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# Complex Business Environment Systems and Corporate Innovation

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**Abstract:** Sustainable development has become a corporate goal all over the world, and innovation as a crucial prerequisite for sustainable development has attracted much attention. This study investigates the relationship between the business environment and corporate innovation in Chinese A-share listed enterprises from 2017 to 2020. We use a complex indicator to measure the business environment and use multiple regression models to conduct the analysis. The findings suggest that a favorable business environment promotes corporate innovation by reducing financing constraints and environmental uncertainty. Compared to non-state-owned enterprises, the positive impact of the business environment on corporate innovation is enhanced in state-owned enterprises. Concentrated ownership enhances the positive impact of a favorable business environment on corporate innovation. Our study provides a new analytical perspective on the relationship between the business environment and corporate innovation in the context of China.

**Keywords:** business environment; corporate innovation; property rights; ownership concentration; complex indicator system



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## 1. Introduction

According to the report of the United Nations Environment Programme Making Peace with Nature released in 2021, the Earth is currently facing three major crises: climate change, loss of biodiversity, and pollution. The interaction of these three crises, together with our reliance on fossil fuels and disregard for environmental damage, poses a serious threat to future human survival and development. In response to these crises, technological innovation has gained importance. Since the implementation of its innovation-driven development strategy in 2012, China has adopted technological innovation as the core of its development [1]. Business enterprises are where technological innovation occurs; in this study, we investigate the factors influencing technological innovation in business enterprises.

The business environment is the ecosystem in which a firm operates, a critical source of resources for its survival and growth. A favorable business environment can provide enterprises with sufficient capital and human resources for innovation and protection of innovative achievements, which is important to cope with external shocks and enhance competitiveness. The quality of the business environment has various effects on corporate innovation at the micro level. Therefore, the primary focus of this study is to explore the relationship between complex business environment systems and corporate innovation and the mechanism behind it. In addition, we explore which factors can moderate the impact of the business environment on corporate innovation. Our research has important theoretical value and practical significance for the development of enterprises.

Impacts of the following external factors on corporate innovation have been discussed previously: (i) political factors, such as government subsidies, political uncertainty, and corruption [2–5]; (ii) economic factors, such as uncertainty regarding fiscal policy, taxes,

internationalization, market competition, and financial market development [6–10]; and (iii) social factors, such as legal systems, public governance, and population size [11–14]. However, there is a gap in the research regarding the impact of the business environment on corporate innovation in China. In our study, we explore the relation between the business environment and corporate innovation in the Chinese context.

Using data from Chinese A-share listed enterprises from 2017 to 2020, we examine the impact of the business environment on corporate innovation. We use the provincial business environment index to characterize the business environment and the number of patents awarded to each enterprise to measure corporate innovation. The findings suggest that a favorable business environment has a positive impact on corporate innovation. The business environment influences corporate innovation by reducing financing constraints and environmental uncertainty. Compared with non-state-owned enterprises (non-SOEs), the beneficial influence of the business environment on corporate innovation is strong in state-owned enterprises (SOEs). In addition, concentrated ownership enhances the positive impact of the business environment on corporate innovation. The findings are robust to a series of robustness tests.

This study has three main contributions: (i) Our study comprehensively examines the impact of the business environment on corporate innovation. Previous research has mainly focused on investigating individual external environmental factors, such as politics, economics, society, culture, or ecology, and their relationship with corporate innovation [9,10,12]. However, there is a lack of literature evaluating the overall influence of the business environment on corporate innovation. In practical day-to-day operations, companies not only consider the impact of individual external factors but also conduct holistic assessments of their external environments. To address this research gap, our study utilizes a unique dataset encompassing business environments in China at the provincial level and draws upon the holistic thinking of systems theory to evaluate how the overall business environment impacts corporate innovation within the Chinese context. By adopting a holistic perspective rather than solely focusing on individual external environmental factors, our analysis offers distinct advantages in providing novel insights and empirical evidence. (ii) The relationship between external environmental factors and corporate innovation has received more attention in Western countries than in Asian countries [3,5,15]. However, China differs significantly from Western countries in terms of national culture, government role positioning, and the economic system. According to Hofstede's national cultural theory, China's characteristics include high power distance, high uncertainty avoidance, and collectivism [16]. In terms of government, China has a centralized political system, and the government actively intervenes in the market rather than playing a passive "night watchman" role. China also has a socialist market economy in which the influence of the planned economy can still be observed to some extent. Therefore, in exploring the relationship between China's unique business environment and corporate innovation, our study makes valuable contributions to academia. Additionally, this research provides valuable references for academic studies and planning of practical business activities in Confucian cultures like those in South Korea, Japan, and Southeast Asia. (iii) Examining the overall business environment and its impact on corporate innovation, we introduce two moderating factors: property rights and ownership concentration. We construct a comprehensive analytical framework that includes these factors to investigate the relationship between the business environment and corporate innovation in the Chinese context.

The rest of the paper is structured as follows: Section 2 summarizes the relevant literature and develops our hypotheses. Section 3 presents the research design, including data sources and sample selection, variable definitions, and our empirical model. Section 4 includes descriptive statistics, correlation analysis, the main analysis, and robustness checks. Section 5 reports the results of the test for moderating effects. Section 6 presents our conclusions and discussions of our results.

## 2. Literature Review and Hypothesis Development

### 2.1. Literature Review

There are many factors affecting innovation in enterprises. Many studies have examined the influence of external factors on corporate innovation from political and economic perspectives.

From a political perspective, prior literature mainly focused on the impact of uncertainty regarding policy and the effects of corruption on corporate innovation. Political uncertainty reduces R&D investment [3], while political activism supports corporate innovation by reducing political uncertainty [17]. It is widely accepted that political uncertainty has a negative impact on corporate innovation. Corruption is another significant political factor influencing corporate innovation. Existing studies show an association between corruption and high costs of innovation; corruption also has a detrimental effect on firm innovation [4,5,18]. Scholars have also focused on the effects of government subsidies [2], regulatory policies [19], and political connections [3,20] on corporate innovation.

From the economic perspective, the existing literature has focused on economic and fiscal policy, taxes, internationalization, and financial market development. The findings suggested that various taxes are closely related to corporate innovation, such as the cuts and concessions of R&D tax [7,21], taxes on patent income [22], and corporate income tax [23], which have an incentivizing effect on innovative behavior. Economic and fiscal policies have drawn considerable attention as policy determinants. For example, uncertainty regarding economic policy discourages innovation by increasing capital costs [24], and uncertainty regarding fiscal policy curtails investment by increasing constraints related to bank credit [6]. The positive impacts of internationalization and international collaboration on firm innovation have been recognized by many scholars [8,25,26]. The development of financial markets can provide additional financing channels and promote investment in innovation [10,27]. In addition, stock market liberalization [28] and stock liquidity [29,30] can also affect corporate innovation.

At the social level, the legal system, social capital, population size, labor costs, and social media have all been discussed in previous studies. The impact of the legal system on corporate innovation has received extensive attention from scholars; those studies revealed that strong shareholder protection facilitates access to stock market financing and secures capital for innovative activities [11]. Comprehensive legal protection for intellectual property effectively overcomes the negative externalities of corporate innovation, stimulates entrepreneurial innovation, and motivates firms to engage in innovative activities [10,12]. However, the risk of litigation can trigger management myopia and inhibit corporate innovation [15]. Corporate innovation is also affected by social capital [31], public governance [13], population size [14], and social media [32,33].

According to property rights, we usually divide enterprises into SOEs and non-SOEs. And property rights more often act as moderating variables in existing research. In terms of corporate innovation, the moderating effect of property rights nature involves economic policy uncertainty [34], institutional dynamics [35], competitive imitation of firms [36], and the impact of institutional investor networks [37] on corporate innovation.

Ownership concentration affects the degree of supervision and checks and balances of major shareholders and then affects the strategic development of enterprises [38]. Ownership concentration affects corporate financial policy [39], the sensitivity of expansion investment and maintenance investment to changes in corporate cash flow [40], corporate R&D investment [41], and firm value [42].

Overall, existing studies have some limitations. First, they mainly focused on the impact of specific external factors on corporate innovation. However, these factors may both drive and hinder innovation in an interactive system; their holistic effect may elicit various responses from companies towards the overall external environment. Therefore, a comprehensive analysis of the relationship between the business environment and corporate innovation is necessary. Unfortunately, this fact has been overlooked by the existing literature. Second, existing studies prioritize country-level factors, but a detailed discussion

of the relationship between the business environment and corporate innovation at the provincial or municipal level is lacking, and the research lacks sufficient depth. Third, the existing literature has ignored the relationship between the business environment and enterprise innovation in the Chinese context.

### 2.2. Hypothesis Development

The business environment, which includes politics, economics, society, and culture, influences enterprise innovation by reducing financing constraints and environmental uncertainty. On the one hand, a favorable business environment can compensate for limited resources for innovation within companies and can promote their innovative activities in terms of enterprise financing constraints. Specifically, a well-functioning financial market includes numerous financing channels [28], an efficient administrative environment ensures that government subsidies go to deserving enterprises [43], a sound legal environment protects fund providers' rights effectively [11], and a favorable cultural environment attracts more investors to businesses [44]. On the other hand, a favorable business environment can reduce environmental uncertainty faced by enterprises and provide stability for operations. High environmental uncertainty may discourage companies from engaging in highly uncertain innovative activities due to risk-balancing considerations [45]. A quality business environment, including healthy government-business relationships, not only promotes orderly market competition but also enhances communication and dialogue between the government and enterprises, thereby reducing operational risks caused by information asymmetry and environmental uncertainty. Businesses can then form stable expectations for the future and participate actively in long-term continuous innovation. According to complex systems theory, the interaction and interdependence of various sub-domains within the business environment play an important role in facilitating innovation. Based on the findings of previous research, as outlined above, we propose our hypotheses.

**Hypothesis 1.** *A favorable business environment has a positive effect on corporate innovation.*

**Hypothesis 2.** *A favorable business environment promotes corporate innovation by reducing financing constraints.*

**Hypothesis 3.** *A favorable business environment promotes corporate innovation by reducing environmental uncertainty.*

A favorable business environment promotes corporate innovation by alleviating financing constraints for enterprises. As the benefits of innovation in SOEs belong to the government, they receive preferential support from various dimensions [46]. In the process of capital allocation, the incremental capital brought by a favorable business environment is prioritized for higher state-owned equity enterprises, thereby alleviating their financing constraints first. This results in a stronger promotion effect of a good business environment on corporate innovation in high state-owned equity enterprises. We now present Hypothesis 4.

**Hypothesis 4.** *State-owned property rights enhance the positive impact of a favorable business environment on corporate innovation.*

A favorable business environment promotes corporate innovation by reducing environmental uncertainty. A favorable business environment provides the necessary conditions for enterprises to avoid uncertainties and risks in the innovation process [47]. In this case, managers and shareholders have more positive expectations for the prospects of enterprise development, and managers are more willing to engage in innovative activities that benefit long-term company growth [43]. As ownership concentration increases, major shareholders develop a convergence of interests with the company. With higher ownership concentration, major shareholders have greater motivation and ability to seize opportunities arising from

reduced environmental uncertainty, making them more inclined to support innovative decisions within the company. Therefore, an increase in ownership concentration enhances the promotion effect of a favorable business environment on corporate innovation. Based on the above, we now propose Hypothesis 5.

**Hypothesis 5.** *Concentrated ownership enhances the positive impact of a favorable business environment on corporate innovation.*

## 3. Research Design

### *3.1. Data Source and Sample Selection*

The analysis includes A-share enterprises listed on the Shanghai and Shenzhen Stock Exchanges from 2017 to 2020. Data from the business environment index were adopted from the Research Report on Business Environment in Chinese Provinces published by the Management Innovation Interdisciplinary Platform of Guanghua School of Management in Peking University and the Peking University—Wuhan University Business Research Joint Group. Data on enterprise patents were taken from the Chinese Research Data Service, which is widely cited in innovation research in China. All other data were collected from the China Stock Market and Accounting Research Database.

Data from the initial sample were processed as follows: (i) financial enterprises were excluded; (ii) ST and *ST enterprises were excluded; and (iii) enterprises with missing values for the main variables were excluded. In addition, in order to avoid the possible influence of outliers on the results, a tailing process of the top and bottom 1% was applied to all continuous variables. In the end, an unbalanced panel dataset of 13,820 firm–year observations was utilized in the analysis.

### *3.2. Variable Definitions*

#### 3.2.1. Measurement of the Business Environment

The business environment index system was first proposed by the World Bank, and the comprehensive ranking is obtained by rating ten groups of indicators of the business environment of various countries. However, the resulting business environment indicator system is aimed at the national level, often selecting representative cities in countries as samples. Due to the different institutional situations in China, there are obvious differences in the business environment. Therefore, we referred to Xi and Wan [48] and Qian et al. [49] and adopted the data at the provincial level. We used the business environment index in the Research Report on Business Environment in Chinese Provinces published by the Management Innovation Interdisciplinary Platform of Guanghua School of Management, Peking University, and the Peking University—Wuhan University Business Research Joint Group to measure the business environment.

This index provides evaluative data for 31 provinces in China from 2017 to 2020, constituting 4 primary indicators, including market environment (ME), governmental environment (GE), legal policy environment (LE), and humanistic society environment (HE). The weights of 16 secondary indexes were determined by text analysis. The secondary indicators of the evaluation system were empowered according to the content of the Regulations on Optimizing the Business Environment, and the weight of 16 secondary indicators was determined by examining the frequency of the evaluation content of each secondary indicator in the Regulations on Optimizing the Business Environment. Finally, based on the connotation of secondary indicators and the short-term availability, long-term sustainability, and source authority of relevant data, 29 tertiary indicators under the secondary indicators were determined. The index system is shown in Table 1.

Table 2 shows the descriptive statistics for the provincial business environment in China. The data cover 124 items for 31 provincial-level annual business environment indicators from 2017 to 2020. The mean value of the business environment variable (BE) is 48.58, the minimum value is 22.19, and the maximum value is 70.99, indicating that the BE condition varies significantly among provinces. The standard deviations of ME, GE,

LE, and HE are, respectively, 11.66, 12.76, 14.93, and 19.68, indicating large differences among provinces.

**Table 1.** Business environment index system.

| Primary Indicators | Weight | Secondary Indicators | Weight |
|---|---|---|---|
| Market environment | 20.62% | Financing | 2.06% |
| | | Innovation | 2.06% |
| | | Fair competition | 8.25% |
| | | Resources retrieval | 3.09% |
| | | Market medium | 5.15% |
| Governmental environment | 52.58% | Government care | 9.28% |
| | | Government efficiency | 18.56% |
| | | Government cleanness | 10.31% |
| | | Government transparency | 14.43% |
| Legal policy environment | 21.65% | Judicial justice | 10.31% |
| | | Property right protection | 3.09% |
| | | Law and order | 2.06% |
| | | Judicial services | 2.06% |
| | | Judicial openness | 4.12% |
| Humanistic society environment | 5.15% | Opening up | 1.03% |
| | | Social credit | 4.12% |

Notes: please refer to the following website for details. http://jszy.whu.edu.cn/zhang/zh_CN/zzcg/416874/content/6104.htm#zzcg (accessed on 15 July 2024)

**Table 2.** Descriptive statistics of the BE index.

| Variable | Year | N | Mean | S.D. | Min | P25 | Median | P75 | Max |
|---|---|---|---|---|---|---|---|---|---|
| BE | 4 years | 124 | 48.58 | 9.80 | 22.19 | 42.05 | 47.74 | 54.65 | 70.99 |
| ME | 4 years | 124 | 33.18 | 11.66 | 11.75 | 26.00 | 30.06 | 36.28 | 71.97 |
| GE | 4 years | 124 | 55.14 | 12.76 | 18.42 | 48.70 | 54.91 | 64.06 | 80.08 |
| LE | 4 years | 124 | 43.05 | 14.39 | 15.35 | 32.09 | 41.47 | 54.09 | 79.44 |
| HE | 4 years | 124 | 62.69 | 19.68 | 1.560 | 52.52 | 68.49 | 77.34 | 88.80 |
| BE | 2017 | 31 | 45.01 | 9.10 | 22.19 | 38.35 | 44.09 | 49.19 | 66.79 |
| ME | 2017 | 31 | 29.65 | 10.24 | 11.89 | 23.51 | 26.29 | 31.02 | 58.21 |
| GE | 2017 | 31 | 53.64 | 12.70 | 18.42 | 46.33 | 52.54 | 61.07 | 80.08 |
| LE | 2017 | 31 | 33.94 | 11.85 | 15.35 | 27.50 | 33.06 | 38.56 | 67.84 |
| HE | 2017 | 31 | 64.99 | 20.65 | 1.66 | 53.98 | 71.74 | 78.05 | 87.50 |
| BE | 2018 | 31 | 46.42 | 9.28 | 29.16 | 38.28 | 45.19 | 53.16 | 70.99 |
| ME | 2018 | 31 | 31.14 | 11.65 | 11.85 | 24.41 | 27.27 | 33.52 | 67.86 |
| GE | 2018 | 31 | 48.48 | 12.52 | 20.70 | 38.85 | 49.38 | 54.97 | 74.92 |
| LE | 2018 | 31 | 49.35 | 12.94 | 16.37 | 41.29 | 49.94 | 57.86 | 71.49 |
| HE | 2018 | 31 | 59.41 | 19.15 | 1.62 | 47.79 | 64.42 | 73.80 | 81.88 |
| BE | 2019 | 31 | 51.62 | 9.27 | 29.66 | 46.18 | 50.56 | 55.75 | 69.84 |
| ME | 2019 | 31 | 36.38 | 11.75 | 11.75 | 30.15 | 33.81 | 40.91 | 71.97 |
| GE | 2019 | 31 | 59.79 | 10.57 | 25.46 | 54.18 | 61.69 | 67.25 | 77.51 |
| LE | 2019 | 31 | 43.31 | 14.35 | 17.16 | 31.48 | 43.04 | 55.77 | 73.76 |
| HE | 2019 | 31 | 64.26 | 19.50 | 1.560 | 53.60 | 69.31 | 77.42 | 88.80 |
| BE | 2020 | 31 | 51.25 | 10.23 | 27.54 | 44.59 | 50.89 | 57.97 | 69.70 |
| ME | 2020 | 31 | 35.56 | 12.05 | 17.62 | 28.07 | 32.75 | 40.70 | 65.97 |
| GE | 2020 | 31 | 58.67 | 12.43 | 23.40 | 51.83 | 60.02 | 69.00 | 76.24 |
| LE | 2020 | 31 | 45.57 | 14.20 | 18.50 | 34.16 | 43.31 | 57.39 | 79.44 |
| HE | 2020 | 31 | 62.11 | 19.90 | 1.66 | 49.15 | 64.94 | 77.78 | 86.91 |

3.2.2. Measurement of Corporate Innovation

Referring to Li et al. [50], we used the number of patents granted to measure corporate innovation. Chinese patent law classifies patent types into invention patents, utility model patents, and design patents. Since invention patents are the most original and have highly innovative content, we used the number of invention patents granted plus 1 and then took the natural logarithm to measure corporate innovation. This variable is expressed as PAT.

3.2.3. Moderating Variables

Referring to Zhou et al. [46], we distinguished property rights (SOE) according to the ultimate controller using a dummy variable, with SOEs taking a value of 1 and non-SOEs 0.

Referring to Li et al. [51], we used the percentage of shares held by the largest shareholder of the enterprise to measure the ownership concentration (TOP1).

3.2.4. Control Variables

Referring to Lidia et al. [3], we included the following control variables: Leverage ratio (LEV) is the ratio of total liabilities to total assets. Return on total assets (ROA) is the ratio of net profit for the period to average total assets. Firm size (SIZE) is obtained by taking the natural logarithm of total assets. The value of property rights (SOE) is 1 if the firm is state-owned and 0 otherwise. The rate of growth of operating income (GROW) is calculated by subtracting 1 from the ratio of the current year's operating income to that of the previous year. Firm age (AGE) is the natural logarithm of the current year minus the year of the firm's establishment plus 1. Ownership concentration (TOP1) is obtained by dividing the number of shares held by the largest shareholder by the total number of shares. Board independence (INDEP) is the percentage of independent directors to all directors. Board size (BSIZE) is the natural logarithm of the total number of board members. To measure loss (LOSS), we assigned a value of 1 if the net profit for the current year is less than 0; otherwise, it is 0. In addition, we control for year dummy variables (YEAR) and industry dummy variables (IND). We utilized the 2012 industry classification standards of the China Securities Regulatory Commission.

*3.3. Empirical Model*

We established model (1) to test the impact of the business environment on corporate innovation. PAT measures firm innovation. The independent variables X are BE, ME, GE, LE, and HE. Research Hypothesis 1 is supported if the estimated coefficient $\alpha_1$ of X is significant and positive.

$$\begin{aligned} PAT = {} & \alpha_0 + \alpha_1 X + \alpha_2 LEV + \alpha_3 ROA + \alpha_4 SIZE + \alpha_5 SOE + \alpha_6 GROW + \alpha_7 AGE + \\ & \alpha_8 TOP1 + \alpha_9 INDEP + \alpha_{10} BSIZE + \alpha_{11} LOSS + \sum YEAR + \sum IND + \varepsilon \end{aligned} \quad (1)$$

To test Hypothesis 4, we added the interaction term X × SOE based on model (1) to form model (2). SOE is a dummy variable for property rights. Hypothesis 4 is supported if the estimated coefficient $\beta_2$ of X × SOE is significant and positive.

$$\begin{aligned} PAT = {} & \beta_0 + \beta_1 X + \beta_2 X \times SOE + \beta_3 LEV + \beta_4 ROA + \beta_5 SIZE + \beta_6 SOE + \\ & \beta_7 GROW + \beta_8 AGE + \beta_9 TOP1 + \beta_{10} INDEP + \beta_{11} BSIZE + \beta_{12} LOSS + \\ & \sum YEAR + \sum IND + \varepsilon \end{aligned} \quad (2)$$

To test Hypothesis 5, we estimated the interaction term X × TOP1 based on model (1) to form model (3). In model (3), TOP1 represents ownership concentration. Hypothesis 5 is supported if the estimated coefficient $\beta_2$ of X × TOP1 is significant and positive.

$$PAT = \lambda_0 + \lambda_1 X + \lambda_2 X \times TOP1 + \lambda_3 LEV + \lambda_4 ROA + \lambda_5 SIZE + \lambda_6 SOE + \lambda_7 GROW + \lambda_8 AGE + \lambda_9 TOP1 + \lambda_{10} INDEP + \lambda_{11} BSIZE + \lambda_{12} LOSS + \sum YEAR + \sum IND + \varepsilon \quad (3)$$

## 4. Empirical Results

### *4.1. Descriptive Statistics*

Table 3 presents the descriptive statistics for the main variables. The minimum values of BE, ME, GE, LE, and HE are 22.19, 11.75, 18.42, 15.35, and 15.60, respectively; the maximum values are 70.99, 71.97, 80.08, 79.44, and 88.80, respectively; and the standard deviations are 9.45, 13.13, 10.74, 15.10, and 15.82, respectively, indicating great differences in the business environments among the provinces. The average value for PAT is 1.26, which indicates that the enterprises in the sample obtain three invention patents per year on average. For the control variables, the mean value of LEV is 0.41, the average ROA is 0.04, and the average SIZE is 22.28. The mean value of SOE is 0.29, indicating that about 29% of the firms in the sample are SOEs, the average value for GROW for the firms in the sample is 15%, the average AGE is 20 years, and the mean value of TOP1 is 33%. The mean value of INDEP is 0.38, indicating that approximately 38% of the firms in the sample have independent directors, the average firm has about eight directors, and approximately 11% of the firms in the sample are loss-making enterprises.

**Table 3.** Descriptive statistics.

| Variable | N | Mean | S.D. | Min | P25 | Median | P75 | Max |
|---|---|---|---|---|---|---|---|---|
| BE | 13,820 | 56.71 | 9.45 | 22.19 | 48.81 | 57.56 | 64.57 | 70.99 |
| ME | 13,820 | 44.95 | 13.13 | 11.75 | 33.78 | 47.12 | 56.61 | 71.97 |
| GE | 13,820 | 61.71 | 10.74 | 18.42 | 54.13 | 61.88 | 71.10 | 80.08 |
| LE | 13,820 | 50.96 | 15.10 | 15.35 | 38.97 | 55.87 | 61.30 | 79.44 |
| HE | 13,820 | 74.34 | 15.82 | 1.56 | 71.26 | 80.24 | 84.35 | 88.80 |
| PAT | 13,820 | 1.26 | 1.29 | 0.00 | 0.00 | 1.10 | 2.08 | 7.79 |
| LEV | 13,820 | 0.41 | 0.20 | 0.06 | 0.25 | 0.40 | 0.56 | 0.91 |
| ROA | 13,820 | 0.04 | 0.08 | −0.40 | 0.02 | 0.04 | 0.08 | 0.24 |
| SIZE | 13,820 | 22.28 | 1.31 | 19.89 | 21.33 | 22.09 | 23.01 | 26.40 |
| SOE | 13,820 | 0.29 | 0.45 | 0.00 | 0.00 | 0.00 | 1.00 | 1.00 |
| GROW | 13,820 | 0.15 | 0.38 | −0.66 | −0.02 | 0.10 | 0.25 | 3.39 |
| AGE | 13,820 | 2.98 | 0.29 | 2.20 | 2.83 | 3.00 | 3.18 | 3.56 |
| TOP1 | 13,820 | 0.33 | 0.14 | 0.09 | 0.22 | 0.31 | 0.43 | 0.73 |
| INDEP | 13,820 | 0.38 | 0.05 | 0.31 | 0.33 | 0.36 | 0.43 | 0.57 |
| BSIZE | 13,820 | 2.11 | 0.20 | 1.61 | 1.95 | 2.20 | 2.20 | 2.71 |
| LOSS | 13,820 | 0.11 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 |

### *4.2. Pearson Correlation Analysis*

Table 4 reports the correlations among the variables. As expected, BE, ME, GE, LE, and HE are significantly and positively correlated with PAT, indicating that a favorable business environment enhances corporate innovation; thus, these initial results support hypothesis 1. LEV, ROA, SIZE, SOE, GROW, and BSIZE are significantly and positively correlated with PAT, and AGE, TOP1, INDEP, and LOSS are also significantly correlated with PAT, indicating that our control variables are appropriate. In addition, the variance inflation factor is less than the threshold value of 10, indicating that there is no multicollinearity problem in our sample.

**Table 4.** Pearson correlation analysis.

| | PAT | BE | ME | GE | LE | HE | LEV | ROA | SIZE | SOE | GROW | AGE | TOP1 | INDEP | BSIZE | LOSS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PAT | 1 | | | | | | | | | | | | | | | |
| BE | 0.08 *** (0.00) | 1 | | | | | | | | | | | | | | |
| ME | 0.08 *** (0.00) | 0.87 *** (0.00) | 1 | | | | | | | | | | | | | |
| GE | 0.07 *** (0.00) | 0.82 *** (0.00) | 0.60 *** (0.00) | 1 | | | | | | | | | | | | |
| LE | 0.02 *** (0.01) | 0.67 *** (0.00) | 0.57 *** (0.00) | 0.30 *** (0.00) | 1 | | | | | | | | | | | |
| HE | 0.07 *** (0.00) | 0.53 *** (0.00) | 0.64 *** (0.00) | 0.30 *** (0.00) | 0.28 *** (0.00) | 1 | | | | | | | | | | |
| LEV | 0.10 *** (0.00) | −0.06 *** (0.00) | −0.07 *** (0.00) | −0.04 *** (0.00) | −0.05 *** (0.00) | −0.06 *** (0.00) | 1 | | | | | | | | | |
| ROA | 0.03 *** (0.00) | 0.03 *** (0.00) | 0.03 *** (0.00) | 0.02 *** (0.00) | 0.01 (0.17) | 0.05 *** (0.00) | −0.36 *** (0.00) | 1 | | | | | | | | |
| SIZE | 0.33 *** (0.00) | −0.01 (0.33) | −0.02 ** (0.01) | 0.02 ** (0.04) | −0.03 *** (0.00) | −0.04 *** (0.00) | 0.52 *** (0.00) | −0.02 * (0.03) | 1 | | | | | | | |
| SOE | 0.07 *** (0.00) | −0.10 *** (0.00) | −0.12 *** (0.00) | −0.03 *** (0.00) | −0.12 *** (0.00) | −0.12 *** (0.00) | 0.25 *** (0.00) | −0.07 *** (0.00) | 0.38 *** (0.00) | 1 | | | | | | |
| GROW | 0.03 *** (0.00) | −0.08 *** (0.00) | −0.07 *** (0.00) | −0.06 *** (0.00) | −0.08 *** (0.00) | 0.00 (0.68) | 0.02 *** (0.00) | 0.26 *** (0.00) | 0.03 *** (0.00) | −0.05 *** (0.00) | 1 | | | | | |
| AGE | −0.04 *** (0.00) | −0.02 ** (0.04) | −0.06 *** (0.00) | 0.00 (0.63) | 0.01 (0.24) | −0.10 *** (0.00) | 0.17 *** (0.00) | −0.11 *** (0.00) | 0.19 *** (0.00) | 0.24 *** (0.00) | −0.09 *** (0.00) | 1 | | | | |
| TOP1 | −0.02 (0.03) | −0.01 (0.24) | 0.00 (0.64) | −0.02 * (0.06) | −0.00 (0.67) | 0.02 ** (0.03) | 0.03 *** (0.00) | 0.17 *** (0.00) | 0.17 *** (0.00) | 0.24 *** (0.00) | 0.00 (0.97) | −0.04 *** (0.00) | 1 | | | |
| INDEP | 0.01 (0.24) | 0.02*** (0.01) | 0.04 *** (0.00) | 0.01 (0.29) | −0.00 (0.84) | 0.027 *** (0.00) | 0.01 (0.57) | −0.02 * (0.05) | −0.01 * (0.08) | −0.04 *** (0.00) | −0.00 (0.67) | −0.03 *** (0.00) | 0.05 *** (0.00) | 1 | | |
| BSIZE | 0.09 *** (0.00) | −0.06 *** (0.00) | −0.09 *** (0.00) | −0.03 *** (0.00) | −0.04 *** (0.00) | −0.06 *** (0.00) | 0.13 *** (0.00) | 0.01 (0.31) | 0.27 *** (0.00) | 0.24 *** (0.00) | −0.01 (0.16) | 0.11 *** (0.00) | 0.01 (0.41) | −0.59 *** (0.00) | 1 | |
| LOSS | −0.05 *** (0.00) | −0.01 * (0.10) | −0.02 * (0.08) | −0.02 * (0.07) | 0.01 (0.47) | −0.04 *** (0.00) | 0.19 *** (0.00) | −0.69 *** (0.00) | −0.07 *** (0.00) | −0.03 *** (0.00) | −0.22 *** (0.00) | 0.05 *** (0.00) | −0.14 *** (0.00) | 0.02 *** (0.00) | −0.05 *** (0.00) | 1 |

Notes: (1) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; (2) $p$ values in parentheses.

### *4.3. Results of Baseline Regression*

Table 5 reports the results of the regression analysis of the influence of the business environment on corporate innovation. In columns (1)–(5), the coefficients of BE, ME, GE, LE, and HE are 0.0115, 0.0082, 0.0091, 0.0021, and 0.0057, respectively, all of which are significant and positive at the 1% level, indicating that the business environment has a significant positive relationship with corporate innovation. The results show that a favorable business environment can promote corporate innovation. Thus, hypothesis 1 is supported. The results suggest that corporate innovation is influenced by both sub-environments and

the overall business environment. A favorable business environment provides abundant resources and stability for innovation. Therefore, practitioners and policymakers seeking to improve the business environment should consider multiple aspects of the business environment as a whole rather than focusing on just one factor.

**Table 5.** Results of the baseline regression.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | **PAT** | **PAT** | **PAT** | **PAT** | **PAT** |
| BE | 0.0115 *** | | | | |
| | (11.15) | | | | |
| ME | | 0.0082 *** | | | |
| | | (10.86) | | | |
| GE | | | 0.0091 *** | | |
| | | | (10.12) | | |
| LE | | | | 0.0021 *** | |
| | | | | (3.25) | |
| HE | | | | | 0.0057 *** |
| | | | | | (10.24) |
| LEV | −0.4180 *** | −0.4137 *** | −0.4285 *** | −0.4532 *** | −0.4380 *** |
| | (−7.04) | (−6.96) | (−7.21) | (−7.63) | (−7.39) |
| ROA | −0.4063 ** | −0.3915 ** | −0.3923 ** | −0.3881 ** | −0.3985 ** |
| | (−2.33) | (−2.25) | (−2.24) | (−2.21) | (−2.28) |
| SIZE | 0.4956 *** | 0.4953 *** | 0.4964 *** | 0.5005 *** | 0.4983 *** |
| | (45.77) | (45.84) | (45.72) | (45.84) | (45.99) |
| SOE | 0.1350 *** | 0.1373 *** | 0.1184 *** | 0.1221 *** | 0.1365 *** |
| | (5.71) | (5.80) | (5.01) | (5.12) | (5.76) |
| GROW | −0.0605 ** | −0.0597 ** | −0.0614 ** | −0.0670 *** | −0.0634 ** |
| | (−2.38) | (−2.35) | (−2.41) | (−2.62) | (−2.49) |
| AGE | −0.1807 *** | −0.1682 *** | −0.1865 *** | −0.1920 *** | −0.1723 *** |
| | (−5.39) | (−5.03) | (−5.55) | (−5.69) | (−5.14) |
| TOP1 | −0.2979 *** | −0.3111 *** | −0.2789 *** | −0.2853 *** | −0.3069 *** |
| | (−4.38) | (−4.57) | (−4.10) | (−4.18) | (−4.50) |
| INDEP | 0.7997 *** | 0.7810 *** | 0.7911 *** | 0.7876 *** | 0.7671 *** |
| | (3.59) | (3.51) | (3.55) | (3.52) | (3.43) |
| BSIZE | 0.2427 *** | 0.2522 *** | 0.2341 *** | 0.2266 *** | 0.2348 *** |
| | (3.73) | (3.87) | (3.60) | (3.48) | (3.61) |
| LOSS | −0.0853 ** | −0.0842 ** | −0.0876 ** | −0.0894 ** | −0.0871 ** |
| | (−2.21) | (−2.19) | (−2.26) | (−2.31) | (−2.26) |
| CONSTANT | −10.9988 *** | −10.7565 *** | −10.9525 *** | −10.5578 *** | −10.9102 *** |
| | (−37.41) | (−37.08) | (−37.21) | (−36.21) | (−37.20) |
| Industry | Yes | Yes | Yes | Yes | Yes |
| Year | Yes | Yes | Yes | Yes | Yes |
| N | 13,820 | 13,820 | 13,820 | 13,820 | 13,820 |
| Adj-$R^2$ | 0.3566 | 0.3567 | 0.3556 | 0.3513 | 0.3555 |
| F | 204.07 *** | 187.99 *** | 200.32 *** | 188.76 *** | 202.63 *** |

Notes: (1) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; (2) t values in parentheses; (3) heteroskedastic robust standard errors are used.

### *4.4. Endogeneity Checks*

#### 4.4.1. Endogeneity Check Using Fixed-Effects Model

To mitigate possible endogeneity problems due to omitted variables, we use a fixed-effects model (Table 6). The results show that the coefficients of BE, ME, and HE are 0.0064, 0.0064, and 0.0052, respectively, all of which are significant and positive at the 1% level; the coefficient of GE is 0.0014, which is significant and positive at the 5% level. The coefficient of LE is 0.0014, which is significant and positive at the 10% level. This implies that the results of the empirical analysis using the fixed-effects model still support research hypothesis 1, indicating that our findings are robust.

**Table 6.** Results of the fixed-effects model.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | **PAT** | **PAT** | **PAT** | **PAT** | **PAT** |
| BE | 0.0064 *** | | | | |
| | (4.59) | | | | |
| ME | | 0.0064 *** | | | |
| | | (4.88) | | | |
| GE | | | 0.0014 ** | | |
| | | | (1.99) | | |
| LE | | | | 0.0014 * | |
| | | | | (1.93) | |
| HE | | | | | 0.0052 *** |
| | | | | | (5.99) |
| LEV | −0.5268 *** | −0.5257 *** | −0.5340 *** | −0.5348 *** | −0.5347 *** |
| | (−6.16) | (−6.15) | (−6.24) | (−6.24) | (−6.26) |
| ROA | −0.6156 *** | −0.6128 *** | −0.6119 *** | −0.6109 *** | −0.6153 *** |
| | (−4.42) | (−4.40) | (−4.39) | (−4.38) | (−4.42) |
| SIZE | 0.3887 *** | 0.3884 *** | 0.3896 *** | 0.3898 *** | 0.3894 *** |
| | (19.36) | (19.39) | (19.34) | (19.33) | (19.40) |
| SOE | −0.0697 * | −0.0658 | −0.0760 * | −0.0736 * | −0.0645 |
| | (−1.72) | (−1.63) | (−1.88) | (−1.81) | (−1.60) |
| GROW | −0.0104 | −0.0109 | −0.0105 | −0.0116 | −0.0102 |
| | (−0.61) | (−0.65) | (−0.62) | (−0.69) | (−0.61) |
| AGE | −0.4065 *** | −0.3937 *** | −0.4158 *** | −0.4163 *** | −0.3967 *** |
| | (−6.72) | (−6.54) | (−6.85) | (−6.84) | (−6.56) |
| TOP1 | −0.4442 *** | −0.4478 *** | −0.4427 *** | −0.4433 *** | −0.4541 *** |
| | (−3.75) | (−3.78) | (−3.73) | (−3.73) | (−3.84) |
| INDEP | 0.0421 | 0.0342 | 0.0352 | 0.0310 | 0.0260 |
| | (0.17) | (0.14) | (0.14) | (0.12) | (0.10) |
| BSIZE | 0.0917 | 0.0980 | 0.0847 | 0.0861 | 0.0909 |
| | (1.06) | (1.13) | (0.98) | (0.99) | (1.06) |
| LOSS | −0.0488 * | −0.0478 * | −0.0490 * | −0.0482 * | −0.0474 * |
| | (−1.86) | (−1.83) | (−1.87) | (−1.84) | (−1.81) |
| CONSTANT | −6.3095 *** | −6.2738 *** | −6.0359 *** | −6.0015 *** | −6.4027 *** |
| | (−12.93) | (−12.96) | (−12.55) | (−12.53) | (−13.14) |
| Year | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes |
| N | 13,820 | 13,820 | 13,820 | 13,820 | 13,820 |

Notes: (1) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; (2) t values in parentheses; (3) heteroskedastic robust standard errors are used.

#### 4.4.2. Endogeneity Check Using Propensity-Score Matching

To alleviate potential endogeneity problems caused by selection bias, we used propensity-score matching. Depending on whether BE is larger than or equal to the median, we divided the sample into a high BE group and a low BE group. The high BE group is assigned a value of 1, and the low BE group is assigned a value of 0. LEV, GROW, SOE, SIZE, BSIZE, ROA, and AGE are selected as covariates for the logit regression, and the samples are matched by the nearest-neighbor matching method. In the end, we obtained 12,231 matched samples for the regression.

Table 7 reports the results of the regression analysis using the matched samples. The coefficients of BE, ME, HE, LE, and HE are all significant and positive at the 1% level, indicating that the positive relationship between the business environment and corporate innovation still holds, thereby supporting Hypothesis 1.

**Table 7.** Results using propensity-score matching.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | **PAT** | **PAT** | **PAT** | **PAT** | **PAT** |
| BE | 0.0113 *** | | | | |
| | (10.39) | | | | |
| ME | | 0.0084 *** | | | |
| | | (10.45) | | | |
| GE | | | 0.0087 *** | | |
| | | | (9.02) | | |
| LE | | | | 0.0024 *** | |
| | | | | (3.44) | |
| HE | | | | | 0.0060 *** |
| | | | | | (10.12) |
| LEV | −0.4412 *** | −0.4342 *** | −0.4521 *** | −0.4708 *** | −0.4577 *** |
| | (−6.84) | (−6.73) | (−7.00) | (−7.29) | (−7.12) |
| ROA | −0.4660 ** | −0.4494 ** | −0.4591 ** | −0.4569 ** | −0.4653 ** |
| | (−2.48) | (−2.40) | (−2.44) | (−2.42) | (−2.49) |
| SIZE | 0.4995 *** | 0.4989 *** | 0.5000 *** | 0.5031 *** | 0.5014 *** |
| | (42.79) | (42.86) | (42.69) | (42.74) | (42.94) |
| SOE | 0.1555 *** | 0.1578 *** | 0.1414 *** | 0.1488 *** | 0.1599 *** |
| | (6.13) | (6.22) | (5.58) | (5.82) | (6.29) |
| GROW | −0.0363 | −0.0373 | −0.0340 | −0.0368 | −0.0388 |
| | (−1.19) | (−1.23) | (−1.11) | (−1.19) | (−1.27) |
| AGE | −0.1998 *** | −0.1868 *** | −0.2061 *** | −0.2123 *** | −0.1906 *** |
| | (−5.55) | (−5.21) | (−5.72) | (−5.86) | (−5.29) |
| TOP1 | −0.2622 *** | −0.2736 *** | −0.2450 *** | −0.2486 *** | −0.2692 *** |
| | (−3.61) | (−3.76) | (−3.37) | (−3.41) | (−3.69) |
| INDEP | 0.8300 *** | 0.8068 *** | 0.8200 *** | 0.8157 *** | 0.7965 *** |
| | (3.49) | (3.39) | (3.44) | (3.41) | (3.33) |
| BSIZE | 0.2143 *** | 0.2234 *** | 0.2073 *** | 0.2024 *** | 0.2098 *** |
| | (3.10) | (3.23) | (2.99) | (2.92) | (3.04) |
| LOSS | −0.0903 ** | −0.0888 ** | −0.0928 ** | −0.0948 ** | −0.0917 ** |
| | (−2.18) | (−2.15) | (−2.23) | (−2.27) | (−2.21) |
| CONSTANT | −10.9713 *** | −10.7338 *** | −10.9064 *** | −10.5248 *** | −10.8974 *** |
| | (−34.91) | (−34.65) | (−34.66) | (−33.83) | (−34.82) |
| Industry | Yes | Yes | Yes | Yes | Yes |
| Year | Yes | Yes | Yes | Yes | Yes |
| N | 12,231 | 12,231 | 12,231 | 12,231 | 12,231 |
| Adj-$R^2$ | 0.3565 | 0.3570 | 0.3551 | 0.3515 | 0.3559 |
| F | 209.46 *** | 175.83 *** | 203.28 *** | 181.75 *** | 210.08 *** |

Notes: (1) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; (2) t values in parentheses; (3) heteroskedastic robust standard errors are used.

### *4.5. Robustness Checks*

#### 4.5.1. Robustness Check Using an Alternative Dependent Variable

We tested the robustness of the empirical results by replacing the variable representing corporate innovation. The new variable was PAT2, measured as the natural logarithm of the total number of patents granted for invention, utility model, and design patents plus 1. Table 8 reports the results of this robustness test after replacing the variable representing corporate innovation. In columns (1)–(5), the coefficients of BE, ME, GE, LE, and HE are 0.0132, 0.0089, 0.0098, 0.0029, and 0.0082, respectively, all of which are significant and positive at the 1% level. These results imply that the results of the main analysis are still robust after changing the dependent variable.

**Table 8.** Results using an alternative dependent variable.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | **PAT2** | **PAT2** | **PAT2** | **PAT2** | **PAT2** |
| BE | 0.0132 *** | | | | |
| | (10.67) | | | | |
| ME | | 0.0089 *** | | | |
| | | (10.14) | | | |
| GE | | | 0.0098 *** | | |
| | | | (8.94) | | |
| LE | | | | 0.0029 *** | |
| | | | | (3.59) | |
| HE | | | | | 0.0082 *** |
| | | | | | (11.96) |
| LEV | 0.1592 ** | 0.1612 ** | 0.1446 ** | 0.1197 | 0.1420 * |
| | (2.17) | (2.19) | (1.97) | (1.63) | (1.95) |
| ROA | 0.1287 | 0.1466 | 0.1459 | 0.1476 | 0.1319 |
| | (0.59) | (0.68) | (0.67) | (0.68) | (0.61) |
| SIZE | 0.5936 *** | 0.5935 *** | 0.5947 *** | 0.5991 *** | 0.5960 *** |
| | (51.01) | (51.05) | (50.96) | (51.25) | (51.39) |
| SOE | −0.0166 | −0.0155 | −0.0361 | −0.0298 | −0.0084 |
| | (−0.59) | (−0.55) | (−1.29) | (−1.06) | (−0.30) |
| GROW | −0.0837 *** | −0.0833 *** | −0.0853 *** | −0.0911 *** | −0.0860 *** |
| | (−2.62) | (−2.61) | (−2.66) | (−2.84) | (−2.69) |
| AGE | −0.3374 *** | −0.3245 *** | −0.3446 *** | −0.3504 *** | −0.3222 *** |
| | (−8.46) | (−8.15) | (−8.61) | (−8.72) | (−8.10) |
| TOP1 | −0.0506 | −0.0637 | −0.0287 | −0.0377 | −0.0694 |
| | (−0.62) | (−0.78) | (−0.35) | (−0.46) | (−0.85) |
| INDEP | 0.3647 | 0.3424 | 0.3530 | 0.3548 | 0.3271 |
| | (1.43) | (1.34) | (1.39) | (1.39) | (1.29) |
| BSIZE | 0.2087 *** | 0.2178 *** | 0.1979 *** | 0.1909 ** | 0.2029 *** |
| | (2.79) | (2.91) | (2.65) | (2.55) | (2.72) |
| LOSS | −0.1061 ** | −0.1052 ** | −0.1090 ** | −0.1106 ** | −0.1072 ** |
| | (−2.21) | (−2.19) | (−2.26) | (−2.29) | (−2.23) |
| CONSTANT | −12.0629 *** | −11.7668 *** | −11.9708 *** | −11.5718 *** | −12.0839 *** |
| | (−37.82) | (−37.31) | (−37.30) | (−36.38) | (−38.09) |
| Industry | Yes | Yes | Yes | Yes | Yes |
| Year | Yes | Yes | Yes | Yes | Yes |
| N | 13,820 | 13,820 | 13,820 | 13,820 | 13,820 |
| Adj-$R^2$ | 0.4482 | 0.4477 | 0.4468 | 0.4441 | 0.4494 |
| F | 326.26 *** | 327.36 *** | 323.02 *** | 316.48 *** | 329.54 *** |

Notes: (1) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; (2) t values in parentheses; (3) heteroskedastic robust standard errors are used.

#### 4.5.2. Robustness Check Using Alternative Independent Variables

The explanatory variables BE, ME, GE, LE, and HE are processed by year according to the median, and samples larger than the median are assigned a value of 1, while those smaller than the median are assigned a value of 0. Then the corresponding dummy variables BE2, ME2, GE2, LE2, and HE2, respectively, are obtained. Table 9 reports the results of the regression analysis after changing the independent variables; the coefficients of BE2, ME2, GE2, LE2, and HE2 are 0.1118, 0.1499, 0.1485, 0.1063, and 0.1514, respectively, all of which are significant and positive at the 1% level. These results indicate that the results of the main analysis are still robust after changing the independent variables.

**Table 9.** Results using alternative independent variables.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | **PAT** | **PAT** | **PAT** | **PAT** | **PAT** |
| BE2 | 0.1118 *** | | | | |
| | (5.49) | | | | |
| ME2 | | 0.1499 *** | | | |
| | | (7.91) | | | |
| GE2 | | | 0.1485 *** | | |
| | | | (8.12) | | |
| LE2 | | | | 0.1063 *** | |
| | | | | (5.38) | |
| HE2 | | | | | 0.1514 *** |
| | | | | | (8.09) |
| LEV | −0.4427 *** | −0.4364 *** | −0.4390 *** | −0.4522 *** | −0.4416 *** |
| | (−7.45) | (−7.35) | (−7.39) | (−7.61) | (−7.44) |
| ROA | −0.3919 ** | −0.3844 ** | −0.3895 ** | −0.3932 ** | −0.3856 ** |
| | (−2.23) | (−2.20) | (−2.22) | (−2.24) | (−2.21) |
| SIZE | 0.4990 *** | 0.4991 *** | 0.4974 *** | 0.5009 *** | 0.4991 *** |
| | (45.84) | (45.97) | (45.77) | (45.95) | (45.96) |
| SOE | 0.1212 *** | 0.1330 *** | 0.1129 *** | 0.1276 *** | 0.1332 *** |
| | (5.11) | (5.61) | (4.77) | (5.36) | (5.62) |
| GROW | −0.0647 ** | −0.0618 ** | −0.0619 ** | −0.0688 *** | −0.0629 ** |
| | (−2.54) | (−2.43) | (−2.42) | (−2.69) | (−2.47) |
| AGE | −0.1858 *** | −0.1805 *** | −0.1892 *** | −0.1910 *** | −0.1809 *** |
| | (−5.52) | (−5.37) | (−5.63) | (−5.66) | (−5.39) |
| TOP1 | −0.2876 *** | −0.3047 *** | −0.2755 *** | −0.2874 *** | −0.3011 *** |
| | (−4.22) | (−4.47) | (−4.05) | (−4.21) | (−4.42) |
| INDEP | 0.7787 *** | 0.7515 *** | 0.7674 *** | 0.7890 *** | 0.7630 *** |
| | (3.48) | (3.36) | (3.43) | (3.53) | (3.41) |
| BSIZE | 0.2339 *** | 0.2408 *** | 0.2295 *** | 0.2315 *** | 0.2433 *** |
| | (3.59) | (3.69) | (3.53) | (3.55) | (3.73) |
| LOSS | −0.0896 ** | −0.0869 ** | −0.0909 ** | −0.0897 ** | −0.0846 ** |
| | (−2.31) | (−2.25) | (−2.34) | (−2.32) | (−2.19) |
| CONSTANT | −10.4817 *** | −10.5145 *** | −10.4718 *** | −10.5111 *** | −10.5662 *** |
| | (−36.19) | (−36.35) | (−36.20) | (−36.23) | (−36.47) |
| Industry | Yes | Yes | Yes | Yes | Yes |
| Year | Yes | Yes | Yes | Yes | Yes |
| N | 13,820 | 13,820 | 13,820 | 13,820 | 13,820 |
| Adj-$R^2$ | 0.3523 | 0.3539 | 0.3539 | 0.3522 | 0.3540 |
| F | 187.07 *** | 196.92 *** | 188.84 *** | 180.37 *** | 190.84 *** |

Notes: (1) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; (2) t values in parentheses; (3) heteroskedastic robust standard errors are used.

#### 4.5.3. Robustness Check Incorporating Additional Control Variable

To control for other factors that may affect both the business environment and firm innovation, such as local economic development, we now add an additional control variable, per capita GDP (GDP), which is a comprehensive index that can reflect the development level of regional social productive forces and people's living standards. Referring to [52], we use per capita GDP to measure local economic development. In Table 10, the coefficients of BE, ME, GE, LE, and HE are 0.0106, 0.0075, 0.0084, 0.0023, and 0.0052, respectively, all of which are significant and positive at the 1% level. The results show that even after considering local economic development, the business environment still has a significant positive relationship with corporate innovation. Consistent with previous findings, this indicates that the robustness of our conclusions still holds after the addition of new control variables.

**Table 10.** Results with additional control variable.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | **PAT** | **PAT** | **PAT** | **PAT** | **PAT** |
| BE | 0.0106 *** | | | | |
| | (10.28) | | | | |
| ME | | 0.0075 *** | | | |
| | | (9.52) | | | |
| GE | | | 0.0084 *** | | |
| | | | (9.23) | | |
| LE | | | | 0.0023 *** | |
| | | | | (3.53) | |
| HE | | | | | 0.0052 *** |
| | | | | | (8.99) |
| GDP | 0.0000 *** | 0.0000 ** | 0.0000 *** | 0.0000 *** | 0.0000 *** |
| | (4.30) | (2.42) | (4.54) | (6.11) | (4.06) |
| LEV | −0.4025 *** | −0.4070 *** | −0.4113 *** | −0.4262 *** | −0.4223 *** |
| | (−6.78) | (−6.85) | (−6.93) | (−7.18) | (−7.14) |
| ROA | −0.3855 ** | −0.3794 ** | −0.3714 ** | −0.3624 ** | −0.3786 ** |
| | (−2.21) | (−2.18) | (−2.13) | (−2.07) | (−2.17) |
| SIZE | 0.4923 *** | 0.4937 *** | 0.4928 *** | 0.4952 *** | 0.4950 *** |
| | (45.56) | (45.70) | (45.51) | (45.57) | (45.78) |
| SOE | 0.1231 *** | 0.1292 *** | 0.1071 *** | 0.1082 *** | 0.1243 *** |
| | (5.19) | (5.43) | (4.52) | (4.53) | (5.23) |
| GROW | −0.0597 ** | −0.0597 ** | −0.0606 ** | −0.0652 ** | −0.0627 ** |
| | (−2.35) | (−2.35) | (−2.38) | (−2.55) | (−2.46) |
| AGE | −0.1659 *** | −0.1613 *** | −0.1704 *** | −0.1697 *** | −0.1594 *** |
| | (−4.95) | (−4.82) | (−5.08) | (−5.05) | (−4.76) |
| TOP1 | −0.2973 *** | −0.3085 *** | −0.2798 *** | −0.2873 *** | −0.3048 *** |
| | (−4.38) | (−4.53) | (−4.12) | (−4.22) | (−4.47) |
| INDEP | 0.7928 *** | 0.7772 *** | 0.7845 *** | 0.7831 *** | 0.7629 *** |
| | (3.57) | (3.49) | (3.53) | (3.51) | (3.42) |
| BSIZE | 0.2445 *** | 0.2514 *** | 0.2366 *** | 0.2316 *** | 0.2367 *** |
| | (3.76) | (3.86) | (3.65) | (3.56) | (3.65) |
| LOSS | −0.0874 ** | −0.0857 ** | −0.0896 ** | −0.0917 ** | −0.0890 ** |
| | (−2.27) | (−2.23) | (−2.32) | (−2.37) | (−2.31) |
| CONSTANT | −10.9908 *** | −10.7496 *** | −10.9463 *** | −10.6102 *** | −10.8963 *** |
| | (−37.52) | (−37.11) | (−37.33) | (−36.51) | (−37.29) |
| Industry | Yes | Yes | Yes | Yes | Yes |
| Year | Yes | Yes | Yes | Yes | Yes |
| N | 13,820 | 13,820 | 13,820 | 13,820 | 13,820 |
| Adj-$R^2$ | 0.3575 | 0.3569 | 0.3566 | 0.3534 | 0.3563 |
| F | 220.71 *** | 220.13 *** | 219.86 *** | 216.76 *** | 219.58 *** |

Notes: (1) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; (2) t values in parentheses; (3) heteroskedastic robust standard errors are used.

### *4.6. Mediating Effect Test*

We then ran a test to determine the mediating mechanism for the path of alleviating financing constraints and the path of reducing environmental uncertainty, as mentioned earlier.

Using the calculation method of Whited and Wu [53], we defined model (4) to calculate the WW index, which is the proxy variable for financing constraints. The larger the index, the more serious the constraints on financing in enterprises.

$$\begin{aligned} WW_{(i,t)} = {} & -0.091 \times CF_{(i,t)} - 0.062 \times DIVPOS_{(i,t)} + 0.021 \times TLTD_{(i,t)} - \\ & 0.044 \times LNTA_{(i,t)} + 0.102 \times IGROWTH_{(i,t)} - 0.035 \times GROWTH_{(i,t)} \end{aligned} \quad (4)$$

In model (4), CF denotes the ratio of cash flow to total assets; DIVPOS denotes whether dividends are paid; LNTA denotes the logarithm of total assets; TLTD denotes the long-term

debt ratio; IGROWTH denotes the rate of growth of industry sales income; and GROWTH denotes the rate of growth of corporate sales income.

Referring to Ghosh and Olsen [54], we used the industry-adjusted standard deviation of sales income in the past 5 years to measure environmental uncertainty. A portion of the change in sales income over the past 5 years is attributable to steady growth; therefore, to measure environmental uncertainty accurately, we excluded the stable growth component of sales income. That is, for each enterprise, we utilized data from the past 5 years. Model (5) was used to estimate abnormal sales income for the past 5 years separately.

$$SALE = \alpha_0 + \alpha_1 YEAR + \varepsilon \quad (5)$$

In model (5), SALE is sales income; YEAR is the annual variable, with a value of 1 if the observation belongs to the 4th year in the past, a value of 2 if the observation belongs to the 3rd year in the past, and so on. The residual $\varepsilon$ of the model is the abnormal sales income. The standard deviation of each enterprise's abnormal sales income in the past 5 years is divided by the average value of the sales income in the past 5 years to obtain a value for environmental uncertainty without industry adjustment. The unadjusted value for environmental uncertainty divided by the value for industry environmental uncertainty is the industry-adjusted environmental uncertainty for a given firm, which is the environmental uncertainty variable (EU) used in our study. Industry environmental uncertainty is the median of the unadjusted environmental uncertainty of all enterprises in the same industry in the same year.

Row 2 of Table 11 reports the results of testing of the financing constraints path. The results show that the 95% confidence interval of the bootstrap test is [0.000294, 0.000636], excluding 0, indicating that financing constraints play a mediating role. This result supports hypothesis 2. Row 3 of Table 11 reports the results of testing for the mediating mechanism of EU, showing that the 95% confidence interval of the bootstrap test is [0.000130, 0.000465], excluding 0, indicating that EU is a mediating factor in the business environment to stimulate corporate innovation. This result supports hypothesis 3.

**Table 11.** Results of the test for a mediating mechanism.

| X | M | Y | effect | Coef. | Boot SE | 95%Conf.Interval |
|---|---|---|---|---|---|---|
| BE | WW | PAT | indirect | 0.000458 | 0.000093 | [0.000294, 0.000636] |
| BE | EU | PAT | indirect | 0.000255 | 0.000082 | [0.000130, 0.000465] |

### *4.7. Moderating Effect Test*

#### 4.7.1. Property Rights

Table 12 reports the results of testing for the moderating effect of property rights. Focusing mainly on the coefficients of the interaction terms in the model, we see that the coefficients of BE × SOE, ME × SOE, GE × SOE, LE × SOE, and HE × SOE are significant and positive (0.0113 with t = 6.2261; 0.0070 with t = 4.6322; 0.0079 with t = 4.4409; 0.0046 with t = 3.4881; and 0.0049 with t = 4.1604, respectively). These results indicate that property rights can positively affect the relationship between the business environment and corporate innovation; therefore, the promotional effect of the business environment on corporate innovation is more significant in SOEs. This result supports Hypothesis 4. Possible explanations are as follows: Firstly, because of SOEs' close affiliations with the government, information asymmetry is reduced, and access to innovation incentives is increased. Secondly, corporate social responsibilities prompt the government to allocate more resources towards SOEs. Lastly, stringent regulation of SOEs curbs opportunistic behavior during the innovation process.

**Table 12.** Results of the test for a moderating effect of property rights.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | **PAT** | **PAT** | **PAT** | **PAT** | **PAT** |
| BE | 0.0075 *** | | | | |
| | (6.23) | | | | |
| BE × SOE | 0.0113 *** | | | | |
| | (5.61) | | | | |
| ME | | 0.0057 *** | | | |
| | | (6.42) | | | |
| ME × SOE | | 0.0070 *** | | | |
| | | (4.63) | | | |
| GE | | | 0.0065 *** | | |
| | | | (6.17) | | |
| GE × SOE | | | 0.0079 *** | | |
| | | | (4.44) | | |
| LE | | | | 0.0008 | |
| | | | | (1.13) | |
| LE × SOE | | | | 0.0046 *** | |
| | | | | (3.49) | |
| HE | | | | | 0.0040 *** |
| | | | | | (5.94) |
| HE × SOE | | | | | 0.0049 *** |
| | | | | | (4.16) |
| LEV | −0.3978 *** | −0.3945 *** | −0.4184 *** | −0.4413 *** | −0.4268 *** |
| | (−6.69) | (−6.64) | (−7.04) | (−7.42) | (−7.21) |
| ROA | −0.3821 ** | −0.3712 ** | −0.3768 ** | −0.3790 ** | −0.3764 ** |
| | (−2.19) | (−2.13) | (−2.16) | (−2.16) | (−2.15) |
| SIZE | 0.4908 *** | 0.4908 *** | 0.4934 *** | 0.4987 *** | 0.4955 *** |
| | (45.40) | (45.59) | (45.48) | (45.73) | (45.79) |
| SOE | −0.4939 *** | −0.1635 ** | −0.3656 *** | −0.1032 | −0.2141 ** |
| | (−4.36) | (−2.39) | (−3.32) | (−1.50) | (−2.47) |
| GROW | −0.0607 ** | −0.0599 ** | −0.0609 ** | −0.0681 *** | −0.0630 ** |
| | (−2.39) | (−2.35) | (−2.39) | (−2.66) | (−2.47) |
| AGE | −0.1852 *** | −0.1707 *** | −0.1879 *** | −0.1941 *** | −0.1773 *** |
| | (−5.52) | (−5.11) | (−5.59) | (−5.75) | (−5.28) |
| TOP1 | −0.3037 *** | −0.3192 *** | −0.2853 *** | −0.2843 *** | −0.3126 *** |
| | (−4.48) | (−4.70) | (−4.20) | (−4.17) | (−4.59) |
| INDEP | 0.8130 *** | 0.7955 *** | 0.7924 *** | 0.7951 *** | 0.7943 *** |
| | (3.66) | (3.57) | (3.56) | (3.55) | (3.55) |
| BSIZE | 0.2498 *** | 0.2549 *** | 0.2377 *** | 0.2321 *** | 0.2380 *** |
| | (3.85) | (3.92) | (3.66) | (3.56) | (3.66) |
| LOSS | −0.0809 ** | −0.0823 ** | −0.0842 ** | −0.0871 ** | −0.0850 ** |
| | (−2.10) | (−2.14) | (−2.18) | (−2.25) | (−2.20) |
| CONSTANT | −10.6793 *** | −10.5563 *** | −10.7285 *** | −10.4641 *** | −10.7237 *** |
| | (−36.19) | (−36.49) | (−36.28) | (−35.89) | (−36.50) |
| Industry | Yes | Yes | Yes | Yes | Yes |
| Year | Yes | Yes | Yes | Yes | Yes |
| N | 13,820 | 13,820 | 13,820 | 13,820 | 13,820 |
| Adj-$R^2$ | 0.3580 | 0.3577 | 0.3565 | 0.3519 | 0.3562 |
| F | 193.61 *** | 185.14 *** | 188.09 *** | 187.80 *** | 194.22 *** |

Notes: (1) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; (2) t values in parentheses; (3) heteroskedastic robust standard errors are used.

#### 4.7.2. Ownership Concentration

Table 13 reports the results of testing for the moderating effect of ownership concentration. The results show that the coefficients of BE × TOP1, ME × TOP1, GE × TOP1, and LE × TOP1 are significant and positive (0.0158 with t = 2.2498; 0.0087 with t = 1.6925; 0.0129 with t = 2.0316; and 0.0108 with t = 2.4943, respectively). They indicate that high ownership concentration positively moderates the relationships between BE, ME, GE, LE, and corporate innovation.

The coefficient of HE × TOP1 is −0.0022, which fails to pass the significance test, indicating that ownership concentration does not significantly affect the relationship between the social environment and corporate innovation. Therefore, we conclude that the higher the ownership concentration, the stronger the positive impact of business environment optimization on corporate innovation. The test results, therefore, support Hypothesis 5. The concentration of equity ownership enhances supervision, reduces the potential for opportunistic behavior by management, and facilitates optimal utilization of resource advantages within favorable business environments. This promotes innovation within enterprises.

**Table 13.** Results of the test for a moderating effect of ownership concentration.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | **PAT** | **PAT** | **PAT** | **PAT** | **PAT** |
| BE | 0.0067 *** | | | | |
| | (2.64) | | | | |
| BE × TOP1 | 0.0158 ** | | | | |
| | (2.25) | | | | |
| ME | | 0.0058 *** | | | |
| | | (3.10) | | | |
| ME × TOP1 | | 0.0087 * | | | |
| | | (1.69) | | | |
| GE | | | 0.0055 ** | | |
| | | | (2.41) | | |
| GE × TOP1 | | | 0.0129 ** | | |
| | | | (2.03) | | |
| LE | | | | −0.0014 | |
| | | | | (−0.89) | |
| LE × TOP1 | | | | 0.0108 ** | |
| | | | | (2.49) | |
| HE | | | | | 0.0066 *** |
| | | | | | (4.91) |
| HE × TOP1 | | | | | −0.0022 |
| | | | | | (−0.55) |
| LEV | −0.3284 *** | −0.3242 *** | −0.3355 *** | −0.3594 *** | −0.3449 *** |
| | (−5.36) | (−5.29) | (−5.48) | (−5.88) | (−5.66) |
| ROA | −0.2856 | −0.2694 | −0.2586 | −0.2579 | −0.2618 |
| | (−1.51) | (−1.43) | (−1.3686) | (−1.3597) | (−1.3903) |
| SIZE | 0.4900 *** | 0.4900 *** | 0.4898 *** | 0.4942 *** | 0.4925 *** |
| | (46.69) | (46.78) | (46.63) | (46.86) | (47.01) |
| GROW | −0.0453 | −0.0457 | −0.0443 | −0.0519 | −0.0522 |
| | (−1.26) | (−1.27) | (−1.23) | (−1.43) | (−1.45) |
| SOE | 0.1429 *** | 0.1448 *** | 0.1254 *** | 0.1313 *** | 0.1439 *** |
| | (6.17) | (6.25) | (5.42) | (5.61) | (6.20) |
| AGE | −0.2070 *** | −0.1935 *** | −0.2115 *** | −0.2213 *** | −0.1976 *** |
| | (−5.99) | (−5.63) | (−6.12) | (−6.35) | (−5.72) |
| TOP1 | −1.1608 *** | −0.6710 *** | −1.0403 *** | −0.7975 *** | −0.1138 |
| | (−2.90) | (−2.81) | (−2.64) | (−3.49) | (−0.38) |
| INDEP | 0.9973 *** | 0.9660 *** | 0.9976 *** | 0.9906 *** | 0.9531 *** |
| | (4.07) | (3.95) | (4.07) | (4.02) | (3.88) |
| BSIZE | 0.3245 *** | 0.3329 *** | 0.3180 *** | 0.3048 *** | 0.3127 *** |
| | (4.77) | (4.89) | (4.67) | (4.47) | (4.60) |
| LOSS | −0.0800 ** | −0.0788 ** | −0.0805 ** | −0.0838 ** | −0.0803 ** |
| | (−2.04) | (−2.01) | (−2.04) | (−2.13) | (−2.05) |
| CONSTANT | −10.8262 *** | −10.7474 *** | −10.8244 *** | −10.4565 *** | −11.0640 *** |
| | (−33.05) | (−35.32) | (−32.95) | (−34.18) | (−35.73) |
| Industry | Yes | Yes | Yes | Yes | Yes |
| Year | Yes | Yes | Yes | Yes | Yes |
| N | 13,820 | 13,820 | 13,820 | 13,820 | 13,820 |
| Adj-$R^2$ | 0.3412 | 0.3415 | 0.3400 | 0.3354 | 0.3398 |
| F | 220.87 *** | 196.24 *** | 206.71 *** | 197.37 *** | 214.05 *** |

Notes: (1) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; (2) t values in parentheses; (3) heteroskedastic robust standard errors are used.

### *4.8. Further Analysis*

Based on the four dimensions of the business environment, we further explore how the interaction between different dimensions will affect the innovation of enterprises. As is

shown in Table 14, the results show that the coefficients of ME × LE, ME × HE, GE × LE, GE × HE, and LE × HE are −0.0002, −0.0002, −0.0002, −0.0001, and −0.0001, respectively, all of which are significant.

**Table 14.** Results of the interaction between different dimensions.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | **PAT** | **PAT** | **PAT** | **PAT** | **PAT** | **PAT** |
| ME | 0.0080 * | 0.0198 *** | 0.0260 *** | | | |
| | (1.87) | (6.60) | (3.98) | | | |
| GE | 0.0062 ** | | | 0.0137 *** | 0.0139 *** | |
| | (2.30) | | | (5.19) | (4.21) | |
| LE | | 0.0048 ** | | 0.0056 * | | 0.0062 ** |
| | | (2.00) | | (1.66) | | (2.21) |
| HE | | | 0.0104 *** | | 0.0104 *** | 0.0102 *** |
| | | | (4.04) | | (3.65) | (5.18) |
| ME × GE | −0.0000 | | | | | |
| | (−0.48) | | | | | |
| ME × LE | | −0.0002 *** | | | | |
| | | (−3.41) | | | | |
| ME × HE | | | −0.0002 *** | | | |
| | | | (−3.09) | | | |
| GE × LE | | | | −0.0001 * | | |
| | | | | (−1.78) | | |
| GE × HE | | | | | −0.0001 ** | |
| | | | | | (−2.07) | |
| LE × HE | | | | | | −0.0001 ** |
| | | | | | | (−2.35) |
| LEV | −0.4106 *** | −0.4101 *** | −0.4165 *** | −0.4296 *** | −0.4214 *** | −0.4381 *** |
| | (−6.91) | (−6.91) | (−7.02) | (−7.23) | (−7.11) | (−7.40) |
| ROA | −0.3966 ** | −0.3765 ** | −0.4050 ** | −0.3895 ** | −0.4100 ** | −0.4020 ** |
| | (−2.28) | (−2.16) | (−2.32) | (−2.23) | (−2.35) | (−2.30) |
| SIZE | 0.4946 *** | 0.4945 *** | 0.4964 *** | 0.4963 *** | 0.4959 *** | 0.4982 *** |
| | (45.80) | (45.84) | (45.96) | (45.69) | (45.90) | (45.98) |
| SOE | 0.1341 *** | 0.1323 *** | 0.1431 *** | 0.1186 *** | 0.1366 *** | 0.1348 *** |
| | (5.66) | (5.58) | (6.05) | (4.99) | (5.79) | (5.67) |
| GROW | −0.0587 ** | −0.0571 ** | −0.0598 ** | −0.0617 ** | −0.0605 ** | −0.0624 ** |
| | (−2.32) | (−2.26) | (−2.35) | (−2.42) | (−2.38) | (−2.45) |
| AGE | −0.1721 *** | −0.1639 *** | −0.1660 *** | −0.1866 *** | −0.1733 *** | −0.1745 *** |
| | (−5.15) | (−4.91) | (−4.97) | (−5.55) | (−5.18) | (−5.20) |
| TOP1 | −0.3028 *** | −0.3063 *** | −0.3138 *** | −0.2789 *** | −0.2999 *** | −0.3035 *** |
| | (−4.45) | (−4.51) | (−4.61) | (−4.10) | (−4.41) | (−4.46) |
| INDEP | 0.7928 *** | 0.7643 *** | 0.7990 *** | 0.7888 *** | 0.7972 *** | 0.7665 *** |
| | (3.56) | (3.43) | (3.59) | (3.54) | (3.58) | (3.43) |
| BSIZE | 0.2500 *** | 0.2571 *** | 0.2509 *** | 0.2330 *** | 0.2411 *** | 0.2346 *** |
| | (3.84) | (3.95) | (3.86) | (3.59) | (3.72) | (3.61) |
| LOSS | −0.0839 ** | −0.0823 ** | −0.0828 ** | −0.0864 ** | −0.0846 ** | −0.0875 ** |
| | (−2.18) | (−2.14) | (−2.15) | (−2.23) | (−2.19) | (−2.27) |
| CONSTANT | −11.0131 *** | −11.1038 *** | −11.5243 *** | −11.2110 *** | −11.6045 *** | −11.2063 *** |
| | (−33.56) | (−35.39) | (−32.65) | (−34.14) | (−33.25) | (−34.87) |
| Industry | Yes | Yes | Yes | Yes | Yes | Yes |
| Year | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 13,820 | 13,820 | 13,820 | 13,820 | 13,820 | 13,820 |
| Adj-$R^2$ | 0.3575 | 0.3578 | 0.3576 | 0.3556 | 0.3584 | 0.3557 |
| F | 214.61 *** | 214.82 *** | 214.70 *** | 212.84 *** | 215.40 *** | 212.88 *** |

Notes: (1) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; (2) t values in parentheses; (3) heteroskedastic robust standard errors are used.

## 5. Discussions

We found that a favorable business environment can improve corporate innovation. A well-functioning financial market and a sound legal environment alleviate the dilemma of corporate financing constraints, an efficient administrative environment restrains corporate rent-seeking behavior and alleviates the impact of policy uncertainty, and a favorable cultural environment improves the level of opening up and social credit, all these jointly constructing a favorable business environment, which is conducive to corporate development [11,55,56]. Existing studies have found that the business environment promotes

enterprises' digital transformation [57,58], promotes urban digitization development [59], affects the choice of entry mode of OFDI [60], and reduces corporate default risk [61], which are confirmed the positive impact of the business environment. Consequently, the business environment can be considered an important external factor in alleviating financing constraints, promoting enterprise development, and realizing corporate innovation.

We also found that the impact of the business environment on corporate innovation is mainly divided into two paths: alleviating financing constraints and reducing environmental uncertainty [11,55]. Financing constraints and environmental uncertainty play a good mediator role in the influence mechanism of the business environment on enterprise innovation. In addition, the positive impact of the business environment on enterprise innovation is more significant in SOEs than in non-SOEs. This is because compared with non-SOEs, SOEs have more advantages in government resource allocation and innovation policy support, which is more conducive to the promotion of the business environment to corporate innovation. Similarly, the positive impact of the business environment on corporate innovation is also more significant in high-concentrated ownership companies than in low-concentrated ownership companies. This is because, with the increase in ownership concentration, major shareholders will have stronger motivation and a stronger ability to supervise and restrain management and better seize the opportunity of the business environment to implement corporate innovation.

This study has some limitations that may point to future research directions. First, corporate innovation may be technological, product-oriented, or process-oriented. This study only focuses on corporate technological innovation. Future research may focus on other dimensions of corporate innovation to expand our understanding of the relationship between the business environment and corporate innovation. Second, due to data constraints, our research was limited to the time span from 2017 to 2020, which somewhat narrows the scope. To enhance generalizability, future studies can extend the period under examination. Third, we examine the interaction effects between different dimensions in further analysis, and we cannot explain its internal mechanism reasonably for the time being. Future research can further explore it. Finally, as this study is based on the Chinese context, its conclusions primarily apply to countries in East Asia and Southeast Asia with similar cultural and political backgrounds to those of China. Future studies could explore how the overall business environment relates to corporate innovation in different cultural contexts, like in Islamic countries.

## 6. Conclusions and Implications

This paper explores the relationship between the business environment and corporate innovation using the provincial business environment index with data from a sample of A-share listed enterprises in China from 2017 to 2020. The findings reveal that a favorable business environment has a significant positive impact on corporate innovation. There are two main mediating factors in promoting corporate innovation: financing constraints and environmental uncertainty. Second, compared with non-SOEs, the promotional effect of the business environment on corporate innovation is stronger in SOEs. Third, centralized ownership can enhance the positive effect of the business environment on corporate innovation. After a series of robustness tests using a fixed-effects model, propensity-score matching, alternative dependent and independent variables, and additional control variables, the findings remain robust.

The findings of our analysis provide the following practical implications. First, a favorable business environment can have a positive impact on corporate innovation. This finding should inspire the Chinese government to improve the business environment in terms of the market, governance, laws, policies and regulations, and culture so as to provide comprehensive support for sustainable development in enterprises. Second, because property rights affect the relationship between the business environment and corporate innovation, the allocation of innovative resources between SOEs and non-SOEs is unbalanced. Thus, governments should increase supervision and improve transparency, thereby promoting

fair allocation of resources between SOEs and non-SOEs. The government should also increase financial and technological support for non-SOEs so as to stimulate their innovative efforts and accelerate the building of China as an innovation-oriented country. Third, excellent corporate governance can encourage managers to seize opportunities available in a favorable business environment and make innovative decisions that contribute to long-term corporate growth. Internal governance systems must also be fortified to achieve sustainable corporate development.

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