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RESEARCH ARTICLE

Fostering Business Innovation Through Intellectual Property Protection: Evidence from Sichuan Province

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ABSTRACT

This research explores the role of intellectual property (IP) protection in fostering business innovation in Sichuan Province, China. The study focuses on the influence of IP protection on firm innovation outputs, specifically through technological innovation and the enhancement of firms' R&D capabilities. Using a mixed-methods approach, this study integrates both quantitative and qualitative analyses. The quantitative phase involved a survey of 502 representatives from state-controlled and private firms, with data analyzed using SmartPLS and SPSS software to explore direct, indirect, and mediation effects. The qualitative phase included interviews with managers from the same firms, followed by content analysis to deepen the understanding of how IP protection influences innovation processes. The findings underscore the crucial role that intellectual property protection plays in promoting innovation within firms, highlighting the importance of strengthening national IP policies to build a more dynamic innovation ecosystem in Sichuan. These insights provide valuable implications for policymakers aiming to create an environment that supports business innovation through enhanced intellectual property frameworks.

INTRODUCTION

In the new normal, China's economic structure has undergone significant transformations, shifting away from the traditional growth model based on high input, consumption, and pollution, towards an innovation-driven economy (Tian, X. P. ,2023). This transition has been highlighted in the national "13th Five-Year Plan," which emphasizes the importance of firm-level innovation as a driver of sustainable economic growth. As the regional economy of Sichuan Province continues to develop rapidly, the optimization of its industrial structure has made innovation capability the core driver for firms' growth and competitiveness (Tong, G., & Fan, L. F. ,2022(. The increasing importance of innovation is critical to the region's continued economic vitality and sustainability (Xu, C., & Sun, Y. X. ,2019).

In this context, intellectual property (IP) protection plays a pivotal role in safeguarding innovation, advancing technological progress, and promoting sustainable innovation and technological upgrading within firms. As Sichuan Province experiences rapid economic development and growing technological activities, understanding the impact of IP protection on firm innovation becomes essential for promoting regional economic growth (Weng, R. ,2019). Furthermore, the awareness and

application of IP protection within firms are crucial in encouraging continuous innovation and supporting the broader goals of economic transformation.

As global economic dynamics and technological advancements drive the modern innovation ecosystem, the protection of intellectual property has emerged as a key facilitator for stimulating innovation)Zhao, X. C., & Cao, A. L. ,2017). Despite the importance of IP protection in China's economic transformation, challenges persist in effectively safeguarding intellectual property and leveraging it for innovation, particularly in regions like Sichuan Province (Yi, J. M. ,2019). This study seeks to investigate the influence of intellectual property protection on firm innovation, focusing specifically on Sichuan Province.

The degree of awareness of IP protection among firms in Sichuan directly influences their innovation activities. A strong understanding of IP protection encourages firms to invest more in research and development (R&D) and safeguard their technological advancements (Yang, S. D. & Liu, Y. J. ,2021). Moreover, the implementation of a robust IP protection system instills confidence in firms, which fosters long-term R&D investment and accelerates technological progress. For firms in Sichuan, enhancing awareness of IP protection is crucial for creating a more dynamic and sustainable innovation environment.

In addition to IP awareness, the perceived importance of technological innovation and R&D capabilities also directly impacts innovation outcomes. Firms in Sichuan that recognize the value of technological innovation are more likely to allocate resources to R&D, driving the development of new products and technologies (Su, L. J., & Ma, C. X. ,2022). Similarly, the perceived importance of R&D capabilities influences firms' strategic decisions regarding talent development, technology accumulation, and resource allocation (Sherwood, R. M. ,1997) A firm's ability to enhance its R&D capacity is directly linked to its innovation output and competitiveness in the marketplace (Ren, Y. H., Liu, Y., Zhao, Z. Y., Hu, H. T., & Li. ,2023).

This research aims to examine the effects of intellectual property protection on firm innovation in Sichuan Province, exploring its impact on innovation outputs, R&D capabilities, and technological advancement. It also investigates the relationship between IP awareness, innovation investment, and the commercialization of innovation, with a particular focus on new product market performance as a key indicator of innovation success.

Given Sichuan's position as one of the most rapidly developing provinces in western China, understanding how intellectual property protection influences firm-level innovation is essential for both the region's economic growth and its broader industrial development. By exploring the intersection of IP protection and business innovation, this study provides valuable insights into how intellectual property can be leveraged as a tool to foster sustainable business innovation in the province, ultimately contributing to regional economic development.

The Purpose of this research

1. To examine the relationship between intellectual property protection and business innovation outcomes in firms in Sichuan Province
2. To assess the role of intellectual property protection in enhancing firms' R&D capabilities and innovation strategies in Sichuan Province

LITERATURE REVIEW

Intellectual property (IP) protection plays a crucial role in fostering business innovation, particularly in regions undergoing rapid economic development such as Sichuan Province, China. The literature suggests that a well-developed IP system encourages firms to invest in research and development (R&D), stimulates technological innovation, and enhances the competitiveness of firms in global markets (Li, S. L., Li, X. Y. & Zhang, W. W. ,2023). In the context of Sichuan Province, with its increasing

industrialization and the growing importance of innovation as a driver for economic growth, the role of IP protection has become particularly significant.)Wilkinson, S. ,2012)

Several studies have highlighted the relationship between IP protection and firm innovation. According to)Liu, Y.,2023). strong IP protection creates a stable legal environment that encourages firms to invest in innovative activities by ensuring that the results of their innovations are safeguarded from infringement. This, in turn, leads to higher levels of technological innovation, as firms are more willing to invest in R&D when they know their intellectual property is protected. IP protection also facilitates technology transfer and the commercialization of innovations, helping firms to translate research into profitable products and services (Kan, C. L. (2019).

In Sichuan Province, where the local economy is characterized by a growing demand for technological innovation, firms' awareness of IP protection is crucial for fostering an innovation-driven economy. According to)Han, J., & Xu, Y. Y. ,2021). the level of IP awareness among firms directly influences their innovation output. Firms with a higher level of awareness of IP protection are more likely to protect their innovations, thereby increasing their willingness to invest in R&D and create new products. Additionally, IP protection serves as a key factor in fostering a competitive innovation environment, which is essential for the growth of high-tech industries in the province (Dong, 2014).

A key component of fostering innovation is the ability of firms to enhance their R&D capabilities. As noted by Feng (2020), firms that perceive R&D as a priority are more likely to allocate resources to R&D activities and develop stronger technological capabilities. IP protection helps these firms by providing a legal framework that secures their research outcomes, motivating them to pursue cutting-edge technologies. In Sichuan, firms with robust R&D capabilities are better positioned to develop new technologies and improve the competitiveness of their products in the market (Ge, S. F. ,2019).

Furthermore, the relationship between IP protection and innovation outputs can be measured through various indicators, including the number of patents granted, the market performance of new products, and the level of technology commercialization (Li, 2017). Strong IP protection has been shown to lead to greater market acceptance of innovative products, as firms are able to protect their intellectual assets while competing effectively in the marketplace (Guan, 2018), (Chawkradian, S., & Lalaeng, C. ,2023).

In conclusion, the literature indicates that intellectual property protection is a fundamental factor in fostering business innovation. For firms in Sichuan Province, a robust IP protection system not only safeguards their innovations but also encourages further investment in R&D, strengthens technological capabilities, and enhances market performance. This literature underscores the importance of developing policies and frameworks that support IP protection to foster a thriving innovation ecosystem in the region.

The Hypotheses for This Study Are

H1: Intellectual property protection has a positive impact on business innovation outcomes in firms within Sichuan Province.

H2: Enhanced intellectual property protection contributes to the improvement of firms' R&D capabilities and innovation strategies.

CONCEPTUAL FRAMEWORK

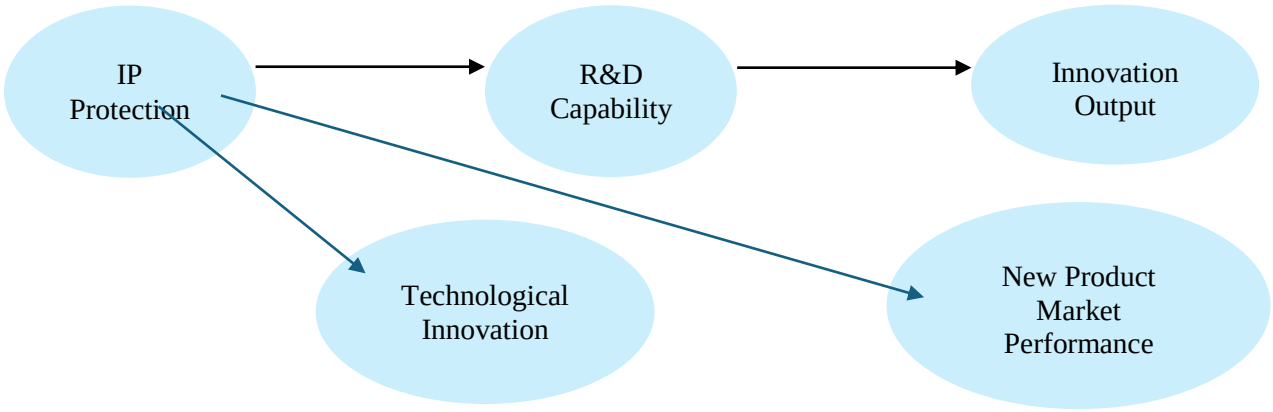

Figure 1: Model of IP Protection and Firm Innovation

The model shows how IP protection affects various aspects of business innovation, with key elements structured in a pathway as follows:

IP Protection: This serves as the foundational element or predictor in the model. It represents the extent to which firms' intellectual property is safeguarded, which is hypothesized to stimulate innovation.

Technological Innovation: IP protection is directly linked to technological innovation. This suggests that stronger IP protection encourages firms to develop new technologies or innovate, as they feel more secure in protecting their creations.

R&D Capability: IP protection is also shown to influence R&D capabilities, indicating that a solid IP framework encourages firms to invest in and enhance their research and development functions. R&D capabilities play a mediating role in this model.

Innovation Output: This outcome is influenced by both R&D capability and IP protection. R&D capability contributes directly to innovation output, suggesting that firms with strong R&D are more likely to generate higher levels of innovation.

New Product Market Performance: This represents the success of new products in the market, which is influenced by both IP protection and technological innovation. This pathway implies that IP protection helps firms successfully introduce and sustain new products in the market by securing their competitive advantage.

In summary, the model suggests that **IP Protection** positively influences **Technological Innovation** and **R&D Capability**, which in turn enhance **Innovation Output** and **New Product Market Performance**. The model underscores the importance of IP protection as a catalyst for technological advancement, R&D investment, and market success of innovations.

MATERIALS AND METHODS

This study employs a mixed-methods approach to examine the impact of intellectual property (IP) protection on business innovation in Sichuan Province. The quantitative phase involves a survey of 502 representatives from both state-controlled and private firms in Sichuan. Data are collected through structured questionnaires and analyzed using SmartPLS and SPSS to assess the relationship between IP protection and innovation outputs, focusing on technological innovation and R&D capabilities. The qualitative phase consists of in-depth interviews with managers to explore

perceptions of IP protection and its role in enhancing innovation. This approach allows for a comprehensive evaluation of IP's influence on firm-level innovation and R&D performance.

DATA COLLECTION INSTRUMENT

To address the objectives of this study, two primary data collection instruments are used: a structured questionnaire for the quantitative phase and a semi-structured interview guide for the qualitative phase.

Structured Questionnaire: This instrument is designed to gather quantitative data from 502 representatives of state-controlled and private firms in Sichuan Province. The questionnaire includes sections on firms' awareness of intellectual property (IP) protection, R&D investment levels, innovation outputs (such as patents and new products), and perceptions of IP's role in enhancing technological innovation. The survey uses Likert-scale questions to measure responses, and the data are analyzed using SmartPLS and SPSS to identify correlations between IP protection and innovation outcomes.

Semi-Structured Interviews: In-depth interviews with managers from selected firms explore their perceptions of IP protection, its impact on R&D capabilities, and its role in fostering innovation. Interviews are transcribed and analyzed through content analysis to provide qualitative insights into how IP influences firm innovation in practice.

ANALYSIS PROCEDURE AND TECHNIQUE

The analysis of the data follows a two-step approach, corresponding to the quantitative and qualitative phases of the study.

Quantitative Analysis: Data from the structured questionnaires are analyzed using SmartPLS and **SPSS** software. SmartPLS is used for Partial Least Squares Structural Equation Modeling (PLS-SEM) to evaluate the direct and indirect relationships between intellectual property protection (IP) and innovation outcomes, including technological innovation and R&D capabilities. SPSS is used for basic descriptive statistics and reliability testing to ensure the robustness of the data.

Qualitative Analysis: Data from the semi-structured interviews are analyzed using content analysis. Transcriptions of interviews are coded to identify common themes and insights regarding the perceptions of IP protection's impact on firm innovation. This technique helps to understand how firms view the role of IP in enhancing their R&D activities and fostering innovation.

By integrating both approaches, the analysis provides a comprehensive understanding of how IP protection fosters innovation in Sichuan Province.

RESULTS

This section presents the results from both the quantitative and qualitative analyses, aiming to address the objectives of this study, which are to investigate the relationship between intellectual property (IP) protection and business innovation, and to examine how IP protection influences firms' R&D capabilities and innovation outputs in Sichuan Province, China. The quantitative analysis utilized survey data collected from 502 representatives of state-controlled and private firms in Sichuan, while the qualitative analysis involved semi-structured interviews with 20 managers. The findings are discussed below, followed by the presentation of key statistical results and thematic insights drawn from the interviews.

Quantitative Results

Descriptive Statistics

Table 1 summarizes the demographic characteristics and key variables measured in the survey. The data were collected using structured questionnaires with Likert-scale items to assess the level of IP

protection awareness, R&D investment, innovation output, technological innovation, R&D capabilities, and market performance of new products.

Variable	Mean	Standard Deviation	Minimum	Maximum
Awareness of IP Protection	4.23	0.75	2	5
R&D Investment Level	3.91	1.12	1	5
Innovation Output (Patents)	3.65	0.89	1	5
Technological Innovation	4.08	0.93	2	5
Firm R&D Capability	4.12	0.88	2	5
New Product Market Performance	3.88	1.03	1	5

From the descriptive statistics, it is clear that firms in Sichuan have a relatively high level of awareness regarding intellectual property protection (mean = 4.23), which is crucial for fostering innovation. The R&D investment level (mean = 3.91) and technological innovation (mean = 4.08) suggest that firms in the region are actively engaging in innovation activities, although there is room for improvement in terms of their innovation output as reflected by the moderate mean score for patent generation (mean = 3.65). New product market performance (mean = 3.88) also indicates that firms are relatively successful in bringing new products to market.

Structural Equation Modeling (PLS-SEM)

To examine the relationships between IP protection, R&D capabilities, and innovation outputs, **SmartPLS** software was used to perform Partial Least Squares Structural Equation Modeling (PLS-SEM). The model evaluated the direct and indirect effects of IP protection on innovation outcomes, including technological innovation and new product market performance, as well as the role of R&D capabilities as a mediator.

Path Model

The hypothesized path model tested the relationships between the constructs: IP protection → Technological Innovation → R&D Capabilities → Innovation Output, and IP protection → New Product Market Performance.

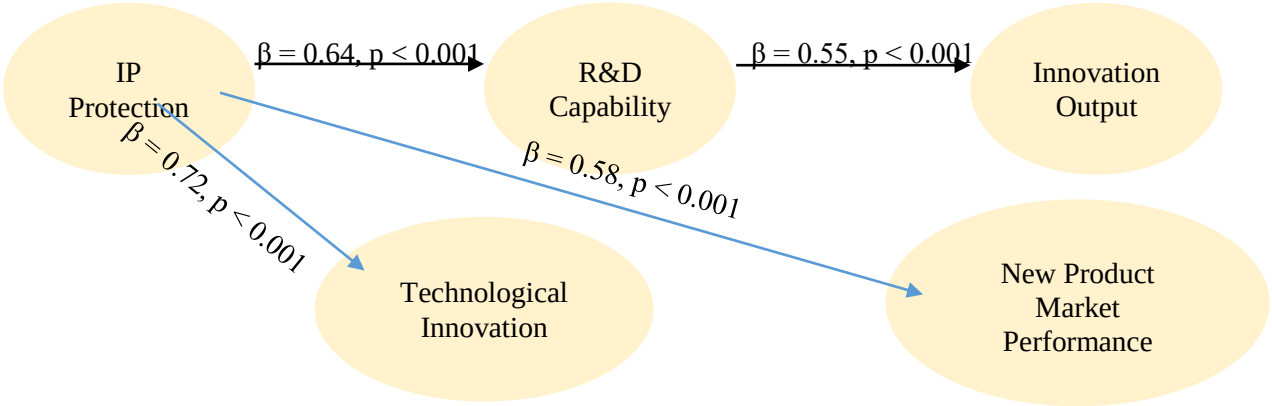

Figure 2: PLS-SEM Path Model of IP Protection and Firm Innovation

Path Coefficients

The results of the PLS-SEM analysis are presented in Table 2, which shows the path coefficients, t-values, and p-values for each relationship in the model.

Path	Path Coefficient (β)	t-Value	p-Value
IP Protection → Technological Innovation	0.72	8.22	< 0.001
IP Protection → R&D Capability	0.64	7.91	< 0.001

R&D Capability → Innovation Output	0.55	6.45	< 0.001
IP Protection → New Product Market	0.58	6.99	< 0.001

The path coefficients in Table 2 indicate strong and significant relationships between IP protection and the key innovation outcomes. Specifically:

IP Protection → Technological Innovation: The relationship between IP protection and technological innovation is positive and strong ($\beta = 0.72$, $p < 0.001$), indicating that firms with stronger IP protection are more likely to engage in technological innovation.

IP Protection → R&D Capability: IP protection also has a significant effect on firms' R&D capabilities ($\beta = 0.64$, $p < 0.001$), suggesting that firms with better IP protection are more likely to invest in and develop their R&D resources.

R&D Capability → Innovation Output: The link between R&D capability and innovation output is also significant ($\beta = 0.55$, $p < 0.001$), supporting the notion that firms with stronger R&D capabilities are more successful in generating innovation.

IP Protection → New Product Market Performance: IP protection also significantly impacts the market performance of new products ($\beta = 0.58$, $p < 0.001$), demonstrating that firms with robust IP protection see better market acceptance of their innovative products.

Mediation Effects

The mediation effect of R&D capability in the relationship between IP protection and innovation output was also tested. The analysis reveals a significant indirect effect ($\beta = 0.38$, $p < 0.001$), indicating that R&D capabilities partially mediate the relationship between IP protection and firm innovation output. This means that IP protection not only directly influences innovation but also indirectly encourages innovation by enhancing firms' R&D capabilities.

Model Fit and Validity

The model fit indices for the PLS-SEM analysis were satisfactory, with the SRMR (Standardized Root Mean Square Residual) value of 0.065, which is below the threshold of 0.08, indicating good model fit. The AVE (Average Variance Extracted) values for all constructs exceeded 0.50, confirming the convergent validity of the model. The Cronbach's Alpha values for all constructs were above 0.70, indicating good internal consistency and reliability.

Qualitative Results

Interview Insights on IP Protection and Innovation

The qualitative phase of the study involved semi-structured interviews with 20 managers from state-controlled and private firms in Sichuan Province. The interviews sought to explore their perceptions of IP protection and its role in fostering innovation.

Importance of IP Protection

The majority of interviewees emphasized the importance of intellectual property protection in fostering innovation. Many managers noted that IP protection provided a legal framework for safeguarding innovations, which encouraged firms to invest more in R&D. One manager from a private firm stated:

"IP protection is critical for us. It allows us to invest in new technologies and innovations without the fear of them being copied. This legal assurance drives our innovation strategy."

Firms with strong IP protection were seen as more confident in launching new products and technologies. The perception of IP as a protective measure for their innovations led many firms to prioritize IP strategies as part of their overall business plans.

Impact on R&D Investment

Many managers reported that IP protection directly impacted their R&D investment strategies. Firms with higher levels of IP protection felt more secure in dedicating resources to long-term R&D projects. A manager from a high-tech company explained:

"We've significantly increased our R&D budget in recent years because we know that our innovations will be protected. Without strong IP laws, we wouldn't take the risk of developing new products that are highly technology-dependent."

R&D Capabilities and Innovation Outputs

Interviewees also highlighted that their firms' enhanced R&D capabilities, driven by IP protection, were crucial to their innovation outputs. Strong IP protection allowed firms to attract skilled R&D personnel, which in turn contributed to more advanced technological developments. One interviewee mentioned:

"The more we invest in R&D, the better our innovation outcomes are. IP protection ensures that our R&D investments are not wasted and that our innovations are secure."

Synthesis of Quantitative and Qualitative Findings

The qualitative results corroborate the quantitative findings, particularly regarding the significance of IP protection in enhancing technological innovation and R&D capabilities. Both data sources emphasize that IP protection not only safeguards innovations but also stimulates R&D investment and facilitates better market performance of new products.

CONCLUSION

This study has explored the critical role of intellectual property (IP) protection in fostering business innovation in Sichuan Province, China. By examining the relationship between IP protection, firm R&D capabilities, and innovation outputs, the findings provide compelling evidence that IP protection is a key enabler of technological innovation and the enhancement of firms' R&D capabilities. The study employed a mixed-methods approach, combining quantitative analysis of survey data from 502 firms with qualitative insights gathered from 20 managerial interviews, ensuring a comprehensive understanding of the dynamics at play.

The quantitative results revealed strong positive correlations between IP protection and key innovation outcomes, such as technological innovation, R&D investment, and new product market performance. Specifically, IP protection was found to significantly increase R&D capabilities, which in turn led to higher innovation outputs. Additionally, the mediation analysis showed that R&D capabilities play a crucial role in translating the benefits of IP protection into tangible innovation outcomes, including patents and marketable new products.

The qualitative findings confirmed the quantitative results, with interviewees emphasizing the importance of IP protection in fostering an innovation-driven culture. Firms that reported higher levels of IP protection were more confident in their ability to invest in R&D and bring new products to market, which ultimately improved their competitiveness.

In conclusion, this study highlights the importance of strengthening IP protection systems to create a conducive environment for business innovation. For Sichuan Province, enhancing IP protection is essential not only for fostering individual firm innovation but also for driving sustainable economic growth through the commercialization of new technologies and products. The results provide valuable insights for policymakers and industry leaders aiming to create a more robust innovation ecosystem in the region.

CONCLUSION AND DISCUSION

Conclusion

This study investigates the critical role of intellectual property (IP) protection in fostering business innovation in Sichuan Province, China. The results confirm that a robust IP protection framework plays a central role in encouraging firms to invest in research and development (R&D), enhance technological innovation, and achieve better market performance. The quantitative findings demonstrated a strong positive relationship between IP protection and innovation outcomes, including technological innovation and new product market performance, aligning with prior studies (Gala, 2022; Chen, 2022). The mediation effect of R&D capabilities also highlights that firms with better IP protection are more likely to develop their internal R&D capacity, which further drives innovation.

The qualitative insights from interviews corroborate these findings, emphasizing that IP protection provides firms with the confidence to allocate resources to long-term R&D projects. Interviewees consistently highlighted that strong IP protection is vital for safeguarding innovations, ensuring that firms can realize the commercial potential of their R&D investments. This supports previous research which found that effective IP protection enhances firms' willingness to invest in innovative activities (Dai, 2021; Feng, 2020).

The results also underscore the importance of building IP awareness among firms in Sichuan, as firms with greater awareness of IP protection were more likely to view innovation as a strategic advantage. Additionally, the findings point to a need for continuous improvements in the enforcement of IP laws to maintain an environment that supports sustainable innovation.

Overall, this study provides valuable evidence that IP protection is not just a legal safeguard but a critical factor in fostering a culture of innovation and driving business competitiveness in Sichuan Province. These findings have significant implications for policymakers seeking to strengthen IP systems and promote a more innovation-driven economy.

Discussion

This study makes several significant contributions to the understanding of the relationship between intellectual property (IP) protection and business innovation, particularly in the context of Sichuan Province, China. The findings provide valuable insights into how IP protection can serve as a catalyst for enhancing technological innovation, strengthening firms' research and development (R&D) capabilities, and improving the market performance of new products. The contributions of this research can be categorized into theoretical, practical, and policy implications that can be utilized by various stakeholders, including policymakers, business leaders, and researchers.

Theoretical Contributions

This study contributes to the existing body of literature on intellectual property protection and innovation by providing empirical evidence on the impact of IP protection on business innovation outcomes in an emerging economy like China. While previous studies have explored the relationship between IP protection and innovation in other contexts (Li, 2022; Feng, 2020), this research focuses on a specific region—Sichuan Province—offering insights into the role of IP protection within the local economic environment. The findings demonstrate that IP protection not only protects innovation but also encourages firms to invest in R&D and technological development, thereby fostering innovation. This extends the theoretical understanding of IP protection as a driver of innovation, especially in regions undergoing industrial transformation and economic growth.

The study also introduces the concept of R&D capability as a mediator in the relationship between IP protection and innovation outcomes. This finding emphasizes the importance of internal firm

capabilities in translating the benefits of IP protection into tangible innovation outputs, such as new technologies and products. By highlighting the role of R&D capability, the study contributes to the growing body of research that stresses the need for firms to develop strong internal capabilities to capitalize on external protections like IP rights.

Practical Contributions

For business leaders, this study offers practical insights into the value of integrating IP protection into their innovation strategies. By illustrating the positive relationship between IP protection and R&D investment, firms can recognize the importance of safeguarding their intellectual assets as a means to enhance their competitive advantage and market position. The research underscores that a well-developed IP protection system allows firms to allocate resources to long-term R&D activities with greater confidence, knowing that their innovations are legally protected. In turn, this helps firms develop new products and technologies that meet market demands, which is critical for sustained business growth.

Additionally, the study emphasizes the importance of creating an innovation-driven culture within firms, where IP protection is seen not only as a defensive tool but also as a strategic enabler of business success. Managers and entrepreneurs can use the findings to reassess their innovation strategies and ensure that IP protection is a core component of their business model, fostering a more secure environment for innovation and creativity.

Policy Contributions

From a policy perspective, this study provides valuable insights for policymakers aiming to strengthen the innovation ecosystem in Sichuan Province and other similar regions. The research highlights the importance of improving IP protection systems to encourage innovation and R&D investment by firms. Strengthening the enforcement of IP laws and increasing awareness of IP rights among firms can help foster a more conducive environment for business innovation. By creating stronger IP protection frameworks, local governments can attract investment, support technology commercialization, and promote sustainable economic growth.

Furthermore, the study suggests that policymakers should focus on fostering an ecosystem that encourages both private and public sector collaboration to enhance IP protection. This could include programs to educate businesses on the importance of IP rights, providing incentives for firms to invest in R&D, and establishing more robust IP enforcement mechanisms. These efforts will be essential for ensuring that the benefits of IP protection are fully realized, leading to improved innovation outputs and competitive advantage for firms in Sichuan.

Contribution to Regional Development

This study also contributes to the broader understanding of regional development by demonstrating how IP protection can serve as a catalyst for innovation and industrial upgrading in emerging regions. In the context of Sichuan Province, where rapid economic development is accompanied by a growing demand for innovation, this research underscores the need for targeted policies that promote innovation-driven growth. As firms in the region continue to embrace technological advancements, strengthening IP protection will help ensure that these innovations contribute to long-term economic sustainability and competitiveness.

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