



A Threshold Regression Study of Tax Incentives and Innovation Based on Big Data

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Abstract. As China's economy enters the new normal of development, the impact of innovation on the economy has become more and more significant, and companies have gradually realized the importance of innovation. In recent years, the government has issued a number of preferential tax policies for macro-control of enterprise innovation, in-depth analysis of the incentive effect of tax incentives on enterprise innovation, which is conducive to improving the effect of tax preferential policies, promoting the universal application of tax incentives in enterprises, and improving national innovation. This paper collects the big data about tax preference and innovation, uses threshold regression model to analyze the tax preference and innovation output, and puts forward some suggestions.

Keywords: tax incentives · innovation · big data

1 Introduction

In the past 40 years of reform and opening up, China's economic development has achieved remarkable results, and its overall national strength has been greatly improved, making it the world's second largest economy. If China's economy is to continue to maintain a momentum of rapid and stable development, it must develop in an innovation-driven direction. The key to achieving economic transformation and upgrading lies in technological innovation. Only by improving production efficiency and enhancing the core competitiveness of enterprises can China rely on its technological advantages to seize more international markets and achieve continuous improvement of the country's comprehensive strength. As China's economy enters the new normal of development, the impact of innovation is becoming more and more significant, and companies have gradually realized the importance of innovation. Big Data Survey results show that China's R&D expenditure in 2019 increased by 11.6% year-on-year, and the specific amount was as high as 1.750 billion yuan, and its growth rate increased by 1% year-on-year. Compared with 2018, the investment intensity of R&D expenditure has increased

The thesis is the result of the Taishan University Introduced Talents Scientific Research Start-up Fund Project.

by 0.01%, accounting for 2.12% of the gross national product. From the perspective of R&D activities, the R&D expenditure of enterprises in 2019 increased by 13.1% year-on-year, and the specific amount was as high as 1373.3 billion. Yuan; In terms of the conversion efficiency of R&D expenditures, the “2019 World Intellectual Property Indicators” report shows that China has reached a new high in terms of patent applications, trademark and industrial design applications. Chinese enterprise innovation has achieved rapid development in recent years, but we should also note that innovation has characteristics such as public goods, high risks, and externalities. The characteristics of innovation determine that the marginal revenue of enterprise innovation may be less than the social marginal revenue, and this phenomenon will affect the innovation enthusiasm of the enterprise. The government can adopt tax preferential policies to macro-control enterprise innovation and further promote enterprise innovation behavior. In-depth analysis of the incentive effect of tax incentives on enterprise innovation is conducive to improving the effect of tax incentives, promoting the universal application of tax incentives in enterprises, and is of great significance to improving the country’s overall innovation capabilities.

2 Literature Review

A large number of studies have shown that tax incentives can promote enterprise innovation. American scholars believe that tax incentives can indeed encourage corporate innovation to a certain extent. Romer conducted in-depth research on technological development and proposed a knowledge spillover growth model [1]. Hall selected companies in different industries in the United States as the research objects [2]. By analyzing the impact of the government’s tax incentives on the R&D of different companies, he finally concluded that the impact of tax policies on corporate R&D and innovation will depend on the industry and the company in which the company is located. There are differences in scale. Among them, preferential tax policies have the most obvious impact on the R&D and innovation of technology-intensive and medium and large enterprises. David believes that knowledge innovation is a complex process, and only with the help of tax incentives can the enthusiasm and initiative of enterprise innovation be improved, and the risks brought by the uncertainty in the innovation process can be resolved [3]. Klassen designed and constructed a model that affects corporate R&D investment, and selected multiple indicators that affect corporate R&D investment, and found that government tax incentives can increase the after-tax profit rate of enterprises, and the increase in after-tax profit of enterprises [4]. This will in turn encourage companies to increase R&D investment. Engers and Mitchell used a general equilibrium model to study the role of preferential taxation policies on corporate technology R&D investment on a global scale [5]. Berger took some American pharmaceutical companies as a sample and found that preferential tax policies have significantly affected the technological innovation of pharmaceutical companies, and the impact is more pronounced than in other industries. In terms of research methods, some foreign scholars adopt the method of investigation and research [6]. Cappelen et al. pointed out that due to the unique externality, publicity, and risk characteristics of enterprise R&D, the external effects of R&D activities are often greater than the benefits to the enterprise itself, causing most enterprises to lack

the enthusiasm to increase R&D investment [7]. Michael Peneder selected a number of developed countries as the research object, and found that the tax policies of various countries have different effects on corporate R&D, but they have a certain positive effect on corporate innovation as a whole. Among them, the United States has the most impact on preferential tax policies.

3 Research Hypothesis

Preferential tax policies mainly encourage enterprises to innovate through various channels such as “lightening” the burden on enterprises, correcting the externalities of innovative activities, and releasing positive signals to the market. First of all, tax incentives mean that the state increases the after-tax profits of enterprises by reducing taxes and transferring part of the benefits, and reduces the burden on enterprises, which has played a role in “burden reduction”. By implementing tax incentives for corporate R&D element inputs, companies can reduce the investment cost of innovative activities, reduce corporate capital outflows, directly reduce R&D pressure, and improve their internal financing capabilities. Second, R&D is a public good. A large number of scholars have found that the benefits of corporate innovation activities are lower than the social benefits of innovation activities. An innovation achievement can be quickly enjoyed by other enterprises, and the cost is far from the investment invested by the innovation subject. Externalities lead to low enthusiasm for enterprise innovation, and tax policies can correct the externalities of R&D activities. R&D activities are high-risk investment activities. Companies invest a lot of manpower, material resources, and time costs, but the results are very uncertain, and R&D activities are more risky. Tax incentives increase the expected income and reduce the risk of R&D and innovation by reducing the burden on enterprises and reducing investment costs. Third, preferential tax policies have a very good guiding role and can send positive signals to the market. On the one hand, they can stimulate more social resources to invest in R&D and innovation, and on the other hand, they can alleviate the problem of external financing difficulties for enterprises. Therefore, the paper puts forward the following hypothesis.

Hypothesis: Tax incentives promote innovation.

4 Data and Variables

This paper selects A-share listed companies from 2008 to 2017 as research samples, and the data are from CSMAR database. The sample size is 15041. This paper uses the number of corporate patent applications to measure innovation, and uses the difference between the benchmark corporate income tax rate of 25% and the actual corporate income tax rate to measure tax incentives. The paper chooses ROE, net cash flow per share, asset-liability ratio, firm value and establishment time as control variables, and the calculation methods are listed in Table 1 (Table 2).

Table 1. Variable definition

Variables	Symbol	Variable definition
Innovation	Innovation	Ln(patent application + 1)
Tax incentive	Tax	25%-effective tax rate
ROE	ROE	Net profit/net assets
Net cash flow per share	cash	Net cash flow from operating activities/number of ordinary shares
asset liability ratio	lev	liabilities /assets
Firm value	tobinQ	Tobin'Q
establishment time	age	Ln(establishment time + 1)

Table 2. Description statistics

Variable	Mean	Median	Sd	Max	Min
innovation	2.9340	2.9960	1.5590	9.0160	0.0000
tax	0.0829	0.0983	0.1174	0.4960	-0.4150
ROE	0.0827	0.0734	0.0566	0.2862	0.0034
cash	0.3322	0.0437	1.5460	26.7500	-16.1200
lev	0.3712	0.3566	0.1940	0.8324	0.0428
tobinQ	2.6660	2.0530	2.0940	11.1600	0.2234
age	2.5500	2.6390	0.4922	3.6110	0.0000

5 The Threshold Regression

This paper uses the threshold regression to verify the positive relationship between tax incentives and innovation. The threshold variable tax, t is the tax incentive intensity, which is the difference between 25% and the effective tax rate. When tax, $t > 0$, it means the firm enjoys tax incentives. When tax, $t < 0$, it means the firm does not enjoy tax incentives. The following threshold regression model is established.

The model tests the impact of tax incentives on innovation in current and future periods. The results list in Table 3. When the enterprises enjoy tax incentive, that is, the effective tax rate is less than 25%, the coefficients in each period is significantly positive; suggesting that tax incentives can effectively promote long-term innovation. When enterprises do not enjoy tax incentives, that is, the effective tax rate is higher than 25%, the coefficients in each period is negative, which verifies that firms without tax incentives have no incentive to innovate. This conclusion is in line with current results [8].

Table 3. The results of the threshold regression

	Effective tax rate < 25%		tax > 0	Effective tax rate > 25%		tax < 0
	invent	F.invent	F2.invent	invent	F.invent	F2.invent
tax	0.9749** (2.4130)	0.7979* (1.8830)	0.9249*** (2.6641)	-0.6016 (-1.3958)	-0.4014 (-1.3064)	-0.3766 (-0.9749)
ROE	0.0854*** (9.3285)	0.1205*** (8.9872)	0.1200*** (8.5020)	0.0768*** (5.4314)	0.1204*** (6.0536)	0.1202*** (4.7860)
cash	0.4783*** (7.9720)	0.4594*** (7.7736)	0.4533*** (7.5950)	0.4006*** (5.0600)	0.3728*** (4.9923)	0.3754*** (4.8895)
tobinQ	0.1201*** (4.7386)	0.1320*** (4.9680)	0.1437*** (4.7869)	0.0656 (1.0445)	0.089 (1.6184)	0.11 (1.5661)
lev	-0.2036 (-1.4554)	-0.0053 (-0.0374)	0.0262 (-0.1636)	-0.2059 (-0.6740)	-0.2665 (-0.7385)	#VALUE! (-0.4647)
age	-0.1687** (-2.5400)	-0.1780*** (-2.7234)	-0.1926*** (-2.8328)	-0.2772 (-1.6687)	-0.3110* (-1.8018)	-0.3562** (-2.0887)
N	12470	9086	7515	2571	1574	1339
adj. R-sq	0.2421	0.2548	0.2432	0.2278	0.2398	0.2414

6 Conclusions

The thesis uses A-share listed companies as research samples to test the incentive effect of tax incentives on corporate innovation. Preferential taxation policies help promote enterprise innovation. The government should rationally design the breadth, depth, scope and implementation process of preferential taxation policies in light of the country's industrial development status and market demand, and strive to improve the pertinence of preferential taxation policies in the process of using preferential taxation policies to incentivize enterprises to innovate. Preferential tax policies that simply lower the marginal tax rate are not feasible. When the tax incentives for stimulating enterprise innovation reach a certain level, the loss of tax revenue to the government will far exceed the benefits of stimulating enterprise technological innovation. Therefore, preferential tax policies that focus on lowering tax rates play a very limited role in promoting technological innovation. There are certain differences in the effectiveness of different preferential tax policies, and there is a complementary relationship. It is necessary to make scientific choices and combinations according to the scope of application of different preferential policies to give full play to the effectiveness of various preferential tax policies [9]. At present, a comprehensive incentive method based on indirect preferential policies is mainly implemented to avoid the shortcomings of different preferential tax policies, and to give play to the advantages of different preferential tax policies to maximize the effect of tax innovation incentives. Therefore, finding the optimal combination of various tax preferential policies is the direction that innovation research needs to pay attention to.

It should also be noted that the country's preferential tax policies for promoting enterprise innovation are still scattered among various interim regulations, implementation rules or departmental regulations, and an independent and complete unified system has not yet been formed. The decentralized policy distribution leads to insufficient coordination among various preferential policies to effectively play a role [10]. In addition, compared with preferential tax policies in legal form, the interim regulations, implementation rules, and departmental regulations are relatively lack of policy authority. Relevant tax preferential policies in western developed countries are often determined in the form of laws, involving multiple taxes from direct taxes to indirect taxes, and comprehensively cover the production and operation processes of enterprises. At present, our country is vigorously advancing the process of taxation statutory, and establishing perfect tax preferential policies in the form of law can make our tax preferential policies more authoritative, which will help enterprises to fully enjoy the country's policy dividends and actively rely on the government's preferential policies.

References

1. Paul M. Romer. Increasing Returns and Long-Run Growth[J]. *Journal of Political Economy*.1986,94(5)
2. Hall B, Van Reenen J. How effective are fiscal incentives for R&D? A review of the evidence[J]. *Research Policy*.2000, 29(4)
3. David Held, Anthony McGrew, David Goldblatt, Jonathan Perraton. *Global Transformations: Politics, Economics and Culture*[J]. *Politics at the Edge*.2000,15(3)
4. Engers M, Mitchell S K. R&D policy with layers of economic integration[J]. *European Economic Review*.2005, 50(7).
5. Berger M. Technological Capabilities and Innovation in Southeast Asia[J]. *Science, Technology & Society*.2006,11(1).
6. Michael Peneder. The problem of private under-investment in innovation: A policy mind map[J]., *Technovation*.2008(28)
7. Cappelen Å, Raknerud A, Rybalka M. The effects of R&D tax credits on patenting and innovations[J]. *Research Policy*.2011,41(2).
8. Atanassov, J., and X. Liu. Can Corporate Income Tax Cuts Stimulate Innovation? [J]. *Journal of Financial and Quantitative Analysis*.2019,55 (5)
9. Griliches, Z. *Productivity, R&D, and the data constraint*[J]. *R&D and productivity: The econometric evidence*. University of Chicago Press.1998.
10. Thomson R. Tax Policy and R&D Investment by Australian Firms[J]. *Economic Record*.2010,86(273).

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