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The Impact of Corporate Innovation on Business Confidence

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Abstract

Innovation is the driving force behind high-quality business development, while business confidence plays a crucial role in activating the vitality of market players. This paper conducts an empirical analysis using data from Shanghai Stock Exchange (SHSE) and Shenzhen Stock Exchange (SZSE) listed companies over the period of 2010-2019 to examine the influence of corporate innovation on business confidence. The findings indicate that: (1) Both corporate innovation and substantive corporate innovation contribute significantly to increasing business confidence. In particular, substantive innovation has a stronger impact. These conclusions remain robust to a series of robustness checks. (2) Furthermore, the study shows that financial performance and risk level act as mediating variables influencing business confidence for both corporate innovation and substantive corporate innovation. Specifically, corporate innovation and substantive innovation enhance business confidence by improving financial performance and reducing risk level. (3) Controlling for firm heterogeneity, the analysis shows that corporate innovation and substantive innovation have a stronger positive effect on business confidence for non-state-owned enterprises, non-heavily polluters, and enterprises led by CEOs with a background in research and development (R&D).

Keywords

Corporate Innovation; Business Confidence; Financial Performance; Risk Level; Mediating Effect.

1. Introduction

The company's operational problems were exacerbated by the sudden outbreak of the COVID-19 pandemic and the drastic changes in the global situation. Enterprises had little confidence in development and the country have a hundred things to do. Data from the OECD (Figure 1) show a sharp fall in the Business confidence index (BCI) in 2008 and 2020. In the two years following the global financial crisis, the numbers gradually returned to normal levels. However, the lingering effects of the COVID-19 pandemic mean that the index is often below 100 and may take longer to recover. General Secretary Xi Jinping emphasized the need to encourage and support the development of the private economy and private enterprises at the National Committee of the Chinese People's Political Consultative Conference (CPPCC) in 2023, boosting market expectations and confidence. Confidence plays an important role in the success or failure of a subject's behavior, which is embodied in outer sensory perceptions, emotional responses, and external awareness [1], and has a positive impact on promoting economic growth, policy implementation, and enhancing international status. At the same time, business confidence is crucial to a company's future growth. Companies that are confident about the future tend to be better managed and more cohesive than those that lack confidence. Some studies have shown that optimistic investors tend to be positive in their investment expectations and increase their investments, while pessimistic investors tend to be pessimistic

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in their expectations and reduce their investments accordingly [2]. Boosting business confidence therefore plays an important role in shaking off the effects of the epidemic and achieving high-quality economic development [3].

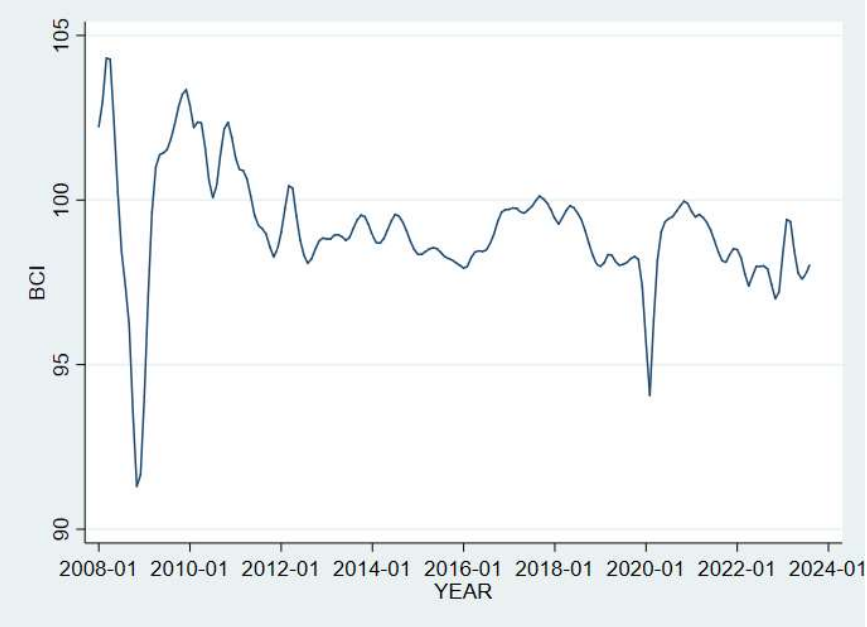

Figure 1. Business confidence index, 2008(Jan)-2023(Aug)

Since the reform and opening up, the sustained development of scientific and technological innovation has been the driving force behind China's rapid economic growth. The 20th National Congress of the Communist Party of China (CPC) clearly proposed that innovation is the first driving force, emphasized the central position of innovation in the overall situation of China's modernization and advocated the formation of a globally competitive open innovation ecosystem. At the national level, innovation is one of the key factors in a country's ability to stand out in international competition, and it is also a concrete embodiment of comprehensive national strength. General Secretary Xi has emphasized that innovation means development and the future. According to the People's Daily, from 2012 to 2021, China's society-wide R&D investment increased by 270.87%, its global innovation index rose from 34th to 12th, and China successfully entered the ranks of innovative countries in 2022. In addition, WIPO reported that China's international patent applications exceeded 70,000 for the first time in 2022, ranking first in the world for the fourth consecutive year since 2019, further demonstrating China's activity in innovation. At the enterprise level, innovation is even more important in determining whether a company can survive in a market where the competitive environment tends to be white-hot. When studying corporate innovation, academics often use the number of patent applications and the number of patents granted to measure the level of corporate innovation. According to the data of China National Intellectual Property Administration, the overall rate of patent industrialization in China continues to increase. The innovation of Chinese corporate is developing at a fast pace and is already at a high level.

Academic research on corporate innovation has mainly focused on fiscal policy. The literature focuses on the role of industrial policy and fiscal policy in promoting corporate innovation. However, there is less research on business confidence, which tends to focus on how government policies affect business confidence. It is against this background that the research idea of this paper is established. China's scientific and technological innovation is already at a high level, so can corporate innovation boost business confidence? If so, in what ways does corporate innovation boost business confidence? Is there any difference between different

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types of enterprises in boosting business confidence? This paper aims to answer these questions through empirical research.

The marginal contributions of this paper are as follows:(1) It bridges the gap between studies related to business confidence. The existing literature mainly focuses on the role of external factors (i.e. government policies) in promoting business confidence, such as targeted poverty alleviation policies [3] and tax incentives [4]. However, there is still a relative lack of research on the impact of internal factors on business confidence, and this paper fills this research gap. (2) Enriching the content of corporate innovation research. The existing literature mainly explores the influencing factors of corporate innovation, such as corporate governance [5], government subsidies [6] and foreign trade [7]. However, there is a lack of research on how corporate innovation helps enterprises to develop better. This paper expands the field of corporate innovation research by investigating how corporate innovation enhances business confidence. (3) Expand research on the mediating role of financial performance and risk level. Regarding financial performance, most existing studies examine the relationship between CSR and financial performance [8, 9, 10]; with regard to risk level, most existing studies focus on the relationship between company executives and corporate risk [11, 12, 13]. This paper explores the mediating role of financial performance and risk level in the process of corporate innovation affecting business confidence, which fills the gap in the literature in this area.

The remainder of this paper is structured as follows. Section 2 presents the theoretical foundations and formulates the research hypotheses; Section 3 contains the research design. It includes sample selection and data sources, variable selection and descriptive statistics. Section 4 analyzes the empirical results. It includes the benchmark regression, robustness checks and further analysis. Finally, the conclusions and implications of this paper are summarized in Section 5.

2. Theoretical Foundations and Research Hypotheses

2.1. Corporate Innovation and Business Confidence

Innovation is the first driver. The term "innovation" was first proposed by Schumpeter in the 1910s, who defined the concept of innovation as a kind of disruptive production behavior involving the recombination of production factors and production conditions. After a century, corporate innovation has taken on the heavy responsibility of national innovation and development. Corporate innovation is a new process for enterprises that involves the production, reception, digestion, assimilation and application of valuable and novel knowledge in a given economic and social context in order to update and expand product lines, services, processes and systems [14, 15]. Corporate innovation can improve enterprise performance and maintain sustainable competitive advantage, which is particularly important for enterprises with backward technology and uncompetitive products in China [16, 17]. First of all, in terms of the factors influencing corporate innovation, previous studies have found that industrial policy can promote corporate innovation, especially technological innovation by private enterprises [18]; High adjustment costs and unstable sources of financing inhibit enterprises' innovative activities [19]; Governmental R&D subsidy policies have both the "pre-incentive" and the "post-reward" effects, which significantly increase enterprises' performance and maintain a sustainable competitive advantage, while tax incentives do not encourage corporates to innovate [20]; Financial investment by enterprises has a negative effect on both inputs and outputs of corporates' technological innovation [21]. Second, while there is a large body of literature on the factors that influence corporate innovation, there is a lack of literature on the factors that corporate innovation can influence. The only literature that exists focuses primarily on examining the impact of firm innovation on firm performance. Wang Xigang (2016) found that organizational innovation and technological innovation capabilities have a

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contributing effect on enterprise performance [22]; Tang Qing and Chen Haiyan (2015) found that investment in technological innovation by enterprises can improve enterprise performance [23]; Li Jingxun and Zheng Runkun (2021) conducted an empirical study on high-tech enterprises and found that exploitative innovation and marketing capabilities significantly and positively affect enterprise performance [24]. Finally, some scholars have found that corporate innovation can effectively increase firms' capacity utilization, improve audit quality and reduce default risk [25, 26, 27]. There is also a qualitative dimension to corporate innovation, with innovation that focuses on the quantity of innovation being referred to as strategic innovation, and innovation that focuses on the quality of innovation being called substantive innovation, which is the "breadth" and "depth" of innovation respectively [28].

Enterprises, as one of the market entities, have made important contributions to the success of China's socialist market economy since the reform and opening up. The current market is a market with a complex competitive environment, and in order to survive and achieve core competitiveness in such a market, building up business confidence is undoubtedly an important choice. First of all, business confidence may be affected by the external environment. Zhu Limin et al. (2021) found that enterprises' participation in targeted poverty alleviation can effectively enhance business confidence [3]; Zhang Shijing and Gao Wenliang (2022) found that the government's policy of tax cuts and fee reductions enhanced the enterprises' confidence in the future economic development in a positive direction, taking the financial data of listed companies as a sample [29]; For small and micro enterprises, the problems of difficult and expensive financing can significantly increase the pessimistic expectations of the operator and reduce business confidence [30]. In addition, investment, as an important source of corporate capital, is affected by business confidence. Positive entrepreneurial market confidence will significantly promote business investment, while negative entrepreneurial market confidence will significantly inhibit business investment [4]. China needs to have Chinese confidence, and enterprises need to have business confidence. Whether a company's attitude to future development is negative or positive may lead to two completely opposite outcomes.

In summary, corporate innovation has an important impact on boosting business confidence. First, as one of the core competitiveness of enterprises, corporate innovation can promote enterprise performance, help enterprises improve their market position, and make them stand out in the competitive market, thus enhancing their confidence; Second, substantial innovation, which pays more attention to the "depth" of innovation, can better promote the technological progress of enterprises, develop more new products, attract new customers and retain old ones, thus enhancing their confidence in future development. Therefore, this paper proposes the following hypotheses:

H1: Both business innovation and substantive business innovation increase business confidence.

2.2. Mediating Effects of Financial Performance and Risk Level

2.2.1. Mediating Effects of Financial Performance

Enterprise financial performance is an important indicator of whether an enterprise can obtain investment from investors. At home and abroad, whether corporate innovation can improve financial performance has been the focus of research by scholars. A large number of domestic and foreign literature shows that the higher the level of corporate innovation, the better the financial performance [31, 32, 33, 34]. The main reasons for this are as follows. Firstly, corporate innovation will improves the quality and quantity of a firm’s new products and attracts new customers to expand its market share. Secondly, it has been shown that corporate innovation has a positive impact on stock market capitalization, which to some extent attracts investors and thus improves financial performance of firms [35, 36]. Finally, the higher the level of innovation, the easier it is for firms to obtain financial subsidies, which on the one hand can

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help it alleviate financing constraints and improve risk-taking; on the other hand, it has a "signaling" effect, attracting more investment and thus improving the financial performance of firms [37, 38].

In summary, corporate innovation can improve enterprise performance. Specifically, corporate innovation can improve enterprise financial performance by expanding the market through launching new products, attracting investors through the stock market, and reducing the difficulty of financing and lowering the probability of risk by obtaining financial subsidies. Therefore, this paper proposes the following hypothesis:

H2: Corporate innovation and substantive corporate innovation enhance business confidence through improved financial performance.

2.2.2. Mediating Effects of Risk Level

Risk has always been a central factor affecting business operations. The level of risk is used to measure the intensity of the external and internal risks faced by business operations. Only with a certain level of risk resistance can a company survive in a competitive market [39]. Corporate innovation is often associated with risk due to its high-risk and long-cycle characteristics. On the one hand, companies with weak risk tolerance will not choose to engage in high-risk innovation activities, and only companies with strong risk tolerance will take the initiative to seize market opportunities and choose innovation activities to maximize corporate value. On the other hand, corporate innovation can gain competitive advantage, through the endogenous accumulation of the enterprise's high-risk financial behavior to provide resource reserves [40]; At the same time, enterprises with innovative credentials usually receive government subsidies, according to the "signaling" effect, which allows the enterprises to obtain more exogenous investment, so as to reduce the risk level of the enterprise. The lower the risk of a firm, the higher the confidence of its managers. This makes managers more willing to invest in high-risk, high-return activities.

In summary, corporate innovation can reduce risk. Specifically, corporate innovation can reduce the level of risk by absorbing exogenous investment, obtaining government subsidies and improving its competitive position in the market. Meanwhile, the lower the risk level of the enterprise, the higher the confidence of the enterprise in the future. Therefore, this paper proposes the following hypothesis:

H3: Corporate innovation and substantive corporate innovation increase business confidence by reducing the risk level.

2.3. Enterprise Character, Polluted Situation and The Background of The CEO's R&D

This paper further examines the effect of firm heterogeneity on corporate innovation and business confidence. Specifically, the role of firm heterogeneity is examined by categorizing firms into state-owned and non-state-owned enterprise (SOEs and NSOEs), heavily polluting and non-heavily polluting enterprise, and enterprise with CEOs having R&D backgrounds and enterprise with CEOs not having R&D backgrounds.

Firstly, SOEs tend to be monopolies and NSORs tend to be competitive enterprises. Arrow developed a model to analyze the role of corporate innovation in SOEs and NSOEs. He analyzes the potential benefits of a new product based on competitive and monopolistic environments. He found that the incentives to innovate are greater under competitive conditions than under monopolistic conditions [41]. Although there is less resistance to innovation in monopolies, the benefits are smaller than those of innovation by competing firms. Tirole (1988) argues that competing firms can innovate to become monopolies, whereas monopolies can easily innovate to "live off their past gains"[42]. SOEs are less competitive and face fewer financial constraints, making it easier for them to engage in innovative activities. However, due to their state-owned

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characteristics, the government has high expectations for their development and wants them to grow into globally competitive world-class enterprises [43]. As a result, SOEs will choose to engage in higher-quality innovation, rather than lower-quality innovation. Unlike SOEs, NSOEs face fierce market competition and severe financial constraints, which favour low-quality innovation [44]. They pin their hopes on gaining market position through innovation and thus make profits. Based on the above analysis, this paper proposes the following hypothesis:

H4: Compared with SOEs, corporate innovation and corporate substantive innovation enhance the confidence of NSOEs to a higher extent.

Secondly, based on the "Porter Hypothesis", Jaffe and Palme (1997) found that strict environmental regulation have a significant inducing effect on firms' investment in innovation [45]. For heavily polluting firms, environmental regulation increase the difficulty of borrowing and financing, and given the connatural high venture characteristics of innovation activities, heavily polluting firms usually do not engage in innovation activities freely. For non-heavily polluting firms, they have less difficulty in borrowing and financing and are more likely to engage in innovative activities. Therefore, relative to heavily polluting firms, corporate innovation is more likely to increase the business confidence of non-heavily polluting firms. Based on the above analysis, this paper proposes the following hypothesis:

H5: Corporate innovation and substantive corporate innovation boost business confidence in non-heavily polluting firms more than in heavily polluting firms.

Finally, the executive team is the ultimate subject and decision-maker of corporate governance. The background characteristics of managers have an important impact on innovation performance [46]. Specifically, the technological feature of CEO background characteristics (i.e. the CEO's R&D background) may bring a direct promotion effect for the firm. On the one hand, CEOs with an R&D background will be more familiar with cutting-edge technologies and have more specialized skills. This can provide a clear vision of technological development and improve the efficiency of corporate innovation, which can encourage firms to innovate. On the other hand, technical talent, as an important part of the company, can make better use of its technical advantages under the leadership of a CEO with an R&D background. This can improve the company's resource utilization and reduce R&D costs. Han Zhongxue et al. (2014) empirically analysed private listed companies and found that technical managers made a significant contribution to improving the technical efficiency of enterprises [47]. Guo Yue (2018) found that innovation subsidies significantly stimulate R&D investment and substantial innovation output of firms whose CEOs have R&D backgrounds [48]. Therefore, it can be expected that firms with CEOs have R&D backgrounds have higher innovation efficiency, higher talent utilization and better confidence enhancement. Based on the above analysis, this paper proposes the following hypothesis:

H6: Corporate innovation and corporate substantive innovation have a higher degree of confidence enhancement for firms whose CEOs have an R&D background compared to firms whose CEOs do not have an R&D background.

3. Research Design

3.1. Sample Selection and Data Sources

In order to boost business confidence, activate the vitality of market entities, and adhere to the central position of innovation in the overall situation of modernization. This paper conducts an empirical study on whether corporate innovation increases business confidence. This paper chooses the data of listed companies in SHSE and SZSE as the research sample, and chooses 2010-2019 as the sample interval to avoid the interference of large-scale emergencies on the research results. The main reasons are as follows: (1) The global financial crisis broke out in 2008, which greatly diminished the confidence of market entities, and the business confidence

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index did not return to normal until two years later (2010). Therefore, the two years after the global outbreak of the financial crisis were chosen as the beginning of the statistical interval; (2) The infection cases of the COVID-19 pandemic began to appear at the end of 2019, and the full-scale outbreak of it in January 2020 had a serious negative impact on the daily operations of enterprises. Therefore, 2019 was chosen as the end of the statistical interval.

To summarize, this paper selects the data of listed companies in SHSE and SZSE from 2010 to 2019 as the research sample to test the impact of corporate innovation on business confidence. According to the availability of sample data, this paper pre-processes the raw data as follows: (1) Listed companies in the financial industry have special financial statements, and their innovations are not suitable for measuring the level of innovation, so listed companies in the financial industry are excluded; (2) Listed companies with ST or *ST are excluded; (3) Listed companies with missing main variables are excluded; (4) In order to eliminate the effect of extreme values, continuous variables are subjected to the before and after 1% shrinkage treatment. After the above screening process, the final sample of this paper contains 2444 listed companies, with a total of 16,265 annual unbalanced panel data. All the listed company data used in this paper are obtained from the China Stock Market & Accounting Research Database (CSMAR).

3.2. Selection of Variables

3.2.1. Explained Variables.

Business confidence. Business confidence is the expectation of enterprise managers on the future development of the enterprise, which helps to activate the market vitality. The annual report of listed companies will give a textual description of the company's operation in the current fiscal year, and the positive and negative terms used in the annual report can reflect the management's satisfaction with the company's operation in the current fiscal year. Referring to the method of Zhu Limin et al. (2021), (number of positive words - number of negative words) / (number of positive words + number of negative words) is used to measure the confidence of companies in the current year [3].

3.2.2. Explanatory Variables.

Business innovation and substantial business innovation. According to the experience of previous research [18, 28], the amount of patent data at firm level applications and the amount of granted patents are usually used to measure corporate innovation. Among them, the number of granted patents can better reflect the innovation performance of firms compared to the number of patent applications, but it usually takes 2-4 years for patents to go through the process from application to grant. During this process, although the patent is not granted, it makes a greater contribution to improving the innovation level of the enterprise. Comprehensively, the innovation quality of the number of patent applications is not as high as the number of patent grants, but patent applications can reflect the innovation level of enterprises in a timely manner; While the number of patent grants, although of higher quality than patent applications, have a 2-4 year application process and have contributed to the innovation level of enterprises in the process, which cannot be well reflected in the data. According to the research experience of Wenjing Li and Manni Zheng (2016), invention patents better reflect the innovation "quality" of enterprises, therefore, this paper adopts the number of patent applications and the number of invention patents filed to measure the innovation and substantial innovation of enterprises, respectively [28].

3.2.3. Mediating Variables.

(1) Financial performance. The financial performance of an enterprise can affect the investment behavior of investors, and at the same time, the financial performance is also affected by the

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innovation input [34]. This paper adopts the ratio of enterprise net profit to total assets to measure the financial performance of enterprises.

(2) Risk level. Corporate innovation behavior is characterized by high venture, and enterprises need to control risk factors to avoid the break of the capital chain. This paper adopts the risk coefficient from the business distress database in CSMAR to measure the risk degree of enterprises. In order to eliminate the quantitative gap, this paper expands the risk coefficient by 103 times.

3.2.4. Control Variables.

Table 1. Variable definitions and descriptions

Categorization	Variable name	Variable symbol	Description of variables
Explained variable	Business confidence	conf	(number of positive words - number of negative words)/(number of positive words + number of negative words)
Explanatory variable	Corporate innovation	pat_app	ln(1 + patent applications)
	Substantive innovation in enterprises	inv_app	ln(1 + number of patent applications for inventions)
Mediating Variable	Financial performance	roa	Net profit/total assets balance
	Risk level	risk	Risk factor*10^3
Control variable	Enterprise size	size	Natural logarithm of total business assets
	Gearing ratio	lev	Total liabilities/total assets
	Current ratio	liq	Current assets/current liabilities
	Firm growth	grow	Revenue growth rate
	Capital intensity	cap_inten	Ratio of total business assets to operating revenues
	Total remuneration of top three management	salary	Total remuneration of the top three directors and supervisors
	Independent director ratio	dire	Number of independent directors/number of board of directors
	Ownership concentration	top1	Shareholding ratio of the largest shareholder

Based on the existing literature and combining the research content of this paper, the data of enterprise financial indicators and enterprise management indicators are controlled [49, 50, 51]. Among them, there are five enterprise financial indicators, namely: (1) Enterprise size. According to Schumpeter, large enterprises have enough capital to bear the consequences of innovation failure, which will stabilize business confidence. In this paper, we use the natural logarithm of the firm's total assets to measure enterprise size; (2) Gearing ratio. Existing literature shows that appropriate debt financing can constrain firms' over-investment behavior and allow firms to use capital rationally [52]. In this paper, the ratio of total liabilities to total assets is used to measure the gearing ratio; (3) Current ratio. Jiashu Ge and Meisong Zhan (2008) believe that liquidity affects the financial flexibility, risk and so on of enterprises [53]. This paper uses the ratio of current assets to current liabilities to measure the current ratio; (4) Firm growth. The higher the growth of a corporate, the stronger its value-added ability and the greater the corporate's confidence in the future. In this paper, the growth rate of operating income is used to measure firm growth; (5) Capital intensity. Zhou et al. (2022) found that capital intensity contributes significantly to the high-quality development of enterprises with a midstream level [54]. In this paper, we use the ratio of total assets to operating income of enterprises to measure capital intensity. There are three management indicators, which are (1) Total compensation of the top three management. The gap in management compensation can

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lead to inefficient investment behavior and undermine business confidence [55]. In this paper, the natural logarithm of the total compensation of the top three directors and supervisors is used to measure the total compensation of the top three management; (2) Independent director ratio. Independent directors are the core of the company. This paper uses the proportion of the number of independent directors in the total number of board members to measure the independent director ratio; (3) Ownership concentration. Ownership concentration significantly contributes to the business performance of a firm [56]. This paper adopts the shareholding ratio of the first largest shareholder to measure the equity concentration.

3.3. Descriptive Statistics

The results of the descriptive statistics of the variables are shown in Table 2.

Table 2. Descriptive Statistics

Variable	Obs	Mean	Sd	Min	Max
conf	16265	0.2820	0.1127	-0.0572	0.5321
pat_app	16265	0.5403	1.3088	0.0000	5.6525
inv_app	16265	0.3344	0.9131	0.0000	4.6250
roa	16011	0.0426	0.0485	-0.2800	0.1917
risk	16011	0.6196	1.5508	0.0000	29.7890
size	16265	22.1360	1.1921	19.8575	26.1608
lev	16265	0.4162	0.1977	0.0515	0.8986
liq	16265	2.4127	2.1942	0.3335	17.9966
grow	16265	0.3203	0.7380	-0.7008	7.2039
cap_inten	16265	2.2953	1.6166	0.3973	13.1269
salary	16265	14.4765	0.6463	12.7939	16.4690
dire	16265	0.3729	0.0501	0.3333	0.5714
top1	16265	0.3449	0.1406	0.0872	0.7341

For the explanatory variables, the maximum value of business confidence (conf) is 0.5321, the minimum value is -0.0572, and the mean value is 0.2820, indicating that not all enterprises have hope for the future, but most of them are optimistic about the future development; For the explanatory variables, the maximum value of corporate innovation (pat_app) is 5.5625, and the minimum value is 0, and the mean value is 0.5403, with a standard deviation of 1.3088, indicating that there is a large gap between the patent applications of different enterprises, and that the innovation ability is not balanced; The maximum value of enterprise substantive innovation (inv-app) is 4.6250, while the minimum value is 0, with a mean value of 0.3344, and the mean value of invention patents is lower, indicating that the level of technological innovation of Chinese enterprises is not high; The maximum value of financial performance (roa) is 0.1917, while the minimum value is -0.2800, the gap between the financial level of different enterprises is obvious; The mean value of the degree of risk (risk) is 0.6196, and the standard deviation is 1.5508, indicating that the risk coefficient of our enterprises is low.

3.4. Modeling

3.4.1. Benchmark Regression.

This paper selects the data of listed companies in SHSE and SZSE from 2010 to 2019 to test the impact of corporate innovation on business confidence. This paper adopts OLS regression to test the research hypotheses, and the specific model is shown below:

$$Confi,t = \alpha 1 + \alpha 2 \cdot Pat\_appi,t\ (Inv\_appi,t) + \alpha i \cdot Controli,t + \lambda i,t + \tau i,t + \varepsilon i,t \quad (1)$$

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where i represents the enterprise, t represents the year, business confidence (Conf) is the explanatory variable, corporate innovation (Pat_app) and corporate substantial innovation (Inv_app) are the explanatory variables, Controli,t is the ensemble of control variables, λi,t is the individual fixed effect, τi,t is the time fixed effect, and εi,t is the residual term. The sign of the coefficients on the right-hand side of the equation before corporate innovation and substantial innovation reflects the effect of firm's innovation.

3.4.2. Mediating Effect.

In order to infer the transmission mechanism of corporate innovation affecting business confidence, this paper refers to the previous research method to test whether there is a significant mediating effect of financial performance and risk level between corporate innovation and business confidence [57, 58, 59, 60], and the following is the test model:

$$\begin{aligned} Confi,t &= \alpha 0 + \alpha 1 \cdot Xi,t + \alpha i \cdot Controli,t + \lambda i,t + \tau i,t + \varepsilon i,t \\ M &= \gamma 0 + \gamma 1 \cdot Xi,t + \lambda i,t + \tau i,t + \varepsilon i,t \\ Confi,t &= \beta 0 + \beta 1 \cdot Xi,t + \beta 2 \cdot M + \beta i \cdot Controli,t + \lambda i,t + \tau i,t + \varepsilon i,t \end{aligned} \quad (2)$$

where i, t, Confi,t , λi,t , τi,t , εi,t as above, the explanatory variables $X = \{Pat\_app \quad Inv\_app\}^T$ are proxies for corporate innovation and corporate substantive innovation; the mediator variables $M = \{Roa \quad Risk\}^T$ are proxies for financial performance and risk level.

This paper follows the sequential testing method process proposed by Baron and Kenny (1986) to test the mediating effect of the mediating variables (roa, risk) on corporate innovation and business confidence [57]. First, to test the existence of the mediating effect of the conditions: (1) The coefficient before the explanatory variable α1 is not zero; (2) γ1 is not zero; (3) The coefficient before the mediating variable β2 is not zero; (4) β1 is zero, or its absolute value is less than α1. Second, to test the mediating effect of the mediating variable, the specific steps are: (1) Test the significance of the α1, if α1 is significant, then go to the next step, and vice versa, there is no "mediated" effect; (2) Test the significance of γ1, if γ is significant, then it indicates that the explanatory variable X affects the mediator variable; (3) Test the significance of β2, if β2 is significant, which means that the mediator variable influences the interpreted variables; (4) Test the significance of β1 , if β1 is significant, it means that the mediator variable is a "complete mediation" of the relationship between the explanatory variable and the explained variable, and vice versa, it indicates that the mediator variable is the "partial mediation".

4. Results of Empirical Analysis

4.1. Benchmark Regression

Table 3 shows the results of OLS estimation of the effect of corporate innovation on business confidence.

As can be seen in Table 3, columns (1) and (2) show the regression results without controlling the control variables. Among them, the regression results in column (1) show that the coefficient of the explanatory variable corporate innovation is significantly positive, which indicates that the impact of corporate innovation on business confidence has a positive effect (i.e. corporate innovation can significantly increase business confidence). The regression results in column (2) show that the coefficient of another explanatory variable, corporate substantive innovation, is also significantly positive. This indicates that substantive innovation, which represents the quality of innovation, also has a positive impact on business confidence (i.e. corporate substantive innovation can significantly increase business confidence). The results of the regression with the control variables controlled are shown in columns (3) and (4).

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It shows that, similar to columns (1) and (2), the coefficients of the explanatory variables corporate innovation and corporate substantive innovation are both positive (i.e. both have a positive effect on firm information).

Table 3. Impact of corporate innovation on business confidence

Variant	(1)	(2)	(3)	(4)
	conf	conf	conf	conf
pat_app	0.0016**		0.0017**	
	(0.0007)		(0.0007)	
inv_app		0.0019*		0.0022**
		(0.0010)		(0.0010)
top1			0.0549**	0.0548**
			(0.0217)	(0.0217)
dire			-0.0670**	-0.0672**
			(0.0303)	(0.0303)
lev			-0.0168	-0.0164
			(0.0136)	(0.0136)
liq			0.0006	0.0006
			(0.0007)	(0.0007)
grow			0.0045***	0.0045***
			(0.0013)	(0.0013)
cap_inten			-0.0061***	-0.0061***
			(0.0012)	(0.0012)
size			0.0117***	0.0117***
			(0.0034)	(0.0034)
salary			0.0154***	0.0154***
			(0.0035)	(0.0035)
Control variable	N	N	Y	Y
Fixed effect	Y	Y	Y	Y
Obs	16265	16265	16265	16265
R^2	0.099	0.099	0.111	0.111

Note: Values in parentheses are standard errors; *, **, and *** represent P<0.1, P<0.05, and P<0.01, respectively. The following tables are the same.

In summary, according to the benchmark regression estimation test, both corporate innovation and substantive corporate innovation have positive effects on business confidence, and hypothesis H1 is verified.

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4.2. Robustness Checks

4.2.1. Robustness Checks for Replacement Variables

In this paper, variables are substituted to test the robustness of the benchmark regression results. Table 4 shows the regression results of OLS estimation with replacement variables.

Table 4. Robustness checks results for replacement variables

Variant	(1)	(2)	(3)	(4)
	conf	conf	conf_r	conf_r
pat_emp	0.0028***			
	(0.0009)			
inv_emp		0.0031**		
		(0.0013)		
pat_app			0.0003***	
			(0.0001)	
inv_app				0.0003**
				(0.0001)
Control variable	Y	Y	Y	Y
Fixed effect	Y	Y	Y	Y
Obs	16272	16272	16263	16263
R^2	0.112	0.111	0.078	0.078

1) Replacement of Explanatory Variables

Both the number of patents granted and the number of patent applications are often used to measure the level of corporate innovation, but patents have already played a role in improving the level of corporate innovation before they are granted. Therefore, in this paper, the number of patents granted and the number of invention patents granted are used to measure corporate innovation and substantial innovation respectively, which are denoted by Pat_app and Inv_app. Columns (1) and (2) of Table 4 are the results of the regression with replacement of explanatory variables. It can be seen that the estimation results are basically consistent with the benchmark regression estimates, which indicates the stability of the original conclusions.

2) Replacement of Explained Variables

Business confidence is measured by (number of positive words - number of negative words) / (total number of words) and is denoted by conf_r. Columns (3) and (4) of Table 4 lists the results of the regression with replacement of the explanatory variables. It can be seen that the estimates are generally consistent with the benchmark regression estimates, indicating the stability of the original conclusions.

4.2.2. Endogeneity Problem

This section examines the endogeneity of the benchmark regressions. On the one hand, successful corporate innovation may increase firms' confidence in the future. On the other hand, firms with confidence in the future may further increase their R&D investment and improve their innovation capabilities. Thus, there may be a bi-directional causality problem between corporate innovation and business confidence. First, following the previous research methods and uses the first-order lagged term of the explanatory variables as an instrumental variable to lag corporate innovation and substantive innovation by one period to mitigate the possible endogeneity problem [40, 61, 62]. Second, the one-period lagged corporate innovation and substantive innovation are strongly correlated with the current period's corporate innovation and substantive innovation, which satisfies the correlation requirement of instrumental variables, while not directly affecting business confidence in the current period, which satisfies

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the exogeneity requirement of instrumental variables. The results of the regression using the instrumental variables method are shown in Table 5.

Table 5. Regression results of instrumental variable method

Variant	(1)	(2)	(3)	(4)
	conf	conf	conf	conf
L.pat_app	0.0154***		0.0155***	
	(0.0057)		(0.0057)	
L.inv_app		0.0185**		0.0188**
		(0.0078)		(0.0077)
Control variable	N	N	Y	Y
Fixed effect	Y	Y	Y	Y
Obs	13241	13241	13241	13241
R^2	0.063	0.070	0.075	0.082
F	121.7077	122.4052	73.8684	74.3271

As can be seen in Table 5, the coefficients of the explanatory variables (L.pat_app and L.inv_app) in columns (1) to (4) are still significantly positive, which is basically consistent with the results in Table 3. This indicates that hypothesis H1 remains valid after using the instrumental variables approach to mitigate the interference of the endogeneity problem.

4.3. Further Analysis

4.3.1. Heterogeneity Test

To further analyze the heterogeneity of the impact of corporate innovation on business confidence, a series of sub-sample regressions are conducted.

1) Enterprise Character

Different nature of enterprises will have different effects on the regression results. In this paper, enterprises are classified into state-owned enterprises and non-state-owned enterprises for heterogeneity test, and the regression results are shown in Table 6.

Table 6. Regression results grouped by enterprise character

Variant	SOEs		NSOEs	
pat_app	0.0011		0.0018**	
	(0.0026)		(0.0008)	
inv_app		-0.0006		0.0024**
		(0.0039)		(0.0010)
Control variable	Y	Y	Y	Y
Fixed effect	Y	Y	Y	Y
Obs	1614	1614	14651	14651
R^2	0.094	0.094	0.120	0.120

Columns (3) and (4) of the Table 6 show that both corporate innovation and substantial innovation have a significant positive effect on the confidence of NSOEs. Columns (1) and (2) show that corporate innovation has a non-significant positive effect on SOEs' business confidence, while corporate substantive innovation has a non-significant negative effect on SOEs, which suggests that substantive innovations that are of higher quality and cost more in terms of R&D are putting some pressure on SOEs.

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In summary, this paper conducts a heterogeneity test to account for the different nature of enterprises. The results show that corporate innovation and substantial innovation significantly increase the confidence of NSOEs. This is because NSOEs face more difficult financing conditions and receive less financial subsidies, and they value corporate innovation more. On the other hand, SOEs have more policy support and stronger financing ability, and their purpose of innovation is more to obtain financial subsidies, which is a kind of "strategic" innovation. Therefore, the innovation of SOEs does not promote business confidence as much as that of NSOEs, and may even reduce business confidence. Therefore, hypothesis H4 is verified.

2) Polluted Situation

It has been shown in the literature that the pollution level of a firm affects corporate innovation. Therefore, this paper follows the method of Ma Yongqiang et al. (2021), where firms are classified into heavily polluting firms and non-heavily polluting firms according to the industry code for group regression [63]. The regression results are shown in Table 7.

Table 7. Regression results grouped by pollution situation

Variant	Heavily polluting firms		Non-heavily polluting firms	
pat_app	0.0009		0.0020**	
	(0.0014)		(0.0009)	
inv_app		0.0010		0.0029**
		(0.0018)		(0.0012)
Control variable	Y	Y	Y	Y
Fixed effect	Y	Y	Y	Y
Obs	4459	4459	11806	11806
R^2	0.130	0.130	0.109	0.109

Columns (3) and (4) of the Table 7 show that corporate innovation and substantial innovation significantly increase the confidence of non-heavy polluting firms. According to columns (1) and (2), although corporate innovation and substantial innovation also increase the confidence of heavily polluting firms, the results are not significant.

In summary, non-heavily polluting firms have a significant advantage in enhancing business confidence through corporate innovation, as measured by the difference in the degree of pollution of the firms. This can be attributed to the fact that non-heavily polluting firms face relatively mild environmental regulations and fewer financial constraints, while heavily polluting firms face stricter environmental regulations and regulatory efforts. Therefore, hypothesis H5 is verified.

3) The background of the CEO's R&D

Differences in CEO background may lead to different directions in corporate governance. [64] Among them, CEO with or without R&D background may affect the innovation level of the firm. [65] Therefore, this paper takes into account the CEO's background and conducts group regressions for firms with CEOs having R&D background and firms with CEOs without R&D background, respectively, and the regression results are shown in Table 8.

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Table 8. Regression results for CEO R&D background subgroups

Variant	Having R&D background		No R&D background	
pat_app	0.0016**		0.0049	
	(0.0008)		(0.0033)	
inv_app		0.0023**		-0.0025
		(0.0010)		(0.0055)
Control variable	Y	Y	Y	Y
Fixed effect	Y	Y	Y	Y
Obs	14445	14445	1820	1820
R^2	0.110	0.111	0.148	0.147

Columns (1) and (2) of the Table 8 show that corporate innovation and substantive innovation significantly increase CEOs' business confidence with R&D background. Column (3) shows that corporate innovation also enhances CEOs' confidence in firms with no R&D background, while column (4) shows that corporate substantive innovation instead reduces CEOs' confidence in firms with no R&D background, and none of the results are significant.

To summarize, in terms of whether the CEO has an R&D background or not, firms with R&D background will pay more attention to the development of corporate innovation, which will increase the firm's business confidence in the future. On the contrary, firms with no R&D background do not pay enough attention to corporate innovation or even carry out substantial innovation instead, which will reduce the firm's business confidence in the future. Therefore, hypothesis H6 is verified.

4.3.2. Mediating Effect

In this paper, the mediating effects of financial performance and risk level in corporate innovation on business confidence are separately tested and empirically analyzed using model (2). For the first formula in model (2), the regression results are shown in columns (3) and (4) of Table 3, the coefficient α1 of corporate innovation and corporate substantive innovation on business confidence is significantly positive, and there is the effect of "being mediated". The regression results of the second and third formulas in model (2) are shown in Tables 9 and 10.

Table 9. Intermediation test: financial performance perspective

Variant	Business confidence		Financial performance	
pat_app	0.0013*		0.0008***	
	(0.0008)		(0.0003)	
inv_app		0.0015		0.0015***
		(0.0010)		(0.0004)
roa	0.4978***	0.4977***		
	(0.0258)	(0.0258)		
Control variable	Y	Y	Y	Y
Fixed effect	Y	Y	Y	Y
Obs	16011	16011	16011	16011
R^2	0.147	0.146	0.194	0.195

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Table 10. Intermediation test: risk level perspective

Variant	Business Confidence		Risk Level	
pat_app	0.0016**		-0.0183**	
	(0.0008)		(0.0072)	
inv_app		0.0020**		-0.0253**
		(0.0010)		(0.0117)
risk	-0.0076***	-0.0076***		
	(0.0008)	(0.0008)		
Control variable	Y	Y	Y	Y
Fixed effect	Y	Y	Y	Y
Obs	16011	16011	16011	16011
R^2	0.119	0.119	0.202	0.202

1) Mediating Effects of Financial Performance

For the mediation mechanism test of financial performance perspective, the regression results are shown in Table 9. First, according to the results of the benchmark regression (i.e. Tables 3 and 9), α1, γ1, and β2 are not zero, and the absolute value of β1 is less than α1, and financial performance satisfies the four conditions for the existence of mediating effects. Second, according to columns (3) and (4) in the Table 9, the coefficient of the explanatory variables γ1 is significantly positive, which implies that there is a significant positive effect of corporate innovation and substantial innovation on financial performance. Columns (1) and (2) show that the coefficients of financial performance β2 are both significantly positive, which means that financial performance improves business confidence; Meanwhile, the coefficient of corporate innovation β1 is significantly positive, which means that financial performance is a "partial mediator" of corporate innovation in influencing business confidence; And the coefficient of substantive innovation β1 is positive but not significant, which means that financial performance is a "partial mediator" of substantive innovation in influencing business confidence. The coefficient of β1 for substantial innovation is positive but not significant, which means that financial performance is a "full mediator" of the impact of substantial innovation on business confidence. Therefore, hypothesis H2 is verified.

2) Mediating Effects of Risk Level

For the mediation mechanism test of risk level perspective, the regression results are shown in Table 10. First, according to the results of the benchmark regression (i.e. Table 3 and Table 10), α1, γ1, β2 are not zero, the absolute value of β1 is less than α1, and the risk level satisfies the four conditions for the existence of mediating effects. Second, according to columns (3) and (4) in the Table 10, the coefficient of the explanatory variables γ1 is significantly positive, indicating that there is a significant negative effect of corporate innovation and substantial innovation on the risk level. Columns (1) and (2) show that the coefficient of risk level β2 is significantly negative, which indicates that the lower the risk level, the higher the confidence of enterprises, while the coefficient of corporate innovation and substantial innovation β1 is significantly positive, which indicates that the risk level is a "partial mediator" of corporate innovation and substantial innovation in affecting the confidence of enterprises. Therefore, hypothesis H3 is verified.

5. Conclusion and Outlook

The two-year-long epidemic of COVID-19 has left many enterprises facing operational difficulties and lacking confidence in the future. Boosting business confidence, activating the vitality of market players and promoting entrepreneurship are of great theoretical and practical

significance for the country's economic recovery and the high-quality development of enterprises.

This paper empirically examines the impact of corporate innovation on business confidence using data from Shanghai Stock Exchange and Shenzhen Stock Exchange listed companies from 2010 to 2019. The empirical results show that: (1) Both corporate innovation and corporate substantive innovation can significantly boost business confidence. Among them, the promotion effect of substantive innovation is stronger. After a series of robustness checks, the conclusion still holds. (2) Further research finds that financial performance and the risk level are mediating variables in the impact of corporate innovation and corporate substantive innovation on business confidence. Specifically, corporate innovation and corporate substantive innovation enhance business confidence by improving financial performance and reducing the risk level. (3) In terms of firm heterogeneity, corporate innovation and corporate substantive innovation increase business confidence to a greater extent for non-state-owned enterprises, non-heavily polluter, and enterprises whose CEOs have an R&D background.

Finally, the findings of this paper are important insights for boosting business confidence, activating the vitality of market players and promoting entrepreneurship. First of all, corporate innovation can significantly enhance enterprises' confidence in the future. Therefore, firms should increase their investment in innovation R&D and enhance their innovation capability, especially substantive innovation capability. Second, corporate financial performance and riskiness play a mediating role in the process of corporate innovation to enhance business confidence. Therefore, firms should pay attention to financial performance and risk level, which can effectively enhance business confidence. Finally, as a model of national enterprises, state-owned enterprises should pay more attention to corporate innovation and upgrade their innovation ability to international level. At the same time, companies should pay more attention to whether they have a background in R&D rather than focusing only on management background when recruiting executives.

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References

[1] Chen Taiyi, Wang Yan, Zhao Xiaosong. Business environment, business confidence and high-quality development of enterprises-Empirical evidence from the 2018 China Enterprise General Survey (CEGS)[J]. Macro Quality Research,2020,8(02):110-128.

[2] Zhu Limin, Zhao Jing, Sun Zejun. Can Social Responsibility Undertaking Enhance Business confidence? -- An empirical study of corporate participation in precision poverty alleviation[J]. Economic Management,2021,43(04):71-87.

[3] Heaton J B. Managerial optimism and corporate finance[J]. Financial Management, 2002: 33-45.

[4] Yang Yang, Yang Bing. Tax Preferences, Entrepreneurial Market Confidence and Corporate Investment-Empirical Evidence Based on Text Mining of Listed Companies' Annual Reports[J]. Tax Research,2020,426(07):86-94.

[5] Feng Genfu, Wen Jun. An empirical analysis of the relationship between governance and corporate technological innovationin Chinese listed companies[J].China Industrial Economy,2008,244(07): 91-101.

[6] Zheng Chunmei, LI Pei. The impact of government subsidies and tax incentives on corporate innovation performance--an empirical study based on GEM high-tech enterprises[J]. Science and Technology Progress and Countermeasures,2015,32(16):83-87.

[7] Wang Xiongyuan, Bu Luofan. International export trade and enterprise innovation--a quasi-natural experimental study based on the opening of "China-Europe liner train"[J]. China Industrial Economy, 2019,379(10):80-98.

[8] Wen Subin, Fang Yuan. An empirical study on the relationship between corporate social responsibility and financial performance--a panel data analysis from stakeholder perspective[J]. China Industrial Economy,2008,247(10):150-160.

[9] Zhang Zhaoguo, Jin Xiaocui, LI Gengqin. An empirical study on the interaction cross-period impact between corporate social responsibility and financial performance[J].Accounting Res-earch, 2013, 310(08):32-39+96.

[10] Yang Wansu, Yang Shanlin. An empirical study on the relationship between corporate social responsibility and financial performance in the Chinese context - A comparative analysis based on large, small and medium-sized listed companies[J]. China Management Science,2016,24(01):143-150.

[11] Jiang Fuxiu, Zhang Min, Lu Zhengfei et al. Managerial overconfidence, corporate expansion and financial distress[J]. Economic Research,2009,44(01):131-143.

[12] Yu Minggui, LI Wengui, PAN Hongbo. Managerial overconfidence and corporate risk taking[J]. Financial Research,2013,391(01):149-163.

[13] He Ying, Yu Wenlei, Yang Mianzhi. CEO Composite Career Experience,Corporate Risk Taking and Firm Value[J]. China Industrial Economy,2019,378(09):155-173.

[14] Marquis D G. The anatomy of successful innovation[J]. Innovation Magazine, 1969,1(1):28-37.

[15] Mary M C, Marina A. A Multi-Dimensional Framework of Organizational Innovation: a Systematic Review of the Literature[J]. Journal of Management Studies, 2010,47(6):1154-1191.

[16] Shi Xianrui, Li Zhaoyou. A Review of Research on Technological Innovation Capability of Enterprises[J]. Research on Science and Technology Management,2004,(02):53-55.

[17] Chen Litian, Zhao Xiaoqing, Wei Zhishen. The connotation of corporate innovation capabili-ty and its evolution:a systematic literature review[J]. Science and Technology Progress and Countermeasures, 2012,29(14):154-160.

[18] Yu Minggui, Fan Rui, Zhong Huijie. China's industrial policy and corporate technological innovation[J]. China industrial economy,2016,345(12):5-22.

[19] Ju Xiaosheng, Lu Di, Yu Yihua. Financing constraints, working capital management and corporate innovation sustainability[J]. Economic Research,2013,48(01):4-16.

[20] Shi Yongdong, Wang Tongtong. Government support and enterprise innovation[J]. Systems Engineering Theory and Practice,2022,42(08):2002-2016.

[21] Duan Junshan, Zhuang Xudong. Financial investment behavior and corporate technological innovation-Motivational analysis and empirical evidence[J]. China Industrial Economy,2021,394 (01):155-173.

[22] Wang Xigang. Research on the impact of organizational innovation and technological innovation capability on enterprise performance[J].Research Management,2016,37(02):107-115.

[23] Tang Qing, Chen Haiyan. Research on the impact of technological innovation and marketing ability on enterprise performance[J]. Science and Technology Management Research,2015,35(09):110-114.

[24] LI Jingxun, Zheng Runkun. A study on the impact of innovation culture on enterprise performance in high-tech enterprises - the role of dual innovation and marketing capability[J]. Journal of Beijing University of Aeronautics and Astronautics (Social Science Edition),2021,34(06):85-93.

[25] Li Houjian, Zhang Jian. Research on the influence mechanism of corporate innovation on overcapacity[J]. Industrial Economics Research,2017,87(02):114-126.

[26] Xu Jingchang, Wang Mang. Can corporate innovation improve audit quality? [J]. Accounting Research,2017,362(12):80-86+97.

[27] Meng Qingbin, HOU Chanyan, Lu Bing. Corporate innovation and default risk[J]. World Economy, 2019,42(10):169-192.

[28] Li Wenjing, Zheng Manni. Substantive or strategic innovation? --The impact of macro-industrial policy on micro-firm innovation[J]. Economic Research,2016,51(04):60-73.

[29] Zhang Shijing, Gao Wenliang. Research on the effect of tax reduction and fee cut policy on the confidence enhancement of real enterprises--Based on the perspective of enterprise cash decision-making behavior[J]. Macroeconomic Research,2022,284(07):53-64.

[30] Hou Baofeng, Su Zhi, Shi Jianping. Financing Difficulties, Financing Expensiveness and Confidence of Small and Micro Operators-Analysis Based on the Joint Questionnaire Survey of Small and Micro Enterprises of All-China Federation of Industry and Commerce and Ant Gold[J]. Journal of Central University of Finance and Economics,2022,419(07):25-36.

[31] Ernst H. Patenting strategies in the German mechanical engineering industry and their relationship to company performance[J]. Technovation, 1995, 15(4): 225-240.

[32] Zhang J, Rogers J D. The technological innovation performance of Chinesefirms: the role of industrial and academic R&D, FDI and the markets in firm patenting[J]. International Journal of Technology Management, 2009, 48(4): 518-543.

[33] Zhou Xuan, Cheng Liru, Wang Hao. Is the higher the level of technological innovation the better the financial performance of enterprises? --An empirical study based on 16 years of patent application data of Chinese pharmaceutical listed companies[J]. Financial Research,2012,386(08):166-179.

[34] Zhu NaiPing, Zhu Li, Kong Yusheng et al. Research on the synergistic effect of technological innovation investment and social responsibility undertaking on financial performance[J]. Accounting Research,2014,316(02):57-63+95.

[35] Austin D H. An event-study approach to measuring innovative output: The case of biotechnology[J]. The American economic review, 1993, 83(2): 253-258.

[36] Yang Jianjun, Liu Ren. Empirical study on the relationship between corporate innovation strategy selection and stock price volatility[J]. Journal of Management Engineering,2009,23(01):35-40+46.

[37] Yu Minggui, Hu Yafu, Pan Hongbo. Political linkages, rent-seeking and the effectiveness of local government fiscal subsidies[J]. Economic Research,2010,45(03):65-77.

[38] Li Jian, Yang Beibei, Pan Zhen. Government subsidies, equity concentration and corporate innovation sustainability[J]. China Soft Science,2016,306(06):180-192.

[39] Shang Hongtao, Fang Dan. Government Subsidies, Risk Taking and Enterprise TechnologicalInnovation--The Case of Private Science and Technology Enterprises[J]. Journal of Manage-ment,2021,34(06):45-62.

[40] Li Tian, Du Yang. Market Driven, Innovation Efficiency and Enterprise Risk Taking--A Discussion on the Realization Path of "Active Government"[J]. Journal of Jiangxi University of Finance and Economics,2020,132(06):32-45.

[41] Arrow K J. Economic welfare and the allocation of resources for invention [M]. Macmillan Education UK, 1972.

[42] Tirole J. The Theory of Industrial Organization[J]. Economica, 1988, 56(223):226-227.

[43] Li Wenjing, Peng Yuanhuai, Tan Youchao. Judicial Protection of Intellectual Property Rights and Corporate Innovation--An Introduction to the Changes in the Innovation Structure of Chinese Firms[J]. Economic Research,2021,56(05):144-161.

[44] Jiang Shisong, He Wenlong, Lu Jiangyong. Innovation as a political strategy: Symbolic corporate innovation in the context of transition economy[J]. Nankai Management Review,2019,22(02):104-113.

[45] Jaffe A B, Palmer K. Environmental regulation and innovation: a panel data study[J]. Review of economics and statistics, 1997, 79(4): 610-619.

[46] He Xinwen, Hong Lin. The impact of executive team R&D background on firms' innovation performance - a moderated mediation effect test[J]. Science Management Research,2021,39(06): 82-89.

[47] Han Zhongxue, Cui Jianwei, Wang Shan. Do technology executives enhance firms' technological efficiency? [J]. Research in Science,2014,32(04):559-568.

[48] Guo Yue. Signaling mechanism of government innovation subsidies and corporate innovation[J]. China Industrial Economy,2018,366(09):98-116.

[49] Yi Jingtao, Zhang Xiuping, Wang Huacheng. Firm heterogeneity, executive overconfidence and firm innovation performance[J]. Nankai Management Review,2015,18(06):101-112.

[50] Tang Song, Wu Xuchuan, Zhu Jia. Digital finance and corporate technological innovation - structural characteristics, mechanism identification and effect differences under financial regulation[J]. Management World,2020,36(05):52-66+9.

[51] Zhang Xueying, WU Duowen, Wang Yuan. Research on the impact of green bonds on corporate green innovation[J]. Contemporary Economic Science,2022,44(05):28-38.

[52] Wu Haibing. Research on the relationship between debt financing and investment decision of listed companies[J]. Statistics and Decision Making,2011,333(09):140-142.

[53] Ge Jiashu, Zhan Meisong. Several financial information that must be emphasized in the analysis of corporate financial reporting--liquidity, financial adaptability, expected net cash inflow, profitability and market risk[J]. Accounting Research,2008,247(05):3-9+95.

[54] Zhou Zhiqiang, Wang Jieying, Yi Wenting et al. The impact of capital intensity on the high-quality development of enterprises-an empirical analysis based on state-owned mixed enterprises[J]. Systems Engineering,2022,40(03):45-55.

[55] Li Miao, Li Cunpu. Executive compensation comparison psychology, controlling shareholder nature and investment behavior[J].Statistics and Decision Making,2021,37(12):178-181.

[56] Xu Liping, Xin Yu, Chen Gongmeng. Equity concentration and equity checks and balances and their effects on firms' operating performance[J]. Economic Research,2006,(01):90-100.

[57] Baron R M, Kenny D A. The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations[J].Journal of Personality and Social Psychology,1986,51(6):1173.

[58] Wen Zhonglin, Ye Baojuan. Mediation effects analysis:Methods and model development[J]. Advances in Psychological Science,2014,22(05):731-745.

[59] Ma Yaming, Hu Chunyang, Liu Xinlong. Issuance of green bonds and enhancement of corporate value - mediation effect test based on DID model[J].Financial Forum,2020,25(09):29-39.

[60] Jiang Ting. Mediating and moderating effects in empirical studies of causal inference[J]. China Industrial Economy,2022,410(05):100-120.

[61] Wang Zhengxin, Zhu Hongtao. Nonlinear impact of innovation efficiency on export complexity of high-tech industries[J]. International Trade Issues,2017,414(06):61-70.

[62] Chen Shenglan, Liu Xiaoling. Economic policy uncertainty and corporate commercial credit supply[J]. Financial Research,2018,455(05):172-190.

[63] Ma Yongqiang, Zhao Liangkai, YANG Huayue et al. Air Pollution and Corporate Green Innovation - Empirical Evidence Based on A-share Listed Companies in Heavy Pollution Industries in China[J]. Industrial Economics Research,2021,115(06):116-128.

[64] He Ying, Yu Wenlei, Dai Yichi et al. Executive career experience and corporate innovation[J]. Management World,2019,35(11):174-192.

[65] Zhang Qin. Technological background CEOs, technological innovation and corporate performance-an empirical analysis based on private high-tech enterprises[J]. Economic Issues,2018,465(05):82-87.