Fiscal Transparency and Urban Innovation: Evidence from a Panel of Chinese Prefecture-level Cities

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Abstract

Fiscal transparency is an important manifestation of proactive government and profoundly affects economic activities. This paper selects panel data of Chinese prefecture-level cities from 2013-2019 to empirically analyse the significant impact and mechanism paths of local government fiscal transparency on urban innovation capacity. The study finds that local government fiscal transparency significantly increases the level of urban innovation. The heterogeneous discussion finds that the boosting effect of fiscal transparency on the level of urban innovation is mainly found in the central region, with a significantly positive effect in ordinary prefecture-level cities, provincial capitals and sub-provincial cities. These findings hold true after replacing economic indicators and controlling for the endogeneity problem, among other robustness tests. Further mechanism analysis shows that fiscal transparency increases the overall level of innovation in cities by increasing the scale of invention patent output and the scale of foreign direct investment in cities. This paper enriches the literature on the impact of local government fiscal transparency on economic development, and the relevant findings are of significant reference value.

Keywords

Fiscal Transparency; Urban Innovation Level; Number of Invention Patents; Foreign Direct Investment.

1. Introduction

Fiscal transparency is the foundation and an important pillar of national governance, the "bottom line requirement" for building a responsible government, a basic condition for guaranteeing people's right to participate in politics, and an institutional safeguard against waste of financial resources and administrative corruption. Fiscal transparency is essential for restraining government power. It plays a very important role in achieving social justice. In May 2008, the State Council issued the Regulations of the People's Republic of China on Information Disclosure, and in 2010, the Ministry of Finance's Guidance on Further Improving Budget Information Disclosure mentioned that budget information disclosure is an essential requirement of public finance. All regions and departments should take the initiative to make their budgets and final accounts public, actively promote the disclosure of departmental budgets and vigorously promote the disclosure of livelihood expenditures. in 2013, the "Notice of the Ministry of Finance on Promoting the Disclosure of Sub-provincial Budgets and Accounts" required that all provinces should make public their financial budgets and accounts, departmental budgets and accounts and the budgets and accounts of the 'three public funds', and municipal (county) level summary by 2015 in all governments above the county level in the province "three public funds, etc." In November 2013, the Third Plenary Session of the 18th Central Committee of the Communist Party of China (CPC) stated in its deliberations and adoption of the Decision of the CPC Central Committee on Several Major Issues of

Comprehensively Deepening Reform: "We should strengthen the system of constraints on and supervision of the operation of power, insist on using the system to govern power and matters, and allow the people to supervise power, let power run under the sun, and implement a comprehensive, standardized, open and transparent budget system".In 2014, the revised version of the Budget Law called for the establishment of a comprehensive, standardized, open and transparent budget system. In the China Fiscal Transparency Report 2018, it is shown that the fiscal transparency of governments at the provincial (autonomous regions and municipalities directly under the Central Government) level in China is on the rise. Fiscal transparency is conducive to reducing corrupt practices and optimising the structure of fiscal expenditure, but at the same time citizens are also made aware of irrationalities in the government's fiscal practices.In 2017, the 19th Party Congress proposed the full implementation of performance management and the establishment of a comprehensive, standardised and transparent budget system with scientific standards and strong constraints, pointing to a new direction for reform and innovation in the modern fiscal management system.

At present, innovation is an important path for China to achieve high-quality development. In his report to the 19th Party Congress, General Secretary Xi Jinping put forward the epoch-making assertion that "science and technology are the core combat power". The implementation of strategies such as developing the country through science and education, strengthening the country with talents, and innovation-driven development are important strategic plans to promote economic development and social progress. Innovation capability is not only the central expression of today's new international competitive advantage, but also the main source of comprehensive competitiveness among cities. As a spatial carrier for China to improve its independent innovation capability, achieve technological self-sufficiency and self-improvement, and participate in global technological competition, cities play a fundamental role in supporting the construction of a strong technological nation in the new era. The high risk and high investment nature of innovation, as well as the positive externalities, make innovation activities more in need of government support. Fiscal transparency, as an important tool for governments at all levels to transform their own functions and optimise the business environment, has a logical necessity to influence the innovation activities of micro-entities within their jurisdictions.

Current research on fiscal transparency has mainly explored its impact and mechanisms of action on corruption, fiscal deficits, government debt and fiscal efficiency as independent variables, as well as some earlier literature that has focused on defining and quantifying fiscal transparency. Very little literature has examined the impact of fiscal transparency on the ability to innovate to the city level. Most of the literature on urban innovation has taken the number of patents on urban innovation as its object of study, and most of it has focused on national innovation, provincial innovation and firm innovation, especially at the level of SMEs, while less has analysed its impact on urban innovation capacity. This paper focuses on the impact of fiscal transparency on the improvement of urban innovation capacity, and theoretically analyses the mechanisms by which it affects urban innovation capacity.

This paper selects panel data on prefecture-level cities in China from 2013-2019 to empirically analyse the important impact of local government fiscal transparency on the innovation capacity of cities. The study finds that local government fiscal transparency is an important engine driving urban innovation. This finding persists across a series of robustness tests. Further regional heterogeneity analysis shows that the contribution of fiscal transparency to the level of urban innovation is mainly found in the central region. In addition, the analysis of city administrative level heterogeneity shows that the effect is significantly positive for ordinary prefecture-level cities, provincial capitals and sub-provincial cities. Finally, two potentially important mechanisms of influence are discussed in depth. Firstly, the mediation mechanism of the number of invention patents in cities leads to the conclusion that the higher

the fiscal transparency of a city, the higher the number of invention patents in the city; and that the number of invention patents has a significant positive contribution to the overall innovation performance of the city. Thus, it can be concluded that fiscal transparency increases a city's invention patent output, which in turn increases the overall level of innovation in the city. Secondly, looking at the mediating effect of foreign direct investment, the higher the fiscal transparency of a city, the larger the city's FDI; the estimated coefficient of FDI is 0.744, again significantly and positively contributing to city innovation. Thus, fiscal transparency increases the size of FDI in a city, which in turn increases the overall level of innovation in the city.

Compared to previous studies, the contributions of this paper are: firstly, it is the first to explore in detail the impact of local government fiscal transparency on the innovation capacity of cities, enriching the important literature on the economic consequences of local government actions; secondly, it provides an important governmental dimension to explain the development of regional economies and innovation levels, and to some extent fills in the literature on the important role of government on economic growth. Secondly, the paper provides an important governmental dimension to the development of regional economies and innovation levels, and to some extent fills in the literature on the important role of government in economic growth. Thirdly, the paper discusses in detail the important mechanisms between patents and FDI, providing an important reference for related research.

The subsequent structure of this paper is organised as follows: Part II contains a review and discussion of the relevant literature and the formulation of the theoretical hypothesis; Part III presents the data structure and research design of the paper respectively; Part IV presents the basic empirical results; Part V provides further discussion of the mechanism; and finally, the concluding remarks and policy implications of the whole paper.

2. Literature Review and Theoretical Hypotheses

2.1. Related Research on Financial Transparency

Fiscal transparency, i.e. the extent to which information related to fiscal policy intentions and fiscal forecasts is made public, reflecting the costs and benefits of government activities, is of great importance to economic and social development. The authoritative definition of fiscal transparency is proposed by Kopits and Craig (1998), which is the disclosure of information to the public on the structure and functions of government, fiscal policy intentions, public sector accounts, fiscal revenues and expenditures, and fiscal forecasts.

The International Monetary Fund (IMF) Fiscal Affairs Department's Fiscal Transparency Handbook adopts this definition and considers that fiscal transparency includes four areas: governments should be clear about their functions and areas of responsibility; governments must make budget information fully public; governments should make their budgeting and decision-making processes reasonably open and provide budget data; and governments should provide truthful fiscal data. The OECD also developed Best Practices on Budget Transparency in 2001, based on the needs of member countries.

Since the promulgation of the Information Disclosure Regulation in 2008, a number of scholars and research institutions have conducted long-term studies on the question of how transparent China's finances really are, among which the earliest and more far-reaching study was carried out by the China Fiscal Transparency Assessment Group of Shanghai University of Finance and Economics, which has published the fiscal transparency scores of each province in China once a year since 2009.

There is a wealth of research on the impact of fiscal transparency, both as an explanatory variable and as an explanatory variable, and relevant empirical studies have quantified and analysed it from a macro perspective. Early on, they mainly focused on the definition and measurement of fiscal transparency and the influencing factors of fiscal transparency. In

addition, scholars have also analysed fiscal transparency indicators themselves, such as Deng Shulian (2012), who analyses the current challenges facing fiscal transparency in China.

Fiscal transparency, as an important means to effectively alleviate information asymmetry, is the foundation and necessary condition for promoting government supervision and accountability (Ma Jun, 2012; Li Jingtao and Chen Zhibin, 2015). In the process of strengthening the power of social supervision, the disclosure of budget and account information can effectively reduce corruption among government officials and promote the improvement of the efficiency of the use of funds, thus improving fiscal performance in general (Bai Yanfeng and Wang Xiuyuan, 2019).

Representative domestic results on the quantification of fiscal transparency include the Research Report on Fiscal Transparency of Municipal Governments in China published annually by Tsinghua University since 2011 and the China (Provincial) Fiscal Transparency Report published by Shanghai University of Finance and Economics for ten consecutive years from 2009-2018, with many relevant academic studies using the aforementioned reports as direct data sources.

The Economic Consequences of Fiscal Transparency focuses on the impact of fiscal transparency on fiscal efficiency, rent-seeking or corruption, deficits and debt, etc.

In terms of fiscal efficiency, in foreign studies, Heald analyses the impact of fiscal transparency on fiscal efficiency from a theoretical perspective, arguing that there are two possibilities for the impact of fiscal transparency on fiscal efficiency: one is that increased fiscal transparency has some positive effects, but too much transparency can make information overly public, thus causing higher transaction costs and political risks and leading to impaired fiscal efficiency, while the other is that increased fiscal transparency may have a sustained improvement on fiscal performance.

Chinese scholars have also been promoting research on fiscal transparency in China, with some scholars conducting research in terms of reforming the fiscal budget, revising the Budget Law and improving budgeting (Ma Jun, 2005: Zhao Qian, 2009). Other scholars have conducted studies from the perspective of international comparison, and put forward path options as well as policy recommendations for fiscal transparency in China (Deng Shulian, 2012; Xiao Peng and Yan Chuan, 2013).

In response to the question of whether fiscal transparency has an impact on the allocation of fiscal funds, Ferejohn (1999) argues that increased fiscal transparency increases voters' trust in government, which in turn increases investment in public goods; James et al. (2006) argue that voters are willing to allocate more resources to the public sector with greater fiscal transparency; Ellis et al. (2006) argue that increased (2006) argued that voters are willing to allocate more resources to the public sector with greater fiscal transparency; Ellis et al. Based on two perspectives: fiscal expenditure efficiency and expenditure structure, Li Dan et al. conclude that the effect of fiscal transparency on per capita social security and employment expenditure is significantly positive, but not on other livelihood expenditure categories, so that improving fiscal transparency in China is not yet effective in improving fiscal expenditure efficiency.

In addition, fiscal transparency can also have a significant impact on corruption, with Bastida et al. (2007) finding through international comparisons that increased fiscal transparency can be effective in reducing corruption; Kolstad et al. (2009) arguing that fiscal transparency can be effective in reducing government corruption by exposing wasteful and rent-seeking government behaviour and making government corruption a high risk; and Hameed - Empirically found that fiscal transparency is negatively related to corrupt rent-seeking behaviour, holding other economic variables constant. Huang Shoufeng (2015) argues that improving fiscal transparency can effectively curb corruption, but with a limited effect, where:

trade openness, public service salaries and government size have a significant negative effect on corruption, and education level and economic development level have no significant effect on corruption.

Among the studies on the effects of fiscal transparency, scholars have focused more on the effects of fiscal transparency on deficits and debt. Generally speaking, increased fiscal transparency is effective in reducing government deficits and public debt and promoting improved economic performance (Benito et al., 2009).Alt and Lassen (2006) empirically tested the effect of fiscal transparency on the size of government debt and fiscal deficit using cross-country data and found that fiscal transparency significantly reduces the size of debt and deficit.Alt and Lowry ((2010) empirically tested the effect of fiscal transparency on the size of government debt and deficit using state-level data in the US, finding that an increase in fiscal transparency significantly reduces the growth of tax revenue and achieves a stable growth of tax revenue. At the domestic level, Xiao and Peng (2010) show that a lack of fiscal transparency leads to an increase in local government debt under China's "promotion tournament" model and the realities of the banking sector, and demonstrate through empirical analysis that there is a significant negative relationship between fiscal budget transparency and local government debt.

2.2. Related Research on Urban Innovation

Innovation is the first driving force leading China's economic transformation and development. Releasing the vitality of urban innovation, improving the innovation capacity of cities and promoting the construction of urban innovation systems are important initiatives for establishing an innovative country. As an important symbol of urban competition, urban innovation capacity has attracted extensive attention from scholars in recent years. Around urban innovation, established studies have mainly discussed from the following aspects:

First, it examines the impact of innovation policies on the innovation level of cities and affirms the positive effect of innovation policies on enhancing the innovation level of cities. For example, the pilot policy of setting up national innovation cities has an incentive effect on the innovation level of cities. In addition, innovation policies such as the construction of national intellectual property model cities, the construction of smart cities and the construction of national high-tech zones are also positively associated with the innovation power of cities.

Secondly, the impact of innovation input factors on urban innovation is examined, mainly in terms of land resources and human capital. For example, the mismatch of land factors is not conducive to the improvement of urban innovation levels, such as the comprehensive impact of the resource allocation method of large-scale industrial land concessions on urban innovation levels.

She Shuo (2019) argues that the comprehensive innovation policies introduced for the construction of innovative cities have not played a significant role in promoting the enhancement of urban innovation capacity; moreover, innovation policies have different incentive effects on innovation agents at different levels, and most literature focuses studies on national innovation, provincial innovation and enterprise innovation, especially at the level of small and medium-sized enterprises, while less analysis is made of their impact on urban innovation capacity. This paper focuses on the impact of different types of innovation policies on the enhancement of urban innovation capacity, and theoretically analyses the mechanisms by which they have an impact on urban innovation capacity.

2.3. Theories on Fiscal Transparency

The initial definition of fiscal transparency was given by George Kopits and Jon D. Craig: information on the structure and functions of government, fiscal policy intentions, public sector accounts and fiscal forecasts is made available to the public to the maximum extent possible

and is reliable, detailed, timely, easily understood and comparable so that voters and financial markets can accurately the financial position of the government and the true costs and benefits of its activities. This definition was adopted in the Revised Fiscal Transparency Handbook prepared by the IMF's Fiscal Affairs Department.

2.4. Financial Information is a Special Kind of Public Good

The government's various financial statistics and statements, etc., are public information goods to which members of society have free access. In terms of use, access to fiscal information is non-exclusive, and the quantity and quality of fiscal information products are independent of how often they are used and for what purpose they are used, which constitutes one of the rational expectations underlying fiscal information products as social public goods: no market participant would want to invest in an information system if the price could display the information that the market participant needed at no cost. This means that no one will be willing to spend resources to produce information, because the utility gained by those who invest in information systems will not differ from the utility gained by those who do not invest and who are able to obtain information at no cost by observing the price system. Such information becomes extremely valuable when no one else collects it. Thus, if you are the only person collecting such information, then the environmental conditions create a strong incentive for you to obtain such information, which changes the distribution of information in the market, which in turn provides an incentive for others to collect the same information. The indivisible public nature of the benefits of information again forms the basis of financial information as a public good.

2.5. The Contractual Spirit of Financial Transparency

Social contract theory holds that the state as a political entity is formed by people entering into contracts and ceding all or part of their rights. The relationship between the public and the government is essentially a fiduciary relationship, in which the government, as a fiduciary, is obliged to fulfil the fiduciary responsibilities entrusted to it by the public. In recent years, the amount of government expenditure has been on the rise around the world, and the proportion of government expenditure to GDP in China has exceeded 20% since 2002. The expansion of fiscal expenditure means, on the one hand, an expansion of the government's fiduciary responsibilities, but it also means that there is a hidden danger of wasting resources in government operations. The public pays taxes to provide the government with financial security and has the power to monitor the efficiency and effectiveness of the government's use of public financial resources. However, under conditions of incomplete contracts, there is a serious information asymmetry between the government and the public, with the government being the creator and owner of public information and the public being in a situation of information asymmetry. The game between the government and the public can create a strong incentive for the public to monitor the government's actions and obtain public information. Therefore, increasing fiscal transparency and respecting the public's right to know and monitor is an effective way for governments to voluntarily fulfil the social contract, strengthen public fiduciary responsibility and achieve the legitimacy of the existence of contemporary governments.

2.6. Information Symmetry and Financial Transparency

Principal-Theory argues that information asymmetry is the source of problems (adverse selection, moral hazard). If people are required to act in the interests of their principals, they are required to behave transparently. Governments, as people, sometimes have a stronger incentive to conceal information in order to cover up their policy failures, while most citizens do not have access to the "opt-out" option. Greater transparency can lead to more accountable officials fulfilling their public fiduciary responsibilities and to more effective public and

legislative oversight and evaluation of government. Fiscal transparency is therefore an inherent requirement for citizens to reduce the costs of government. Transparency is an institutional arrangement for achieving perfect and complete information, which indicates the extent to which information of a certain quality is shared by various subjects. The objective of the institutional arrangement of transparency is perfect symmetry of information. Complete symmetry of information includes two meanings, namely complete information and perfect information. Perfect information means that people have a clear understanding or expectation of the outcome, benefit or loss of each decision of the parties involved in the game; perfect information means that both parties to the game can observe each other's behavioural decisions during the game. Therefore, financial information transparency is the extent to which the government discloses financial information to the public at a specified time and with a specified frequency.

2.7. Theoretical Assumptions

Fiscal transparency can significantly increase the level of innovation in cities. This is reflected in two ways. Firstly, for micro-entities, increased fiscal transparency can make the government actively disclose financial data, which can effectively solve the problem of information asymmetry, further urge local governments to regulate their budgetary practices, guarantee access to information for innovative enterprises, increase the confidence of innovative enterprises in the government, and ensure that financial resources can be fully invested in innovative enterprises, thus effectively improving the performance output of innovative enterprises and significantly improving The city's innovation level. Secondly, for the macro environment of the city, fiscal transparency can optimise the investment environment of the city and provide a favourable environment for the development of innovative enterprises. On the one hand, higher fiscal transparency represents a strong management capacity of the local government, which is conducive to attracting foreign investment, and foreign capital can facilitate resource allocation, reducing the risk and R&D costs of innovative enterprises. On the other hand, higher fiscal transparency represents a good institutional environment in the region, where companies can concentrate on R&D activities without having to prepare for the substantial costs of defending their rights, thus increasing the level of innovation in the city.

Based on the above analysis, this paper proposes that:

Hypothesis 1: Fiscal transparency significantly increases the level of innovation in cities.

In order to explore the specific mechanisms by which fiscal transparency contributes to the level of innovation in cities, this paper proposes the following two possible mechanism hypotheses.

Hypothesis 2: Fiscal transparency increases the level of innovation in cities by increasing their output of patents for inventions

Hypothesis 3: Fiscal transparency increases the level of innovation in cities by increasing the scale of foreign direct investment in cities.

3. Sample Description and Empirical Model Setting

3.1. Sample Selection and Data Sources

This paper uses city-level data for the period 2013-2019 to verify how city fiscal transparency affects the level of innovation in cities. In this case, the source of data for the city sample is the City Statistics Yearbook for all years.

3.2. Urban Innovation Indicators

This paper uses the China Regional Innovation and Entrepreneurship Index constructed by the National Development Institute of Peking University and the Longxin Data Institute for

robustness analysis. The index is based on enterprise big data, capturing all industries and all sizes of enterprises (The indicator is constructed using a "full" volume of enterprise data, covering micro, small and medium-sized enterprises and start-ups with a high level of innovation activity) . It examines the actual output of innovation and entrepreneurship of enterprises within a city, thus forming a more objective and realistic evaluation of innovation performance at the city level than the traditional measure of innovation performance using the number of patents or innovation input using R&D expenditure. This paper discusses the use of per capita city innovation scores as the core explanatory variable.

3.3. Local Government Financial Transparency

The report assesses the transparency of local governments' public financial information based on three major principles: full-calibre financial information disclosure, one-stop financial information dissemination and user-friendly financial information service interface. This is a more systematic and authoritative report on the measurement of municipal financial transparency in China. The full-calibre indicator system proposed by the Tsinghua University team includes four major components: 1. the disclosure of government and quasi-government agencies that use fiscal funds; 2. the disclosure of the four government accounts, including public finance, government funds, state-owned capital management and social security funds; 3. the disclosure of other important fiscal information; and 4. the three principles of full-calibre, user-friendly and one-stop service for fiscal disclosure. 4. the three principles of full-calibre, user-friendly and one-stop service.

Empirical model setting

This paper uses a panel two-way fixed effects model to examine the important impact of municipal fiscal transparency on urban innovation. The model is constructed as shown in equations (1) and (2):

$$Innovation_{ct} = \alpha + \beta_1 Tran_{ct} + X_{ct}'\delta + \lambda_t + \mu_c + \varepsilon_{ct} \tag{1}$$

where the subscripts c and t denote city as well as year, respectively. The explanatory variable $Innovation_{ct}$ is the level of innovation in city c in year t. X_{ct} is a set of city control variables. λ_t are year fixed effects to capture changes in the macroeconomic environment external to the city. μ_c are individual city fixed effects that control for potential city characteristics that do not count for time variation, including but not limited to geography, climatic factors, cultural practices norms, etc. Thus equation (1) is a standard panel two-way fixed effects model. ε_{ct} is the perturbation term of the model. Finally, to prevent heteroskedasticity issues from affecting the reliability of the empirical results in this paper, all statistical inferences in this paper are discussed based on heteroskedasticity robust standard errors.

Selection of control variables

In this paper, four important urban variables are selected as core control variables: city GDP (lnGDP, measured as the natural logarithm of the city's total GDP for the year), the share of tertiary value added (GDP3ratio, measured as the share of tertiary value added in the city for the year), ln total city population (People, measured as the natural logarithm of the city's total household population at the end of the year), and ln year-end loan balance (Finance, measured as the natural logarithm of the financial institutions' year-end deposits in the city). (measured by the natural logarithm of the total household population in the city at the end of the year), and lnyear-end loan balance (measured by the natural logarithm of the year-end balance of RMB deposits in financial institutions in the city at the end of the year). The above control variables take into account four dimensions: the level of economic development, industrial structure characteristics, population size and financial development of the city. Table 1 shows the descriptive statistics of the variables.

Table 1. Descriptive statistics of variables

Variable name		Sample size	Average value	Standard deviation	Minimum value	Median	Maximum value
Innovation score per capita	per score	960	54.272	28.561	0.685	56.335	100
Municipal financial transparency	Tran	960	0.396	0.198	0	0.385	0.858
City GDP	lnGDP	960	7.475	0.859	5.36	7.332	10.021
Share of tertiary sector value added	GDP3ratio	960	41.575	9.166	16.44	41.021	77.5
ln Total urban population	People	960	5.93	0.613	4.057	5.966	7.244
ln Year-end loan balances	Finance	960	16.57	1.078	13.951	16.333	19.837

Correlation coefficient test

Before conducting the empirical regression analysis, the results of the correlation analysis between the main research variables are also required, and the results of the correlation test of the variables are shown in Table 2. As can be seen from Table 2, firstly, the correlation coefficients between the control variables are not significant, and for the core explanatory variables, the maximum correlation coefficient between Tran and the other control variables is 0.46. Therefore, there is no systematic bias in the statistical inference of this paper due to the high degree of co-linearity.

Table 2. Correlation coefficient test for variables

	Tran	lnGDP	GDP3_ratio	People	Finance
Tran	1				
lnGDP	0.392*	1			
GDP3_ratio	0.432*	0.348*	1		
People	0.149*	0.644*	0.048	1	
Finance	0.460*	0.905*	0.587*	0.499*	1

4. Empirical Results

4.1. Basic Empirical Results

Table 3 presents the results of the baseline regression of equation (1) in the previous section. The explanatory variable in all columns of Table 3 is the city innovation level per_score. where column (1) does not control for any control variables and fixed effects, column (2) adds city and year two-way fixed effects and column (3) considers further inclusion of control variables, hence Table 3 presents the results of the benchmark stepwise regression. It can be seen that the estimated coefficients of all core explanatory variables fiscal transparency Tran significantly enhance urban innovation at the 1% statistical level, regardless of the set of controls. The previous theoretical hypothesis is therefore also tested: local government fiscal transparency is an important engine driving urban innovation.

Table 3. Benchmark regression: fiscal transparency and urban innovation

VARIABLES	(1) per_score	(2) per_score	(3) per_score
Tran	53.242***	7.093***	6.816***
	(4.075)	(2.347)	(2.282)
lnGDP			14.602***
			(4.485)
GDP3_ratio			0.361*
			(0.209)
People			-10.586*
			(5.690)
Finance			8.345**
			(4.084)
Constant	33.188***	51.463***	-148.119**
	(1.854)	(0.972)	(64.071)
Urban fixed effects	Uncontrolled	Control	Control
Year fixed effects	Uncontrolled	Control	Control
Observations	960	960	960
R-squared	0.136	0.941	0.944

Note: Observations are at the city level. ***, **, * denote statistically significant at the 1%, 5% and 10% levels respectively. Control indicates that the fixed effect is controlled for, uncontrolled indicates that the fixed effect is not controlled for. Heteroskedasticity robust standard errors are in parentheses.

4.2. Robustness Tests

Table 4. Robustness tests: replacement of measures of explanatory variables

VARIABLES	(1) perarea_score	(2) perarea_score	(3) perarea_score
Tran	50.944***	2.623***	2.473***
	(3.944)	(0.973)	(0.938)
lnGDP			6.782***
			(1.538)
GDP3_ratio			0.143***
			(0.053)
People			-5.843**
			(2.416)
Finance			3.225*
			(1.736)
Constant	37.747***	56.882***	-18.500
	(1.840)	(0.403)	(29.009)
Urban fixed effects	Uncontrolled	Control	Control
Year fixed effects	Uncontrolled	Control	Control
Observations	960	960	960
R-squared	0.138	0.990	0.991

Note: Observations are at the city level. ***, **, * denote statistically significant at the 1%, 5% and 10% levels respectively. Control indicates that the fixed effect is controlled for, uncontrolled indicates that the fixed effect is not controlled for. Heteroskedasticity robust standard errors are in parentheses.

In the baseline regression, urban innovation is measured using a per capita score. The robustness of this proxy variable needs to be analyzed. Based on this, this paper further selects the city unit area score indicator as a proxy variable for innovation. The results of the robustness tests for replacing the explanatory variable measures are shown in Table 4: again, the core explanatory variables in Table 4 are all fiscal transparency. Where column (1) does not control for any control variables and fixed effects, column (2) adds city and year two-way fixed effects, and column (3) considers further inclusion of control variables. As can be seen from the results in Table 4, the estimated coefficient on the core explanatory variable Tran remains statistically significantly positive at the 1% level. Therefore, replacing the innovation performance measure does not affect the core findings of this paper.

4.3. Heterogeneity Analysis

China is a vast country with many administrative divisions and unevenly distributed resources, and the level of economic development varies greatly from region to region. The economic environment, institutional policies and industrial agglomeration phenomena vary significantly between regions. Therefore, in order to examine and clarify how fiscal transparency affects urban innovation, this paper further conducts a regional heterogeneity analysis.

Columns (1)-(4) of Table 5 examine the impact of urban fiscal transparency on urban innovation in the eastern, central, western and northeastern regions respectively. From the results, it can be seen that only the Central Region's fiscal transparency Tran significantly enhances urban innovation. Therefore, this boosting effect is mainly found in cities in the Central region.

Table 5. Analysis of regional heterogeneity

VARIABLES	(1) per_score	(2) per_score	(3) per_score	(4) per_score
	East	Central	Western	North East
Tran	1.334	16.002***	4.521	1.486
	(2.759)	(5.828)	(4.060)	(7.395)
lnGDP	10.968	-15.546	-18.986	20.487***
	(8.019)	(13.797)	(14.349)	(6.472)
GDP3_ratio	1.134***	0.195	-0.399	0.185
	(0.418)	(0.446)	(0.504)	(0.294)
People	8.891	-14.946**	2.855	99.881**
	(10.429)	(6.059)	(18.303)	(46.473)
Finance	-1.427	39.223***	5.706	-3.050
	(4.365)	(9.611)	(14.159)	(6.526)
Constant	-98.540	-401.272**	76.287	-616.700*
	(103.114)	(154.706)	(258.288)	(317.947)
Urban fixed effects	Control	Control	Control	Control
Year fixed effects	Control	Control	Control	Control
Observations	354	301	177	128
R-squared	0.952	0.897	0.969	0.943

Note: Observations are at the city level. ***, **, * denote statistically significant at the 1%, 5% and 10% levels respectively. Control indicates that the fixed effect is controlled for, uncontrolled indicates that the fixed effect is not controlled for. Heteroskedasticity robust standard errors are in parentheses.

Secondly, the administrative level of cities is further considered. Under the Chinese political system, all important resources or factors of production, such as capital, human capital, investment in infrastructure, advanced technology and preferential policies, are allocated from the central to the local level, from higher to lower level cities, one by one. In this context, the administrative level of a city represents a political resource symbol and, like prices, is a means of allocating resources. For a large country in transition and development, the government can also use administrative means to optimise the allocation of resources to a certain extent when market mechanisms are not sufficiently developed. It can therefore be expected that for different cities, there may be heterogeneity in fiscal transparency for urban innovation.

Based on this discussion, columns (1)-(3) of Table 6 examine the impact of fiscal transparency on urban innovation for ordinary prefecture-level cities, provincial capital cities and sub-provincial cities respectively. As can be seen from the results, the estimated coefficients for all sub-samples of Tran are significantly positive, but in terms of economic significance, sub-provincial cities have the largest impact.

Table 6. City administrative level heterogeneity

	(1)	(2)	(3)
VARIABLES	per_score	per_score	per_score
	Ordinary prefecture-level cities	Provincial Capital Cities	Sub-provincial cities
Tran	6.973***	6.738**	8.454**
	(2.495)	(2.923)	(3.415)
lnGDP	15.131***	43.401***	7.506*
	(4.837)	(14.061)	(4.338)
GDP3_ratio	0.382*	-0.681***	0.295
	(0.222)	(0.228)	(0.204)
People	-10.503*	65.681*	22.044**
	(6.284)	(37.765)	(9.016)
Finance	9.668**	0.054	-5.326
	(4.492)	(5.020)	(4.902)
Constant	-175.127**	-637.703**	-40.202
	(72.782)	(267.385)	(64.167)
Urban fixed effects	Control	Control	Control
Year fixed effects	Control	Control	Control
Observations	846	47	67
R-squared	0.930	0.944	0.955

Note: Observations are at the city level. ***, **, * denote statistically significant at the 1%, 5% and 10% levels respectively. Control indicates that the fixed effect is controlled for, uncontrolled indicates that the fixed effect is not controlled for. Heteroskedasticity robust standard errors are in parentheses.

4.4. Analysis of Mechanisms

Why does financial transparency in cities contribute significantly to the innovation performance of firms? This section will discuss this question in more detail. In order to test the above-mentioned mediating effects, the following mediating effects model is set up, as shown in equations (2) and (3):

$$Z_{ct} = \gamma_0 + \gamma_1 Tran_{ct} + \gamma_2 X_{ct} + \lambda_t + \mu_c + \varepsilon_{ct}^2 \qquad (2)$$

$$Innovation_{it} = \delta_0 + \delta_1 Tran_{ct} + \rho Z_{ct} + \delta_2 X_{ct} + \lambda_t + \mu_c + \varepsilon_{ct}^3 \tag{3}$$

whereZ_{ct} is the mediating variable. Therefore, equation (2) is the first stage of the mediating effects model and equation (3) is the second stage of the mediating effects model. According to the definition of the mediating effect model, if the model if both satisfy the equation (2) inγ_1 is significant and in equation (3)ρ is significant, thenZ_{ct} there is a mediating effect.

First, the existence of a mediating mechanism for city invention patenting is examined. Column (1) of Table 7 reveals that the estimated coefficient of Tran is significantly positive, i.e. the higher the fiscal transparency of a city, the higher the number of invention patents in the city; while the results from column (2) show that patent_faming has a significant positive contribution to the overall innovation performance of the city. Thus, the mediating mechanism of invention patents is verified: fiscal transparency increases a city's invention patent output, which in turn increases the city's overall innovation level.

Table 7. Mechanism analysis I: Patents for inventions

VARIABLES	(1) patent_faming	(2) per_score
patent_faming		0.320***
		(0.054)
Tran	4.049**	5.520**
	(1.833)	(2.203)
lnGDP	9.695***	11.500***
	(2.603)	(4.375)
GDP3_ratio	0.266**	0.276
	(0.111)	(0.210)
People	-7.477	-8.193
	(4.630)	(5.058)
Finance	7.483**	5.950
	(3.710)	(3.641)
Constant	-107.599*	-113.686**
	(61.977)	(56.409)
Urban fixed effects	Control	Control
Year fixed effects	Control	Control
Observations	960	960
R-squared	0.967	0.947

Note: Observations are at the city level. ***, **, * denote statistically significant at the 1%, 5% and 10% levels respectively. Control indicates that the fixed effect is controlled for, uncontrolled indicates that the fixed effect is not controlled for. Heteroskedasticity robust standard errors are in parentheses.

Second, the mediating effect of FDI is examined: column (1) of Table 8 reveals that the estimated coefficient of Tran is significantly positive, i.e. the higher the fiscal transparency of a city, the larger the FDI size of the city; the results in column (2) of Table 8 show that the estimated coefficient of FDI is 0.744, which also significantly and positively promotes urban innovation. Thus, the mediating mechanism of FDI is also validated: fiscal transparency increases the size of FDI in a city, which in turn increases the overall level of innovation in the city.

Table 8. Mechanism Analysis II: Foreign Direct Investment

VARIABLES	(1) FDI	(2) per_score
FDI		0.744*
		(0.442)
Tran	0.585**	6.381***
	(0.242)	(2.290)
lnGDP	2.740***	12.565***
	(0.423)	(4.805)
GDP3_ratio	0.024	0.344
	(0.015)	(0.210)
People	0.376	-10.866*
	(0.488)	(5.643)
Finance	0.286	8.132**
	(0.395)	(4.074)
Constant	-18.432***	-134.411**
	(6.555)	(64.770)
Urban fixed effects	Control	Control
Year fixed effects	Control	Control
Observations	960	960
R-squared	0.876	0.945

Note: Observations are at the city level. ***, **, * denote statistically significant at the 1%, 5% and 10% levels respectively. Control indicates that the fixed effect is controlled for, uncontrolled indicates that the fixed effect is not controlled for. Heteroskedasticity robust standard errors are in parentheses.

5. Research Findings and Policy Recommendations

This paper selects panel data of prefecture-level cities in China from 2013 to 2019 to empirically analyse the relationship between fiscal transparency and urban innovation capacity. The results of the benchmark regressions show that local government fiscal transparency is an important engine driving urban innovation. The estimated coefficients of all core explanatory variables, fiscal transparency Tran, significantly enhance urban innovation at the 1% statistical level. In the robustness analysis, the estimated coefficients of fiscal transparency remain significantly positive at the 1% statistical level when the city unit area score is chosen as a proxy variable for urban innovation, so replacing the measure of innovation performance does not affect the core findings of this paper. Further regional heterogeneity analysis was conducted to examine the impact of fiscal transparency on urban innovation in the eastern, central, western and north-eastern regions. Further, considering the administrative level of cities, the impact of fiscal transparency on urban innovation is examined for ordinary prefecture-level cities, provincial capitals and sub-provincial cities respectively. The estimated coefficients for ordinary prefecture-level cities, provincial capitals and sub-provincial cities are all significantly positive, but in terms of economic significance, sub-provincial cities have the greatest impact.

Finally, two mechanisms of influence are explored. First, the mediating mechanism of invention patenting in cities is examined. The higher the fiscal transparency of a city, the higher the number of invention patents in the city; and the number of invention patents has a significant positive contribution to the overall level of innovation performance of the city. Thus, the mediating mechanism of invention patents is verified: fiscal transparency increases a city's invention patent output, which in turn increases the overall level of innovation in the city.

Secondly, the mediating effect of foreign direct investment is examined; the higher the fiscal transparency of a city, the larger the city's FDI; the estimated coefficient of FDI is 0.744, again contributing significantly and positively to city innovation. Thus, the mediating mechanism of FDI is also validated: fiscal transparency increases the size of FDI in a city, which in turn increases the overall level of innovation in the city.

From the above findings, this paper recommends the following:

Firstly, local governments have increased their efforts to disclose financial information and improve their systems. Release relevant implementation system policies, further clarify the work objectives, carry out inspection and assessment of the disclosure of municipal districts, and inform the assessment results. The government will promptly develop annual performance assessment methods for information disclosure, incorporate information disclosure into the performance assessment system, establish and improve a long-term mechanism for information disclosure, achieve full-calibre disclosure of the general public budget, government fund budget, state-owned capital operation budget and social insurance fund budget, and promote full disclosure of departmental budgets and accounts, "The government has also made public information on the management methods, annual arrangements and implementation of special funds in a timely manner. The government has also stepped up its efforts to disclose information on government procurement, promoting the disclosure of information on the entire process, from the procurement budget to the procurement process and procurement results. At the same time, through the adoption of press releases and online exchanges, the interpretation of key information of social concern has been strengthened.

Secondly, Improve the information disclosure platform, enrich the form of disclosure and the channels of disclosure, and insist on synchronising the disclosure of government financial information on the Internet with the enquiry of electronic devices in libraries and archives to facilitate public enquiry. Build and use information management platforms to make public the application criteria, declaration process and approval results of relevant funds in a timely manner. Increase the publicity of financial information governmental carriers, such as the WeChat public number, to make the budget execution, the introduction of major policies and financial work dynamics public in a timely manner.

Thirdly, benchmarking standards and learning from advanced cities. Local governments should strictly compare the laws, regulations and documents on financial disclosure, such as the Budget Law of the People's Republic of China and the Regulations of the People's Republic of China on the Disclosure of Government Information, learn from the excellent practices of advanced cities in terms of indicator systems and performance evaluation disclosure, and carefully sort out gaps and shortcomings, striving to achieve both local realities and ensure openness and transparency.

Fourth, local governments should actively operate a good business and investment environment and increase their attraction to foreign investment in order to further expand the positive effect of fiscal transparency on the city's innovation capacity. Local governments should continue to increase their investment promotion and service protection efforts, strengthen regular communication with foreign-funded enterprises and business associations, coordinate and solve difficult problems in enterprise operation and project construction in a timely manner, and provide greater convenience for foreign investors to engage in trade and investment in China.

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