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Intellectual Property Protection and the Innovation Capacity of Chinese Manufacturing Enterprises: A Quasi-Experimental Study Based on the Development of National Intellectual Property Demonstration Cities

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Abstract: The economic benefits of intellectual property protection are closely tied to the design of the institutional framework, and the development of national intellectual property demonstration cities helps foster an external environment conducive to innovation. Based on data from Chinese A-share listed companies from 2008 to 2023, this paper treats the policy on the development of National Intellectual Property Demonstration Cities—enacted in 2011—as a quasi-experimental design. Using a multi-period difference-in-differences model, the study empirically examines the impact of intellectual property protection on the innovation capabilities of Chinese manufacturing firms. The research findings indicate that: (1) Intellectual property protection can enhance the innovation capabilities of Chinese manufacturing firms. (2) Tests of the mechanism reveal that intellectual property protection promotes the enhancement of innovation capabilities in manufacturing firms through two pathways: the innovation-driven effect, which increases R&D investment and improves patent quality; and the market performance effect, which expands market influence and improves financial performance. (3) Heterogeneity tests revealed that the role of intellectual property protection in enhancing the innovation capabilities of manufacturing firms is more pronounced south of the Hu-Huan-Yong Line and among "specialized, refined, distinctive, and innovative" enterprises.

Keywords: Intellectual Property Protection; Corporate Innovation Capabilities; Innovation-Driven Impact; Market Performance Effect.

1. Introduction and Literature Review

Strengthening the protection of independent innovation among manufacturing enterprises and encouraging them to innovate in new models, content, methods, and technologies will not only help Chinese manufacturing enterprises boldly engage in innovative activities, but also enable them to chart a course that fosters their capacity for innovation. In the process of manufacturing enterprises engaging in innovation activities and enhancing their innovation capabilities, intellectual property protection, as a form of institutional safeguard, exerts a certain influence on various aspects, including innovation investment, innovation output, and innovation quality.Existing research has found that the impact of intellectual property protection on corporate innovation capacity is a double-edged sword. Intellectual property protection is one of the key factors in building an innovation system at the national legislative and enforcement levels. By using legal means to protect innovators' investment in innovation resources and establishing a robust safeguard for their potential future returns [1], it promotes corporate innovation output [2]. Intellectual property protection may lead to market rigidity and knowledge lock-in, thereby stifling innovation or reducing innovation rates [3–4]. This hinders companies' ability to imitate and innovate through "learning by doing," resulting in a direct increase in their innovation costs and indirect expenses [5–6], as well as a reduction in their R&D expenditures and innovation outputs [7]. In addition, the measurement of intellectual property protection has evolved into a diverse and multifaceted approach. These methods primarily include constructing indicator systems based on the RR Index [8] and the GP Index [9], utilizing single indicators such as the number of intellectual property cases [10], and employing subjective evaluation methods based on intellectual property surveys [11]. To resolve the aforementioned research gaps, this paper leverages China's Intellectual Property Demonstration City policy (launched in 2012) as an exogenous quasi-natural experiment. Based on cities' participation and policy implementation time, we compare regional variations in intellectual property protection. The difference-in-differences approach is utilized to alleviate reverse causality and explore the link between intellectual property protection and manufacturing enterprises' innovation performance.

This paper offers three main potential contributions: First, drawing on a quasi-natural experiment based on the development of China's National Intellectual Property Demonstration Cities, this study examines and tests the impact of intellectual property protection on the innovation capabilities of manufacturing enterprises. Second, building on the identification of the effects of establishing intellectual property model cities on the innovation capabilities of manufacturing enterprises, this study further examines and tests the mechanisms through which such initiatives influence these capabilities, focusing on innovation-driven effects and market performance effects. Third, we examined the heterogeneity in the impact of intellectual property demonstration city initiatives on the capabilities of manufacturing enterprises at both the regional and firm levels.

2. Policy Context and Theoretical Analysis

2.1. Policy Background

The Evaluation Measures for National Intellectual Property Model Cities reflect China's "dual-track system" for intellectual property protection: Judicial and administrative protection of intellectual property rights helps enhance the capacity for intellectual property protection, further strengthens enterprises' awareness of intellectual property protection, and helps incentivize enterprises to vigorously pursue innovation and research and development activities. From 2012 to 2020, China organized and implemented six rounds of pilot programs to designate model cities for intellectual property, namely: Demonstration Cities designated in 2012, followed by the second batch of 18 in 2013, the third batch of 12 in 2015, the fourth batch of 11 in 2016, and the fifth batch of 6 in 2018, and seven in the sixth batch in 2019. For details, see Table 1.

Table 1. List of National Intellectual Property Model Cities

Selection Date	Region
2012	Wuhan; Guangzhou; Shenzhen;, Changsha; Chengdu; Suzhou; Hangzhou; Jinan; Qingdao; Zhengzhou; Harbin; Nanjing; Nantong; Zhenjiang; Fuzhou; Dongying; Dalian; Yantai; Luoyang; Quanzhou; Wenzhou; Xi'an; Wuhu
2013	Xiamen; Ningbo; Changchun; Dongguan; Wuxi; Taizhou; Zhuzhou;, Changji Hui Autonomous Prefecture; Weifang; Zibo; Hefei; Jiaxing; Huzhou; Nanyang; Xinxiang; Guiyang; Changshu; Kunshan
2015	Chaoyang District, Beijing; Changzhou; Anyang; Yichang; Xiangtan; Panzhihua; Foshan; Zhongshan; Nanchang; Jiangyin; Danyang; Zhangjiagang
2016	Mianyang; Huizhou; Deyang; Haidian District; Beijing; Minhang District, Shanghai; Xiqing District, Tianjin; Jiangbei District, Chongqing; Jimo; Haimen; Ningguo; Yiwu
2018	Ma'anshan; Shantou; Shijiazhuang; Xuzhou; Jiulongpo District, Chongqing; Shenyang
2019	Pudong New Area, Shanghai; Kunming; Yancheng; Jinhua; Nanning; Zhuhai; Binhai New Area, Tianjin

Note: Compiled by the author

2.2. Theoretical Analysis

2.2.1. The Impact of Intellectual Property Protection on the Innovation Capacity of Chinese Manufacturing Enterprises

First, intellectual property protection provides long-term exclusive rights for innovative achievements through a legal framework; even amid short-term policy fluctuations, manufacturing companies can still form stable expectations regarding the returns on innovation based on existing systems. Furthermore, intellectual property helps manufacturing companies establish technological barriers. A robust protection mechanism encourages companies to continue investing in research and development, creating a virtuous cycle of "innovation—protection—re-innovation." Through strategic patent portfolio management and trademark protection, companies can maintain the uniqueness of their products, avoid price wars driven by product homogenization, and consolidate their competitive advantage in niche markets. For example, high-end equipment manufacturers are able to maintain their pricing power even during industry downturns thanks to their core patent portfolios. Finally, the intellectual property system strikes a balance between monopoly and sharing through restrictive provisions such as fair use and compulsory licensing. Consequently, the rigidity, market orientation, and international compatibility of the intellectual property protection system make it a "stabilizing force" for innovation in manufacturing enterprises. In summary, intellectual property protection provides a solid institutional foundation for the innovation capabilities of China's manufacturing enterprises.So, the hypothesis is proposed:

Assumption 1: Intellectual property protection contributes to enhancing the innovation capabilities of Chinese manufacturing companies.

2.2.2. Mechanism of Action

Intellectual property policies have significantly increased the intensity of R&D investment among Chinese manufacturing firms by establishing a framework of institutional incentives. The exclusive rights conferred by patent protection create a legal shield for innovative achievements, enabling companies to recoup their R&D costs and generate excess profits through technological monopolies. Financial innovations such as intellectual property-backed financing have broadened companies' access to capital and effectively deepened their innovation in core technology areas. In addition, policy guidance can help concentrate R&D resources on core technology areas. Intellectual property protection directly increases the expected returns on innovation for enterprises by guaranteeing exclusive rights to the benefits of innovation, thereby stimulating enterprises' enthusiasm for research, development, and innovation activities [12]. How intellectual property protection policies influence manufacturing firms' innovation is presented in Figure 1.

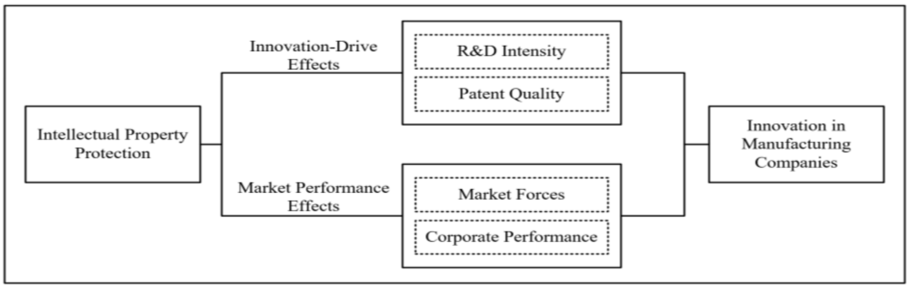

Figure 1. The Mechanism Through Which Intellectual Property Protection Influences the Innovation Capacity of Manufacturing Enterprises

(1) The Impact of Innovation-Driven Development

Intellectual property protection significantly enhances the quality of patents held by manufacturing companies through a multidimensional mechanism. Its core role lies in the fact that the exclusive right to innovate granted by patent protection creates technological barriers, enabling companies to share technology and achieve iterative upgrades through cross-licensing agreements. The cultivation and commercialization of high-value patents create a virtuous cycle that directly accelerates the efficiency of translating laboratory research into industrial applications. Intellectual property protection enhances the quality of technological innovation by strengthening the innovation environment in the technology market [13]. Intellectual property protection ensures that the returns on innovation by manufacturing enterprises do not leak out. With this assurance, manufacturing enterprises have the confidence to increase their R&D intensity by expanding their R&D teams, increasing R&D funding, and formulating long-term strategies for innovative development, thereby helping to raise their expected returns on innovation. It's sproposed that Hypotheses 2a and 2b.

Hypothesis 2a: Intellectual property protection enhances the innovation capacity of manufacturing firms by increasing their R&D intensity.

Hypothesis 2b: Intellectual property protection enhances the innovation capacity of manufacturing firms by improving patent quality.

(2) Market Performance Effects

Supported by intellectual property protection, manufacturing companies receive financial and policy support through high-value patents. The right to priority review of patent applications further ensures the predictability of their innovation outcomes, helping to reduce costs, improve input-output efficiency, and enable companies to achieve better market performance. Intellectual property protection fosters a favorable business environment, creating a more stable environment for innovation among manufacturing companies. As uncertainty in the innovation environment decreases, the predictability of manufacturing companies' innovation outcomes increases, helping them generate more revenue and further enhance their market influence and business performance. Market power and corporate performance in manufacturing firms are effective drivers of market performance, and both influence a firm's operating income. So, we propose Hypothesis 3.

Hypothesis 3a: Intellectual property protection enhances the market power of manufacturing firms, enabling them to secure more funding for innovation and R&D, thereby boosting their innovation capabilities.

Hypothesis 3b: Intellectual property protection improves the performance of manufacturing firms, enabling them to secure more funding for innovation and R&D, thereby enhancing their innovative capabilities.

3. Model Specification, Sample Selection, and Variable Descriptions

3.1. Model Setup

Between 2012 and 2019, the pilot program for "Intellectual Property Model Cities" was implemented in a phased and gradual manner, which made it feasible to use quasi-experimental methods to study the impact of intellectual property protection on the innovation capabilities of manufacturing enterprises. A multi-period difference-in-differences model is constructed to identify the net effect of this policy on the innovation capacity of manufacturing enterprises. The baseline model is defined as in Equation 1:

$$Innovation_{i,t} = \alpha + \beta did_{i,t} + \delta X_{i,t} + \lambda_j + \mu_t + \varepsilon \quad (1)$$

In particular, the dependent variable Innovationi,t represents the innovation capacity of manufacturing firm i in year t. The key explanatory variable is didi,t, which is a dummy variable representing the designation of a city as a National Intellectual Property Demonstration City. Furthermore, if the National Intellectual Property Demonstration City policy enhances innovation among manufacturing firms, the coefficient β of didi,t should be significantly positive. Xi, t represent control variables at the firm level. This is because differences in key variables are primarily found among firms within the same industry, rather than within individual firms [14]. Therefore, Model (1) includes industry-fixed effects and year-fixed effects, with the industry classification based on the China Securities Regulatory Commission's industry classification standards. In addition, this paper performs clustering analysis at the city level.

3.2. Variable Selection

(1) Dependent variable: Innovation capacity of Chinese manufacturing enterprises (Innovation)

This paper uses the total number of invention patents granted to a manufacturing enterprise group—both individually and jointly—as a measure of the group's innovation capacity. Innovation enhances the innovation capabilities of Chinese manufacturing companies. The calculation method is $\ln(Patent_{i,t} + 1)$.

(2) Key Explanatory Variable: Policies for Building Intellectual Property Model Cities(did)

The variable takes the value 1 in the year a city is designated as an intellectual property model city and in subsequent years; otherwise, it takes the value 0.

(3) Control Variables

The control variables X were selected based on factors such as the size, economic performance, and operational status of manufacturing firms. They primarily include the natural logarithm of total assets (lnassets), the debt-to-equity ratio (Leverage), the natural logarithm of total intangible assets (lnintangible), the number of years since the company's establishment (age), return on assets (ROA), and the Tobin Q ratio (TobinQ).

3.3. Variable Descriptions

This paper uses data from Chinese A-share listed companies from 2008 to 2023. The industry classification is based: (1) Exclude ST and ST* companies; (2) Exclude companies listed on the Beijing Stock Exchange whose stock codes begin with "4" "8" or "920". (3) To avoid the impact of outliers, the relevant data was winsorized to the 1%–99% range. The descriptive statistics for the variables are presented in Table 2. To eliminate the effects of multicollinearity in the baseline regression model, this paper calculates the variance inflation factor (VIF) for the independent variables; the VIF value among the variables is 1.63.

Table 2. Descriptive statistics of main variables

Variable Name	Variable Symbols	Number of observations	Mean	Standard Deviation	Minimum value	Maximum value
Innovation Capabilities of Manufacturing Enterprises	Innovation	28448	1.5935	1.3208	0	5.5683
Development of National Intellectual Property Model Cities	did	28448	0.5067	0.4999	0	1
Total Assets	lnassets	28448	22.0159	1.1564	18.3936	25.2973
Debt-to-Equity Ratio	Leverage	28448	39.1042	19.8241	5.5283	90.5895
Intangible Assets	lnintangible	28448	18.5678	1.4648	12.4061	22.1838
Years in Operation	age	28448	18.5994	6.0651	0	35
Return on Total Assets	ROA	28448	6.2634	7.2798	-18.1770	40.3910
Tobin's Q ratio	Tobin Q	28448	2.0343	1.1519	0.9002	7.6295

4. Empirical Results and Analysis

4.1. Benchmark Regression Results

The regression results in the columns of Table 3 show that, regardless of whether control variables are included, the coefficient of the core explanatory variable did is significantly positive, indicating that the implementation of the Intellectual Property Model City policy helps enhance the innovation capacity of manufacturing enterprises. The findings of the above study confirm that the pilot policy for intellectual property model cities has a statistically significant effect on enhancing the innovation capabilities of manufacturing enterprises. It follows that Hypothesis 1 has been verified. The pilot policy for Intellectual Property Model Cities is not a single protective rule, but rather a set of complementary protective measures that effectively encourage enterprises to increase their R&D investment, guide them to concentrate resources on core technology areas, optimize the allocation of innovation resources, and ultimately lead to a significant improvement in corporate innovation capabilities.

Table 3. Regression Analysis Results on the Impact of Intellectual Property Policies on Innovation in Manufacturing Enterprises

Model	(1)	(2)	(3)	(4)	(5)
Variable	Innovation	Innovation	Innovation	Innovation	Innovation
did	0.5529***	0.1856***	0.3800***	0.3266***	0.2378***
	(0.0152)	(0.0176)	(0.0611)	(0.0382)	(0.0422)
Control Variables			Control	Control	Control
Constant term	1.2594***	0.9408***	-11.8715***	-13.0335***	-12.3706***
	(0.0111)	(0.0662)	(0.6324)	(0.5350)	(0.6001)
Year-fixed effects	No	Yes	Yes	No	Yes
Industry-fixed effects	No	Yes	No	Yes	Yes
Observed values	28448	28448	28448	28448	28448
R^2	0.0425	0.1464	0.3332	0.3983	0.4104

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively; the numbers in parentheses are cluster standard errors. The same applies below.

4.2. Robustness Test

(1) Test for Parallel Trends

To verify the reliability of these results, following the approach used by Beck et al. [15] to test for parallel trends in a multi-period double-difference model, this paper designates the cities selected for the National Intellectual Property Demonstration City program as the treatment group and the others as the control group to test the parallel trends assumption, constructing the dynamic model in Equation 2.

$$Innovation_{i,t} = \alpha + \sum_{-4}^{11} \beta_t did_{i,t} + \delta X_{i,t} + \lambda_j + \mu_t + \varepsilon \quad (2)$$

As shown in the results in Figure 2, the coefficient βt in Equation 2 was not significant in the two years prior to the pre2 pilot, the three years prior to the pre3 pilot, and the four years prior to the pre4 pilot. However, this coefficient was significant in the periods following the post1 through post11 pilots.

(2) Placebo Test

Following the method described by Cai et al. [16] for randomly assigning pilot regions to a placebo test, this study designates the intellectual property demonstration cities where listed manufacturing companies are headquartered as the experimental group, with the remaining cities serving as the control group. Figure 3 illustrates the relationship between the kernel density distributions of the estimated did coefficients for approximately 500 core explanatory variables and their corresponding p-values.

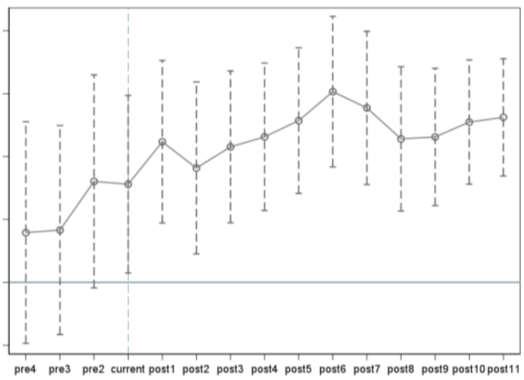

Figure 2. Testing the Parallel Trends of Innovation in Manufacturing Enterprises Under the Influence of Intellectual Property Demonstration City Policies

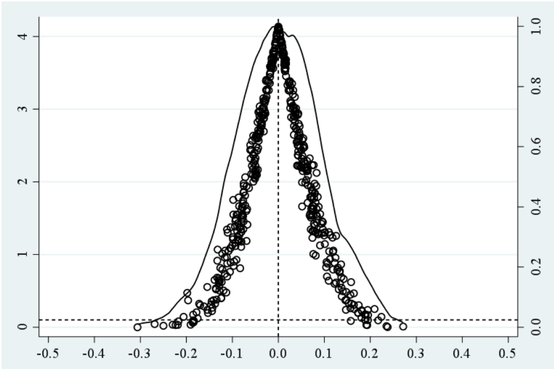

Figure 3. Policy Impact of Intellectual Property Demonstration Cities on Innovation in Manufacturing Enterprises: A Placebo Test

(3) Preference-Based Matching Method

In Table 4, columns (1) through (3) present three methods for constructing control groups that are close neighbors to the treatment group based on the similarity of observable variables: a fixed-effects model, a sample with non-zero weights, and a sample satisfying the common support assumption.

(4) Other Robustness Tests

① Shorten the time window

The coefficient for did is 0.2176 and is significant at the 1% level in Column (4) of Table 4, after controlling for external factors, the test results regarding the effect of the policy on the development of intellectual property model cities on enhancing the innovation capacity of manufacturing enterprises remain robust.

② Exclude samples from certain cities

Following the approach taken by Zhang Jun et al. [17], in order to prevent municipalities directly under the central government and first-tier cities from skewing the overall estimation results due to their exceptionally strong innovation capabilities, we have excluded manufacturing firms located in the six major cities of Beijing, Shanghai, Guangzhou, Shenzhen, Tianjin, and Chongqing. After excluding all listed manufacturing companies located in the above six cities, although the absolute value of the coefficient for the core explanatory variable did decreased compared to that in Column (5) of Table 4, the National Intellectual Property Demonstration City policy still significantly promotes the innovation capacity of manufacturing enterprises.

Table 4. Robustness Test Results

	PSM-DID			2008-2019	Exclude certain cities
	Fixed-Effects Model FE	Use samples with non-empty weights	Use samples that satisfy the common support assumption	Innovation	Innovation
	(1)	(2)	(3)	(4)	(5)
did	0.2378***	0.2343***	0.2367***	0.2176***	0.2213***
	(0.0422)	(0.0442)	(0.0422)	(0.0473)	(0.0469)
Control Variables	Control	Control	Control	Control	Control
Constant term	-12.3706***	-11.7162***	-12.4283***	-11.6680***	-11.1574***
	(0.6001)	(0.6166)	(0.5963)	(0.7338)	(0.5361)
Year-fixed effects	Yes	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes
Observed values	28448	11828	28441	16808	21603
R^2	0.4104	0.4037	0.4113	0.3930	0.3806

(5) Instrumental Variables Method

Table 5. Instrumental Variables Estimation Results on the Impact of Intellectual Property Demonstration Cities on Innovation in Manufacturing Enterprises

	Innovation	
	Phase 1	Phase 2
rjsy_did	0.2194***	
	(0.0008)	
did		0.2044***
		(0.0179)
Control Variables	Control	Control
Constant term	0.0550*	-12.7392***
	(0.0311)	(0.1596)
R^2	0.8140	0.4113
F-statistic	8182.74	
Wald F-statistic	18006.04	
P-value	0.0000	

To better avoid endogeneity issues caused by reverse causality, omitted variables, and other factors, this paper uses the number of Confucian academies in each prefecture-level city as an instrumental variable to estimate the establishment of intellectual property demonstration cities. The data on urban Confucian academies is based on historical records of academies in prefecture-level cities across the country from the Tang to the Qing dynasties, as documented in the Dictionary of Chinese Academies; this data is sourced from the CNRDS Confucian Culture Database. Table 5 presents the results of the two-stage instrumental variable regression.

4.3. Heterogeneity Analysis

4.3.1. Analysis of Heterogeneity at the Regional Level Sub-section Headings

The estimation results in Table 6, items (1) and (2), indicate that in the region southeast of Hu Huanyong, the intellectual property demonstration city policy significantly enhances the innovation capacity of manufacturing firms at the 1% significance level, whereas in the region northwest of Hu Huanyong, the intellectual property demonstration city policy has a negative impact on the innovation capacity of manufacturing firms at the 5% significance level. In the region southeast of the Hu-Huan-Yong Line, there is a high degree of specialization and concentration in the manufacturing sector [18], a high level of marketization, and a high concentration of innovation resources such as universities, research institutes, and technology companies.

To prevent their innovations from being imitated, manufacturing enterprises have an even greater need for intellectual property protection mechanisms In contrast, the population distribution on the northwest side of the Hu Huanyong Line is dispersed and relatively sparse, and there is a scarcity of innovation factors. Manufacturing enterprises there are predominantly traditional, resource-based firms with low economic value added; R&D and innovation activities are limited, and companies focus primarily on survival and basic manufacturing.

4.3.2. Analysis of Heterogeneity at the Firm Level

Based on the results in columns (3) and (4) of Table 6, the Intellectual Property Model City policy is significantly positively correlated at the 1% level with the innovation capabilities of both "Specialized, Refined, Distinctive, and Innovative" (SRDI) and non-SRDI manufacturing firms; the policy's effect has a greater promotional impact on the innovation capabilities of SRDI manufacturing firms than on those of non-SRDI manufacturing firms. SRDI enterprises aim to establish a leading global position in specific market segments. "Specialized and Refined" refers to focusing on core businesses and optimizing processes to drive efficiency gains, while "Unique and Innovative" emphasizes achieving innovation leadership through technological breakthroughs and product iteration [19]. The synergistic development of "Specialized and Refined" and "Unique and Innovative" helps enterprises advance scientific and technological innovation; improving efficiency and fostering innovation are key factors for these enterprises [20]. Compared with non-SRDI manufacturing enterprises, the innovation activities undertaken by SRDI enterprises typically involve breakthrough innovations that require significant investment, have long development cycles, and carry high risks. To overcome specific technical challenges, these enterprises must continuously invest substantial resources.

Table 6. Estimated Results of Regional and Firm Level Heterogeneity Analysis

	(1)	(2)	(3)	(4)
	Innovation	Innovation	Innovation	Innovation
	Hu Huanyong Line		Specialized, Refined, Unique, and Innovative Enterprises	Non-Specialized, Non-High-Tech, Non-Innovative Enterprises
	Southeast Side	Northwest Side		
did	0.2000***	-0.4916**	0.2436***	0.1782***
	(0.0410)	(0.2380)	(0.0550)	(0.0470)
Control-Variablese	Control	Control	Control	Control
Constant term	-12.5834***	-10.2294***	-13.8885***	-10.8116***
	(0.5994)	(1.5071)	(0.5421)	(0.7157)
Year-fixed effects	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes
Observed values	27482	966	11143	17305
R^2	0.4131	0.5596	0.4855	0.3596

5. Further Discussion

The development of intellectual property model cities, as a pilot program for institutional innovation at the national level, aims to establish a high-standard, market-oriented, law-based, and international business environment by improving the systems for the creation, utilization, protection, and services related to intellectual property. On the one hand, a robust intellectual property protection system enhances companies' expectations of returns on innovation, incentivizing them to increase R&D investment, boost R&D intensity, and improve the quality of innovation, thereby creating an innovation-driven mechanism; on the other hand, policies optimize the regional innovation ecosystem and the order of market competition, enhancing companies' market power and profitability, and providing a sustainable source of funding and a competitive advantage for innovation activities, thereby creating a market-based performance mechanism. This paper constructs a testing model that examines the transmission mechanisms of R&D intensity and the spillover effects of innovation quality, as well as the transmission mechanisms mediated by market power and profitability, in order to identify the specific pathways through which the development of intellectual property model cities influences innovation in manufacturing firms. In Equation 3, $M_{i,t}$ represent R&D intensity (RD), innovation quality (patentquality), market power (lerner), and firm financial performance (revenue), respectively; the notations for the remaining variables and fixed effects are consistent with those in Equation 1.

$$M_{i,t} = \alpha + \beta did_{i,t} + \delta X_{i,t} + \lambda_j + \mu_t + \varepsilon \tag{3}$$

In this context, R&D intensity (RD) is calculated in the same manner as in most literature, using "R&D expenses / operating revenue"—that is, the relative amount of a company's R&D investment—to measure the R&D intensity of manufacturing firms, thereby reflecting the extent to which a company allocates resources to innovation. Regarding methods for measuring innovation quality, patent quality is used as the metric here. There is currently no consensus or established standard within the academic community on how to measure the impact of patent quality on corporate innovation; some studies use the number of patent citations to assess patent quality [21], while others rely on the patent breadth method [22]. In Equation 4., Q_{imt} represents the cumulative number of invention and utility model patent applications filed by manufacturing firms in Group m as of year. Q_{it} represents the cumulative number of patent applications filed by firm i across all groups as of year.A firm's market power or market dominance can be expressed using the Lerner Index, which measures the firm's competitive position. Corporate financial performance (revenue) is expressed as the logarithm of a manufacturing company's operating revenue.

$$patentquality_{it} = 1 - \sum \left(\frac{Q_{imt}}{Q_{it}}\right)^2 \tag{4}$$

5.1. Testing the Innovation-Driven Effect

In Column (1) Table 7, the dependent variable is the R&D intensity of manufacturing firms. The coefficient for the Intellectual Property Model City policy (did) is 0.9673, indicating that it significantly promotes firm innovation at the 1% significance level; this conclusion is consistent with that of Zhang Jing and Chen Zhilong [23]. The ratio of a company's R&D expenditures to its operating revenue is defined as the R&D intensity; this metric reflects the company's commitment to innovation [24]. As cities enhance their capacity to protect intellectual property and strengthen legal safeguards for the investment environment, this initiative has created more favorable conditions for the implementation of intellectual property protection, encouraging enterprises to increase their R&D investment, strengthening their commitment to innovation, and promoting sustained growth in their innovative output. Hypothesis 2a is verified.Patent quality is measured using two dimensions: the quality of patent applications (patentquality) and the quality of granted patents (patentquality). As shown in columns (2) and (3) of Table 7, the Intellectual Property Model City policy significantly improves the quality of innovation among manufacturing enterprises, and its effect on improving the quality of granted patents is greater than its effect on improving the quality of patent applications. High-quality patents help promote innovation [25]. Therefore, this policy effectively incentivizes manufacturing enterprises to improve the quality of their innovation, thereby having a dual promotional effect on both the patent application and grant processes. It follows that Hypothesis 2b is verified.

Table 7. R&D Intensity and Innovation Quality of Manufacturing Enterprises

	(1)	(2)	(3)
	RD	patentquality	patentquality
did	0.9673^{***}	0.0168^{***}	0.0210^{***}
	(0.1387)	(0.0059)	(0.0061)
Control Variablese	Control	Control	Control
Constant term	6.7882^{***}	-0.3180^{***}	-0.5363^{***}
	(1.3748)	(0.0572)	(0.0576)
Year-fixed effects	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes
Observed values	22293	26921	26921
R^2	0.3617	0.1485	0.1867

5.2. Testing for Market Performance Effects

Column (1) of Table 8 presents the regression results with market power (Lerner) as the instrumental variable. The regression coefficient for the policy effect (did) is 0.0058 and is significant at the 5% level. The greater a firm's market power, the greater its capacity to increase investment in innovation. Market competition not only helps stimulate firms' motivation to innovate [26], but also strengthens their confidence and capabilities in innovation, encouraging them to proactively seek out innovation opportunities [27]; thus, Hypothesis 3a is confirmed. From the perspective of the innovation ecosystem, manufacturing firms with strong market power have greater influence over market rules under intellectual property protection; not only do they possess strong sales capabilities and generate high revenue, but they are also able to build more robust innovation systems and provide financial support for innovation investments.

As shown in Column (2) of Table 8, the coefficient of "Intellectual Property Model City Construction" (did), 0.0058, significantly promotes improvements in corporate financial performance (revenue) at the 5% significance level. The unique nature of the products for which manufacturing companies seek patent protection means they do not have to engage in price wars due to product homogeneity, thereby avoiding the need for extensive promotional efforts and saving costs. Manufacturing companies have effectively improved their profitability thanks to the combined effects of higher selling prices and lower selling expenses. Improved profitability can enhance a company's financial position; a sound financial position enables the company to better withstand risks and allocate resources more effectively. Furthermore, when a company has ample resources to support innovation, it creates favorable conditions for exploring new ideas and developing products, allowing it to conduct R&D activities with greater ease, which has a positive impact on innovation and R&D [28]. Based on this, Hypothesis 3b has been confirmed.

Table 8. Market Power and Profitability of Manufacturing Enterprises

	(1)	(2)
	lerner	revenue
did	0.0058^{**}	0.0529^{**}
	(0.0024)	(0.0220)
Control	Control	Control
Constant term	-0.0219	0.4912
	(0.0303)	(0.3898)
Year-fixed	Yes	Yes
Industry-fixed	Yes	Yes
Observed values	28472	28482
R^2	0.5907	0.8497

6. Conclusions and Recommendations

The main research findings are as follows: First, the development of intellectual property model cities has a significant positive impact on the innovation capacity of manufacturing firms; this conclusion holds after a series of robustness tests. Second, the effect of intellectual property model city development on enhancing the innovation capacity of manufacturing firms exhibits marked heterogeneity; the differential impact was verified across two dimensions: regional heterogeneity and firm heterogeneity. Third, the development of intellectual property model cities not only promotes innovation in manufacturing enterprises by enhancing their R&D intensity and patent quality but also influences enterprise innovation through two market-based transmission mechanisms: market power and firm performance. An examination of the mechanisms through which the development of intellectual property model cities drives innovation in manufacturing enterprises provides empirical support and a roadmap for these enterprises to enhance their innovation capabilities.

Although intellectual property legislation is standardizedat the national level, there are significant differences among local governments in terms of the allocation of regulatory resources and the effectiveness of law enforcement, resulting in inconsistent implementation of the system. It is recommended that the central government combine top-level design with region-specific, targeted measures, strengthen supervision and guidance of local intellectual property protection efforts, and establish a mechanism for assessing regional protection capabilities and conducting dynamic monitoring.

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