Preferential Income Tax Rate and Research and Development Investment: Evidence from Small and Medium-Sized Listed Firms in China

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Abstract

This study investigates the impact of a preferential income tax rate on research and development investment for small and medium-sized Chinese listed firms from 2013 to 2017. The results reveal a significantly positive relation between the preferential income tax rate and research and development investment. Such a positive relation appears to be more significant for non-state-owned firms and for firms located in provinces with higher research and development intensity. The instrumental variable method, the two-stage Heckman method and propensity score matching are employed in this study to support the finding that the preferential income tax rate has a positive external impact on research and development investment. The empirical results are robust with respect to endogeneity.

Keywords: income tax rate, preferential tax, small and medium-sized firms, research and development investment
JEL classification: H25

1. Introduction

The number of small and medium-sized firms (SMEs) has been increasing in the recent decades of Chinese economic reform. However, lower credit ratings cause difficulty for SMEs facing a lack of funding for innovation and research and development (R&D). Governments can provide a number of preferential policies to promote the sound development of SMEs. Preferential tax policies such as tax reduction, tax exemption and the addition of deductions for R&D expenses and accelerated depreciation are widely throughout the world. China has implemented preferential policies for R&D expenses for SMEs by means of a pre-tax deduction and credit corporate income tax. This study aims to investigate the relation between the preferential income tax rate and R&D investment of SMEs and to examine whether preferential tax policy can truly promote the scientific development and technological innovation of SMEs.

This study considers listed SMEs from 2013 to 2017 and finds that the overall level of R&D investment of SMEs in China remains very low. SMEs have various levels of intensity of R&D investment and enjoy different preferential income tax rates. The empirical results show that there is a significantly positive relation between a preferential income tax rate and the R&D investment of SMEs, indicating that a preferential tax policy promotes R&D investment for SMEs. The positive relation between a preferential income tax rate and the R&D investment of SMEs is more significant for non-SOEs and for firms located in provinces with higher R&D intensity. The instrumental variable method, the two-stage Heckman method and propensity score matching (PSM) are employed in this study to prove that a preferential income tax rate has a positive external impact on the R&D investment of SMEs. The results are robust with respect to endogeneity.

This study contributes to the literature discussing the relation between a preferential tax policy and the R&D investment of SMEs by examining the distribution of SMEs from state-owned firms (SOEs) and non-state-owned firms (non-SOEs) and SMEs located in provinces with high R&D investment and with low R&D investment. Based

on corporate attribute this study divides SMEs into SOEs and non-SOEs. This study finds that various corporate attributes are embodied in the different relationships between a preferential income tax rate and R&D investment. In addition, the 2017 National Statistical Yearbook shows that the R&D investment of SMEs in Guangdong Province, Fujian Province, Zhejiang Province, Shandong Province, Shanghai City, and Jiangsu Province accounts for 59.96% of all R&D investment in China. This study assigns a value of 1 to SMEs in those six provinces and city and 0 otherwise. On the one hand, this study fills a gap for different regions regarding the impact of a preferential income tax rate on R&D investment. On the other hand, the evidence from this study has practical significance for provinces with low R&D investment.

The remainder of the paper is organised as follows. In the following section, an overview of preferential tax policy and prior research on accounting for R&D investment are introduced. From this background, hypotheses are also developed. Section 3 describes the research design, including the various measures of the preferential income tax rate and the control variables used in the analyses. Section 4 provides some preliminary descriptive results and the main results of the analysis regarding the impact of a preferential income tax rate on R&D investment, together with robustness tests. Finally, the conclusions are presented in Section 5.

2. Literature Review and Hypothesis Development

Continuously engaging in technological innovation increasingly fuels corporate development. Preferential tax policy is a driving force for SMEs to continue innovations (Bai, 2014). Recent years, the government has introduced preferential tax policies for SMEs, particularly preferential policies for R&D investment. Ni (2013) finds that SMEs in China are the main force for technological innovation and that the present tax mechanism plays a vital role in stimulating the technological innovation of SMEs. Wang, Shi and Xie (2014) illustrate that preferential tax is one of the most effective means of stimulating the technological development and innovation of SMEs. Zha (2017) examines Chinese listed SMEs from 2012 to 2016 and finds that preferential tax policy has a positive impact on total R&D investment, the number of R&D technicians and the number of technicians with bachelor's degrees or above. By using PSM, Ma, Hu and Zhao (2017) find that fiscal policy has a positive impact on R&D activities for high-tech firms. SMEs are more sensitive to preferential tax policies, and tax incentives play an important role in stimulating the R&D activities of SMEs.

A preferential tax policy is conducive to encouraging SMEs to increase R&D investment and promotes technological innovation. However, a preferential tax policy has disadvantages that include inconvenient operations and unsatisfactory implementation effects (Jiang, 2015). Xie (2015) demonstrates that a preferential tax policy of promoting technological innovation in China has a nonsignificant effect on the technological innovation of SMEs. Yuan (2016) finds that the present preferential tax policy fails to increase the R&D investment of SMEs. Another study finds that a [referential tax policy fails to achieve the expected incentive effect on the R&D investment of SMEs (Wang, 2017). Wang (2017) further reveals that 60% of R&D investments are affected by a preferential tax policy. Wang and Li (2014) conclude that a preferential tax policy has a nonsignificant contribution to the R&D investment of listed SMEs from 2010 to 2012. There is an inverse U-shaped relation between R&D investment and corporate income tax rates. Fewer SMEs make use of the preferential tax policy for R&D activities and thus do not take the initiative in seeking tax benefits (Wang, 2016).

In addition, prior literature documents that a preferential tax policy leads firms in the Organisation for Economic Co-operation and Development (OECD) countries to increase R&D investment. Kang and Mah (2015) report that the preferential tax policy of South Korea actively promotes the R&D investment of SMEs. Consistent with Kang and Mah (2015), the empirical results of Kobavashi (2014) show that a preferential tax policy boosts the R&D investment of Japanese SMEs. For firms in Holland, an incentive tax policy encourages firms to increase their R&D investment (Lokshin & Mohnen, 2012). Baghanan and Mohnen (2009) investigate the impact of a preferential tax policy on manufacturing firms in Quebec, Canada, and find that the short-term and long-term price elasticity of R&D investment are -0.10 and -0.14. respectively. The price elasticity for smaller-scale firms is slightly greater than that for larger firms. The loss in R&D investment caused by a tax incentive policy for larger-scale firms is greater than that for smaller firms. Smaller-scale firms do not restrict themselves from engaging in additional R&D investment. A preferential tax policy for R&D investment exhibits a nonsignificant increase with deadweight loss.

In contrast, Hong and Lee (2016) indicate that a preferential tax policy is related to the growth rate of SMEs. A preferential tax policy for R&D investment is associated with the country-specific situation and the individual characteristics of firms in OECD countries such as Spain, Germany and Cuba. Among the OECD members, Spain is regarded as the most generous country with respect to fiscal support for R&D investment. However, Corchuelo and Mart ńez-Ros (2010) illustrate that there is a positive relation between a preferential tax policy and innovation

activities for high-tech sectors of firms. SMEs appear to use a preferential tax policy randomly because of some obstacles that they face. Romero, Delgado and Alvarez (2014) demonstrate that a preferential tax policy and public grants have a nonsignificant impact on R&D investment for Spanish manufacturing firms. Larger-scale firms prefer to implement a preferential tax policy, while SMEs utilise public grants to ease financial difficulty.

Koppel (2017) finds that preferential tax policy makers in Germany, an OECD member country, should account for the heterogenicity of SMEs. Belitz, Dreher, Kovač, Schwäbe and Som (2017) agree that SMEs in Germany have high heterogenicity. SMEs do not find preferential tax policy necessary. Governments should pay more attention to developing a combination of innovation policies for SMEs rather than introducing new tax incentives for R&D investment. Castellacci and Pons (2016) suggest that for Cuba, tax incentives with various characteristics should be explored. Preferential tax should concentrate on the amount of tax for SOEs. SMEs should obtain greater excess deductions from fiscal incentive mechanisms in order to accelerate innovation and imitation.

However, some previous studies document a negative impact of tax incentives on R&D investment. Cowling (2016) finds that SMEs implement tax incentives randomly in the U.K. Tassey (2007) illustrates that tax incentives for R&D investment are influenced by US credit coverage, through which it is difficult to promote the R&D investment of SMEs. Based on a comparative analysis of tax incentives, Grikevich, Grinkevich and Belomytteva (2017) illustrate that the tax mechanism of the Russian Federation is an inefficient stimulus for SMEs. Czrnitzki and Delanote (2015) illustrate that a preferential tax policy is effective in promoting the R&D investment of SMEs.

To develop and promote SME innovation, the Chinese government has continuously introduced preferential tax policies for R&D investment. The government aims to retain a ‘tax’ for SMEs, which is the corporate income tax; such tax on SMEs undoubtedly increases the government’s cash flow. Consequently, SMEs can expand operating activities, particularly by increasing R&D investment. A preferential income tax is also viewed as a "transfer" of state revenue to SMEs. This study proxies for the intensity of R&D investment with the R&D investment index, which is R&D expenditure / operating income. Preferential tax items include tax reduction, tax exemption and tax deduction. SMEs ultimately pay less actual income tax, thereby obtaining greater net profits and having more capital to spend on R&D. Based on the above statements and Ni (2013), Wang, Shi and Xie (2014) and Zhao (2017), the first hypothesis of this study is developed as follows:

H1: A preferential income tax rate is positively related to the R&D investment of SMEs.

A unique feature for firms in China is that the government participates strongly in the allocation of resources. Listed SMEs have a high degree of government ownership. SME operations can be significantly influenced by political interventions (Fan & Firth, 2007; Piotroski & Wong, 2012). In fact, the government is a controlling shareholder of SOEs and thus has the significant impact on SOEs. In contrast, non-SOEs have clearer property and unitary operation objectives. All operational activities of non-SOEs are based on the objective of maximising firm value. Compared with SOEs, non-SOEs are more sensitive to the relationship between a preferential income tax rate and the R&D investment of SMEs. Accordingly, hypothesis H2a is developed as follows:

H2a: The relationship between a preferential income tax rate and the R&D investment of SMEs is more significantly positive for non-SOEs than for SOEs.

The 2017 National Statistical Yearbook shows that the R&D investment of SMEs in Guangdong Province, Fujian Province, Zhejiang Province, Shandong Province, Shanghai City and Jiangsu Province accounts for 59.96% of all R&D investment in China. SMEs located in provinces with higher R&D investment have greater demand for a preferential income tax rate. Accordingly, hypothesis H2b is proposed as follows:

H2b: The relationship between a preferential income tax rate and the R&D investment of SMEs is more significantly positive in provinces with higher R&D investment than in provinces with lower R&D investment.

3. Research Design

3.1 Sample Selection

This study extracts samples from the SME Board of Wind database. ST firms and firms with incomplete information are omitted, and 898 SMEs remain. A mandatory requirement for SMEs to disclose financial information on R&D investment was imposed in 2012; thus, information on the R&D investment for most SMEs is lacking prior to 2013. This study therefore selects SMEs from 2013 to 2017. All variables used in this study are from the SME Board of Wind database and are collated from annual reports of sample SMEs.

3.2 Definitions of Variables

Table 1 shows the definition of variables, including the intensity of R&D investment, preferential tax policy, several

control variables and dummy variables.

Table 1. Definitions of variables

Name	*Symbol*	*Definition*
R&D investment intensity	RDI	R&D expenditure / Operating income
Preferential income tax rate	Taxpre	Nominal income tax rate - Actual income tax rate for SMEs
Proportion of employees with bachelor's degrees and above	Bachelor	Employees with bachelor's degrees or above / total employees
Asset-liability ratio	Lev	Total liabilities / total assets
Growth property	Growth	Increasing rate of operating revenue
Government subsidy	GS	Natural logarithm of total government subsidies
Firm scale	Size	Natural logarithm of the total assets of firms
Total market value	TMV	Natural logarithm of total market value
Age of firms	Age	Operating registration year + 1
Attribute of firms	BC	1 for state-owned firms; 0 for non-state-owned firms
Location of firms	Location	1 for provinces with high R&D investment (Guangdong, Shanghai, Jiangsu, Shandong, Zhejiang and Fujian) and 0 otherwise

3.3 Regression Model

The hypothesis of the "Rational Man" in Western economics posits that firms engaging in economic activity aim to obtain maximum economic benefits at minimum economic costs. Based on "Rational Man" theory, SMEs should make full use of income tax incentives for R&D investment, and A preferential tax policy should thus have a positive relationship with the R&D investment of SMEs. This study utilises the following multivariate linear equation to investigate the relation between a preferential income tax policy and the R&D investment of SMEs.

$$RDI=\beta_0 + \beta_1 * Taxpre + \sum_{n=2}^{7} \beta_n * Control_n + \sum_{m=8}^{9} \beta_m * Dummy_m + \epsilon$$

4. Analysis Results

4.1 Descriptive Analysis

Table 2 shows the descriptive statistical results for all variables used in this study to examine the relationship between a preferential income tax policy and the R&D investment of 898 SMEs from 2013 to 2017.

Table 2. Descriptive statistical analysis

Variable	*Min*	*Max*	*Mean*	*S.D.*	*Variance*
Taxpre	0.0000	25.0000	8.1017	5.4041	29.2040
RDI	0.0000	76.3500	4.6287	4.4847	20.1130
Bachelor	0.0000	95.5191	20.4777	19.7987	391.9890
Lev	0.7969	268.0918	39.0004	19.4315	377.5830
Growth	-91.4960	2399.8365	18.9043	58.3807	3408.3080
GS	0.0000	20.9668	15.8830	1.3844	1.9170
Size	18.5240	27.6626	21.6848	1.0688	1.1420
TMV	20.7444	26.6092	22.6455	0.8036	0.6460
Age	0.0000	14.0000	7.4400	3.5680	12.7300
BC	0.0000	1.0000	0.1400	0.3450	0.1190
Location	0.0000	1.0000	0.6800	0.4670	0.2180

The preferential income tax rate used herein is defined as 25% – the year-end income tax rate of SMEs. The maximum is 25%, while the minimum is 0%. This range of 25% is drawn from two extremums, indicating the variation in how the preferential income tax policy is applied among SMEs. Some SMEs reduce their year-end income tax rate to zero by using a preferential tax policy, while others that devote less attention to the preferential tax policy maintain a 25% income tax rate. For Taxpre, the standard deviation is 5.4041, while the variance is 29.2040, indicating that a preferential income tax policy is used to a significant degree by different SMEs. The average preferential tax rate of SMEs is 8.1017%. The government is increasingly focusing on the preferential income tax policy because of its impact on SMEs.

In February 2018, the National Bureau of Statistics (NBS) noted that the R&D investment intensity of China is 2.12%. The average R&D investment intensity for the OECD and EU are 2.40% and 2.08%, respectively. Firms can continue their operations with an R&D investment intensity of 2%. Prior studies demonstrate that firms with an R&D investment intensity of 5% may develop a competitive advantage through R&D innovation. The average R&D investment intensity of the sample SMEs is 4.63%, which is far greater than the figures of 2.4% for the OECD and 2.08% for the EU. R&D investment intensity helps maintain growth, indicating that the sample SMEs pay a great deal of attention to R&D investment although they have not developed a strong competitive advantage through R&D innovation. The difference between the maximum and minimum R&D investment intensity is greater than 76.35; the standard deviation and variance are 4.48 and 20.11, respectively. Levels of R&D investment differ among SMEs, and there is a significant relationship among R&D investment, the attributes of SMEs and the industry of SMEs.

4.2 Correlation Analysis

Table 3 shows a correlation analysis for the impact of a preferential tax policy on the R&D investment of SMEs.

Table 3. Correlation analysis

	RDI	*Taxpre*	*Bachelor*	*Lev*	*Growth*	*GS*	*Size*	*TMV*	*Age*	*BC*	*Location*
RDI	1										
Taxpre	0.212**	1									
Bachelor	0.427**	-0.011	1								
Lev	-0.192**	-0.094**	-0.014	1							
Growth	-0.027	-0.032**	0.059**	0.052**	1						
GS	0.113**	0.029	0.125**	0.176**	0.050**	1					
Size	-0.056**	-0.224**	0.282**	0.409**	0.127**	0.519**	1				
TMV	0.101**	-0.079**	0.290**	0.085**	0.130**	0.403**	0.680**	1			
Age	0.052**	-0.137**	0.239**	0.038**	0.017	0.251**	0.429**	0.087**	1		
BC	0.049**	-0.040**	0.145**	0.137**	-0.035*	0.083**	0.164**	0.027	0.181**	1	
Location	-0.093**	-0.057**	-0.147**	-0.011	0.006	-0.057**	-0.040*	0.024	-0.001	-0.189*	1

Note: * indicates significance at the 5% level; ** indicates significance at the 1% level

The coefficient of correlation between the preferential income tax rate of SMEs and R&D investment is 0.212 at a 1% level of significance. There is a significantly positive relation between the preferential income tax rate of SMEs and R&D investment intensity.

4.3 Regression Analysis

Table 4 shows the results of multivariate linear regression.

Table 4. Results of regression analysis

	B	*t-stat.*	*P-value*	*Sig*	*VIF*
β_0	5.372	2.482	0.013	*	
Taxpre	0.141	8.979	0.000	**	1.055
Bachelor	0.101	26.340	0.000	**	1.146
Lev	-0.035	-7.461	0.000	**	1.589
Growth	-0.002	-1.442	0.149		1.030
GS	0.659	10.225	0.000	**	1.515
Size	-1.035	-7.294	0.000	**	3.536
TMV	0.375	2.736	0.006	**	2.446
Age	0.105	4.200	0.000	**	1.138
BC	-0.061	-0.284	0.776		1.113
Location	-0.258	-1.667	0.096		1.074
Adjust R^2			0.300		
F	133.862		0.000	**	

Note: * indicates significance at the 5% level; ** indicates significance at the 1% level

The adjusted R-square is 0.300, and the coefficient for preferential income tax is 0.141 at a 1% level of significance. The F-value is 133.862, and the P-value is 0.000, suggesting that there is a significant relationship between a preferential tax policy and R&D investment. The results support hypothesis 1.

All sample SMEs are classified into two different sub-samples based on the attributes of firms (SOEs vs. non-SOEs) and their provincial location (high vs. low level of R&D investment). The results of regression analysis for different groups are shown in Table 5.

Table 5. Regression analysis results by sub-group

	Full sample	*SOE*	*Non-SOE*	*High level*	*Low level*
B & Sig	0.141**	0.125*	0.142**	0.151**	0.104**
Adjust R^2	0.300	0.316	0.313	0.285	0.344
F	133.862	22.288	136.960	95.547	56.973

Note: The regression results are detailed in Appendix Tables 1-1, 1-2, 1-3 and 1-4. * indicates significance at the 5% level; ** indicates significance at the 1% level

The results show that the coefficients for non-SOEs and SMEs located in provinces with high R&D investment are higher than those for SOEs and SMEs located in provinces with low R&D investment. The impact of the preferential income tax rate on R&D investment is more significant for non-SOEs and SMEs located in provinces with high R&D investment than for SOEs and SMEs located in provinces with low R&D investment. Therefore, the results support hypotheses 2a and 2b.

4.4 Analysis of Robustness

4.4.1 Alternative measurement for R&D investment

This study presents a robust analysis of hypothesis 1. The R&D investment of SMEs includes R&D expenditure and R&D personnel. The latter reflects human capital investment. The intensity of R&D investment is usually consistent with the proportion of the number of R&D personnel. SMEs that pay great attention to R&D investment have a greater proportion of R&D personnel among their total staff; the presence of R&D personnel benefits corporate performance. However, a number of SMEs fail to report the proportion of R&D personnel and instead report the proportion of technical personnel. For SMEs that do not report the number of R&D personnel, the number of technicians is used as a variable substituting for the number of R&D personnel. For SMEs that report both the number of R&D personnel and technicians, the sum of R&D personnel and technicians is used as the variable for R&D personnel. Intensity of R&D personnel = number of R&D staff / number of total staff. The results of multivariate regression are shown in Table 6.

Table 6. Results of regression analysis

	B	*t-stat.*	*P-value*	*Sig*	*VIF*
β_0	35.927	6.253	0.000	**	
Taxpre	0.406	10.263	0.000	**	1.068
Bachelor	0.565	54.537	0.000	**	1.153
Lev	-0.030	-2.426	0.015	*	1.632
Growth	0.005	1.650	0.099		1.030
GS	0.269	1.683	0.092		1.375
Size	-1.804	-4.855	0.000	**	3.374
TMV	0.016	0.044	0.965		2.431
Age	0.435	6.419	0.000	**	1.112
BC	-1.950	-3.557	0.000	**	1.113
Location	0.579	1.420	0.156		1.071
Adjust R^2			0.495		
F	368.324		0.000	**	

Note: * indicates significance at the 5% level; ** indicates significance at the 1% level

The adjusted R-square is 0.495, and the F-value is 368.324 with significance at the p-value 0.000, suggesting that there is a significantly positive relationship between a preferential tax policy and R&D investment. The coefficient for preferential income tax is 0.141 at a 1% significance level, indicating that a preferential tax policy has a significantly positive relationship with SMEs' investment in R&D personnel. Therefore, hypothesis 1 of this study is robustly supported. A preferential income tax policy has a positive impact on the R&D investment of SMEs. The findings are consistent with Ni (2013), Wang, Shi and Xie (2014), Zhao (2017) Kang and Mah (2015), Kobavashi

(2014), and Lokshin and Mohnen (2012).

4.4.2 Instrumental variable analysis

A preferential tax policy also has disadvantages associated with poor applicability, inconvenient operation, and unsatisfactory implementation effects (Qiang, 2015). SMEs use a preferential income tax rate based on their own R&D investment strategy. There appears to be a problem of inversion here. This study utilises the instrumental variable method to address the problem of endogeneity. A preferential income tax rate is an endogenous explanatory variable[1] based on the Hausman test and Durbin–Wu–Hausman (DWH) test. Based on Groves, Hong, Mcmillan and Naughton (1994), this study uses preferential income tax rates as the first instrumental variable and study selects SME attributes as the second instrumental variable. Based on Pearson correlation analysis, preferential income tax is highly correlated with its lagging variables and SME attributes[1].

Moreover, the lagged value of the preferential income tax rate and SME attributes are exogenous, which is unrelated to the disturbance term[2]. The two instrumental variables selected in this study are reasonable. Table 7 shows the results of the 2SLS regression employed in this study.

Table 7. Results of 2SLS regression

	First-stage regression					*Instrumental variable (2SLS) regression*			
Taxpre	Coef.	Robust S.D.	t-stat.	P>|t|	RDI	Coef.	Robust S.D.	t-stat.	P>|t|
Bachelor	-0.001598	0.002975	-0.54	0.591	Taxpre	0.167756	0.015016	11.17	0.000
Growth	0.001971	0.001423	1.38	0.166	Bachelor	0.075476	0.005470	13.80	0.000
Lev	-0.006478	0.003827	-1.69	0.091	Growth	-0.000696	0.002263	-0.31	0.758
Lngs	-0.533205	0.057285	-9.31	0.000	Lev	-0.041895	0.004331	-9.67	0.000
Lnsize	0.206756	0.097810	2.11	0.035	Lngs	0.270571	0.020543	13.17	0.000
Lntmv1	-0.036133	0.010539	-3.43	0.001	Lnsize	-0.272590	0.079855	-3.41	0.001
Age	0.031189	0.020389	1.53	0.126	Lntmv1	-0.017474	0.011223	-1.56	0.119
Location	0.132070	0.112559	-1.17	0.241	Age	0.061164	0.022698	2.69	0.007
Taxpre 1	0.837564	0.016582	50.51	0.000	Location	0.162674	0.140968	1.15	0.249
BC	-0.057177	0.161758	-0.35	0.724	_cons	3.626432	1.539011	2.36	0.018
_cons	6.348429	1.704138	3.73	0.000			—		
F		331.13			Wald chi2 (9)		658.21		
Prob > F		0.0000					0.0000		
Adj R^2		0.6550					0.2404		

The first-stage regression results show that the instrumental variable of Taxpre1 (endogenous explanatory variable – lagged value of preferential income tax rate) can better explain the endogenous explanatory variable Taxpre with a p-value less than 0.01. The results of instrumental variable regression (2SLS regression) show that the coefficient is 0.167756 at a 1% significance level. Considering the previous coefficient of 0.141, the endogenous explanatory variable of preferential income tax (Taxpre1) has a more significantly positive relationship with R&D investment with respect to the endogeneity problem. Therefore, the empirical results remain robust.

4.4.3 Two-stage Heckman test

Given data collection limitations, there appears to a self-selection bias. A non-random endogeneity problem of sample selection is likely. The two-stage model with the Heckman test is thus employed in this study. The results are shown in Table 8.

Table 8. Results for the two-stage Heckman test

	1st Stage	*2nd Stage*
Taxpre	0.02100***	0.21700***
	(0.00404)	(0.01800)
Bachelor	-0.00150	-0.00053
	(0.00113)	(0.00419)
Growth	0.00023	0.00352***
	(0.00039)	(0.00120)
Lev	-0.00179	-0.00130
	(0.00126)	(0.00458)
Age	-0.06150***	-0.01770
	(0.00871)	(0.03210)
BC	-0.10300*	-0.21500
	(0.06170)	(0.23300)
Location	-0.03170	-0.08650
	(0.04580)	(0.16500)
GS	0.00099	0.02750
	(0.00784)	(0.03020)
Size	0.06060**	0.03950
	(0.02430)	(0.09410)
TMV	0.02700***	-0.00876
	(0.00403)	(0.01530)
Constant	-0.71900	1.95100
	(0.46100)	(1.79900)
Inverse Mills Ratio		-0.73466
		(0.88929)
Observations	4,485	3,405
Pseudo or Adj R-squared	0.0178	0.0452

Note: * indicates significance at the 10% level; ** indicates significance at the 5% level; *** indicates significance at the 1% level

The inverse Mills ratio for the second-stage regression of the Heckman test is -0.73466. There is no sample selection bias for the regression equation for the first stage of the Heckman test. The coefficient for the preferential income tax rate is 0.02100 at the 1% significance level. The coefficient for the preferential income tax rate remains positive for the second-stage regression of the Hackman test at a 1% significance level. Therefore, this study effectively solves the endogeneity problem of sample selection bias. The original results remain robust.

4.4.4 Propensity score matching (PSM)

The preferential income tax rate of SMEs may fail to have an impact on R&D investment. R&D investment can be attributed not to the preferential income tax rate but to the heterogeneity of attributes and geographical locations of SMEs. This study uses PSM to match the treated group (SMEs with preferential tax) with a control group (SMEs without preferential tax) based on the attributes of SMEs (BC) and their provincial location (location)s. The results are given in Tables 9 and 10.

Furthermore, this study uses the PSM method developed by Rosenbaum and Rubin (1983) to solve the problem of endogeneity of self-selection bias and to correct for bias due to confounding factors that may be found in the estimate of the preferential tax rate effect obtained by simply comparing the results between SMEs that earn preferential tax

versus those that do not. Applying the PSM method, this study classifies samples into two groups: (1) the treated group, which includes SMEs with a preferential tax, and (2) the control group, which includes SMEs without such preferential tax. Using this approach, this study obtains propensity scores (PSs), which measure the extent of matching between the treated group and control group in multiple dimensions.

Briefly, the results in sections A and B of Table 9 show that the matching effect by either the nearest neighbour matching approach or the radius matching approach is good for all variables, and bias is significantly reduced. Untabulated results indicate that there is no significant difference between the covariates within the two groups. This finding suggests that the equilibrium effect of each covariate improves under the matching approach.

Section A of Table 10 shows an ATT estimation with the PSM method, which indicates that regardless of whether the nearest neighbour matching approach or radius matching approach is used, the R&D investment of SMEs exhibits a decreasing R^2, thus showing better effects of the preferential tax. Section B indicates that the R^2 of SMEs with a preferential tax is lower than that of SMEs without a preferential tax, which means that SMEs with a preferential tax have more R&D investment than SMEs without a preferential tax. In short, either of the matching methods employed in this study results in a consistent and positive association between preferential tax and R&D investments. The results of robustness checks lend further support to our hypotheses.

Table 9. PSM results (K=1)

Section A

		k=1			*Radius Matching*		
variable	*unmatched*	*Mean*		*reduct*	*mean*		*reduct*
	matched	*treated*	*controlled*	*bias(%)*	*treated*	*controlled*	*bias(%)*
bachelor	U	19.635	19.102		19.635	23.017	
	M	19.673	21.299	51.9	19.656	22.134	26.7
Growth	U	15.420	28.924		15.420	28.924	
	M	15.526	20.869	60.4	15.487	20.043	66.3
Lev	U	39.314	37.987		39.314	37.987	
	M	39.253	39.224	97.8	39.241	39.321	94
Age	U	7.777	39.224		7.777	6.410	
	M	7.773	39.224	35.0	7.774	8.493	47.4
Bc	U	0.143	0.123		0.143	0.123	
	M	0.143	0.158	26.0	0.143	0.161	6.3
Location	U	0.680	0.679		0.680	0.679	
	M	0.680	0.654	-1663.4	0.680	0.672	0.3
Lngs	U	15.313	15.966		15.313	15.966	
	M	15.349	15.802	30.6	15.349	15.693	47.3
Lnsize	U	21.604	21.888		21.604	21.888	
	M	21.621	21.870	12.3	21.620	21.862	14.6
lntmv1	U	19.096	20.756		19.096	20.756	
	M	19.102	20.554	12.5	19.100	20.004	45.5

Table 9. Summary sheet of PSM results (K=5)

Section B

		k=5			*Radius Matching*		
variable	*unmatched*	*Mean*		*reduct*	*mean*		*reduct*
	matched	*treated*	*controlled*	*bias(%)*	*treated*	*controlled*	*bias(%)*
bachelor	U	19.635	23.017		19.635	23.017	
	M	19.673	22.398	19.4	19.656	22.134	26.7
growth	U	15.420	28.924		15.420	28.924	
	M	15.526	19.989	67.0	15.487	20.043	66.3
Lev	U	39.314	37.987		39.314	37.987	
	M	39.253	39.066	85.9	39.241	39.321	94.0
Age	U	7.777	6.410		7.777	6.410	
	M	7.773	8.505	46.4	7.774	8.493	47.4
Bc	U	0.143	0.123		0.143	0.123	
	M	0.143	0.159	19.4	0.143	0.161	6.3
location	U	0.680	0.679		0.680	0.679	
	M	0.680	0.6729	-392.2	0.680	0.672	-422.0
Lngs	U	15.313	15.966		15.313	15.966	
	M	15.349	15.655	53.2	15.349	15.693	47.3
Lnsize	U	21.604	21.888		21.604	21.888	
	M	21.621	21.863	14.7	21.620	21.862	14.6
lntmv1	U	19.096	20.756		19.096	20.756	

Table 10. Summary sheet of PSM results (K=1)

Section A

Match	*Variable*	*Sample*	*Treated*	*Controls*	*Difference*	*S.E.*	*t-stat*
psm (k=1)	Rdi	Unmatched	4.083	1.805	2.278	0.147	15.46
		ATT	4.087	1.387	2.700	0.211	12.77
radius matching	Rdi	Unmatched	4.083	1.805	2.278	0.147	15.46
		ATT	4.086	1.454	2.632	0.162	16.26

Table 10. Summary sheet of PSM results (K=5)

Section B

Match	*Variable*	*Sample*	*Treated*	*Controls*	*Difference*	*S.E.*	*T-stat*
psm (k=5)	Rdi	Unmatched	4.083	1.805	2.278	0.147	15.46
		ATT	4.087	1.452	2.635	0.171	15.37
radius matching	Rdi	Unmatched	4.083	1.805	2.278	0.147	15.46
		ATT	4.086	1.454	2.632	0.162	16.26

5. Conclusions

Preferential tax policies constitute a popular method adopted by all countries in the world. The Chinese government implements a preferential policy for the R&D investment of SMEs that includes pre-tax deduction and preferential income tax. Frequently, government increases tax incentives for the R&D investment of SMEs. This study aims to investigate the relationship between tax incentives and the R&D investment of SMEs. Based on Chinese listed SMEs from 2013 to 2017 this study investigates the impact of a preferential income tax rate on the R&D investment of SMEs. There is evidence that the overall R&D investment intensity of SMEs in China remains low. A few SMEs

have not gained a competitive advantage through R&D investment. Moreover, the intensity of R&D investment and the preferential income tax rate differ very much among SMEs. There are great differences in the level of R&D investment among SMEs, indicating that SMEs in China should more strongly emphasize R&D investment.

Second, there is a significantly positive association between a preferential income tax policy and the R&D investment of SMEs, indicating that a preferential tax policy increases the R&D investment of SMEs. Such a positive relationship is more significant for non-SOEs and SMEs located in provinces with higher R&D investment. The instrumental variable method, the two-stage Heckman method and PSM are employed in this study to support the finding that a preferential income tax rate has a positive influence on the R&D investment of SMEs. The results remain robust to the problem of endogeneity. This study also divides the samples based on SME attributes and provincial locations (province with high vs. low R&D investment levels). This study also explores the relationship between the preferential tax rate and the R&D investment of SMEs by regions and attribute of SMEs. The findings have practical significance for provinces with low R&D investment. A preferential income tax rate is found to have a significantly positive impact on the R&D investment of SMEs.

Appendix I

Table 1-1. Results of regression analysis (state-owned SMEs)

	B	*t-stat.*	*P-value*	*Sig*	*VIF*
β_0	-11.013	-1.513	0.131		
Taxpre	0.125	2.400	0.017	*	1.163
Bachelor	0.063	5.514	0.000	**	1.308
Lev	-0.032	-2.370	0.018	*	1.701
Growth	0.023	2.390	0.017	*	1.106
GS	1.513	7.280	0.000	**	1.493
Size	-1.978	-4.803	0.000	**	3.350
TMV	1.432	3.095	0.002	**	2.966
Age	0.119	1.358	0.175		1.094
Location	.806	-1.690	0.092		1.074
Adjust R^2			0.316		
F	22.288		0.000	**	

Note: * indicates significance at the 5% level; ** indicates significance at the 1% level

Table 1-2. Results of regression analysis (non-state-owned SMEs)

	B	*t-stat.*	*P-value*	*Sig*	*VIF*
β_0	8.121	3.606	0.000	**	
Taxpre	0.142	8.875	0.000	**	1.048
Bachelor	0.108	26.782	0.000	**	1.133
Lev	-0.031	-6.191	0.000	**	1.565
Growth	-0.002	-2.144	0.032	*	1.029
GS	0.509	7.681	0.000	**	1.512
Size	-0.881	-5.901	0.000	**	3.564
TMV	0.195	1.390	0.165		2.387
Age	0.103	3.977	0.000	**	1.141
Location	-0.132	-0.810	0.418		1.063
Adjust R^2			0.313		
F	136.960		0.000	**	

Note: * indicates significance at the 5% level; ** indicates significance at the 1% level

Table 1-3. Results of regression analysis (provinces with high R&D investment)

	B	*t-stat.*	*P-value*	*Sig*	*VIF*
β_0	9.146	4.651	0.000	**	
Taxpre	0.151	10.343	0.000	**	1.041
Bachelor	0.079	20.980	0.000	**	1.092
Lev	-0.023	-5.480	0.000	**	1.491
Growth	-0.002	-1.784	0.075	*	1.029
GS	0.648	10.696	0.000	**	1.545
Size	-0.853	-6.572	0.000	**	3.523
TMV	0.058	0.462	0.644		2.436
Age	0.024	1.042	0.297		1.093
BC	-0.215	-0.930	0.353		1.042
Adjust R^2			0.285		
F	95.547		0.000	**	

Note: * indicates significance at the 5% level; ** indicates significance at the 1% level

Table 1-4. Results of regression analysis (provinces with low R&D investment)

	B	*t-stat.*	*P-value*	*Sig*	*VIF*
β_0	-4.424	-0.788	0.431		
Taxpre	0.104	2.753	0.006	**	1.083
Bachelor	0.133	15.539	0.000	**	1.239
Lev	-0.063	-4.965	0.000	**	1.925
Growth	-0.004	-1.176	0.240		1.057
GS	0.719	4.711	0.000	**	1.448
Size	-1.170	-3.197	0.001	**	3.761
TMV	0.847	2.426	0.015	*	2.563
Age	0.293	4.374	0.000	**	1.372
BC	-0.025	-0.056	0.955		1.281
Adjust R^2			0.344		
F	56.973		0.000	**	

Note: * indicates significance at the 5% level; ** indicates significance at the 1% level

Appendix II

Table 2-1. Results of Hausman test

	IV	*OLS*	*Difference*	*S.E.*
Taxpre	0.1678	0.1428	0.0250	0.0094
bachelor	0.0755	0.0760	-0.0005	0.0002
growth	-0.0007	-0.0006	-0.0001	0.0000
lev	-0.0419	-0.0424	0.0005	0.0002
lngs	0.2706	0.2611	0.0095	0.0036
lnsize	-0.2726	-0.2862	0.0137	0.0051
lntmv1	-0.0175	-0.0185	0.0011	0.0004
age	0.0612	0.0619	-0.0007	0.0003
location	0.1627	0.1447	0.0180	0.0067
_cons	3.6264	4.3094	-0.6830	0.2564
Chin (1)		7.09		
Prob > chi2		0.0077		

Table 2-1 shows that the p-value is 0.0077 (Prob > chi2). The preferential income tax rate (Taxpre) is an endogenous variable. The traditional Hausman test is not valid in the case of heteroscedasticity. The DWH test for heteroscedasticity is employed to examine the robustness:

Table 2-2. Results of the DWH test

		P-value
Durbin (score) chi2 (1)	7.1123	0.0077
Wu-Hausman F (1,3550)	7.1045	0.0077

Table 2-2 provides the F-value and χ^2, which are asymptotically equivalent for large samples. Both p-values are less than 0.01. The preferential income tax rate is an endogenous variable.

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