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Business Environment and Enterprise Digital Transformation

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Abstract: The impact and mechanism of the business environment on the digital transformation of enterprises are empirically studied in this paper, which uses data from Chinese A-share listed companies from 2017 to 2021 as a sample. Based on the regional business environment score, a time-fixed effect model is constructed to examine the influence of the business environment on the digital transformation of enterprises. The empirical findings demonstrate that a favorable business environment has a substantial impact on the digital transformation of businesses. The mechanism of action for this effect is that business environment reform raises the bar for urban marketization, improves infrastructure, and fosters enterprise innovation. Subsequent analyses of heterogeneity revealed that the business environment had a greater impact on the digital transformation of enterprises in central and western areas, as well as in locations with larger levels of government participation and SOEs. The results can offer valuable perspectives for advancing the digital transformation of businesses and strengthening the reform of the business environment.

Keywords: time-fixed effects modeling, business environment, digital transformation.

1. Introduction

The ongoing advancements in artificial intelligence, blockchain, and the Internet have made digital technology a vital tool for businesses looking to boost creativity. In order to maintain a leading position and achieve sustainable development in the digital era, enterprise digitization requires significant changes to the organizational structure. As a result, the digital transformation of businesses has emerged as a key area for quality economic growth.

Business environment is the sum of institutional mechanisms and external factors such as governmental affairs, market, rule of law, humanities and ecological environment. The business environment also fosters the market economy and gives the market its oxygen, all in an effort to further optimize the environment and encourage the modernization and transformation of businesses. Consequently, one of the key avenues for investigating the digital transformation of businesses is the study of the mechanisms of the business environment.

In order to investigate the internal mechanisms of the business environment influencing the digital transformation of enterprises under a comprehensive indicator system, we will thoroughly analyze and study the various aspects of the business environment in this paper. This paper employs empirical research and regression analysis to provide a practical perspective on how the business environment impacts the digital transformation of enterprises. The ultimate goal is to assist the government and

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state in optimizing the business environment through targeted practices, mitigating the costs and risks associated with the digital transformation of enterprises, and fostering high-quality economic development.

2. Literature review

Enterprise digital transformation has become essential in today's highly developed information technology era. Studying the elements influencing an enterprise's digital transition is therefore extremely important from both a theoretical and practical standpoint. Many studies have been conducted on this topic, and after a thorough analysis of the body of research, the variables influencing an enterprise's digital transformation can be split into two groups: macro and micro.

From a macro perspective, according to Lu Shicheng, the government can effectively encourage firm transformation and upgrade by raising the tax rebate[1]. According to Zhao Xinyu, creative policies enhance the development of digital innovation talent, and then offer robust assistance for the digital transformation of businesses[2]. Luo Peng and others believe that economic policy uncertainty promotes enterprise digital transformation[3].

On the micro side, according to Wang Haoxuan research, corporate digital transformation is significantly benefited by the stability of the executive team[4]. Zhang Kequn argued that managerial characteristics contribute to firms' digital transformation tendencies and outputs[5]. According to Bai Fuping, intellectual capital helps businesses shift digitally by removing financial barriers[6].

The aforementioned studies have examined the factors influencing an enterprise's digital transformation from a variety of angles, particularly from a micro perspective. However, few studies have looked at the influence of the business environment on an enterprise's digital transformation from a macro perspective. As a result, this article directly examines how the business environment affects enterprise digital transformation and examines its internal mechanism from a variety of angles. It also integrates the two concepts into a single analytical framework.

3. Mechanism analysis and hypothesis development

Business environment will drive enterprise digital transformation through different paths[7]. Firstly, a healthy degree of marketization is necessary for the digital transformation of businesses, and a more favorable business environment raises the marketization level of cities. Secondly, the digital transformation of businesses is made possible by well-constructed infrastructure, and the enhancement of the business environment greatly encourages enhancement of the building of urban infrastructure. Thirdly, By boosting enterprise innovation vitality, the business environment's optimization greatly encourages businesses to innovate. This becomes a key factor in propelling businesses to accelerate their digital transformation. Based on this this paper proposes hypothesis 1:

The business environment has a significant impact on the digital transformation of enterprises.

4. Research design

4.1. Modeling

It can be observed that the business environment has a strong randomness and exogeneity relative to the digital transformation of enterprises. The business environment comprises the market environment, governmental environment, legal policy environment, and humanistic environment. These environments are influenced less by specific enterprises and are determined by macro conditions like local government. Thus, this research uses the time-fixed effects model for empirical testing in order to investigate how the business environment affects firms' digital transformation. The regression model is built as follows:

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$$Digital =_{it} \alpha +_0 \alpha_1 lnenvironment_{it} + \alpha_n Ctrls_{it} + \lambda_t + \varepsilon_{it}$$

When the year is indicated by the subscript t, the enterprise is indicated by i, and the explanatory variable is "lnenvironment," which is the logarithm of the business environment in the cities and provinces where various businesses are situated. $Digital_{it}$ indicates enterprise i's degree of digital transformation in year t; To absorb the confounders in the regression that are constant across time and enterprise, λ_t is a time-fixed effect; ε is a random perturbation term, and $Ctrls_{it}$ is a control variable that indicates the amount of elements besides the business environment that influence an enterprise's digital transformation. variables that impact a company's digital transformation besides the business environment; ε is a term for random disruption.

Chinese A-share listed firms from 2017 to 2021 make up the research sample for this paper. Data on listed companies were sourced from the Cathay Pacific database (CSMAR) and enterprise annual reports; ST and delisted companies were not included. The business information comes from Zhang Sanbao's study on the business climate in Chinese provinces and cities.

4.2. Selection of variables

Explained variable: digital transformation of firms (Digital).

In order to calculate the enterprise digital transformation index, which is used as a proxy variable for the enterprise's digital transformation, this paper adopts the CSMAR digital transformation database of listed companies, which is based on the data in the annual reports, fund-raising announcements, qualification accreditation, and other announcements of listed companies from 2017 to 2021.

Explanatory variable: business environment (lnenvironment).

This study uses the provincial (city) business environment reports from China for 31 provinces, municipalities directly under the central government, and 297 prefectural-level cities for the years 2017–2021. Based on various data sources, including the statistical yearbook, the study constructs first-level indicators of the market, governmental, legal policy, and humanistic environments.

Control variable

This study adds control variables at the enterprise and city levels based on its research goals and refers to the literature's current practices to rule out other factors impacting the digital transformation of organizations. The gearing ratio (Lev), return on assets (ROA), enterprise size (Size), and Tobin's Q (TobinQ) are the control variables at the enterprise level. The population, degree of urbanization, and industrial structure are the control variables at the urban level.

4.3. Descriptive statistics

Table 1 displays the variables' descriptive statistics. With a wide range between the lowest and largest values, digital has a mean value of 38.28 and a standard deviation of 10.72. This indicates that the extent of digital transformation varies greatly throughout businesses. Specifically, environmentp has a mean value of 4.044 and a standard deviation of 0.163, while environmentc has a mean value of 3.844 and a standard deviation of 0.19, which suggests that there are disparities in the business climate between cities and provinces and that regional growth is out of balance.

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Table 1: Results of descriptive statistics

	(1)	(2)	(3)	(4)	(5)
variant	sample size	average value	(statistics) standard deviation	minimum value	maximum values
digital	15,646	38.280	10.720	23.420	66.560
lnenvironmentc	15,646	3.844	0.190	3.418	4.252
lnenvironmentp	15,646	4.044	0.163	3.499	4.301
population	15,646	6.513	0.633	4.779	8.133
Urban	15,646	0.784	0.131	0.468	1.000
InduStr	15,646	0.590	0.121	0.356	0.839
Size	15,646	22.330	1.324	20.010	26.250
Lev	15,646	0.417	0.199	0.065	0.868
ROA	15,646	0.040	0.071	-0.254	0.219
TobinQ	15,646	1.941	1.208	0.834	7.615

5. Analysis of empirical results

5.1. Benchmark regression results

The findings of the overall test of business environment on the digital transformation of enterprises are presented in Table 2. Only the independent variable lnenvironment, and the dependent variable digital, are included in Column 1's regression findings. It is discovered that the coefficient for business environment is considerably positive, at the 1% statistical level. Column (2), which incorporates year-fixed effects into column (1), concludes that the urban business climate is still considerably beneficial. Business environment is still significantly favorable even if column (1) is supplemented with firm- and city-level control factors (column (3)). The business environment is still statistically favorable at the 1% level when year-fixed effects and firm- and city-level control variables are included in column (1)(Column (4)). The aforementioned test findings suggest that improving the business environment can have a positive impact on firms' digital transformation.

Table 2: Regression results on the impact of urban business environment on the digital transformation of enterprises

	(1)	**(2)**	**(3)**	**(4)**
	digital	digital	digital	digital
lnenvironmentc	11.909***	11.595***	4.144***	4.214***
	(0.442)	(0.443)	(0.734)	(0.736)
population			0.690***	0.711***
			(0.175)	(0.175)
Urban			12.924***	12.834***
			(1.003)	(1.007)
InduStr			-0.703	-1.163
			(1.034)	(1.040)
Size			1.262***	1.246***
			(0.077)	(0.078)
Lev			-3.301***	-3.269***

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Table 2: (continued).

			(0.530)	(0.529)
ROA			-23.633***	-23.212***
			(1.293)	(1.295)
TobinQ			1.058***	1.047***
			(0.074)	(0.075)
_cons	-7.503***	-7.541***	-19.778***	-20.290***
	(1.702)	(1.706)	(2.662)	(2.674)
N	15646	15646	15646	15646
R^2	0.044	0.049	0.091	0.092
YEAR	NO	YES	NO	YES
FE	NO	NO	NO	NO

Standard errors in parentheses
* $p < 0.1$,** $p < 0.05$,*** $p < 0.01$

5.2. Robustness check

(1)Replacement of independent variables

Replacing the measure of business environment from the city business environment score lnenvironmentc to the province business environment score lnenvironmentp in Column (1), the findings indicate that the business environment is still playing a major role in helping firms go digital, and the findings hold up even when the independent variable measure is substituted.

(2)Time lag effect test

Taking into account the cyclical nature of digital transformation and the time-lag effect of the business environment's impact on organizations' digital transformation, the test further extends the window period, as shown in Column (2). The regression is re-run using the business environment data in period t+1 (L.lnenvironmentc). The findings support a firm conclusion by demonstrating a considerable and constant enabling influence of the corporate environment on the degree of digital transformation in period t+1.

(3)Placebo testing

To check whether the model is correctly explaining the causal effects and not a chance result due to the specific choice of independent variables, the dependent variable is replaced with a randomly generated variable that is theoretically independent of the independent variables, i.e., random_digital, the regression is performed as shown in Column (3), and the results show that the randomly generated random_digital variable has a coefficient is insignificant with a large p-value, which indicates that the model results are robust and not due to chance results caused by the model setting or specific choice of the independent variable.

(4)Add more control variables

In order to eliminate any confounding variables that might influence the correlation between the two types of variables, other control variables ROE and Cashflow are added to the test and regressed again, as shown in Column (4), the fact that the business environment continues to play a major role in encouraging firms to undergo digital transformation shows how strong the model is.

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Table 3: Robustness test regression results

	(1)	(2)	(3)	(4)
	digital	digital	random_digital	digital
lnenvironmentp	3.283***			
	(0.603)			
L. lnenvironmentc		4.217***		
		(0.847)		
lnenvironmentc			0.042	4.251***
			(0.039)	(0.735)
control variable	YES	YES	YES	YES
	(2.767)	(3.100)	(0.357)	(2.686)
N	15646	11830	15646	15646
R^2	0.092	0.087	0.001	0.097
YEAR	YES	YES	YES	YES
FE	NO	NO	YES	NO

6. Mechanism check

6.1. Mediating check

While the preceding section has established the beneficial impact of the business environment on firms' digital transformation, the influence channel of this effect has not been examined. The subsequent mediation effect model is developed to examine the impact mechanism of the business environment on corporate digital transformation, drawing from the theoretical analysis presented in the preceding section.

$$Mid_{it} = \beta_0 + \beta_1 \, lnEnvironment_{it} + \beta_n \, Ctrls_{it} + \lambda_t + \varepsilon_{it}$$

Mid_{it} is the mediator variable, which is divided into city and firm levels, with the city level being studied in terms of marketization level as well as infrastructure, and the firm level being studied in terms of firm innovation.

(1) Market level

The marketization level in this article is determined by regressing the ratio of urban-employed workers to urban private and self-employed workers in the business environment. The findings are displayed in Table 4's column (1). The marketization level is a significant way that the business environment influences the digital transformation of firms, according to the regression coefficient, which is strongly positive at the statistical level of %1.

(2) Infrastructure

This paper measures the infrastructure level through the indicator of books in public libraries per 100 people. Findings can be seen from the data in column (2), the business environment may support firms' digital transformation by improving infrastructure, since the regression coefficient is considerably positive at the statistical significance level of %1.

(3) Enterprise innovation

In this study, the logarithm of the total plus one of the independent patent applications that businesses submitted that year was used to gauge the innovation level of those businesses. The regression findings are displayed in column (3). The coefficient is very positive at the statistical significance level of %1, confirming that the business environment may support firms' digital transformation by raising their degree of creativity.

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6.2. Analysis of moderating effects

This paper uses the number of Confucian temples within 200 kilometers of the company's registered location to measure the degree of influence of Confucian culture on enterprises in order to study the impact of the informal system on the formal business environment and the digital transformation of enterprises[8]. The interaction term between the centered business environment and Confucian culture is added, as shown in columns (4) and (5). At this point, the main effect of the business environment's coefficient is still significantly positive, but the interaction term's coefficient is significantly negative, indicating that Confucian culture has lessened the positive influence of the business environment on enterprises' digital transformation. The moderating effect results show that Confucian culture, as an informal system, has an effect that replaces the formal system of doing business.

Table 4: Mechanism test regression results

variant	(1)	(2)	(3)	(4)	(5)
	marketlevel	infrastructure	innovation	digital	digital
lnenvironmentc	0.328***	833.539***	0.653***	3.818***	3.072***
	(0.066)	(22.156)	(0.120)	(0.744)	(0.756)
CONF_200				0.550***	-0.029
				(0.128)	(0.167)
lnenvironmentc _CONF_200_c					-4.358***
					(0.804)
control variable	YES	YES	YES	YES	YES
time fixed effect	YES	YES	YES	YES	YES
_cons	2.493***	-3.1e+03***	-1.971***	-18.709***	-15.270***
	(0.187)	(62.279)	(0.435)	(2.695)	(2.767)
N	15644	15646	15637	15534	15534
R^2	0.173	0.372	0.046	0.092	0.093

7. Heterogeneity analysis

Do the location of a company and the degree of engagement from the local government have an impact on the business environment's role in the digital transformation of that company? Exist distinctions between businesses with varying property rights and executive backgrounds? This article aims to examine the variations in the effects of business environments on the digital transformation of organizations at the regional and enterprise levels.

(1)Location Heterogeneity Analysis

Due to the stark disparities, the cities in the East, Central, and West will be separated into three categories for this article. Table 5 shows the regression results for the eastern group (column (1)), where the coefficient is not significant; for the central group (column (2)), the explanatory variable coefficient is more significant; and for the western group (column (3)), where the explanatory variable coefficient is significantly positive. The findings indicate that central and western cities have a greater influence on enterprise digital transformation as a result of the business environment.

(2)Analysis of the heterogeneity of government participation

In different areas, the level of government engagement varies substantially[9]. In this study, the data are regressed and split into two groups based on the level of government participation: higher and lower. The two groups' results are displayed in columns (4) and (5). All of the explanatory variables have significantly positive coefficients, but the business environment in the regions with

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higher levels of government involvement has a greater impact on enterprise digitization, indicating that these areas offer more favorable conditions and an environment that is more conducive to enterprise digital transformation.

(3)Analysis of Property Rights Heterogeneity

The sample in this article is regressed based on the ownership type of the firm and split into state-owned and non-state-owned companies. The state-owned enterprise group's explanatory variable coefficients, as indicated in column (6), are significantly positive, whereas the non-state-owned enterprise group's coefficients, as indicated in column (7), are positive but not significant. The findings suggest that state-owned firms are more significantly impacted by the business environment when it comes to enterprise digital transformation.

(4)Analysis of Executive Background Heterogeneity

This article separates the sample into two groups and performs regressions depending on whether or not the firm's leaders have foreign experience since the attributes of executives have a significant influence on the organization. The group of executives with overseas backgrounds exhibits positive but insignificant explanatory variables in column (8), while the group of executives without overseas backgrounds exhibits significantly positive coefficients in column (9). The findings suggest that the business environment has a greater influence on an organization's digital transformation when its executives are not foreign-born.

Table 5: Heterogeneity test results

variant	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	locational heterogeneity			Government Involvement in heterogeneity		Property rights heterogeneity		Executive background heterogeneity	
	East	Central	West	Greater involvement	Smaller participation	State enterprise	Non-state enterprise	Overseas background	No overseas contexts
	Digital	*Digital*	*Digital*	*Digital*	*Digital*	*Digital*	*Digital*	*Digital*	*Digital*
lnenvironment	1.353 (0.960)	4.924** (1.982)	12.713*** (2.181)	6.500*** (1.336)	3.201*** (0.899)	6.317*** (1.215)	1.814 (0.928)	1.770 (0.999)	7.022*** (1.080)
control variable	YES	YES	YES	YES	YES	YES	YES	YES	YES
sample size	11379	2,366	1901	6543	9103	4951	10269	9488	6122
Year fixed	YES	YES	YES	YES	YES	YES	YES	YES	YES
R^2	0.092	0.097	0.064	0.104	0.100	0.072	0.132	0.078	0.103

8. Conclusions and recommendations

This study concludes that by raising the city's marketization level, perfecting infrastructure development, and enhancing businesses' capacity for innovation, business environment optimization supports the digital transformation of businesses, and in different cities and companies, the effects are different. The recommendations presented in this paper are based on the results mentioned above.

Firstly, the business environment is universal, equitable, and institutional. In order to create a more stable, fair, transparent, and predictable business environment, the government should further reform the business environment, optimize the market, the rule of law, government affairs, and the humanities environment, and strengthen infrastructure construction while promoting innovation and development, among other measures.

Secondly, digitization is an unavoidable option for the company sector's transformation, modernization, and high-caliber development. Therefore, the local government should promote deep industry-academia integration, and create an ideal digital transformation service system that provides businesses with full-chain services like design, implementation, operation, and maintenance. As a result, corporate confidence and innovation consciousness will increase, and the complexity and risk of enterprise digital transformation will be reduced.

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Thirdly, business environment reform should be customized to the requirements of various development scenarios and areas. In developed regions, policy environments should be optimized, technological innovation and the introduction of high-end talent should be encouraged; in developing regions, infrastructure development should be prioritized, in less developed regions, the concept of "digital poverty alleviation" should be investigated, and businesses should be gradually guided toward digital transformation.

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