Capital Market Opening and Enterprise Innovation ——An Empirical Analysis Based on the "Shanghai-Hong Kong Stock Connect program" Trading System

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ABSTRACT

Whether the Shanghai-Hong Kong Stock Connect program promotes the innovation and development of the real economy is an essential issue in opening up the country's capital market. Based on the DID model, this paper takes the implementation of the country's Shanghai-Hong Kong Stock Connect program trading system as a natural experimental event. It examines the impact of the capital market opening policy represented by the Shanghai-Hong Kong Stock Connect program on its innovation activities. The study finds that after implementing the Shanghai-Hong Kong Stock Connect program, the target company has significantly increased the output of patents and improved the innovation performance of enterprises, which shows that the improvement of the degree of opening up of the capital market significantly promotes enterprise innovation. The conclusion not only expands the research on the influencing factors of corporate innovation but also provides empirical evidence from the micro-company level for the economic impact of the implementation of the Shanghai-Hong Kong Stock Connect program trading system, and provides a theoretical reference for the subsequent deepening of the reform of the capital market.

Keywords: *Shanghai-Hong Kong Stock Connect program, Trading system, Capital market opening, Enterprise innovation.*

1.INTRODUCTION

The 19th National Congress of the Communist Party of China put forward two key points. First, deepen the reform of the financial system, enhance the ability of financial services to the real economy, increase the proportion of direct financing, and promote the healthy development of the multi-level capital market. It is pointed out the primary direction and path for the capital market to serve the high-quality development of the real economy. In particular, Shanghai-Hong Kong Stock Connect program trading system was launched in 2014. As a financial innovation mechanism of the two-way opening of the capital market to the outside world, it has realized the interconnection between China's mainland capital market and Hong Kong's capital market(Luo Yanxin, WuLina.2018)[1]. It is of great significance for deepening China's financial market and promoting the development of the real economy. Second, the core of the effective strategy of building an innovative country is to improve technological innovation and increase the input and output of the whole society to innovation activities. Enterprises are the main body of technological innovation, and their innovation willingness and innovation ability are directly related to the implementation effect of national strategy and the future development of China's economy. Then, can the financial innovation mechanism of capital market opening represented by the Shanghai-Hong Kong Stock Connect program achieve the expected effect of policy at the micro-level? Will this change affect the innovation decision-making of enterprises? Around this problem, scholars mainly study the impact of capital market opening on enterprise investment and financing and the ways to optimize the efficiency of the capital market from the macro and meso levels. Many kinds of literature have studied the economic impact of capital inflow on emerging capital markets from three aspects of the market system: corporate governance and the real economy, proving that capital market opening can positively impact domestic economic growth. As an essential part of countries' opening-up policies, the capital market can promote not only domestic financial system reform(LianLishuai,2019; Kose et al.,2009)[2], but also promote economic and social development(ZouYang，2019)[3]. However, few kinds of

literature have studied the specific path of capital market opening to enterprises from the micro-level, such as improving the overall output level of enterprises by promoting enterprise innovation. Few have studied the impact of the system with Chinese characteristics (Shanghai-Hong Kong stock connect) on the input and output of enterprise technological innovation, Or only from the perspective of RD investment （Bekaert et al.,2005; Moshirian et al.,2019; Adhikari,2016） [5,6,7,8].In short, the current research data at the micro-level is very scarce.

To sum up, this paper will explore the impact of the implementation of the trading system of the Shanghai-Hong Kong Stock Connect program on enterprise innovation activities through the empirical test of PSM-DID, aiming to expand the research on the impact of China's capital market opening on micro corporate governance, and answer the important proposition of how the capital market affects the real economy. It is proved that the trading system of the Shanghai-Hong Kong Stock Connect program promotes the technological innovation of enterprises and enriches the literature on the economic consequences of capital market opening; From the micro perspective of enterprise technology innovation, this paper reveals the specific ways of capital market opening to promote macroeconomic growth; From the perspective of capital market opening, this paper supplements the influencing factors of enterprise innovation decision-making and enriches the research on the influencing factors of innovation.

2. RESEARCH DATA AND METHODS

2.1.Data Sources

This paper uses the double-difference model (DID) to test the impact of the Shanghai-Hong Kong Stock Connect program on corporate innovation and selects Shanghai A-share listed companies from 2009 to 2020 as the research sample. Specifically, the non-financial companies listed in Shanghai A-share listed companies that have entered the Shanghai-Hong Kong stock connect program is taken as the treatment group, and the non-financial companies that have not entered the list are taken as the control group. After excluding the notable processing companies such as financial insurance and the samples with missing data, 10938 observations are obtained. The data used in this paper are from the wind database and CSMAR database. In order to reduce the interference of variable outliers on the research conclusions, the relevant continuous variables in the model are treated with win collate at 1% and 99% levels.

2.2. Setting Of Each Variable

The explained variable is the patent index. There are three kinds of patents in China: invention patent, utility model patent, and design patent. Among them, invention patent has the highest technology content and the strongest novelty. In order to fully reflect the patent output of enterprises, this paper uses a patent to represent the total patent output and uses the natural logarithm of patent plus 1 to represent the explained variable (y). In the sample, the mean value of the explained variable ln (patient + 1) is 0.67, the standard deviation is 1.38, and the floating degree is large, the minimum value is 0, and the maximum value is 9.51.

The core variable of this paper is enterprise innovation performance. The existing literature mainly measures enterprise innovation performance from R & D input and patent output. This paper chooses patent output rather than R & D input as the primary index because R & D input may be distorted by financial fraud, outsourcing, and other factors. Patent output is a relatively specific embodiment of innovation ability.

Treated is the dummy variable of the underlying company of Shanghai Stock Connect. If the sample company belongs to the underlying company of Shanghai Stock connect, treated is 1. Otherwise, it is 0. A period is the dummy variable of the time dimension. If the sample period belongs to the same year and after the subject matter of Shanghai Stock connect, the value is 1; Otherwise, the value is 0.

The main control variables are as follows: return on total assets (ROE); Financial leverage (Lev); The ratio of net fixed assets to total assets (PPE); The ratio of net intangible assets to total assets at the end of the year (intan); The proportion of R & D investment in operating revenue (RD).

2.3. Research Method

DID is a measurement method specially used to analyze the effect of the policy. Institutional change and new policy are regarded as a "natural experiment" of the exogenous economic system. Instead of directly comparing the mean changes of samples before and after the policy, it uses individual data for regression to judge whether the impact of the policy has significant statistical significance.

$$Y = \beta_0 + \delta_0 du + \beta_1 dt + \delta_1 du \cdot dt + \varepsilon_t \quad （1）$$

du is the individual fixed effect and the individual characteristics between the two groups (if treatment group, du = 1; If control group, du = 0).

dt is the time fixed effect, policy implementation variables (if before policy implementation, dt = 0; If the policy is implemented, dt= 1).

The coefficient of the interaction term represents the processing effect.

Propensity score matching is a method to match

samples by using the propensity of individuals to receive treatment as the distance. The expression of propensity value E is as follows:

$$e = \Pr(treatment = 1 \mid X_i) \quad （2）$$

That is to say, given the covariate, the probability of an individual accepting treatment is calculated based on logit regression or probit regression.

In the research, the PSM-DID hybrid model is often used. That is, after completing the single-phase matching, the unmatched observations are deleted to get the "matched sample." Then, the PSM-DID estimator can be obtained by the usual double-difference estimation (i.e., two-way fixed effect model) for this matched sample.

3.AN EMPIRICAL ANALYSIS ON THE TRADING SYSTEM OF SHANGHAI-HONG KONG STOCK CONNECT

3.1. Analysis Framework Of The Trading System Of Shanghai-Hong Kong Stock Connect

Table 1 shows the results of descriptive statistics. The mean value of the explained variable y (LN (patent + 1) is 0.67, the standard deviation is 1.38, the minimum value is 0, and the maximum value is 9.51. From the original value, the mean value of patent output is 63.49, the standard deviation is significant, reflecting the significant difference in the innovation level of listed companies. The independent variable (the natural logarithm of the total number of patents plus 1) reflects that the company's innovation ability is close to other innovation research literature. The values of other control variables are also in a reasonable range, comparable with the values of control variables in the existing literature.

Table1 Descriptive statistics

Variable	Mean	Std.Err	Min	Max
Ln(patent+1)	0.6728366	1.383254	0	9.513921
patent	63.48943	472.2466	0	13546
lev	0.3361898	0.18870688	0.007521	2.861043
roa	0.0700611	0.0771391	-1.838246	1.019731
ppe	0.1816169	0.13017853	0	0.937071
intan	0.0434472	0.436513	0	0.654822
RD	5.618465	5.523647	0	98.39

First, this paper uses the OLS estimation model as a benchmark regression model to judge the impact direction of the Shanghai-Hong Kong Stock Connect program on enterprise innovation. Secondly, in order to estimate the processing effects of the Shanghai-Hong Kong Stock Connect program and the changes before and after the implementation of the trading system, we build a model with the logarithm of the total number of patents plus 1 as the explained variable (Y), use the introduction of the Shanghai-Hong Kong Stock Connect program policy as an exogenous shock event, further analyze it

through the DID model, and then consider the systematic differences between the two groups of samples. First, the propensity score (PSM) is used for matching grouping and then DID model is used to enhance robustness.

First of all, according to the literature research, the opening of a capital market can promote financing, alleviate the financing difficulties of enterprises, improve investors' tolerance of failure in the short term, and promote enterprise innovation

H: Other conditions remain unchanged. The implementation of the trading system of the Shanghai-Hong Kong Stock Connect program improves the innovation performance of the target company.

3.2. Benchmark Return: Enterprise Innovation And Trading System Of Shanghai-Hong Kong Stock Connect

In this paper, we use a multiple linear regression model as the benchmark regression. Firstly, we only set treated as the explanatory variable, and the treated coefficient is significantly positive, which indicates that the implementation of the Shanghai-Hong Kong Stock Connect program will promote the level of enterprise innovation. It shows that the implementation of the trading system of the Shanghai-Hong Kong Stock Connect program under the condition of control variables can promote the innovation level of enterprises, thus verifying hypothesis h. The results of other control variables are consistent with the existing research. It is worth noting that the control variable PPE is significant at the level of 1%, which indicates that the benchmark regression model has endogeneity problems and apparent shortcomings. Therefore, the double-difference model (DID) is used for the more in-depth test.

Table2 Enterprise innovation and trading system of Shanghai-Hong Kong stock connect-OLS

VARIABLES	（1）	（2）	（3）
treated	0.156*** （0.029）	0.149*** （0.290）	0.153*** （0.290）
period		-0.191*** （0.032）	-0.106*** （0.032）
lev		-0.105 （0.733）	-0.111 （0.730）
roa		0.236 （0.168）	0.252 （0.168）
ppe			0.268*** （0.973）
intan			0.454 （0.326）

Note: the bracket in the table is Std. Err, * * * indicates the statistical significance level of 1%, and the constant term is omitted.

3.3. In-depth Analysis:The Differential Impact Of "Shanghai-Hong Kong Stock Connect" Trading System

In-depth analysis: the differential impact of "Shanghai-Hong Kong stock connect" trading system

The basic settings of the DID model in this paper are as follows:

$$Y_{i,t} = \alpha + \beta_1 TREATED_{i,t \times} PERIOD +$$
$$\beta_2 TREATED_{i,t} + \gamma ControlVariables_{i,t} + \varepsilon_{i,t} \quad (3)$$

The patent represents the total number of patent output, Y represents the natural logarithm of the total number of patents plus 1, and control variables represent the control variables. Treated has been explained in the variable setting of 3.2 above. The interactive term treated * period describes the "policy processing effect" of the Shanghai-Hong Kong Stock Connect program on the innovation level of enterprises, and its coefficient is the focus of our attention.

The result of DID model shows that after controlling the time effect, the explained variable increases by 101.746 due to the net policy effect, and the variable treated is significant at the 5% level, which verifies the hypothesis h, that is, the Shanghai-Hong Kong stock connect, as a significant reform measure of capital market opening to the outside world, can effectively promote the development of the real economy with innovation as the core element.

Furthermore, since the stocks in the pilot range of the Shanghai-Hong Kong stock connect program all belong to the Shanghai component stock index, the company's asset scale and other fundamentals of these stocks are generally better than that of ordinary companies, so they have inherent advantages in R & D capability. It may cause some endogenous problems in the research conclusions. Secondly, there are differences in asset size, profitability, and stock liquidity between the standard stock and non-standard stock in the Shanghai-Hong Kong stock connect program. The regression analysis using a total sample may lead to sample selection bias in the empirical results. In order to avoid the impact of the above problems on the research conclusions and further alleviate the endogenous problems, this paper uses the research of Zhong Qinlin and Lu Zhengfei, and adopts the propensity score matching method (PSM). The matching samples are found for the Shanghai-Hong Kong stock connect program in batches, and the companies of the Shanghai Stock connect program is matched by 1:1. Regression is performed again using the samples on the matching.

The results of PSM-DID show that there is no significant difference in control variables between the two groups. This shows that PSM pairing is effective, and the sample re regression after PSM pairing can control the systematic differences between the target samples and non-target samples of Shanghai Stock Connect. After regression with PSM-DID, treated × The regression coefficient of the period is positive, and the control variables Lev and roe are significant at the level of 1%, which is consistent with the conclusions of other kinds of literature.

Table3 Enterprise innovation and trading system of Shanghai-Hong Kong Stock Connect program PSM-DID

VARIABLES	Diff	|t|	Pr(|T|>|t|)
Lm(patent+1)	0.754	0.59	0.5541
RD	1.224	4.33	0.000***
lev			0.000***
roa			0.000***

Note: the * * in the table indicates the statistical significance level of 1%

When R&D investment as a proportion of operating revenue (RD) is used to measure enterprise innovation, treated is the best choice × The regression coefficient of the period is significantly positive, and the research conclusion remains unchanged, which further proves the robustness of the conclusion.

3.4. Discussion On The Results Of Empirical Analysis

Firstly, the data distribution of various variables is observed by descriptive statistics; Secondly, the OLS multiple regression model is used as the benchmark regression, and the control variables are gradually added to verify that the trading system of the Shanghai-Hong Kong Stock Connect program has a positive impact on the level of enterprise innovation; Thirdly, in order to reduce the impact of endogenous problems, the double-difference model (DID) is used for in-depth study. It is observed that the regression coefficient of before treated is not significant, which indicates that before the implementation of the trading system of Shanghai-Hong Kong stock connect, there is no noticeable trend change in the innovation investment intensity between the target companies of Shanghai Stock connect and the non target companies of Shanghai Stock connect, The regression coefficient of after treated is significant at the level of 1%, which indicates that after the implementation of the trading system of Shanghai-Hong Kong stock connect, there is a significant difference in enterprise innovation investment between the target companies of Shanghai Stock connect and the non target companies of Shanghai Stock connect, but it is still significant at the level of 5% after the double difference, which further verifies the hypothesis H. Finally, in order to enhance the robustness of the conclusion, the PSM-DID model is used to verify that after the implementation of the trading system of

Shanghai-Hong Kong stock connect, the innovation level of the target enterprises of Shanghai Stock connect rises significantly, which supports the research hypothesis H.

4. CONCLUSIONS AND RECOMMENDATIONS

The Chinese government's continuous opening is a major capital market reform initiative carried out by the Chinese government in recent years. It is of great significance to study the impact of capital market opening on the economic consequences of micro-enterprises. The country's economic development is changing from factor-driven to innovation-driven, and the technological advantages brought about by technological innovation are gradually replacing traditional low-cost advantages to promote profound changes in the country's economy and society. Based on the above background, this article selects corporate innovation as the entry point. It cleverly uses the implementation of the Shanghai-Hong Kong Stock Connect trading system, an important measure of the country's capital market opening, as an exogenous event, which effectively overcomes the premise of the endogenous problems in previous innovation research. Next, the study found that the implementation of the Shanghai-Hong Kong Stock Connect trading system has effectively promoted the innovation performance of the target company, which is manifested in a significant increase in patent output. This research not only expands the analysis of factors affecting corporate innovation but also provides empirical evidence for the economic effectiveness of the Shanghai-Hong Kong Stock Connect trading system after the implementation of the trading system, and has reference significance for the country to improve further the level of opening up of the capital market.

This article proves that the capital market opening represented by the Shanghai-Hong Kong Stock Connect program is of positive significance for promoting the development of China's real economy, and one of the specific manifestations is that it promotes the improvement of micro-enterprises innovation level. The policy enlightenment drawn from this is mainly two: First, China should increase the level of capital market opening while increasing international trade, deepening the institutional reform of the stock and bond markets at home and abroad represented by the Shanghai-Hong Kong Stock Connect Programme. The degree of financial openness in various regions will further enhance the positive impact on the innovation level of enterprises. Second, pay attention to risk prevention, strengthen supervision and guidance, and further strengthen the positive impact of the virtual economy on the real economy.

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