

Study on the Impact of Tax Reduction Policies on Total Factor Productivity of Manufacturing Industry in Sichuan Province under High-Quality Development

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Abstract: China's government has adopted an active tax reduction policy in order to alleviate the difficulties in the development of the manufacturing industry and promote its high-quality development. 2022, the Sichuan Provincial Party Committee has set the goal of "building an advanced manufacturing province with significant influence in the country", so how is the manufacturing industry in Sichuan affected by the country's macro-tax reduction policy, and what is the effect of different tax reduction policies, and whether it is affected by the heterogeneity of enterprises? How is the manufacturing industry in Sichuan affected by the China macro tax cut policy? This paper finds that tax cuts on the total factor productivity of listed manufacturing enterprises in Sichuan: In general, both income tax cuts and value-added tax (VAT) cuts have played a positive role in the total factor productivity of manufacturing enterprises in Sichuan, but different types of manufacturing enterprises have been affected to varying degrees. The findings of this paper are useful for the formulation of targeted, precise and efficient tax policies.

1. Background of the study

The manufacturing industry is the foundation of the national economy, and its high-quality development is of great significance to the country's economy, science and technology, and national defense and other fields. Since 2010, the value added of China's manufacturing industry has surpassed that of the United States, ranking first in the world for 13 consecutive years.

Nevertheless, China's manufacturing industry is still characterized as "big but not strong". In order to promote the total factor productivity of the manufacturing industry and realize high-quality development, China's government has formulated a series of fiscal and tax support policies, including lowering the value-added tax (VAT) rate of the manufacturing industry, increasing the proportion of deductions for manufacturing industry's research and development (R&D) expenses, and increasing the strength of VAT tax rebates for the manufacturing industry.

Sichuan's economic roots in industry, home base in the manufacturing industry, in order to actively implement the "Made in China 2025" strategic deployment, in October 2015, Sichuan Province issued the "Made in China 2025 Sichuan Action Plan". 2020 October, the Sichuan Provincial Party Committee issued the "Opinions on the Promotion of High-quality Development of Manufacturing Industry", by 2035, basically realize the modernization of the manufacturing industry, and build the

national important and influential advanced manufacturing province. Based on the above analysis, the study of whether the tax reduction policy has a positive effect on the total factor productivity improvement of the manufacturing industry in Sichuan Province is an extremely important and valuable academic and practical exploration, which helps to provide useful reference for optimizing the tax policy to support the development of the manufacturing industry, and has far-reaching theoretical and practical significance.

2. Current status of research on the impact of tax reduction policies on total factor productivity

Scholars generally agree that tax reduction policies have a significant role in promoting total factor productivity. In terms of income tax cuts, Lin Xiaoling et al. (2019) found that corporate income tax cuts can stimulate the vitality of enterprise endogenous financing and enhance enterprise total factor productivity[1]. Yan Hongguo et al. (2022) find that income tax incentives provide a significant boost to firms' total factor productivity[2]. From the point of view of VAT reduction, Shen Guangjun et al. (2016) found that the VAT tax burden of manufacturing enterprises was significantly reduced after the reform, which raised the level of enterprises' fixed asset inputs and labor force, and led to a significant increase in the total factor productivity of enterprises[3]. Kang, Maonan (2019) found that VAT reform significantly contributes to resource allocation efficiency in manufacturing firms[4]. Yu J et al. (2022) confirm that for listed companies in advanced manufacturing industries, the VAT tax credit refund policy can promote total factor productivity in the short run[5]. In addition, some scholars have noted differences in the effects of different taxes. Cai Lei et al. (2022) found that the total factor productivity of listed companies in the private manufacturing industry is more sensitive to the response of indirect tax cuts, while the effect of direct tax (e.g., income tax) cuts on productivity improvement is not obvious[6]. It has also been argued that tax cuts have little effect on total factor productivity and may have a dampening effect. Mallick et al. (2013) argue that there is a significant and non-linear effect of tax rates on productivity levels[7]. Sally Yang (2019) confirms the "inverted U-shaped" relationship between tax incentives and the investment, production and innovation of manufacturing firms, further suggesting that tax incentives do not always have a positive effect on firms' total factor productivity improvement[8].

As can be seen from the above analysis, there is more literature on the effect of tax reduction policies on total factor productivity in existing studies, but the literature with Sichuan Province as the research object has not been seen yet. This paper not only takes manufacturing industry in Sichuan Province as the research object, but also examines the effect of tax reduction policy on total factor productivity under heterogeneous situations such as ownership nature, whether advanced manufacturing industry and life cycle stage from different perspectives of income tax and value-added tax reduction, so this paper's research has a good practical value.

3. Empirical Analysis of the Impact of Tax Reduction on Total Factor Productivity of Manufacturing Industry in Sichuan Province

3.1. Research hypotheses

Enterprise income tax reduction can stimulate enterprises to increase R&D investment, human capital investment and optimize resource allocation, alleviate capital pressure, increase net income and improve production efficiency. Secondly, enterprises can convert the tax savings into employee compensation and benefits, motivate employees' enthusiasm and creativity, improve their professional skills, innovation and absorption of technology, introduce high-end technical talents, and improve the productivity of enterprises. Once again, lowering the income tax rate can enhance the efficiency of resource allocation, utilize market competition to eliminate low-productivity enterprises,

and increase the total factor productivity of enterprises.

Hypothesis 1: Income tax reduction can promote total factor productivity of manufacturing enterprises;

Value-added tax reduction can reduce the operating costs of enterprises, reduce external financing needs, and help stimulate enterprise investment. The reduction of VAT rate will help enterprises to improve investment expectations and encourage enterprises to increase investment in research and development. Can enable manufacturing enterprises to lower commodity prices and expand sales, for the formation of economies of scale. Value-added tax reduction will bring more bargaining space for enterprises and enable them to have strong bargaining power. Enterprises will continue to increase research and development investment and hire high-end technical talents to achieve continuous technological progress and effectively improve total factor productivity.

Hypothesis 2: VAT reduction can promote the total factor productivity of manufacturing enterprises;

The effects of tax reduction policy on SOEs and non-SOEs are different. First, SOEs have relatively abundant sources of funds, and non-SOEs have narrow sources of funds. Second, some SOEs have strong bargaining power and can get more subsidies from the government, and non-SOEs must have competitive products, so they are more sensitive to the tax cut policy. Finally, state-owned enterprises must pay attention to social benefits and fulfill social responsibility, while non-state-owned enterprises need not bear too much social responsibility.

Hypothesis 3: Income tax and VAT reduction have a better effect on TFP of non-state-owned manufacturing enterprises in Sichuan;

Compared with the traditional manufacturing industry, the advanced manufacturing industry has the following advantages: First, the industry is advanced, the advanced manufacturing industry in the industry has unique advanced and innovative, more easily to achieve significant economic benefits. Secondly, technology is advanced, and the industry can innovate itself by constantly using high technology to achieve sustainable development. Thirdly, management is advanced. Advanced management concepts and methods are very important for the development of manufacturing enterprises. Advanced manufacturing industry is advanced in industry, technology and management.

Hypothesis 4: Income tax and VAT reduction have a better effect on TFP of advanced manufacturing enterprises in Sichuan;

Adizes (1988) points out that businesses have life-cycle characteristics similar to the whole process of an organism from birth to death. In different stages of life cycle, the scale, profitability, investment strategy, innovation willingness and R&D capability of enterprises are significantly different. During the growth period, enterprises have tighter financing constraints, more capital expenditures, lack of R&D experience and lower success rate of innovation. Tax reduction policies can relieve enterprises' financing constraints to some extent, and play a certain role in supporting R&D investment and resolving risks. When the enterprise develops to the mature stage, because its production and management pattern is day by day mature, the organizational structure unceasingly consummates, the endogenous financing restriction can alleviate. In terms of the risks, willingness and capability of innovation, after the market exploration and accumulation of R&D experience in the early stage and supported by the feedback information from the sales network, the R&D of enterprises is often targeted and the risk of failure is obviously reduced. After the enterprise enters the recessionary period, the sale starts to reduce, the market share and the profit presents the decline tendency. From the perspective of internal structure, enterprises in recession often have problems such as rigid system, redundancy of bureaucracy, shirking of responsibility by management and lack of innovation awareness. In terms of innovation capability, enterprises in recession often lose core talents due to obsolete production equipment, outdated technology and poor salary incentive design. It is difficult for enterprises to actually enjoy the tax preference, and they may prefer to invest the funds in the

regular production and operation activities rather than the technological progress with high cost, high risk and uncertain return period.

Hypothesis 5: Income tax and VAT reduction have better effect on TFP of manufacturing enterprises in Sichuan during growth and maturity.

3.2. Model design

To test the above assumptions, the following benchmark regression models were constructed:

$$perf_{i,t} = \alpha_0 + \alpha_1 taxbur_{i,t} + \alpha_2 ctrol_{i,t} + \mu_i + \tau_t + \varepsilon_{i,t} \quad (1)$$

Among them, $perf_{i,t}$ is the dependent variable representing total factor productivity, α_i is the regression coefficient of each variable, $taxbur_{i,t}$ is the independent variable representing the effect of different tax reduction policies for enterprises, $ctrol_{i,t}$ is the set of control variables, μ_i is the individual effect, τ_t is the time effect, $\varepsilon_{i,t}$ is the random error item, i is the enterprise code, and t is the year.

3.3. Selection of variables

① Explained variables and explained variables

This paper selects the LP method to measure the total factor productivity of listed manufacturing enterprises in Sichuan (Lu Xiaodong and Lian Yujun, 2012) [9]. The following models are used to measure the total factor productivity:

$$LnY_{it} = \beta_0 + \beta_l LnL_{it} + \beta_k LnK_{it} + \beta_m lnM_{it} + \varepsilon_{it} \quad (2)$$

In the above expression, Y represents output, L represents labour input, K represents investment, and M represents intermediate input, as shown in Table 1:

Table 1: Input-Output Variable Table for LP Calculation of Total Factor Productivity

Variable name	Symbol of variable	Definition of variable
Output	Y	Main business income
Labor input	L	Number of employees
Capital input	K	Net fixed assets
Intermediate input	M	Amount of Goods and Services Purchased

On the basis of previous studies (Zhang Shijing et al., 2022) [10], the actual rate of income tax burden and the actual rate of value-added tax burden shall be used to calculate the tax reduction. When the relevant tax burden rate decreases, the positive impact of the tax reduction policy can be proved. The formula is as follows:

Actual tax burden rate of enterprise income tax = Actual income tax expenses/(pre-tax profit) (formula 3)

Actual VAT burden = Actual VAT expenses/operating income (formula 4)

Actual VAT expenses = various taxes and fees paid in the cash flow statement (tax expenses under the "cash flow system") + year-end balance of taxes and fees payable - year-end balance of taxes and fees payable (converted to current taxes and fees under the "accrual basis" by adjusting the closing and opening balances) - current income tax (current income tax expenses - current deferred income tax) - business taxes and surcharges (taxes and surcharges after 2017) (formula 5)

② Control variable

This paper selects the control variables in Table 2 to control the impact of other possible factors on total factor productivity.

Table 2: Variable selection and description

variable	Variable name	Symbol of variable	Variable declaration
Interpreted variable	Total productivity.	tfp	LP,OP
Interpretative variable	Actual rate of income tax	sdsr	Income tax expense/interest EBIT
	Sales tax actual tax burden rate	zzsr	Sales tax/operating revenue
Control variable	Ratio of investment to expenditure	tzzcr	Fixed assets, intangible assets and other long-term ass
	Asset-liability ratio	lev	Total liabilities/total assets
	Rate of return on total assets	ROAa	(Total profit + interest expense)/Total average assets
	Concentration of ownership	gqj4z	Sum of the Top Ten Largest Shareholders of the Compa
	Life span	lnage	Ln (sample year - year of incorporation + 1)
	Enterprise scale	lnzzc	Ln (total assets + 1)
	Capital intensity	lnzbmjrb	Ln (net fixed assets/number of employees + 1)

(4) Source of sample data and descriptive statistics

This paper selects Csmar and Choice database of Shanghai and Shenzhen A-share Sichuan manufacturing listed companies' financial statements data. In order to ensure the scientificity of sample selection, firstly, foreign investment and Sino-foreign equity joint venture enterprises shall be excluded; secondly, ST and * ST enterprises shall be excluded; thirdly, enterprises with income tax burden rate or value-added tax burden rate of less than 0 or more than 1 shall be excluded; finally, the relevant indicators for computation of total factor productivity of manufacturing enterprises shall be negative after eliminating the absence of key variables in the sample year and the relevant indicators. In order to eliminate the disturbance of abnormal value to the stationarity of statistical results, Winsor tail reduction with critical value of 1% is applied to total factor productivity and tax reduction index.

(5) Empirical results

① Benchmark regression

As shown in Table 3 below, income tax, VAT and other tax reduction policies have significantly increased TFP of Sichuan manufacturing enterprises, so hypothesis 1-2 is proved.

② Robustness test

a. Robustness tests for substitution of major variables

Firstly, the dependent variables are replaced, and the TFP measured by OP method is used as the substitution variable for robustness test. Then, the ratio of income tax expense to total profit is used as the substitution variable, and the ratio of the difference between tax expense and income tax expense to operating income is used as the substitution variable. As can be seen from table 4 below, the conclusions are robust.

Table 3: Main regression results

Variable	tfplp			
	sdsr	-0.843***	-0.776***	
	(-3.00)	(-3.29)		
zzsr			-2.754**	-1.970**
			(-2.22)	(-2.59)
R-squared	0.609	0.911	0.639	0.929
ctrl var		YES		YES
id FE	YES	YES	YES	YES
year FE	YES	YES	YES	YES
*** p<0.01, ** p<0.05, * p<0.1				

Table 4: Robustness tests (replace main variables)

Variable	tfpop		tfplp		tfpop		tfplp	
sdsr	-0.941***	-0.854***						
	(-3.56)	(-3.40)						
sdsrb			-0.825**	-0.532***				
			(-2.18)	(-2.94)				
zzsr					-2.814**	-2.210**		
					(-2.21)	(-2.59)		
lzsr							-4.620***	-1.947***
							(-4.10)	(-2.98)
R-squared	0.611	0.893	0.616	0.91	0.646	0.914	0.658	0.931
ctrl var		YES		YES		YES		YES
id FE	YES	YES	YES	YES	YES	YES	YES	YES
year FE	YES	YES	YES	YES	YES	YES	YES	YES
*** p<0.01, ** p<0.05, * p<0.1								

b. Endogenous test

There may be endogenous problems in regression models, which are generally caused by the causal relationship between omitted variables and independent and dependent variables. From the results in Table 7 below, it can be seen that there is neither first-order autocorrelation nor second-order autocorrelation for the difference perturbation term in the model. Hansen test was not significant, indicating that the instrumental variables were valid. The results also support the hypothesis that the conclusion of this paper is robust. The specific results are shown in Table 5.

Table 5: Robustness Test (Endogenous Test)

Variable	tfplp	
sdsr	-1.855*	
	(-1.77)	
L.sdsr	0.018	
	-0.02	
L2.sdsr	0.602*	
	-1.78	
zzsr		5.316
		-0.65
L.zzsr		-6.501*
		(-1.70)
L2.zzsr		-5.324*
		(-1.82)
AR(1)	0.71	0.217
AR(2)	0.257	0.965
Sargan	0.061	0.184
Hansen	0.766	0.783
ctrl var	YES	YES
id FE	YES	YES
year FE	YES	YES
*** p<0.01, ** p<0.05, * p<0.1		

c. Considering the impact of fiscal subsidies

In the promotion of total factor productivity of manufacturing enterprises in Sichuan Province, the government's policy support can be divided into indirect tax reduction policy and direct financial subsidies. In order to examine the respective roles played by tax reduction policies and fiscal subsidies, distinguish the interference of fiscal subsidy effects on tax reduction policies as far as possible, and examine the effect of adding fiscal subsidies to tax reduction, it can be found from Table 6 below that, considering the impact of fiscal subsidy policies, the total factor productivity of Sichuan

manufacturing enterprises is still significantly affected by tax reduction policies, and the original conclusion is still valid.

Table 6: Conservatism test (impact of fiscal subsidies)

Variable	tfplp			
	lnzfbz	0.022*	-0.013**	0.027***
	-1.97	(-2.30)	-2.77	(-2.09)
R-squared	0.613	0.896	0.631	0.915
ctrl var		YES		YES
id FE	YES	YES	YES	YES
year FE	YES	YES	YES	YES
*** p<0.01, ** p<0.05, * p<0.1				

d. Heterogeneity test

As can be seen from the Table 7 below, after the regression of the classification of manufacturing enterprises into state-owned and non-state-owned enterprises according to the nature of ownership, it is found that the effect of income tax reduction on the promotion of total factor productivity of non-state-owned enterprises in Sichuan is more significant, and the effect of value-added tax reduction on the promotion of total factor productivity of state-owned manufacturing enterprises in Sichuan is more significant, assuming three parts of certificates are obtained; the effect of income tax reduction and value-added tax reduction on the promotion of total factor productivity of advanced manufacturing enterprises in Sichuan is more significant, assuming four certificates are obtained; the effect of income tax reduction and value-added tax reduction on the promotion of total factor productivity of Sichuan manufacturing enterprises in the growth and maturity period is more significant, assuming five certificates are obtained.

Table 7: Heterogeneity analysis

Variable	soe1	adv1	lif0	soe1	adv1	lif0
sdsr	-0.970*	-0.642**	-0.598**	-3.762**	-1.806**	-2.184*
	(-1.93)	(-2.57)	(-2.31)	(-2.24)	(-2.21)	(-1.95)
R-squared	0.906	0.914	0.916	0.943	0.929	0.937
ctrl var	YES	YES	YES	YES	YES	YES
id FE	YES	YES	YES	YES	YES	YES
year FE	YES	YES	YES	YES	YES	YES
*** p<0.01, ** p<0.05, * p<0.1						

4. Main conclusions and recommendations

(1) Research conclusions

Through empirical analysis of the impact of tax reduction policy on total factor productivity of Sichuan manufacturing enterprises, the following conclusions are drawn. First, tax reduction policies can significantly promote the TFP of Sichuan manufacturing enterprises. Second, considering the impact of financial subsidies, the original conclusion is still valid. At the same time, we should also note that fiscal subsidies in some cases do not play a catalytic role, there may be negative situation. Thirdly, income tax reduction is more effective for Sichuan non-state-owned manufacturing enterprises, advanced manufacturing enterprises and manufacturing enterprises in growth and maturity. Value-added tax reduction is more effective for Sichuan state-owned manufacturing enterprises, advanced manufacturing enterprises and manufacturing enterprises in growth and maturity.

(2) Countermeasures and suggestions

First, the tax reduction policy needs long-term stability. It is suggested that the government should extend the term of validity of relevant policies according to the characteristics and development of

the manufacturing enterprises to ensure the sustainable promotion of reasonable and effective tax reduction policies and form a long-term mechanism for policy implementation.

Second, tax reduction policies need to be strengthened. In terms of income tax, Sichuan manufacturing enterprises not included in the high-tech category may be guided to transform and upgrade to high-tech category, and the additional deduction of 100% of research and development expenses may be expanded to the whole industry. From the perspective of value-added tax, the reduction of tax rates can directly reduce the burden of enterprises, but also reduce the burden of additional taxes. Through optimizing the value-added tax deduction mechanism, eliminating unreasonable preferential transfer and actively expanding the scope of deduction and other measures, can play a positive effect.

Thirdly, the tax reduction needs to be implemented accurately. First of all, we can formulate more attractive and mandatory policies on income tax reduction for SOEs in Sichuan, and guide some backward SOEs to change their business decisions and develop with high quality. For the non-state-owned manufacturing enterprises in Sichuan, the scope of VAT credit can be expanded in one stage. Secondly, non-advanced manufacturing enterprises in Sichuan should be guided to develop from labor-intensive and low-technology level to technology-intensive and advanced manufacturing industry. We shall, within a certain time limit, strengthen and broaden the scope of application of tax reduction policies, increase the support for tax credit and refund for non-advanced manufacturing industries, and help the non-advanced manufacturing industries to integrate into the advanced ranks. Thirdly, Sichuan manufacturing enterprises in the period of growth and maturity should continue the effective tax reduction policies. For manufacturing enterprises in recession in Sichuan, for manufacturing enterprises with small future demand and strong substitutability, enterprises are required to realize vitality rebirth through transformation and upgrading within a time limit, and for manufacturing enterprises with big market demand for products and weak substitutability, tax reduction policies with certain compulsion and orientation shall be implemented specifically.

In addition, we can formulate a series of supporting measures to promote the TFP of Sichuan manufacturing industry, such as optimizing the business environment and highlighting the driving role of science and technology, so as to promote the continuous and stable improvement of TFP of Sichuan manufacturing enterprises and finally achieve high-quality development.

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