

Exploring the Relationship between Foreign Shareholding and Innovation Capability of Listed Companies

Xiuting Wang¹, Junhui Yu², Yuhan Jiang¹

¹Liaoning University, Shenyang, 110036, Liaoning, China

²Tianjin University of Technology, Tianjin, 300384, China

Keywords: Foreign shareholding, Corporate governance, Corporate innovation

Abstract: In recent years, innovation capability has become a core element for companies to maintain sustainable competition. This paper empirically analyzes the relationship between foreign shareholding and the innovation ability of listed companies and its mechanism of action, taking the A-share listed companies in Shanghai and Shenzhen from 2011 to 2020 as the sample. The findings: (1) Foreign equity ownership promotes innovation. The findings remain robust after transforming the Tobit model and testing the laggedness. (2) Foreign equity ownership enhances firms' innovation capability by alleviating firms' financing constraints. (3) Further study finds that the promotion effect of foreign shareholding on corporate innovation is more significant in firms with lower executive shareholding and lower audit quality; the study in this paper suggests that foreign shareholding plays an important role in improving the innovation capability of listed firms and enriches the research on the effect of foreign shareholding. This paper reveals the intrinsic ways and influencing factors of foreign shareholding to improve the innovation ability of enterprises through corporate governance, and provides theoretical evidence for the government to formulate and improve relevant laws and regulations and deepen the opening of capital market.

1. Introduction

Innovation capability is an indispensable part of the core competitiveness of enterprises, which can establish comparative advantages for enterprises (Porter, 1992) and is an important force to promote economic and social development. Therefore, issues such as the formation mechanism and influencing factors of enterprise innovation capability are hot research topics in the economics field. Meanwhile, as economic globalization continues to deepen, international investment has become a common phenomenon. In recent years, foreign ownership of Chinese listed companies has become more and more common, and the entry of foreign shareholders has changed the shareholding structure of Chinese listed companies, thus bringing impact on their corporate governance and business performance. Therefore, it is important to study the impact of foreign shareholding on Chinese firms and economy.

A large body of literature has analyzed the role of firm size and market power on innovation (Wu, Y. B., 2007). Also, the legal system has a crucial impact on firm innovation (Acharya, 2009). A study by Lu Tong and Dang Yin (2014) shows that the relationship between the shareholding ratio of large shareholders and firm innovation varies in different industries. S. P. Luo and Y. D. Yu (2012) found that managerial characteristics affect firm innovation. However, so far, there has been little exploration of whether firm innovation is affected by foreign shareholder ownership. Moreover, among the existing literature, studies such as Gary (2000) ^[1] show that foreign shareholders can effectively contribute to the improvement of corporate governance mechanisms in domestic firms because they are in a more independent position. Ma, Li (2020) and Bu, Danlu et al. (2021) analyzed the impact of foreign shareholding from the perspective of corporate social responsibility and risk, respectively. However, so far, few studies have focused on the effect of foreign shareholders' shareholding from the perspective of innovation activities.

To this end, this paper will use data from A-share listed companies in Shanghai and Shenzhen to analyze in depth the impact of foreign shareholding on corporate innovation and its pathways of

action. An attempt is made to fill the gaps in the existing literature system. This paper finds that: First, foreign shareholders' shareholding enhances firms' innovation ability, and this finding still holds after robustness testing by changing the model settings and changing the sample interval. Second, by examining the mechanisms and pathways through which foreign shareholding affects firm innovation, this paper finds that financing constraints play a mediating effect in the process of foreign shareholding affecting firm innovation. The inclusion of foreign shareholding can make it easier for firms to obtain loans from foreign banks as well as to attract investors' investment, thus increasing firms' R&D investment and improving their innovation capability. Third, the governance effect of foreign ownership on firm innovation is closely related to the executive shareholding ratio and audit quality of the firm. In firms with low executive shareholding ratio or low audit quality, foreign ownership can significantly improve the innovation capability of the firm, while in firms with high executive shareholding ratio or high audit quality, the above effect of foreign ownership is not significant.

The contributions of this paper are mainly in the following two aspects: First, this paper explores the ways and mechanisms through which foreign ownership affects corporate innovation from the perspectives of financing constraints, technology level, executive shareholding and audit quality, and enriches the research perspective on the corporate governance effects of foreign ownership. Second, this paper enriches the research on the factors influencing corporate innovation. Unlike the previous research on the relationship between non-state equity and enterprise technological innovation capability that included foreign equity in non-state equity, this paper takes foreign equity alone as an explanatory variable to investigate its relationship with enterprise innovation capability, and finds that foreign shareholders' shareholding affects enterprise innovation output, further enriching the research in the field of enterprise innovation.

The remainder of the paper is organized as follows: Part II is a theoretical analysis, which briefly reviews the relevant literature and presents the testable hypotheses of this paper; Part III explains the research design of this paper; Part IV analyzes the empirical results; Part V is a robustness test; and finally summarizes the whole paper and draws conclusions.

2. Theoretical Analysis

2.1 Literature Review

2.1.1 Foreign Ownership

Regarding the impact of foreign ownership on the host country, the current research analysis mainly falls into two categories.

One category analyzes the impact of foreign investment introduction on national economy and industry development from a macro perspective. At this level, scholars do not have a unified view on whether the introduction of foreign investment can have a positive impact on the host country. Some scholars argue that foreign ownership can promote macroeconomic development by bringing advanced technology (Keller and Yeaple, 2003), promoting talent flow and knowledge sharing (Kahanna and Palepu, 2000), and improving firm performance (Wang Chang and Jiao Juanni, 2009). Negative correlation theorists, on the other hand, argue that foreign capital entry can squeeze the output of pre-existing firms (Aitken & Harrison, 1999), cause resource loss within the industry (He, Jie, 2000), and jeopardize macroeconomic stability (Bae, 2004; Li, Wei, 2008). The possible reason for the inconsistency of the empirical results is that the overall foreign ownership of the sample firms is low and does not play a significant role.

Another category examines the impact of foreign ownership on corporate governance at the micro level. The general conclusion of existing studies is that foreign shareholders listed companies enhance corporate governance by alleviating corporate financing constraints (Chuan Deng and Jinjin Sun, 2014)^[2], reducing agency problems (Ferreira 2008), and improving the quality of corporate information (Danlu Bu, 2017)^[3].

2.1.2 Corporate Innovation

For the factors influencing the innovation capability of listed companies, the research is divided into two main perspectives, internal and external.

The internal influencing factors of corporate innovation capability include corporate governance, corporate characteristics, and the nature of corporate property rights. In terms of corporate governance, Zhu Desheng and Zhou Xiaopei (2016) took high-tech enterprises as the research object and explored the relationship between the degree of equity checks and balances, the ratio of executive shareholding and corporate innovation efficiency; in terms of corporate characteristics, Jeferson et al. (2013) took Chinese industrial enterprises as the research object and found that company size, market concentration and company profitability were the main factors driving corporate R&D investment factors. In terms of the nature of corporate ownership, Li, Wengui and Yu, Mingguai (2015) investigated the relationship between the proportion of non-state ownership and the innovation capacity of private firms. Permit et al. (2019) found that foreign-owned and Hong Kong, Macao and Taiwan firms performed better in IPR litigation and were more innovative compared to state-owned firms.

The external influences on firms' innovation capacity include the economic development of the region in which the firm is located and government policies. In terms of the economic development of the region in which the firm is located, Cheng Shixiong and Liu Jianping (2014) studied the output efficiency of R&D inputs in China, and the results showed that trade openness has a significant contribution to the improvement of R&D output efficiency. In terms of government policies, the findings of the current study are inconsistent. Li Miao Miao et al. (2014) found that within a certain range, the impact of fiscal policy on the technological innovation capacity of enterprises its promotional effect, and outside its range its effect is negative; however, Liu Fang et al. (2016) found that tax preferences are positively related to enterprise innovation investment; in addition to the above factors, many other scholars look at the market-oriented environment (Lu Tong, 2014; Yuan, 2015), industry (Zhao 2016) and other aspects have been studied on the factors influencing the innovation ability of enterprises.

Based on the above literature review, it can be found that, first, so far, there is less research data to explore the corporate governance effects of foreign ownership from the perspective of corporate innovation. Second, most of the studies only divide the foreign ownership into the equity structure to examine the impact on the innovation capability of enterprises, and there are relatively few studies that focus on the relationship between foreign ownership and enterprise innovation alone. Third, most studies have used innovation investment as a measure of firm innovation capability, but higher innovation investment does not necessarily lead to more significant innovation benefits, which is prone to bias in the study. Therefore, this paper will use the number of independently licensed inventions as a measure of corporate innovation capability, and focus on the relationship between foreign equity ownership and corporate innovation capability and the transmission mechanism of foreign equity ownership affecting corporate innovation capability; meanwhile, we will compare whether the degree of influence of foreign equity ownership on corporate innovation capability changes under different executive ownership ratios and audit quality.

2.2 Hypothesis Proposed

2.2.1 Foreign Shareholding and Corporate Innovation

With the gradual opening of China's securities market, more and more foreign investors have entered the Chinese asset market. This paper argues that foreign shareholding promotes the technological innovation capability of enterprises in the following aspects: first, in terms of corporate governance, the entry of foreign shareholders diversifies the shareholding and creates a benign mutual check and balance effect, and also brings advanced management techniques and experience to listed companies, thus reducing the short-sightedness of operators and inefficient investment, thus promoting enterprise innovation. Second, in terms of innovation investment, the government often imposes some social functions on SOEs to pursue certain political goals and interfere with corporate investment. A higher proportion of non-state equity can help reduce

government intervention in enterprises' investment decisions and promote enterprises' investment in innovative projects. Third, in terms of information transmission, foreign ownership promotes innovation by enhancing the information quality of listed companies. High-quality corporate information sends positive signals to the market (Copley, 2000). Foreign ownership increases the information content of stock prices, from which managers can identify better investment opportunities and improve the efficiency of corporate innovation (He, 2013). In summary, foreign shareholding is beneficial to corporate technological innovation at least in terms of corporate governance, innovation investment, and information transmission.

Therefore, the following hypotheses are proposed:

H1: Foreign shareholding will promote corporate innovation

As mentioned earlier, one of the ways in which foreign shareholding affects firm innovation is by alleviating financing constraints. When firms have foreign shareholders, they are more likely to obtain loans from foreign banks. Investment by foreign shareholders also signals to the market that the firm is of good quality, has high potential, and has low risk of default, attracting other investors to invest. At the same time, according to the political view, the government intervenes in state-owned enterprises to choose high-risk innovative investment projects in order to ensure stable social employment and economic growth (Boubakriet al., 2013). The higher the proportion of non-state equity in a firm, the higher the cost of government intervention will be. Therefore, a higher proportion of non-state equity helps to reduce the policy burden that firms bear less in terms of investment, which in turn facilitates firms to obtain more investment based on their innovation objectives.

Based on this, this paper proposes the following hypothesis.

H2: Foreign equity ownership promotes corporate innovation by alleviating firms' financing constraints

2.2.2 Heterogeneity Test: Executive Shareholding Ratio

Managers' motivation to innovate determines whether a company implements its own innovative behavior (D.S. Chu, 2016) ^[4]. Corporate executives holding certain shares can make executive interests converge with shareholders' interests, and managers are willing to engage in innovation activities and take innovation risks for their own interests. At the same time, the agency problem between managers and shareholders is improved, and the external incentives and constraints of shareholders on operators are transformed into self-motivation and self-restraint of managers. For companies with different percentages of executive shareholding, the promotion effect of foreign shareholding on corporate innovation is different. If the company's executive shareholding ratio is low, under the management of foreign shareholders, the incentive and supervision mechanism of the company is improved, agency costs are reduced, and managers better serve shareholders and choose innovative projects that are beneficial to the long-term development of the company. Conversely, if the company itself has a high percentage of executive shareholding, there is less room for improvement by foreign shareholders and the innovation capacity of the firm will not be significantly improved.

Based on this, this paper proposes the following hypothesis.

H3: The promotion effect of foreign shareholding on corporate innovation is more obvious in the group with a low percentage of executive shareholding.

2.2.3 Heterogeneity Test: Audit Quality

Xu (2020) ^[5] and others show that high-quality audits make firms have sufficient funds to support innovation activities. Specifically, on the one hand, the high-quality accounting information generated by high-quality audits governs the internal agency problems of firms through the external environment; on the other hand, it provides investors with more truthful and accurate information about the firm's operations, reduces the cost of obtaining corporate information for investors, and alleviates corporate financing constraints. Obviously, for companies with different audit quality of their own, foreign ownership has different effects on promoting corporate innovation. If the company's audit quality is low, the internal agency problem of the enterprise is more serious, which

will cause the enterprise management to be short-sighted and not pay attention to innovation. At this time, in order to ensure their own rights and interests, foreign shareholders will be more inclined to choose international “Big Four” to improve the audit quality of the company (Danlu Bu, 2017), which can play a stronger function in alleviating the internal agency conflict and the external financing constraints of the company, and promote the investment in corporate innovation; on the contrary, if the company itself has higher audit quality, the governance of foreign shareholders will be more important. quality is high and the governance space of foreign shareholders is small, the innovation ability of enterprises will not be significantly improved.

Based on this, this paper proposes the following hypothesis.

H4: The promotion effect of foreign shareholders on corporate innovation is more obvious in the group with low audit quality.

3. Study Design

3.1 Sample Selection and Data Sources

This paper uses all A-share listed companies in Shanghai and Shenzhen from 2010 to 2020 as the initial sample. In accordance with the existing research practice and the characteristics of this paper, the sample is screened as follows: (1) remove companies in the financial sector; (2) remove observations that have been listed for less than one year; (3) remove ST companies; (4) remove observations with missing research variables. To avoid the effect of extreme values, all continuous variables are Winsorized by 1% up and down in this paper. All data in this paper are obtained from the Guotaian Economic and Financial Research Database.

3.2 Research Model

In order to test hypothesis 1, the following regression model is constructed:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 C_{it} + \beta_3 \sum Year_t + \beta_4 \sum Ind_i + \varepsilon_{it} \quad (1)$$

Where the explanatory variable is Y_{it} , representing firm innovation output; the core explanatory variable is X_{it} , representing controlling shareholder equity pledges; C_{it} represents the control variable; $Year$ is the time trend variable; Ind denotes the industry-level fixed effect.

If research hypothesis 1 holds, the coefficient on firm innovation output is significantly positive.

For research hypothesis 2, the mediating variable financing constraint (sa) is added. In the first step, the regression coefficients of the explanatory variables on the explanatory variable firm innovation are tested. In the second step, the regression coefficients of the explanatory variables on the mediating variables are tested. In the third step, the mediating variable is included in the model of the first step, and if the coefficients of both mediating and explanatory variables are significant, it indicates a partial mediation effect, and if the coefficient of the mediating variable is significant and the coefficient of the explanatory variable is insignificant, it is a full mediation effect;

For research hypothesis 3, the mediating variable skill level (Amount) was included. The rest of the test steps are the same as hypothesis 2.

For research hypothesis 4, a split-sample regression test is conducted based on the model (1) based on the high percentage of executive shareholding. If hypothesis 4 holds, the positive effect of foreign ownership on firm innovation output is stronger in firms with lower executive shareholding compared to firms with higher executive shareholding.

For research hypothesis 5, a sub-sample regression test is conducted based on model (1) based on the high audit cost of the firm. If hypothesis 5 holds, the positive effect of foreign ownership on firms' innovation output is stronger in firms with lower audit quality compared to firms with higher audit quality.

3.3 Variable Definition and Description

3.3.1 Explained Variables

Corporate innovation output (Invig) : Measuring corporate innovation can be broadly divided

into innovation input and innovation output (Wang Hongjian et al., 2016). Innovation input is greatly affected by factors such as outsourcing business and surplus management, and using innovation input as a measure of innovation capability may have data errors and missing problems (Jia Jiansheng et al., 2017). Therefore, this paper uses innovation output as an indicator to measure the innovation capability of enterprises. Referring to the existing literature, since invention patents have strong specialization among the three patent types, while utility model patents and design patents are less innovative, this paper mainly uses the number of patents invented by enterprises in the current year to measure the innovation capacity of enterprises.

Table 1 Variable Definition

Variable Name	Variable Definition	Calculation method
<i>Invig</i>	Enterprise innovation output	Number of patents invented by the company in the year
<i>Foreign0</i>	Whether foreign ownership	Dummy variable, assigned with a value of 1 if the company's top ten shareholders have overseas shareholders, and 0 otherwise.
<i>Foreign1</i>	Shareholding ratio	The ratio of the number of company shares held by foreign shareholders among the top ten shareholders of the company to the total number of outstanding shares of the company.
<i>Size</i>	Company size	Total assets at the end of the year are taken as logarithm
<i>Lev</i>	Debt level	Total liabilities/total assets
<i>TobinQ</i>	Tobin's Q, Company growth	(Market value of stocks + total liabilities at year-end)/total assets
<i>owncon1</i>	Shareholding ratio of the largest shareholder	Ratio of the number of shares held by the largest shareholder to the total share capital of the company
<i>natureID</i>	State-owned enterprises	Set to 1 if it is a state-owned enterprise, otherwise it is 0
<i>Grow</i>	Revenue growth rate	Percentage increase of annual operating revenue of the company over the previous year
<i>Exc</i>	Management shareholding ratio	Proportion of management's shareholding to the total number of outstanding shares of the company
<i>Roa</i>	Profitability	Net profit/total assets
<i>CF</i>	Cash Flow	Net operating cash flow for the year/total assets
<i>Age</i> <i>Audit-quality</i>	Company Age Audit Quality	Number of years the company has been established

3.3.2 Core Explanatory Variables

Foreign ownership: Drawing on the existing literature, this paper chooses two ways to measure the presence of foreign ownership in listed companies, one is to assign a value of 1 if there are foreign shareholders in the top ten shareholders of the company, otherwise it is 0 (*Foreign0*); the other is the proportion of foreign ownership in listed companies, measured by the ratio of the number of shares held by foreign shareholders in the top ten shareholders of the company to the total number of outstanding shares of the company (*Foreign1*).

Exc: The ratio of the number of shares held by management to the total number of outstanding shares of the company is used as a measure.

Audit-quality: Measured by the natural logarithm of audit fees of listed companies.

3.3.3 Control Variables

Regarding the control variables of corporate innovation investment, referring to the existing literature (Jun Wen and Genfu Feng, 2012; Changqing Li et al. 2018^[6]; Yang Zou et al. 2019^[7]),

this paper controls for firm size (Size), firm age (Age), firm growth (TobinQ), shareholding ratio of the first largest shareholder (owncon1), state-owned enterprises (natureID) The following variables are defined and measured: company size (Size), company age (Age), company growth (TobinQ), shareholding of the largest shareholder (owncon1), state-owned enterprises (natureID), institutional shareholding (Insti), revenue growth (Grow), management shareholding (Exc), debt level (Lev), profitability (Roa), cash flow (CF), and proportion of sole directors (indep directors). All the above variables are defined and measured in Table 1.

4. Empirical Results and Analysis

4.1 Descriptive Statistics

The results of descriptive statistics of the variables involved in this paper are shown in Table 2. The statistical results show that the mean value of the number of patented inventions of the sample companies is 5.947, which is still low compared to developed countries; the minimum value is 0 and the maximum value is 3083, which indicates a large gap in the innovation capacity of Chinese companies. Foreign ownership is present in 28% of the listed companies in the sample, which is a little higher than the existing literature. This is mainly due to the fact that the sample of this paper starts from 2011, and it is the foreign shareholding that has developed rapidly in recent years. The descriptive statistics of other variables are generally consistent with existing studies and will not be repeated here.

Table 2 Descriptive Statistics

Variables	Sample size	Mean	SD	Min	Max
<i>Invig</i>	400744	5.947	59.94	0	3083
<i>foreign0</i>	400803	0.280	0.449	0	1
<i>foreign1</i>	400803	0.041	0.112	0	0.886
<i>size</i>	407359	22.29	1.344	19.72	26.11
<i>lev</i>	407359	0.428	0.215	0.00752	8.612
<i>TobinQ</i>	407195	2.099	2.798	0.0477	349.0
<i>owncon1</i>	407359	0.349	0.151	0.00286	0.900
<i>roa</i>	407359	0.0434	0.133	-6.714	20.79
<i>ocfasset</i>	407359	0.0498	0.0792	-1.238	1.679
<i>Exc</i>	405776	0.152	0.365	0	8.091
<i>grow</i>	407359	0.370	1.085	-0.652	9.062
<i>natureID</i>	407359	0.385	0.487	0	1
<i>age</i>	407359	2.887	0.310	1.099	3.983

4.2 Fundamental Regression: the Impact of Foreign Shareholding on Corporate Innovation

Table 3 reports the results of testing hypothesis 1. The explanatory variables in columns (1) and (2) are the firm's innovation output (*Invig*), and the explanatory variables are the presence of foreign ownership (*Foreign0*) and the proportion of foreign ownership (*Foreign1*), respectively. Columns (3) and (4) are the regression results without controlling for industry and year. The empirical results show that *Foreign0* is positively correlated with firm innovation output at 1% significance level, indicating that firms with foreign shareholders in the top ten shareholders have more innovation output and stronger innovation capability; *Foreign1* is positively correlated with firm innovation output at 1% significance level, indicating that the number of shares held by foreign shareholders in the top ten shareholders accounts for the total number of outstanding shares of the firm *Foreign1* is positively correlated with innovation output at 1% significance level, indicating that the higher the proportion of shares held by foreign shareholders in the top ten shareholders of a company to the total number of outstanding shares, the higher the innovation output and the stronger the innovation capability of the company. These empirical results support the hypothesis 1 of this paper, that foreign shareholding promotes corporate innovation.

Table 3 Test Results For Hypothesis 1

	(1)	(2)	(3)	(4)
	Invig	Invig	Invig	Invig
foreign1	14.008***		16.808***	
	(0.745)		(0.801)	
foreign0		5.026***		5.446***
		(0.225)		(0.230)
lev	3.643***	4.107***	1.108**	1.640***
	(0.441)	(0.451)	(0.424)	(0.433)
TobinQ	0.495***	0.474***	0.483***	0.474***
	(0.062)	(0.059)	(0.057)	(0.056)
owncon1	-11.373***	-10.583***	-13.467***	-12.491***
	(0.610)	(0.589)	(0.645)	(0.619)
roa	-6.703***	-6.843***	-5.625***	-5.783***
	(1.506)	(1.544)	(1.309)	(1.347)
ocfasset	46.691***	45.458***	48.185***	46.792***
	(4.345)	(4.355)	(4.312)	(4.326)
Exc	1.815***	1.760***	2.166***	2.082***
	(0.121)	(0.120)	(0.122)	(0.121)
grow	0.247***	0.301***	-0.439***	-0.389***
	(0.033)	(0.033)	(0.035)	(0.034)
natureID	-2.071***	-2.231***	-2.724***	-2.896***
	(0.354)	(0.362)	(0.311)	(0.319)
age	3.597***	3.484***	-0.622**	-0.894***
	(0.227)	(0.224)	(0.221)	(0.222)
cons	-201.875***	-196.081***	-161.881***	-155.375***
	(5.560)	(5.340)	(4.393)	(4.168)
N	399095.000	399095.000	399095.000	399095.000
r2_a	0.039	0.040	0.030	0.031

Note: ***, **, *, are significant at the 1%, 5%, and 10% levels, respectively; the values in parentheses are robust standard errors, as follows.

4.3 Impact Mechanism Analysis: Financing Constraints

Next, this paper further examines whether financing constraints play a mediating role in the process of foreign equity ownership affecting firms' innovation capability. Drawing on the mediation effect test procedure proposed by Zhonglin Wen et al. (2004)^[8], this paper conducts the following steps: in the first step, the regression coefficients of the explanatory variables whether foreign ownership and the proportion of foreign ownership on the explanatory variable firm innovation output (Invig) are tested, and if they are significant, the second step is continued, otherwise the test is terminated; in the second step, the regression coefficients of whether foreign ownership and the proportion of foreign ownership on the financing constraint (sa If the coefficients of sa and whether foreign ownership and foreign ownership are significant, it means there is a partial intermediation effect, and if the coefficient of sa is significant but the coefficients of whether foreign ownership and foreign ownership are not, it is a full intermediation effect.

Table 4 reports the results of testing hypothesis 2. The empirical results show that in the first step, the regression coefficients of whether or not foreign ownership and the proportion of foreign ownership are significant on the explanatory variable of firm innovation output (Invig); in the second step, whether or not foreign ownership, the proportion of foreign ownership and financing constraint are significantly negatively related, indicating that foreign ownership will alleviate the financing constraint of firms; in the third step, the coefficients of financing constraint and whether or not foreign ownership, the proportion of foreign ownership In the third step, the coefficients of

financing constraint and whether foreign ownership and foreign ownership ratio are significant, indicating that financing constraint has a partial mediating effect in the process of foreign ownership affecting firms' innovation output. The above results support the hypothesis 2 of this paper, that foreign ownership promotes innovation by alleviating the financing constraints of firms.

Table 4 Test Results For Hypothesis 2

	(1)	(2)	(3)	(4)
	Foreign0	Foreign0	Foreign0	sa
Step1	4.728***			
Invig	(0.856)			
Step2		0.015***		
sa		(0.002)		
Step3			3.768***	63.782***
Invig			(0.753)	(8.682)
Control variables	Yes	Yes	Yes	Yes
Observations	399095	399154	399095	399095

	(1)	(2)	(3)	(4)
	Foreign1	Foreign1	Foreign1	sa
Step1	14.008***			
Invig	(0.745)			
Step2		0.105***		
sa		(0.002)		
Step3			6.916***	67.778***
Invig			(0.626)	(2.132)
Control variables	Yes	Yes	Yes	Yes
Observations	399095	399154	399095	399095

4.4 Heterogeneity Test: Executive Shareholding Ratio

Table 5 reports the results of the test of hypothesis 4. The regression results of Panel A show that whether foreign ownership is positively associated with innovation investment at 1% significance level in companies with low executive ownership, and whether foreign ownership is positively associated with innovation investment at 10% significance level in companies with high executive ownership. The regression results of Panel B show that foreign ownership is positively correlated with innovation investment at 1% significance level in companies with low executive ownership and at 10% significance level in companies with high executive ownership, and the absolute value of the regression coefficient is significantly larger in the group with low foreign ownership than in the group with high ownership. Overall, these results suggest that the effect of foreign ownership on corporate innovation is more significant in the group with low executive ownership, and hypothesis 4 holds.

Table 5 Test Results For Hypothesis 4

Panel A		
	(1)	(2)
	Invig	Invig
	Low executive shareholding group	High executive shareholding group
Foreign0	8.111***	1.998*
	(1.605)	(0.819)
Control variables	Yes	Yes
Ajusted R ²	0.060	0.041
N	191054	208041
Intergroup coefficient test	(1) VS(2) =7.470***	
Panel B		
	(1)	(2)
	Invig	Invig
	Low executive shareholding group	High executive shareholding group
Foreign1	2.237***	2.214
	(0.657)	(2.376)
Control variables	Yes	Yes
Ajusted R ²	0.060	0.041
N	191054	208041
Intergroup coefficient test	(1) VS(2) =8.254***	

4.5 Heterogeneity Test: Number of Audits

Table 6 reports the results of the tests of hypothesis 5. The regression results of Panel A show that whether foreign ownership is positively associated with innovation investment at the 1% significance level in both lower and higher audit quality firms, and the regression results of Panel B show that foreign ownership is positively associated with innovation investment at the 1% significance level in lower audit quality firms and at the 5% significance level in higher audit quality firms. The absolute value of the regression coefficient is significantly larger for the lower audit quality group than for the higher audit quality group. Overall, these results suggest that the contribution of foreign ownership to corporate innovation is more significant in the group with lower audit quality, and hypothesis 5 holds.

Table 6 Test Results For Hypothesis 5

Panel A		
	(1)	(2)
	Invig	Invig
	Low audit quality group	High Audit Quality Group
Foreign0	6.037***	0.996***
	(1.307)	(0.232)
Control variables	Yes	Yes
Ajusted R ²	0.057	0.047
N	11620	14581
Intergroup coefficient test	(1) VS(2) =3.857***	
Panel B		
	(1)	(2)
	Invig	Invig
	Low audit quality group	High Audit Quality Group
Foreign1	15.719***	3.057**
	(4.247)	(1.151)
Control variables	Yes	Yes
Ajusted R ²	0.056	0.047
N	11620	14581
Intergroup coefficient test	(1) VS (2) =8.519***	

5. Robustness Test

To enhance the robustness of the empirical results, the regression model is transformed as follows:

First, all the current period values of the core explanatory variables whether foreign ownership and foreign ownership ratio in the model are replaced with lagged one-period values, i.e., the model using equation (2) is regressed, and the regression results are shown in Table 7.

$$Y_{it} = \beta_0 + \beta_1 X_{it-1} + \beta_2 C_{it} + \beta_3 \sum Year_t + \beta_4 \sum Ind_i + \varepsilon_{it} \quad (2)$$

As seen in columns (1) and (2), the regression coefficients of the two explanatory variables Foreign0 and Foreign1 on the dependent variable Invig are significantly positive at the 10% level, which is consistent with the main test of the paper and proves that foreign shareholding promotes corporate innovation.

Next, the Tobit model is used to re-test the main regression (baseline) in the paper. The regression results are shown in Table 7. From columns (3) and (4), we can see that the regression coefficients of foreign ownership (Foreign0) and foreign ownership (Foreign1) are significantly positive on the innovation output (Invig) of enterprises, which further proves that foreign ownership promotes enterprise innovation.

Table 7 Robustness Tests

	(1)	(2)	(3)	(4)
	Invig	Invig	Invig	Invig
foreign0		4.728***		5.026***
		(0.806)		(0.226)
foreign1	13.616***		14.008***	
	(3.147)		(0.872)	
lev	3.003	3.344	3.643***	4.107***
	(1.879)	(1.880)	(0.557)	(0.558)
TobinQ	0.264**	0.252**	0.495***	0.474***
	(0.093)	(0.093)	(0.038)	(0.038)
owncon1	-10.371***	-9.571***	-11.373***	-10.583***
	(2.495)	(2.490)	(0.705)	(0.704)
roa	-4.095	-4.161	-6.703***	-6.843***
	(2.230)	(2.229)	(0.755)	(0.755)
ocfasset	48.784***	47.643***	46.691***	45.458***
	(4.325)	(4.333)	(1.252)	(1.254)
Exc	2.021*	1.961	1.815***	1.760***
	(1.009)	(1.009)	(0.286)	(0.286)
grow	0.228	0.269	0.247**	0.301***
	(0.298)	(0.298)	(0.091)	(0.091)
natureID	-1.348	-1.497	-2.071***	-2.231***
	(0.829)	(0.824)	(0.236)	(0.234)
age	2.540*	2.415*	3.597***	3.484***
	(1.226)	(1.225)	(0.348)	(0.348)
_cons	-171.838***	-166.838***	-201.875***	-196.081***
	(8.604)	(8.671)	(2.473)	(2.496)
N	399095.000	399095.000	399095.000	399095.000
r2_a	0.039	0.039	0.039	0.040

6. Conclusion

Based on the data of A-share listed companies in Shanghai and Shenzhen from 2011 to 2020, this paper empirically analyzes the impact of foreign shareholding on corporate innovation. The results show that: firstly, foreign shareholding has a significant promotion effect on the innovation activities of listed companies. The robustness of this finding is verified by transforming the Tobit model and testing the lags. Second, the governance effect of foreign ownership on corporate

innovation increases corporate R&D investment and thus corporate innovation output by alleviating the financing constraints of firms. Third, the governance space of foreign shareholders on corporate innovation capacity is larger and the effect is more significant in firms with lower executive shareholding and lower audit quality.

This paper provides firm-level empirical evidence on the governance effects of foreign shareholders by examining the effects of foreign shareholders' shareholding on firms' innovation capacity; it also provides new evidence for understanding the factors influencing firms' innovation capacity. First, foreign shareholding is positively correlated with firms' technological innovation capability. In order to obtain the improvement of corporate governance and technological spillover effect brought by the introduction of foreign capital, and thus enhance firms' technological innovation capability, we can further expand the degree of opening to the outside world, increase foreign investment, create a relaxed foreign investment environment, and increase the level of foreign shareholders' shareholding in firms. Second, for enterprises, they need to further promote corporate governance reform, improve the level of corporate governance, and establish a reasonable incentive mechanism. At the same time, high quality auditing firms should be used to improve the transparency and effectiveness of corporate accounting information, and audit quality should be improved to enhance external corporate governance.

It should be noted that there are at least some limitations in this paper: (1) Since this paper takes listed companies that have disclosed the number of independently authorized inventions as the sample, there may be some selection bias in the study; meanwhile, it is not known whether these findings hold for non-listed companies. (2) This paper examines the situation of foreign shareholders among the top ten shareholders, but further research is needed to investigate the impact of small foreign shareholders on corporate innovation..

References

- [1] Gary H. Jefferson, Bai Huamao, Guan Xiaojing, Yu Xiaoyun. R&D Performance in Chinese industry[J]. *Economics of Innovation and New Technology*, 2006, 15(4-5).
- [2] Deng Chuan, Sun Jinjin. QFII shareholding, nature of property rights and corporate financing constraints[J]. *Management World*, 2014(05):180-181.
- [3] BU Danlu, TU Changwen. Foreign equity ownership, institutional environment and audit quality[J]. *Audit Research*, 2017(04):65-72.
- [4] Zhu Desheng, Zhou Xiaopei. Equity checks and balances, executive shareholding and corporate innovation efficiency[J]. *Nankai Management Review*, 2016, 19(03):136-144.
- [5] Xu Jianwei, Chen Yanbin, Liu Kun. Research on the mechanism of the role of external audit quality on innovation activities of enterprises[J]. *Scientific Research Management*, 2020, 41(10):11-20.
- [6] Li Changqing, Li Yukun, Li Maoliang. Controlling shareholders' equity pledges and firms' innovation investment[J]. *Financial Research*, 2018(07):143-157.
- [7] Zou Yang, Zhang Ruijun, Meng Qingbin, Hou Deshuai. Can capital market opening curb listed companies' violations? --Empirical evidence from the "Shanghai-Hong Kong Stock Exchange"[J]. *China Soft Science*, 2019(08):120-134.
- [8] Wen Zhonglin, Zhang Lei, Hou Jietai, et al. Mediation effect test procedure and its application[J]. *Journal of Psychology*, 2004(5) : 614-620.