Analysis of the Impact of Tax Incentive Policies on the Digital Transformation of Manufacturing Industry in Heilongjiang Province

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Abstract: Using the sample data of listed companies in Heilongjiang Province from 2012 to 2023, this article applies the double difference, two-way fixed effects and robustness analysis to find that the tax policy plays a positive incentive role in the intelligent transformation of manufacturing industry in listed companies in Heilongjiang Province The results show that, although the tax policy is universal, the tax incentive effect on manufacturing industry is better.

Key words: Manufacturing Industry; Digital Transformation; Tax Incentive Policy

1.Introduction

How to focus on the integration of new generation information technology and manufacturing industry, build a high-level industrial support, and naturally become a new engine for high- economic development. In terms of Heilongjiang Province, the scale of intelligent industry is low, and there is still a lot of room for development compared with the whole country, urgently needs to be stimulated through the analysis of tax policy tools.

2.Sources of Data and Selection of Variables

2.1 Sources of Data

Select the data of listed companies in Heilongjiang Province from 2012 to 2023, and perform relevant processing on it exclude ST-type companies; exclude samples with total assets equal to 0; exclude companies with severe missing variables; adopt linear interpolation method to supplement individual missing values; and perform % tail trimming on the variables. Finally, 11 manufacturing and 11 non-manufacturing companies are selected.The relevant data come from the annual of listed companies and the Guotai An database, and the data analysis is carried out by Stata 15.1 software.

2.2 Variable

Dependent variable: degree of intelligence.This paper uses the entropy method to calculate the total weight of the factors involved in the intelligent transformation of listed companies as a representative of the degree of intelligent transformation ， Construct the enterprise intelligent transformation index and process it by entropy method； Explanatory variables: DID is the interaction term, which is the product of the group variable and the time dummy variable; Control variables: Referring to existing, this paper selects the factors that may affect the digital transformation of enterprises, see Table 1:

Table 1 Variable definition

Variable	Symbol	Definition
Digital transformation	INT	Calculation by entropy value method
Tax policy implementation	DID	Dual difference term
Individual income tax burden	ITAX	(Income tax expense Deferred tax assets - Deferred tax liabilities) / Operating income
Basic earnings per share	EPS	Derived from the annual report of listed companies
Cost profit margin	CEP	Total profit / (operating cost taxes and surcharges selling expenses administrative expenses financial expenses)
Market value	SZ	A shares*Today's closing price B shares*Today's closing price
Financing constraint	SA	-0.737*size+0.043*size^2-0.04*age age is the difference between the year of calculation and the year of establishment, and size is the logarithm of total assets.
Tax burden	TAX	(Business tax and surcharges income tax expense) / total profit

2.3 Hypothesis and Model Selection

(1)Hypothesis.This paper proposes a basic hypothesis: tax policies have a positive incentive effect the digital transformation of

manufacturing industry and there is a crowding-out effect.

(2)Model Selection.To study the impact of tax incentive policy on the degree digitalization of manufacturing industry in Heilongjiang Province, the DID double difference model is used to infer the effect of intervention by comparing the differences before and after the policy intervention and the intervention group and the control group. Manufacturing industry is regarded as the treatment group and non-manufacturing industry as the control group. Setup a model: $\mathbf{INT_{it} = \beta_0 + \beta_1 treat_i * post_t + \alpha Control_{it} + \theta_i + \eta_t + \varepsilon_{it}}$

where: INT is the digital degree of the explained variable, $treat_i$ is the grouping dummy variable, $treat_i$=1，Otherwise

, $treat_i$=0. $post_t$ is the period dummy variable, $post_t$=1, otherwise $post_t$=0. $treat_i \times post_t$ the double difference term.

The double difference model selects 2018 as the time of tax policy intervention. In 2018, the goal of tax reduction and fee reduction first proposed, and a series of tax policies were introduced to support the development of manufacturing industry.

3.Empirical Analysis

3.1 Descriptive

After processing the data, in order to have a preliminary understanding of the continuous variables, understand the average level of the variables and individual differences of listed companies in Heilongjiang Province. Descriptive statistics were performed on the sample data of the variables needed in the model to obtain the average, minimum, maximum values of the variables,etc. and the results are shown in Table 2.

Table 2. Descriptive Statistics

VarName	Obs	Mean	SD	Min	Median	Max
INT	264	0.160	0.119	0.035	0.136	0.627
DID	264	0.250	0.434	0.000	0.000	1.000
ITAX	264	3.469	6.551	-22.360	2.308	30.170
TAX	264	46.590	89.399	-28.518	25.763	638.439
EPS	264	0.247	0.516	-1.211	0.178	2.820
CEP	264	15.054	28.760	-57.308	5.765	118.596
SZ	264	266.744	600.566	15.421	105.758	4225.386
SA	264	-3.866	0.244	-4.342	-3.901	-3.221

As can be seen from Table 2, the maximum value of the explained variable digital transformation degree (INT) is 0.627, and the value is 0.136, with a gap as high as 0.491, indicating that there is a large difference in the degree of digitalization among enterprises in listed companies in Heilongjiang Province. The mean value of 0.160 is greater than the median value of 0.136, indicating the dichotomy of digital transformation of enterprises in Heilongjiang Province is obvious, and the overall degree of digital transformation is low. The standard deviation is 0.11, indicating that the data is relatively concentrated.

The minimum income tax burden (ITAX) is -22.360, indicating that some enterprises are in a loss-making situation. The value is 30.170, and the income tax burden of enterprises is generally controlled between 1%-4%, and the statutory income tax rate is only 2% at most, indicating that the income tax burden of some enterprises is far higher than the statutory tax rate, and there is a situation of excessive income tax burden. The maximum burden (TAX) reaches 638.439, indicating that enterprises have a heavy tax burden. The mean value of 46.590 is greater the median of 25.763, indicating that the tax burden factor has a greater impact.

3.2 Linear Regression Analysis

After analyzing the overall situation of the sample data, the simple OLS linear regression analysis was carried out with the sample of listed companies in Heilongjiang Province by using Stata software to determine the quantitative relationship of interdependence between variables. The results of linear regression found that the P value the implementation of tax policy (DID) was less than 0.01 and significant at the 1% level, the correlation coefficient 0.110 was positive and the digital transformation was positively correlated.

3.3 Correlation Analysis

Correlation analysis can measure the correlation degree between data characteristics, which can

reflect the correlation degree and influence direction between variables and is of great significance for subsequent regression. The correlation analysis of the corresponding sample data of the variables determined above is carried out, and the results are shown in Table 3.

Table 3. Correlation Analysis

	INT	DID	ITAX	TAX	EPS	CEP	SZ	SA
INT	1.0000							
DID	0.4192* 0.0000	1.0000						
ITAX	-0.1241* 0.0440	-0.0412 0.5050	1.0000					
TAX	0.0892 0.1480	0.0124 0.8410	-0.0514 0.4050	1.0000				
EPS	0.0867 0.1600	0.0730 0.2370	0.0392 0.5260	-0.0899 0.1450	1.0000			
CEP	-0.2424* 0.000100	-0.1507* 0.0142	0.3141* 0.0000	-0.1028* 0.0957	0.4241* 0.0000	1.0000		
SZ	-0.0742 0.2300	-0.0990 0.1090	0.3660* 0.0000	-0.0445 0.4710	0.0208 0.7370	0.2871* 0.0000	1.0000	
SA	0.0287 0.6430	-0.2161* 0.000400	0.1864* 0.00240	-0.0443 0.4730	0.1204* 0.0508	0.3004* 0.0000	0.2808* 0.0000	1.0000

Note: * denotes significant at the 10% level, ** denotes significant at the 5% level, and *** denotes significant at the 1% level

From Table 3, it can be found that the double difference item (DID) is significant with the digitalization degree (INT) at the 1% level, with a coefficient of 0.4192, indicating that there is a positive correlation between the two, and the digitalization level of enterprises gradually increases with implementation of tax policies, which is in line with hypothesis one. The negative tax (ITAX) and the degree of digitalization (INT) are significant at the 10 level, with a coefficient of -0.1241, indicating that the negative tax is negatively correlated with the degree of digitalization.

3.4 Model Inspection

The use of the model can be tested through the selection of fixed and random effects, so, first, set the null hypothesis of the Hausman test H0 there is no significant difference in variables, and choose random effects. F-test, LM test, Hausman test results are shown in Table 4:

Table 4. F, LM Test, Hausman Test Results

	Check object	P value	Test result
F-test	Fixed effects and mixed regression	0.0000	Fixed effects
LM-test	Random effects and mixed regression	0.0000	Random effects
Hausman-test	Fixed effects and random effects	0.0031	Fixed effects

When comparing the fixed effect with the OLS mixed regression, the P value is 0.0000 less than 0.05, indicating of the null hypothesis that the fixed effect is superior to the mixed regression; when comparing the random effect with the OLS mixed regression, the P value is 0.000 less than 0.05, indicating rejection of the null hypothesis that the random effect is superior to the mixed regression; when comparing the random effect with the fixed effect the P value is 0.0031 less than 0.05, indicating rejection of the null hypothesis that the fixed effect is superior to the random effect. can be seen that the study of the impact of tax policy can choose the fixed effect model.

3.5 Reliability Test

(1) The placebo test of time. This paper constructs a fake tax policy implementation time of 2016 and 2017 respectively by that the policy implementation time is advanced, and then carries out a two-way fixed regression on the sample data of listed companies in Heilongjiang Province from 201 to 2023. The results (1) one period in advance, (2) two periods in advance are shown in Table 5:

Table 5. The Results of the Robustness Test

VARIABLES	(1)One period ahead INT	(2)Two periods ahead INT
DID	0.000	-0.020

	(0.00)	(-1.44)
ITAX	-0.002** (-2.12)	-0.002** (-2.15)
TAX	-0.000*** (-3.02)	-0.000*** (-3.25)
EPS	0.013 (0.89)	0.012 (0.85)
CEP	0.000 (1.56)	0.000 (1.60)
SZ	0.000* (1.81)	0.000** (2.42)
SA	-0.152*** (-2.96)	-0.206*** (-4.35)
Constant	-0.431** (-2.24)	-0.630*** (-3.56)
Observations	264	264
Number of code	22	22
R-squared	0.179	0.186
code FE	YES	YES
year FE	YES	YES

Note: *** p<0.01， ** p<0.05， * p<0.1

Analyzing the regression results of DID (1) and DID (2), we find that the regression results of the model are not significant at the 0% level. When the policy time is brought forward by one and two periods, the tax policy is not the main factor affecting the digital transformation of manufacturing industry, which shows that tax policy does not spontaneously promote the degree of digital transformation with the development of the times. At the same time, the results of the time placebo test verify that there is no significant in the time trend between the control group and the experimental group, which once again confirms that the 2018 tax policy has a positive incentive effect on the digital transformation of industry.

4. Conclusion

Empirical analysis of listed companies in Heilongjiang Province shows that tax burden has a positive incentive effect on the digital transformation of manufacturing industry Tax policy is inclusive, and tax incentives for the digital transformation of manufacturing industry are not related to the trend over time. Due to the impact of tax preference policy, enterprises are guided transform digitally, which enhances the reliability of the study. At the same time, it also shows that the crux of the low degree of digitalization is that large enterprises do not a leading role.

Acknowledgments

This paper is supported by Special Research on the Spirit of the Important Speech and Instructions of General Secretary Xi Jinping (Project number: 23XZT033)

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