

Intellectual Property Strategy and Urban Innovation: Experience from Intellectual Property Demonstration Cities

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Abstract: The protection of intellectual property is the protection of innovation. As a policy pilot of China's national intellectual property strategy, the construction of intellectual property demonstration city is of great significance to urban innovation. Based on the panel data of 283 cities in China from 2006 to 2018, this paper uses the double difference method to evaluate the impact of intellectual property demonstration cities on urban innovation. The research of this paper shows that: (1) Intellectual property demonstration cities have a significant effect on improving urban innovation, and the effect is stable. (2) Prefecture level cities with low administrative level and weak degree of government intervention are approved. Intellectual property demonstration cities play a greater role in promoting urban innovation. (3) The mechanism shows that the intellectual property demonstration city mainly promotes urban innovation by increasing the government's scientific and technological expenditure in finance and strengthening the protection of intellectual property rights.

Keywords: intellectual property demonstration city; urban innovation; intellectual property protection

JEL Classification: C51; D78; O31

1. Introduction

Innovation is the first driving force leading development. At present, China's domestic and international environment is facing complex changes and economic development is gradually changing from the stage of high-speed growth to the stage of high-quality development, it is urgent to strengthen the first driving force of innovation. In the environment of the new era, the original regional economic growth mode relying on demographic dividend and resource endowment has brought a series of challenges to the sustainable growth of urban economy, which no longer meets the requirements of high-quality urban economic development. Innovation is an important way to solve China's regional development and transform the existing urban economic development mode. Innovation activities do not occur in a vacuum. They need a series of resources such as capital, technology, personnel and system, most of which are inseparable from the participation of the government. In the process of practicing innovation and leading development, the Chinese government has carried out a number of policy pilot work. These measures provide a starting cradle for innovation activities from the aspects of financial supply, institutional guarantee and administrative support. Among them, intellectual property pilot and

demonstration cities is a new practice of promoting the reform of intellectual property governance model in China (Zheng & Li, 2020). Existing studies have proved that intellectual property demonstration cities can significantly promote the optimization and upgrading of urban industrial structure (Bo & Angang, 2020), but existing studies have not answered in detail the impact of intellectual property demonstration cities on innovation. Based on this, this paper attempts to study the impact of intellectual property demonstration cities on urban innovation, and how the pilot policies affect urban innovation.

2. Literature Review

Market economy can stimulate the innovation power of various micro market subjects to the greatest extent. In market economy, many micro innovation subjects can spontaneously build an innovation network and even an innovation ecosystem suitable for the birth of innovation activities (Tianyang & Lihong, 2019). At the same time, the government plays an indispensable role in the ecosystem composed of micro innovation subjects. The government will have an important impact on the innovation activities of micro market subjects by issuing fiscal and tax policies to support scientific and technological innovation, directly setting up guidance funds to provide funds for enterprise innovation, and legislating measures to protect innovation achievements (Lishan & Yuanhai, 2019).

The characteristics of high investment, uncertain income and long cycle of innovation make the traditional capital suppliers such as banks and financial institutions unwilling to provide or only provide less loans to many micro innovation subjects (Hart & Moore, 2008). At this time, in order to make up for market failure, it is necessary for government departments to intervene. On the one hand, they formulate policies to force financial institutions to complete a certain amount of loans for small and micro enterprises (Teixeira & Ferreira, 2019). On the other hand, they directly give certain financial support to micro innovation subjects through financial science and technology expenditure. Compared with other government policies, fiscal expenditure on science and technology plays a more targeted and exemplary role. The pertinence is to directly give funds to micro innovation subjects, bear part of the R&D costs of enterprises, and may be more efficient in operation than other methods (Chang, 2011).

Dexin et al. (2020) believe that for innovation activities with long-term and high-risk characteristics, a single enterprise cannot independently bear the innovation cost. The government's financial science and technology expenditure enters the enterprise R&D process and plays a role in sharing the enterprise cost, thus reducing the enterprise's innovation risk. The demonstration lies in the entry of government financial science and technology expenditure, which is equivalent to a kind of certification for enterprises, enhances the credibility of micro innovation subjects, gives them fishing, and weakens the adverse selection problem caused by information asymmetry in the financing market (Yue, 2018). At the same time, it can also be combined with a number of policies to leverage social capital into enterprises, so as to alleviate the problem of insufficient R&D funds (Bloom et al., 2019).

As one of the formal systems faced by innovation, the importance of regional legal environment to innovation activities has been recognized by theoretical circles (Chunye &

Zuyin, 2012). As a regional legal protection of innovation benefits, the weak level of intellectual property protection will cause free riding behavior of market participants and restrict the innovation motivation of micro innovation subjects. Appropriate intellectual property protection is a necessary condition for the existence of the incentive effect of independent innovation (Chaopeng & Di, 2016). Therefore, government departments design and implement more effective formal laws to strengthen the current intellectual property system, which is conducive to encouraging micro themes to engage in innovation and obtain patents.

One of the main sources of non-innovation related forces of patent surge is policy incentive. The competition between market participants not only occurs in the product market, but also in the court (Hu et al., 2017). Whether the legitimate interests of the intellectual property owner can be effectively maintained affects the incentive of the company's innovation power (Huang et al., 2017). In the work focus of Intellectual Property Demonstration City, it is mentioned to strengthen the protection, and the main tasks include improving the effect of urban intellectual property law enforcement and protection. Under the supervision of the assessment requirements, the importance of intellectual property law enforcement and protection in intellectual property demonstration cities will inevitably be improved. On the one hand, administrative penalties will be used to stop the infringement of market participants and reduce free riding; On the other hand, the legal system helps micro innovation subjects obtain their reasonable rights and interests and stimulate the innovation power of innovation subjects (Grimaldi et al., 2021).

3. Methodology

3.1. Model Building

This paper uses DID (Differences-in-Differences) to evaluate the performance of intellectual property demonstration cities on urban innovation, and constructs two virtual variables according to the basic steps of DID model.

$$Innovation_{jt} = \alpha_0 + \alpha_1 policy + \alpha_i X_{jt} + \varepsilon_{jt} + \mu_j + \delta_t \quad (1)$$

In formula (1), the subscript j represents the city and t represents the time. $Innovation_{jt}$ is the explanatory variable of this paper, which indicates the innovation of city j in t year; $policy$ is the core explanatory variable of this paper; X_{jt} represents a series of other control variables that change over time and affect urban innovation; ε_{jt} is the error term. Coefficient; μ_j is urban fixed effect; δ_t is time fixed effect. α_1 is the core parameter of this paper, which indicates the impact of intellectual property demonstration city on urban innovation. If intellectual property demonstration city can indeed improve the urban innovation, then the coefficient α_1 should be significantly positive.

This paper uses the intermediary effect model to explore the action mechanism of Intellectual Property Demonstration City on urban innovation, and constructs the following regression model.

$$Innovation_{jt} = \alpha_0 + \alpha_1 policy + \alpha_i X_{jt} + \varepsilon_{jt} + \mu_j + \delta_t \quad (2)$$

$$ZS_{jt}(KJ_{jt}) = \beta_0 + \beta_1 policy + \beta_i X_{jt} + \theta_{jt} + \mu_j + \delta_t \quad (3)$$

$$Innovation_{jt} = \gamma_0 + \gamma_1 policy + \gamma_2 ZS_{jt}(KJ_{jt}) + \gamma_i X_{jt} + \varphi_{jt} + \mu_j + \delta_t \quad (4)$$

In equations (2) to (4), ZS and KJ respectively represent the intermediary variable intellectual property protection effect and financial science and technology support effect. μ_{jt} 、 φ_{jt} is the random disturbance term. If the regression coefficient α_1 、 β_1 and γ_2 are significant, if the regression coefficient of the core explanatory variable in equation (4) γ_1 less than α_1 . Explain that the effect of the core explanatory variable on the explained variable is partially absorbed by the intermediary variable, and there is some intermediary effect; if γ_1 is not significant, indicating that the influence of explanatory variables on the explained variables is completely absorbed by intermediary variables, and there is a complete intermediary effect.

3.2. Data Sources

In this paper, the data of patents to measure innovation, financial science and technology expenditure to measure the effect of financial support and control variables are from China research data service platform. The missing data of some prefecture level cities in some years are supplemented through the statistical yearbook of the province (District) where the city is located. The data of intellectual property protection intensity to measure the effect of property protection comes from the magic weapon judicial case database of Peking University and is collected and sorted manually.

3.3. Index Selection

In this paper, the widely recognized patent index is adopted, and the total number of patents applied in that year represents the innovation of the city. The explanatory variable of this paper is the virtual variable of Intellectual Property Demonstration City (policy), if an intellectual property demonstration city is approved in a certain year, the value is 1, and other cases are 0. Government financial science and technology support (KJ) adopts the proportion of government science and technology expenditure in public financial expenditure; For the intensity of intellectual property protection, the degree of intellectual property protection (ZS) is measured by the number of intellectual property trial cases closed in the judicial case base of Peking University magic weapon, and logarithmic processing.

This paper selects the degree of economic development (GDP), which is calculated by dividing GDP by the total resident population at the end of the year; Financial market development level (Fin), calculated by dividing the balance of deposits and loans of financial institutions by GDP; Entrepreneurial activity (Act), calculated by the proportion of urban private and individual employees in the total resident population at the end of the year; Human capital level (Hum), calculated by the proportion of the number of students in Colleges and universities in the total resident population of the city at the end of the year; FDI level (FDI): calculated by dividing the actual amount of foreign capital utilized by GDP.

Table 1. Descriptive statistical analysis of variables

Variable	Variable Meaning	N	Mean Value	Std. Deviation
Innovation	innovation of the city	3,679	0.4516	11886
Policy	intellectual property demonstration city	3,679	0.0794	0.2704
KJ	financial support for science and technology	3,679	1.3809	1.4103
ZS	Intensity of intellectual property protection	3,679	2.1676	2.0927
GDP	economic development	3,679	4.3686	46142
Fin	Financial market development level	3,679	0.8505	0.4516
Act	Entrepreneurial activity	3,679	11.9066	13.7474
Hum	Human capital level	3,679	1.6768	2.2873
FDI	Foreign direct investment	3,679	0.0181	0.01922

3.4. Model Hypothesis

This paper puts forward the following assumptions from the analysis of policy effect and action path.

Hypothesis 1: Intellectual property demonstration cities can improve urban innovation.

Hypothesis 2: Intellectual property demonstration cities has significantly promoted urban innovation by increasing regional financial and scientific and technological expenditure and improving the protection of intellectual property rights.

4. Results

4.1. Results of the Benchmark Model

As a unique policy pilot, intellectual property demonstration city has a positive impact on promoting the cultivation of urban innovation environment and the supply of innovation resources, and then improves urban innovation. The net effect of intellectual property demonstration cities is given in column (1) of Table 2. Before the control variable is added, the estimated coefficient of the impact of intellectual property demonstration cities on the urban innovation is 1.727, which is significant at the level of 1%, indicating that approved intellectual property demonstration cities can significantly improve the innovation, which preliminarily verifies the rationality of theoretical hypothesis 1. After adding control variables in column (2) of Table 2, at this time, the net impact coefficient of Intellectual Property Demonstration City on urban innovation is 0.9269, which is significant at the level of 1%. It is reasonable to believe that intellectual property demonstration city can significantly promote urban innovation.

As a quasi natural experiment, Intellectual Property Demonstration City, as an institutional experiment, provides a strong boost to the creation of innovation atmosphere and the supply of innovation resources in pilot cities, which is of profound significance to China's urban economy from factor driven development to innovation driven development and realize high-quality economic development, and strongly supports the rationality of theoretical hypothesis 1.

4.2. Robustness Check

1. Elimination of unobservable variables. Due to the large number of prefecture level cities in China, there are great differences in their development endowments. As a special

Table 2. Impact of Intellectual Property Demonstration City on urban innovation

Variable	Innovation	Innovation	Innovation	Innovation	Innovation
	(1)	(2)	(3)	(4)	(5)
Policy	1.7270*** (34.06)	0.9269*** (18.65)	0.7806*** (15.41)	0.5658*** (17.03)	0.5307*** (23.92)
Fin	/	0.0312** (7.88)	0.0411*** (9.76)	0.0354** (9.07)	0.0707** (2.52)
Act	/	0.0052*** (3.25)	0.0066*** (4.52)	0.0031*** (2.91)	0.0040* (1.75)
FDI	/	-0.0249*** (-3.39)	-0.0373*** (-5.43)	-0.0224*** (-4.54)	-0.0167** (-2.07)
Hum	/	-0.1109*** (-5.68)	-0.1541*** (-6.15)	-0.0702*** (-5.37)	-0.0800*** (-3.91)
GDP	/	0.2489*** (30.66)	0.2167*** (28.79)	0.1539*** (28.37)	0.2040*** (22.22)
Cons	0.0863** (2.51)	-0.3081*** (-7.36)	-0.2462** (-6.71)	-0.1828** (-6.54)	-0.3238*** (-4.73)
City fixed effect	Yes	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes	Yes
N	3,679	3,679	3,341	3,679	3,679
R2	0.4569	0.5506	0.5141	0.5126	0.5574

Note: *, **, *** are significant at the level of 10%, 5% and 1% respectively. In parentheses is the value of t
 policy pilot, intellectual property demonstration city plays an important role in the innovation of the pilot city. The provincial capital city may lead to systematic differences due to its unique urban characteristics. In order to eliminate the unobservable variables between cities, eliminate all provincial capital cities in the sample, and use the new sample for robustness test. The regression results are shown in column (3) of Table 2. It can be seen that the regression results are consistent with the above.

2. Replace the explained variable. Motivated by obtaining R&D subsidies, enterprises continue to increase the number of patent applications, but the average quality of patents is not necessarily improved. Therefore, the number of patent applications does not necessarily reflect the innovation of the city. According to the existing literature, this paper uses the number of inventions authorized in the current year in the number of patent applications as the proxy index of the innovation of the city, and re estimates the benchmark model. The results are shown in column (4) in Table 2. The results fully confirm that the intellectual property demonstration city can significantly promote urban innovation.

3. Avoid simultaneous equation errors. Considering that the pilot policy may not have an immediate impact, this paper deals with the pilot of the demonstration city in a delayed phase. At the same time, in order to avoid the error of simultaneous equations, all control variables are also treated with one-stage lag. The regression results are shown in column (5) of Table 2. It can be found that after the lag treatment, the estimation coefficient of the pilot demonstration city is still significantly positive, indicating that the error of simultaneous equations has not affected the estimation results.

4.3. Action Mechanism Test

After proving the innovation effect of intellectual property model city construction, this paper further explores the mechanism of promoting the effect. In the previous theoretical hypothesis, this paper believes that intellectual property demonstration city has financial support effect and property protection effect, and promotes urban innovation through the above two effects. According to the models (2) to (4) set up in this paper, this part makes an empirical test on the intermediary effect.

First, the test and analysis of the mechanism of financial support effect. The regression results of financial support effect after adding control variables and fixing time and city at the same time are shown in columns (2) and (3) of Table 3. The coefficient of the core explanatory variable policy is significantly positive at the level of 1%, indicating that intellectual property demonstration city has significantly promoted the level of urban financial science and technology expenditure. And $\gamma_1 = 0.8887$ less than $\alpha_1 = 0.9269$, indicating that intellectual property demonstration city can improve the level of urban innovation by increasing urban financial science and technology expenditure, and the intermediary effect is significant. The above test results confirm the view that intellectual property demonstration city promotes urban innovation through financial support effect.

Second, the test and analysis of the effect mechanism of property right protection. The regression results of property protection effect after adding control variables and fixing time and city at the same time are shown in columns (4) and (5) of Table 3, and the coefficient of the core explanatory variable policy is significantly positive at the level of 1%, indicating that intellectual property demonstration city can significantly increase the city's protection of intellectual property. After adding the variable of intellectual property protection, the promotion coefficient of innovation level of intellectual property protection cities will be increased $\gamma_2 = 0.1484$ is significantly positive at the level of 10%, and $\gamma_1 = 0.9186$ less than $\alpha_1 = 0.9269$ shows that intellectual property demonstration city can indeed promote the level of urban innovation by increasing the protection of urban intellectual property rights, and the intermediary effect is significant. Therefore, the test results support the view that intellectual property demonstration city promotes urban innovation through property protection effect.

Table 3. Function mechanism of Intellectual Property Demonstration City on urban innovation

Variable	Innovation (1)	KJ (2)	Innovation (3)	ZS (4)	Innovation (5)
policy	0.9269*** (18.65)	0.2574*** (3.26)	0.8887*** (18.37)	0.5730*** (5.75)	0.9186*** (18.40)
KJ			0.1484*** (14.12)		
ZS					0.0146* (1.70)
Cons	-0.3081*** (-7.36)	0.0616*** (0.93)	-0.3172*** (-7.80)	1.0509* (12.53)	-0.3234*** (-7.56)
City fixed effect	Yes	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes	Yes
N	3,679	3,679	3,679	3,679	3,679
R2	0.5141	0.2401	0.5757	0.5933	0.5510

Note: *, **, *** are significant at the level of 10%, 5% and 1% respectively. In parentheses is the value of t.

To sum up, the promotion effect of Intellectual Property Demonstration City on urban innovation is mainly realized through two mechanisms: financial support effect and property protection effect. Among them, the effect of financial support is to provide financial support for the R&D and innovation of urban micro innovation subjects; The effect of property right protection is to protect the legitimate rights and interests of micro innovation subjects and improve their enthusiasm for innovation by cracking down on violations of law and infringement.

5. Discussion

As a special policy pilot, intellectual property demonstration city plays an important role in the innovation of pilot cities, which is easily affected by the degree of government intervention and urban administrative level (Ben & Lihua, 2018). Specifically, the decisive role of the market in resource allocation can realize the effective incentive of property rights, fair and orderly competition and the survival of the fittest. In a good market economic environment, it can stimulate the vitality and innovation willingness of microeconomic subjects to the greatest extent, while strong government intervention will affect the operation effect of market mechanism (Manfeng et al., 2019), and then weaken the role of Intellectual Property Demonstration City in improving urban innovation.

In terms of urban administrative level, provincial capital cities, sub provincial cities and cities specifically designated in the state plan have a unique aura in terms of access to policy care and resource preference due to their high urban administrative level. Therefore, even if intellectual property demonstration cities are approved, the resources obtained will not improve their urban innovation. The general prefecture level cities can obtain more policy preferences and financial subsidies than before in approved intellectual property demonstration cities, so they have the unique effect of late development advantage (Fuzheng & Guanghang, 2021). Therefore, the promotion effect of its approved intellectual property model city on the urban innovation is greater than that of sub provincial cities and above.

Table 4. Regulatory effect test results

Variable	Weak government	Weak government	Low administrative	High administrative
	intervention	intervention	level	level
	Innovation	Innovation	Innovation	Innovation
	(1)	(2)	(3)	(4)
policy	0.8778*** (12.46)	0.5987*** (7.20)	0.7701*** (19.55)	0.6527*** (3.16)
Cons	-0.8048** (-6.02)	-0.0181 (0.68)	-0.2072** (-7.76)	-0.0619 (-0.13)
City fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
N	1,827	1,852	3,263	416
R2	0.5867	0.2631	0.5504	0.7294

¹ Note: *, **, *** are significant at the level of 10%, 5% and 1% respectively; In parentheses is the value of t.

This paper measures the degree of regional government intervention by the proportion of local fiscal expenditure in regional GDP. According to the cities higher and lower than the median degree of government intervention in each year, they are divided into two samples

for regression respectively. The results show that columns (1) and (2) in Table 4. Intellectual property demonstration cities with weak government intervention can significantly promote urban innovation, and its core explanatory variable is significantly greater than the coefficient of cities with high degree of government intervention. It fully shows that the intellectual property demonstration city with weak government intervention plays a stronger role in promoting urban innovation.

In this paper, provincial capital cities, sub provincial cities and cities specifically listed in the state plan are defined as high administrative level cities, and the rest are defined as low administrative level cities. The regression results are shown in columns (3) and (4) of Table 4. The promotion effect of demonstration cities with higher financial business environment on urban innovation is much greater than that of cities with lower financial business environment, which highlights that the promotion effect of demonstration cities on urban innovation with higher financial business environment has a higher marginal effect.

6. Conclusions

Institutional reform is the key boost to China's economic rise, and the policy pilot is the pioneer of the institutional reform test and has an important impact on the improvement of China's urban innovation level. As a part of the policy pilot, the construction of intellectual property demonstration cities with intellectual property as the theme has become an important step to drive urban innovation. Based on the panel data of 283 prefecture level cities in China from 2006 to 2018, this paper empirically tests the impact of the construction of intellectual property demonstration cities on the level of urban innovation and its channels by using the double difference model.

The conclusions of this paper are as follows: (1) the construction of intellectual property demonstration city can significantly promote the improvement of urban innovation; (2) The mechanism test shows that the construction of intellectual property demonstration city has significantly improved urban innovation by increasing regional financial science and technology expenditure and improving the level of regional intellectual property protection; (3) Heterogeneity research shows that the impact of the construction of intellectual property demonstration cities on urban innovation is significantly different due to their different administrative levels and the degree of government intervention. Specifically, the intellectual property demonstration cities with weak government intervention and low administrative level cities will play a greater role in promoting urban innovation.

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