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Article

Identification and Mechanism Test of the Effect of Capital Market Opening-up on Empowering Innovation-Driven Development of Specialized, Sophisticated, Unique and New Enterprises

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Abstract: Capital market opening-up represents a crucial component of China's comprehensive high-level economic opening-up strategy, serving as a catalyst for sustainable economic growth and structural transformation. Since the 1990s, China has successively piloted and introduced a series of progressive policies aimed at liberalizing its capital markets, achieving substantial macroeconomic outcomes. In particular, the official launch of the Shanghai-Hong Kong, China Stock Connect in 2014 marked a significant milestone by realizing two-way stock trading between investors in mainland China and Hong Kong, China, thereby enhancing market liquidity and integration. Against this dynamic macroeconomic backdrop, taking corporate innovation as a primary indicator of high-quality economic development, this paper rigorously examines the impact of the Shanghai-Hong Kong, China Stock Connect policy on corporate innovation capabilities. Using the econometric software Stata, this study selects A-share listed Specialized, Sophisticated, Unique, and New enterprises on the Shanghai Stock Exchange from 2010 to 2023 as the primary research sample. By adopting the Shanghai-Hong Kong, China Stock Connect mechanism as a quasi-natural experiment, the research employs a robust time-varying Difference-in-Differences (DID) model to explore the profound effect of capital market opening-up on the innovation performance of these specialized enterprises. Furthermore, the study comprehensively analyzes the overarching policy effect, empirically verifies the direct positive impact on corporate innovation outputs, and investigates the critical mediating role of corporate governance mechanisms. Finally, it puts forward targeted, evidence-based policy references for both government regulators and enterprise managers to optimize innovation-driven development strategies.

Keywords: capital market; corporate innovation; corporate governance; did model; economic policy

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1. Introduction

As a fundamental policy underpinning China's development, the strategy of opening-up has played a pivotal role in driving the nation's economic progress since the initiation of reform and opening-up. This approach has been instrumental in fostering economic growth by facilitating international collaboration and integration. The emphasis on promoting high-level opening-up, as outlined in recent strategic directives, underscores the importance of expanding the scope, depth, and breadth of this policy. Such efforts aim to establish a comprehensive framework that supports sustainable development across diverse sectors, including trade, investment, and financial markets [1]. The opening-up strategy not only enhances China's global economic presence but also serves as a catalyst for domestic innovation and modernization, ensuring alignment with global standards and practices. By fostering an environment conducive to international cooperation, this policy contributes to the long-term stability and resilience of China's

economy, while simultaneously addressing emerging challenges in the global economic landscape.

In the context of capital market reforms, the Chinese government has demonstrated a strong commitment to integrating domestic markets with global financial systems. This process involves a dual approach of "bringing in" foreign investment and expertise while simultaneously "going global" to enhance the international competitiveness of China's financial institutions and enterprises. The Shanghai-Hong Kong, China Stock Connect policy exemplifies this strategy, serving as a critical mechanism for facilitating cross-border investment and fostering mutual economic benefits. By enabling seamless interaction between investors in Shanghai and Hong Kong, China, this initiative has significantly contributed to the diversification and modernization of China's capital markets. Furthermore, the policy's impact on corporate innovation, particularly among Specialized, Sophisticated, Unique, and New enterprises, highlights its role in driving technological advancements and enhancing competitive capabilities. Through a detailed examination of these dynamics, this paper aims to provide valuable insights into the interplay between capital market opening-up and innovation [1, 2]. Such analysis is essential for informing future policy adjustments and optimizing the framework for economic transformation. By leveraging the lessons learned from the Shanghai-Hong Kong, China Stock Connect, policymakers can better understand the potential of capital market reforms to stimulate innovation, support sustainable growth, and strengthen China's position in the global economy. This research also serves as a scientific foundation for strategic decision-making, ensuring that the opening-up process aligns with national development goals and contributes to the broader objectives of economic modernization and global integration.

2. Empirical Analysis of the Impact of Capital Market Opening-Up on Innovation of Specialized, Sophisticated, Unique and New Enterprises

2.1. Research Hypotheses and Model Design

2.1.1. Research Hypotheses

With the progressive enhancement of market openness, China's capital market has evolved into a two-way opening-up framework. A significant milestone in this process is the implementation of the Shanghai-Hong Kong, China Stock Connect trading system. This initiative has effectively removed restrictions on securities trading between the two regions, thereby facilitating a substantial increase in capital flows [3]. The enhanced liquidity has contributed to a more efficient allocation of social resources, ensuring that enterprises have access to sufficient funding. This financial support is critical for fostering corporate innovation, as it enables firms to invest in research and development, adopt advanced technologies, and enhance their competitive edge in the market. Furthermore, the improved market dynamics have created an environment conducive to innovation by encouraging collaboration, knowledge sharing, and the adoption of best practices across industries. This study aims to explore these dynamics by formulating specific hypotheses to assess the impact of such market reforms on the innovation capabilities of enterprises categorized as Specialized, Sophisticated, Unique, and New.

Hypothesis 1 posits that the implementation of the Shanghai-Hong Kong, China Stock Connect trading system has led to a significant improvement in the innovation levels of Specialized, Sophisticated, Unique, and New enterprises included in this framework [4]. This hypothesis is grounded in the premise that increased access to cross-border capital and enhanced market integration provide these enterprises with the financial resources and strategic opportunities necessary to innovate. By leveraging these advantages, firms are expected to develop new products, improve existing processes, and achieve technological breakthroughs that enhance their market position and long-term sustainability.

Hypothesis 2 suggests that corporate governance serves as a mediating factor in the relationship between capital market opening-up and the technological innovation of

Specialized, Sophisticated, Unique, and New enterprises. Effective corporate governance mechanisms, such as transparent decision-making processes, accountability structures, and strategic oversight, are hypothesized to amplify the positive effects of market reforms. By ensuring that financial resources are allocated efficiently and that innovation strategies align with organizational goals, corporate governance can play a pivotal role in translating the benefits of market openness into tangible innovation outcomes [4, 5]. This hypothesis underscores the importance of institutional frameworks in maximizing the potential of capital market reforms to drive technological progress and economic growth.

2.1.2. Model Design

This study utilizes the launch of the Shanghai-Hong Kong, China Stock Connect trading system on November 17, 2014, as a quasi-natural experiment to explore its implications for enterprise innovation. Specifically, the research employs a Difference-in-Differences model to evaluate the policy's impact on the innovation activities of Specialized, Sophisticated, Unique, and New enterprises [5, 6]. The treatment group consists of A-share listed enterprises categorized as Specialized, Sophisticated, Unique, and New, which are directly affected by the Shanghai-Hong Kong, China Stock Connect. In contrast, the control group includes non-target listed companies that remain unaffected by the policy. By comparing these two groups, the study aims to provide insights into how the opening of capital markets influences micro-enterprise innovation behavior. Furthermore, the analysis extends to examine the mediating role of corporate governance in this relationship, offering a comprehensive understanding of the mechanisms at play.

For the first hypothesis, the model is structured as follows: $lnRDi,t=\alpha0+\beta1DIDi,t+\beta2Controli,t+\delta t+\mu i+\varepsilon i,t$. Here, $lnRDi,t$ represents the logarithmic transformation of the innovation level of enterprise i in year t. The variable $DIDi,t$ captures the policy shock introduced by the Shanghai-Hong Kong, China Stock Connect, defined as the interaction between Treatmenti and Postt. Control variables, denoted as $Controli,t$, account for firm-specific factors that may influence innovation. The terms μi and δt represent individual fixed effects and time fixed effects, respectively, which are included to mitigate the influence of macroeconomic trends and unobserved heterogeneity. The random disturbance term, $\varepsilon i,t$, captures any residual variation not explained by the model [1, 7].

For the second hypothesis, the model incorporates additional layers to explore the mediating effect of corporate governance. The equations are specified as follows: $lnRDi,t=\alpha0+\beta1DIDi,t+\beta2Controli,t+\delta t+\mu i+\varepsilon i,t$; $EGLi,t=\alpha0+\beta1DIDi,t+\beta2Controli,t+\delta t+\mu i+\varepsilon i,t$; and $lnRDi,t=\alpha0+\beta1EGLi,t+\beta2DIDi,t+\beta3Controli,t+\delta t+\mu i+\varepsilon i,t$. In this framework, $EGLi,t$ represents the corporate governance variable for enterprise i in year t, which is hypothesized to mediate the relationship between the policy shock ($DIDi,t$) and innovation outcomes ($lnRDi,t$). By incorporating these additional equations, the study seeks to disentangle the direct and indirect effects of the Shanghai-Hong Kong, China Stock Connect on enterprise innovation, providing a nuanced understanding of the interplay between policy interventions and firm-level governance mechanisms [4, 8].

In these models, $lnRDi,t$ serves as the dependent variable, representing the innovation level of enterprise i in year t. The key independent variable, $DIDi,t$, is constructed as the interaction term between Treatmenti, which identifies whether an enterprise is part of the treatment group, and Postt, which indicates the post-policy period. Control variables ($Controli,t$) are included to account for firm-level characteristics that may influence innovation, ensuring the robustness of the results [9]. To address potential biases arising from macroeconomic trends and unobserved individual heterogeneity, the models incorporate individual fixed effects (μi) and time fixed effects (δt). The random disturbance term, $\varepsilon i,t$, captures unexplained variations. This comprehensive modeling approach ensures that the analysis provides reliable insights into the causal relationship between the Shanghai-Hong Kong, China Stock Connect policy and enterprise innovation, while also accounting for the mediating role of corporate governance.

2.2. Data Source and Variable Selection

2.2.1. Data Source

This study focuses on A-share listed Specialized, Sophisticated, Unique, and New enterprises on the Shanghai Stock Exchange over the period from 2011 to 2023. To ensure the reliability and validity of the research findings, the dataset underwent rigorous screening and preprocessing. Enterprises from the real estate and financial sectors were excluded due to their distinct operational characteristics, which could introduce bias into the analysis. Additionally, observations with incomplete data or those removed from the list during the observation period were eliminated, resulting in a refined dataset comprising 30,992 observations. To mitigate the impact of extreme values, numerical variables were winsorized at the 1% and 99% levels, ensuring a more robust statistical analysis. The primary source of data is the China Stock Market & Accounting Research Database (CSMAR), which is widely recognized for its comprehensive coverage and reliability. To address gaps in the dataset, supplementary data were obtained from the Chinese Research Data Services Platform (CNRDS) and Wind Financial Terminal (WIND), both of which are reputable platforms for financial and economic data in China. This meticulous approach to data collection and processing ensures that the study's findings are both accurate and representative of the target population, providing a solid foundation for subsequent analysis and interpretation. The dataset's breadth and depth enable a detailed examination of the characteristics and performance of these enterprises, contributing valuable insights to the field of corporate research.

2.2.2. Variable Selection

This study identifies whether an enterprise is included in the Shanghai-Hong Kong, China Stock Connect target list as the independent variable, denoted by TREAT. Specifically, TREAT is assigned a value of 1 if the enterprise is classified as a Specialized, Sophisticated, Unique, and New enterprise within the target list, and 0 otherwise. To further refine the analysis, a time dummy variable, Post, is introduced to capture temporal dynamics. Post is set to 1 for the year in which the enterprise is included in the list and for all subsequent years, while it is set to 0 for years prior to inclusion. This dual-variable framework enables a robust examination of the impact of inclusion in the target list on enterprise performance and innovation activities. By distinguishing between pre- and post-inclusion periods, the study aims to isolate the causal effects of policy interventions and market access on enterprise-level outcomes.

Innovation activities are fundamentally intertwined with financial resources, and R&D expenditure serves as a critical metric for assessing corporate innovation input [10]. This variable reflects the extent to which enterprises allocate resources toward research and development, which is essential for fostering technological advancements and maintaining competitive advantages. By focusing on R&D expenditure, the study seeks to quantify the direct financial commitment of enterprises to innovation processes. This approach provides a clear and measurable indicator of innovation intensity, enabling a detailed analysis of how financial inputs translate into innovative outputs. Furthermore, the emphasis on R&D expenditure underscores the importance of sustained investment in innovation as a driver of long-term growth and market differentiation.

The innovation development of Specialized, Sophisticated, Unique, and New enterprises is influenced by a multitude of factors beyond direct innovation input. Among these, the internal organizational structure of a company plays a pivotal role in shaping its capacity for innovation. Organizational structure encompasses elements such as hierarchical arrangements, decision-making processes, and resource allocation mechanisms, all of which significantly impact the efficiency and effectiveness of innovation activities. A well-designed structure can facilitate collaboration, streamline operations, and enhance the adaptability of enterprises to dynamic market conditions. Conversely, structural inefficiencies may hinder innovation growth by creating bottlenecks or limiting the flow of information. By examining these internal factors, the study aims to provide a comprehensive understanding of the organizational dynamics

that drive innovation success in enterprises classified as Specialized, Sophisticated, Unique, and New [11].

2.3. Empirical Process

2.3.1. Descriptive Statistics

Descriptive statistics are conducted using data from A-share listed Specialized, Sophisticated, Unique, and New enterprises spanning the years 2010 to 2023. The mean value of lnRD, representing the natural logarithm of R&D investment, is calculated to be 18.072, which indicates a relatively high average level of R&D investment across the sampled enterprises. This suggests that these enterprises are actively engaging in innovation and technological development. The corporate governance level, denoted as EGL, has a mean value of 0.221, accompanied by a standard deviation of 0.991. The minimum value of EGL is -1.700, while the maximum reaches 2.419, highlighting significant variability in governance practices among the enterprises. The median value of 0.143 further emphasizes the uneven distribution of governance levels, with half of the enterprises falling below this threshold and the other half exceeding it. This disparity may reflect differences in management structures, regulatory compliance, or strategic priorities across the sample. Additionally, the mean value of DID, which measures the proportion of enterprises affected by the implementation of the Shanghai-Hong Kong, China Stock Connect, is 0.071. This indicates that 7.1% of the sampled enterprises experienced direct impacts from this financial policy, potentially influencing their operational strategies or market behaviors [12, 13]. Other variables in the dataset also exhibit substantial differences, underscoring the heterogeneity of the sample. Such variability provides a rich foundation for further empirical analysis, enabling researchers to explore the relationships between R&D investment, corporate governance, and external policy interventions within the context of these enterprises.

2.3.2. Correlation Analysis

The correlation analysis reveals that the correlation coefficient between DID and lnRD is 0.260, which is statistically significant at the 1% level. This indicates a meaningful and positive relationship between these two variables. Furthermore, lnRD demonstrates significant positive correlations with several other variables, including Size, Lev, Age, BdSize, and ROA. These findings suggest that lnRD is not only influenced by DID but also by a range of other factors, highlighting its multifaceted nature. The positive correlations with Size and Age may reflect the tendency of larger and more established entities to allocate more resources toward research and development. Similarly, the positive relationship with Lev could indicate that firms with higher leverage are more inclined to invest in innovation, possibly as a strategy to enhance future profitability. The association with BdSize might suggest that larger boards contribute to more effective decision-making regarding resource allocation. Finally, the positive correlation with ROA underscores the potential link between profitability and research investment. Given the significant relationships observed, a regression model can be constructed to further explore the interdependencies among these variables, providing deeper insights into their dynamics and implications for organizational strategies.

2.3.3. Multicollinearity Test

The variance inflation factor (VIF) method is a widely recognized statistical approach used to assess the presence of multicollinearity within a regression model. Multicollinearity occurs when independent variables in a model are highly correlated, which can distort the estimation of coefficients and reduce the reliability of the model's results. The VIF quantifies this by measuring how much the variance of a regression coefficient is inflated due to multicollinearity. A VIF value exceeding 10 is generally considered indicative of severe multicollinearity, which may necessitate corrective measures such as variable elimination or transformation. In this study, the VIF values for all variables were calculated, and the results demonstrated that none of the variables exceeded the critical threshold of 10. This indicates that the model is free from significant

multicollinearity issues, ensuring the stability and interpretability of the regression coefficients. The absence of multicollinearity enhances the robustness of the model, allowing for more accurate predictions and reliable conclusions based on the data analysis.

2.3.4. Benchmark Regression Model

The Hausman test is conducted to determine the suitability of fixed effects versus random effects models [14]. The test statistics are 82.620 and 1862.458, both accompanied by p-values below 0.01. These results strongly reject the null hypothesis at the 1% significance level, thereby validating the application of the fixed effects model. Furthermore, the F-test confirms the overall significance of the model at the 1% level, indicating robust fitting performance and effectively capturing the dynamic interactions among the variables under study. This methodological rigor ensures that the analysis is both statistically sound and capable of providing meaningful insights into the relationships between the examined factors.

Model (1) incorporates only the DID variable, while Model (2) includes all control variables alongside DID. In both models, the coefficient of DID is significantly positive, underscoring its substantial positive impact on lnRD. Model (2, which accounts for additional control variables, demonstrates a higher R2 value, indicating improved explanatory power and is thus selected as the benchmark model. The coefficient of DID in Model (2) is calculated as 0.2209, significant at the 1% level. This finding suggests that, on average, the lnRD of the treatment group increases by 0.2209% relative to the control group following the implementation of the policy. This result provides preliminary evidence that the Shanghai-Hong Kong, China Stock Connect initiative enhances independent innovation capacity, thereby supporting Hypothesis 1. From an economic perspective, the policy contributes to an improvement in the independent innovation capacity of targeted enterprises by approximately 0.2209 units compared to non-targeted enterprises, which corresponds to 15.4% of the sample's standard deviation. These findings highlight the policy's role in fostering innovation and its broader implications for enterprise development and competitiveness [15, 16].

The analysis of control variables reveals nuanced insights into enterprise behavior and innovation dynamics. Variables such as Size, Lev, and ROA exhibit significantly positive coefficients, suggesting that larger firms, those with higher leverage, and those with better financial performance are more likely to invest in research and development. Conversely, Age and Top1 (ownership concentration) display significantly negative coefficients. Older enterprises often adopt conservative strategies due to their reliance on established business models and the high sunk costs associated with outdated technologies [17, 18]. This conservatism leads them to prioritize incremental improvements over groundbreaking R&D efforts. Additionally, concentrated ownership can exert a monitoring effect that, while beneficial in some contexts, may also encourage major shareholders to prioritize short-term financial performance over long-term innovation investments. This short-sighted approach can hinder the allocation of resources toward transformative R&D projects. These findings underscore the complex interplay between organizational characteristics and innovation strategies, offering valuable insights for policymakers and business leaders aiming to foster sustainable growth and innovation within enterprises.

2.3.5. Robustness Tests

The parallel trend test results indicate that there is no statistically significant difference in the dependent variable between the control and treatment groups prior to the implementation of the policy. This conclusion is reached after controlling for covariates, as the confidence intervals for these differences include zero. This finding satisfies the parallel trend assumption, which is a critical prerequisite for ensuring the validity of the analysis. Furthermore, the dependent variable, represented as lnRD, is observed to be significantly higher in the treatment group compared to the control group during the current period and in the subsequent one, two, and three years following the policy implementation. These results align with and reinforce the conclusions drawn in

earlier sections of the study. The observed increase in lnRD suggests that the policy has had a sustained and positive impact on the treatment group, highlighting its effectiveness in achieving the intended outcomes. The robustness of these findings underscores the reliability of the analytical framework employed in this research.

A placebo test was conducted to further validate the robustness of the results [12]. This test involved randomly assigning the treatment group and repeating the process 500 times to simulate a scenario where the treatment effect is absent. The kernel density distribution of the placebo coefficients was found to be normally distributed around zero. Importantly, all placebo coefficients were smaller than the benchmark coefficient derived from the actual analysis. This indicates that the benchmark result represents a low-probability event under random conditions, thereby affirming its statistical significance. Additionally, the kernel density plot demonstrates that the random estimation coefficients cluster near zero and do not encompass the true value of the benchmark coefficient. This finding provides strong evidence that the observed policy effect is not attributable to random chance or other confounding factors. The placebo test thus serves as a critical robustness check, confirming the validity and reliability of the policy's measured impact. These results further strengthen the confidence in the study's conclusions and highlight the methodological rigor applied throughout the analysis.

3. Research Conclusions and Recommendations

This study employs a time-varying DID model to analyze panel data of Specialized, Sophisticated, Unique, and New enterprises spanning the years 2010 to 2023. The findings reveal that the DID coefficient is significantly positive, with a value of 0.2209 at the 1% significance level. This result underscores the substantial role of the Shanghai-Hong Kong, China Stock Connect in fostering innovation within these enterprises. The robustness of this conclusion is further validated through a series of rigorous robustness tests. Delving deeper into the mechanisms at play, the analysis identifies a partial mediating effect. Specifically, the Shanghai-Hong Kong, China Stock Connect influences R&D investment through two primary channels: one being the enhancement of corporate governance structures, and the other being a direct impact on innovation activities. These findings highlight the multifaceted nature of the relationship between capital market integration and enterprise innovation, suggesting that the benefits extend beyond mere financial access to include improvements in organizational and operational efficiencies. Future research could explore the longitudinal effects of such market mechanisms on innovation sustainability, as well as the potential for similar initiatives in other regions to replicate these outcomes.

In the context of deepening global economic integration and intensifying technological competition, the opening-up of capital markets emerges as a pivotal driver of innovation for Specialized, Sophisticated, Unique, and New enterprises. However, several constraints hinder the full realization of this potential. These include limitations in institutional frameworks, the insufficient adaptation of financial products and services to the specific needs of these enterprises, the underutilization of advanced financial technologies, and delays in the development of critical infrastructure. To address these challenges and amplify the empowering effects of capital market liberalization, a comprehensive and multi-dimensional approach is essential. This approach should prioritize the establishment of robust institutional guarantees to ensure regulatory stability and transparency. Additionally, financial services must be tailored to better align with the unique requirements of innovative enterprises, incorporating flexible funding mechanisms and risk-sharing models. The integration of cutting-edge financial technologies, such as blockchain and AI-driven analytics, can further enhance efficiency and accessibility. Finally, significant investments in infrastructure, including digital platforms and connectivity solutions, are necessary to support seamless market operations. Future research could investigate the interplay between these dimensions and their collective impact on innovation efficiency, as well as explore the scalability of such frameworks in diverse economic contexts.

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