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Patent Insurance Pilot Policy and Corporate Total Factor Productivity

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Abstract

The difficulty, lengthy procedures, and high costs associated with patent rights protection may discourage firms from engaging in innovative activities. By introducing a risk-sharing mechanism, the patent insurance pilot policy helps reduce the costs and uncertainties arising from patent infringement disputes. While previous studies have mainly examined its impact on innovation output, little attention has been paid to whether patent insurance can improve firms' total factor productivity (TFP). Taking the patent insurance pilot policy launched in 2012 as a quasi-natural experiment, this paper employs data on Chinese A-share listed firms from 2008 to 2024 and adopts a multi-period difference-in-differences approach to evaluate its effects on TFP. The results indicate that patent insurance significantly enhances firms' TFP, with the effect emerging about four years after policy implementation. Further analysis suggests that increased risk-taking and improved innovation quality are two important channels through which the policy operates. The positive effect is more pronounced among state-owned firms, high-tech firms, firms operating in highly competitive industries, and firms located in eastern China. These findings enrich the understanding of the economic consequences of patent insurance and provide evidence for improving intellectual property protection policies and supporting firm development.

Keywords

patent insurance pilot, total factor productivity, risk-taking, innovation quality

1. Introduction

High-quality development has become a central objective in China’s current stage of economic development. As an important indicator of economic performance, total factor productivity (TFP) reflects the efficiency with which production factors are allocated and utilized, and is closely associated with the optimization of economic structure and the transformation of growth patterns. Since enterprises are the primary actors in market activities, sustained improvements in firm-level TFP provide an essential micro-foundation for achieving high-quality economic development at the macro level (Huang Xianhai, 2023) [1]. Accordingly, identifying effective ways to enhance firms’ productivity has long been a key concern for both researchers and policymakers (Hsieh & Klenow, 2009; Restuccia & Rogerson, 2017) [2, 3]. Existing studies generally suggest that improvements in productivity are closely tied to technological innovation, while the realization of innovation outcomes depends to a considerable extent on the effectiveness of intellectual property protection

(Huang Bo, 2023) [4]. Nevertheless, firms often face substantial risks of patent infringement during the innovation process.

Although the innovation capacity of Chinese enterprises has continued to improve and patent applications have increased rapidly in recent years, difficulties in patent enforcement remain widespread. Problems such as burdensome evidence collection, lengthy litigation procedures, and high enforcement costs continue to constrain the protection of innovation outcomes. Survey data released by the China National Intellectual Property Administration (CNIPA) in 2012 show that nearly 30% of domestic patentees had encountered infringement disputes, yet only around 10% chose to pursue legal remedies. More importantly, the costs associated with enforcement often exceeded the compensation ultimately received. For firms that rely heavily on internal funds to support R&D activities, these additional costs may reduce incentives to innovate and, over time, undermine production efficiency.

Against this background, CNIPA launched the patent insurance pilot policy in 2012. The core product of the program is patent enforcement insurance, under which investigation expenses, legal fees, and other costs incurred during patent rights protection are covered by insurance providers when infringement occurs. By transferring part of the enforcement risk to insurers, the policy lowers the expected costs associated with safeguarding patent rights. The pilot was implemented in two batches and eventually covered 33 cities. According to data released by the National Financial Regulatory Administration, by March 2026 the cumulative insured amount of patent insurance nationwide had reached 56 billion yuan, providing protection for more than 27,000 enterprises, including a substantial number of listed firms. The expansion of the pilot program offers a valuable opportunity to evaluate its economic effects using firm-level data. Against this backdrop, an important question arises: can patent insurance contribute to improvements in corporate total factor productivity? If so, through what channels does this effect operate?

Existing research has provided useful insights into these issues. A large body of literature finds that stronger intellectual property protection encourages innovation activities (Fang et al., 2017) [5] and stimulates both R&D investment and patent output (Hu Kai and Wu Qing, 2018) [6]. More recent studies have begun to examine patent insurance as a specific policy instrument and suggest that it may affect firm behavior by strengthening risk-taking capacity, easing financing constraints, and facilitating cross-regional innovation cooperation (Yuan Hui et al., 2026) [7]. However, most of this literature focuses on innovation-related outcomes, particularly patent applications and other quantitative measures of innovation. Relatively little attention has been paid to whether patent insurance ultimately improves firms' production efficiency. Evidence regarding its impact on total factor productivity remains limited, and the role of innovation quality has yet to be systematically examined.

From a theoretical perspective, patent insurance may influence corporate TFP through at least two channels. First, it may increase firms' willingness to undertake risk. When enterprises face lower uncertainty regarding the protection of innovation returns, they may be more willing to invest resources in projects with higher risk and potentially higher returns, thereby expanding their scope for innovation (Yuan Hui et al., 2026) [7]. Second, patent insurance may improve innovation quality. By strengthening protection for innovative outcomes and reducing incentives for imitation and free-riding, the policy may encourage firms to place greater emphasis on the quality rather than the quantity of innovation activities (Qian Linyi et al., 2025) [8]. To examine these possibilities, this paper treats the patent insurance pilot policy launched in 2012 as a quasi-natural experiment and employs a difference-in-differences framework based on data from A-share listed companies between 2008 and 2024. The results indicate that the policy significantly improves corporate TFP. The effect is particularly evident among state-owned enterprises, high-tech firms, enterprises operating in highly competitive industries, and firms located in eastern China. Further analysis shows that both risk-taking and innovation quality serve as important channels through which patent insurance affects productivity.

This paper contributes to the existing literature in three respects. First, while previous studies primarily evaluate patent insurance from the perspective of innovation output, this paper focuses on its consequences for total factor productivity. An increase in patent applications does not necessarily translate into higher production efficiency and may, in some cases, reflect excessive emphasis on patent quantity. By examining TFP, this study provides evidence on whether the policy generates broader economic benefits beyond innovation output itself.

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Second, this paper exploits the staggered rollout of the patent insurance pilot program to construct a multi-period difference-in-differences model. Compared with studies based on regional aggregates or cross-sectional data, this approach allows for a more rigorous assessment of policy effects at the firm level. In addition, a series of robustness checks, including propensity score matching DID, entropy balancing, and placebo tests, are conducted to alleviate concerns regarding sample selection and omitted-variable bias.

Third, the findings offer implications for the ongoing development of patent insurance policies. The results suggest that patent insurance contributes to productivity growth by encouraging risk-taking and improving innovation quality, while the magnitude of the effect varies across different types of firms and regions. These findings provide useful evidence for refining policy design, expanding the coverage of patent insurance, and improving the effectiveness of intellectual property protection mechanisms.

The remainder of the paper is organized as follows. Section I develops the theoretical framework and research hypotheses. Section II introduces the research design, including data sources, variable definitions, and empirical models. Section III reports the empirical results, robustness tests, mechanism analysis, and heterogeneity analysis. Section IV concludes and discusses the corresponding policy implications.

2. Literature Review

2.1 Theoretical Research on Patent Insurance

Research on patent insurance in the international literature has mainly focused on why such a system emerges, how it operates, and what economic consequences it may generate. Regarding the rationale for its emergence, Lanjouw and Schankerman (2004) [9] argued from the perspective of transaction costs that patent litigation is often extremely costly, with average litigation expenses reaching millions of dollars. For many small and medium-sized enterprises, such costs are difficult to bear, creating demand for mechanisms that can spread litigation risks. Their analysis suggests that patent insurance arises largely as a response to the mismatch between high enforcement costs and the limited risk-bearing capacity of smaller firms.

With respect to the operation of patent insurance, Meurer (1989) [10] provided one of the earliest discussions of its economic logic. He noted that patent insurance works by pooling dispersed litigation risks and redistributing them through an insurance mechanism, thereby lowering the expected cost of patent enforcement for individual firms. In this sense, the system functions as a form of risk-sharing arrangement that helps reduce uncertainty associated with intellectual property disputes.

Scholars have also examined the potential economic effects of patent insurance and related enforcement mechanisms. Lanjouw and Schankerman (2001) [11] found that high litigation costs may weaken the incentive function of patents and reduce the returns to innovative activities. Their study further showed that litigation risks vary considerably across firms and patents, with small and medium-sized enterprises often facing relatively greater burdens. These findings provide an important theoretical basis for the development of patent litigation insurance and similar risk-transfer instruments.

Compared with the international literature, research on patent insurance in China emerged relatively later and has been developed largely in response to the country's institutional environment and practical needs. Focusing on the difficulties commonly encountered in patent enforcement, including burdensome evidence collection, lengthy procedures, and high enforcement costs, Long Xiaoning and Lin Hanxin (2018) [12] discussed the necessity of introducing patent insurance into China's intellectual property protection system. They argued that patent insurance combines ex ante risk transfer with ex post compensation, offering firms a market-oriented approach to managing innovation-related risks.

Subsequent studies have paid greater attention to the mechanisms through which patent insurance may influence firm behavior. From the perspective of risk sharing, Yuan Hui et al. (2026) [7] argued that patent insurance transforms uncertain and potentially substantial litigation expenditures into relatively stable insurance premiums. By reducing the downside risks associated with innovation activities, the policy may encourage managers to undertake projects with higher levels of risk and potential return. Qiu Yangdong (2022) [13] examined the innovation incentives generated by patent insurance from both extensive and intensive margins, finding that the policy can not only encourage more firms to participate in innovation activities but also stimulate innovative firms to increase their R&D investment.

Building on these studies, recent research has gradually expanded the discussion of the channels through which patent insurance affects firms. Existing literature suggests that its effects may operate through multiple mechanisms, including easing financing constraints, increasing risk-taking, reducing uncertainty surrounding R&D activities, improving innovation quality, generating innovation spillovers, and facilitating cross-regional technological collaboration (Qian Linyi et al., 2025; Zhong et al., 2025) [8, 14]. Although the specific conclusions differ across studies, most scholars agree that patent insurance may influence enterprise behavior not only by reducing enforcement costs but also by shaping firms' innovation incentives and resource allocation decisions.

2.2 Theoretical Research on Total Factor Productivity

Total factor productivity (TFP) is widely regarded as an important indicator of production efficiency and has long been a central topic in economic research. Existing studies generally focus on two related issues: the conceptual understanding of TFP and the factors that contribute to its growth.

The concept of total factor productivity originates from the work of Solow (1957), who decomposed economic growth into the contributions of factor inputs and a residual component. This residual was interpreted as the efficiency gains generated by technological progress and later became known as total factor productivity. Building on this framework, Krugman (1994) [15] argued that sustained economic growth ultimately depends more on productivity improvements than on the continuous accumulation of capital. Subsequent research extended the concept from the macroeconomic level to the firm level, viewing enterprise TFP as a measure of how efficiently firms transform factor inputs into outputs. In this context, TFP reflects not only technological progress but also broader dimensions of firm performance, including managerial capability and resource allocation efficiency.

A substantial body of literature has explored the determinants of TFP from different perspectives. One prominent line of research emphasizes the role of technological innovation. Studies suggest that R&D investment and innovation outputs are important sources of productivity improvement because they facilitate the development and diffusion of new technologies (Aghion et al., 2005) [16]. Another strand of literature focuses on resource allocation. Hsieh and Klenow (2009) [2] argued that reallocating resources from less productive firms to more productive firms can generate considerable productivity gains at both the firm and aggregate levels.

Institutional conditions have also received considerable attention in the TFP literature. Existing studies indicate that a sound market environment and effective intellectual property protection can strengthen innovation incentives and improve production efficiency (Wu Chaopeng and Tang Wan, 2016; Liu Jianjiang et al., 2022) [17, 18]. In addition, some scholars have highlighted the role of corporate risk-taking. Moderate risk-taking may enable firms to pursue innovation opportunities with higher expected returns and thereby contribute to productivity growth (Yu Minggui et al., 2013; Yuan Hui et al., 2026) [7, 19].

More recently, researchers have begun to distinguish between innovation quantity and innovation quality when examining productivity performance. Relevant studies show that substantive innovation, often measured by invention patents, tends to generate stronger productivity effects than strategic or quantity-oriented innovation activities (Li Wenjing and Zheng Manni, 2016; Zhang Jie and Zheng Wenping, 2018) [20, 21]. This suggests that improvements in innovation quality may represent an important channel through which firms enhance total factor productivity.

2.3 Theoretical Research on the Impact of Patent Insurance on Corporate Total Factor Productivity

The existing literature has not yet developed a fully unified theoretical framework on how patent insurance affects corporate total factor productivity. Based on related studies, the potential transmission mechanisms can be summarized from several perspectives.

One important channel is the easing of financing constraints. Patent insurance may improve the perceived value of patent assets, allowing them to function more effectively as a form of implicit collateral, which in turn

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increases firms' access to external financing. At the same time, by covering part of the costs associated with patent litigation, it helps stabilize firms' cash flow and reduces financial uncertainty (Yuan Hui et al., 2026; Zhong et al., 2025) [7, 14]. With improved financing conditions, firms are more likely to maintain or expand R&D investment, which is widely regarded as a key driver of productivity improvement (Wu Chaopeng and Tang Wan, 2016) [17]. In this sense, patent insurance may indirectly support TFP growth by relaxing financial constraints that would otherwise limit innovation activities.

Another frequently discussed mechanism relates to firms' risk-taking behavior. In the absence of effective protection for innovation returns, firms may become more cautious in their investment decisions, particularly when facing the possibility that patented outcomes cannot be adequately protected. This may lead to underinvestment in high-risk but potentially high-return projects, a phenomenon often described as a "chilling effect" on innovation (Zhong et al., 2025) [14]. By converting uncertain and potentially large litigation costs into predictable insurance premiums, patent insurance reduces the downside risk associated with innovation activities and, in turn, may weaken managerial risk aversion (Wu & Wu, 2026; Yuan Hui et al., 2026) [22, 7]. As firms become more willing to undertake riskier projects, successful innovations are more likely to generate substantial improvements in production efficiency (Yu Minggui et al., 2013; John et al., 2008) [19, 23].

A further channel operates through changes in market competition and firms' competitive position. Patent insurance strengthens firms' ability to defend intellectual property rights by lowering enforcement costs, which may reduce the risk of imitation and imitation-based erosion of profits (Pan Guangxi et al., 2025) [24]. When firms are better able to protect core technologies, their market position becomes more secure, and the incentives to improve internal efficiency are reinforced. From the perspective of industrial organization, stronger competitive pressure and more stable property rights protection can both encourage firms to enhance productivity through more efficient resource allocation.

The literature also suggests that patent insurance may influence the nature of innovation itself. In environments where patent protection is weak or costly, firms may rely on a large number of low-quality patents as a defensive strategy, sometimes referred to as "strategic patenting" (Mansfield et al., 1981) [25]. By improving the expected returns to valuable patents and reducing the cost of protecting them, patent insurance may encourage firms to shift attention toward more substantive innovation activities (Qian Linyi et al., 2025; Zhong et al., 2025) [8, 14]. Such a shift implies that, for a given level of input, firms are able to generate higher-quality innovation outputs, which is closely associated with productivity improvement (Li Wenjing and Zheng Manni, 2016; Zhang Jie and Zheng Wenping, 2018) [20, 21].

Beyond these channels, some studies extend the discussion to the utilization of underused resources. Firms often hold patents or technical knowledge that are not fully commercialized due to concerns about infringement risks. By reducing the cost and uncertainty associated with rights protection, patent insurance may encourage firms to make better use of these dormant resources and integrate them into production processes, thereby improving overall efficiency (Pan Guangxi et al., 2025) [24].

Finally, patent insurance may also generate broader knowledge spillover effects. As shown by Jaffe (1986) [27], firms' R&D activities tend to produce spillovers that benefit other firms within and across industries. Patent disclosure mechanisms allow part of this knowledge to become publicly accessible, and wider participation in patenting activities may increase the stock of usable knowledge in the economy. In this sense, the impact of patent insurance on productivity is not necessarily confined to insured firms themselves but may also extend to other firms through knowledge diffusion.

2.4 Literature Commentary

Overall, the literature on patent insurance and total factor productivity has developed along relatively separate lines.

Research on patent insurance has examined its institutional origins, operational logic, and potential economic effects, and has identified several channels through which the policy may influence firm behavior. However, most existing studies tend to focus on innovation outcomes, such as patent quantity or quality. Whether these mechanisms can further translate into improvements in firms' production efficiency has received comparatively less attention. In particular, the link between policy-induced changes in firms' behavior—such as risk-taking or innovation upgrading—and total factor productivity has not been fully explored.

In contrast, the literature on total factor productivity has documented the importance of factors such as risk-taking and innovation quality in shaping productivity performance. Yet these discussions are often developed at a relatively general level and are rarely connected to specific policy instruments such as patent insurance. As a result, the channel through which institutional arrangements like patent insurance may influence TFP remains insufficiently clarified.

Against this backdrop, this paper uses the patent insurance pilot policy launched in 2012 as a quasi-natural experiment and applies a multi-period difference-in-differences framework to examine its impact on corporate total factor productivity at the firm level. In the mechanism analysis, the study focuses on risk-taking and innovation quality as two key channels, with the aim of providing more direct micro-level evidence on how patent insurance may affect firms' productivity outcomes.

3. Policy Background and Theoretical Hypotheses

3.1 Policy Background

Patents, as important intangible assets of enterprises, have protection strength that directly affects enterprises' innovation returns and production efficiency. For a long time, Chinese enterprises have faced prominent difficulties in patent rights enforcement characterized by "difficulty in providing evidence, long cycles, and high costs." According to the 2012 enforcement statistics of the China National Intellectual Property Administration (CNIPA), a total of 2,232 patent infringement dispute cases were accepted throughout the year, along with 6,512 counterfeit patent cases investigated and handled, resulting in a total of 9,022 cases handled, representing a year-on-year increase of 199% [33]. Among the closed patent infringement dispute cases, 603 were settled through mediation (46.6%), 424 through withdrawal (32.8%), and 138 through adjudication (10.7%) [34]. In addition, empirical studies show that the proportion of statutory compensation applied in Chinese patent infringement damage compensation cases is as high as 95.68%, with relatively low average compensation amounts [35]. The stark contrast between high enforcement costs, lengthy litigation cycles, and low compensation amounts has severely weakened the innovation motivation of enterprises, especially small and medium-sized enterprises, becoming a significant institutional obstacle constraining the improvement of production efficiency among Chinese enterprises.

In response to these challenges, the China National Intellectual Property Administration (CNIPA) and the People's Insurance Company of China (PICC) jointly initiated cooperation in late 2011 to explore the integration of insurance mechanisms with intellectual property protection, marking the initial stage of patent insurance design and development. On this basis, CNIPA launched patent insurance pilot programs in batches in 2012 and 2016, covering multiple cities across China. The list of pilot cities is presented in Table 1.

The pilot policy mainly focuses on improving the institutional arrangement for patent protection through market-based mechanisms. One core feature is the introduction of patent enforcement insurance, under which litigation-related costs, such as investigation and legal expenses, can be partially covered by insurance companies when patent infringement occurs. This mechanism effectively reduces firms' expected enforcement costs. Another feature is the reliance on a government-led, market-oriented implementation model, where local intellectual property authorities cooperate with insurance institutions to design products and provide premium subsidies, thereby lowering participation costs for firms. In addition, the pilot regions have gradually developed supporting service arrangements involving insurance companies, intermediaries, and enterprises to facilitate policy implementation and claims processing.

With the gradual expansion of pilot regions, the policy has accumulated a certain scale of practice. According to data released by the National Financial Regulatory Administration at a State Council Information Office press conference in March 2026, the cumulative insured amount of patent insurance in China has reached 560 billion yuan [36]. In some pilot cities such as Ningbo, local exploration has further refined the institutional framework, forming a relatively integrated system combining government support, market operation, and professional services. By March 2026, Ningbo had provided patent insurance coverage for more than 17,000 enterprises, with a cumulative insured amount of 22 billion yuan.

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Overall, the development of the patent insurance pilot policy reflects an institutional attempt to reduce firms' costs of patent protection and improve incentives for innovation activities, providing a relevant institutional background for examining its potential impact on corporate total factor productivity.

Table 1: List of Patent Insurance Pilot Regions

Time	Pilot Batch	Pilot Cities
2012	First Batch	Beijing, Dalian, Guangzhou, Chengdu, Zhenjiang, Shenyang, Nanjing, Wuxi, Suzhou, Nantong, Jiaxing, Hefei, Bengbu, Fuzhou, Jinan, Dezhou, Wuhan, Xiangtan, Zhuzhou, Shenzhen, Dongguan, Foshan, Chongqing, Mianyang, Baoji
2016	Second Batch	Yantai, Anyang, Huizhou, Jiangmen, Zhaoqing, Deyang, Shanghai, Jieshou

Data Source: China National Intellectual Property Administration

3.2 Theoretical Hypotheses

Patent infringement is a common risk faced by firms in the process of innovation. When the returns to patented technologies cannot be adequately protected, firms may experience a decline in expected innovation benefits, which in turn weakens incentives for R&D investment and innovative activities (Deng et al., 2024) [28]. In practice, however, the enforcement of intellectual property rights in China has long relied on judicial channels, and firms often face difficulties such as high enforcement costs, long litigation cycles, and challenges in evidence collection (Cai Xianjun et al., 2025) [29]. Against this background, the patent insurance pilot policy introduces an insurance-based mechanism that combines ex-ante risk sharing with ex-post compensation, potentially reshaping firms' responses to innovation-related risks. Accordingly, this paper proposes the following baseline hypothesis.

Hypothesis 1: The patent insurance pilot policy can promote the improvement of corporate total factor productivity.

The expected impact of patent insurance on TFP is likely to operate through changes in firms' innovation behavior. One possible channel is the adjustment of firms' risk-taking decisions. Innovation activities are inherently uncertain, and in the absence of effective protection for innovation returns, firms may become more cautious in allocating resources to R&D, particularly when faced with the possibility that patented outcomes are difficult to enforce. This may lead to underinvestment in high-risk and potentially high-return projects, thereby constraining productivity improvement. Existing studies suggest that infringement risks and enforcement costs can suppress firms' innovation incentives and generate a noticeable "chilling effect" (Zhong et al., 2025) [14]. By providing compensation for enforcement costs and part of the related losses, patent insurance reduces the downside risk of innovation and may alter firms' risk perceptions. Related evidence also shows that technology-related insurance mechanisms can enhance firms' willingness to undertake risky innovation activities, especially in high-tech industries and regions with stronger legal environments (Wu & Wu, 2026) [22]. In addition, patent insurance has been found to facilitate inter-firm and cross-regional cooperation by reducing uncertainty in innovation activities (Yuan Hui et al., 2026) [7]. Overall, when firms are more willing to undertake uncertain but high-return projects, productivity improvements are more likely to emerge. Based on this, Hypothesis 2 is proposed.

Hypothesis 2: The patent insurance pilot policy can promote the improvement of total factor productivity by enhancing enterprises' risk-taking levels.

Another potential channel is related to innovation quality. Compared with innovation quantity, innovation quality is more closely associated with productivity growth (Aghion et al., 2005) [16]. When patent protection is weak or costly, firms may rely on a large number of low-quality patents for defensive purposes, such as building "patent fences," while being reluctant to engage in more substantial technological breakthroughs (Mansfield et al., 1981) [25]. Patent insurance may partially alleviate this situation by improving the economic feasibility of protecting high-value patents and reducing concerns about infringement-related losses. Recent studies find that such mechanisms can mitigate the discouraging effects of enforcement costs on innovation and promote both incremental and breakthrough innovation (Zhong et al., 2025) [14]. There is also evidence that patent insurance is associated with improvements in both the quantity and quality of firm-level patents through channels such as increased R&D investment and eased financing constraints (Qian Linyi et al., 2025) [8]. To the extent that firms shift toward more substantive innovation activities, output can be generated more efficiently given the same level of input, which contributes to higher total factor productivity. Accordingly, Hypothesis 3 is proposed.

Hypothesis 3: The patent insurance pilot policy can promote the improvement of corporate total factor productivity by improving corporate innovation quality.

4. Research Design

4.1 Model Specification

This paper employs the patent insurance pilot policy as an exogenous shock. Enterprises located in pilot cities within the sample are considered the treatment group, while those in non-pilot cities are considered the control group. The study investigates whether a significant difference in total factor productivity emerges between the treatment and control groups after the implementation of the policy pilot.

The baseline model is specified as follows:

$$TFP_{it}=\alpha+\beta \mathrm{Policy}_{ct}+\mathbf{X}'_{\gamma}+u_i+v_t+\varepsilon_{ict} \tag{1}$$

In the equation, i, c, and t denote firm, city, and time, respectively; TFP_{it} represents total factor productivity; Policy_{ct} represents the patent insurance policy pilot, which takes the value of 1 if city c implemented the policy in year t, and 0 otherwise; $\mathbf{X}'_{\gamma}$ represents the vector of control variables; u_i and v_t represent firm fixed effects and time fixed effects, respectively, which control for time-invariant inherent characteristics at the firm level and the common impact of macro-level shocks or time trends on all firms; ε_{ict} represents the error term.

4.2 Variable Construction

Dependent Variable: Total Factor Productivity (TFP). This paper measures TFP using the Levinsohn–Petrin (LP) method (Levinsohn & Petrin, 2003) [26]. Following the standard practice in the literature, output is proxied by operating revenue, labor input is measured by the number of employees, capital input is captured by net fixed assets, and intermediate inputs are proxied by cash paid for goods and services. This approach helps mitigate the simultaneity bias commonly associated with traditional OLS estimations.

Core Independent Variable: Patent Insurance Pilot Policy (Policy_{ct}). Policy_{ct} represents the patent insurance policy pilot, taking the value of 1 if city c implemented the policy in year t, and 0 otherwise.

Control Variables: (1) Firm Size. Measured by the logarithm of total assets, reflecting firm resource endowment and economies of scale. Larger firms typically possess stronger technological innovation capabilities and resource integration abilities. (2) Leverage Ratio. Calculated as total liabilities divided by total assets, reflecting firm financial leverage and operational risk. Higher leverage ratios may inhibit corporate R&D investment. (3) Return on Assets (ROA). Measured as net profit divided by total assets, reflecting firm profitability. More profitable firms have stronger incentives to engage in technological innovation. (4) Revenue Growth Rate. Calculated as (current year's operating revenue / previous year's operating revenue) - 1, reflecting firm growth. High-growth firms tend to pay more attention to production efficiency improvement. (5) Fixed Assets Ratio. Measured as net fixed assets divided by total assets, reflecting firm capital intensity. The production efficiency of asset-heavy firms may be affected by capital allocation efficiency. (6) Shareholding Ratio of the Largest Shareholder. Measured as the number of shares held by the largest shareholder divided by total share capital, reflecting ownership concentration. Ownership structure may influence firm innovation decisions and governance efficiency. (7) GDP Growth Rate. Measured by the year-on-year growth rate of regional GDP, reflecting regional economic vitality and expansion trends. Rapidly growing economies are often accompanied by resource reallocation and efficiency improvements. (8) Share of Tertiary Industry. Measured by the value added of the tertiary industry as a share of regional GDP, reflecting industrial structure. An increasing share of the service sector contributes to improved resource allocation efficiency and technological sophistication. (9) Foreign Openness. Measured by the ratio of actually utilized foreign capital to regional GDP, reflecting the degree of foreign openness. Foreign capital entry can affect

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local production efficiency through channels such as technology spillovers and competition effects. (10) Human Capital. Measured by the ratio of the number of enrolled students in higher education institutions, reflecting the regional level of human capital.

At the city level, the analysis further controls for GDP growth rate, the share of the tertiary industry, foreign openness, and human capital. Since the policy is implemented at the city level, time-varying regional characteristics may affect both policy exposure and firm outcomes. Following Sun Puyang et al. (2025) [27], these variables are included to reduce potential omitted variable bias in the baseline specification.

It is worth noting that data on foreign openness and human capital contain a relatively large number of missing observations. These variables are nevertheless retained in the benchmark regressions, as they are commonly recognized as important determinants of regional innovation conditions and firm productivity (Wu Chaopeng and Tang Wan, 2016; Qian Linyi et al., 2025) [17, 8]. Excluding them may introduce omitted-variable bias, although this comes at the cost of a smaller effective sample size.

Finally, to ensure consistency in prefecture-level city matching, observations from Jieshou City are merged with the corresponding city-level characteristics of Fuyang, to which it administratively belongs.

4.3 Data Sources

This paper uses panel data from prefecture-level cities and above from 2008 to 2024 as the research sample. The raw data are sourced from the China City Statistical Yearbook and the CSMAR database. In addition, information on patent insurance pilot cities and pilot periods is obtained from policy documents published by the China National Intellectual Property Administration.

Following the practices of existing studies, this paper processes the initial sample as follows: (1) All nominal variables are deflated using 2008 as the base year. (2) Samples from the financial industry, including banks, securities firms, and insurance companies, which have unique characteristics, are excluded. (3) Samples with abnormal trading status, such as ST, *ST, and PT, are excluded. (4) Samples with missing values for the main variables are excluded. (5) All continuous variables are winsorized at the 1st and 99th percentiles to mitigate the influence of extreme values on the estimation results.

The descriptive statistics for each variable are presented in Table 2.

Table 2: Descriptive Statistics

	Observations	Mean	Std. Dev.	Min	Max
Total Factor Productivity	17960	8.8006	1.1223	6.3249	11.6112
Patent Insurance Pilot Policy	17960	0.3409	0.4740	0	1
Firm Size	17960	22.9333	2.1384	19.2081	29.3515
Leverage Ratio	17960	0.4322	0.2233	0.0524	0.9944
Return on Assets	17960	0.0302	0.0733	-0.3337	0.2020
Revenue Growth Rate	17960	0.1291	0.3882	-0.6305	2.3364
Fixed Assets Ratio	17960	0.2071	0.1603	0.0015	0.6946
Shareholding Ratio of Largest Shareholder	17960	0.3326	0.1498	0.0785	0.7397
GDP Growth Rate	17960	8.0471	3.7074	0 .6000	17.2000
Share of Tertiary Industry	17960	51.2512	11.0997	27.4000	73.2600
Foreign Openness	17960	3.4453	3.9972	0.1174	20.9725
Human Capital	17960	0.0521	0.0411	0.0012	0.1439

Note: The sample size for the baseline regression is smaller than that of the original matched sample, primarily due to the high proportion of missing values for the city-level variables foreign openness and human capital.

5. Empirical Analysis

5.1 Parallel Trends Test

To verify the applicability of the difference-in-differences model, this paper conducts a parallel trends test. The period immediately preceding the policy implementation (i.e., policy relative time period -1) is set as the base period, and the years from the 8th year after the policy onwards are consolidated into a single period (period 8). The specific model is specified as follows:

$$TFP_{it}=\alpha+\beta_k \sum_{k=-4}^{8+} \mathrm{Post}_{ctk} + \mathbf{X}'_{\gamma}+u_i+v_t+\varepsilon_{ict} \quad (2)$$

Post_{ctk} represents the k-th year before (or after) the implementation of the patent insurance pilot policy. If the year is the k-th year before (or after) the implementation of the patent insurance pilot policy in the city where the firm is located, Post_{ctk} is assigned a value of 1; otherwise, it is 0.

Figure 1 reports the dynamic treatment effects before and after the implementation of the patent insurance pilot policy, together with 95% confidence intervals.

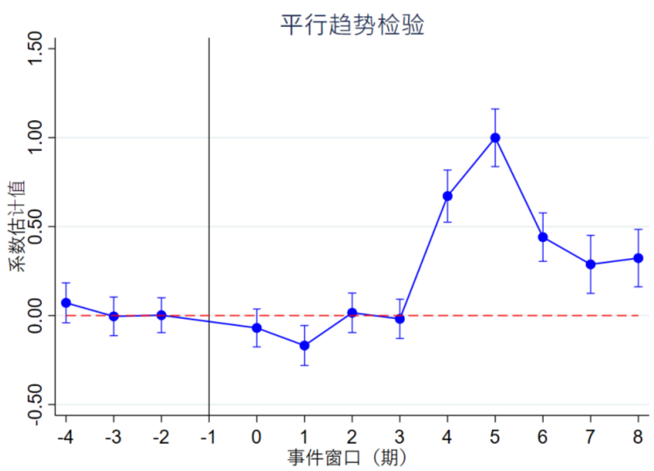
Before policy implementation (relative periods −4 to −2), the estimated coefficients are statistically indistinguishable from zero, and all confidence intervals include zero. This suggests that there are no significant pre-existing differences in total factor productivity between the treatment and control groups, supporting the validity of the parallel trends assumption.

After the policy is introduced, the estimated effects begin to evolve over time. In the first period following implementation, the coefficients remain statistically insignificant. In the immediate post-treatment period, the estimated effect turns negative and becomes statistically significant. This short-term decline may reflect adjustment processes in firms' innovation behavior, as firms reallocate R&D resources and adjust their patenting strategies in response to the new institutional environment.

Starting from approximately the fourth post-policy period, the estimated coefficients become significantly positive. This indicates that the patent insurance pilot policy begins to exhibit a positive impact on total factor productivity with a certain lag. The effect remains positive in subsequent periods, although its magnitude shows some decline after period six. Despite this variation, the confidence intervals continue to exclude zero, suggesting that the policy effect persists over time.

One possible interpretation is that the policy initially triggers a concentrated adjustment in firms' innovation and enforcement behavior, while the longer-term effect reflects a more stable improvement in innovation incentives. The observed pattern is consistent with a delayed but persistent treatment effect rather than a one-time shock.

Figure 1: Parallel Trends Test



Parallel Trends Test; Coefficient Estimates; Event Window (Period)

5.2 Benchmark Analysis

Table 3 presents the baseline regression results under different model specifications. Across all columns, the estimated coefficients of the patent insurance pilot policy are positive and statistically significant at the 1% level, suggesting a consistently positive association between the policy and corporate total factor productivity.

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In terms of magnitude, the coefficient is 0.562 in the specification without fixed effects. After including time fixed effects, the estimate decreases to 0.481, and further declines to 0.333 when firm fixed effects are added. Under the two-way fixed effects specification in Column (4), the coefficient remains positive at 0.216 and is still statistically significant at the 1% level. Based on this specification, the implementation of the patent insurance pilot policy is associated with an increase in firm TFP of approximately 2.45%.

Overall, the estimated effect becomes smaller as additional fixed effects are introduced, but its sign and statistical significance remain stable across all specifications. This suggests that the baseline finding is not sensitive to model specification and is robust to the inclusion of different sets of fixed effects.

In summary, the benchmark results indicate that the patent insurance pilot policy is associated with a statistically significant improvement in corporate total factor productivity.

Table 3: Baseline Regression Results

	(1)	(2)	(3)	(4)
	Total Factor Productivity	Total Factor Productivity	Total Factor Productivity	Total Factor Productivity
Patent Insurance Pilot Policy	0.562***	0.481***	0.333***	0.216***
	(0.018)	(0.019)	(0.035)	(0.043)
Control Variables	Yes	Yes	Yes	Yes
Firm Fixed Effects	No	No	Yes	Yes
Time Fixed Effects	No	Yes	No	Yes
Observations	17960	17960	17960	17960
Adjusted R^2	0.098	0.154	0.122	0.217

*Note: ***, **, and * indicate that the estimated coefficients are statistically significant at the 1%, 5%, and 10% levels, respectively. Standard errors clustered at the city level are shown in parentheses. The same applies to the tables below.*

5.3 Robustness Checks

5.3.1 PSM-DID

To address potential sample selection bias, this paper applies a propensity score matching combined with difference-in-differences (PSM-DID) approach. Firms in the treatment and control groups are matched using key firm-level characteristics, including size, leverage, profitability, growth, asset structure, and ownership concentration, based on a 1:3 nearest-neighbor matching strategy.

After matching, the covariate balance between the treatment and control groups is substantially improved, and the common support condition is largely satisfied, with only a very small number of observations excluded. Re-estimating the baseline model using the matched sample yields a coefficient of 0.2515, which remains positive and significant at the 1% level and is close to the benchmark estimate (0.216). This suggests that sample selection bias is unlikely to drive the main results.

5.3.2 Entropy Balancing

The entropy balancing method assigns weights to the control group samples to achieve perfect alignment between the treatment and control groups in the first, second, and third moments of the covariates. The post-balancing results, shown in Column (2) of Table 4, indicate that the means of all covariates are exactly equal between the treatment and control groups, demonstrating an ideal balancing outcome. The two-way fixed effects regression results based on the entropy-balanced weighted sample show that the coefficient of the patent insurance pilot policy is 0.171, significant at the 1% level, which is broadly consistent with the benchmark regression result (0.216). This confirms the robustness of the promoting effect of the patent insurance pilot policy on corporate total factor productivity.

5.3.3 Adding City Time Trends

To rule out the interference of differential time trends caused by unobservable factors such as economic development and industrial structure changes across different cities on the policy evaluation, this paper further adds an interaction term between city and linear time trends to the baseline model. The regression results in Column (3) of Table 4 show that the coefficient of the patent insurance pilot policy is 0.089, significant at the

1% level, and consistent in direction with the benchmark regression result (0.216). This implies that after controlling for city-specific time trends, the policy effect remains significant, indicating that the promoting effect of the patent insurance pilot policy on corporate total factor productivity is not driven by city-specific time trends. Thus, the benchmark conclusions are robust.

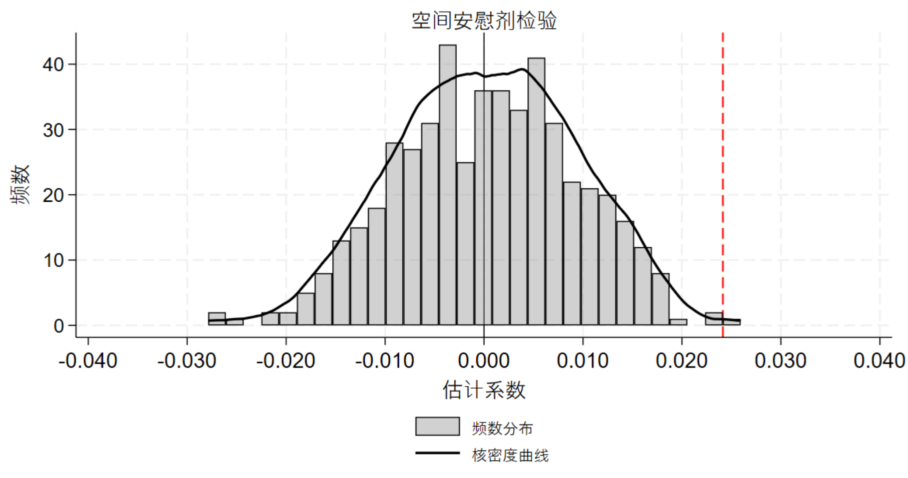
5.3.4 Placebo Test

Figure 2 presents the frequency distribution of the estimated coefficients of the pseudo-policy variable after 500 random samplings. The results show that the pseudo-estimated coefficients are highly concentrated around zero, with approximately 70% of the estimated coefficients falling within the interval [-0.01, 0.01]. The shape of the distribution is inverted U-shaped, approximating a normal distribution. The true estimated coefficient from the benchmark regression is 0.21614, which significantly deviates from this distribution. The empirical p-value is 0.000, and among the 500 random samplings, the number of times the pseudo-estimated coefficient exceeds the true coefficient is zero. These findings indicate that the treatment effects of the patent insurance pilot policy are not driven by unobservable factors, and the benchmark regression results possess good robustness.

Table 4: Robustness Tests

	(1)	(2)	(3)
	Nearest Neighbor 1:3	Entropy Balancing	Adding City Time Trends
	Total Factor Productivity	Total Factor Productivity	Total Factor Productivity
Patent Insurance Pilot Policy	0.2515***	0.1710***	0.0892***
	(0.0707)	(0.0467)	(0.0393)
Control Variables	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Observations	9768	17960	17960
Adjusted R^2	0.2476	0.2433	0.4984

Figure 2: Placebo Test



Spatial Placebo Test; Frequency; Estimated Coefficient; Frequency Distribution; Kernel Density Curve

6. Further Analysis

6.1 Mechanism Tests

6.1.1 Risk-taking Level

Risk-taking reflects firms' willingness to undertake projects with higher uncertainty and potentially higher returns. By converting uncertain and potentially large litigation costs into fixed insurance premiums, patent insurance may reduce perceived downside risks and thereby affect firms' investment preferences toward more

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uncertain innovation activities (Wu et al., 2026) [22]. To examine this channel, this paper uses risk-taking as the outcome variable.

Following existing studies (Yuan Hui et al., 2026) [7], risk-taking (RiskTaking) is measured by the volatility of firm profitability. Specifically, ROA is first calculated as earnings before interest and taxes divided by total assets, and then adjusted by subtracting the industry-year mean. The standard deviation of the adjusted ROA over a 3-year rolling window is then used as the proxy for risk-taking. Higher values indicate greater variability in firm performance and are commonly interpreted as higher risk tolerance.

The following mechanism test model is constructed:

$$RiskTaking_{it}=\alpha+\beta \mathrm{Policy}_{ct}+\mathbf{X}'_{\gamma}+u_i+v_t+\varepsilon_{ict} \tag{3}$$

The regression results in Column (1) of Table 5 show that the DID coefficient of the patent insurance pilot policy is 0.616, which is significant at the 10% level ($p = 0.058$), indicating that after the implementation of the patent insurance pilot policy, the risk-taking level of enterprises in pilot cities significantly increased. The above results validate the logic of the patent insurance policy affecting corporate behavior through the risk-taking channel: the policy reduces the uncertainty and potential loss risks faced by enterprises, making them more willing and capable to engage in high-risk, high-return innovation activities.

Existing studies generally suggest that enhanced corporate risk-taking capacity helps firms pursue high-risk, high-return innovation projects, thereby promoting improvements in production efficiency (Yu Minggui et al., 2013) [19]. Combined with the above regression results, it can be concluded that the patent insurance policy lays an important foundation for the improvement of total factor productivity by enhancing enterprises' risk-taking levels.

6.1.2 Innovation Quality

Innovation quality captures the technological content of firms' innovation activities and is commonly used to distinguish substantive innovation from more strategic or low-value patenting behavior. By reducing the costs associated with patent enforcement and improving the expected returns from patented technologies, the patent insurance policy may influence firms' incentives to engage in higher-quality innovation activities (Qian Linyi et al., 2025) [8]. To examine this channel, innovation quality is used as the dependent variable.

Following existing literature (Nie Changfei et al., 2022) [31], innovation quality is measured by the share of invention patents in total granted patents in a given year. This indicator reflects the relative importance of high-value patents within firms' overall patent portfolios.

Considering that the grant of invention patents typically involves an examination period of 2-3 years, there may be a time lag in the impact of the policy on innovation quality. To accurately capture the long-term effects of the patent insurance policy on innovation quality, this paper tests the policy variable with a lag of three periods, i.e.using the policy status at year t-3 to explain the proportion of invention patents in year t.

The following mechanism test model is constructed:

$$\mathrm{InnovationQuality}_{it}=\alpha+\beta \mathrm{Policy}_{ct}+\mathbf{X}'_{\gamma}+u_i+v_t+\varepsilon_{ict} \tag{4}$$

The regression results in Column (2) of Table 5 show that the regression coefficient of the patent insurance pilot policy on innovation quality is 0.222, which is significant at the 5% level ($p = 0.028$). This indicates that three years after the implementation of the patent insurance policy, the proportion of invention patents held by enterprises in pilot cities significantly increased, and innovation quality was significantly improved. These findings suggest that the patent insurance policy not only incentivizes enterprises to increase the quantity of their innovation activities but, more importantly, guides enterprises to allocate R&D resources toward invention patents with greater technological sophistication, thereby achieving an innovation upgrade from "quantity" to "quality."

Existing research suggests that innovation quality is closely associated with improvements in corporate total factor productivity. High-quality innovation can contribute to productivity growth by facilitating the application and commercialization of new knowledge, thereby improving production efficiency (Lei Guoxiong and Yang Li, 2024) [32]. Prior studies also identify innovation quality as an important channel through which policy interventions affect firm performance. Consistent with this line of research, the results reported above suggest that the patent insurance policy may contribute to total factor productivity growth by encouraging higher-quality innovation activities.

Table 5: Mechanism Test Regression Results

	(1)	(2)
	Risk-Taking Level	Innovation Quality
Patent Insurance Pilot Policy	0.616*	0.222**
	(0.325)	(2.21)
Control Variables	Yes	Yes
Firm Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes
Observations	5684	931
Adjusted R^2	0.089	0.037

6.2 Heterogeneity Analysis

6.2.1 Corporate Ownership Attributes

Enterprises with different ownership structures may respond differently to the patent insurance pilot policy because of variations in resource endowments, financing conditions, and access to policy support. To examine this heterogeneity, the sample is divided into state-owned enterprises (SOEs) and non-state-owned enterprises according to ownership type. Separate regressions are conducted for each subgroup, and Fisher's permutation test is used to assess whether the estimated coefficients differ significantly across groups.

The results reported in Table 6 show that the coefficient of the patent insurance pilot policy is 0.225 for SOEs and significant at the 1% level ($p = 0.003$). For non-state-owned enterprises, the estimated coefficient is 0.203 and is also significant at the 1% level ($p < 0.001$). Fisher's permutation test yields a coefficient difference of 0.022 with an empirical p-value of 0.022, indicating that the difference between the two groups is statistically significant at the 5% level. Overall, the patent insurance pilot policy is associated with higher total factor productivity in both groups, although the estimated effect is somewhat larger for SOEs.

One possible explanation is that SOEs generally possess stronger technological accumulation and larger patent portfolios, which may enable them to benefit more from the protection and risk-sharing functions provided by patent insurance (Lanjouw & Schankerman, 2004) [9]. In addition, SOEs may have advantages in obtaining policy-related information and participating in pilot programs, making it easier to translate policy support into innovation and productivity gains (Long Xiaoning and Lin Hanxin, 2018) [12]. By comparison, non-state-owned enterprises often face tighter financing conditions and possess fewer patent resources, which may limit the extent to which they can benefit from the policy. The observed heterogeneity is broadly consistent with these differences in firms' resource conditions and policy accessibility.

Table 6: Heterogeneity Analysis: Differences by Corporate Ownership Attributes

	(1)	(2)
	State-owned Enterprises	Non-state-owned Enterprises
	Total Factor Productivity	Total Factor Productivity
Patent Insurance Pilot Policy	0.225***	0.203***
	(0.003)	(0.000)
Control Variables	Yes	Yes
Firm Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes
Observations	5963	11997
Adjusted R^2	0.215	0.202
Coefficient Difference Between Groups	0.022**	

Note: Inter-group differences are tested using Fisher's permutation test (Bootstrap 500 times). The same applies below.

6.2.2 Corporate Technology Attributes

High-tech enterprises are generally more dependent on technological innovation and intellectual property protection than other firms. To examine whether the effect of the patent insurance pilot policy varies across

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firms with different technological characteristics, the sample is divided into high-tech and non-high-tech enterprises, and separate regressions are conducted for each subgroup.

The results reported in Table 7 show that the coefficient of the patent insurance pilot policy is 0.268 for high-tech enterprises and is significant at the 1% level ($p < 0.001$). For non-high-tech enterprises, the estimated coefficient is 0.099 and is significant at the 10% level ($p = 0.092$). Fisher's permutation test further indicates that the coefficient difference between the two groups is 0.169, with an empirical p-value of 0.026, suggesting that the difference is statistically significant at the 5% level. Overall, the patent insurance pilot policy is associated with higher total factor productivity in both groups, although the estimated effect is considerably larger among high-tech enterprises.

One possible explanation is that high-tech enterprises typically engage in more R&D-intensive activities and hold a larger number of patents, making them more exposed to intellectual property risks and more likely to benefit from patent protection mechanisms (Lanjouw & Schankerman, 2004) [9]. In addition, innovation projects in high-tech industries often involve greater uncertainty and longer investment horizons. By reducing the potential costs associated with patent disputes, patent insurance may encourage firms to undertake innovation activities that would otherwise be viewed as excessively risky. Existing studies also suggest that recent policy initiatives have provided stronger insurance-related support for technology-oriented firms, creating a more favorable institutional environment for the use of patent insurance products (Yuan Hui et al., 2026) [7]. The stronger policy effect observed among high-tech enterprises is broadly consistent with these characteristics.

Table 7: Heterogeneity Analysis: Differences by Corporate Technology Attributes

	(1)	(2)
	High-tech Enterprises	Non-high-tech Enterprises
	Total Factor Productivity	Total Factor Productivity
Patent Insurance Pilot Policy	0.268***	0.099*
	(0.000)	(0.092)
Control Variables	Yes	Yes
Firm Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes
Observations	10699	7261
Adjusted R^2	0.203	0.190
Coefficient Difference Between Groups	0.169**	

6.2.3 Industry Competition Level

Industry competition is an important factor shaping firms' innovation incentives and strategic decisions. This paper measures industry competition using the Herfindahl–Hirschman Index (HHI). Industries with an HHI below the sample median are classified as highly competitive industries, while the remaining industries are classified as less competitive industries. Separate regressions are conducted for the two groups.

The results reported in Table 8 show that the coefficient of the patent insurance pilot policy is 0.258 for firms operating in highly competitive industries and is significant at the 1% level ($p < 0.001$). By contrast, the estimated coefficient for firms in less competitive industries is 0.085 and statistically insignificant ($p = 0.287$). Fisher's permutation test yields a coefficient difference of 0.173 with an empirical p-value of 0.002, indicating a statistically significant difference between the two groups at the 1% level. These findings suggest that the positive effect of the patent insurance pilot policy on total factor productivity is concentrated among firms facing stronger competitive pressure.

One possible explanation is that firms in highly competitive industries generally face greater pressure to innovate and respond more quickly to technological change. In such environments, intellectual property protection becomes increasingly important, making the risk-sharing function of patent insurance more valuable. Existing research has similarly found that the innovation effects of patent insurance tend to be stronger among firms operating in highly competitive markets (Qiu Yangdong, 2022) [13].

In addition, firms facing intense market competition often maintain relatively high levels of R&D investment in order to preserve their competitive position. By reducing the uncertainty associated with patent disputes and enforcement costs, patent insurance may further encourage these firms to undertake innovation activities with higher expected returns but greater risks. The stronger policy effect observed in highly competitive industries is broadly consistent with these characteristics.

Table 8: Heterogeneity Analysis: Differences by Industry Competition Level

	(1)	(2)
	High-Competition Industries	Low-Competition Industries
	Total Factor Productivity	Total Factor Productivity
Patent Insurance Pilot Policy	0.258***	0.085
	(0.000)	(0.287)
Control Variables	Yes	Yes
Firm Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes
Observations	14076	3884
Adjusted R^2	0.211	0.173
Coefficient Difference Between Groups	0.173***	

6.2.4 Regional Distribution

Regional differences in economic development, institutional environments, and intellectual property protection may influence the effectiveness of the patent insurance pilot policy. To explore potential regional heterogeneity, the sample is divided into firms located in the eastern region and those located in the central and western regions, and separate regressions are conducted for the two groups.

The results reported in Table 9 show that the coefficient of the patent insurance pilot policy is 0.255 for firms in the eastern region and is significant at the 1% level. For firms in the central and western regions, the estimated coefficient is 0.186 and is also significant at the 1% level. Fisher's permutation test further indicates that the coefficient difference between the two groups is 0.069, with an empirical p-value of 0.012, suggesting a statistically significant difference at the 5% level. These findings indicate that the patent insurance pilot policy is associated with higher total factor productivity in both regions, although the estimated effect is larger for firms located in the eastern region.

A possible explanation is that the eastern region generally benefits from more developed market institutions, stronger legal protection, and a more mature innovation environment, which may facilitate the implementation and utilization of patent insurance policies (Qian Linyi et al., 2025) [8]. In addition, firms in the eastern region tend to possess stronger innovation capabilities and larger patent portfolios, allowing them to make more effective use of the protection and risk-sharing functions provided by patent insurance.

By contrast, firms in the central and western regions often operate in relatively less developed innovation and market environments. As a result, the effects of patent insurance may take longer to materialize, particularly where firms have more limited innovation resources and patent reserves. The stronger policy effect observed in the eastern region is broadly consistent with these regional differences in institutional and innovation conditions.

Table 9: Heterogeneity Analysis: Differences by Regional Distribution

	(1)	(2)
	Eastern Region	Central and Western Regions
	Total Factor Productivity	Total Factor Productivity
Patent Insurance Pilot Policy	0.255***	0.186***
	(0.000)	(0.007)
Control Variables	Yes	Yes
Firm Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes
Observations	12703	5257
Adjusted R^2	0.212	0.184
Coefficient Difference Between Groups	0.069**	

7. Research Conclusions and Policy Recommendations

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7.1 Research Conclusions

This paper uses data from Chinese A-share listed firms from 2008 to 2024 and examines the impact of the patent insurance pilot policy launched in 2012 on corporate total factor productivity, treating the policy as a quasi-natural experiment within a multi-period difference-in-differences framework.

The main findings can be summarized as follows.

First, the patent insurance pilot policy is associated with an improvement in corporate total factor productivity. The baseline results show that firms in pilot regions experience an average increase in TFP of about 2.45% relative to firms in non-pilot regions, and the effect is statistically significant at the 1% level. The dynamic results further suggest that the effect does not emerge immediately, but becomes visible after a lag of several years and remains persistent over time. This pattern suggests that the effects of patent insurance may depend on gradual institutional adjustment and policy diffusion.

Second, the policy appears to operate through two main channels, namely risk-taking and innovation quality. The results show an increase in the volatility of corporate profitability after policy implementation, which is commonly interpreted as an increase in firms' risk-taking behavior. In addition, the share of invention patents increases with a certain lag, suggesting an improvement in the structure of innovation output. Taken together, these findings provide supporting evidence that patent insurance may influence firm performance through both behavioral change and innovation upgrading.

Third, the effects of the policy are not uniform across firms. The estimated impact is larger for state-owned enterprises, high-tech firms, firms operating in more competitive industries, and firms located in the eastern region. Overall, these differences suggest that the effectiveness of patent insurance is likely related to firms' resource conditions and external institutional environments, and may be stronger where innovation capacity and policy absorption ability are relatively higher.

7.2 Policy Recommendations

Based on the above findings, several policy implications can be drawn.

First, the development of patent insurance may be further integrated into a more stable and institutionalized policy framework. Recent policy documents have emphasized the importance of strengthening intellectual property insurance and expanding its coverage in strategic emerging industries. In this context, patent insurance can be gradually incorporated into local technology finance systems, shifting from pilot-based implementation toward more standardized application across regions.

Second, attention should be given to the heterogeneity in policy effects across different types of firms. The empirical results suggest that the effects of patent insurance are more pronounced for high-tech firms and state-owned enterprises, implying that firms' technological characteristics and resource endowments may influence how effectively they can utilize the policy. Recent policy guidance has also encouraged the development of differentiated intellectual property insurance products, including those targeting high-value patents and overseas intellectual property risks. This provides room for further refinement of product design to better match the needs of heterogeneous firms.

Third, regional differences in policy effects suggest that the diffusion of patent insurance may depend on local institutional and innovation environments. The stronger effects observed in the eastern region are broadly consistent with its relatively more developed innovation system. While pilot regions such as the Yangtze River Delta and the Guangdong–Hong Kong–Macao Greater Bay Area have accumulated relevant experience, the central and western regions may require more time and context-specific approaches to policy adaptation.

Finally, patent insurance may also be considered within the broader framework of technology finance. The mechanism analysis in this paper suggests that risk-taking and innovation quality are important channels through which the policy operates. From this perspective, patent insurance can potentially complement other financial instruments related to innovation, such as intellectual property pledge financing and venture capital support, forming a more diversified risk-sharing system for firms' R&D activities.

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Conflicts of Interest

The authors declare no conflict of interest.

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