

Capital Market Liberalization and Manufacturing Firm Innovation: Evidence from the Shanghai-Shenzhen-Hong Kong Stock Connect

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Abstract

An active and open capital market plays a crucial role in guiding the allocation of financial resources and supporting innovation in manufacturing enterprises. This study examines the issue from the perspective of market macrostructure, utilizing data from listed manufacturing enterprises spanning from 2010 to 2022 as samples. By constructing a multi-period difference-in-differences model, it verifies that the opening-up of the capital market, represented by the Shanghai-Shenzhen-Hong Kong Stock Connect, promotes innovation in manufacturing enterprises. This conclusion remains valid after passing relevant robustness tests. Heterogeneity analysis reveals that this promotional effect is more pronounced in non-state-owned enterprises, manufacturing enterprises with relatively low information transparency, and those with higher institutional ownership. Mechanism analysis shows that the opening-up of the capital market fosters innovation in manufacturing enterprises by enhancing investment efficiency, alleviating financing constraints, and improving the information environment of enterprises. The research findings indicate that the opening-up of the capital market plays a significant role in promoting innovation in manufacturing enterprises and achieving high-quality economic development, providing theoretical support for further deepening capital market reforms and expanding capital market openness.

Keywords

Shanghai-Shenzhen-Hong Kong Stock Connect; Enterprise Innovation; Investment Efficiency; Financing Constraints; Information Environment.

1. Introduction

Manufacturing is the foundation of the Chinese economy and a crucial pillar for safeguarding people's livelihood, employment, and economic stability. China's manufacturing industry has seen continuous improvements in its overall technological level and position in the international division of labor. However, the fundamental fact of its development remains that it is large but not strong, with many fields facing bottlenecks imposed by developed countries. On December 28, 2023, eight departments, including the Ministry of Industry and Information Technology and the National Development and Reform Commission, jointly issued the "Guiding Opinions on Accelerating the Transformation and Upgrading of Traditional Manufacturing Industries." The guidance emphasizes promoting the transformation of traditional manufacturing towards high-end, intelligent, green, and integrated directions, enhancing development quality and efficiency, and accelerating the achievement of high-quality development. To maintain competitive advantages and achieve sustainable development, manufacturing enterprises must constantly enhance their innovation capabilities. How to promote innovation in manufacturing enterprises? Many scholars have explored this topic from perspectives such as industrial policy support[1], corporate governance[2], and executive incentives[3]. However, few studies have linked capital market liberalization with corporate

innovation. Even when they do, their research subjects often encompass all types of enterprises, whereas the impact of capital market liberalization differs among different types of enterprises. Innovation cannot be separated from financial support. The capital market is an important financing channel for enterprises to obtain funds[4], providing substantial financial backing for their operational management and innovation. Manufacturing enterprises typically require significant capital investment to support research and development, production, and technological innovation. An open capital market can attract more domestic and foreign investors, providing enterprises with additional financial resources that facilitate innovative activities [5], promote product upgrades and technological advancements, and subsequently enhance their competitiveness and market share.

To achieve deeper integration with international markets and continuously elevate the level and quality of opening up, China launched pilot programs for the Shanghai-Hong Kong Stock Market Interconnection Mechanism and the Shenzhen-Hong Kong Stock Market Interconnection Mechanism in November 2014 and December 2016, respectively. The implementation of these initiatives marked a new step in the two-way opening up of China's capital market. They not only facilitated interconnection between mainland and Hong Kong capital markets but also provided global investors with more convenient investment channels. Therefore, studying the Shanghai-Shenzhen-Hong Kong Stock Market Interconnection Mechanism (SHSMIM) policy has significant theoretical and practical value for promoting innovation in manufacturing enterprises. It offers new insights into the innovation pathways for manufacturing enterprises and provides theoretical support and guidance for governments to formulate policies that promote enterprise innovation and further opening up of the capital market, which is of great importance for driving high-quality economic development.

Compared with existing research, the contributions of this paper may include the following: Firstly, most current studies on the impact of capital market liberalization on enterprise innovation use all types of enterprises as research samples. In contrast, this paper considers the specificity of the industry and focuses specifically on the manufacturing sector when selecting variables. Secondly, when selecting indicators to measure enterprise innovation, most studies use indicators such as R&D investment, talent ratio, or revenue growth rate. However, this paper employs the number of patent applications by enterprises to measure their innovation capability. R&D investment only indicates the enterprise's support and investment in innovation, but it cannot measure the output of innovation or whether the innovation level has improved. Additionally, patents require a considerable amount of time from application to authorization, so the number of authorized patents may have a certain lag in reflecting current technological innovation status. In contrast, the number of patent applications can more timely reflect the dynamic changes in technological innovation activities and has stronger timeliness. Thirdly, this paper enriches and expands the research on the influence mechanism of innovation from the perspective of investment efficiency.

2. Literature Review and Research Hypotheses

2.1. Literature Review

Current research on the impact of capital market liberalization primarily focuses on financial market and enterprise levels. At the financial market level, studies have found that capital market liberalization enhances the resource allocation function of stock prices by increasing their information content[6], and strengthens the guiding role of capital markets in the real economy through stock price information feedback and financing mechanisms, thereby improving capital market efficiency[7]. Simultaneously, it optimizes the structure of market investors, positively impacting stock price stability and helping to alleviate speculative atmospheres in the A-share market[8]. At the enterprise level, research has shown that capital

market liberalization increases the enthusiasm of listed companies for financing and significantly expands financing scales[9], providing more financing opportunities and broader financing channels for Chinese enterprises[10]. Furthermore, capital market liberalization can introduce foreign institutional investors, improving the quality of information disclosure of listed companies[11], enhancing corporate governance levels [12], promoting enterprise innovation[13], and ultimately increasing corporate value.

Regarding research on the influencing factors of innovation in manufacturing enterprises, at the macro level, government and industrial policies can promote technological innovation in enterprises through credit, taxation, government subsidies[14], and market competition mechanisms[15]. The role of government subsidies and related policies in enterprise innovation is also influenced by the intellectual property protection system[16], as the degree of intellectual property infringement has a strong inhibitory effect on enterprise innovation [17]. At the micro level, unstable financing sources constrain enterprise innovation activities, with internal funds being the primary financing channel for enterprise innovation investment. External financing is often difficult to obtain due to fewer channels and higher requirements[18]. However, executive compensation incentives[19] and the supervision of institutional investors [20] can both promote enterprise innovation activities.

2.2. Research Hypothesis

The opening up of capital markets has increased channels for foreign capital inflow and broadened financing avenues for enterprises. For manufacturing enterprises, this implies access to more funds for research and development, technological transformation, and innovation activities. The reduction in financing costs and the enhancement of financing efficiency help enterprises overcome funding constraints in the innovation process, accelerating the advancement of innovation projects. The opening up of capital markets also facilitates the exchange of domestic and international information, technology, and management experience. The process of internationalization also compels enterprises to continuously adapt to changes in the global market. To maintain a competitive edge, manufacturing enterprises must continuously innovate and enhance the quality and technological content of their products and services.

The opening up of capital markets introduces foreign investors with advanced investment philosophies and professional information collection and processing capabilities. These investors can uncover and disseminate more corporate information into the capital market, reducing the degree of information asymmetry and improving the information environment of enterprises. Additionally, foreign investors can exercise oversight on corporate operations and constrain opportunistic behavior of managers through voting rights and the threat of selling shares. Foreign investors tend to favor companies with higher innovation capabilities and broad development prospects, prompting enterprises to pay more attention to long-term value and sustainable development. Corporate innovation is largely influenced by corporate governance mechanisms. Firms with better governance engage in more innovation, while those with higher agency costs engage in less. A well-structured corporate governance system encourages management to focus more on long-term development and innovation investments. The inclusion of foreign investors helps drive enterprises to improve their internal governance structures, enhance decision-making efficiency of management, and subsequently boost the overall investment efficiency of enterprises. In summary, the opening up of capital markets promotes innovation activities of manufacturing enterprises through multiple dimensions, including providing financial support, introducing external oversight, improving corporate governance, and enhancing enterprise investment efficiency.

Based on the above analysis, this paper proposes the hypothesis: The opening up of capital markets enhances the innovation level of manufacturing enterprises.

3. Research Design

3.1. Data Sources

The data for this study is sourced from A-share manufacturing listed companies in Shanghai and Shenzhen stock exchanges from 2010 to 2022, serving as the initial research sample. Based on the research requirements, the following data processing steps are taken: firstly, ST and *ST listed companies are excluded; secondly, company samples with significant missing data for relevant variables are removed; thirdly, continuous variables undergo tail trimming at the 1% and 99% percentiles. The data is sourced from the CSMAR and CNRDS databases.

3.2. Model Specification

This paper uses the Shanghai-Hong Kong Stock Connect and Shenzhen-Hong Kong Stock Connect as experimental platforms symbolizing the opening up of capital markets. A-share manufacturing listed companies included in the Shanghai-Hong Kong Stock Connect and Shenzhen-Hong Kong Stock Connect lists during the sample period are classified as the experimental group, while those not included are classified as the control group. A multi-time point Difference-in-Differences (DID) model is used to quantitatively analyze the relationship between the opening up of capital markets and manufacturing enterprise innovation. The following model is constructed:

$$PA_{i,t} = \beta_0 + \beta_1 * OPEN_{i,t} + \beta_2 * CONTROL_{i,t} + \mu_{i,t} + \lambda_{i,t} + \varepsilon_{i,t} \quad (1)$$

In the equation, PA is the dependent variable, representing the innovation capability of manufacturing enterprises; OPEN is the explanatory variable, representing the opening up of capital markets; CONTROL represents control variables; $\mu_{i,t}$ is the firm fixed effect; $\lambda_{i,t}$ is the year fixed effect; $\varepsilon_{i,t}$ is the standard residual term.

3.3. Indicator Selection

Explanatory Variable: The opening up of capital markets, represented by Shanghai-Hong Kong Stock Connect and Shenzhen-Hong Kong Stock Connect. If company *i* is on the Shanghai-Hong Kong Stock Connect and Shenzhen-Hong Kong Stock Connect trading list in year *t*, it is assigned a value of 1; if not, it is assigned a value of 0.

Dependent Variable: Manufacturing enterprise innovation. This paper uses the number of patent applications by manufacturing enterprises to measure their innovation capability. To address the right-skewed distribution of patent application data, the number of patent applications is incremented by 1 and then log-transformed. Patents take a considerable amount of time from application to grant, so patent grants may have a certain lag in reflecting current technological innovation status. In contrast, patent applications can more timely reflect dynamic changes in technological innovation activities and have stronger timeliness. Additionally, patent grants may be influenced by human factors and have greater uncertainty. Therefore, patent applications better reflect the innovation capability and activity level of enterprises.

Control Variables: Total assets (SIZE), company age (AGE), asset-liability ratio (ALA), return on assets (ROA), current ratio (CR), tangible asset ratio (TAR), top shareholder holding ratio (TOP1), property right nature (PRN), management holding ratio (MHOLD), and institutional investor holding ratio (INS).

4. Empirical Analysis

4.1. Descriptive Statistics

Table 1. Descriptive statistical results

Variable	observation	mean	standard deviation	minimum value	maximum value
PA	12495	2.53502	1.43013	0	6.1570
OPEN	12495	0.18824	0.39092	0	1
SIZE	12495	22.13789	1.22430	17.0185	27.6211
AGE	12495	2.86954	0.34726	0.6931	3.8501
ALA	12495	0.40093	0.32674	0.0075	29.454
ROA	12495	0.04638	0.21836	-5.2594	22.0051
CR	12495	2.76160	3.97332	0.0334	190.8692
TAR	12495	0.93489	0.06697	0.3650	1
TOP1	12495	33.84348	14.04602	3.62	88.55
PRN	12495	0.30620	0.46093	0	1
MHOLD	12495	16.06069	20.63429	0	89.1771
INS	12495	41.87374	24.77590	0.0001	101.1401

The descriptive statistics for the main variables in this paper are presented in Table 2. The mean (standard deviation) of patent application numbers for manufacturing enterprises is 2.53502 (1.43013), with a minimum value of 0 and a maximum value of 6.157. This indicates significant variation in innovation levels among different manufacturing enterprises, providing ample scope for this study.

4.2. Basic Regression Results

This paper employs a multi-period DID model to investigate the impact of the Shanghai-Shenzhen-Hong Kong Stock Market Transactions Interconnection Mechanism (SHSZHKSIM) policy on innovation in manufacturing enterprises. The empirical results are shown in Table 3. In column (1), the dependent variable is the sum of invention patent applications and utility patent applications (PA) by enterprises. The coefficient of the SHSZHKSIM policy variable (OPEN) is 0.117 ($t=3.19$), significantly positive at the 1% level, suggesting a notable positive relationship between capital market liberalization and innovation in manufacturing enterprises. Columns (2) and (3) feature invention patent applications (Invia) and utility patent applications (Umia) as dependent variables, respectively. The coefficients of the OPEN variable are 0.086 ($t=2.45$) and 0.136 ($t=3.89$), respectively, significantly positive at the 5% and 1% levels. This indicates that the impact of capital market liberalization on utility patent output is more prominent, aligning with real-world observations.

Table 2. Basic regression: The impact of capital market opening on the innovation of manufacturing firms

	(1)	(2)	(3)
	PA	Invia	Umia
OPEN	0.117***	0.086**	0.136***
	(3.19)	(2.45)	(3.89)
SIZE	0.209***	0.197***	0.152***
	(8.80)	(8.76)	(6.76)
AGE	-0.552***	-0.545***	-0.220*
	(-4.35)	(-4.53)	(-1.83)
ALA	0.066**	0.065**	0.047
	(2.14)	(2.22)	(1.60)
ROA	0.090**	0.080**	0.069*
	(2.29)	(2.14)	(1.84)
CR	0.003	0.005*	-0.001
	(0.97)	(1.71)	(-0.50)
TAR	-0.030	0.138	0.192
	(-0.16)	(0.78)	(1.09)
TOP1	0.001	-0.000	0.003**
	(0.73)	(-0.13)	(2.22)
PRN	0.093	0.056	0.121**
	(1.55)	(0.99)	(2.13)
MHOLD	0.004***	0.004***	0.002*
	(3.73)	(3.83)	(1.87)
INS	-0.002*	0.000	-0.002**
	(-1.70)	(0.03)	(-2.23)
_cons	-1.227*	-1.870***	-1.578***
	(-1.94)	(-3.11)	(-2.63)
N	12495	12495	12495
r2_a	-0.032	-0.023	-0.056
Individual effect	YES	YES	YES
Time effect	YES	YES	YES

t statistics in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

5. Robustness Checks

5.1. Parallel Trends Test

The parallel trends test is a crucial step in assessing the validity of the Difference-in-Differences (DID) model. This study employs this test to verify that the development trends between the treatment group and the control group are similar before the policy intervention occurs, referred to as the "parallel trends" assumption. To avoid multicollinearity issues, this paper uses the first year before policy implementation as the base period and conducts a parallel trends test for the four years before and three years after policy implementation. The results indicate that the development trends of the dependent variable between the treatment group and the control group before policy implementation show a high degree of parallelism, with insignificant regression coefficients. This suggests that before policy implementation, the enterprises in the treatment group and the control group exhibited the same trend in innovation. After policy implementation, the coefficients deviate significantly from zero, basically confirming the validity of the comparison between the treatment group and the observation group. Since the parallel development path of the treatment group and the control group before the intervention is confirmed, we can be more confident that the observed changes in the differences between groups are primarily caused by the treatment variable, rather than other unobserved variables or time trends. Therefore, the improvement in innovation capability of manufacturing enterprises in this study can be reasonably attributed to the impact of capital market liberalization, providing strong empirical evidence for relevant policy evaluations and theoretical constructions.

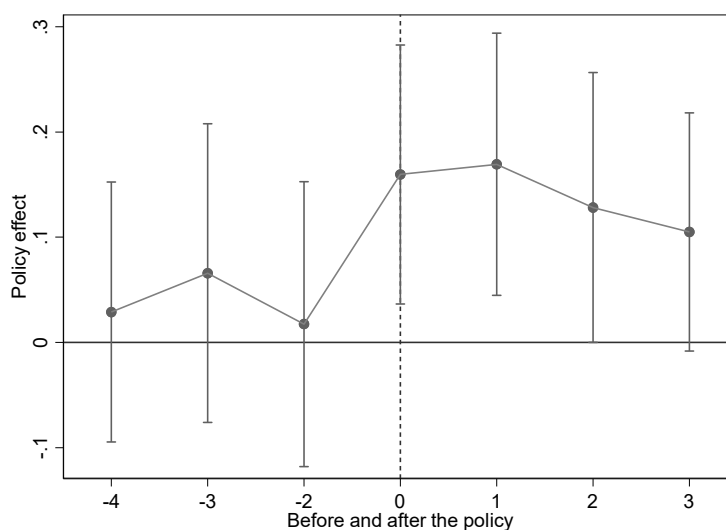


Figure 1. Parallel trend test diagram

5.2. Placebo Test Over Time

In this study, to validate the robustness of the multi-period Difference-in-Differences (DID) estimates and exclude false correlations arising from chance factors or confounding variables, we employed a placebo test over time. This test simulates the treatment effect by artificially setting a "pseudo-treatment time" where no policy intervention exists, aiming to test whether our main findings are significant merely due to random fluctuations or non-treatment factors. If significant effects are observed at these fictitious time points, it suggests that the original treatment effect may be unreliable. In this paper, we selected the three and four years preceding the actual policy implementation as the "pseudo-treatment times". For each selected pseudo-treatment time, we repeated the DID analysis, keeping the definitions of the control and

treatment groups unchanged but altering the time point of the treatment, and derived the estimated treatment effects and their statistical significance under the virtual intervention. The results of the placebo test over time showed that at all selected fictitious policy time points, the P-values were 0.331 and 0.301, respectively, indicating that the treatment effects were not significant (both P-values were greater than 0.1). This suggests that, in the absence of real policy interventions, we did not observe similar real effects. The results support the robustness of our initial DID estimates and reduce the possibility of confusion due to random fluctuations or other unobserved variables. The validity of the placebo test over time enhances our confidence in the research findings, namely, that capital market liberalization promotes innovation in manufacturing enterprises. Although the placebo test can provide additional evidence, it cannot completely exclude all potential sources of bias. Future research could consider incorporating more robustness tests and theoretical mechanism explorations to enhance the comprehensiveness of the conclusions.

Table 3. Temporal placebo test

	(1)	(2)
	PA	PA
OPEN_3	0.041	
	(0.97)	
OPEN_4		0.049
		(1.03)
Control variables	control	control
N	12495	12495
r2_a	-0.032	-0.032
Individual effect	YES	YES
Time effect	YES	YES

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5.3. Replacement of the Explanatory Variable

To verify the robustness of our research findings regarding the impact of capital market liberalization on corporate innovation, we conducted further tests. In the initial model, we used the number of corporate patent applications as a proxy for corporate innovation and found that capital market liberalization had a significant positive effect on corporate innovation. To exclude measurement errors or potential limitations of patent application numbers as a proxy for innovation, we chose an alternative explanatory variable for robustness testing, namely, the ratio of corporate R&D investment to operating revenue. This indicator more directly reflects the actual investment of enterprises in innovation activities, thus providing a more robust method for validating the results. The regression results, as shown in Column (1) of Table 4, indicate that with the ratio of R&D investment to operating revenue as the explanatory variable, capital market liberalization also has a significant positive impact on corporate innovation. Specifically, the regression coefficient is 0.331 and significant at the 5% level. This means that even when we change the definition of the explanatory variable, our core finding still holds true, namely, that capital market liberalization promotes innovation among manufacturing enterprises.

5.4. Adoption of the Tobit Model

This study aims to explore the impact of capital market liberalization on the innovation of manufacturing enterprises. We used the number of corporate patent applications as a proxy for

corporate innovation. However, in actual data, many enterprises have no patent application records, resulting in a large number of zero values in the number of patent applications. To accurately address this left-censored phenomenon, we chose the Tobit model for empirical analysis. The Tobit model can effectively handle the accumulation of dependent variables at a certain threshold (here, 0), thereby avoiding estimation biases that may arise from traditional linear regression models. The regression results from the Tobit model, as shown in Column (2) of Table 4, indicate that capital market liberalization, represented by the Shanghai-Hong Kong Stock Connect and Shenzhen-Hong Kong Stock Connect, significantly promotes innovation activities among manufacturing enterprises. This conclusion remains stable across various scenarios, demonstrating that our empirical results are reliable and robust.

Table 4. Replaces the explained variables and the Tobit model

	(1)	(2)
	RDSR	PA
OPEN	0.331**	0.083**
	(2.50)	(2.34)
Control variables	control	control
N	18469	12495
Individual effect	YES	/
Time effect	YES	/

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

6. Heterogeneity Analysis

6.1. Based on Information Disclosure Transparency of Listed Co-mpanies

This paper conducts heterogeneity analysis based on the three grades of information disclosure transparency of listed companies disclosed by the Shanghai Stock Exchange (SSE) and Shenzhen Stock Exchange (SZSE): excellent, good, and pass. Among companies with good and pass levels of information disclosure transparency, the Shanghai-Hong Kong Stock Market Transactions Interconnection Mechanism (SH-HK Stock Connect) policy has a significant promotional effect on corporate innovation at the 5% statistical significance level, with coefficients of 0.115 and 0.563, respectively. This result indicates that companies with relatively poor information disclosure transparency have significantly enhanced their innovation capabilities after capital market liberalization. However, in companies with excellent information disclosure transparency, the impact of capital market liberalization on corporate innovation is weaker and not statistically significant. Companies with relatively poor information disclosure transparency (good and pass grades) demonstrate stronger innovation capabilities after capital market liberalization. The possible reason is that companies with lower information disclosure transparency face greater obstacles in obtaining external financing. The implementation of the SH-HK Stock Connect policy provides them with more financing channels and lower-cost funds, thereby promoting their innovation activities. Additionally, these companies may be more susceptible to policy incentives, as improving information disclosure and enhancing innovation capabilities can significantly boost their market value and competitiveness. In contrast, companies with excellent information disclosure transparency show insignificant improvement in innovation capabilities after capital market liberalization. This may be because these companies already have well-established information disclosure practices, have fully utilized capital market resources, possess relatively complete internal governance structures and efficient financing channels,

and have a relatively low dependence on external capital markets. Therefore, the further liberalization of the capital market has a limited impact on them.

Table 5. Heterogeneity analysis: Transparency of corporate information disclosure

	(1) excellent	(2) good	(3) pass
	PA	PA	PA
OPEN	0.009	0.115**	0.563**
	(0.10)	(2.24)	(2.30)
Control variables	control	control	control
N	2470	6716	967
r2_a	-0.238	-0.124	-0.718
Individual effect	YES	YES	YES
Time effect	YES	YES	YES

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

6.2. Based on the Level of Institutional Ownership

Considering the impact of institutional ownership on corporate decision-making, the sample is divided into two groups based on the median institutional ownership ratio: low institutional ownership and high institutional ownership, for heterogeneity analysis. The results indicate that in companies with high institutional ownership, the impact of capital market liberalization on corporate innovation is significant at the 5% significance level. However, in companies with low institutional ownership, the impact of capital market liberalization on corporate innovation is not significant. Companies with high institutional ownership demonstrate stronger innovation capabilities after capital market liberalization. This may be because institutional investors, especially those with high ownership ratios, typically actively participate in corporate governance, promoting improvements in internal control, implementing effective equity incentives, and managing expense controls, all of which are important factors in driving corporate innovation. The active participation of institutional investors can enhance corporate governance and provide a stable internal environment for innovation activities. In contrast, companies with low institutional ownership show insignificant improvement in innovation capabilities after capital market liberalization. This may be due to the limited influence of institutional investors with low ownership ratios on corporate governance. Additionally, companies with low institutional ownership may have weaker financing capabilities in the capital market and are unable to fully utilize the capital inflow brought about by capital market liberalization.

6.3. Based on Ownership Nature

To gain a deeper understanding of the impact mechanism of capital market liberalization on the innovation of manufacturing enterprises, this paper further conducts heterogeneity analysis, with a particular focus on the differences in impact between enterprises with different ownership natures, namely state-owned enterprises (SOEs) and non-state-owned enterprises (non-SOEs). Ownership nature, as an important institutional background for enterprises, may significantly influence the way and extent to which enterprises respond to external policy changes. The results of the heterogeneity analysis indicate that there are significant differences in the impact of capital market liberalization on corporate innovation between SOEs and non-SOEs. In non-SOEs, the impact of capital market liberalization on corporate innovation is significant at the 1% significance level. In contrast, in SOEs, the impact of capital market liberalization on corporate innovation is not significant. This heterogeneity may be attributed

to differences in financing constraints, governance structures, incentive mechanisms, and speed of market response between SOEs and non-SOEs. Non-SOEs demonstrate stronger innovation capabilities after capital market liberalization, which may be due to the fact that they face higher financing constraints but gain more financing channels and support after the liberalization, enabling them to invest more resources in research and development (R&D) and technological innovation. In addition, non-SOEs are more flexible in market competition and can respond faster to market changes and seize new development opportunities. In contrast, SOEs may be subject to more administrative interventions and restrictions from internal governance structures, leading to a relatively lagging or insensitive response in terms of innovation.

Table 6. Heterogeneity analysis: institutional shareholding ratio and property rights of enterprises

	(1) low	(2) high	(3) Non-SOEs	(4) SOEs
	PA	PA	PA	PA
OPEN	0.079	0.121**	0.137***	-0.100
	(1.59)	(2.09)	(3.46)	(-0.88)
Control variables	control	control	control	control
N	6248	6247	8669	3826
r2_a	-0.036	-0.058	-0.033	-0.021
Individual effect	YES	YES	YES	YES
Time effect	YES	YES	YES	YES

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

7. Mechanism Analysis

Most scholars adopt the three-stage mediation effect model for analysis, where in step 3, both the independent variable and the mediator are added to the baseline regression model to test the significance of their coefficients. However, this method has sparked numerous controversies. Ting Jiang(2022) pointed out that multicollinearity in step 3 can render the results unreliable due to endogenous biases and other factors[21]. Therefore, this study draws on the method proposed by Ting Jiang for mechanism testing, observing whether the coefficient of the influence of the core independent variable on the mediator passes significance to determine the presence of a mediation effect.

7.1. Investment Efficiency

Capital market liberalization enables foreign investors to more easily invest in mainland and Hong Kong markets. These investors, often equipped with mature investment philosophies and extensive market experience, contribute to enhancing the overall investment efficiency of the market. With the influx of foreign investors, the trading activity of related stocks increases, boosting stock liquidity. Higher liquidity helps reduce transaction costs and improve market efficiency, thereby creating a more favorable environment for corporate financing and reinvestment. Domestic stock market investors are often characterized by irrational investment behaviors, tending to force corporate management to focus on short-term interests and make investment decisions conducive to short-term performance and stock prices but detrimental to the long-term stable development of enterprises. Foreign investors, who tend to prioritize long-term development and corporate governance, contribute to improving the internal governance structure of enterprises and enhancing the decision-making efficiency of

management, thereby lifting the overall investment efficiency of enterprises. Higher investment efficiency means that enterprises can more effectively utilize funds for investment and innovation activities. This paper establishes a model to measure the degree of inefficient investment in enterprises, referring to the methods of Richardson (2006), Qian Xu (2014), Xiaodong Chen et al. (2016), and Wenwen Li et al. (2020). The lower the degree of inefficient investment, the higher the investment efficiency. The regression results are presented in Column (2) of Table 7. Column 2 shows that the degree of inefficient investment is the dependent variable, while capital market liberalization is the independent variable. The coefficient of capital market liberalization is negative and significant at the 1% level, indicating that capital market liberalization significantly enhances the investment efficiency of manufacturing enterprises. The improvement in investment efficiency means that enterprises can more effectively utilize funds for investment and innovation activities, and capital market liberalization promotes innovation in manufacturing enterprises.

7.2. Financing Constraints

Capital market liberalization provides domestic and foreign investors with more investment channels, allowing more external funds to flow into the mainland market and providing strong financial support for the innovation and research and development (R&D) of manufacturing enterprises. Innovation in manufacturing enterprises typically requires large-scale capital investment, including the development and importation of high-precision equipment, with relatively long payback periods. After the liberalization of the capital market, the inflow of external funds can effectively alleviate the financial pressure on enterprises, enabling them to focus more on technological innovation and product development. Drawing on the research methods of Hadlock and Pierce (2009), Xuwen Kuang et al. (2010), Yuemei Zhang et al. (2017), Leilei Gu et al. (2020), and Jun Chen et al. (2020), we construct an FC index to measure the degree of financing constraints faced by enterprises. A higher FC index indicates greater financing constraints. We use the FC index as a mediator to study the mechanism through which capital market liberalization affects innovation in manufacturing enterprises. The regression results are presented in Column (3) of Table 7. Column (3) shows that the degree of financing constraints (FC index) is the dependent variable, and capital market liberalization is the independent variable. The coefficient of capital market liberalization is negative and significant at the 1% level, indicating that capital market liberalization significantly alleviates financing constraints for enterprises. Capital market liberalization can promote enterprise innovation by alleviating financing constraints in manufacturing enterprises.

7.3. Information Environment

When the capital market is opened to foreign investors, it attracts more foreign investors to participate in the market. These investors typically have higher requirements for corporate financial transparency and information disclosure. This forces enterprises to improve their information disclosure quality, including more detailed financial reports, more transparent operations, and more timely risk warnings, thereby enhancing the visibility and credibility of corporate information. The improved information environment reduces information asymmetry, enabling external investors to more accurately assess the value and risks of enterprises and make more informed investment decisions. This environment is particularly beneficial for innovation, as innovative projects often involve high uncertainty and information opacity. The improved information environment brought about by capital market liberalization helps attract more venture capital, which is crucial for innovative projects. Companies with high analyst coverage typically have more efficient information transmission, as analysts' research findings are quickly absorbed by the market, improving the corporate information environment. We use analyst coverage as a mediator to study the mechanism through which capital market liberalization affects manufacturing enterprises. The regression results are

presented in Column (4) of Table 9. Column (4) shows that analyst coverage is the dependent variable, and capital market liberalization is the independent variable. The coefficient of capital market liberalization is positive and significant at the 1% level, indicating that capital market liberalization significantly improves the corporate information environment. Capital market liberalization can promote enterprise innovation by improving the information environment of manufacturing enterprises.

Table 7. Mechanism analysis

	(1)	(2)	(3)	(4)
	PA	inefficient investment	Financing Constraints	Information Environment
	IID	FC	AAT	
OPEN	0.117***	-0.013***	-0.059***	1.549***
	(3.19)	(-2.90)	(-12.92)	(4.94)
SIZE	0.209***	0.008***	-0.159***	5.149***
	(8.80)	(2.77)	(-52.15)	(20.44)
AGE	-0.552***	-0.021	-0.048***	1.138
	(-4.35)	(-1.23)	(-2.94)	(1.00)
ALA	0.066**	0.043***	-0.362***	-0.487
	(2.14)	(3.80)	(-30.59)	(-0.51)
ROA	0.090**	0.041**	0.195***	25.572***
	(2.29)	(2.46)	(10.73)	(16.14)
CR	0.003	-0.000	0.001**	0.016
	(0.97)	(-0.25)	(2.26)	(0.67)
TAR	-0.030	-0.262***	0.006	4.016**
	(-0.16)	(-12.39)	(0.29)	(2.36)
TOP1	0.001	0.000**	0.001***	-0.094***
	(0.73)	(2.49)	(4.52)	(-6.13)
PRN	0.093	0.002	-0.006	-3.650***
	(1.55)	(0.26)	(-0.79)	(-5.56)
MHOLD	0.004***	-0.000	-0.000	0.096***
	(3.73)	(-0.77)	(-0.69)	(8.26)
INS	-0.002*	0.001***	-0.001***	0.164***
	(-1.70)	(4.30)	(-5.33)	(17.23)
_cons	-1.227*	0.126	4.274***	-110.490***
	(-1.94)	(1.64)	(53.69)	(-17.37)
N	12495	10489	11278	9214
r2_a	-0.032	-0.077	0.480	0.072
Individueffect	YES	YES	YES	YES
Time effect	YES	YES	YES	YES

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

8. Conclusion and Policy Implications

Using data from listed manufacturing companies between 2010 and 2022, this paper analyzes the relationship between capital market liberalization and innovation in manufacturing

enterprises and concludes that capital market liberalization, represented by the Shanghai-Shenzhen-Hong Kong Stock Market Transactions Interconnection Mechanism (SHSZ-HK Stock Market Transactions Interconnection Mechanism), can promote innovation in manufacturing enterprises. The SHSZ-HK Stock Market Transactions Interconnection Mechanism not only marks a significant breakthrough in the internationalization of China's capital market but also serves as a powerful engine driving the innovative development of domestic manufacturing enterprises. By broadening financing channels, the influx of international capital has significantly increased the investment of Chinese manufacturing enterprises in innovation, thereby promoting technological innovation and industrial upgrading. Additionally, this mechanism has increased the market's sensitivity to corporate information, creating a positive incentive for innovation. Meanwhile, with the participation of international capital, the corporate governance structure has been optimized, improving investment efficiency and creating a more favorable environment for innovative activities.

Based on the research findings, this paper also proposes several policy recommendations to promote the deep integration of capital market liberalization and manufacturing innovation. Firstly, it is essential to continuously deepen the openness of financial markets and optimize the policy environment for foreign investment participation. Measures such as simplifying foreign investment access procedures and relaxing restrictions on foreign ownership should be implemented to attract more international capital into China's manufacturing sector, particularly in support of high-tech and green environmental protection projects. At the same time, the SHSZ-HK Stock Market Transactions Interconnection Mechanism should be improved by further expanding the scope of tradable stocks and increasing foreign participation. Secondly, cross-border regulatory cooperation should be strengthened to ensure financial security and stability during the opening-up process. On this basis, a comprehensive ecosystem supporting innovation should be established, with sound incentive mechanisms for innovation. Manufacturing enterprises should be encouraged to increase their R&D investment and enhance their independent innovation capabilities. Tax incentives, fund subsidies, and other measures should be implemented to stimulate enterprises' innovation vitality and promote the development of manufacturing enterprises towards high-end, intelligent, and green directions. Thirdly, the quality of corporate information disclosure should be improved to ensure that innovative achievements and progress are accurately assessed and reasonably priced, attracting more attention and support from domestic and foreign investors. In summary, through targeted policies, the synergistic effect between capital market liberalization and manufacturing innovation will be maximized, injecting continuous innovative vitality into the high-quality development of China and even the global economy.

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