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Tax Preferences and Corporate Innovation-Evidence from China

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Abstract

Based on data from China, our paper disentangles the impacts of tax preferences on corporate innovation behaviors. Statistical outcomes show that tax incentives significantly enhance corporate R&D expenses and innovation behaviors. Our findings are robust to a series of checks. Furthermore, we also verified that tax preferences significantly mitigate the financial constraints. Our research adds to empirical evidence on the policy impacts of tax tools on innovation from developing countries and transitional economies.

Keywords

Tax Preferences; Corporate Innovation; Financial Constraints.

1. Introduction

Firm innovation activities are the crucial drivers for economic growth (Tassey, 2007; Aghion et al., 2013; Arginelli,2015). Thus, in recent decades, many countries have attached great importance to stimulating innovation from corporations in society (Howell, 2016). Among the policy tools that incentives firm-level innovation, tax policies are fundamental but crucial public policy instruments (Campodonico et al., 2016). Tax policies stimulating firm innovation can be classified into tax incentives (ex-ante tools) and patent boxes (post-ante tools).Compared with post-ante tools, ex-ante tools, which refer to cost reduction from innovation inputs, are more likely to benefit startups and firms with longer innovation cycles since the financial constraints can be mitigated earlier and further support the immediate financing of innovation activities (Hall, 2019).

In the real world of tax policy application, developed countries, including the United States, Japan, France, Canada, and Australia, have implemented policies like tax credits and super deductions decades ago. For instance, Australia applies a 125% super deduction plus a 175% incremental deduction, while Canada has a 20% flat tax credit (Tassey, 2007). They are implementing such policies in developed economies incentives for developing economies like India, Brazil, Vietnam, China and so on to follow such suits (Liakhovets, 2014; Appelt et al., 2016; Ivus & Sharma, 2021).

A few studies have explored the policy impacts of tax incentives on both in developed countries. Most of the existing literature has disentangled whether the tax credits or super-deduction incentives the R&D investment; however, only a few pieces of literature have discussed the efficiency and the quality of the innovation (Larédo & Rammer, 2016. At the same time, as market-oriented policies, tax credits have gained much applause from practitioners and scholars in the application to advanced economies (Paff, 2005; Kobayashi, 2014). However, there is still a lack of empirical findings on the impact of R&D tax credits on innovation investment and performance in developing countries and economies (Crespi et al., 2016; Chen & Yang, 2019). Coleman's boat indicates that it is worthwhile to understand the behaviours of organizations based on institutional background and cultural issues due to individual-level cognitive biases (Welter & Smallbone, 2011; Ortiz-de-Mandojana et al., 2016). This paper hopes

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to understand the impact of tax credits on innovation in China, which has accumulated monumental achievements and created many economic miracles in the transition to marketization.

The remainder of this paper is organized as follows: Section 2 presents the literature review. Section 3 presents the analytical framework and hypotheses. Section 4 introduces the identification strategy and the data sources. Section 5 reports the empirical work outcomes. Section 6 presents further analysis, conclusions, and policy implications.

2. Literature Review

2.1. Corporate Innovation Behavior

The production and spillover of knowledge accompany innovation behaviour. This means that innovation behaviour is a prominent attribute of public goods (Campodonico et al.,2016). Innovation plays a vital role in the development of an enterprise (He & Tian, 2018) in the whole life cycle. Existing literature has disentangled factors that affect corporate innovation from the spectrum of firm, market and country (He & Tian, 2018). To be specific, at the firm level, the determinants can be categorized as venture capitals (VCs) (Tian & Wang, 2014), internal (Galasso & Simcoe, 2011; Hirshleifer et al., 2012) and external firm characteristics (Aghion et al.,2013;Chang et al., 2019). While internal factors mainly explore the incentives for innovation choices and behaviours of Chief executive officers (CEOs) (Hirshleifer et al., 2012), non-CEO executives (Chang et al., 2015) and rank and file employees (Dutta & Fan, 2012). Current studies find that CEOs' personality traits (Sunder et al., 2017), skill set (Custodio et al.,2019), network connection (Faleye et al., 2014) can affect the outcomes of firm innovation and patents. For instance, Sunder et al. (2017) find that a CEO's hobby of flying airplanes is positively related to firm-level innovation activities and related innovation efficiency, which indicates that risk tolerance plays a vital role in the initiation and process of innovative investments. Another paper by Sauermann and Cohen (2010) explored the innovative-related incentives of non-executives and found that responsibility and job security are negatively related to innovation performance.

External factors consider more about the current financial market intermediaries (Aghion et al., 2013; Goldman & Peress, 2016), stock market trading (Yang, 2021), and even stakeholders (Flammer & Kacperczyk, 2016). Another stream of literature focuses on country-level factors, including national institution factors (Tan et al., 2016), laws and policies (Bradley et al., 2017) and financial market development (Moshirian et al., 2018). Moreover, another strand of literature further explores the institutional traits, including laws and policies (Williams, 2013), market competition (Aghion et al., 2005), and socio-economic characteristics of one country for the region (Gao & Zhang, 2017).

2.2. Tax Credits and Innovation

As mentioned in section one, tax incentives are instruments from fiscal policies designed to increase innovation supply by mitigating two issues. First, the associated risks and uncertainties that are difficult to diversify away or insured against in the whole R&D procedures. Second, there is information asymmetry between the innovator and his financer, so moral hazard problems are complex to avoid (Nelson, 1959; Arrow, 1972). However, R&D is only one element of innovation. Other elements for innovation include purchasing external intellectual property, training employees, marketing, and organizational innovation costs (Goolsbee & Jones, 2021). Compared with government direct funding, tax incentives on corporate taxes leave the whole decision-making process of innovation in the hands of corporations (Goolsbee & Jones, 2021). Both theoretical (Campodonico et al., 2016; d'Andria and Savin, 2018) and empirical (Dechezleprêtre et al., 2016; Kao, 2018) studies have tried to

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evaluate the policy impacts of the tax on innovation. While theoretical framework has disentangled that the threat of adverse selection will increase the cost of capital in financing innovation, empirical work has verified that the tax relief scheme promotes business R&D and then affects the spillovers on the innovations of tech-logically related firms positively (Campodonico et al, 2016). However, a few recent studies find that the R&D credits only increase the R&D expenditure but may not increase the scientific quality of patents, but the effectiveness of the tax credits is shaped by the institutional context (Howells, 2005) and varies on account of the social return of the projects (David et al., 2000). Furthermore, larger firms with many patients benefit more from the tax credit policies, suggesting that the effect of the R&D tax credit may be heterogeneous in firm sizes or sectors (Castellacci & Lie, 2015).

To sum up, the current literature still does not consistently conclude on the policy impacts of tax credits. Considering the institutional contexts of different countries, it is worthwhile to understand this topic in developing countries, especially transitional economies like China.

3. Institutional Background in China

The implementation of R&D incentives in the form of tax deductions in China can be dated back to the 1990s (Tian et al., 2020). The implementation of the policy can be summarized as three stages. The first stage is the experimental stage. The pilot experiment began in the 1990s, and only the firms located in the high zones or science and technology parks were in the pilot scheme at this stage. The second stage began in 2008. In the second stage, the volume-based tax credits policy was adopted nationwide, while the Technologically Advanced Service Company and the High-New Technology Enterprise status were the primary beneficiaries. The time node for the third stage is 2015. At the third stage, all the firms are enrolled in the R&D tax incentive programs except for a few industries like real estate, retail sales, and entertainment. Another stream of tax incentive tools is the super-deduction policy. The evolution of the super deduction policy can also be summarized as three stages.

The first stage was from 1996 to 2007. Initially, the super-deduction policy was only applicable to state-owned enterprises (SOEs). As time went by, the scope of this policy also expanded to collective enterprises and corporate enterprises. The second stage was from 2008 to 2017. At this stage, the super-deduction policy was enacted due to the promotion of the Enterprise Income Tax Law of the People's Republic of China; the ratio is 50%. The third stage began in 2018. At this stage, not only was the scope of the enterprises able to enjoy this policy expanded, but the deduction ratio was also increased to 75%.

Since two sets of the abovementioned tax incentive policies were applied in China simultaneously, we shall consider both impacts in our baseline estimations first and try to distinguish the two policies in further analysis. Based on data from China, our paper disentangles the impacts of tax preferences on corporate innovation behaviors. Statistical outcomes show that tax incentives significantly enhance corporate R&D expenses and innovation behaviors. Our findings are robust to a series of checks. Furthermore, we also verified that tax preferences significantly mitigate the financial constraints. Our research adds to empirical evidence on the policy impacts of tax tools on innovation from developing countries and transitional economies.

4. Research Design

4.1. Data

Our research is based on A-share listed firms in China from 2008 to 2020. Our sample period starts in 2008 due to the publication of a new accounting standard in 2007 by the Ministry of Finance of the People's Republic of China. We collect firm-level data from the China Stock

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Market & Accounting Research Database (CSMAR) and supplement a few measures and missing values by referring to the annual financial reports of these firms. We also conducted a series of procedures for our data sets: First, we excluded specially treated (ST) and special transferred (PT) firms during the sample period. Second, we winsorized the data at the 1% level, which means we adjusted extreme values to reduce their impact on the analysis. Third, we exclude missing and abnormal values. Fourth, we exclude firms from industries not enrolled in the policies, such as real estate, retail sales, entertainment, etc.

After the meticulous data preparation, we have finally obtained an unbalanced panel dataset of 21925 firm-year observations. This dataset, with its breadth and depth, forms the backbone of our research, providing a robust foundation for our analysis and conclusions.

4.2. Empirical Strategy and Model Setting

In our baseline regression, we introduce a two-way fixed effects model to examine the impacts of tax incentives and firm innovation, as shown in equation (1). The dependent variable is corporate innovation behaviors, and the core independent variables are the degree of tax incentives. We also include a series of firm-level characteristics as controls. Importantly, we include firm and year-level fixed effects, ensuring that our model accounts for any potential biases. The coefficient for TP captures the policy impacts that we are interested in.

$$R\&D_{it} = \alpha_{it} + \beta * TP_{it} + \gamma^{T} * Controls_{it} + \delta_{it} + \theta_{it} + \mu_{it} \quad (1)$$

After obtaining the outcomes from baseline regression, we also conduct robust checks to examine and verify the findings from baseline regressions. We use alternative measurements of innovation behaviour and alternative measures to determine the degree of tax incentives. We also explore the efficiency of specific incentive tools by using grouping regression techniques and interactive approaches. Besides, we disentangle the mechanisms based on empirical work on a series of grouping regressions.

4.3. Variable Construction and Definitions

Table 1. Definition of the Variables

Variable	Definition
R&D expense	The total amount of the R&D expense in billion as of current year
Inno_textual	(Sum of word frequency corresponding to the word set of innovation index keywords/Total words of the annual report) *100
TP	(Nominal tax rate-real tax rate) *Total Profits
STP	((R&D expense* deduction rate*Nominal Tax Ratio)/Total Assets) *100
ATP	(R&D expense* deduction rate)/ (taxable incomes expense*deduction rate)
SIZE	The logarithm for total assets
LEV	Long-term debt divided by total assets
ROA	Return to assets
AGE	The natural logarithm of the year of observation minus the year of listing plus one.
Tobin Q	The market value of equity divided by the book value of the total assets.
TOP10	The sum of ownership proportions of the top ten shareholders
BOARD	The natural logarithm of the number of board members
INST	Institutional investor shares divided by the total number of shares

Our dependent variable is firm-level innovation behaviour. Following Hall& Lerner (2010) and Bellstam et al. (2021), we use the number of R&D expenses as of the current year as the

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dependent variable in our baseline regression and use textual data on innovation from an annual financial report by text mining as alternative measurements for innovation behaviour in the robust check.

Our core independent variable in our analysis is the degree of tax incentive. We use the difference between income tax and effective tax rate multiplied by the income before tax as the measurement for the tax incentive (reference). Furthermore, we also use the two other indicators as the alternative measurements for the degree of tax incentives in the robust checks, and we show the details for the measurements in Table 1. Meanwhile, we also consider a series of firm-level characteristics in our model, including (1) firm size, (2) leverage ratio, (3) ROA, (4) proportion of intangible assets, (5) age, (6) Tobin q; (7) Ownership concentration; (8) Size of the board; (9) Institutional ownership. Considering the limit of the words, the detailed definitions of the variables are shown in Table 1.

4.4. Summary Statistics

Table 2 shows the summary statistics for the main variables in the analysis. As shown in the table, the mean for the firm-level R&D expense in billion is 0.1331, with a standard deviation of 0.358, which indicates that the R&D expenses among firms are different. The mean for Inno_textual is 0.8604, indicating that among 100 words in the annual report, 0.8604 are innovation-related expressions. The mean for TP is 0.0171, suggesting that the firm tax preferences are 0.0171 billion. The distributions for other measures and controls are consistent with the existing literature.

Table 2. Summary Statistics

Variable	N	Mean	SD	Min	Max
R&D_expense	21,925	0.1331	0.358	0	2.928
Inno_textual	21,925	0.8604	0.4084	0.1818	2.1031
TP	21,925	0.0171	0.0561	0	0.4047
STP	21,925	0.0048	0.0047	0	0.0232
ATP	21,925	0.3017	0.2416	0	0.8821
SIZE	21,925	22.0244	1.2748	19.7626	26.074
LEV	21,925	0.3979	0.2003	0.0503	0.9882
ROA	21,925	0.0542	0.0419	-0.342	0.2165
AGE	21,925	1.9427	0.926	0	3.3673
TobinQ	21,925	2.0703	1.2945	0.8372	8.5867
TOP10	21,925	0.5976	0.152	0.2214	0.9546
BOARD	21,925	8.6401	1.7095	5	15
INST	21,925	0.4463	0.2519	0.0004	0.9306
year	21,925			2008	2020

5. Empirical Outcomes

5.1. Baseline Estimations

Table 3 shows the baseline regressions on the tax preferences on corporate innovation behaviors. In the baseline analysis, we use the total amount of the R&D expense in billions as our dependent variable and use the difference between the nominal tax rate and the actual tax rate multiplied by total profits as the independent variable. We control for both year and firm-level fixed effects. In column (1), we include no controls; in column (2), we include firm-level characteristics. The coefficient for tax preferences (TP) in column (1) is 1.0095, and in column (2) is 0.6005. Both the coefficients for TP in the two columns are positively significant at 1%,

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suggesting that tax preferences enhance corporate innovation behaviors. The Adjusted R-square in columns (1) and (2) are 0.6873 and 0.7507, respectively, suggesting that our empirical model has enough explanatory power.

Table 3. Baseline Regressions

Variable	(1)	(2)
	R&D_expense	R&D_expense
TP	1.0095***	0.6005***
	(0.1861)	`(0.1911)
SIZE		0.0067***
		(0.0007)
LEV		0.0537**
		`(0.0247)
ROA		-0.0931
		`(0.079)
AGE		`-0.0445***
		`(.0147)
TobinQ		0.0034
		`(0.0023)
TOP10		-0.041
		`(0.0541)
BOARD		0.0038
		`(0.0037)
INST		0.0276
		`(.0396)
Constant	0.1159***	0.0895
	`(0.0032)	`(0.0574)
Year FE	Yes	Yes
Firm FE	Yes	Yes
N	21,925	21925
Adj.R^2	0.6873	0.7507

5.2. Robust Checks

5.2.1. Alternative Measurement for Dependent Variable.

Table 4. Alternative Measures for Dependent Variables

Variable	(1)	(2)
	Inno_textual	Inno_textual
TP	0.1419***	0.1279***
	`(.0543)	`(0.0531)
Controls	No	Yes
Year FE	Yes	Yes
Firm FE	Yes	Yes
N	21925	21925
Adj.R^2	0.7742	0.7742

To examine the robustness of the findings from the baseline estimations, we introduce textual data as the alternative measurement for corporate innovation behaviors. Specifically, we use the sum of word frequency corresponding to the word set of innovation index keywords,

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including the total words of the annual report times 100, to measure corporate innovation. The Wingo Textual, Data Analysis Database, is the source for innovation index keywords and annual report data. As shown in Table 4, the coefficients for TP in two columns are positively significant at 1%, suggesting that higher tax preferences motivate firm-level innovation behaviors.

5.2.2. Alternative Measurements for Independent Variable.

In our project, we introduce two alternative measurements for tax preferences. First, we use ((R&D expense* deduction rate*Nominal Tax Ratio)/Total Assets) *100 to measure the strength of tax preferences. Second, we use (R&D expense* deduction rate)/ (taxable income expense*deduction rate) to measure the availability of the tax preferences. We present detailed outcomes in Table 5. In columns (1) and (2), we use the strength for tax preferences (STP) as an independent variable. In contrast, in columns (3) and (4), we use the availability of the tax preferences (ATP) as the independent variable. In columns (1) and (3), we include no controls, while in columns (2) and (4), we introduce a series of firm-level controls. The coefficients in columns (1) to (4) are positively significant at the level of 1%, suggesting that findings from baseline regressions are robust to different measures for tax preferences.

Table 5. Alternative Measures for Tax Preferences

Variable	(1)	(2)	(3)	(4)
	R&D_expense	R&D_expense	R&D_expense	R&D_expense
STP	`0.2412***	`0.2925***		
	`(0.0154)	`(0.0173)		
ATP			`0.2886***	`0.2907***
			`(0.0220)	`(0.0273)
Controls	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
N	21925	21925	21925	21925
Adj.R^2	0.7064	0.7844	0.6904	0.7684

5.2.3. Additional Analysis

Table 6. Preferential tax ratio

Variable	(1) Preferential tax ratio	(2) Non-Preferential tax ratio
	R&D_expense	R&D_expense
TP	` 1.9366***	`0.2088
	`(0.4340)	`(0.2072)
Controls	Yes	Yes
Year FE	Yes	Yes
Firm FE	Yes	Yes
N	13,858	7,601
Adj.R^2	0.7688	0.8041

Tax incentives for innovation are a series of tools that can be differentiated into preferential tax ratios and super-deduction incentives. We distinguish these two tools to understand the impacts better and check the main findings' robustness. Specifically, we run grouping regressions to differentiate the preferential tax ratio and non-preferential tax ratio in Table 6, and we construct interactive terms to explore the impacts of super-deduction incentives in Table 7. As shown in column (1) Table 7, firms that enjoy preferential tax ratios tend to have higher R&D expenses and are more sensitive to the intensity of tax preferences. In Table 8, we

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can also find that the interactive terms of the TP and post are positively significant at 1%, suggesting that implementing the high deduction ratio increases the willingness of innovation at the firm level. Considering the findings in Table 6 and Table 7, we can conclude that preferential tax ratio tools and super-deduction incentive tools positively impact firm-level innovation behaviors.

Table 7. Additional Analysis-High deduction ratio

Variable	`(1)	`(2)
	R&D_expense	R&D_expense
TP	`0.1599	`0.2392
	`(0.2044)	`(0.2031)
TP*Post	`1.5375***	`0.6796***
	`(0.1989)	`(0.1858)
Controls	No	Yes
Year FE	Yes	Yes
Firm FE	Yes	Yes
N	21,925	21,925
Adj.R^2	0.753	0.753

6. Mechanism Analysis

Tax preferences incentives provide more freedom to firm-level cash flow, which may mitigate financial constraints (Denis & Sibilkov, 2010; Beladi & Hu, 2021). We argue that the tax preference mechanism is releasing financial constraints. To examine this mechanism, we test the property right attribute channel and present the detailed analytical outcomes in Table 8. Columns (1) to (2) in Table 8 show us the examination of the property right channel based on grouping analysis on stated-owned enterprises and non-stated-owned enterprises. As shown in the table, the coefficients for non-SOEs are positively significant, indicating that tax preferences mitigate the financial constraints of non-SOEs that face severe financing constraints (An, Pan and Tian, 2016). Hence, the financing constraints mechanism is verified.

Table 8. Mechanism-Financing Constraints

Variable	Property-rights attribute Channel	
	(1) SOE	(2) Non-SOE
TP	`0.2970	`1.1509***
	`(0.2355)	`(0.2963)
Controls	Yes	Yes
Year FE	Yes	Yes
Firm FE	Yes	Yes
N	8483	13443
Adj.R^2	0.7516	0.7714

7. Conclusion and Policy Implications

Based on data from listed firms in China, our paper examines and explores the policy impacts of tax preferences on corporate innovation behaviors. Empirical evidence shows that tax preferences significantly improve firm-level innovation behaviors, and this finding is consistent with a series of robust checks. Furthermore, we verified that tax preferences enhance corporate innovation behaviors by mitigating financing constraints. Our findings provide empirical

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evidence of the policy impacts of tax incentives on innovation in developing countries and transitional economies. Developing countries can introduce tax tools to enhance firm-level innovation.

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