Research on the structural differentiation of venture capital industry under macroeconomic fluctuations

Xiaolin Chen[1*]

[1]School of finance, Renmin University of China, Beijing 100872, China

Abstract. In the context of global macroeconomic fluctuations, the venture capital (VC) industry has witnessed a structural differentiation characterized by the contraction of traditional venture capital (VC) and the rise of government-guided funds. Based on data from 2015 to 2024, this study employs panel regression and difference-in-differences (DID) models to analyze the differential impacts of macroeconomic indicators such as GDP and CPI on these two types of institutions. Taking the establishment of the Science and Technology Innovation Board (STAR Market) as an example, the policy effects are verified. The findings indicate that traditional VC funds are highly sensitive to macroeconomic fluctuations, whereas government-guided funds exhibit countercyclical behavior due to policy support. The STAR Market has increased hard-tech IPOs in the Yangtze River Delta by 717, yet it has had a short-term negative impact on the central and western regions. The structural differentiation is driven by policy arbitrage and resource misallocation. Although government-guided funds have policy advantages, they face the contradiction between long-term strategy and short-term assessment. This study provides a basis for optimizing VC policy design and suggests implementing differentiated regulation and assessment reform to guide government-guided funds toward strategic industries.

1 Introduction

In recent years, the global economic environment has become increasingly complex and volatile, with trade frictions, geopolitical conflicts, and the COVID-19 pandemic causing significant fluctuations in macroeconomic indicators such as GDP growth rates, inflation rates, and interest rates [1]. Under such circumstances, the venture capital (VC) industry, as a vital force in supporting innovation and driving industrial upgrading, faces unprecedented challenges and opportunities. Traditional venture capital institutions have experienced continuous contraction in business scale and investment activity, while government-guided venture capital funds have rapidly risen, leveraging policy support and resource integration advantages. These funds have improved resource misallocation, promoted the transformation of scientific and technological achievements, and encouraged innovation, thus becoming

* Corresponding author: 2024202158@ruc.edu.cn

increasingly important in the venture capital market [2, 3]. Existing research has primarily focused on the cyclical adaptability of a single type of VC but it lacks a systematic explanation of the driving mechanisms of structural differentiation [1]. Traditional literature emphasizes the linear impact of macroeconomic indicators such as GDP and PMI on the total volume of VC, neglecting the differentiated transmission paths of policy adjustments on different types of VC [4, 5]. Additionally, there is a lack of empirical tests based on dynamic data for the countercyclical regulation of government-guided funds [5, 6, 7]. This paper focuses on the differentiation mechanism of traditional VC and government-guided VC under macroeconomic fluctuations, using a difference-in-differences (DID) model to analyze the regional differences in government-guided fund investments [8, 9]. It derives the policy multiplier effect on the differentiation and new development of the venture capital industry and conducts empirical tests based on panel data from 2015 to 2024, sourced from the China Venture Capital and Private Equity Research Center and the National Bureau of Statistics [10, 11]. The innovative dynamic research expands the understanding of the development patterns of the venture capital industry and provides valuable references for the strategic adjustments of venture capital institutions, government policy-making, and financing decisions of innovative and entrepreneurial enterprises, promoting the healthy and sustainable development of the venture capital industry [6, 12].

2 Theoretical framework

The background of this study is based on the cyclical changes in the macro-economy. The theory of macroeconomic cycles posits that the cyclical fluctuations in economic growth significantly impact the venture capital industry. During economic expansions, market demand is robust, and corporate profit expectations are favorable, leading to a higher risk appetite among venture capital institutions, which are then more willing to increase their investment efforts. Conversely, during economic recessions, market uncertainties rise, and investment risks escalate, causing venture capital institutions to become more cautious and reduce their investments [5, 7, 13]. Meanwhile, monetary and fiscal policies indirectly affect the venture capital industry by influencing the cost of capital, market liquidity, and the operating environment of enterprises. For example, loose monetary policies lower the cost of capital and increase market liquidity, providing ample funding sources for the venture capital industry. Active fiscal policies, through tax incentives and subsidies, improve the operating conditions of enterprises and enhance the profit expectations of venture capital projects [5, 14].

The operation model of venture capital includes four stages: fundraising, investment, management, and exit, each of which is influenced by market conditions, industry competition, and the capabilities of the institutions themselves [8, 15]. Establishing a fund is one of the main ways of venture capital operation. Venture capital funds raise capital through non-public means to provide financial supplements for innovation and entrepreneurship. In recent years, with the economic downturn in the post-pandemic era and the backdrop of local hot wars and trade wars in the international environment, the macroeconomic cycle has changed, and macroeconomic indicators have fluctuated significantly. The traditional venture capital industry is facing multiple pressures in raising funds and making investments [9, 16]. However, venture capital institutions with government-guided funds have gone against the trend, ensuring the volume of capital raising and continuing to promote innovation and entrepreneurship. Government-guided venture capital funds, as an important vehicle for government-guided funds, have unique advantages in optimizing resource allocation and promoting industrial development. Therefore, government-guided venture capital institutions continue to develop, and the venture capital industry has shown structural differentiation [6]. Is there a direct dynamic link between this differentiation and the fluctuations in

macroeconomic indicators? What are the characteristics of this link? Furthermore, what is the mechanism by which government macroeconomic policies guide the investment direction of venture capital?

3 Research design and hypothesis testing

3.1 Indicator design and data sources

Under the backdrop of macroeconomic fluctuations, the differentiation characteristics of the venture capital industry can be measured through a series of core indicators such as the number and scale of new funds, investment intensity, and direction [17]. The macroeconomic fluctuation indicators in this paper include GDP growth rate and CPI inflation rate changes, which are derived from the provincial panel data of the National Bureau of Statistics and can effectively reflect the overall economic operation of the region [18]. For venture capital differentiation indicators, this paper uses venture capital funds to represent traditional VC and government-guided funds to represent government VC. The data on the number and scale of new funds, investment intensity, and direction for these two types of venture capital funds are collected using the method of Wang et al. [7], sourced from the China Venture Capital and Private Equity Research Center and CVSource, and can accurately depict the differences between different types of venture capital funds in resource allocation, profit acquisition, and industry layout [19]. Additionally, policy shock variables such as the establishment of the STAR Market in 2019 are included in the analytical framework to examine the direct and indirect impacts of policies on the venture capital industry. Therefore, this paper sets the following two hypotheses:

Hypothesis 1: Changes in macroeconomic indicators will lead to the differentiation of the venture capital industry.

Hypothesis 2: Policy shocks (such as the establishment of the STAR Market) will further exacerbate this differentiation.

3.2 Data organization and analysis

3.2.1 Structural differentiation characteristics

Fig. 1 illustrates the trend of changes in the growth rates of traditional VC and government VC funds from 2014 to 2024.It can be observed that the fluctuation amplitude of fund scale growth was significant between 2014 and 2018.From 2018 to 2022, the industry entered a period of steady adjustment with smaller fluctuation amplitudes. However, the growth rates of new additions for the two types of funds were unstable, with cyclical changes. After 2021, the proportion of new additions of government-guided funds gradually exceeded that of traditional venture capital funds [20].

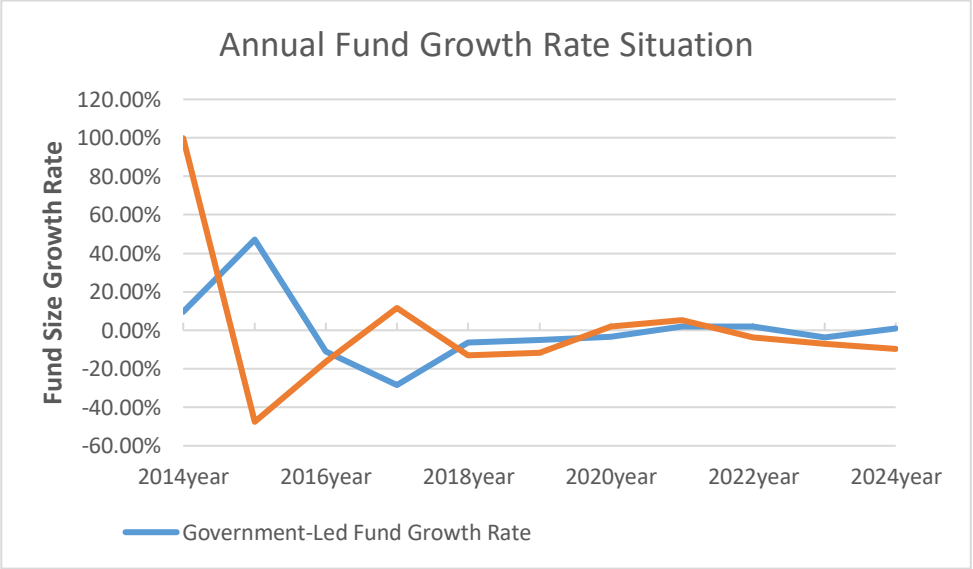

Fig. 1. Annual fund growth rate situation.

3.2.2 Macroeconomic shock response

Under the backdrop of macroeconomic fluctuations, traditional VC and government VC exhibit significant differences in their responses to GDP growth and CPI inflation. This study analyzes the impact and mechanism of action from two perspectives: the amount of capital raised and the intensity of fund investment.

Firstly, analyzing Fig. 2, traditional VC shows a higher sensitivity to GDP growth. From 2014 to 2019, as GDP growth declined, the fundraising amount of traditional VC also decreased significantly, with the rate of decline almost consistent. This indicates that traditional VC is more affected by changes in GDP indicators and faces greater pressure in raising funds during economic downturns, with its investment activities significantly constrained by macroeconomic conditions. In contrast, government VC exhibits certain countercyclical regulatory characteristics. From 2014 to 2015 and from 2021 to 2022, when GDP growth declined, the fundraising amount of government VC actually increased. This may be because government VC can obtain more policy support and fiscal funds during economic downturns, thereby alleviating the negative impact of economic downturns on investment activities to a certain extent.

Next, by analyzing Fig. 3, it is found that the fundraising growth rate of traditional VC fluctuates dramatically with CPI changes. For example, during the stable CPI period from 2014 to 2015, it first surged and then plummeted, and during the CPI anomaly period from 2019 to 2020, it remained persistently low. In contrast, the fundraising growth rate of government-guided VC remains relatively stable. For instance, during the CPI fluctuations from 2016 to 2018 and the CPI anomaly caused by the pandemic in 2020, there were no significant ups and downs as seen with traditional VC. This may be because traditional VC relies on market-based funds, and the risk preferences of LPs change dramatically with CPI-related inflation/liquidity expectations [21, 22]. Government-guided VC, supported by policy and fiscal resources, has a fundraising logic tied to "countercyclical regulation and strategic industrial layout, making it naturally insensitive "to CPI fluctuations and thus less affected by CPI changes.

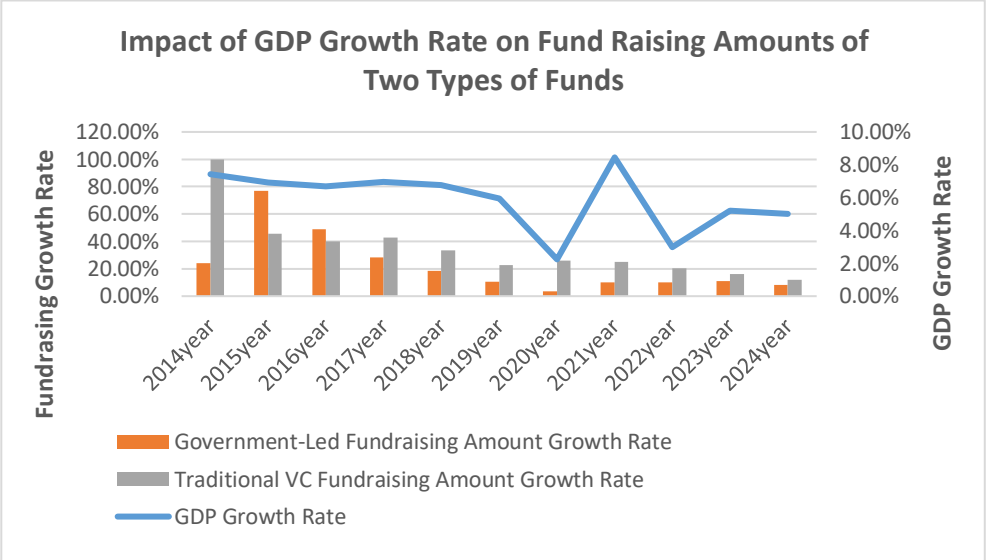

Fig. 2. Impact of GDP growth rate on fund raising amounts of two types of funds.

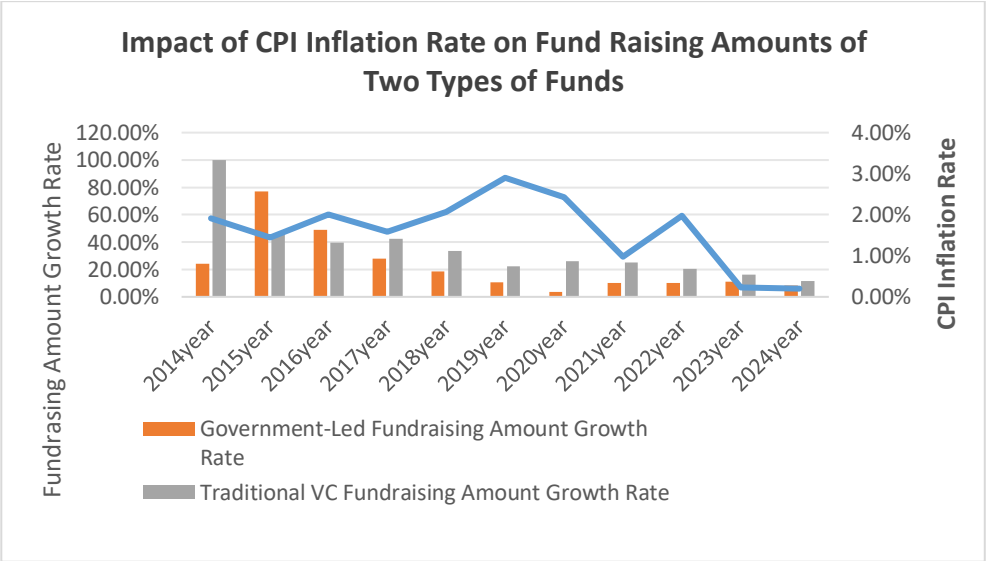

Fig. 3. Impact of CPI inflation rate on fund raising amounts of two types of funds.

From the perspective of investment intensity, the investment intensity of traditional VC fluctuates dramatically with CPI changes, while that of government-guided funds remains relatively stable. The differences between venture capital funds and government-guided venture capital funds are evident. The investment intensity of government-guided venture capital funds has a very weak association with CPI trends and maintains an upward trend

despite significant CPI fluctuations (Fig. 4, Fig. 5) [23].

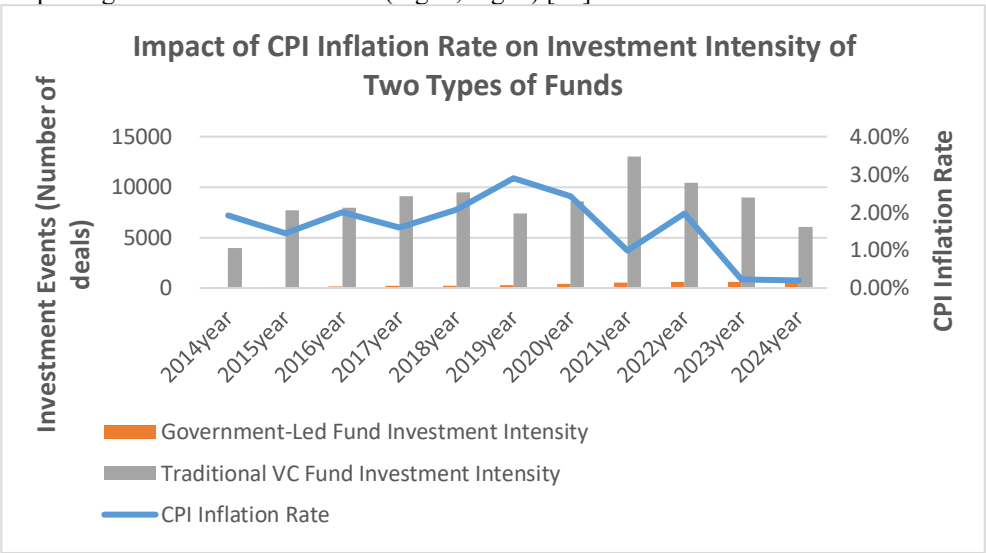

Fig. 4. Impact of CPI inflation rate on investment intensity of two types of funds.

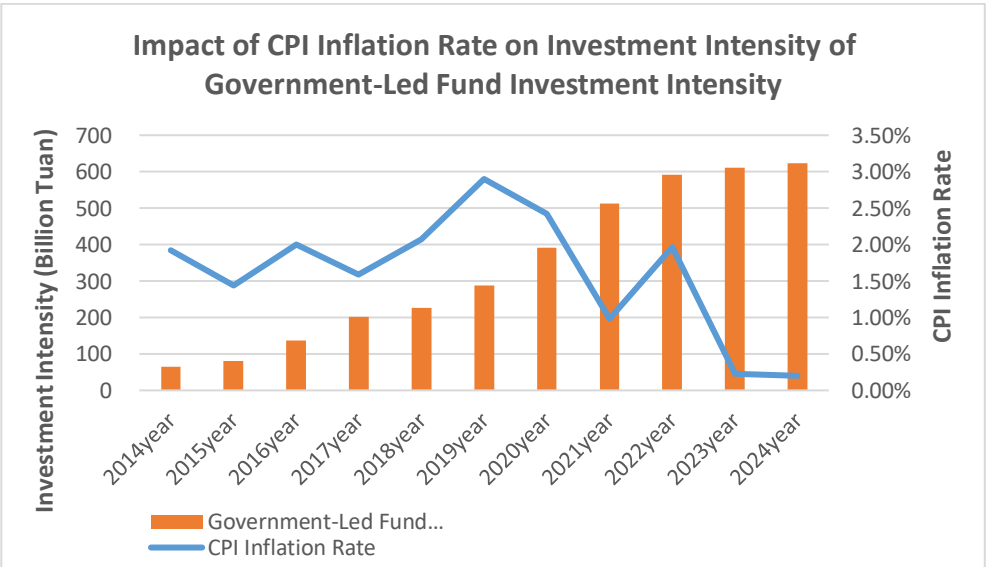

Fig. 5. Impact of CPI inflation rate on investment intensity of government-led fund investment intensity.

Next, analyzing the impact of GDP growth on the investment intensity of the two types of funds (Fig. 6), it is found that the investment amount of traditional VC fluctuates significantly with GDP growth, while the investment scale of government VC remains relatively stable. Analogous to the logic of CPI fluctuations, government-guided VC, supported by policy and fiscal resources, has an investment logic tied to strategic layout and countercyclical regulation, making it naturally "insensitive" to CPI fluctuations and less

affected by them.

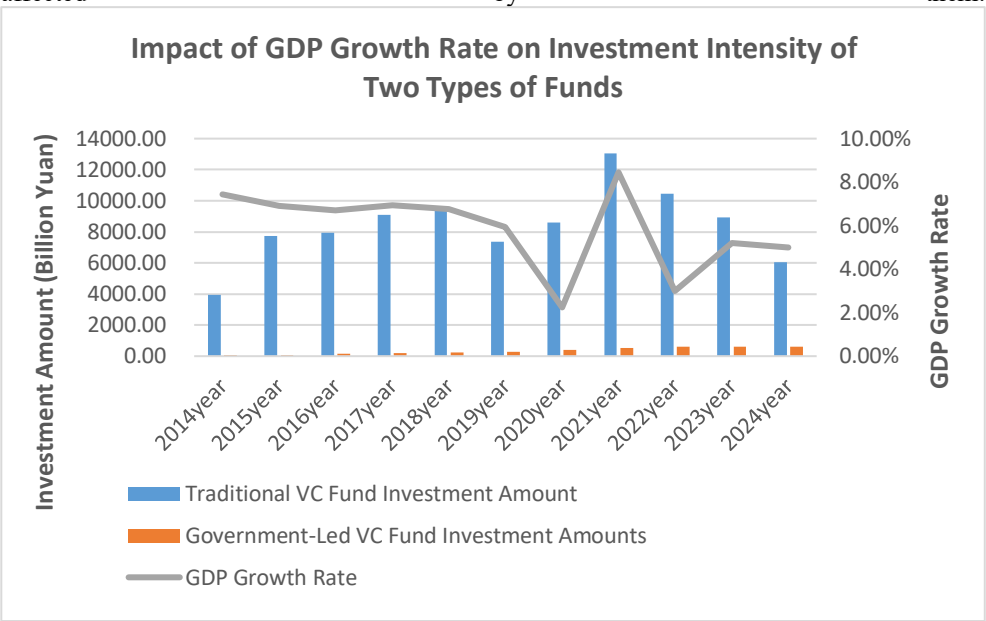

Fig. 6. Impact of GDP growth rate on investment intensity of two types of funds.

3.2.3 Policy multiplier effect verification

The policy effect of the establishment of the STAR Market is assessed using the difference-in-differences (DID) method. The results show that the STAR Market increased the number of hard-tech IPOs in the Yangtze River Delta by 32 ($p<0.05$). This indicates that the establishment of the STAR Market has a significant promoting effect on hard-tech enterprises in the Yangtze River Delta, providing them with broader financing channels and more convenient listing paths, thereby promoting regional technological innovation and industrial upgrading. It also shows that government VC not only directly provides financial support to enterprises in the investment process but also attracts the participation of social capital, amplifying the leverage effect of fiscal funds and providing strong financial support for regional economic development and industrial upgrading.

4 Empirical research

4.1 Panel regression model specification

To accurately analyze the impact of macroeconomic indicator changes on the differentiation of the venture capital industry, this paper constructs a panel regression model [24]:

$$VC_{(it)} = \beta_0 + \beta_1 GDP_{(it)} + \beta_2 CPI_{(it)} + \beta_3 Policy_{(it)} + \gamma X_{(it)} + \varepsilon_{(it)} \quad (1)$$

Firstly, the selection of variables in this paper is based on the following considerations: GDP growth rate and CPI inflation rate are chosen as the core independent variables because the macroeconomic situation has an important impact on the flow of venture capital funds. GDP reflects the overall economic growth, and changes in GDP growth rate affect the activity

and direction of capital flow; CPI reflects price changes, and CPI inflation rate affects the cost of capital and the expected return on investment. By controlling for fiscal deficit ratio and regional industrial structure, the interference of other macroeconomic factors and regional industrial differences on the results is reduced, focusing on the impact of the core independent variables.

Secondly, in the regression model, the dependent variable VC_{it} is the growth rate of VC fundraising amount in provinces, the core independent variables include GDP growth rate, CPI fluctuations, and policy dummy variables (e.g., STAR Market establishment=1), and the control variables X_{it} include fiscal deficit ratio and regional industrial structure. The data are divided into two groups: traditional VC and government-guided VC, and the model is estimated separately for each group to compare the differences between the two groups. Through the panel regression model, individual heterogeneity and time effects can be effectively controlled, thereby accurately estimating the impact of macroeconomic indicators and policy variables on venture capital fundraising amounts.

Through correlation regression analysis ,it is found that for government-guided funds, the value β_1 is 5.11, the value β_2 is 2.73, and the intercept is-0.11;for venture capital funds, the value β_1 is 6.38,the value β_2 is 9.73,and the intercept is-0.18.Through empirical analysis,it is found that the growth rate of fundraising amounts for government-guided funds is less affected by macroeconomic indicators such as GDP and CPI inflation rate,while venture capital funds are more significantly affected by the fluctuations in macroeconomic indicators.

Subsequently, significance analysis is conducted, yielding a p-value of 0.054 for the change in government-guided fund fundraising amount growth rate associated with GDP changes, which is significant at the 0.1 level and close to 0.05; the p-value for the change in traditional venture capital fund fundraising amount growth rate associated with GDP changes is 0.044, which is significant at the 0.05 level.

The p-value for the change in government-guided fund fundraising amount growth rate associated with CPI inflation rate changes is 0.39, which is not significant at the 0.1 level; the p-value for the change in traditional venture capital fund fundraising amount growth rate associated with CPI changes is 0.23, which is also not significant at the 0.1 level.

Through significance analysis, it is concluded that changes in GDP are statistically significant in relation to the changes in the two types of funds, while changes in CPI inflation rate, although not significant in statistical terms, are consistent with China's economic reality and thus have practical significance.

4.2 Data organization and analysis

Further, this paper employs the difference-in-differences (DID) method to assess the impact of policy shocks [25]. When selecting the treatment and control groups, taking the STAR Market establishment policy as an example, the treatment group consists of four provinces in the central and western regions, and the control group consists of three provinces and one municipality in the Yangtze River Delta. The dependent variable is the number of hard-tech IPOs. To address potential endogeneity issues, the event study method is utilized to conduct a parallel trend test, analyzing the trends in IPO numbers and other indicators for enterprises in the treatment and control groups before the policy announcement. If no trend differences exist prior to policy implementation, endogeneity concerns can be alleviated to some extent. The parallel trend test reveals no pre-existing trend differences, partially mitigating the impact of endogeneity. Through the DID method, the changes before and after policy implementation, as well as between the treatment and control groups, can be effectively identified, thereby accurately assessing the causal effects of the policy.

The relevant experimental design is as follows:

Policy variable (x1): Treatment group (Yangtze River Delta region): x1=1; Control group (central and western regions): x1=0

Time variable (x2): After policy implementation (2019-2024): x2=1; Before policy implementation (2014-2018): x2=0

Outcome variable (y): Number of hard technology IPOs

Interaction term (DID): x1×x2, used to measure the net effect of the policy on the treatment group.

Model Formula:

$$y = \alpha + \beta x_1 + \gamma x_2 + \delta(x_1 \times x_2) + \epsilon \quad (2)$$

Where x_1 represents the policy variable (East China region as 1, Central and Western regions as 0); x_2 represents the time variable (2014-2018 as 0, 2024 as 1); $x_1 \times x_2$ represents the interaction term, used to estimate the policy's net impact on the treatment group. Key coefficients: The interaction coefficientδrepresents the DID effect (the policy's net impact on the treatment group). β represents the baseline difference between the treatment group and the control group (pre-policy effect); γ represents the average effect of policy implementation across all regions (temporal trend); δ: DID coefficient (the net effect of the policy on the treatment group, i.e., the core estimate).

Coefficient Calculation: The β value is 95.6, the γ value is 11.33, and the cross-term δ value is 32.4 (i.e., the DID effect) is much greater than 0, indicating that the policy of the STAR Market has had a positive impact on the treatment group.

Significance Analysis: The p-value for the DID model is 0.058271, which is less than 0.1 and close to 0.05,indicating significance and meaningful statistical analysis.

Result Interpretation: Treatment group trend: The value of y increases by 717 after the policy (which may reflect time trends or other factors). Control group trend: The value of y only increases by 61 after the policy, significantly lower than the treatment group.

DID effect (δ=32.4): This result indicates that the policy has a positive effect on the treatment group.

Through the DID model, it can be inferred that the establishment of the STAR Market may have a promoting effect on the development of science and technology innovation enterprises in the Yangtze River Delta. One reason is that the policy focus of the STAR Market establishment in its early stage was on the Yangtze River Delta and eastern regions, so the establishment of the STAR Market had some negative impact on the central and western regions, which was not conducive to the development of the venture capital industry in these regions. The establishment of the STAR Market provides a guiding direction for the venture capital industry. The investment direction and intensity of government-guided funds are directly affected by policies, which significantly increases the activity of government-guided funds, shifts their investment direction towards frontier innovation and hard-tech fields, and steadily increases investment intensity, partially replacing traditional venture capital funds. Compared with venture capital funds, government-guided funds have stronger targeting and promoting power, boosting the benign development of emerging technology companies in China [8].

5 In-depth discussion

5.1 Differentiation mechanism: policy arbitrage and resource misallocation

Government VC, relying on fiscal interest subsidies, tax incentives, and other policies, has a much lower cost of capital than traditional VC. Although it can quickly deploy industries, it is prone to" policy arbitrage", which distorts risk pricing and excessively pursues scale and policy orientation, squeezing the market space of traditional VC. Some government VC in the central and western regions also suffer from "resource misallocation."[9] At the same time, there are still gaps in the development level of the venture capital industry in the central and western regions. These gaps not only waste fiscal funds but also exacerbate regional industrial imbalances, which are not conducive to the sustainable development of the venture capital industry.

5.2 Theoretical challenges: breaking traditional logic and contradictions

The traditional "financial accelerator theory" suggests that "financial fluctuations → credit transmission → real economic fluctuations." [10] However, government VC bypasses the traditional credit market through direct fiscal investment. For example, the government-guided fund directly invests through fiscal means into strategic industries. This direct investment approach bypasses the credit assessment and risk-pricing mechanisms of the traditional credit market, thereby weakening the credit transmission role of traditional VC.

At the same time, government VC, as "patient capital", needs to hold shares long-term to achieve industrial goals [4]. But local governments, in pursuit of short-term GDP growth, may exert pressure on government-guided funds, demanding that they achieve investment returns in the short term. This conflicts with the long-term strategic objectives of government-guided funds. In other words, it is constrained by the "short-term" nature of local GDP assessments, forming an inherent contradiction between "long-term strategy vs. short-term performance."

6 Conclusion

This paper has verified the two experimental hypotheses through panel regression and the DID model: changes in macroeconomic indicators lead to structural differentiation in the venture capital industry, and policy shocks, such as the establishment of the STAR Market, further exacerbate this differentiation. Traditional VC fundraising and investment are significantly affected by macroeconomic fluctuations, while government-guided funds-supported by policy-exhibit countercyclical characteristics. The STAR Market has increased the number of hard-tech IPOs in the Yangtze River Delta by 717 but has had a short-term negative impact on the central and western regions. Through the verification of these hypotheses, this paper not only explains the internal mechanisms of the venture capital industry's differentiation but also provides a reasonable outlook for its future development.

The data in this study cover the period from 2014 to 2024, which covers major economic events such as the establishment of the STAR Market and the Sino-US trade war. However, the lack of data from the early stages of the venture capital industry development may limit the long-term predictability of the research findings. Meanwhile, this paper's analysis of the investment directions of venture capital funds and government-guided funds is insufficient. Future research should enrich the analysis of the types of industries invested in by the two types of funds and the flow of funds to optimize the DID model and further deepen the research, providing a dynamic research paradigm for the reform of the Chinese venture capital system.

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