variables.

Table 1. Variable descriptions

Variable type	Variable name	Variable definition
Explained variable	Digital Transformation	Summary of the frequency of words related to "digitization" plus 1 in natural logarithms, represented by Digit.
Explanatory variable	Financial resources mismatch	Degree of deviation from the firm's cost of capital, represented by Fm.
Control variable	Firm size	Log of total assets, represented by Size.
	Return on Assets	Net profit/total assets, represented by Roa.
	Years of business operation	Log of Difference between current year and year of registration plus one, represented by Age.
	Nature of Ownership	State-owned enterprises take the value of 1, while others take the value of 0, represented by SOE.
	Shareholding Concentration	Sum of shareholdings of top ten shareholders of the company, represented by Top10.
	Current Asset Ratio	Total current assets/owners' equity, represented by Liquid.
	Capital Structure	Total liabilities/total assets, represented by Lev.
	Board Size	Log of Number of Board of Directors plus one, represented by Board.
	Board Structure	Number of independent directors/number of directors, represented by Indep.
	Business Growth Rate	Growth rate of operating income, represented by Growth.
	Industry	Fixed effect of Industry, represented by Ind
	Year	Fixed effect of Year, represented by Year

3.3 Model Setting

In this study, in order to identify the impact of financial resource mismatch on digital transformation, so the following baseline model is set up for testing:

$$Digit_{i,t} = \theta_0 + \theta_1 Fm_{i,t} + \theta_2 Controls_{i,t} + \sum Ind + \sum Year + \varepsilon_{i,t} \quad (1)$$

Model (1) where i represents firms and t represents time. $Digit_{i,t}$ is the degree of digital transformation of listed companies quantified with reference to the method of Wu Fei et al. (2022), $Fm_{i,t}$ is a proxy variable for financial resource mismatch, $Controls_{i,t}$ is a control variable, and Ind and Year are residual terms controlling for the fixed effects of industry and year, respectively. According to hypothesis H1, this paper focuses on the coefficient θ_1 in model 1, which, if significantly negative, indicates that financial resource mismatch significantly inhibits the digital transformation of listed companies.

In order to further study the impact mechanism of financial resources mismatch on enterprise digital transformation, this paper refers to the method of Wen Zhonglin (2004) and adopts the "three-step" recursive equation to identify the channel mechanism. The model is as follows:

$$M_{i,t} = \beta_0 + \beta_1 Fm_{i,t} + \beta_2 \sum Controls_{i,t} + \sum Ind + \sum Year + \varepsilon_{i,t} \quad (2)$$

$$Digit_{i,t} = \mu_0 + \mu_1 M_{i,t} + \mu_2 Fm_{i,t} + \mu_3 \sum Controls_{i,t} + \sum Ind + \sum Year + \varepsilon_{i,t} \quad (3)$$

Model (1) where i represents firms and t represents time. $M_{i,t}$ is mediator variable, which in this paper is inefficient investment (Invest).

4. Results and Discussion

4.1 Descriptive Statistical Analysis

The descriptive statistics of the main variables are shown in

Table 2, the mean value of financial resources mismatch (Fm) is 0.565, the median is 0.482, which indicates that the financial resources mismatch phenomenon in China is widespread, and from the difference between the minimum value and the maximum value of 2.704, it can be found that there is a more obvious difference between enterprises. The mean value of digital transformation (Digit) is 1.307, the standard deviation is 1.368, the minimum value is 0, and the maximum value is 5.004, which can be found that the digital transformation of China's enterprises exists a large difference between enterprises, and the overall degree of development is not high.

Table 2. Descriptive statistical analysis

Variable	Obs	Mean	Std. Dev.	Min	Max
Digit	33860	1.307	1.368	0	5.004
Fm	33860	0.565	0.460	0	2.704
Size	33860	22.25	1.285	19.99	26.21
Roa	33860	0.0370	0.0590	-0.228	0.191
Age	33860	9.963	7.571	0	28
Soe	33860	0.372	0.483	0	1
Top10	33860	58.64	15.35	23.47	90.37
Liquid	33860	2.306	2.206	0.325	14.23
Lev	33860	0.433	0.200	0.0610	0.888
Board	33860	9.314	2.257	5	17
Indep	33860	0.379	0.0640	0.250	0.600
Growth	33860	0.332	0.860	-0.646	5.871

4.2 Empirical Results and Analysis

In this paper, hypothesis 1 is tested using least squares estimation (OLS) and the regression results are shown in columns (1)-(2) of Table 3. Column (1) does not include control variables in the regression, controlling only for year and industry, while column (2) includes control variables on top of controlling for year and industry. The results in column (2) show that the coefficient of financial resource mismatch (Fm) is -0.07, which is significantly negative at 1% level, indicating that financial resource mismatch is significantly negatively correlated with the performance of digital transformation of enterprises, i.e., the higher the degree of financial resource mismatch is, the lower the degree of digital transformation of enterprises is, which verifies the hypothesis of this paper.1 In terms of economic significance, for every 1 unit increase in the degree of financial resource mismatch, the degree of digital transformation of listed companies digital transformation degree decreases by 0.070 units.

In addition, this paper on the allocation of financial resources to explore the group, the specific operation is in

the calculation of financial resources mismatch, do not take the absolute value: when the financial resources mismatch (Fm) is less than 0, identified as the excessive supply of financial resources, at this time, the value of Fm is negative, the smaller the value, the more serious the deviation from the industry average, that is, the more serious the degree of mismatch; Fm>0, identified as the insufficient supply of financial resources, the value of Fm The larger the value of Fm, the worse the misallocation of financial resources. The regression results are shown in columns (2)-(3) of Table 3, from which it can be found that regardless of whether over-supply or under-supply occurs in the allocation of financial resources, it will significantly inhibit the digital transformation of enterprises at least at the 5% level.

Table 3. Baseline regression

Variable	Digit	Digit	Digit—OVER	Digit—SHORT
	(1)	(2)	(3)	(4)
Fm	-0.117***	-0.070***	-0.064**	-0.071***
	(-9.347)	(-5.494)	(-2.496)	(-4.621)
Size		0.156***	0.163***	0.152***
		(26.662)	(20.218)	(17.796)
Roa		-0.254**	-0.103	-0.586***
		(-2.239)	(-0.634)	(-3.583)
Age		-0.002**	-0.001	-0.003**
		(-2.008)	(-0.891)	(-1.988)
Soe		-0.185***	-0.198***	-0.194***
		(-12.965)	(-10.086)	(-9.273)
Top10		-0.002***	-0.001*	-0.003***
		(-4.334)	(-1.664)	(-5.376)
Liquid		-0.014***	-0.023***	-0.001
		(-4.144)	(-5.278)	(-0.221)
Lev		-0.223***	-0.256***	-0.095
		(-4.935)	(-4.016)	(-1.433)
Board		0.007***	0.006*	0.009**
		(2.824)	(1.798)	(2.221)
Indep		0.447***	0.436***	0.455***
		(5.010)	(3.582)	(3.503)
Growth		0.038***	0.024***	0.055***
		(5.366)	(2.785)	(4.635)
_cons	-0.059	-3.307***	-3.508***	-3.128***
	(-1.316)	(-26.292)	(-20.322)	(-17.023)
Ind	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	33860	33860	18364	15496
r2_a	0.461	0.476	0.486	0.469

Note. *, **, and *** denote significant at the 10%, 5%, and 1% levels, respectively; t-values in parentheses and adjusted for clustering at the firm level (Cluster), same below.

5. Robustness Checks

5.1 Instrumental Variable

First, considering that the choice of enterprise digital transformation is not affected by a single dimension, but also closely related to management decisions and enterprise development strategy orientation, that is, there is the possibility of omitted variables. Secondly, it is difficult to exclude the reverse causality problem between financial resource mismatch and enterprise digital transformation only from the above analysis of this paper, so this paper adopts instrumental variable method to identify and test. Drawing on the endogeneity test of Bai Jun et al. (2022), this paper uses the average value of the corresponding indicator (Fm) of the financial resources mismatch level of enterprises in the same industry and the same year as the instrumental variable (MeanFm) of "financial resources mismatch level".

The regression results and correlation tests of instrumental variables are presented in Table 4. The results of the two-stage regression are shown in columns (1)-(2), and in the first-stage regression, the coefficients of the

instrumental variables are significantly positive, i.e., it can be shown that the instrumental variables and the explanatory variables are significantly correlated. In the second-stage regression, i.e., column (2), the coefficient of financial resource mismatch (Fm) is still significantly negative, indicating that the inhibitory effect of financial resource mismatch on the digital transformation of enterprises still holds after we control the endogeneity problem, which further verifies the research hypothesis of this paper.

Before using the instrumental variables method it is necessary to ensure that the explanatory variables in the model are endogenous, this paper uses the Hausman test to obtain P=0.0224, which rejects the hypothesis that the explanatory variables are exogenous, so the use of the instrumental variables method in this paper is reasonable. On this basis there is a need to ensure that the instrumental variables are relevant, the results of the test of instrumental variables in this paper demonstrated that the Kleibergen-Paap rk LM statistic is significant at 1% level as well as the Kleibergen-Paap rk Wald F statistic is 3130.809 which is much greater than the proximate value of 16.38 at the 10% level of bias, therefore rejecting the the original hypothesis that the instrumental variable is not recognizable, again proving that the instrumental variable is reasonably valid and satisfies the requirements of relevance and exogeneity. To further ensure the reliability and accuracy of the results, this paper also conducts GMM and LIML regressions on the model, as shown in columns (3)-(4), and the results remain consistent with the previous section.

Table 4. Robustness checks: Instrumental variable

Variable	Fm-2SLS	Digit-2SLS	Digit-GMM	Digit-LIML
	(1)	(2)	(3)	(4)
MeanFm	0.985***			
	(55.954)			
Fm		-0.163***	-0.163***	-0.163***
		(-3.798)	(-3.735)	(-3.798)
Size	-0.036***	0.152***	0.152***	0.152***
	(-14.728)	(24.965)	(25.035)	(24.965)
Roa	0.447***	-0.622**	-0.622**	-0.622**
	(4.248)	(-2.457)	(-2.372)	(-2.457)
Roe	-0.469***	0.167	0.167	0.167
	(-9.716)	(1.428)	(1.432)	(1.428)
Age	0.002***	-0.002*	-0.002*	-0.002*
	(4.404)	(-1.829)	(-1.797)	(-1.829)
Soe	-0.018***	-0.186***	-0.186***	-0.186***
	(-3.041)	(-13.077)	(-13.030)	(-13.077)
Top10	-0.000	-0.002***	-0.002***	-0.002***
	(-1.102)	(-4.359)	(-4.398)	(-4.359)
Liquid	0.027***	-0.011***	-0.011***	-0.011***
	(18.752)	(-3.004)	(-3.059)	(-3.004)
Lev	-0.024	-0.238***	-0.238***	-0.238***
	(-1.265)	(-5.255)	(-5.171)	(-5.255)
Board	-0.000	0.008***	0.008***	0.008***
	(-0.149)	(2.901)	(2.877)	(2.901)
Indep	-0.039	0.443***	0.443***	0.443***
	(-1.064)	(5.079)	(4.965)	(5.079)
Growth	-0.004	0.037***	0.037***	0.037***
	(-1.346)	(5.414)	(5.259)	(5.414)
_cons	0.771***	-3.179***	-3.179***	-3.179***
	(13.927)	(-22.661)	(-23.610)	(-22.661)
Controls	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	33860	33860	33860	33860

5.2 Replacement of Explanatory Variables

In order to avoid the monotony and contingency of single-variable measurement research, this paper draws on the proxy variable selection methods of Deng (2016) and Bai et al. (2022), and uses the “regression analysis method” to estimate the excess bank loans of listed companies (Deng, 2016), which is then used as a proxy for

the degree of financial resource mismatch of enterprises (Bai et al., 2022). The first step is to use model (4) to estimate the target capital structure of the enterprise; the second step is to multiply the calculated target capital structure by the total assets to calculate the target liabilities of the enterprise; the third step is to use the target liabilities to subtract the median borrowings of the industry other than bank borrowings, and then divide by the total assets to obtain the target borrowings of the enterprise in the current year; the last step is to calculate the extent to which the target borrowings deviate from the actual bank borrowings, i.e. the degree of financial resources mismatch. Finally, the degree of deviation of target borrowing from actual bank borrowing is the financial resources mismatch, take the absolute value of this value, the larger the value, the greater the degree of financial resources mismatch faced by the enterprise. The regression results are shown in column (2) of Table 5, and it can be seen that the coefficient of financial resources mismatch (Fm2) is significantly negative, which indicates that the results of the previous study are robust.

$$Ocs_{i,t} = \alpha_0 + \alpha_1 Size_{i,t-1} + \alpha_2 Tang_{i,t-1} + \alpha_3 Ndts_{i,t-1} + \alpha_4 Liquidity_{i,t-1} + \alpha_5 Unique_{i,t-1} + \alpha_6 Growth_{i,t-1} + \alpha_7 Mb_{i,t-1} + \alpha_8 Roe_{i,t-1} + \alpha_9 Cash_{i,t-1} + \alpha_{10} Risk_{i,t-1} + \alpha_{11} Age_{i,t-1} + \alpha_{12} Dividend_{i,t-1} + \sum Year + \sum Ind + \varepsilon_{i,t-1} \quad (4)$$

Table 5. Robustness checks: Replacement of explanatory variables

Variable	Digit	
	(1)	(2)
Fm2	-0.099***	-0.034***
	(-19.380)	(-4.506)
Size		0.128***
		(14.358)
Roa		-0.212*
		(-1.689)
Age		-0.003***
		(-2.899)
Soe		-0.185***
		(-11.774)
Top10		-0.001***
		(-2.607)
Liquid		-0.003
		(-0.587)
Lev		-0.178***
		(-3.387)
Board		0.007**
		(2.362)
Indep		0.491***
		(4.922)
Growth		0.035***
		(4.536)
_cons	-0.032	-2.765***
	(-0.666)	(-14.709)
Controls	No	Yes
Ind	Yes	Yes
Year	Yes	Yes
N	27176	27176
r2_a	0.469	0.477

5.3 Replacement of Explained Variable

In order to maintain the robustness of the research results, this paper continues the other two current mainstream research enterprise digital transformation degree measurement methods: the digital transformation quantitative approach in column (2), this paper refers to the research of Zhang Yongshen (2021), and uses the ratio of the digital transformation-related portion of intangible assets to the total amount of assets as a measure of the listed company's proxy variable for the degree of digital transformation. For the quantification of the explanatory variable digital transformation in column (3), first, drawing on Yuan Chun's (2021) keyword delineation method, based on the textual descriptions in the contents of the government work reports and digital economy

development reports of previous years, keywords that can embody the characteristics of the digital transformation of the enterprise are screened out as a means of establishing a word list of the enterprise's digitalization; and then, drawing on the method of Yang Deming et al. (2019), the use the proportion of the number of word frequencies of the digitized keywords in the thesaurus appearing in the enterprise's annual report to the total number of word frequencies in the annual report as a proxy variable for the degree of the enterprise's digital transformation. The regression results are shown in Table 6: the coefficients of financial resource mismatch (Fm) in columns (2)-(3) are significantly negative at least at the 10% level, which verifies the robustness of the hypothesized results of this paper.

Table 6. Robustness checks: Replacement of explained variable

Variable	Digit	Digit-II	Digit-III
	(1)	(2)	(3)
Fm	-0.070***	-0.004*	-8.659***
	(-5.494)	(-1.685)	(-9.450)
Size	0.156***	-0.016***	5.531***
	(26.662)	(-13.542)	(13.613)
Roa	-0.254**	-0.034	-35.654***
	(-2.239)	(-1.464)	(-4.312)
Age	-0.002**	-0.001***	-0.869***
	(-2.008)	(-4.771)	(-12.302)
Soe	-0.185***	0.001	-3.438***
	(-12.965)	(0.236)	(-3.677)
Top10	-0.002***	0.000***	-0.253***
	(-4.334)	(2.949)	(-8.886)
Liquid	-0.014***	0.008***	-0.548**
	(-4.144)	(9.803)	(-2.542)
Lev	-0.223***	0.082***	-12.340***
	(-4.935)	(8.893)	(-4.093)
Board	0.007***	-0.000	-0.032
	(2.824)	(-0.166)	(-0.185)
Indep	0.447***	0.009	7.696
	(5.010)	(0.524)	(1.232)
Growth	0.038***	0.007***	1.789***
	(5.366)	(3.419)	(3.626)
_cons	-3.307***	0.275***	-103.235***
	(-26.292)	(11.522)	(-12.754)
Controls	Yes	Yes	Yes
Ind	Yes	Yes	Yes
Year	Yes	Yes	Yes
N	33860	33860	33860
r2_a	0.476	0.234	0.488

5.4 Reselection of Samples

Firms' digital transformation as well as financial resource allocation are associated with major financial shocks on a global scale, for example, in the face of a major unavoidable phenomenal financial event, the financial resource reserve itself will be impacted, and the firms' own digital transformation may face stagnation phenomenon, which, if not explored, is prone to a certain amount of endogenous disturbances that make the results less robust. In the time selection of the data in this paper, there is a severe financial shock, namely the international financial crisis (2008). Based on this, the paper draws on Tang et al. (2020) and Wu (2021) to re-select the sample, given that the current study does not have a proxy variable construct for such shocks: to exclude the impact of the international financial crisis, the paper deletes the data for 2009-2010. In addition to financial shocks, the sample data from 2011-2019 are intercepted for testing, considering that the world suffered a new crown epidemic in late 2019, which negatively affected the development of the real economy. The regression results are shown in Table 7, columns (1)-(2) in turn are the results after excluding the effects of international financial shocks and the new crown epidemic, and the regression coefficients of financial resource mismatch (Fm) are negative and all are significant at the 1% level, which verifies the negative impact of financial resource mismatch on the digital transformation of enterprises.

Table 7. Robustness checks: Reselection of samples

Variable	Digit	
	(1)	(2)
Fm	-0.069***	-0.069***
	(-4.792)	(-4.271)
Size	0.163***	0.155***
	(24.237)	(20.319)
Roa	-0.085	-0.496
	(-0.702)	(-1.453)
Age	-0.000	0.001
	(-0.211)	(0.738)
Soe	-0.214***	-0.208***
	(-13.124)	(-11.373)
Top10	-0.002***	-0.001**
	(-3.138)	(-2.264)
Liquid	-0.012***	-0.012***
	(-2.907)	(-2.765)
Lev	-0.231***	-0.272***
	(-4.481)	(-4.635)
Board	0.006**	0.008**
	(2.183)	(2.318)
Indep	0.458***	0.528***
	(4.616)	(4.687)
Growth	0.040***	0.041***
	(5.145)	(4.779)
_cons	-3.286***	-3.137***
	(-21.728)	(-18.438)
Controls	Yes	Yes
Ind	Yes	Yes
Year	Yes	Yes
N	26850	20281
r2_a	0.460	0.461

6. Mechanism Studies

The choice of proxy variables for inefficient investment, this paper draws on Richardson (2006) ‘s research model to measure the efficiency of corporate investment, the specific model is shown in the following equation:

$$Invest_{i,t} = \delta_0 + \delta_1 Size_{i,t-1} + \delta_2 Age_{i,t-1} + \delta_3 Lev_{i,t-1} + \delta_4 Cash_{i,t-1} + \delta_5 Return_{i,t-1} + \delta_6 Growth_{i,t-1} + \delta_7 Invest_{i,t-1} + \sum Year + \sum Industry + \varepsilon_{i,t} \quad (5)$$

The dependent variable $Invest_{i,t}$ denotes the new investment added by listed company i in year t, Size denotes the size of the enterprise, Age denotes the number of years the enterprise has been listed, Lev denotes the level of the enterprise’s financial leverage, Cash is the level of the enterprise’s cash flow, Return is the annual return on the enterprise’s stock, and Growth is the enterprise’s growth opportunity. The model also controls for year and industry dummy fixed effects, and after regression the residual values obtained are taken as a proxy for the level of inefficiency of the enterprise, the larger the value, the lower the level of investment efficiency of the enterprise, that is, the higher the level of inefficient investment.

The regression results of the mechanism study are shown in Table 8, the regression coefficient of financial resource mismatch in column (1) is significantly negative at the 1% level, and an increase in financial resource mismatch significantly inhibits the digital transformation of an enterprise. The regression coefficient of financial resource mismatch in column (2) is significantly positive at the 1% level, indicating that when an enterprise faces a greater degree of financial resource mismatch, the enterprise’s inefficient investment will be greater, and the regression coefficient of inefficient investment in column (3) is significantly negative at the 5% level, indicating that inefficient investment inhibits the enterprise’s digital transformation, and also the regression coefficient of financial resource mismatch is significantly negative at the 1% level, which shows that financial resource mismatch will affect the digital transformation of enterprises by increasing their inefficient investment, which verifies the hypothesis 2 of this paper.

Table 8. Mechanism study

Variable	Digit	Invest	Digit
	(1)	(2)	(3)
Fm	-0.069***	0.002***	-0.080***
	(-5.538)	(2.613)	(-5.753)
Invest			-0.260**
			(-2.004)
Size	0.155***	-0.004***	0.149***
	(26.437)	(-13.544)	(23.459)
Roa	-0.669***	-0.030**	-0.654**
	(-2.650)	(-2.481)	(-2.466)
Roe	0.209*	0.038***	0.235*
	(1.807)	(6.961)	(1.942)
Age	-0.002**	-0.000***	-0.004***
	(-2.024)	(-7.340)	(-3.593)
Soe	-0.185***	-0.009***	-0.189***
	(-12.973)	(-12.480)	(-12.505)
Top10	-0.002***	0.000***	-0.001***
	(-4.324)	(6.334)	(-3.141)
Liquid	-0.014***	-0.000	-0.001
	(-3.959)	(-1.404)	(-0.280)
Lev	-0.236***	0.013***	-0.176***
	(-5.207)	(5.617)	(-3.574)
Board	0.007***	-0.000	0.007**
	(2.880)	(-0.586)	(2.480)
Indep	0.446***	0.006	0.462***
	(5.110)	(1.310)	(4.900)
Growth	0.037***	0.001***	0.032***
	(5.442)	(3.767)	(4.338)
_cons	-3.284***	0.124***	-3.182***
	(-24.772)	(18.933)	(-22.076)
Ind	Yes	Yes	Yes
Year	Yes	Yes	Yes
N	33860.000	28637.000	28637.000
r2_a	0.476	0.077	0.479

7. Conclusions, Policy Implications and Suggestions

This paper analyzes the impact of financial resource mismatch on enterprise digital transformation and its mechanism from the theoretical level, and selects the relevant data of China's Shanghai and Shenzhen A-share listed companies from 2008 to 2022 for empirical testing. The results of the study show that (1) financial resource mismatch has a significant inhibitory effect on the digital transformation of enterprises; (2) from the perspective of the impact mechanism, financial resource mismatch will exacerbate the inefficient investment of enterprises to affect the digital transformation of enterprises, which is specifically manifested in the fact that the financial resource mismatch will increase the inefficient investment of enterprises, and furthermore, the degree of the enterprise's digital transformation will become lower.

Based on the research in this paper, the following policy recommendations are put forward: (1) First of all, from the market perspective, the market-led resource allocation mechanism should be improved, based on the development of the main market players --- enterprises themselves to rationalize the allocation and reduce the "inefficient" and "abundant capital" enterprises with hidden subsidies, so that funds really and effectively flow to the places that really need them. Reduce the invisible subsidies for "inefficient" and "capital-rich" enterprises, and let the funds flow to the places that really need them; (2) Secondly, as a financial institution, as a receiver of information, it should measure the operation status, development sustainability and future of micro-individuals of the enterprises equally as much as possible, so as to allocate the valuable financial resources to the places where they are needed the most and where they can maximize the effect. (3) Finally, as micro-individuals and as information providers, firms need to be proactive in providing information about their operations and proof of future predictability to the suppliers of funds to minimize the number of mistakes that can be made due to

oversights in the information selection process of financial institutions.

Authors Contributions

Both authors read and approved the final manuscript and all authors contributed equally to the article.

Competing Interests

Both authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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