

Research on the influencing factors of digital transformation of manufacturing industry in Jiangxi province

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Abstract: Based on the sample data of 11 prefecture-level cities in Jiangxi Province from 2011 to 2020, this paper uses text mining technology to extract the keyword frequency related to digital transformation in government reports to construct the digital transformation index of manufacturing industry. This paper empirically explores the influence of government support and scientific and technological development level on the digital transformation of manufacturing enterprises. The results show that government support and technology development level significantly promote the digital transformation of manufacturing industry. Through the robustness test, the regression results are still consistent. The mechanism analysis finds that the government support and the level of scientific and technological development can promote the digital transformation of manufacturing enterprises by influencing the credit level of financial institutions.

Keywords: Manufacturing; digitization; text mining

1. Introduction and literature review

In recent years, with the policy and technical environment becoming more and more mature, digital transformation has gradually become a necessary option for the development of enterprises, it is the only way to determine its survival and development. In this paper, through the study of the factors affecting the digital transformation of Jiangxi province, to make suggestions for the high-quality development of Jiangxi economy.

In the enterprise interior, the enterprise ability, the senior management team, the research and development investment and so on is the enterprise digitization transformation important influence factor. Wang Xinguang, based on the theory of behavioral economics, empirically analyzes the impact of managers' short-sighted behavior on the digital transformation of enterprises by using the data of listed enterprises, it is found that the short-sighted behavior of managers can significantly reduce the level of enterprise digital transformation by reducing the level of corporate governance^[1]. In the outside of the enterprise, various policies and environmental factors are the important factors that affect the digital transformation of the enterprise. Wu Fei analyzes the path that government spending on science and technology affects the digital transformation of corporations^[2]. The results show that government spending on science and technology can ease corporate financing constraints, stabilize financial conditions, and optimize corporate innovation behavior, finally promote the development of enterprise digital transformation, but there is heterogeneity in enterprise attributes and regions.

To sum up, there are still the following problems in the research of influencing factors of enterprises' digital transformation: (1) the majority of the research objects are the micro-enterprises represented by listed companies, lack of a macro-perspective from the provinces and cities to explore the impact of a regional digital transformation of factors; (2) in the digital transformation of the impact of factors selected, more focused on the internal factors of enterprises, and external factors focus on government support and related policies, the lack of other important macro-level factors to explore.

2. Theoretical analysis and research hypotheses

Research by Jin Yuchao et al. found that enterprises supported by industrial policies received more debt financing^[3]. On the other hand, manufacturing enterprises need capital to upgrade their production, marketing and R & D processes in the process of digital transformation. Tong Yu believes that the greater

the availability of corporate finance, the higher the degree of digital transformation^[4]. Based on the above analysis, the first hypothesis is put forward:

H1: government support can affect the digital transformation of regional manufacturing by affecting the credit level of financial institutions.

The level of development of science and technology has a lot of influence on financial institutions, and the development of financial technology to improve the ability of financial institutions to identify credit is one of the important content. Gu Haifeng et al. further found that technology-finance coupling synergy has a positive impact on corporate financing efficiency^[5]. As an important direction of industrial development supported by policy, digital transformation enterprises have government support, higher credit level, stronger indirect financing ability, and can get more sufficient digital transformation funds. Based on the above analysis, the second hypothesis is put forward:

H2: the development level of science and technology can affect the digital transformation of regional manufacturing industry by affecting the credit level of financial institutions.

According to the above, the support of government policies is conducive to regional digital transformation. However, with the increase of government support, has the effect of regional digital transformation been increasing? Mao Qilin et al. proposed that only moderate subsidies can significantly stimulate new product innovation of enterprises, while high subsidies inhibit new product innovation of enterprises^[6]. In the current wave of digital transformation across the country, local enterprises lack independent innovation capabilities and will be at a disadvantage in homogenization competition. Even with government support, the effectiveness of its digital transformation promotion may decline. Therefore, this paper proposes a third hypothesis.

H3: As the degree of regional digital transformation increases, the promotion effect of government support shows a trend of first rising and then declining.

3. Study design

3.1 Data sources

Considering the availability of data and the timeliness of digital transformation, this paper selects the data of 11 prefecture-level cities in Jiangxi Province from 2011 to 2020 as research samples, and the data of prefecture-level cities studied in this paper are all from the Jiangxi Statistical Yearbook, the statistical yearbook of prefecture-level cities and the work reports of prefecture-level municipal governments.

In order to further strengthen the matching between the data and the research objects in this paper, the existing data were processed as follows before regression analysis: first, linear interpolation was used to complete a very small number of missing data; The second is to add 1 to the non-proportional variable and logarithmize it, that is, $\ln(x+1)$; The third is to use the Winsor method, and the data of the 1% and 99% quantiles are defined as outliers for tail shrinking to eliminate their influence on the result deviation. 3.2 variables set.

3.2 Variable setting

3.2.1 The variable being explained

Digital Transformation (DT) in manufacturing. There are few quantitative studies on digital transformation in domestic academia, and most of them focus on qualitative research. Drawing on the text analysis method of Wu Fei et al, this paper first summarizes and sorts out the keywords on digital transformation in the existing literature, then summarizes the annual government work reports of various cities at the local level, and uses Python software to summarize the keyword frequency of "digital transformation" in various levels and cities^[2]. Based on the above methods, this paper constructs the measurement indicators of the digital transformation of regional manufacturing industry.

3.2.2 Explanatory variables

Government support (gov). Digital transformation is an important way for enterprises to integrate big data, artificial intelligence, blockchain, cloud computing and other high-tech industries for industrial transformation and upgrading, and the government can support its development through scientific and technological financial expenditure. Therefore, this paper selects the proportion of government financial expenditure on science and technology to total fiscal expenditure as an indicator

to measure government support.

Level of Scientific and Technological Development (sci). Big data, artificial intelligence, blockchain, cloud computing and other technologies are necessary conditions for the digital transformation of enterprises, and the level of scientific and technological development in the region determines that enterprises in the region have good technical conditions for digital transformation. Therefore, this paper selects the internal expenditure of R&D funds as an indicator to measure the level of regional science and technology development.

3.2.3 Control variables

This paper adds a series of control variables that may affect the digital transformation of the manufacturing industry, as follows: (1) economic development level, measured by regional GDP; (2) The level of enterprise development, measured by the proportion of the number of enterprises on regional regulations to the number of enterprises on the provincial regulations; (3) labor quality, measured by the number of graduates from colleges and universities in the region;

3.3 Model construction

3.3.1 Random-effects model

Based on the analysis in the previous part, this paper constructs the following model for the study of the influencing factors of the digital transformation of Jiangxi's manufacturing industry:

$$DT = \beta_1 X_i + \beta_2 control_{it} + \mu_i + a \quad (1)$$

Among them, β represents the regression coefficient of the respective variables, DT represents the digital level of Jiangxi manufacturing industry, X_i represents the explanatory variable, and $control_{it}$ is the control variable, μ_i is the residual term of an equation.

3.3.2 Mediation effect model

This paper draws lessons from Wen Zhonglin et al. intermediary effect analysis method to explore the influence mechanism of government support strength and scientific and technological development level on Jiangxi manufacturing digital transformation^[7]. This paper sets up the mediation effect model as follows:

$$Channel_i = \beta_1 X_i + \beta_2 control_{it} + u_i + a \quad (2)$$

$$DT = \beta_1 X_i + \beta_3 Channell_i + \beta_2 control_{it} + u_i + a \quad (3)$$

Channell_i represents a mediation variable. If both coefficients β_1 and β_3 are significant, this indicates the presence of a mediating effect.

4. Empirical results analysis

4.1 The main regression

Table 1: Main effects results

variable	(1) DT	(2) DT
gov	0.588*** (0.176)	
sci		0.228** (0.100)
control		yes
_cons	0.303 (1.853)	-2.249 (1.767)
R2	0.1913	0.1718

Table 1 show that: the greater the government's support for the digital transformation of industries in the jurisdiction, the more conducive it is to promote the digital transformation of the manufacturing industry, and the government can reduce the cost of digital transformation for enterprises through subsidies, preferential policies and other means to promote the improvement of their digital level.

The level of scientific and technological development is an important support for the digital transformation of enterprises, and the development of high-end technologies such as artificial intelligence and big data can provide the necessary external technical conditions for the digital transformation of enterprises, and effectively promote the digital transformation of the manufacturing industry.

4.2 Robustness test

4.2.1 Exclude part of the sample

Table 2: Robustness regression results

variable	(1) DT	(2) DT
gov	0.626*** (0.191)	
sci		0.340*** (0.0983)
control	yes	
_cons	2.827 (2.740)	-1.062 (2.322)
R2	0.1880	0.1917

Considering that provincial capital cities are favored by policy strength and good economic development level, factors have endogenous effects on the explanatory variables. In this paper, the sample data of Nanchang, the capital city of Jiangxi Province, was eliminated, and random effect regression was done again. The regression results are shown in Table 2 above, the government support and the level of scientific and technological development have a significant positive impact on the digital transformation of manufacturing enterprises in Jiangxi Province, and the impact of the level of opening up is still a significant negative impact, and the regression results are consistent with the main effect regression.

4.2.2 Replace the control variable

Table 3: Robustness regression results

variable	(1) DT	(2) DT
gov	0.524*** (0.178)	
sci		0.212** (0.103)
control		yes
_cons	-1.997 (1.534)	-2.708 (1.727)
R2	0.1693	0.1677

In order to test the reliability of the conclusions, this paper replaces the regional enterprise development level with the regional Internet development level of the control variable. As shown in Table 3 above, the regression coefficient results of the explanatory variables government support, the level of opening up and the level of regional scientific and technological development are still significant, indicating that the benchmark regression results are still robust.

4.3 Mechanism analysis

Table 4 shows the regression results using the credit level of financial institutions in prefecture-level cities as the intermediary variable. Specifically, (1) column shows the regression results based on model (2), the coefficient of government support is significant at 10% level, and the coefficient sign is positive, (2) the regression results based on the model (3) show that the coefficient between the credit level of financial institutions and the degree of government support are significantly positive, it indicates that the government support can promote the digital transformation of Jiangxi's manufacturing industry by influencing the credit level of financial institutions. Hypothesis 1 holds.

Table 4: results of mechanistic regression

variable	(1) FIL1	(2) DT1	(3) FIL2	(4) DT2
gov	0.0249* (0.0140)	0.497*** (0.180)		
fil		2.819** (1.251)		2.965** (1.345)
sci			0.0239*** (0.00725)	0.137 (0.106)
control			yes	
_cons	-1.396*** (0.168)	4.038 (2.523)	-1.492*** (0.138)	2.148 (2.559)
R2	0.7825	0.2267	0.7819	0.1956

Similarly, column (3) shows regression results based on model (2), where the coefficient of scientific and technological development level is significantly positive at the 1% level, (4) the regression results based on the model (3) show that the coefficient of credit level of financial institutions is significant under the level of 5%. According to the empirical results in table 3, the digital transformation of regional manufacturing industry can be promoted by influencing the credit level of financial institutions. Hypothesis 2 holds.

4.4 Analysis of heterogeneity

Table 5: Results of heterogeneity analysis

variable	(1) TD(15%)	(2) TD(25%)	(3) TD(35%)	(4) TD(50%)	(5) TD(70%)	(6) TD(85%)
gov	0.663*** (0.239)	0.472* (0.246)	0.430** (0.185)	0.576*** (0.176)	0.595** (0.264)	0.475 (0.333)
control				yes		
_cons	-3.526* (1.870)	-1.967 (2.097)	-2.471 (1.774)	-0.953 (1.944)	-0.0599 (2.535)	-1.291 (3.710)
R2	0.0233	0.0788	0.1722	0.1085	0.0074	0.0856

Drawing on the previous research experience, this paper selects 15%, 25%, 35%, 50%, 70% and 80% of the quantile points for analysis, and it can be seen from Table 5 that except for 85% of the quantiles, the regression coefficients of each quantile are significantly positive and fluctuate in [0.430, 0.663]. The regression coefficient showed a downward trend, and the 85% quantile coefficient decreased by 0.188 compared with the 15% quantile coefficient.

This shows that government funding has always played a role in promoting the digital transformation of the manufacturing industry, but the promotion effect has weakened with the improvement of digital transformation. When the degree of digital transformation of enterprises is high, the dependence on external conditions in the transformation process will be reduced, and the impact of government support as one of the external conditions will be weakened. The investment in digital transformation of enterprises is mainly reflected in the investment in scientific and technological innovation that combines high-tech such as artificial intelligence, big data, cloud computing and the production links of enterprises, which is consistent with the conclusion that "government science and technology funding plays a very significant positive role in enterprise science and technology investment, and its contribution to enterprise innovation first rises, and the effect gradually decreases after the funding level reaches a certain extreme value"^[8].

5. Conclusions

This paper uses the data of 11 prefecture-level cities in Jiangxi Province from 2011 to 2020 to empirically analyze the impact and mechanism of government support, opening up and regional scientific and technological development on the digital transformation of manufacturing enterprises in Jiangxi Province. The benchmark regression results show that the government support and regional science and technology development level significantly promote the digital transformation of manufacturing enterprises, and the level of opening up has a significant negative impact on the digital transformation of manufacturing enterprises. Institutional analysis finds that government support and regional science and technology development level can affect the digital transformation of

manufacturing enterprises by influencing the credit level of regional financial institutions. The heterogeneity analysis shows that with the improvement of the digital transformation of manufacturing enterprises, the role of government support in promoting the digital transformation of manufacturing enterprises has not always increased.

6. Advices

In recent years, China's digital economy construction has made great achievements, many enterprises have begun the road of enterprise digital transformation, how should Jiangxi manufacturing enterprises fully seize the promising historical opportunity period of digital economy development to carry out digital transformation? Based on the above research conclusions, this paper puts forward the following policy recommendations:

First, the government should continue to increase the intensity of enterprise digital transformation policies, and at the same time, strengthen policy coordination, accurately address both the symptoms and root causes, and provide financial guarantees for the digital transformation of enterprises to the greatest extent.

Second: In order to maximize the intermediary role of financial institutions, the government can give encouraging policies to promote financial institutions to innovate new financial products, which is convenient to solve the problem of financing enterprises for digital transformation.

Third: the government should implement incentive policies to promote independent scientific and technological innovation of local enterprises, only by fully encouraging enterprises to accelerate digital technological innovation and develop a digital economy with Chinese characteristics can we better enhance the resilience of economic development and provide solid support for the realization of China's innovation-driven transformation strategy.

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