How Tax Competition Affects the Transformation of Innovations in High-Tech Industries: Based on Provincial Panel Data

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Abstract: Effectively driving the transformation of industrial innovations is an important path to promote high-quality development. This paper empirically analyzes panel data from 30 Chinese provinces from 2007 to 2021 to examine the effects of tax competition (TC) on the transformation of innovation achievements in high-tech industries (HTIAT) and the moderating effect of economic and scientific and technological(S&T) competition on TC. This work offers fresh insights into the investigation of the government's direct impact on the market and broadens the research scope of TC. The study's findings demonstrate that TC significantly inhibits the HTIAT, with the inhibitory impact being most pronounced in the eastern region. S&T competition can alleviate the inhibitory effect of TC on the HTIAT, while economic competition will exacerbate the inhibitory effect. According to this study, local governments should accelerate the development of high-tech industries (HTI), regulate their TC behavior, formulate TC strategies for localities, moderately strengthen local science and S&T competition, and improve the performance evaluation system for local officials.

Keywords: Tax competition; High-technology industries; Innovation achievements; Economic competition; Scientific and technological competition

1 Introduction and literature review

The December 2023 central economic work conference highlighted the need for high-quality development, industrial innovation, and breakthroughs in science and technology (S&T), especially disruptive and cutting-edge technologies, to promote new industries, models, and inventive productivity. China's 2015 legislation classifies scientific and technical breakthroughs as knowledge objects that are the result of intricate intellectual work and have academic or economic worth. This highlights the close relationship between industrial and scientific progress, where industrial advancements typically stem from testing new technologies until they are ready for commercial use, thus benefitting both the business sector and society as a whole (He, 2011[1]). Industrial innovation conversion efficiency is contingent on market dynamics and governmental regulations (Zhu and Wang, 2023[2]). Since the 18th CPC National Congress, government assistance and supervision have helped advance the reform of the science and technology (S&T) system, with the government playing a vital role in translating research and technology into the high-tech industry (HTI) (Wang, 2023[3]). Research has focused on how fiscal decentralization affects the tax competitiveness of local governments and economic development. Previous research has shown that fiscal decentralization may greatly impact the tax competitiveness of

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local governments and may improve community services, resource distribution, and economic development (Tiebout, 1956[4]). Nevertheless, the influence of tax competition (TC) on HTI innovation has not been well investigated. China's HTI has a strong emphasis on innovation, with experts studying innovation ecology, digital transformation, and government R&D subsidies. Most studies on HTI innovation have focused on commercial and government perspectives. The 20th Party Congress advocated for an advanced socialist market economy system, in which resources are allocated by both the market and the government. Technological progress and the expansion of high-tech businesses rely on innovation (Tu et al., 2023[5]).

Recent research has shown the significance of fiscal policy in fostering innovation. There is ongoing discussion over the impact of fiscal policy and industrial innovation on firm research and development (R&D) and competitiveness, with some researchers suggesting that government support for innovation may enhance these aspects (Mazzucato, 2016[6]). Taxes and fiscal policies may either impede or support company innovation, as noted by Yuan and Guo (2018) [7].

The correlation among TC, economic growth, industrial agglomeration, and innovation is intricate and diverse. Research indicates that TC has a limited influence on economic growth, but its intermediate impacts such as factor movement and industrial agglomeration often contribute to economic development (Zhao and Yu, 2020[8]). The impact of TC on HTI innovation is not well understood. Innovation propels the national innovation-driven development agenda. Industrial innovation is essential for quality growth, and industry agglomeration may encourage technical innovation and the evolution of the high-tech sector (Liu and Zhang, 2022[9]). TC may impede industrial restructuring and tax revenue, which may decrease HTI innovation and local government revenues (Xiao and Liu, 2018[10]). The central government has included technical innovation indicators in local government evaluations, highlighting the increasing acknowledgment of the influence of science and technology innovation on economic growth. Intense territorial rivalry among Chinese municipal governments, known as "bottom-by-bottom competition" (Han and Yang, 2020[11]), might impede technical progress.

Following the analysis provided, this paper puts up three hypotheses:

H1: TC dims HTIAT.

H2: Market competition worsens TC's HTIAT disincentive.

H3: Technology competitiveness reduces TC HTIAT disincentives.

This research seeks to enhance the current literature by analyzing the overall effect of local government technology centers on high-tech industry agglomeration and investigating how this impact varies across different geographic regions in promoting high-tech innovation. The study intends to examine how the government's HTI policy interacts with TC, economic competitiveness, and scientific-technological competitiveness.

2 Research design and data sources

2.1 Modeling

To verify whether TC has a dampening effect on the HTIAT, this paper constructs the following two-way fixed-effects panel data model.

$$Htnsr_{i,t} = \alpha_0 + \alpha_1 Taxc_{i,t} + \alpha_2 Con_{i,t} + u_i + v_t + \varepsilon_{i,t} \quad (1)$$

Htnsr represents the HTIAT, which is the explanatory variable of this paper; *Taxc* represents the level of TC, which is the core explanatory variable of this paper; and a series of control variables at the macro level.Con_{it} includes a series of control variables at the macro level, including infrastructure (*Inf*), industrial structure (*Str*), urbanization (*Urb*), financial development (*Fin*), economic development (*Grow*); i denotes province, t denotes year, and u_i denotes province-fixed effects,v_t denotes year-fixed effects, and$\varepsilon_{i,t}$ denotes random error term.

Based on verifying hypothesis 1, to verify hypothesis 2 and hypothesis 3, i.e., economic competition and S&T competition have corresponding moderating effects on TC on the HTIAT, referring to the moderating effect model and testing process proposed by Wen et al. (2005) [12], this paper constructs model (2) and model (3):

$$Htnsr_{i,t} = \alpha_0 + \alpha_1 Taxc_{i,t} + \alpha_2 Govtech_{i,t} + \alpha_3 Taxc_{i,t} * Govtech_{i,t} + \alpha_4 x_{i,t} + u_i + v_t + \varepsilon_{i,t} \quad (2)$$

$$Htnsr_{i,t} = \alpha_0 + \alpha_1 Taxc_{i,t} + \alpha_2 Gdpgr_{i,t} + \alpha_3 Taxc_{i,t} * Gdpgr_{i,t} + \alpha_4 x_{i,t} + u_i + v_t + \varepsilon_{i,t} \quad (3)$$

2.2 Description of variables (Table 1)

1. Explained variable: HTIAT

The HTI is an important main body of S&T innovation, this paper focuses on whether TC will have an impact on the HTIAT. The explanatory variable in this paper is the HTIAT, which is expressed as the logarithm of the indicator of the sales revenue of the new products of the high-tech industry(Htnsr), drawing on the methodology of Li et al. (2014) [13].

2. Core explanatory variable: TC

The core explanatory variable in this paper is the level of TC, which is expressed as the logarithm of the TC index. Several studies have been done by scholars on the measurement of TC indicators. This paper draws on the methodology of Xiao and Liu (2018) [10] and uses the following formula to calculate it:

$$Taxc_{i,t} = \frac{Tax_t/GDP_t}{Tax_{i,t}/GDP_{i,t}} \quad (4)$$

Where $Tax_{i,t}$ denotes the sum of tax revenues of the 30 provinces in year t;GDP_t denotes the sum of GDP of the 30 provinces in year t;$GDP_{i,t}$ denotes the sum of GDP value added of province i in year t;$Tax_{i,t}/GDP_{i,t}$ reflects the level of the effective tax rate in province i in year t.$Taxc_{i,t}$ the larger it is, the lower the relative tax rate in region i, i.e., the higher the level of TC

in region i; and vice versa.

3. Moderating variables

The moderating variables chosen for this paper are economic competition and technological competition.

The S&T competition arises as a result of the external factors associated with S&T innovation. Government involvement can effectively serve as a supplementary factor in increasing the region's potential for innovation. (Yan, 2023[14]) This research acknowledges the constraints of using absolute indicators and instead utilizes the relative indicator of finance S&T expenditure (*Govtech*) to assess the level of intensity in S&T rivalry. It is possible to theorize that as S&T competition intensifies, it can effectively support the transformation of local high-tech industrial innovation results and alleviate the inhibitory effect of local government TC on the HTIAT to some extent.

Economic competition arises from the struggle among local governments to achieve economic growth, driven by the dual incentives of officials' "promotion tournaments" and the need to increase fiscal revenues. (Bian and Bai, 2017[15]). There is a hypothesis that suggests that economic competition will intensify TC among local governments. Additionally, this competition may also worsen the inhibitory influence on the HTIAT. This paper uses the per capita GDP growth rate indicator (*Gdpgr*) as a metric to assess economic rivalry.4. Control variables

In comprehensive existing studies, the control variables affecting the HTIAT mainly include three aspects of economy, society, and government, and five control variables, namely, infrastructure (*Inf*), industrial structure (*Str*), urbanization (*Urb*), financial development (*Fin*) and economic development (*Grow*). The descriptive results for each variable are analyzed in Table 2.

2.3 Data sources

This study focuses on 30 provinces in China, excluding Hong Kong, Macao, Taiwan, and Tibet due to their higher number of missing data values. The panel data from 2007-2021 is selected for analysis, and all data used in this study are sourced from the China Statistical Yearbook and EPS Data Platform. In instances where statistics were missing, linear interpolation was used to estimate the values.

Table1. Description of relevant variables

Variable type	Variable name	Variable symbol	Description of variables
Explanatory variable	High tech industry Transformation of innovations	Htnsr	High-tech industry new product sales revenue indicators take logarithmic values
Core explanatory variables	Tax competition	Taxc	The average effective tax rate for all districts/logarithm of the effective tax rate for a given district
Moderator variable	Technological competition	Govtech	Regional financial expenditure on science and technology/total regional population Logarithmic

Control variable	Economic competition	Gdpgr	GDP per capita growth rate
	Infrastructure	Inf	Logarithmic road density
	Industrial structure	Str	Tertiary value-added ratio in logarithmic scale
	Urbanization	Urb	Urbanization rate in logarithms
	Financial development	Fin	Banking loans/GDP in logarithms
	Economic growth	Grow	Provincial GDP per capita in logarithmic terms

Data source: China Statistical Yearbook, EPS Data Platform

Table2. Descriptive statistics of main variables

Variable name	Observations	Average value	(statistics) Standard deviation	Minimum value	Maximum values
Htnsr	450	1.28e+07	2.95e+07	160	2.46e+08
Taxc	450	1.091	0.288	0.415	1.700
Inf	450	86710.32	46749.06	6644.643	237439.8
Str	450	0.455	0.100	0.286	0.839
Urb	450	0.570	0.134	0.282	0.896
Fin	450	3.080	1.153	1.288	8.131
Grow	450	50386.33	29445.88	6915	183980

3 Analysis of benchmark regression results

This paper conducts an empirical analysis of the influence of TC on the sales revenue of high-tech products in local governments. The analysis utilizes stata17 software to perform the Hausman test, which yields a p-value of less than 0.01. Consequently, the fixed effect panel model is selected. Additionally, the time effect is taken into account, with the test results indicating a p-value of less than 0.01. Consequently. This study employed a two-way fixed-effect model to analyze the influence of TC on the HTIAT. Furthermore, to mitigate the issue of variable multicollinearity, this paper validates all data.

Column (1) of Table 3 reports the regression results of the two-way fixed effects model. In the benchmark regression results after controlling for province and year fixed effects, the regression coefficients of TC are significantly negative at the 1% statistical level, and columns (2) to (4) add a series of control variables based on column (1), and the results are still robust and significantly positive. Accordingly, it is shown that TC will have a dampening effect on the HTIAT, and hypothesis 1 of the paper is tested. This may be because innovation in HTI requires a large amount of R&D investment, and TC may cause the government to reduce its support and investment in HTI, thus inhibiting R&D capability and innovation transformation.

From the perspective of control variables, columns (2) to (4) report that the regression coefficients of infrastructure and urbanization are significantly positive at a 1% statistical level, indicating that infrastructure construction, urbanization, financial development, and economic growth can significantly alleviate the inhibitory effect of TC on the HTIAT, which may be because the level of infrastructure represents the hard environmental conditions of the local

innovation system, and a good level of infrastructure construction can provide support and guarantee for technological innovation. This may be because the level of infrastructure represents the hard environment in the local innovation system, and a good level of infrastructure construction can provide support and guarantee technological innovation; the degree of urbanization has a positive impact on the HTIAT, which may be because urbanization can increase the degree of intensification of the region, and the level of financial development and economic growth also has a positive impact on the HTIAT, which may be because, with the continuous development of the financial and economic level of the region, the local government can provide more financial resources to support the transformation of HTI. The regression coefficient of industrial structure is positive, but it is not significant at all statistical levels, which may be due to the threshold effect of the influence of industrial structure on the efficiency of regional S&T innovation and TC, which varies according to the size of the index of upgrading of industrial structure, and it is easy to form a more favorable external environment and internal motivation for the operation of enterprises in a higher level of upgrading of industrial structure. External environment and internal motivation for enterprise operation, and the effectiveness of TC may be strengthened. (Zhu and Wang, 2023) [16]

Table3. Benchmark regression results

Variables	Explained variable: HTIAT (Htnsr)			
	(1)	(2)	(3)	(4)
Taxc	-1.356***	-1.467***	-1.436***	-1.353***
	(-3.59)	(-3.98)	(-3.32)	(-3.15)
Inf		3.055***	1.906***	1.510***
		(5.82)	(3.43)	(2.67)
Str		0.502	0.359	0.957
		(0.84)	(0.59)	(1.50)
Urb			4.023***	2.115**
			(5.48)	(2.18)
Fin			0.218	1.333**
			(0.46)	(2.22)
Grow				1.607***
				(2.98)
Time effect	Yes	Yes	Yes	Yes
Regional effect	Yes	Yes	Yes	Yes
Cons	13.168***	-19.678***	-4.352	-17.680**
	(95.86)	(-3.40)	(-0.68)	(-2.27)
R^2	0.640	0.669	0.692	0.699
Observations	450	450	450	450

Note: ***, **, and * denote 1%, 5%, and 10% significance levels, respectively, with robust t-values in parentheses, as in the table below.

4 Conclusions and policy recommendations

This paper examines the influence of TC on the conversion of breakthroughs in HTI, which is crucial for fostering the rational and sustainable development of both government and the market. This study empirically analyzes the impact of TC on the HTIAT by using panel data from 30 provinces in China from 2007 to 2021. The paper also examines the moderating effects

of S&T competition and economic competition on TC. To achieve this, the paper employs various statistical techniques including the bidirectional fixed effect model, alternative variable method, instrumental variable hair, regional heterogeneity analysis, and moderating effect model. The primary findings can be summarized as follows: Firstly, TC has a restraining impact on the conversion of inventions in the HTI. This finding remains valid even when substituting the explanatory variables and employing the instrumental variables method to address the endogeneity test. Furthermore, TC notably hampers the conversion of innovative high-tech business in the eastern region, although its impact on the middle and western regions is not substantial. Furthermore, S&T competition can effectively mitigate the hindering impact of TC on the conversion of high-tech industrial innovations, whereas economic competition will intensify the hindering impact of TC on the conversion of high-tech industrial innovations.

This report presents policy proposals in the following areas: Initially, expedite the advancement of cutting-edge industries, enhance their position as the primary drivers of innovation, enhance their ability for technological innovation and industrial competitiveness, and construct a cooperative innovation framework involving industries, universities, and research institutes. Simultaneously, it is imperative to enhance the communication, interaction, and collaboration between high-tech enterprises and the government, universities, and scientific research institutions. This will facilitate resource sharing, leverage each other's strengths, overcome academic barriers, eliminate the isolated nature of S&T innovation, stimulate the innovative capacity and untapped potential of the primary innovators, and propel the regional HTI towards achieving innovation of exceptional quality. Furthermore, it is essential to establish uniformity in the TC practices of local governments and enhance their motivation for economic growth. To enhance investment and stimulate economic growth, it is crucial to establish regulations that govern the behavior of local governments in TC. This includes the development of appropriate policies and measures to ensure that TC is reasonable and sustainable, while also limiting the discretionary power of local governments. Furthermore, the TC strategy should be tailored to local circumstances to expedite the growth of high-tech sectors in the central and western regions. The central and western areas of China are crucial for the advancement of HTI. To expedite their development, these regions should effectively utilize the current development plans and engage in high-quality technology and industrial transfer. The central government can direct the progress of a moderate level of TC to prevent the detrimental effects of excessive TC and facilitate the advancement of regional HTI advances. Furthermore, it is advisable to enhance local rivalry in the field of S&T to a moderate extent. Facilitate technological advancement and enhance industrial progression, hence fostering the high-quality advancement of innovation in HTI. Establish a durable and reliable framework for scientific and technology competitions, consistently enhance financial investment in S&T, and fully utilize the influential role of S&T competitions in promoting innovative development in high-tech businesses. Furthermore, enhances the performance assessment system for the advancement of local officials by establishing an evaluation framework that prioritizes innovation. This will mitigate the hindering influence of officials' promotion competitions on the progress of high-tech industrial innovation. Additionally, it will prevent unnecessary TC and other adverse consequences resulting from performance evaluations, thus fostering the advancement of HTI through innovation.

References

[1] HE D. Analysis of and Considerations on the Concepts of Scientific and Technological Achievement and Its Transformation[J]. China Soft Science, 2011(11): 1-7.

[2] ZHU D, WANG H. The Influence of Tax Competition and Fiscal Expenditure Competition on Regional Technological Innovation Efficiency:A threshold Effect Test Based on Industrial Structure Upgrading[J]. Modern Finance and Economics-Journal of Tianjin University of Finance and Economics, 2023,43(01): 86-102.

[3] WANG X. Research on the transformation configuration of S&T achievements in high-tech industries under the TOE framework[J]. Science Research Management, 2023.

[4] TIEBOUT, C M. A Pure Theory of Local Expenditures[J]. Journal of Political Economy, 1956,64(5), 416-424.

[5] TU W, ZHANG L, SUN D, et al. Evaluating high-tech industries' technological innovation capability and spatial pattern evolution characteristics: Evidence from China[J]. Journal of Innovation & Knowledge, 2023,8(1): 100287.

[6] MAZZUCATO M. From Market Fixing to Market Creating: A New Framework for Innovation Policy[M]. 2018: 79-103.

[7] GUO J, YUAN Z. Life Cycle, Fiscal Policy and Innovation Ability:Empirical Evidences from Technology-Based SMES[J]. Contemporary Finance & Economics, 2018(03): 23-34.

[8] ZHAO Q, YU G. Research on the Mediating Effect of Tax Competition on Economic Growth:Path Analysis Based on Structural Equation Model[J]. East China Economic Management, 2020,34(03): 75-85.

[9] LIU H, ZHANG G. The Impact of Industrial Cooperative Agglomeration on High-quality Economic Development[J].Science & Technology Progress and Policy,2022,39(01):69-77.

[10] XIAO Y, LIU X. Does Tax Competition Promote the Transformation and Upgrading of Industrial Structure?-Based on the Dual Perspectives of Total Amount and Structure[J]. Public Finance Research, 2018(05): 60-74.

[11] HAN F, YANG L. How Does the Agglomeration of Producer Services Promote the Upgrading of Manufacturing Structure?:An Integrated Framework of Agglomeration Economies and Schumpeter's Endogenous Growth Theory[J]. Journal of Management World, 2020,36(02): 72-94.

[12] WEN Z, HAU K, CHANG L. A COMPARISON OF MODERATOR AND MEDIATOR AND THEIR APPLICATIONS[J]. Acta Psychologica Sinica, 2005(02):268-274.

[13] LI E, LI Q. Local Government Innovation Competition and Enterprise Innovation[J]. Contemporary Finance & Economics, 2021(04): 16-27.

[14] YAN H. Government Expenditure on Science and Technology, Regional Innovation and Economic Growth[J]. Statistics & Decision, 2023,39(08): 131-136.

[15] BIAN Y, BAI J. Competition for Growth and Competition for Innovation---A New Explanation for the Impact of Fiscal Decentralization on Technique Innovation[J]. Public Finance Research, 2017(10): 43-53.

[16] ZHU D, WANG H. The Influence of Tax Competition and Fiscal Expenditure Competition on Regional Technological Innovation Efficiency:A threshold Effect Test Based on Industrial Structure Upgrading[J]. Modern Finance and Economics-Journal of Tianjin University of Finance and Economics, 2023,43(01): 86-102.