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Venture Capital and Regional Path Creation: The Medical Industry in the Yangtze River Delta

by

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Thesis for the degree of Doctor of Philosophy

September 2025

University of Southampton

Faculty of Environmental and Life Sciences

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Abstract

Path creation is a key concept in evolutionary economic geography. However, although venture capital has been identified in path creation studies, there is still no comprehensive understanding of its role. This study aims to identify the mechanisms through which venture capital supports local industrial paths. To address this, the thesis takes the rapidly developing medical industry in the Yangtze River Delta over the past two decades as its research object, using a mixed-methods analytical approach. Quantitative models are used to answer "when," "where," and "what" questions, while qualitative analysis addresses "why" and "how." The study uses clinical trials innovatively as an indicator of innovation capacity in medical enterprises, thereby filling a gap in medical industry research. Qualitative research includes 28 interviews with venture capital firms, government entities and startups. The findings are as follows:

Firstly, venture capital in the Yangtze River Delta's medical industry shows uneven characteristics that evolve in tandem with regional innovation activities. Macro-institutional reforms under socio-landscape pressures have created three opportunity spaces for regional medical industry development. Different regional policy responses have led to further differentiation in entrepreneurial ecosystems that ultimately shape local venture capital landscapes. Secondly, through propensity score matching and regression analysis, the thesis confirms that venture capital has supported the development of enterprise clinical trials, and validates this at the regional level. Results show that the impact of venture capital incurs time lags and spatial heterogeneity, with geographic distance, syndication and government venture capital promoting innovation to varying degrees. Thirdly, qualitative findings show that venture capital alleviates regional financing constraints by increasing financial capital supply and facilitating the integration of local knowledge resources by promoting talent mobility within and beyond the region. Meanwhile, venture capital engages in corporate governance to improve the institutional legitimacy of technologies through social networks involving the government. By capturing regional niche markets, it builds diversified, place-based industrial portfolios, helping to restructure regional market resources. In this process, the selection effect of venture capital reflects its inherent path dependence, exacerbating regional development imbalances. Finally, qualitative research also shows that geographic distance constrains enterprise activities through trust-building and information asymmetry. Syndication fosters a complementarity between information and resources among actors, mitigating the effect of geographic distance through risk-sharing. Government venture capital displays a local bias, balancing market orientation and different objectives, thus to some extent contributing to local path creation.

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Acknowledgements

This thesis is dedicated to my parents and my couple Chengjing.

Sincere thanks to the Chinese Scholarship Council (Grant No. 202108440171) and the Sino-British Fellowship Trust for their generous funding.

I am deeply grateful to Qinglan Qian from Guangzhou University, Cassandra Wang from Zhejiang University, all the interviewees and everyone who supported my fieldwork. I also need to thank my friends, especially Haolin, who provided me a place to stay during the final stage of my PhD.

Lastly, I express my deepest gratitude to my supervisors, Peter Sunley and Han Wang, for their invaluable guidance and support.

Zigong said: “Take the example of a palace wall. My wall is only shoulder-high, allowing others to glimpse the beauty of my household. Confucius’ wall, however, rises dozens of metres high; without entering through its gate, one cannot see the splendour of the ancestral temple or the richness of its many chambers. Those who find the gate are few indeed … Confucius’ greatness is like a towering mountain, unreachable by climbing steps.” — *The Analects, Zizhang*

Definitions and Abbreviations

VC ..... Venture Capital

GVC ..... Government Venture Capital

YRD ..... Yangtze River Delta

EEG ..... Evolutionary Economic Geography

PSM ..... Propensity Score Matching

HHI ..... Herfindahl-Hirschman Index

IPO ..... Initial Public Offering

Chapter 1 Introduction

1.1 Regional Path Creation and Agency: The Missing Perspective of Venture Capital

In recent years, evolutionary economic geography has come to focus more strongly on regional path creation. Regional economies often follow established trajectories to obtain better returns and enhance self-reinforcing mechanisms, leading to path dependence (Scott, 1999; Sunley and Martin, 2023). Building on this dependence, path development shows how regions use their existing capabilities to achieve incremental transformation through extension, upgrading or branching (Grillitsch and Sotarauta, 2018). This concept emphasizes the integration of new technologies with organizational knowledge by incorporating innovative external actors, combining intra- and extra-regional assets and fostering knowledge-intensive ecosystems through multidimensional interactions involving capital, markets and labour, ultimately giving rise to entirely new industries (MacKinnon et al., 2019a; Garud et al., 2010; Grillitsch et al., 2018).

The essence of path creation is based on three interrelated mechanisms: endogenous creation, diversity and transplantation. Firstly, endogenous creation relies on a region's internal generalized capital and Schumpeterian innovation to accumulate positive externalities through on-the-job learning, knowledge spillovers and purposeful R&D activities (Romer, 1986; Martin and Sunley, 1998; Arrow, 1962). This enables regions to escape from path dependence on existing industries and achieve industrial renewal. Secondly, heterogenous industries, technologies and organizations within a region offers the room for innovative recombination. The various asset combinations of local capabilities maintain specialized advantages while fostering nonlinear breakthroughs through synergies of related and unrelated variety (Maskell and Malmberg, 1999a; Boschma and Capone, 2016). Thirdly, the transplantation mechanism introduces globally dominant technologies and external actors that are unrelated to the region, using its absorptive capacity and cross-regional networks to establish new industries and create new growth paths (Martin and Sunley, 2006; Niosi and Bellon, 2002; Hidalgo et al., 2007).

Evolutionary economic geographers emphasize the role of institutional change and resource mobilization in path creation. On one hand, regional institutions continuously adjust informal constraints, formal rules and organizational forms through layering, conversion and recombination to provide legitimacy and set up behavioural frameworks for emerging industries (North, 1991; Mahoney and Thelen, 2009; Crouch, 2005). Institutional entrepreneurship,

bottom-up reinterpretation and top-down government-led reforms combine to shape a more flexible and diverse institutional environment that supports path creation (Martin, 2010; Geels and Schot, 2007). On the other hand, entrepreneurs activate resource search and acquisition through network connections, using formal contracts and mechanisms of informal trust to ensure resource transfer and enable value creation (Davidsson and Honig, 2003; Aldrich, 2006). The interactive feedback between institutions and resources works to anchor global technologies and investments locally, fostering knowledge-intensive ecosystems via asset transformation and network collaboration, thereby encouraging the emergence of new industrial paths (Martin and Sunley, 2006; Binz et al., 2016; MacKinnon et al., 2019b).

As part of this process, entrepreneurial agency and ecosystems reinforce each other. The former manifests as three types of agency – innovative entrepreneurship, institutional entrepreneurship and place-based leadership – which identify and construct opportunity spaces, integrate critical resources and challenge existing structures to foster disruptive innovation and systemic institutional change, thus facilitating the creation of new industrial paths (Grillitsch and Sotarauta, 2020; Garud et al., 2010; Battilana et al., 2009b). The latter represents an organic network comprising diverse actors including governments, universities, investors, professional service organizations and incubators, along with their cultural, social and material elements (Spigel, 2020; Stam and van de Ven, 2021). This ecosystem supports high-growth startups through trust-based information flows and resource mobilization strategies to strengthen regional agglomeration effects. These dynamics work together, enabling regions to cultivate new growth trajectories despite the constraints of path dependence.

However, current research on evolutionary economic geography and path creation rarely focuses on the specific mechanisms of venture capital as an active agent, despite the fact that venture capital plays a significant role in the creation of regional industrial pathways, particularly during the acceleration phase (Baumgartinger-Seiringer et al., 2021; Maas et al., 2020). Venture capital, with its tolerance for high risk and deep early-stage involvement, provides financial capital to enterprises (Engel, 2002; Zook, 2008) and promotes technological development as well as market expansion through post-investment management, thereby fostering endogenous regional growth (Metrick and Yasuda, 2021; Landström, 2007). Venture capital simultaneously improves regional diversification by building more diversified investment portfolios and strategically investing in upstream and downstream projects along with related technology initiatives within the same categories of industry (Zider, 1998; Dimov and Shepherd, 2005). By leveraging national and global social networks to transplant external innovation projects, venture capital also facilitates the emergence of new local industrial paths (Powell et al., 2002; Binz and Truffer, 2017). During the post-investment management phase, venture

capital uses its extensive interpersonal networks to efficiently seek out and transfer various resources (including market channels, technical knowledge and policy support) to portfolio companies, profoundly shaping the regional ecosystem and the local development environment (Hallen, 2008; Podolny et al., 2001; Stuart et al., 1999). Meanwhile, by lobbying governments to influence institutional reforms and policy formulation, venture capital also plays the role of institutional entrepreneur in path creation (Gompers et al., 1998; Callagher et al., 2015; Poh et al., 2024). Although previous studies have acknowledged the role of venture capital in path creation, they lack an agency perspective, leaving the specific mechanisms unclear, and this paper aims to address that perspective (Sheng et al., 2024).

1.2 The Medical Industry in the Yangtze River Delta

The medical industry is an ideal subject for studying the role of venture capital in path creation. Firstly, a close relationship exists between the intensity of venture capital involvement and industrial development, with venture capital playing a crucial role in the formation and growth of clusters (Li et al., 2024b). This occurs because the high-risk, high-reward nature of the medical industry amplifies firms' reliance on external equity financing (Smietana et al., 2016). The process of new drug development is time-consuming, costly and fraught with high levels of uncertainty and failure rates. Without sufficient venture capital support, small and medium-sized startups will struggle to navigate the full process from laboratory validation to clinical trials and marketization (Lehoux et al., 2016a; Marangos, 2014). Venture capital allows regional firms to cross critical thresholds by providing sustained financial support, thereby fostering the creation of new industrial paths in the region.

Secondly, the results of innovation in the medical industry are easily quantifiable and traceable. Because of stringent regulatory requirements, data on clinical trials and new drug approvals are publicly available, enabling researchers to map dynamic changes in the medical industry and correlate them with the entry and spatial distribution of venture capital. This makes the medical industry highly quantifiable and conducive to replicable research. Innovation activities in the medical industry also show strong regional agglomeration characteristics (Cooke, 2003; Bathelt and Zhao, 2016). As the medical industry is a sector with high entry barriers, the inherent significant spatial differences between different regions help researchers to explore the different effects of venture capital in path creation.

Choosing China's Yangtze River Delta as the study area offers distinct advantages. Firstly, China's medical industry has made significant progress since the country's reform and opening-up, showing a rapid expansion in scale over the past two decades that provides a foundation for constructing traceable time-series data (Zhang and Xu, 2016; Gu, 2021). Secondly, the Chinese

government prioritizes the development of the medical industry through policy-driven resource allocation, continuous improvements in regulatory systems and R&D capabilities and the establishment of various regional industry guidance funds and policy tools. This creates more opportunities to observe and assess the political economy mechanisms of regional evolution and the interactions between government and venture capital (Yu et al., 2014; Conlé and Taube, 2012). The Yangtze River Delta holds particular observational value. The region boasts a strong industrial base, hosting over 2,000 medical firms that collectively account for 25% of China's total. The region also has a high concentration of significant financial resources, with Shanghai attracting prominent venture capital firms such as IDG, SoftBank and Hillhouse, representing 20% of the nation's investor resources and serving as a national capital hub. Local governments in the region were quick to recognize the importance of supporting the medical industry, implementing measures such as industrial parks, venture capital platforms and a wealth of related industrial policies (Zhang, 2015). The Yangtze River Delta therefore provides a valuable context for an in-depth analysis of the way venture capital shapes regional industrial path creation under the combined influence of policy and market forces.

1.3 Research Objectives and Questions

The Chinese medical industry is a strategic emerging sector which is prioritized by the government (Zhou and Li, 2013). Historically, China has lagged behind global leaders because it has focused on generic drug manufacturing, but ongoing modernization reforms and the return of overseas talent meant that the Chinese medical industry made rapid progress in the 2010s (Conlé, 2019; Schmid and Xiong, 2021). More importantly, a new wave of venture capital investment has injected strong momentum into the development of the industry. In the 2020s, a series of innovative and globally competitive drugs has been launched in the United States, Europe and China, marking the transition of the Chinese medical industry to an innovation-driven development path (Jiang et al., 2024).

This study will examine the role and mechanisms of venture capital in path creation by analysing the Yangtze River Delta's medical industry to construct a foundational theoretical framework that captures the role of venture capital in regional path creation and the characteristics of path dependence. The focus will be on how venture capital uses and generates regional financial, market, knowledge and institutional resources as well as the connections and differences between various types and models of venture capital in the innovation process of the medical industry (Trippl et al., 2020; Binz et al., 2016; MacKinnon et al., 2019a). To achieve this objective, the study sets the following four research questions:

Research Question 1 (RQ1): What are the characteristics of the spatial-temporal distribution and phased development of venture capital in the medical industry of the Yangtze River Delta?

This question aims to characterize the spatial distribution and evolutionary history of venture capital in the medical industry of the Yangtze River Delta. By collecting data on the frequency of venture capital investments in the medical sector across cities in conjunction with related innovation, economic and policy indicators, it will provide a spatial and temporal overview of capital flows. The analysis will explore the degree of differentiation in the intensity of venture capital investment across cities, the links between capital flows and regional entrepreneurial foundations, the internal variations in entrepreneurial evolution of ecosystems across different cities and the role of institutional factors in this process.

Research Question 2 (RQ2): Are firms that receive venture capital investment more innovative than others?

This question analyses the interplay between venture capital and corporate innovation and identifies the potential causal relationships behind this interaction. Here, I will begin by controlling for firm and regional characteristics and then examine whether and to what extent there are differences in firms' clinical activities before and after venture capital investment. I will do this by looking at the degree to which venture capital enhances firms' clinical activity levels, and whether venture capital plays different roles in different regions. I will also analyse the extent to which venture capital supports regional path creation, thereby providing evidence for the next question.

Research Question 3 (RQ3): How does venture capital influence regional path creation?

This question aims to improve our understanding of the role of venture capital in path creation while revealing the potential path dependence mechanisms of venture capital. To address this question, I will discuss the resources that venture capital has mobilized for enterprises in the medical industry of the Yangtze River Delta and how these resources were mobilized to construct the local medical industry path. In this process, I will examine how venture capital identifies and selects enterprises with potential investment value and how this is influenced by and reflects path dependence. Finally, I will identify the major obstacles venture capital faces in regional path creation.

Research Question 4 (RQ4): Through what mechanisms do different types and models of venture capital shape regional industrial paths?

This question aims to connect the different types and models of venture capital with the process of regional path creation. The question addresses the regional contributions of

geographic proximity, syndication and government venture capital to industrial path creation and systematically dissects their mechanisms. Specifically, after preliminary quantitative testing, it will examine the indirect role of geographic proximity in the project identification and resource mobilization of venture capital, analyse the significance of syndication in mitigating barriers of distance and facilitating resource collaboration and address the investment behaviour patterns of government venture capital and its key mechanisms in supporting path creation.

1.4 Thesis Structure

To address the research questions outlined above, this thesis will be divided into eight chapters, structured as follows:

Chapter One serves as an introduction. Here, I discuss the contemporary research landscape of evolutionary economic geography, highlighting the role of agency in regional path creation and identifying the gap in current literature and research regarding the perspective of venture capital. Building on this, I introduce the research case study – the medical industry in the Yangtze River Delta – and outline the research objectives, questions and the structure of the thesis.

Chapter Two provides the theoretical framework through a literature review. The study begins by reviewing path creation theory, defining the concept of industrial paths and discussing the core mechanisms of path creation and the various processes involved in path development. The thesis introduces theories of entrepreneurial agency and entrepreneurial ecosystems to develop a framework for considering agency and structure. I will then review the literature related to venture capital, emphasizing the relationship between institutionalism and venture capital development, exploring the role of venture capital in firm development and examining the relationships between geographic proximity, syndication, government venture capital and venture capital itself. Finally, I introduce the specific context of the medical industry, discussing path creation within the sector and addressing the relationship between venture capital and the medical industry.

Chapter Three presents the empirical framework of the thesis, including the research design, selection of the case study area, data collection and analysis and its challenges and limitations. The thesis will adopt a mixed methods approach combining quantitative and qualitative approaches. The quantitative component measures innovation activities in the medical industry using clinical trial approvals to assess the role of venture capital. The qualitative component involves collecting the transcripts of 28 interviews from the study area with venture capitalists,

entrepreneurs, government officials and other relevant stakeholders. The analysis proceeds in three steps: characterizing the innovation and venture capital landscape of the Yangtze River Delta's medical industry, quantitative analysis and subsequent qualitative evaluation.

Chapter Four maps the evolutionary process of venture capital in the Yangtze River Delta's medical industry. It begins by introducing the Herfindahl-Hirschman Index (HHI) along with the level of coordination to analyse the spatial heterogeneity of venture capital. Then, using the mean threshold method, I identify regions with emerging paths, distinguishing between high- and low-growth groups. Based on this, the thesis identifies three phases (2001-2009, 2010-2014 and 2015-2019) of the Yangtze River Delta's medical industry by reviewing policy documents related to the medical industry, and systematically discusses the co-evolutionary relationship between policy, entrepreneurial ecosystems and venture capital. This addresses the first research question.

Chapter Five analyses the correlation between venture capital and enterprises' clinical trial activities. Using a high-dimensional fixed effects model, the study examines the impact of venture capital and its lagged effects. By introducing propensity score matching analysis, the study then confirms the potential causal relationship between venture capital and enterprise innovation. The study incorporates heterogeneity analysis to explore the roles of different venture capital types and models in regional enterprise innovation. By aggregating data to the regional level, I will then compare the effectiveness of venture capital in regional path creation – specifically in terms of innovation, new enterprise formation and diversification. This section addresses the second research question.

Chapter Six focuses on a qualitative study of the relationship between venture capital and regional path creation. Based on material gathered from the interviews, this chapter addresses the third research question. It firstly discusses the relationship between the selection effect of venture capital and path creation, showing how this selection effect influences regional industrial diversity and endogenous development and affects the regional path creation process through enterprise migration. Secondly, from financial, knowledge, institutional and market resources perspectives, I elaborate further on the mechanisms through which venture capital affects regional resource formation. Finally, I critically discuss potential contradictions between venture capital and path creation. This chapter addresses the third research question from a qualitative perspective.

Chapter Seven explores how different types and models of venture capital connect to regional path creation. The chapter begins by analysing the indirect role of geographical proximity, discussing its relationship with trust-building and information asymmetry. Building on this, I then introduce the syndication perspective, explaining how its collaborative mechanisms

mitigate geographic distance barriers through information complementarity and risk-sharing and emphasizing the role of syndication in selection effects. Finally, the study examines local biases in government venture capital, explaining how Chinese government venture capital is required to strengthen market mechanisms and balance local government development strategies, thus revealing its role in supporting path creation. This chapter addresses the fourth research question.

Chapter Eight concludes the thesis. By comprehensively interpretating the quantitative and qualitative findings, I clarify the core findings related to the research questions, discussing the regional distribution characteristics of venture capital, revealing the agency mechanisms of venture capital in path creation, and explaining the mechanisms of different types and models of venture capital. This situates the findings within the broader context of path creation theory, discuss policy implications based on the results, and conclude by describing the limitations of the thesis and offering directions for future research.

Chapter 2 Literature Review

2.1 Introduction

The literature on path creation is popular in economic geography but remains inadequate when it comes to understanding the development of different types of agencies. Based on the perspective of Martin and Sunley (2014), regional industrial paths adopt the characteristics of complex systems which need to be understood from institutional and relational perspectives. The increase in firms that are oriented toward specific market demands and functionally interconnected generates localized externalities of agglomeration (Massey, 1995; MacKinnon et al., 2019a). These firms may originate from a single specialized industry or can be dispersed across different but related industries. Their development is constrained by region-specific resource conditions and influenced by the institutional environment in which they are situated (Grillitsch and Sotarauta, 2018; Sunley and Martin, 2023; Harris, 2021; Gong and Hassink, 2019). At the same time, these actors exhibit characteristics of agency, transferring information and knowledge across regional boundaries to build the necessary resources for industrial development in the path creation process (Binz and Truffer, 2017; Wu, 2022). However, existing research lacks detailed discussion on the ways in which financial capital acts as an agent, which urgently requires addressing by evolutionary economic geographers.

Venture capital has attracted attention from researchers and sparked intense debates. While venture capital provides post-investment management services to help firms realize commercial value (Miloud et al., 2012; Streletzki and Schulte, 2013), its pre-investment screening role has been widely questioned (Mazzucato, 2013). The question explicitly raised by Mason (2023), “Can venture capital truly stimulate the emergence of innovative firms?” remains unanswered by researchers. In fact, venture capital shows strong agency characteristics, not only in its selection effects but also in its process of providing value-added services (Manigart and Sapienza, 2017; Hyun and Lee, 2022). However, existing studies omit debates that situate this agency within interactions with broader regional structural conditions, preventing a more comprehensive understanding of the role played by venture capital.

Specifically, despite advances in academic research, there is still an absence of studies bridging the relationship between path creation and venture capital. In a study on the internet industry, Zook (2008) discovered that venture capital not only provides funding but also promotes industrial agglomeration through local networks. However, his work does not explain the role of venture capital in path creation, nor does it discuss the process of regional resource formation. By situating venture capital within a broader geographical perspective and integrating

it with the formation of resources in regional industrial paths, this study will contribute to regional industrial path creation studies and the geographical literature on venture capital. Firstly, it will show the co-evolutionary relationship between the geographical distribution of venture capital and regional ecosystems. Secondly, it will demonstrate the role of venture capital in path selection and resource formation within regional path creation. Thirdly, it will explain how different types of venture capital shape regional industrial paths.

The structure of this chapter is as follows. The following subsection reviews path creation literature, summarizing key concepts and mechanisms in path creation and identifying theoretical gaps in agency research within it. I then summarize the literature on venture capital, reviewing its role in firm development and related spatial-temporal studies. After establishing the research gap between venture capital and path creation in the fourth subsection, the fifth subsection discusses the role of venture capital in regional path creation in detail, exploring it from three aspects: the regional development of venture capital, the functions of venture capital and the different types of venture capital. I also explain here the limitations of venture capital in path creation. In the sixth and seventh subsections, I will explain how to understand venture capital in the context of China and the medical industry. The chapter then ends with a concluding summary.

2.2 Path Creation Approach

2.2.1 Industrial Path and Path Creation

The concept of industrial paths originates from neo-Schumpeterian theories of innovation and technology. Schumpeter described technological change driven by entrepreneurs through the concept of “creative destruction” (Sunley and Martin, 2023), but overlooked the role of demand, social institutions and technological interrelations (Nelson and Winter, 1977; Dosi, 1982). Neo-Schumpeterians also argue that technological change is cumulative and historically dependent and driven by techno-economic paradigms, triggering productivity growth and social institutional adjustments through innovation clusters (Perez, 2010). Economic geography introduces a spatial dimension, emphasizing the geographical embeddedness and the uncertainty of industrial paths, describing them as a process of temporal and spatial condensation (Bathelt and Glückler, 2017; Boschma and Frenken, 2018; Martin and Sunley, 2006; Martin, 2014). Regional industrial paths, as a multi-scalar and ambiguous concept, reflect corporate heterogeneity and complex interactions between complementary or unrelated paths (Bergek and Onufrey, 2013) and include soft infrastructure such as institutions, governance and cultural integration (Walker, 2017; Storper, 1997; Storper, 1993).

This perspective suggests that the cumulative and self-reinforcing nature of industrial paths leads to path dependence in regional economies (Scott, 1999). Industrial clusters become more competitive through increasing returns driven by the long-term accumulation of firms and localized externalities, rather than by natural resources or cost advantages (Sunley and Martin, 2023). However, under the influence of random external events and uncontrolled self-reinforcing mechanisms, technology and institutions may exhibit path lock-in (Vergne and Durand, 2010; North, 1990; Martin and Sunley, 2006). However, path dependence does not necessarily lead to rigidity, and regional industrial paths can avoid lock-in through gradual change or even spawn new paths (Martin, 2010; Hassink, 2010). In fact industrial paths inherently include technological change, soft infrastructure, institutions and culture, necessitating a dynamic perspective to define this concept (Sydow et al., 2020).

Industrial paths manifest themselves in different types. Grillitsch et al. (2018), building on Isaksen et al. (2018), categorize path development into six types. Path extension continues existing industrial structures but may limit the potential for innovation due to insufficient acquisition of new knowledge (Parrilli et al., 2016). Path upgrading achieves transformation through technological or organizational innovation, improving value chain positions in global production networks or developing niche markets by integrating symbolic knowledge (Grillitsch et al., 2018). Path importation introduces new industries using non-local firms, skilled talent or remote collaboration to foster new path formation when high-value firms connect with local actors (Isaksen et al., 2018). Path branching and diversification use existing capabilities; branching extends into related fields based on existing assets or industry experience (Klepper, 2007), while diversification enters new industries by integrating unrelated knowledge (Sunley and Martin, 2023). However, path creation is the most radical form of change. Its formation often relies on a region's scientific base and entrepreneurial resources, supported by new firms, spin-offs, universities and external entrepreneurs to foster knowledge-intensive regional innovation ecosystems (Grillitsch et al., 2018).

2.2.2 Processes of Path Creation

The above literature provides insufficient explanation of the intrinsic mechanisms of path creation. Specifically, path creation mechanisms can include endogenous creation, diversification and transplantation (MacKinnon et al., 2019a; Martin and Sunley, 2006). Firstly, the broad capital model and the endogenous innovation model jointly promote increasing regional returns. The former emphasizes externalities such as learning-by-doing and knowledge spillovers triggered by capital investment, making technological progress as a public good in the economy that will drive long-term economic growth (Romer, 1986; Arrow, 1962). The latter, which is considered Schumpeterian, focusses on technological progress driven by intentional

innovation and R&D activities by producers (Martin and Sunley, 1998). Firms and entrepreneurs are central to path creation, forming new industries through new activities and local-external interaction (Isaksen et al., 2018), although their behaviour is influenced by regional, industrial and institutional embeddedness and path dependence (Parrilli et al., 2016). Spin-off firms inherit knowledge and networks from parent companies (Cusmano et al., 2014), following a neo-Darwinian process of variation, selection and replication shaped by existing routines (Nelson and Winter, 1982; Boschma and Frenken, 2006; Frenken and Boschma, 2007).

Secondly, diversity in industries, technologies and organizations facilitates regional structural reorganization, improving local capabilities and promoting path creation (Boschma and Capone, 2016; Boschma et al., 2018; Martin and Sunley, 2006). Local capabilities include infrastructure, natural resources, institutional endowments and knowledge skills (Maskell and Malmberg, 1999a; Maskell and Malmberg, 1999b), whose heterogeneity provides redundancy for actors, technologies and social networks, enhancing regional resilience (Grabher, 1993; Crouch and Farrell, 2004). Recombination theory emphasizes that new knowledge combinations drive non-linear innovation, with heterogeneity improving the potential for diversity and innovation through the recombination of local and extra-regional capabilities (Fleming, 2001; Bathelt, 2001; Essletzbichler, 2007). Path creation mechanisms include related diversification (extending core technologies to related new industries) and industrial upgrading (introducing new technologies or products to revitalize industrial clusters) (Bathelt and Storper, 2023). Related diversification combines the advantages of specialization and diversification to promote knowledge spillovers and co-evolution (Boschma and Capone, 2016; Boschma et al., 2023; Frenken et al., 2007), and is more conducive to regional development than unrelated diversification (Boschma and Frenken, 2006; Frenken et al., 2007), although the latter involves radical new combinations of capability (Castaldi et al., 2017).

Finally, transplantation as a path creation mechanism, compared to rooting (or relying on endogenous knowledge and institutions), differentiation (based on local industrial foundations and institutional innovation), or leaping (completely detached from regional capabilities), introduces industries and technologies that are unrelated to a region's existing knowledge and institutions, adopting mainstream global technologies to drive regional economic development (Martin and Sunley, 2006). This unrelated diversification path requires significant external support, and regional acceptance depends on absorptive capacities (Niosi and Bellon, 2002). Absorptive capacity is influenced by cognitive, organizational and social proximity between developing and advanced regions, and reflects the efficacy of knowledge diffusion of core organizations and their specific innovation systems (Boschma, 2005). Technological relevance and skill similarity are considered to facilitate the introduction of new industries (Hidalgo et al., 2007). Local and trans-regional actors (such as universities and multinational corporations) play

key roles in technological diffusion and institutional change (MacKinnon et al., 2019a; Wu, 2022).

However, not all regions enter the path creation phase, as initial regional conditions influence the likelihood of success. These initial conditions can serve as resources and constraints (Martin, 2010). They may provide critical resources for industrial renewal and branching through the accumulation of knowledge bases, skill structures and institutional environments, but they may also lead to negative lock-ins due to entrenched technological paradigms and institutional inertia (Simmie, 2012). Classic path dependency models underscore that early chance events, which occur under the influence of network externalities and increasing returns, may solidify into long-term development trajectories that limit the emergence of more efficient alternative paths (Martin and Sunley, 2006). This means that initial conditions help shape development opportunities across different regions (Doloreux and Turkina, 2021). Peripheral regions often lack innovation capacity because of weaker organisational structures, while older industrial regions are more prone to decline due to industry life cycles and embeddedness in global production networks. However, metropolitan regions, using their diverse knowledge and networks, are better suited to nurturing emerging industries (Asheim et al., 2019; Neffke et al., 2011). Regional path creation should be understood as a complex and ongoing interactive process by which successful new paths often progress through intricate stages such as research and development, demonstration, pre-commercial development, subsidised diffusion and marketisation (Chlebna and Simmie, 2018).

Baumgartinger-Seiringer et al. (2021) divide the path creation process into three stages. Firstly, the pre-formation stage typically unfolds under existing regional initial conditions and path dependencies. Its core feature is that innovative entrepreneurs or researchers within specific niche environments deliberately deviate to seize emerging opportunities (Garud and Karnøe, 2001). Because of high levels of uncertainty at this stage, proposed new technologies and activities remain unvalidated, with many actors adopting a wait-and-see approach (Sotarauta and Mustikkamäki, 2015; Normann, 2017). Knowledge production by research institutions and support from public funding are therefore crucial (Sotarauta and Suvinen, 2018). If early gaps are overcome, new paths begin to emerge, but further progress towards commercialisation is still needed (Chlebna and Simmie, 2018).

Secondly, the acceleration stage marks the intensification of the path creation process, during which opportunities created in the pre-formation stage start to become more widely exploited. During this period, the commercial potential of new technologies is validated, and this is accompanied by the diffusion of new knowledge (Simmie, 2012). Although many assets remain locked into existing paths, emerging structures provide a foundation for this phase (Foray,

2014). Increasing numbers of actors capitalise on the opportunities created by pioneers through activity restructuring, resource reallocation and new firm spin-offs (Boschma, 2017; Jolly et al., 2020). The key to this stage lies in the formation of collective beliefs and shared visions (Sotarauta, 2017). While path creation directions remain contested, system-level agency is particularly important, and is shown in conflict coordination and agenda-setting (Sotarauta and Pulkkinen, 2011; Sotarauta, 2016). Broader regional assets also start to take shape during this stage with the emergence of specialised labour, suppliers, support institutions, complementary infrastructure and network externalities, allowing new paths to expand progressively (Smith et al., 2017; Trippl et al., 2020).

Thirdly, in the consolidation or path establishment stage, the new path reaches critical mass and gains wider acceptance, marking a transition from experimental practices to an institutionally supported industrial sector (Baumgartinger-Seiringer et al., 2021). In this phase, mature firms, governments and industry associations are seen as central actors that drive the diffusion of innovation outcomes (Simmie et al., 2014). The emergence of new firms also promotes technological differentiation across niche market by creating new products and fostering regional diversification (Breul et al., 2021). With the support of cross-regional cooperation, new sub-paths and clusters begin to form (Simmie, 2008). Based on a collective understanding of interests, some of the old paths are replaced or marginalised, restrictive institutions and assets are dismantled and new institutions and rules come into alignment with the regional path (Martin and Sunley, 2006). However, this process may involve friction, as firms' investments may face high costs due to sunk costs and forced exits (Kivimaa and Kern, 2016).

2.2.3 Agency in Path Creation

Research on path creation has been criticized for focusing too strongly on region-specific conditions while neglecting the role of agency. In evolutionary economic geography, agency refers to actors who take action or intervene to produce specific outcomes (Martin, 2012; Steen, 2016; Sotarauta et al., 2021). These actors may either trigger change (Battilana et al., 2009a; Grillitsch and Sotarauta, 2020) or maintain and replicate existing paths (Baumol, 2010; Lawrence et al., 2011). Such agency actions often rely on existing social networks and interactions between local and non-local actors that collectively shape the evolution of regional industrial paths (Sotarauta and Suvinen, 2018; Bækkelund, 2021).

From a Lamarckian evolutionary perspective, firms and organizations are not merely passive adapters to their environment, but actively reshape it based on internal needs, driving dynamic changes in local economies (Saviotti, 1996). Entrepreneurs restructure local economic frameworks through new combinations and creative destruction, serving as key drivers of

regional path creation (Knight, 1921; Schumpeter and Swedberg, 1934). Such interactions facilitate the emergence of new technologies at a regional level, triggering agglomeration effects and encouraging new paths to expand within local economies (Audretsch et al., 2006; Sotarauta, 2016). According to this analysis, organizations are not directly seen as entities with clear intentions and goals but as "institutionalized structures" (Grillitsch, 2019). Any lack or imbalance of agency will obstruct growth paths, hindering successful regional economic transformation (Feldman et al., 2005; Sotarauta and Heinonen, 2016).

As a process of structural change, entrepreneurship can transform existing paths through reproduction, or in some cases create new ones (Garud et al., 2010). Transformative agency is therefore particularly crucial for the formation of regional paths. This transformation involves a series of actions, and while institutionalized factors may constrain actors' attempts (Scott, 2013), transformative agents can spark industrial change by integrating key resources, challenging social structures and undertaking systemic reform (McMullen et al., 2021; Lévesque and Stephan, 2020). Entrepreneurship can be imitative or innovative, but as long as customers see it as being sufficiently novel and practical it can generate structural impacts (Bhave, 1994; Rindova et al., 2009). However, entrepreneurial actions must operate within social structures (McMullen and Shepherd, 2006), and the relationship between the two follows a dynamic and dual nature in which structures evolve continuously, constraining and supporting actions (Giddens, 1979).

However, entrepreneurship is not the only form of agency. Grillitsch and Sotarauta (2020) suggest that successful path creation requires the coordination of three types of entrepreneurial agency. Firstly, innovative entrepreneurship serves as a driver of economic change, creating value by transforming technical information and addressing inefficiencies (Shane and Venkataraman, 2000) and by promoting social change through product and process innovations across sectoral and industrial boundaries to shape new production methods (Sunley and Martin, 2023). Secondly, institutional entrepreneurship provides legitimacy for change by promoting the establishment of new rules and norms to incentivize and support innovative activities (Mazzucato, 2015). These actors integrate internal and external resources, pressure governments, adjust existing arrangements and establish new institutional connections to create favourable institutional environments for the adoption of new technologies (Garud et al., 2007; Doblinger and Soppe, 2013; Vasi, 2011). Finally, place-based leadership fosters a shared vision for regional development by coordinating various interests and integrating cross-organizational resources to allow the participation of multiple actors (Sotarauta et al., 2017). The informal leadership emerging from local networks also promotes the development of collective interests to form a sustainable regional development path and provide long-term solutions to constraints driven by short-term interests (Collinge et al., 2010).

However, agency does not operate in a vacuum, and its success necessitates discussion within a broader perspective. The concept of opportunity space integrates actors' transformative potential within specific regional, industrial and temporal conditions (Grillitsch, 2019), bridging the theoretical gap between oversocialization and undersocialization (Granovetter, 1985). Through reflexive decision-making, actors construct pathways to transform existing structures through future-oriented analyses, thus demonstrating transformative agency (Maskell and Malmberg, 2007; Steen, 2016). Opportunity space encompasses three specific dimensions (Grillitsch, 2019), while time-specific opportunity space arises from latent potential in global knowledge and resource shifts. Actors can generate new choices by mobilizing historical resources and future visions while perceiving technological changes at specific points in time (Garud et al., 2010). Region-specific opportunity space is determined by a region's industrial structure, institutional conditions and support systems, with different structural conditions affecting actors' ability to perceive and gain opportunities (Hall and Gingerich, 2009). Actor-specific opportunity space focusses on individuals' positions and experiences within social structures (Saxenian and Sabel, 2008), which directly influences their perception of opportunity and capabilities in resource mobilization, which are fundamental for resource integration and breakthrough innovation.

However, the concept of opportunity space does not explain its formation process, and the Multi-Level Perspective (MLP) provides a mid-range theoretical framework to explain opportunity space. Opportunity space emerges and opens through dynamic interactions on three levels: the socio-technical landscape, regime and niche innovations (Geels, 2004; Geels and Schot, 2007; Geels and Schot, 2023). As external landscapes change – whether through gradual shifts in social values, macroeconomic adjustments or disruptive shocks – regimes face pressure, generating windows of opportunity in the temporal dimension (Geels, 2005; Geels, 2007). Here, actors with different technical capabilities and market experience drive transformative momentum within social networks and future-oriented frameworks (Kemp et al., 1998; Schot and Geels, 2008). Protected spaces at the niche level serve as spaces of opportunity for regional entrepreneurship, in which niche innovations can break through existing paths via gradual change or exhibit non-linear transformation in avalanche-like shifts (Levinthal, 1998; Geels, 2002).

The MLP provides a macro framework for understanding opportunity space but falls short of explaining the role of local governments. Policy interventions by local governments are considered critical for addressing regional system failures and building regional advantages (Weber and Rohracher, 2012). Regional system failures stem from weak infrastructure, missing legal norms, insufficient actor interactions or inertia resulting from over-embeddedness, ultimately manifesting themselves as deficiencies in regional firms' knowledge acquisition and

application capabilities (Lundvall and Borrás, 1997; Asheim et al., 2019; Klein Woolthuis et al., 2005). Tödtling and Trippl (2005) categorize regional system failures into organizational thinness, negative lock-in and fragmentation, factors that correspond to low innovation capacity in peripheral regions, reliance on traditional industries hindering new industry development and insufficient knowledge exchange in urban regions. Constructing Regional Advantage (CRA) emphasizes developing region-specific knowledge bases and collaboration, integrating resources to promote cross-industrial knowledge flows to foster structural change and the rise of new industries (Martin and Moodysson, 2011; Asheim et al., 2011a; Grillitsch and Trippl, 2014). Small regions should strengthen context-specific knowledge in DUI mode, and large regions should support technological innovation in STI mode, while highly specialized and diversified regions should pursue path diversification and economic growth through external knowledge interactions and cross-industrial integration respectively (Isaksen and Karlsen, 2013; Grillitsch et al., 2017).

While current research focuses on the operational context of agency, it fails to specify its role. MacKinnon et al. (2019a) propose a geographical political economy framework that integrates agency with key dimensions of path creation, linking the broader dynamics of capital accumulation and emphasizing their co-evolution in time and space (Martin and Sunley, 2014). They highlight critical processes that support regional path creation, including technological innovation, the attraction of financial capital, labour reproduction, market construction, infrastructure operation and state regulation (Sheppard, 2010; Harvey, 2018). Binz et al. (2016) view regional industry formation as driven by resource formation rather than firm routines alone (Musiolik et al., 2012). Trippl et al. (2020) argue that path creation hinges on nurturing new development paths through asset transformation processes. They categorize local assets into natural, infrastructural, industrial, human and institutional, emphasizing actors' deliberate identification of resources, the creation or transplantation of non-local assets and the destruction of outdated assets to achieve regional value addition and path creation (MacKinnon et al., 2019a; Miörner and Trippl, 2019).

The location of emerging industries depends not only on a region's existing resources but also on the ability of local actors to mobilize external resources and anchor them locally (Binz et al., 2016; Martin and Sunley, 2006; Vale and Carvalho, 2013). Saxenian (2008) notes the significant role of immigrant entrepreneurs in the development of Silicon Valley, while Sonderegger and Täube (2010) demonstrate that Bangalore's IT cluster relied on international diaspora networks in its early stages. Key resources are not only generated locally but are also transmitted and anchored across regions within global Technological Innovation System (TIS) networks (Binz et al., 2014). As knowledge and entrepreneurial behaviour become more apparent in international networks, regional development shifts from single-region production systems to multi-location

knowledge-anchoring networks (Crevoisier and Jeannerat, 2009). This anchoring process involves introducing external resources and reconstructing and disseminating them locally through entrepreneurs, universities and flexible institutional environments (Vale and Carvalho, 2013). The resource-anchoring process is interactive, integrating global knowledge, markets and investments into emerging regional networks to encourage self-sustaining regional industries and path dependence (De Propris et al., 2011).

Although EEG increasingly emphasizes the role of agency in regional industrial development, many studies highlight deficiencies in this field. Current path creation research focuses heavily on firms and governments, overlooking the roles of other actors. While some studies note the importance of early-stage financing for entrepreneurial firms, little is known about the ways in which finance influences and shapes path creation processes. Free market capitalism is considered conducive to regional path creation (Boschma and Capone, 2015), but as Sunley and Martin (2023) point out, open financial systems prioritize securities and asset trading, while startups require venture capital to provide value-added services. In response to such critiques, a micro-level perspective is needed to fully understand the role of financial capital – particularly venture capital – in regional path creation.

2.3 Literature on Venture Capital

2.3.1 Venture Capital in Entrepreneurship Growth

Some studies criticize venture capital for not supporting early-stage firm development (Mason, 2023), as VC systematically screens for high-potential startups (Tyebee and Bruno, 1984; Fried and Hisrich, 1994). Deal sourcing relies on the proactive searching and reputation of venture capitalists, while screening is based on more general criteria and firm-specific requirements (Gompers and Lerner, 2004). The evaluation phase includes preliminary and in-depth assessments, with the former focusing on entrepreneur backgrounds and industry information and the latter on investment barriers, deal pricing and management arrangements. Tacit knowledge and social networks are crucial to this process. Venture capitalists obtain high-quality information through local connections and trusted recommendations, reducing uncertainty to optimize resource allocation (Shane and Cable, 2002; Zook, 2004; Zook, 2008). However, only a few projects can pass rigorous screening and secure venture capital.

Further research criticizes that venture capital-backed companies are known for their high risk, meaning most projects ultimately end in failure (Mason and Harrison, 2006). Shikhar Ghosh studied over 2,000 venture capital-backed companies and found that more than 75% failed to provide returns to investors, with 30-40% of them even causing investor losses (Ghosh, 2012).

However, failed enterprises can also generate positive spillover effects. As entrepreneurial ecosystems are highly localized, their development heavily relies on the flow of talent and the recycling of resources within the region (Brown and Mason, 2017, Malecki, 2018). This allows venture-backed companies that ultimately fail to still significantly contribute to the growth of the local entrepreneurial ecosystem through the spillover of talent, experience, and demonstration effects (Mason et al., 2025). Therefore, the evaluation of venture capital's role should focus on its contribution to the entire ecosystem.

VC selection also considers industry choice and entrepreneur characteristics. High-growth industries are favoured for their high return potential, with product differentiation and industry growth rates significantly affecting investment returns (MacMillan and Day, 1987; Zott and Amit, 2008). Entrepreneurs' industry experience, management capabilities and reputation constitute key tacit knowledge, improving firms' ability to address challenges (Manigart and Sapienza, 2017; Zook, 2004). Meanwhile, by providing a broad range of knowledge and skills, management team diversity enhances operational efficiency and market competitiveness, reducing investors' monitoring costs (Miloud et al., 2012). VC success therefore depends not only on industry potential but also on entrepreneurs' and teams' capabilities and network resources, driving startup growth and regional path creation through systematic integration.

In the post-investment phase, VCs intervene in firm operations in various ways to reduce agency risks and encourage investment success (Manigart and Sapienza, 2017). Staged investments mitigate information asymmetry by evaluating firm performance at each stage, optimizing capital liquidity and providing flexible exit mechanisms (Sahlman, 1990; Gompers, 1995; Neher, 1999). Larger investment firms may appoint directors to strengthen oversight, with board seats granting VCs the power of strategic guidance and management appointment, thereby improving the monitoring process (Lerner, 1995; Amornsiripanitch et al., 2019). Equity and option incentives align entrepreneurs' interests with the firm, reducing talent turnover and ensuring the stability of human capital, boosting firm growth and competitiveness (Baker and Gompers, 2000; Qiu and Wang, 2018; Gu et al., 2022).

Despite this, some scholars claim that not all companies seek venture capital. (Broughman and Fried, 2012) discovered that internal financing rounds in venture capital are not primarily used to dilute founders' equity, but serve instead as fallback funding when external financing is insufficient, typically at higher valuations. However, Atanasov et al. (2007) showed that in some internal financing cases, founders felt unfairly treated and filed lawsuits, claiming that venture capital firms used internal financing rounds to dilute their equity. Stuck and Weingarten (2005) and Klonowski (2015) noted that venture capital may lead to entrepreneurs' equity being diluted through multiple financing rounds, resulting sometimes in loss of control over the company,

with losses far exceeding those caused by debt interest. However, venture capital may improve control, leading to reduced operational efficiency and hindering normal business development, thereby increasing the burden on entrepreneurs. Pang and Liu (2021) found that in a sample of Chinese listed companies, venture capital had a negative impact on the growth performance of family businesses, although family control tended to mitigate this negative effect.

The role of VCs is largely reflected in their resource-sharing functions. Beyond alleviating financial constraints, startups require network, intellectual and human capital (Baum and Silverman, 2004). Firm competition is essentially about resources, with startups that possess more resources gaining advantages (Amburgey et al., 1996). Zook (2008) highlights that VCs help startups build connections with professional service firms, suppliers and customers, and help to recruit key talent, significantly improving potential for growth. De Clercq and Manigart (2007) identify three aspects of resource-sharing systems: investors' experience, knowledge exchange among investors and knowledge interactions with entrepreneurs. While some investors diversify, those who focus on specific sectors provide more effective support, reducing information asymmetry (Dimov and Shepherd, 2005). In syndicated investments, different investors share information and resources, enhancing firms' value-added effects (Brander et al., 2002).

2.3.2 Temporal Perspective on Venture Capital

Researchers criticize VC for its strict time constraints within governance frameworks, undermining long-term support for firms. VC operates mainly as limited partnerships, with general partners managing funds and limited partners holding voting rights on key issues. Funds typically last 10 years, with general partners earning management fees (2.5%) and performance-based carried interest (15-30%) (Mason and Harrison, 2000; Zider, 1998; Tyebjee and Bruno, 1984). Venture capital faces significant uncertainty in the early stages and requires more effort. When discussing the role of venture capital in path creation, we therefore need to focus on the stage of development of the enterprise and the region and confirm the role of venture capital. Increasingly, venture capital tends to invest in later stages (Kenney and Zysman, 2019), while also being more inclined to engage in co-investments (Ferrary, 2010; Tian, 2011b). This is because in later-stage financing, enterprises have higher maturity, more transparent performance records and greater certainty (Chiplin et al., 1997; Manigart and Wright, 2013; Deli and Santhanakrishnan, 2010).

VC has a history dating back 80 years. In 1946, George F. Doriot's American Research and Development Corporation (ARD) pioneered modern VC by supporting post-war tech firms through professional management (Ante, 2008; Kasarda and Sexton, 1992). In 1958, the Small

Business Investment Company (SBIC) programme boosted private VC through leveraged financing. The 1978 capital gains tax reduction from 49.5% to 28% and the 1979 ERISA amendment allowed pension funds to invest in VC, significantly expanding funding sources and driving rapid industry growth after 1979, with pension funds' share rising from 15% to 46% by 1988 (Timmons and Sapienza, 1992; Gompers et al., 1998). Active stock markets improved project liquidity and exit channels, fuelling a VC surge in the 1980s, although overheating led to declining returns and market confidence, triggering industry adjustments (MacMillan and Day, 1987; Black and Gilson, 1998). The 1990s market recovery revitalized the industry, culminating in the dot-com bubble (Nicholas, 2019).

The VC market has undergone significant changes since 2000 (Shane and Nicolaou, 2018; Valliere and and Peterson, 2004). The 2001 dot-com bubble burst shrank the VC industry, reducing active funds and managed capital, with traditional VCs shifting to later-stage investments and seed or early-stage investment declining (NVCA, 2019). However, a reduction in software development and market entry costs spurred new entrepreneurial finance institutions, including angel investment groups (Shane, 2012), business accelerators (Hathaway, 2016), micro-VC funds (Kaji, 2015) and equity crowdfunding (Ahlers et al., 2015). The 2008 financial crisis affected the global VC market further, resulting in reduced institutional investment and a sluggish IPO market (Mason and Harrison, 2015), lowering average fundraising by about 20% (Block and Sandner, 2009). In the 2010s, low inflation and reduced interest rates attracted new limited partners to VC, leading to the rise of mega-funds (Mason, 2023).

VC development highlights the role of formal institutional changes as key drivers (Lingelbach, 2015; Shane, 2003). Robust legal frameworks reduce contract risks, enhance monitoring and promote non-contractual support for VC activity (Lerner and Tåg, 2013; Cumming et al., 2010), although experienced investors can mitigate weak legal environments through American-style contracts (Kaplan et al., 2007). Financial institutions influence exit paths and liquidity, with stock markets and relaxed pension fund policies boosting capital reflux (Michelacci and Suarez, 2004; Gompers and Lerner, 2001). Tax systems regulate entrepreneurial and investment incentives, with higher taxes suppressing firm creation and lower capital gains taxes expanding fund scales (Gompers et al., 1998; Cumming, 2005). Labour market regulations increase entrepreneurial costs, deterring VC deployment, although social security policies are more favourable than strict dismissal protections (Gentry and Hubbard, 2000; Djankov et al., 2010; Cuñat and Melitz, 2012). Public R&D spending and intellectual property regimes encourage greater VC activity by fostering innovation and commercialization, with university-VC collaborations amplifying the diffusion of innovation (Da Rin et al., 2006; Samila and Sorenson, 2010,; Ortín-Ángel and and Vendrell-Herrero, 2010). Notably, institutional changes initially spur new firm creation, but survival rates may be low (Carroll and Huo, 1986; Delacroix and Carroll,

1983). As institutional environments stabilize, firms' opportunity spaces shrink (McMillan and Woodruff, 2002).

2.3.3 Spatial Perspective on Venture Capital

VC exhibits significant geographical concentration (Mason, 2007a). In the US, VC is primarily clustered in cities such as San Francisco, Boston and New York, with approximately 39% of investments concentrated in the first two cities during 1997 and 1998 (Zook, 2002). In Europe, while VC is less developed, it also shows spatial clustering, with the UK and Germany absorbing over one-third and one-quarter of European VC respectively between 1998 and 2014, and London, Paris and Berlin recognized as key hubs (Guerini and Tenca, 2018). Regional institutional and cultural differences shape VC patterns significantly, with formal institutions promoting investment by reducing transaction costs and providing incentives (Gantenbein et al., 2019), although their effectiveness depends on the regional institutional environment (Lerner and Schoar, 2005a; Hart and Moore, 1990). In cultures with high uncertainty avoidance, investors' heightened sensitivity to risk demands higher risk premiums, limiting VC activity (McMullen et al., 2008; Mahn et al., 2024; Huang et al., 2022).

Debates surround this geographical pattern, but VC concentration is usually attributed to information asymmetry and transaction costs. Geographical distance restricts the flow of information and increases monitoring costs, exacerbating information asymmetry as distance grows (Zook, 2002; Mason and Harrison, 2002a). Since entrepreneurs possess more project-specific information than investors (Leland and Pyle, 1977), VCs rely more strongly on local community trust mechanisms and face-to-face interactions to mitigate information asymmetry (Fritsch and Schilder, 2008; Cumming and Dai, 2010). Transaction costs such as service fees and travel expenses further limit VC's geographical scope (Hashimzade et al., 2017; Yuan and Wu, 2020). Studies suggest that VC is most effective within a 1-2 hour driving radius (Zook, 2002), while in regions with lower VC concentration, geographical dispersion may restrict financing opportunities for startups (Fritsch and Schilder, 2012). Local social networks are also critical in pre- and post-investment stages. Pre-investment, they facilitate access to high-quality project information and improve the accuracy of due diligence (Cumming and Dai, 2010, Agrawal et al., 2015); post-investment, geographical proximity enables more efficient monitoring and value-added services, significantly enhancing investment efficiency and firm success rates (Mason, 2007a; Metrick and Yasuda, 2011; Alexy et al., 2012)

However, the effects of location also influence the spatial distribution of venture capital, contributing to path dependence. This can be explained through inter-regional differences in innovation intensity. Advantaged regions, with promising entrepreneurial opportunities, dense

innovation activities and strong industrial networks, offer VCs higher return prospects (Asheim et al., 2011b; Cooke et al., 1997). Location serves as a signal of firm quality. In contrast, technologically lagging regions struggle to attract private VC because of insufficient potential returns (Dimov et al., 2012; Chen et al., 2010). Meanwhile, VC funds in less innovative regions also struggle to form critical connections with financial intermediaries and industrial networks, further weakening value creation (Luukkonen et al., 2013; Sorenson and Stuart, 2001). Spatial distance exacerbates this disadvantage, as the formation of social relationships relies on proximity and existing innovation ecosystems. The geographical pattern of VC therefore exhibits a feedback mechanism: regions with high innovative firm activity attract concentrated VC, fostering further local innovation and driving capital market expansion (Martin et al., 2002).

This geographical imbalance can evolve into a "regional equity gap," where significant disparities in VC availability across geographic or economic zones hinder startups and early-stage firms in some regions from securing necessary financing (Mason and Harrison, 1995; Martin et al., 2005). This is driven by several factors (Mason and and Pierrakis, 2013). Firstly, as fund sizes grow VCs prefer larger growth-stage firms, while peripheral regions that are dominated by small-scale startups struggle to attract investment (Dimov and Murray, 2008; Mason, 2007b; Mason and Harrison, 2010). Secondly, VCs promote a herd effect, concentrating investments in a few industries and often overlooking promising sectors in peripheral regions (Valliere and and Peterson, 2004). Thirdly, VC's geographical clustering in technology and financial hubs leaves underdeveloped regions with shortages of equity (Florida and and Kenney, 1988; Martin et al., 2005; Colombo et al., 2019).

Syndication is considered effective in terms of addressing challenges posed by geographical distance through information sharing and resource integration. It involves multiple VC firms co-investing in a single firm, thereby diversifying risk and enhancing resource efficiency, particularly in high-risk industries or during liquidity crises (Lerner, 1994; Sahlman, 2022; Kaiser and Lauterbach, 2007). Lead investors share market and firm information, compensating for their partners' lack of experience in cross-regional investments and expanding deal flow (Jääskeläinen, 2012; Bygrave, 1987; Dimov and Milanov, 2010). Lead investors also coordinate deals and hold larger stakes, while non-lead investors contribute to project selection and management (Manigart and Wright, 2013; Casamatta and Haritchabalet, 2007). Smaller VC firms with more limited resources rely on syndication to access external resources and improve competitiveness (Pfeffer and Salancik, 2015; Barney, 1991). Syndication boosts the value-added capabilities of VC by pooling resources (Lehmann, 2006; Tian, 2011b). In innovation-driven industries, syndication also supports R&D intensity, fostering radical and incremental innovation and laying the foundation for sustained firm growth (Laachach, 2024).

However, syndication opportunities are not equal, as VCs prefer to partner with centrally positioned firms or existing collaborators. VC firms at the core of the network gain significant advantages in accessing high-quality investment opportunities as their reputation and extensive connections enhance startups' legitimacy and visibility, thus increasing cross-regional and cross-industry investment opportunities (Stuart et al., 1999; Wang and Tan, 2024). Centrally positioned VCs are often associated with higher portfolio firm survival rates, making them frequent syndication partners and enabling investment in geographically more distant targets (Hochberg et al., 2007). However, VCs tend to collaborate repeatedly with existing partners for efficiency, although the value-added effect of new knowledge exploration diminishes as industry experience accumulates, encouraging lead investors to prioritize existing partnerships over new ones (Casamatta and Haritchabalet, 2007). For more experienced investors, deal making and management capabilities reduce their reliance on syndication, but introducing new partners becomes a valuable strategy for future value creation when existing partners lack competitive advantages (Verwaal et al., 2010).

Direct government participation in capital supply is often used to address regional equity gaps (Avnimelech and Feldman, 2010; Gompers et al., 1998). On one hand, government venture capital (GVC) can be used to address private VC market failures. Private VC favours high-return, short-cycle projects and is concentrated in a few core cities (Pan et al., 2016; Yang and Zhu, 2023), limiting contributions to broader regional development, while GVC directs resources towards strategic industries and neglected regions (Vogelaar and Stam, 2021). On the other, GVC serves socio-political goals and more balanced regional development. Despite criticisms of financial efficiency and risk management, GVC, as part of national spatial strategies, demonstrates possibilities that transcend traditional capitalist spatial logic (Rin et al., 2013). By supporting innovation and industrial upgrading, governments aim to achieve balanced regional economies and social externalities while promoting capital accumulation (Vogelaar and Stam, 2021).

However, the role of GVC is open to debate. Some researchers argue that it drives capitalist urbanization and innovation (Tsui, 2011, Wu, 2023). Unlike traditional tools such as R&D subsidies, GVC addresses more diverse needs in markets, production and human capital. The core objectives of GVC include supporting portfolio firms and encouraging private VC market development (Colombo et al., 2016; Brander et al., 2014; Su and Lim, 2024). While European university seed funds failed to attract private capital and Canada's Labour-Sponsored Venture Capital Corporations (LSVCC) saw the withdrawal of capital due to inefficient structures (Cumming and MacIntosh, 2006), most studies suggest that GVC generates a crowding-in effect (Lerner, 1999; Leleux and Surlemont, 2003). This incentivizes private capital entry through

signalling, correcting entrepreneurial financing market failures and promoting entrepreneurial economic development (Cumming and Johan, 2013, Hood, 2000).

2.4 Critical Insights on Venture Capital and Path Creation

In general, current research into path creation overlooks the role of VC in regional industrial development. A few studies have recognized the importance of VC in path creation, but there is a lack of understanding of this role from an agency perspective. In fact, VC provides post-investment services that help firms realize commercial value (Miloud et al., 2012). Meanwhile, VC also exerts political influence by lobbying governments, improving firms' legitimacy and reducing institutional barriers (Poh et al., 2024). However, VC – particularly local VC – serves as a key node in local networks, introducing external resources that help shape regional industrial paths (Wang and Noe, 2010). These factors undoubtedly highlight the significance of VC in path creation research. However, current discussions on this issue remain limited, and this study aims to address this gap.

Debates exist regarding the impact of VC on firms, but such micro-oriented research overlooks VC's broader influence on regional industrial paths and structural changes. VC studies primarily focus on firm-level issues such as investment decisions, governance mechanisms and investment performance (Gompers et al., 2010; Gompers et al., 2009; Kerr et al., 2011; Bernstein et al., 2017). Some studies address the geographical aspects of VC, but these discussions often focus on agglomeration (Wu et al., 2022) without exploring the mechanisms of generation and impact. In reality, regions host diverse industrial paths that often compete and are subject to selection (Martin and Simmie, 2008; Cortinovis et al., 2024). However, the investment behaviour of VC directly affects the agglomeration and allocation of regional resources, profoundly influencing regional industrial path selection. To comprehensively understand the role of VC, research must bridge the gap between VC and path creation theories to reveal VC's role at a higher observational scale and assess its actual impact. Table 2-1 summarises the main content and critiques of the EEG and VC literature.

Table 2-1: Summary of EEG and VC Literature

	Key Concepts in Path Creation	**Role of Agents**	**Main Criticisms**
EEG Literature	Endogenous growth Related variety transplantation Resource formation	Innovative entrepreneurship Institutional entrepreneurship Place-based leadership	Lack of understanding of the role of venture capital in path creation

VC Literature	Limited partnership Information asymmetry Regional equity gap	Pre-investment screening Post-investment governance Resource mobilisation	Focus on geographical concentration, lack of analysis integrating the impact of VC into broader geographical spaces

Table 2-1 summarises the main content and critiques of the EEG and VC literature. To systematically address the theoretical gaps in the literature concerning the role of VC in regional path creation, this study integrates perspectives on spatial-temporal dynamics, agency and resource formation and proposes four research questions to provide a clear theoretical framework (Table 2-2). Firstly, VC shows geographical concentration, a spatial pattern that is influenced by information asymmetry and dependent on specific regional entrepreneurial ecosystems and institutional environments. This results in advantaged regions attracting more investment, while disadvantaged regions struggle to secure funding. Examining the spatial-temporal distribution and phased characteristics of VC in the Yangtze River Delta's medical industry as a case study will therefore help to reveal the role of institutional transitions and regional entrepreneurial ecosystems in VC development.

The second research question focuses on whether firms backed by VC are more innovative than others. Given the pre-investment screening mechanisms of VC, it is essential to confirm the causal relationship between VC and innovation performance before going on to discuss its regional impact. Building on this, I raise the core question of how VC influences regional path creation. The literature suggests that VC facilitates new technology development through post-investment governance. However, there is a lack of discussion on how VC drives the scale expansion of regional firms and fosters related local variety. Meanwhile, VC plays a role in resource mobilisation, significantly affecting regional resource formation and entrepreneurial ecosystem development. The absence of related theoretical and empirical studies in this area warrants further exploration.

Finally, the spatial feature of geographical concentration implies that geographical distance constrains VC investment as it affects trust-building and information flow. Local investment and syndication can mitigate this issue, with the former leveraging local social networks for faster information access and the latter reducing risk via complementary mechanisms. However, strong geographical concentration may lead to market failures or regional gaps in equity in some areas. GVC is a key tool for addressing such gaps. However, there is a lack of understanding in terms of how different VC types and models specifically promote regional path creation, which is critical for understanding the geographical aspects of VC comprehensively. Based on these

research questions, the following section provides a core framework to improve our understanding of these factors.

2.5 Venture Capital and Path Creation

2.5.1 Regional Development of Venture Capital

Existing research often sees VC as a component of regional entrepreneurial ecosystems, overlooking the co-evolutionary relationship between VC and these ecosystems (Fritsch and Schilder, 2008). The early development of regional entrepreneurial ecosystems in certain regions creates advantages that encourage a concentration of high-quality entrepreneurial projects and supportive institutional environments, which is further reinforced by VC investments (Luukkonen et al., 2013; Sorenson and Stuart, 2001; Boasson and Boasson, 2015).

Spigel (2020) defines an entrepreneurial ecosystem as a collection of actors and factors within a region, in which entrepreneurs rely on various actors (including governments, educational institutions and investors) to acquire resources and information through networked relationships, supported by different elements (such as culture, policy and infrastructure) to promote the diffusion of innovation and the accumulation of knowledge. These complex relationships generate local economic agglomeration effects that drive the evolution of regional industrial paths (Stam and van de Ven, 2021).

Lifecycle theory and complex adaptive systems theory are considered to be explanatory frameworks for entrepreneurial ecosystem development (Auerswald and Dani, 2017; Root, 2023). Lifecycle theory divides firm development into fixed stages – startup, growth, maturity and decline (Cantner et al., 2021) – but entrepreneurial ecosystems often exhibit non-linear changes, undergoing multiple iterations and strategic transformations that lifecycle theory struggles to address (Cho et al., 2022). Complex adaptive systems theory compensates for these shortcomings by emphasizing self-organization and adaptive change (Fredin and Lidén, 2020), highlighting the heterogeneity of individual actors and the complexity of multi-actor interactions (Bichler et al., 2022; Belitski et al., 2021).

EEG suggests that entrepreneurial ecosystem development should be examined further from an institutionalist perspective (Sunley, 2006). The MLP and the concept of windows of opportunity provide explanations for regional entrepreneurial development (Grillitsch, 2019; Granovetter, 1985; Geels and Schot, 2023). The endogenous momentum of niche innovations corresponds to actor-specific opportunity spaces, while institutions and support systems constitute region-specific opportunity spaces and landscape shocks and macro-institutional changes define

time-specific windows of opportunity (Geels, 2006a; Geels, 2006b). This is crucial for VC, as changes in landscape pressures lead to institutional and regulatory shifts, changing industry expectations (Nicholas, 2019; Timmons and Sapienza, 1992).

However, the MLP lacks an understanding of how local-level institutional changes help to shape regional opportunity spaces. Local government actions should be discussed within the context of region-specific conditions (Grillitsch and Trippl, 2014; Trippl and Otto, 2009; Grillitsch et al., 2017), as entrepreneurial ecosystems are tangible carriers of opportunity spaces, uniting diverse actors such as governments, educational institutions, investors, anchor firms, incubators and accelerators into a cohesive system that supports high-growth entrepreneurship (Spigel, 2017; Aldrich and Yang, 2014; Feldman et al., 2015). Local institutional changes also affect entrepreneurial costs for regional firms (Gertler, 2010; Hayton and Cacciotti, 2013), changing return expectations for technology choices and shaping the path development of local entrepreneurial ecosystems (Asheim and Coenen, 2006; Spigel, 2020). This collective cognitive framework continuously reshapes regional expectations and resource formation as new paths emerge, influencing changes in regional opportunity spaces further (Grillitsch and Sotarauta, 2020; Spigel, 2013; Feld, 2020).

Based on this, the effects of scale in regional entrepreneurial ecosystems are continuously reinforced through cumulative mechanisms. Early success cases as well as universities and research institutions attract entrepreneurs and VCs, driving the expansion of local capital markets and industrial networks (de Wit-de Vries et al., 2019; Qian and Acs, 2013; Kolympiris and Kalaitzandonakes, 2013). Enhanced local resource supply and institutional quality facilitate technology-market alignment, with professional service firms acting as social capital (Griffith et al., 2007; Luukkonen et al., 2013; Feldman, 2014). The concentration of these elements enables rapid information flow, allowing VC to effectively identify high-potential new technologies within the system (Grillitsch and Nilsson, 2015; Shearmur, 2016; Stam and van de Ven, 2021). Through market competition, high-growth projects stand out, encouraging path creation and development (Asheim et al., 2011b; Cooke et al., 1997).

Early local government interventions help attract VC to specific regional industries by influencing investment success rates and entrepreneurial ecosystem development (Callagher et al., 2015; Rin et al., 2013). During this process, VC and entrepreneurial ecosystems signal each other. On one hand, the foundation and reputation of entrepreneurial ecosystems make them hotspots for VC investment, providing regions with capital advantages while nurturing new technologies and projects (Dimov et al., 2012; Chen et al., 2010). On the other, VC investments show the strength of regional entrepreneurial ecosystems, acting as an endorsement to enhance the visibility of the region and its emerging industries and attracting more related

projects (Alperovych et al., 2020; Stuart, 2000; Gulati and Higgins, 2003). A co-evolutionary relationship therefore exists between the two.

In more specific terms, the involvement of venture capital varies across the different stages of regional path creation. In the pre-formation stage, venture capital tends to adopt a cautious, wait-and-see approach due to significant uncertainty as new technologies in the region remain unvalidated (Buzzacchi et al., 2015). This leads to the region facing the "valley of death" threat at this stage (Maas et al., 2020). Public sector funding therefore plays a critical role during this period and is considered a necessary prerequisite to enable regional path creation to overcome this "valley of death" potential (Murphy and Edwards, 2003). Meanwhile, informal venture capital such as angel investment may be more likely to intervene as equity funding in this stage because of geographical proximity and social network relationships (Mason and Harrison, 1996).

In the acceleration stage, as new products start to become validated and early signs of customers and revenue emerge, venture capital selectively comes into play. Staged financing is the primary contract form during this phase, allowing investors to increase funding incrementally, build portfolios with smaller investments and mitigate losses through phased rounds of investment, helping to hedge the structural risks of this stage while balancing constraint and oversight (Ruhnka and Young, 1991). Evidence from Tian (2011a) also indicates that the geographical distance between venture capital and investee firms is a significant factor: the farther the distance, the more the funding rounds, the shorter the intervals between rounds and the smaller the investments per round. However, institutional arrangements that improve the perceived return-to-risk ratio in this stage will reduce investment uncertainty, thus encouraging earlier venture capital involvement (Michelfelder et al., 2022).

In the consolidation stage, as the industry reaches critical scale, venture capital increasingly focuses on the realisation of value. On one hand, it provides value-added services, offering complementary assets to facilitate firms' commercialisation (Park and Steensma, 2012). On the other, it seeks to convert early investments into profitable returns, with some projects looking for exit strategies through sales to larger firms or public listing (Li et al., 2025; Yao and O'Neill, 2022). Meanwhile, as the industry develops, the earliest technological directions and regions become crowded, leading to declining investment returns (Della Rossa et al., 2020b; Choi et al., 2015). Consequently, venture capital shifts focus to new technological sub-paths and investment opportunities in other regions, driving industrial spillovers. Finally, venture capital strengthens interactions with governments during this stage as it benefits from industrial growth, strengthening the legitimacy of the industrial path and further solidifying the establishment of new paths (Poh et al., 2024).

In other words, the role of venture capital is often to strengthen industrial paths that have already been created by entrepreneurs, rather than directly promoting early-stage path formation. It can therefore be understood as a secondary enhancer rather than an inducing agent. Below, I will discuss how venture capital has supported the process of regional path creation in more detail.

2.5.2 The Function of Venture Capital in Path Creation

Venture capital prioritizes investing in companies that possess endogenous growth potential within a region, providing them with a range of value-added services to improve their likelihood of further success. Due to the high uncertainty of venture capital investment success rates, venture capital screens enterprises before investing (Peneder, 2010). Specifically, the decision-making process of venture capital in the pre-investment stage can be divided into three key steps: project sourcing, project screening and project evaluation (Tyebee and Bruno, 1984; Fried and Hisrich, 1994). In the project sourcing stage, venture capital identifies high-quality entrepreneurial opportunities through social networks. In the project screening stage, it conducts an initial selection based on specific criteria such as the industry and the financing stage of the business plan. In the project evaluation stage, venture capital carefully examines the background of the founder, the industry the company operates in and the company's financial and legal status. Only a few projects pass these rigorous stages to gain to go-ahead for investment (Shane and Cable, 2002; Zook, 2008).

In the post-investment management stage, venture capital engages deeply in the investee companies' operations, providing a range of value-added services beyond mere funding. Firstly, venture capital improves corporate governance by restructuring the company's governance framework and adding board seats, thus participating actively in company management (Amornsiripanitch et al., 2019). Secondly, venture capital provides companies with strategic guidance, offering operational and strategic advice based on its extensive industry knowledge and business operation experience (Kortum and Lerner, 2000). Thirdly, venture capital recruits key management and entrepreneurial talent to fill capability gaps within the company (Qiu and Wang, 2018; Gu et al., 2022). Fourthly, venture capital also introduces resources to companies through social networks and recommends companies to potential clients and suppliers (Sapienza et al., 1996). These actions collectively increase the likelihood of success for endogenous development within specific regional industrial paths.

Venture capital also facilitates transplantation. Its investments are believed to increase the likelihood of startup relocation, as this is a factor of value creation (Weik et al., 2024; Shi et al., 2024). A startup's initial location is often tied to the entrepreneur's personal history, with

companies typically established in places where founders have lived or studied as a default choice rather than a deliberate one (Larsson et al., 2017). However, venture capital is driven by profit maximization, and is therefore more sensitive to regional business factors (Cumming et al., 2009). Companies tend to relocate to capital-intensive areas, as this directly affects their access to capital. Meanwhile because venture capital prefers the companies they invest in to be located nearby, as this facilitates oversight and management (Bernstein et al., 2016; Gompers et al., 2020). Startups may also be relocated to relevant industry clusters to access downstream customers, suppliers and service providers (Kirtley and O'Mahony, 2023). As companies grow, early-stage regions may lack necessary resources such as talent, prompting venture capital to move firms to resource-rich areas to support their growth (Kim et al., 2022).

The selection effect of venture capital is influenced by regional diversification, shaping it further. Research shows that venture capital investments exhibit a selection effect. Given the high uncertainty of venture capital, where most portfolio projects fail (Huntsman and Hoban, 1980), only a few successful investments yield significant returns (Florida and Smith, 1993). To mitigate risk, venture capital tends to invest in opportunities with a greater chance of certainty (Gompers, 1995; Lerner et al., 2012), such as mature technologies and high-potential product markets (Ghosh and Nanda, 2010; Pierrakis, 2010). This reliance on regional industrial structures is shaped by path dependence, meaning that new firms build on existing regional capabilities (Isaksen et al., 2018). However, technological and industrial trajectories are tied to regional support systems, thereby influencing venture capital choices (Mason and Harrison, 2003; 2002b). By assessing global technological trends, venture capital targets a region's leading technologies and industries with high growth potential (Miloud et al., 2012; Streletzki and Schulte, 2013). By identifying and prioritizing industries with greater potential for success and supporting their leaders, venture capital reshapes inter- and intra-regional resource allocation, encouraging path creation (Manigart and Sapienza, 2017). New entrepreneurs consequently gravitate towards specific paths, driving agglomeration and influencing local industrial path creation.

Venture capital also drives regional path creation by allocating resources. It reshapes regional financial capital distribution by providing larger-scale resources to high-potential regions. By offering financing, venture capital alleviates early-stage funding bottlenecks (Metrick and Yasuda, 2021) and secures follow-on funding, increasing regional financial capital (Guo et al., 2015). This capital flow is directional, and is tied to venture capital's organizational structure, which is often based on limited partnerships whose limited partners rely on general partners to invest in promising firms (Lerner et al., 2022), highlighting the spatial mobility of venture capital (Pinch and Sunley, 2009). This flow is spatially uneven because the specialized capabilities of investment institutions vary by region, and geographically based social networks exacerbate

this phenomenon further (Luukkonen et al., 2013; Sorenson and Stuart, 2001). Variations in local entrepreneurial and innovation capabilities also encourage financial institutions to redistribute capital to financial and innovation hubs (Mason, 2010; Martin and and Minns, 1995).

Venture capital plays a critical role in fostering local knowledge development. On one hand, it promotes firm spin-offs, contributing to the secondary dissemination of local knowledge as newly established companies carry forward the knowledge and skills of the parent company (Cusmano et al., 2014). On the other, it introduces external experts and talent, improving the reserves of regional knowledge and promoting local knowledge diffusion (Wong, 2007; Tambe and Hitt, 2013; Cusmano et al., 2014). Through these interactions, venture capital shares management and development experience, directly boosting regional knowledge (De Clercq and Manigart, 2007; Gerasymenko et al., 2015). It also strengthens knowledge sharing among portfolio firms through investment networks, improving the integration of local knowledge (Hyun and Lee, 2022; Alexy et al., 2012).

Venture capital also enhances firms' legitimacy, shaping regional narratives for new industries and technologies. By joining boards, it strengthens control over strategic direction and operations by introducing compliance mechanisms to align firms with industry standards and regulations, improving their survival in regulatory environments (Amornsiripanitch et al., 2019). Meanwhile, it helps to legitimize technologies regionally (de Lange and Valliere, 2020) by investing in projects aligned with local plans to gain policy support by serving as a credible endorsement for governments, thereby validating new technologies (Stuart et al., 1999). Furthermore, venture capital provides feedback to governments on challenges faced by firms and technologies, encouraging policy and institutional improvements (Poh et al., 2024).

Venture capital plays a key role in connecting regions to broader external markets, acting as a network builder in regional market development (Gu et al., 2019; Freeman, 1999). Venture capitalists typically have broader business networks that include upstream suppliers and downstream customers (Park and LiPuma, 2020; Mäkelä and Maula, 2005). Once a company is included in their investment portfolio, venture capitalists can help it to establish network relationships with relevant firms quickly, thereby providing market resource advantages (Mejri and Umemoto, 2010). At the same time, venture capital drives the local development of new technologies by enabling local firms to capture niche markets (Streletzki and Schulte, 2013). Due to the geographical constraints of venture capital investments, the portfolio constructed by venture capital can help shape a regional industrial system that is oriented toward downstream market demands, thus improving the diversity of actors in regional industrial pathways (Lehner, 2023; Colombo and Murtinu, 2017; Patzelt et al., 2006).

2.5.3 Types of Venture Capital and Their Path Creation Effects

Bathelt and Glückler (2005) argue that the concept of resources should move from a material to a relational perspective, as resource use and production are embedded in specific social processes and contexts. Traditionally, material resources (such as raw materials and equipment) are seen as finite elements with fixed input-output relationships (Peteraf, 1993). However, from a relational perspective, resources have no inherent value, and their function depends on social contexts and specific applications (Penrose, 1959). According to this view, the true productive input is the services that resources provide, rather than the resources themselves (Bathelt and Glückler, 2002; Portes, 1998). This relational understanding suggests that economic success depends not only on the possession of resource but also on innovative combinations and applications of these resources (Mahoney and Pandian, 1992; Nonaka et al., 2000,; Bathelt, 2002). Resource allocation by venture capital must therefore be understood from an agentive perspective (Maskell, 2001; Desa, 2012; Fisher, 2012).

Resource mobilization is a critical process that links venture capital agency to regional resource formation, encompassing search, acquisition and transfer (Clough et al., 2019; Grossman et al., 2012). During the search phase, investors identify resources through social networks (Ruef et al., 2003), although they are constrained by information asymmetry and social context (Hallen, 2008). When existing networks fall short, investors adjust their search behaviour based on their individual vision, proactively building new relationships to access resources (Posen et al., 2018; Vissa, 2012; Zott and Huy, 2007). Resource acquisition involves market and non-market mechanisms. Market mechanisms emphasize the transmission of signals between investment entities (Amit et al., 1990). Within this, social networks serve as information channels to enhance trust between investors, thus facilitating the expansion of alliances (Podolny et al., 2001; Spence, 1973; Block et al., 2014). Non-market mechanisms prioritize financial goals within narratives that transcend profit, using persuasive discourse to convince resource holders to provide their resources (Lounsbury and Glynn, 2001; Garud et al., 2014). Resource transfer depends on the internal resource conditions of venture capital firms, with resource redundancy facilitating transfer (Marino et al., 2008). Formal mechanisms (such as contracts and authority structures) reduce behavioural risks and promote cooperation through penalties and the protection of property rights (Dushnitsky and Shaver, 2009), while informal mechanisms rely on trust built through long-term relationships and reputation, which is particularly important in early-stage relationships (Gibbons and Henderson, 2012; Poppo et al., 2016).

Different models and types of venture capital significantly influence regional resource formation. Firstly, geographic distance affects trust and information flow, shaping the role of venture capital in regional path creation. Face-to-face communication helps investors to

acquire and verify information more quickly, thereby reducing the risk of information asymmetry and building trust with companies (Alexy et al., 2012; Cumming and Dai, 2010). Although advances in communication technology and transportation have made cross-regional investment more feasible (Han et al., 2021b), the increase in geographical distance further exacerbates information asymmetry between venture capital and entrepreneurs (Kolympiris and Kalaitzandonakes, 2013). To mitigate this, investors rely on local community and industry information-sharing mechanisms, which depend on trust built through frequent face-to-face interactions (Fritsch and Schilder, 2008).

Geographic distance also increases time and travel costs (Metrick and Yasuda, 2011), limiting the frequency of interactions and monitoring between investors and firms (Gompers, 1995; Green, 1991). Studies suggest that the effective geographic range of venture capital is a 1-2 hour drive (Zook, 2002). In regions with low concentrations of venture capital, dispersed distribution restricts financing opportunities for innovative startups further (Fritsch and Schilder, 2012). As distance grows, investors' public visibility declines (Dai et al., 2012, Bender, 2011). Large venture capital firms therefore expand their geographic coverage through new branches to access local market information and resources (Fritsch and Schilder, 2012).

Local investment improves the efficiency of regional firm and resource formation by mitigating information asymmetry and reducing transaction costs. Proximity allows firms to access confidential information through frequent interactions and local networks, improving the accuracy of investment evaluation (Cumming and Dai, 2010; Kolympiris and Kalaitzandonakes, 2013). It also allows investors to monitor firms and provide timely value-added services at lower costs, guiding their development (Metrick and Yasuda, 2011; Hashimzade et al., 2017). This makes local investment more advantageous for regional resource formation and firm growth, fostering agglomeration effects and industrial path creation (Agrawal et al., 2015; Alexy et al., 2012).

Syndication not only reduces investors' risk exposure to individual projects but also mitigates geographic constraints through information sharing (Sahlman, 2022; Wang et al., 2002; Kaiser and Lauterbach, 2007). Long-distance investments face challenges in obtaining comprehensive information on firms, and this may be exacerbated by cultural and institutional differences (Sorenson and Stuart, 2001; Dimov and Milanov, 2010). Syndication provides a channel for investors with diverse expertise to exchange information (Ferrary, 2010; Fritsch and Schilder, 2012), while large-firm participation signals credibility, attracting other investors (Stuart, 2000; Gulati and Higgins, 2003). External venture capital relies heavily on collaboration with local investors to improve valuation accuracy (Powell et al., 2002; Agrawal et al., 2015) and allow access to higher-quality projects (Cumming and Dai, 2010).

The hybrid governance structures of syndication create resource complementarity that benefits regions (Hochberg et al., 2007). Startups, which are generally limited in resources, rely on external resources to expand opportunities and create value (Anderson and Gerbing, 1988; Kogut, 2000). Cross-regional investors, particularly in cross-sector or small-scale investments, may find themselves facing resource scarcity (Pfeffer and Salancik, 2015). Local investors, embedded within local business communities, possess place-specific resources including policy sensitivity and government connections (Wang and Noe, 2010), while external partners offer complementary resources such as sales channels (Keil et al., 2010; Park and LiPuma, 2020). Larger investors typically have more general resource redundancy, in contrast to smaller firms' specialized resources (Verwaal et al., 2010). This complementarity improves regional firms' resource acquisition, offering higher potential returns and serving as a key criterion for syndication (Wang and Tan, 2024).

GVC has significant value-added effects and a strong local bias. Firstly, the limited investment pools of private venture capital may overlook high-quality projects, a market failure that GVC can address by filling funding gaps (Avnimelech and Feldman, 2010; Grilli and Murtinu, 2014). Secondly, private venture capital may avoid high-risk early-stage projects, leaving promising projects underfunded, and GVC corrects this risk-averse funding shortage (Soleimani Dahaj et al., 2018). Thirdly, GVC can alleviate the funding constraints faced by firms in underdeveloped regions. Government venture capital with a strong reputation can even serve as a signal, helping to attract private venture capital and providing firms with more resources (Tsui, 2011). The equity structure of GVC, which is dominated by local government shareholders, prioritizes local innovation and SMEs (Wu, 2023; Colombo et al., 2016; Cumming and Johan, 2013). However, GVC is criticized for its inefficiency and for distorting market mechanisms and lacking incentives (Murray et al., 2012; Snieska and Venckuviene, 2012).

Co-investment with private venture capital improves GVC's ability to support local path creation, but collaboration addresses mutual shortcomings (Tian, 2011b). Government-supported venture funds (GSVFs), as a public-private hybrid, delegate management to private venture capitalists, with governments as limited partners providing funds (Cumming, 2006; Brander et al., 2010; Lerner, 2010b). This reduces market distortion while maintaining incentives and efficiency. GVC also creates syndicates with private venture capital to improve investment performance (Köppl et al., 2025; Alperovych et al., 2020) and firm innovation (Bertoni and Tykvová, 2015), with higher exit success rates under hybrid investments (Rin et al., 2013). Syndication expands the investment networks of GVC, improving project quality (Lerner, 2002), increasing firms' financing scale and enabling further funding to create a resource amplification effect (Guerini and Quas, 2016).

The long-term orientation and scale effects of GVC positively impact regional industrial agglomeration. Successful GVC programs, like Israel's Yozma, typically operate for at least 10 years, adjusting timeframes to maximize value (Lerner, 2009). Success depends on entrepreneurial ecosystems, which require long-term development, as short cycles may lead to rushed deployment and lower returns (Gilson, 2002). Effective GVC programs emphasize the effects of scale (Karsai, 2018), as smaller funds will struggle to attract private capital or firms (Lerner, 2009). Central and Eastern European practices show that many hybrid funds under €16 million fall below Western European benchmarks, limiting risk diversification and economic benefits (Murray et al., 2012). Scale effects, by promoting local employment and entrepreneurship, encourage agglomeration and regional path creation (Grilli and Murtinu, 2014, Lerner, 2002).

2.5.4 Limitations of Venture Capital in Supporting Path Creation

It must be emphasised that the role of VC is conditional rather than catalytic, so VC will not always support regional path creation. Firstly, the effectiveness of VC in fostering regional path creation is constrained by institutional frameworks (Lerner and Tåg, 2013; Li and Zahra, 2012). In countries with weaker legal environments, private equity firms have to rely more on direct equity than complex instruments like convertible preferred stock, which reduces the sophistication of contractual incentives and leads to generally lower investment returns and valuations (Lerner and Schoar, 2005b). However, in environments where property rights protection are lacking, or with high tax rates, VC struggles to mitigate risks through contract design. Weak legal systems prolong periods of due diligence (Nahata et al., 2014) and reduce VC's post-investment management capabilities (Bottazzi et al., 2009), significantly reducing investment success rates (Cumming et al., 2010). In this context, VC may reduce or even abandon regional investments due to excessively high transaction costs.

Meanwhile, financial environments can also limit VC investments. During market booms, VC can secure substantial investment (Michelacci and Suarez, 2004). However, in times of economic crisis, subdued financial markets reduce investors' risk appetite, and market downturns make it difficult for projects to exit through public listings (Black and Gilson, 1998). High interest rates further exacerbate financing constraints for VC (Allen, 2024), potentially leading to a contraction in the scale of VC fundraising (Block and Sandner, 2009). This means that during market upswings, VC flows in, but in downturns many promising projects struggle to secure funding or refinancing, leading to failure.

The role of VC depends heavily on regional ecosystems, making it difficult for regions with weaker entrepreneurial ecosystems to build industrial paths. On one hand, peripheral regions

often lack essential elements, resulting in an inadequate foundation for VC activity (Grilli, 2019). On the other, simply increasing regional VC does not directly address entrepreneurial ecosystem deficiencies faced by innovative firms in peripheral regions (Mason and Harrison, 2002b; Brown and Mason, 2014). As a result, VC investments are concentrated in core regions, while innovative projects in peripheral areas struggle to secure sustained funding (Mason and Harrison, 2001). This leads to a scarcity of investable start-ups in peripheral regions, hindering path creation. Meanwhile, when VC firms in core regions invest in companies, they may relocate these businesses to the VC's region (Weik and Braun, 2022; Testa et al., 2022). This weakens knowledge accumulation and technological innovation in the original region (Quas et al., 2022; Braun et al., 2019) and disrupts the regional industrial path creation process due to firm outflows.

VC exhibits specific industry preferences that can affect the diversity of regional industrial structures. While some VC firms invest across multiple sectors, most specialise in specific subsectors which are closely tied to regional industrial structures (Cabolis et al., 2023). For example, in Silicon Valley, VC primarily focuses on internet and software sectors (Zook, 2008). In China's Zhongguancun region, VC concentrates on electronic information, internet and biotechnology sectors (Han et al., 2021a), offering little support to agriculture. Marshall's concept of external agglomeration highlights the specialised clustering of similar industries (Potter and Watts, 2014; Konzelmann et al., 2025), while Jacobs emphasises cross-innovation driven by regional diversity (Nielsen et al., 2021; Yoshimura et al., 2022). VC investments tend to reinforce the Marshall effect while weakening the Jacobs effect, potentially leading to regional industrial homogenisation and path lock-in.

The organisational structure of VC may cause it to overlook breakthrough innovations in regions. Due to the partnership structure, VC funds typically operate on an 8 to 12-year cycle, with the first five years dedicated to investment and the later years to exits (Gompers and Lerner, 2004). Here, constraint drives VC to pursue short-term returns rather than supporting breakthrough innovations that require long-term commitment (Sahlman, 2022). According to Investopedia, VCs typically expect exits within 4-6 years through mergers and acquisitions (M&A) or initial public offerings (IPOs). Meanwhile, because of their agent structure, VCs are accountable for returns (Landskroner and Paroush, 1995), leading to risk aversion and reluctance to invest in higher risk breakthrough innovation projects (Drucker, 1959). This limits VC's long-term support for regions and stifles the development of potential breakthrough technologies.

VC investment does not expand the base of regional entrepreneurial firms directly, nor does it necessarily benefit all invested companies. VC firms screen for the most promising companies from a wide pool of potential projects (MacMillan et al., 2022) and typically invest only after

firms demonstrate market-beating characteristics, rather than fostering more start-ups directly. In the US, for example, only 0.5% of start-ups are supported by VC (Lerner and Nanda, 2020). In Europe, VC also concentrates on a small number of firms (Bertoni et al., 2015), resulting in insufficient coverage of early-stage projects and a lack of support for the expansion of regional start-up bases (Amit et al., 2017). Furthermore, the low success rate of VC investments indicates limited support for regional invested firms. Statistics show that approximately 75% of VC-backed firms fail to deliver returns to investors, with 30-40% of projects resulting in total loss (Gage, 2012). In other words most investments fail, and only a few achieve outsized returns (Amit et al., 2022). This suggests that the impact of VC on regions may produce diminishing marginal returns, implying that only a minority of investments yield positive outcomes and that most projects do not benefit equally. However, existing discussions primarily focus on the general impact of venture capital, so I will provide further insights by examining the medical industry in more detail.

2.6 Venture Capital in the Medical Industry

Institutional legitimacy is crucial for venture capital in the medical industry, and significantly influences the development of venture capital within the sector (Schmid and Smith, 2005; Evens and Kaitin, 2015). Regulatory policies in the medical industry affect venture capital investment preferences, with venture capital tending to invest in technology areas that have comparatively lenient regulatory policies (Huang and Nambudiri, 2020; Kaiser, 2018). This is because new drugs in these areas tend to be derivative, are more likely to pass approval processes and have lower R&D costs, thus reducing investment risks (Ackerly et al., 2008). Notably, policies outside the industry are critical to the development of regional medical industries (Koenig and MacGarvie, 2011; Ibata-Arens, 2019; 2020). For example, stringent environmental policies can increase pharmaceutical production costs significantly, affecting the layout of medical companies' production sectors and sometimes prompting companies to relocate certain R&D activities to regions with more relaxed regulations (Taylor, 2016; Koenig and MacGarvie, 2011; Hong, 2011).

The medical industry is characterized by high risk, long cycles, high investment and high returns, necessitating substantial venture capital. Despite a 150% increase in R&D investment by large pharmaceutical companies between 1993 and 2004, new drug approvals rose by only 38% (Jones and Clifford, 2005). However, the blockbuster drug model remains a long-term strategy for innovation in the sector (Munos, 2009). In the 1980s, the first blockbuster drug, Tagamet, generated over $1 billion for Smith, Kline and French (Li, 2014), fuelling the demand for and attention to venture capital.

This results in venture capital preferring mid- to late-stage projects due to more certain returns. The success rate for innovative drug development is extremely low, with only about 1% of candidate drugs reaching commercialization (Nwaka and Ridley, 2003), particularly for specific diseases (Hay et al., 2014). Early-stage medical firms often require time to initiate clinical trials after securing investment, and the drug development cycle is lengthy, typically taking about 10 years from preclinical testing to new drug application (NDA) approval (Smietana et al., 2016). In contrast, venture capital investment cycles rarely exceed 5 years, creating a significant mismatch with medical innovation timelines (Tucker et al., 2011). Venture capitalists therefore prefer mid- to late-stage projects in clinical trials or nearing commercialization, as they offer lower risk and shorter return periods (Fleming, 2015).

Venture capital investment in the medical industry is highly concentrated in small, knowledge-intensive firms that are central to innovation. Small biotech companies and startups focus on early-stage drug development, using their specialized technical capabilities to drive new drug discovery (Cooke, 2004; Cooke, 2003). Venture capital supports such firms by providing funding, operational guidance and network resources to address capital shortages and management inexperience (Lehoux et al., 2016a; Marangos, 2014). Large pharmaceutical companies complement this ecosystem by licensing or collaborating with small firms to commercialize R&D results more quickly (Austin, 2006).

As a knowledge-intensive sector, the medical industry requires firms and venture capital to prioritize knowledge accumulation and development. Different stages demand different kinds of knowledge: biology, chemistry, pharmacokinetics and toxicology for drug discovery and R&D, engineering for production and marketing for market entry (Bignami et al., 2020). Medical firms rely heavily on universities and research institutions (Bathelt et al., 2004), which serve as sources of new targets and structures, fostering the early establishment of regional knowledge and enabling technology transfer through collaboration or spinoffs (Pisano, 2006; Zhang et al., 2020; Lorenzen and Mudambi, 2012). Since most biomedical startups are founded by scientists who lack entrepreneurial experience (Powell et al., 2002), VC facilitates knowledge development by allocating executives and researchers to these firms (Lehoux et al., 2016b).

The medical market spans broad geographic areas and is influenced by multiple factors. Expanded medical insurance coverage lowers patient out-of-pocket costs significantly, particularly for major diseases and high-risk treatments, driving market formation and expansion (Guindon et al., 2022; Wanni Arachchige Dona et al., 2021). AS key hubs for medical service delivery, hospitals address diverse patient needs directly (Elrod and Fortenberry, 2017), and centralized procurement models create highly concentrated drug distribution networks (Li et al., 2023; Vogler et al., 2022). With drug development becoming more challenging (Mazzucato

and Parris, 2015; Scannell et al., 2012), large pharmaceutical companies increasingly focus on marketing, acquiring new drugs through M&A or licensing and distributing them globally (Livi and Jeannerat, 2015; Marangos, 2014; Taylor, 2016). This demands value-added services from VC, as investors rely on these channels – particularly large firms – to recover R&D investments and generate profits (Cooke, 2003, Austin, 2006).

Venture capital investment in the medical industry is subject to strict geographic constraints caused by several factors. Large pharmaceutical companies with robust production and market channels serve as key downstream customers and potential acquirers for startups, making them central hubs in regional industry ecosystems (Feldman, 2003). The explicit nature of medical knowledge and the complexity of innovation require the modular division of labour and specialized organizations that rely on spatial agglomeration to improve communication efficiency (Jensen et al., 2007; Phillips et al., 2006). SMEs depend on these specialized services, which drive cluster evolution and regional development (Rasmussen, 2004; Casadevall, 2018; Cooke, 2004). At the same time, the medical industry involves a significant amount of tacit knowledge – such as know-how in drug screening and clinical design – as well as key areas of regulatory compliance, which means that geographical proximity and face-to-face communication cannot be replaced (Sapienza and Lombardino, 2002; Arntzen-Bechina and Leguy, 2007).

Venture capital in the medical industry shows a strong tendency toward collaboration and faces numerous practical challenges when making cross-regional investments due to significant differences in regulations, cultures and demographics across regions (Lee and Dibner, 2005). However, the potential of medical markets is highly attractive to VC. However, the investment threshold in the medical industry is extremely high, and the high level of uncertainty in drug development means that even pharmaceutical companies are facing the risk of declining R&D success rates (Scannell et al., 2012). The patent cliff also significantly increases potential losses in R&D and the competitive environment will intensify in the foreseeable future (Anon, 2010; Pammolli et al., 2011). This means that most investors find it challenging to enter this field or bear the risks of investing alone, necessitating the formation of syndicate groups with more specialized institutions (Chakma et al., 2013).

The long R&D cycles and complexity of the medical industry conflict with the organizational structure of VC, calling for GVC intervention. The temporal mismatch between Medical innovation and VC (Tucker et al., 2011; Fleming, 2015), leaves GVC to play a critical role by funding basic research, providing grants and establishing venture funds to fill the funding gap left by private capital's avoidance of early-stage projects (Cleary and Ledley, 2020; Fajardo-Ortiz et al., 2020), thereby fostering early local industry development (Lee and Tee, 2009).

As noted above, most of the existing literature is based on Western experiences. In the following sections I will examine the situation in China in more detail. China has been undertaking healthcare reforms since 1985, gradually transitioning its medical system towards marketisation (Jakovljevic et al., 2023). In the mid-1990s, the government piloted social medical insurance in Zhenjiang and Jiujiang. In 1998, urban employee medical insurance was introduced, and in 2002 the New Rural Cooperative Medical Scheme was proposed, establishing the initial framework for a social medical security system. The 2003 SARS outbreak prompted the government to prioritise the development of a public health system (Timofeyev et al., 2023). In 2009, a new round of healthcare reforms was launched, focusing on universal medical insurance, a basic drug system, grassroots service capacity and public hospital reform, marking the institutionalisation of China's medical system (Jiwei, 2022). In 2016, urban and rural resident medical insurance was integrated, and in 2017, drug manufacturers were eliminated from urban public hospitals. In 2018, the National Healthcare Security Administration was established, introducing policies such as centralised procurement and payment reforms (Jakovljevic et al., 2023). The medical consortium and medical insurance payment reform in Sanming City achieved remarkable success, earning recognition as a model that was later promoted nationwide (Li and Song, 2023). By 2020, medical insurance coverage exceeded 95%, and the medical service system was largely established.

China's medical industry specifically exhibits significant agglomeration and differentiation characteristics that are shaped by its key actors and their networks. According to Zhou and Sun (2022), the industry was initially dispersed, with Shanghai and Beijing forming distinct clusters. From 2010, the Yangtze River Delta area, centred on Shanghai, began to expand rapidly and started to dominate by around 2015. R&D in the medical industry was primarily led by academic research institutions, with corporate collaboration being relatively inward-focused and international cooperation less prominent. Ye and Xu (2021) found that between 2012 and 2017, during the development of the urban network in China's medical industry, the centrality of peripheral regions grew more quickly. Notably, developed regions relied more on local network strength, while peripheral regions were influenced more strongly by the number of local medical enterprises. Meanwhile, Nie and Liu (2024) examined the relationship between start-up medical enterprises and hospitals, identifying a co-evolutionary process. This explains the industrial advantage of developed regions, where top-tier public hospitals serve as knowledge sources and market gatekeepers, acting as critical nodes for start-ups to gain technical feedback and market access, because such hospitals are concentrated in developed regions.

Against this backdrop, public and private capital play complementary roles in the development of China's medical industry. Qiu et al. (2014) point out that government capital has been crucial in guiding the development of the medical industry in peripheral regions, encouraging the

growth of local private investment. Xu et al. (2021) show that government R&D subsidies significantly increase corporate R&D investment, with a more pronounced effect on private enterprises that indirectly enhances innovation performance. On the other hand, Li et al. (2024b) reveal that as a form of private investment, VC effectively strengthens the innovation capacity of medical enterprises and significantly boosts their profit levels. According to Pei and Dang (2022), venture capital operations in China's medical industry exhibit a highly networked character, with internal community structures such as cohesion and status disparities significantly affecting the efficiency of project and experiential information dissemination, thus influencing the innovation process. Having introduced the role of venture capital in China's medical industry, I will discuss the literature on venture capital in the Chinese context further in the next section.

2.7 The Chinese Approach to Venture Capital

The demand for a venture capital market in China is influenced by broader political and economic changes (Ning et al., 2019). The 1978 economic reforms sparked a market-oriented economy, igniting entrepreneurial activity and resulting in approximately 146 million active business entities by July 2021, providing abundant opportunities for venture capital. Foreign investment, spurred by the reforms, became a key source for Chinese venture capital (Allen et al., 2005), alongside informal financing channels such as family wealth (Huang et al., 2021; Wang, 2012). The 1999 college enrolment expansion significantly increased the number of highly educated citizens, with 4.9 million undergraduate admissions in 2024, intensifying labour market competition and driving graduates toward entrepreneurship (Bai et al., 2024). This also led to a rise in returnee entrepreneurs, with CNRDS data showing that between 2000 and 2020, 14% of biotech and over 10% of IT IPO founders were returnees.

The composition of LPs in China's venture capital market differs markedly from the US. In China, wealthy families and individuals dominate with a market share of about 60%, followed by venture capital/private equity firms (20%) and corporations (10%) (Ma, 2019). In contrast, US markets are led by institutional investors such as public pension funds and university endowments (each roughly 30%), which play a smaller role in China (Ma, 2019). Recent regulatory changes in China have eased restrictions, such as by allowing insurers to invest up to 2% of total assets in venture capital funds (CIRC, 2014), allowing local government pension funds to allocate up to 30% of their net assets to equity (CIRC, 2015) and confirming insurers' investment eligibility (CIRC, 2018). These changes increased institutional investor participation, reducing the share of individual and family LPs, although the impact of these changes on venture capital supply and market development have yet to be quantified.

Unlike the US, China's venture capital exit channels are primarily IPOs (Chen, 2023), which account for roughly 60% of exits in China, followed by mergers and acquisitions at 22%, secondary sales at 16%, and management buyouts at less than 4%. In the US, only 11% of exits are IPOs, with M&A dominating (NVCA, 2019). This reflects significant differences in exit environments between the two countries. Domestic exchanges lead China's IPO exits, outnumbering overseas exits 15-fold, with the ChiNext and STAR Market contributing over 90% of IPO exits by lowering listing standards (Bernstein et al., 2020). The 2021 establishment of the Beijing Stock Exchange relaxed SME listing standards further (Bao, 2021), potentially strengthening venture capital exit mechanisms.

Unlike the long-standing registration-based system practiced in Europe and America, the Chinese market has long adopted an approval-based system for stock listings. European and American exchanges typically conduct only a formal review of the completeness of information disclosure in a company's prospectus, without making value judgments on its business model. In contrast, China employs a system centred on the review by the China Securities Regulatory Commission (CSRC), where regulators not only focus on compliance but also screen companies based on their profitability, industry category, and alignment with national industrial policies (CSRC, 2009). It is important to note that since 2018, both the Chinese and Hong Kong markets have undergone profound institutional reforms, leading to subtle changes in the landscape. The establishment of the Science and Technology Innovation Board (STAR Market) and Hong Kong's Chapter 18A provision have allowed unprofitable companies and those without stable revenue streams to enter the secondary market (CSRC, 2018, HKEX, 2018). While the Shanghai Stock Exchange still performs review functions for the STAR Market, this does not necessarily mean that companies obtaining IPOs are fully mature or successful. Precisely due to the establishment of this board, a large number of medical companies have been able to go public, enabling venture capital to exit. According to the author's statistics, from 2010 to 2025, nearly one-third of medical companies listed in mainland China were listed under the rules of the STAR Market.

China's venture capital exhibits a spatial pattern centred on Beijing, Shenzhen and Shanghai (Chen, 2023; Yao et al., 2021) which resembles the US's multipolar system more closely than the UK's polarized model (Lerner, 2010c), possibly due to geographic size. Like the US, China's venture capital shows frequent cross-regional flows (Pan et al., 2016). However, it should be noted that the geographic patterns of VC in China and the United States may be driven by different factors. In the US it is primarily driven by the geographic distribution of high-tech and innovative industries, while in China it is more closely related to the pattern of financial centres (Florida, 2013).

Syndication within China's venture capital market should be understood from the perspective of resource and information complementarity, and requires greater emphasis to be placed on the role of social networks. Chinese philosophy highlights that the world is a structure composed of interdependent individuals, in which relationships take precedence over individual existence and form the basis of individuality (Rošker, 2014; Rošker, 2017). From a social structure perspective, the Chinese concept of relationships emphasizes the closeness between entities in the horizontal dimension (Peng, 2004) and underscores hierarchical order-based relationships in the vertical dimension (Herrmann-Pillath, 2016). Due to the high uncertainty of the venture capital market, trust built on such relationships is particularly crucial for co-investment among Chinese investment institutions (Zheng et al., 2022). This close-knit relationship sometimes even forms the core of investors' behaviour, so venture capital firms and enterprises within different cliques develop tight connections, with project information and resources circulating within these small circles to foster more widespread success among community members (Luo et al., 2019; Luo et al., 2017).

GVC plays a pivotal role in China's venture capital market. Since the establishment in 2002 of the Zhongguancun Venture Capital Guidance Fund, GVC has grown significantly, raising 1,631 funds with a target scale of 9.0 trillion RMB (approximately $1.3 trillion) between 2002 and 2020 (Chen, 2023). Only 2.21% of these funds were initiated by China's central government, with most led by local governments and over 80% of investors being state-owned enterprises. The establishment of GVC is heavily influenced by government policies, with central government revisions in 2007, 2015 and 2016 spurring growth but causing fund objective overlaps. However, because of GVC's emphasis on preserving state-owned assets, regulations like the Measures for the Supervision and Administration of State-Owned Asset Transactions impose strict exit requirements, reducing fund liquidity and causing delays in GVC exits (Sun and Tian, 2024).

2.8 Chapter Summary

To systematically address theoretical gaps in the literature regarding the role of VC in regional path creation, this study integrates perspectives on spatial-temporal dynamics, agency and resource formation, proposing four research questions to provide a clear theoretical framework (Table 2-2). Firstly, VC shows geographical concentration and a spatial pattern influenced by information asymmetry that is dependent on specific regional entrepreneurial ecosystems and institutional environments. This means that advantaged regions attract more investment, while disadvantaged regions struggle to secure funding. Meanwhile, since venture capital prefers low-risk projects, they tend to play more of an enhancing role rather than a triggering role. Examining the spatio-temporal distribution and phased characteristics of VC in the Yangtze River Delta's

medical industry will therefore help to reveal the role of institutional transitions and regional entrepreneurial ecosystems in VC development.

The second question I propose focuses on whether firms backed by VC are more innovative than others. Given the pre-investment screening mechanisms of VC, it is essential to confirm the causal relationship between VC and innovation performance before discussing its regional impact. Building on this, I raise the core question of how VC influences regional path creation. The literature suggests that VC facilitates the development of new technology through post-investment governance. However, there is a lack of discussion on how VC drives the scale expansion of regional firms and fosters variety locally. VC also plays a role in resource mobilisation, significantly affecting regional resource formation and the development of entrepreneurial ecosystems. The absence of related theoretical and empirical studies warrants further exploration.

Finally, the spatial aspects of geographical concentration imply that geographical distance constrains VC investment as it affects trust-building and information flow. Local investment and syndication can help mitigate this issue, with the former using local social networks for faster information access and the latter reducing risk through complementary mechanisms. However, strong geographical concentration may lead to market failures or regional equity gaps in some areas, and GVC is a key tool for addressing such gaps. However, we lack an understanding of how different types and models of VC specifically promote regional path creation, which is critical to understand the geographical aspects of VC comprehensively. Based on these research questions, the next chapter will provide a core framework for understanding them.

Table 2-2: Research Questions and Core Hypotheses

Research Question	**Hypothesis / Expectation**
Research Question 1: What are the characteristics of the spatial-temporal distribution and staged development of venture capital in the medical industry of the YRD?	**Core Focus:** The regional distribution pattern of venture capital. **H1:** Venture capital is closely linked to the development of entrepreneurial ecosystems and exhibits characteristics of path dependence. **H2:** Government policies have a significant impact on the regional development of venture capital.

Research Question 2: Are enterprises that receive venture capital investment more innovative than others?	**Core focus:** The causal relationship between venture capital and corporate innovation output. **H2:** Enterprises that receive venture capital investment demonstrate significantly higher innovation performance than those without venture capital. **H3:** The larger the investment funding, the higher the enterprise's innovation output.
Research Question 3: How does venture capital influence regional path creation?	**Core Focus:** The impact of venture capital on regional path creation. **H4:** Venture capital investment significantly enhances regional enterprise scale growth, innovation capacity, and the development of diversification. **H5:** Venture capital promotes regional resource formation, thereby supporting regional path creation.
Research Question 4: How do different types and models of venture capital shape regional industrial paths through various mechanisms?	**Core Focus:** The impact of local investments, syndication, and GVC on regional path creation. **H6:** Local venture capital alleviates geographic constraints, enhancing resource formation efficiency. **H7:** Syndicated investment improves regional resource acquisition through resource complementarity. **H8:** The long-term orientation and scale effects of GVC promote the creation of regional industrial paths.

Chapter 3 Methodology

3.1 Research Design Overview

This study explores the impact of venture capital investment on corporate innovation performance, integrating entrepreneurial ecosystems and geospatial factors to analyse the mechanisms of VC in different regions and institutional environments. Using empirical methods it examines the effects of venture capital, including geographic distance, syndication and differences between government and private venture capital on innovation outcomes.

The study is grounded in a pragmatic paradigm, and uses both qualitative and quantitative methods to focus on the interpretation of theories in the real world and emphasize empirical testing in reality. To explore the complex relationship between these factors in the real world, both research methods were used comprehensively in data collection and analysis.

The dataset is made up of two parts. Firstly, secondary time-series panel data are used to assess the validity of overall VC and its various types quantitatively from a macro perspective (Han, 2021; Pandher, 2021). Secondly, primary data from semi-structured interviews are analysed to uncover the behavioural characteristics and complex effects of VC from a micro perspective (Szalavetz and Sauvage, 2024; Shin et al., 2025).

Data analysis proceeds in a sequential manner. A quantitative analysis of secondary data is conducted first to delineate the spatial-temporal features of industry development and quantify the intrinsic validity of VC for regional industrial growth. This is followed by a validation and discussion of quantitative findings through primary interview data, which also supplement and extend aspects that were not fully captured by the quantitative analysis.

The strength of this research design lies in its mixed-methods approach. On one hand, combining quantitative and qualitative methods mitigates the limited explanatory power of single-method studies (Kanemoto et al., 2025). While quantitative research may lack sufficient depth to explain the specific mechanisms by which VC influences firms and regions, in-depth interviews with industry stakeholders provide qualitative insights into path-creation mechanisms, enhancing the generalisability of the findings. On the other, existing research on Chinese VC is predominantly quantitative, with relatively little qualitative work (Pukthuanthong and Walker, 2007; Wu et al., 2022; Pan et al., 2016). By employing a mixed-methods approach to studying the role of VC in the Yangtze River Delta's medical industry, the research offers actionable and replicable lessons for academia and policymakers.

3.2 Case Area Selection

This thesis studies the Chinese medical industry for the following reasons. Firstly, although China is a latecomer to the medical industry, its innovation has developed rapidly over the past two decades. Some sectors have not only integrated into global development but have also produced highly competitive products using advanced technologies. Secondly, studying this industry offers methodological advantages, as the rapid development of the Chinese medical industry and the role played by venture capital have been documented within a relatively short timeframe, from 2000 to 2019.

According to desk data, in 2019, the number of clinical trials in the Yangtze River Delta region was 794, in the Beijing-Tianjin-Hebei region it was 457, and in the Pearl River Delta region it was 162. Moreover, applications in the Beijing-Tianjin-Hebei region were heavily concentrated in Beijing, while the number of clinical trials in the Pearl River Delta's core cities, Guangzhou and Shenzhen, was only one-seventh of Shanghai's. Overall, not only do the Beijing-Tianjin-Hebei and Pearl River Delta regions lag far behind the Yangtze River Delta region, but cities within the Yangtze River Delta also demonstrate broader engagement in the pharmaceutical industry. This extensive engagement implies sufficient diversity within the region to observe different local path-creation processes and their relationship with venture capital. Therefore, the Yangtze River Delta is an advantageous area for studying China's medical industry.

The analysis in this thesis is conducted in the YRD region (Figure 3-1). As shown in Table 3.1, the YRD comprises 27 cities and 214 counties, and is one of China’s most advanced regions. In 2022, its population exceeded 238 million, with a total annual output of nearly RMB 3.32 trillion (approximately £350 billion), over an area of 358 000 km^2. It is also one of the most important regions for China’s medical industry, accounting for more than one third of the nation’s output of medicine.

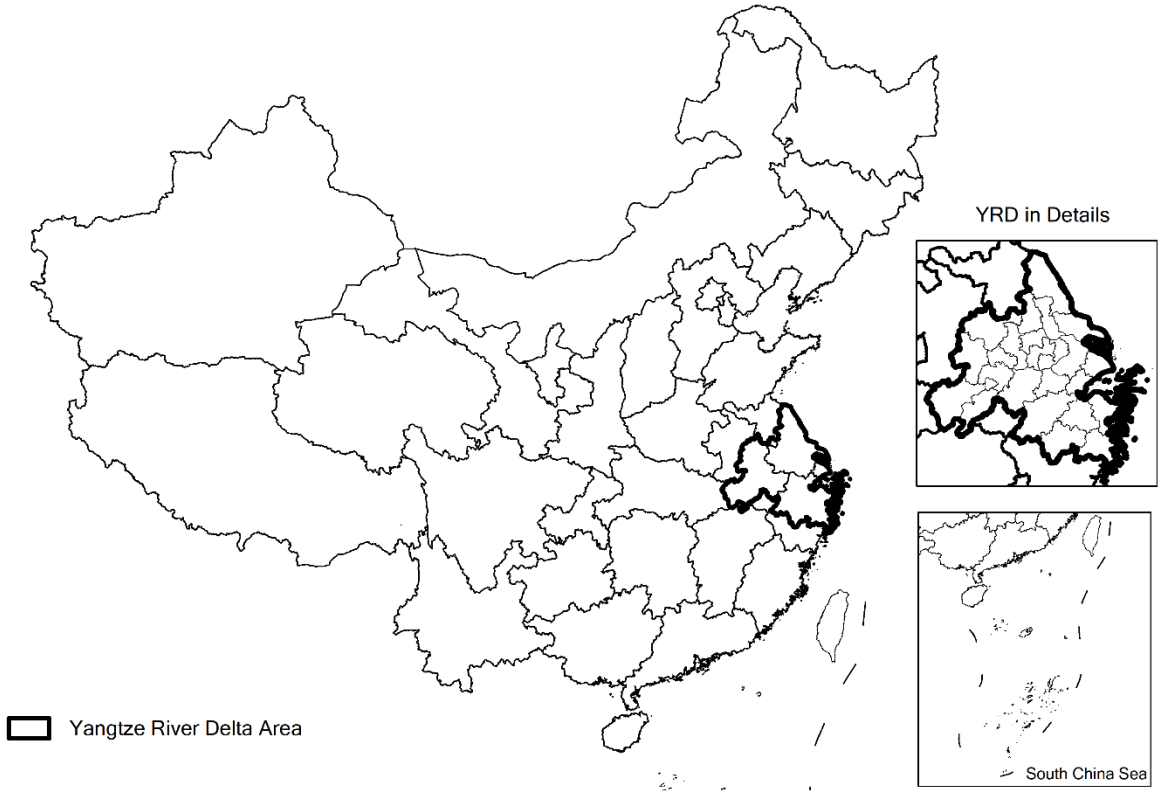

Figure 3-1: The geographical location of Yangtze River Delta area

Table 3-1: The basic social and economic information in Yangtze River Delta area

	Shanghai	Jiangsu	Zhejiang	Anhui
Area (km^2)	6340	107,200	101,800	140,200
Population (million,2024)	24.80	85.26	66.70	61.23
GDP (billion CNY, 2024)	5,393.7	13,7000	9,013.1	5,062.5
GDP (billion USD, 2024)	760.1	19,295.8	1,269.3	713.4
GDP per capita (thousand CNY, 2024)	1,544.3	1,141.0	963.8	587.2
GDP per capita (thousand USD, 2024)	217.5	160.7	135.6	82.7

The YRD is an ideal region for conducting research into the relationship between venture capital and the biomedical industry in China (Table 3-1). Firstly, early desk research shows that the YRD has a good industrial base in the medical industry and has created a large number of biomedical actors. For example, Wuxi Apptec – a world famous CXO company – was established in Suzhou, Jiangsu, and its revenue exceeded $3 billion in 2021. This company now is deeply integrated into global biomedical innovation networks, with 82% of its revenue coming from international markets. Another well-known global medical and healthcare group is Fosun Pharma, which is

involved in drug production, vaccine innovation, medical facilities, medical diagnosis, healthcare services and retail medicine. The company collaborated with Pfizer in covid vaccine innovation, production and retail in the greater China area. The biomedical companies are numerous, so it is impossible to introduce them individually, they and the research institutions in the YRD constitute a strong base for medical innovation. According to the China Statistic Yearbook on High Technology Industry, over 2000 biomedical enterprises were clustered in these four administrative units in 2020, providing over 500,000 jobs and generating more than $100 billion locally. In another words, the data shows that nearly 25% of China's biomedical firms are located in the YRD, 24% of workers in China's medical industry are in the region, and the region contributes nearly 30% of revenue in China's medical industry.

Secondly, a strong financial foundation in this area generated China's earliest venture capitalists. Shanghai, one of the most active cities in China, is the country's financial capital. After the 1970s, when China reopened its market to global investors, Shanghai was given new opportunities to develop its financial base, with the Shanghai Stock Exchange established in 1992. In 1995, the Shanghai Futures Exchange was opened, followed 6 years later by the Shanghai Gold Exchange in 2001. These financial institutions were the pioneers in China's financial market reformation and confirm the position of China as a financial capital. The People's Bank of China (China's central bank) established its second headquarters in Shanghai, and most foreign currency exchange relies on the city, with China's top four banks establishing their headquarters in the city. Shanghai is usually the first stop when foreign investors arrive in Mainland China, and its strong financial foundation provides positive effects for its venture capital development. Although the very early history of venture capital remains unclear, IDG Capital (China) claimed it was the country's first venture capitalist firm, establishing its offices in Shanghai in 1993. Another world-famous venture capital, the Softbank group, set up its company in 2000 with its headquarters in Shanghai. Many of the earliest Chinese VC investors were rooted in Shanghai too. 5Y capital, for example, which manage over $3.5 billion in investments and invested in Xiaomi and Trip was established in Shanghai. Although some venture capital companies have their headquarters elsewhere, they still have a local office in Shanghai, including Sequoia capital, GGV capital, Shenzhen capital and others. Early desk research showed that more than 4500 venture capital companies are clustered in YRD, making up almost 20% of China's VC investors.

Thirdly, local authorities in this area are the pioneers who first recognised the value of China's medical industry and put great efforts in promoting its development. Suzhou, for example, represents a typical city that boosts medical innovation development in the YRD. The Suzhou Industrial Park, a collaborative project between China and Singapore, was built in 1994, and began its involvement int eh medical industry in 2006 when the BioBAY Park was established. At

the same time, it attracted the Cold Spring Harbour Laboratory, a world-class medical research institution founded in 1890, to set up its first foreign branch there. The local government also supported Suzhou Industrial Park and established the Suzhou Venture Group (Oriza Holdings) which proposed to invest in emerging entrepreneurships. Syndicating with Lilly Asia, Medtronic and Sequoia China, the Suzhou Venture Group has invested over 300 deals, some of which have attracted IPOs during the last few years. Against this background, the YRD can be seen as a prototypical region in understanding the role of VC in medical industry.

3.3 Data Sources

To explain the role of VC in regional path creation, this study gathered quantitative and qualitative data on the medical industry in the YRD. Ethical approval was secured from the University of Southampton's Ethics Committee (ERGO reference 81469) before data collection began, and to ensure research integrity and protect privacy, all interviewees participated with informed consent. In accordance with the People's Republic of China's Data Security Law and the Measures for the Security Assessment of Data Exports, corporate and personal data cannot be fully disclosed.

The period between 2010 and 2019 was selected for the panel analysis. To avoid distortions from the Covid-19 pandemic, data from 2020 onwards were excluded. Moreover, the years between 2010 and 2019 were pivotal for the rapid development of the YRD's medical sector; the number of newly founded firms rose sharply, VC activity intensified and clinical trial approvals proliferated.

Table 3-2 shows that the decade from 2010 to 2019 was a critical phase for the rapid growth and structural transformation of the medical industry in the Yangtze River Delta. During this period, the number of newly established enterprises accounted for nearly half of the region's total, reflecting a highly active environment for business entry and entrepreneurship. In terms of clinical trials, more than 25% of all approvals were concentrated in this period, with R&D activities significantly accelerating and innovation outcomes continuously emerging. Meanwhile, enterprises supported by VC accounted for over 60% of the total during this period, indicating strong recognition for the innovation potential of the Yangtze River Delta, leading to concentrated investment from the capital market. Overall, the years between 2010 and 2019 not only witnessed the rapid expansion of enterprises and innovation activities in the YRD but also marked the co-evolution of enterprise development, technological progress and capital investment. An in-depth analysis of the period therefore helps to reveal the evolutionary process of the Yangtze River Delta's medical industry pathway.

Table 3-2: 2010-2019 Enterprise Development and Financing in the YRD versus Nationwide

Indicator	National Total	YRD Total	YRD Proportion (%)
Total number of firms	12 565	2 720	21.60%
Firms established 2010–2019	5 286	1 256	23.80%
Proportion of firms (2010–2019)	42.07%	46.18%	
Total clinical trial approvals	1 026	354	34.50%
Approvals 2010–2019	221	99	44.80%
Proportion of approvals (2010–2019)	21.54%	27.97%	
Total VC-backed firms	1 244	540	43.40%
VC-backed firms 2010–2019	735	339	46.10%
Proportion of VC-backed firms (2010–2019)	59.08%	62.78%	

3.3.1 Secondary Data

This study built a comprehensive panel data model that included firms' innovation output, VC characteristics, firm-level controls and regional ecosystem factors, based on a multidimensional variable framework (Table 3.4). The quantitative analysis aims to examine the efficacy of VC as an agency in breaking local innovation path dependency.

3.3.1.1 Indicators of Medical Innovation

Although patent application counts are widely used to measure technological innovation, they face many limitations in the medical context (Wagner and Wakeman, 2016). Drawing on industry characteristics, this study proposes the number of clinical trials (chemical drugs and biological products, excluding traditional Chinese medicines) as the core measure of firms' innovation activity for three reasons.

Firstly, the public disclosure requirement for patents increases the risk of knowledge leaks, especially in early stages before market approval, so patent data may not reflect innovative activity in a timely manner (Baruffaldi and Simeth, 2020). Secondly, long development timelines and low success rates mean that patent data is highly lagged, hindering the dynamic capture of changes in innovation capacity (Chiu, 2018; Dziallas and Blind, 2019). Finally, compared to chemical drugs, the patentability of biological drugs is lower, mainly because their technical

subjects are natural structures that are not applicable to the scope of patent protection (Andrews, 2022). Therefore, patents struggle to comprehensively measure most technical subjects.

In contrast, clinical trials mark firms' formal entry into the substantive phase of new drug development. They carry both legal and regulatory weight and reflect a company's proactive engagement and capability in technological innovation promptly. Given that most new medicines undergo a lengthy progression from clinical trial to NDA approval, clinical trials are better suited as a measure of innovation activity in this study. It should be noted that due to a series of changes in China's clinical trial system around 2015 caused by regulatory reforms (see Table 3-3), I include a dummy variable to control for this in the data analysis, mirroring research by Zhang et al. (2023).

Table 3-3: Changes in China's Clinical Trial Approval System Before and After 2015

Aspect	**2010-2014**	**2015-2019**
Institutional Support	Relied on government administrative documents and departmental regulations	Relied on legal frameworks such as the Drug Administration Law and Drug Registration Management Measures
Data Quality	Widespread issues with authenticity and standardisation	Strict supervision, significant improvement in data quality
Approval Speed	Decentralised channels, multiple rounds of supplementary submissions, long waiting times, low efficiency in clinical approvals often taking years	Provided priority channels that adopted implied consent and conditional approvals to shorten approval time to months
Internationalisation	Low level of internationalisation, slow adoption of international guidelines	Joined the International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use (ICH), systematically accepted foreign clinical data and aligned approvals with international standards

3.3.1.2 Indicators of Venture Capital

In this study, the total investment funding obtained by companies is considered a core metric for evaluation. The total investment funding reflects the level of recognition from VC and implies the potential growth and innovation capacity of individual companies (Gornall and Strebulaev,

2021). Proxy variables in this study are whether a company secures funding and the number of funding rounds. The binary variable of whether funding is obtained directly is used to distinguish companies. As the number of funding rounds increases, companies not only gain more financial support but can also potentially access more resources, driving innovation activities more strongly (Shi et al., 2019). The dynamic monitoring mechanism brought by multiple rounds of financing also helps to optimize companies' strategic choices and R&D directions, thereby improving innovation performance (Rezaei and Schroder, 2017). Finally, by referring to Zhang et al. (2023), I introduced a policy dummy variable in the analysis to control for the investment to assess the impact of changes in Chinese government clinical policies on companies' clinical applications.

Venture capital, as a key financial agency for promoting innovation, affects corporate innovation performance through funding itself, and is also closely related to the geographical distribution of investors, capital structure and ownership background (Florida and Kenney, 1988; Zheng et al., 2022). Accordingly, three binary VC-feature variables were defined to examine their effects on medical industry innovation.

Firstly, local investment was used to determine whether the venture capital and the invested company were located in the same administrative unit (city), thereby measuring the effect of geographical proximity (Chen et al., 2010). If both are in the same city, the variable was assigned a value of 1; otherwise, it was 0. This variable aims to assess whether geographical proximity optimizes knowledge transfer and resource allocation, thereby enhancing a company's innovation performance.

Secondly, the Syndication variable identified whether a company has received joint support from multiple venture capital firms in a single financing round (Christopoulos et al., 2022). If syndication exists, the variable was assigned a value of 1; otherwise, it was 0. This indicator reflects the role of capital collaboration and risk diversification in enhancing a company's resource integration capabilities.

Thirdly, the GVC variable indicates whether a company received funding from government-backed venture capital (Li et al., 2024a). If a company's financing records include GVC, the variable was assigned a value of 1; otherwise, it was 0. This variable focuses on the institutional role of government funding in promoting high-risk innovation activities.

3.3.1.3 Firm and Regional-Level Control Variables

Drawing on related studies by Pierrakis and Saridakis (2017) and Cumming et al. (2017), this study introduced the following control variables to reduce estimation bias in the model. Firm Size, shows how registered capital is used to reflect their scale, while Knowledge Stock,

measured by whether a company has obtained patent licenses or applied for clinical trials, gauges its knowledge capital foundation.

Based on the entrepreneurial ecosystem theory (Spigel, 2020; Stam and van de Ven, 2021), this study constructed a system of regional-level control variables to capture the external impact of institutional, resource and cultural differences across regions on corporate innovation activities. This system of variables helps to deepen our understanding of the role of local entrepreneurial environments in attracting venture capital and supporting firm growth.

Technical knowledge density, measured as per capita number of medical patents in a region, reflects the agglomeration level of endogenous technological capabilities (Van Looy et al., 2007), while scientific knowledge density, measured as per capita number of medical research papers, indicates the richness of basic scientific research output (Fabiani et al., 2024). Together, these two metrics depict the capacity of a region for knowledge creation and diffusion, providing a cognitive and informational foundation for corporate innovation.

Per capita GDP is a core indicator used for measuring the level of regional economic development. The proportion of private enterprises reflects the share of private businesses in the region, startup density refers to the number of medical startups per capita and foreign company density indicates the number of foreign-funded enterprises per capita. Together, these three metrics reflect the market vitality and entrepreneurial dynamics of a region, highlighting the potential of the entrepreneurial environment to support emerging enterprises (Fritsch, 2011; Hou et al., 2024; Tomiura, 2007). The number and density of listed companies, specifically the number of medical listed companies per capita, indicate the maturity of the capital market, which has a significant impact on the financing environment for innovative enterprises (Didier et al., 2021).

This study also introduces the proportion of university students in the total regional population as a proxy variable for the region's high-skilled talent pool (Pominova and and Gabe, 2023; Beine et al., 2023). Hospital bed density, defined as a city's number of hospital beds per capita, was used to reflect accessibility to medical resources and the region's attractiveness to medical enterprises (Kopczewska et al., 2024; Chavehpour et al., 2017). Local government expenditure was used to measure the fiscal support capacity of the public sector in fostering an innovation-friendly environment (You et al., 2024; Söderström and Melin, 2019).

3.3.1.4 Data Processing

The clinical trial data used in this study was sourced from the China Drug Clinical Trial Registration and Information Publicity Platform (chinadrugtrial.com), established by the National Medical Products Administration (formerly the China Food and Drug Administration).

This platform systematically records information on approved clinical trial drugs and is categorized in detail according to chemical drugs, biological products and traditional Chinese medicines. The data includes the applicant company's name, approval time and location, with all information analysed at firm level, excluding any personal information. The dataset is openly accessible to all users. After excluding traditional Chinese medicines, the study identified a total of 15,341 clinical trial drugs (chemical drugs and biological products, excluding traditional Chinese medicines) covering 2,823 medical firms.

For firm and investment-related data, Qichacha.com was one of the primary data sources for this study (Chen, 2023). This platform is a widely used commercial database in Chinese firm research, covering firm registration information, venture capital transaction records and other regional economic variables. Compared to other commonly used venture capital databases in China (such as Pedata Max) Qichacha.com offers significant advantages in information coverage and data integration accuracy. During preliminary data processing, researchers found that the platform's basic firm information (including location, registered capital, registration time, firm type [private/state-owned/foreign-invested] and legal status [active/dissolved]) can be efficiently matched with clinical trial data. It should be noted that, as this database focuses on non-listed companies, data such as employee size and revenue are unavailable. However, Qichacha.com also provides geographical information on venture capital investors, syndication records and investor ownership structures, facilitating differentiation between the effects of various types of venture capital. Based on this data source, the study established a database covering both active and defunct enterprises and, accordingly, constructed city-level variables.

Scientific publication data were sourced from PubMed, a database maintained by the US National Library of Medicine which includes over 35 million global biomedical literature records. Patent data were obtained from the China National Intellectual Property Administration (CNIPA), providing core information such as patent applicants, locations and technical classifications. Other city-level control variable data were sourced from the China City Statistical Yearbook (2010-2019).

To ensure data privacy and ethical compliance, the resulting database contained no personally identifiable information. All firm data was processed with anonymized identifiers, making it impossible to trace back to specific firms. For example, if Firm C is ranked first in the list of firms in City 6, its identifier is marked as 1-6, and data analysis is conducted solely at the statistical level, ensuring that the specific location information of individual firms is not disclosed. Table 3-4 summarises the selection of variables and indicators using the study, along with their data sources.

Table 3-4: Variables, indicator, and data source

Level	Type	Variable	Indicator	Data Source	Symbol
Firm	Dependent	Biopharma Innovation	Cumulative Clinical Trial Approval	chinadrugtrial.com	$Clinic$
Firm	Independent	VC Financing	Total VC amount received	Qichacha.com	$InvSize$
			Number of VC rounds secured	Qichacha.com	$Round$
			Whether VC was obtained (1 = yes, 0 = no)	Qichacha.com	$hasVC$
			The impact of policy	Qichacha.com	$invsize\_policy$
		Local Investment	Local VC (1 = same city, 0 = otherwise)	Qichacha.com	$hasLocal$
		Syndication	Syndicated VC (1 = yes, 0 = no)	Qichacha.com	$hasSynd$
		Government VC	Government-backed VC (1 = yes, 0 = no)	Qichacha.com	$hasGVC$
Firm	Controls	Patent Held	Patent licence obtained (1 = yes, 0 = no)	CNIPA	$hasPatent$
		Firm Size	Registered capital	Qichacha.com	$Capital$
		Past IND	Prior Clinical Trial Approval (1 = yes, 0 = no)	chinadrugtrial.com	$past\_clinic$
		Industry	The national standard secondary industry	Qichacha.com	*Industry*
		Policy	If year >= 2015, then 1, or 0	NMPA	*Policy*
Region	Controls	Technical Knowledge Density	Biopharma patents per capita	CNIPA	tik
		Scientific Knowledge Density	Biopharma publications per capita	PubMed	siK
		Student Proportion	Higher-education students per capita	City Yearbooks	$students$
		Start-up Density	Biopharma start-ups per capita	Qichacha.com	$startups$
		Listed Firm Density	Listed biopharma firms per capita	Qichacha.com	$pubfirms$
		Hospital Bed Density	Beds per 1 000 population	City Yearbooks	$hospital$
		GDP per Capita	Regional GDP per capita	City Yearbooks	gdp
		Private Firm Share	Private enterprises / total firms	City Yearbooks	$private$
		Government Expenditure	Total local government fiscal outlay	City Yearbooks	gov
		MNC Density	Foreign-invested biopharma firms per capita	Qichacha.com	mnc

3.3.2 Semi-structured Interviews

Quantitative analysis reveals overall trends, while interviews provide more specific insights into the interactions between firms, capital and policies. The interview material used in this study is aimed to provide a deep understanding of the role of VC in fostering innovation in the medical industry and to explore interviewees' expectations for the industry's future development. Interviews were conducted in a semi-structured format, with topics generally starting from industry trends, allowing flexibility in the sequence of questions and maintaining an open-ended approach (Adams, 2015; Adeoye-Olatunde and Olenik, 2021; McIntosh and Morse, 2015). The guiding outline for the interviews included drivers of industry evolution, policy changes, VC operational mechanisms, geographical proximity, syndication and differences between public and private capital (see Appendix A Table 1 for the interview guide).

Interviews were primarily conducted face-to-face on a one-to-one basis to create conditions for eliciting authentic perspectives from the interviewees (Krouwel et al., 2019; Jamshed, 2014). Compared to questionnaire surveys, face-to-face interviews are more conducive to building

trust, especially when addressing sensitive or complex topics, as researchers can adjust their approach by observing non-verbal cues (Foucault Welles et al., 2022). This level of interaction ensures the collection of detailed experiences and opinions while reducing the influence of group dynamics on individual expression, encouraging interviewees to share independent views.

The interviews were conducted between September 2023 and January 2024. The initial list of interviewees was drawn from the researcher's social networks and expanded to a broader group using the snowball sampling method (Palinkas et al., 2015). A total of 28 individuals were interviewed, of whom 24 were from the YRD region and 4 from the Pearl River Delta, with the latter providing an external perspective on the development of the YRD's medical industry. The interviewee composition included government officials (2), members of medical industry startups (6), representatives from large pharmaceutical firms and multinational corporations (1 each), VC professionals (15, including private, public, angel and corporate VCs), researchers (2), and a bank representative (1) (see Appendix A Table 2). Individual interviews ranged in duration from 31 minutes to 3 hours and 48 minutes (see Appendix A Table 3).

To maintain research ethics, informed consent was obtained from all interviewees prior to the start of each interview, and interviewees were allowed to withdraw their recordings and interview content within one month following the interview. However, once recordings had been anonymised and transcribed into text, the interview data could no longer be withdrawn. All data were stored on an encrypted laptop until the project's completion. Audio recordings were accessible only to the research project supervisor, journal editors and reviewers, and were not used for other purposes.

To facilitate data management, information such as interviewees' names, positions, affiliations, years of experience and educational backgrounds was collected. However, all names were anonymised using unique identifiers. For example, if VC firm C was the first interviewed entity in the Suzhou sample list, it would be coded as SZ-VC-1. Consequently, no individual or firm identities can be traced in the research results, ensuring confidentiality.

3.4 Data Analysis

This study uses quantitative and qualitative data from the YRD region to explore how VC influences the spatial distribution and industrial pathways of the medical industry. To explain the relationship between VC and regional innovation, the study is structured around three analytical steps. Firstly, it examines the flow of VC and the spatial distribution and evolution of the medical industry, specifically the ways in which VC and related elements of innovation

aggregate and evolve within the YRD. Secondly, it quantitatively evaluates the impact of VC on firm-level innovation and the way it VC influences firms' innovation activities. Finally, it qualitatively explores the mechanisms through which different types of VC shape innovation pathways by addressing the specific ways in which capital affects firm growth and regional innovation processes.

3.4.1 Step One: Mapping the Evolution of VC and the Medical Industry

This step will provide a foundational context for understanding the relationship between VC and regional development. The study emphasises the embedding mechanisms of different elements of capital within the YRD region, particularly their spatial links with industrial innovation. This step can be sub-divided into four stages:

Firstly, the Herfindahl–Hirschman Index (HHI) is used to quantify the spatial agglomeration of VC and innovation elements within the region (Anokhin et al., 2019; Zandiatashbar and Hamidi, 2022). It will analyse four key elements, namely LP, GP, VC activities and medical industry innovation events in the YRD from 2001 to 2019. This provides a basis for showing the dynamic trends of capital flows and innovation diffusion.

Secondly, to identify the inherent spatial characteristics of VC further, a coupling-coordination degree model (Wang et al., 2023; Zhu et al., 2020) is introduced to comprehensively analyse the co-location of these four elements. The model will examine the synergistic relationship between capital and innovation activities within the region and provide evidence for identifying systemic innovation capabilities.

Thirdly, to identify internal differentiation within the YRD's regional innovation system, the Mean Threshold Grouping method is applied, using per capita clinical trial approvals as an indicator to classify cities into high-growth and low-growth groups. This classification will show spatial differentiation in the formation of innovation pathways between cities, serving as a foundation for subsequent analyses.

Fourthly, to explore the evolutionary characteristics of industrial development across different cities at various stages, the study uses multidimensional indicators including per capita research output, per capita GDP, per capita medical resources, educational resources, VC density, multinational corporation agglomeration, government R&D expenditure and related policies to provide a systematic comparison. This step will explain the historical evolution and complex spatial heterogeneity of the YRD medical industry.

3.4.2 Step Two: Quantitative Analysis

Building on the examination of the evolutionary characteristics of the medical industry in the Yangtze River Delta set out in the previous step, this section will empirically analyse and quantitatively test the relationship between venture capital and the innovation activities of entrepreneurial enterprises, thereby evaluating the role of VC in regional path creation.

Using panel data from Chinese medical industry firms between 2010 and 2019, I will apply the high-dimensional fixed effects model (Correia et al., 2020; Guimarães and Portugal, 2010) to examine the impact of VC on clinical trial approvals, which serve as a proxy for firm innovation activities. The dataset includes 5,111 observations covering firm financing records, clinical trial dynamics, firm characteristics and regional entrepreneurial ecosystem indicators. To ensure causal inference, this section will be combined with propensity score matching (PSM) to effectively control for selection bias in VC investments and any endogeneity arising from firm heterogeneity.

Does venture capital promote corporate innovation, and is there a near-causal relationship between the two? Does this impact show a time-lag effect? What effects do different types of venture capital (local capital, syndication and GVC) have on firm innovation, and how does venture capital differ across regions? At the regional level, how does venture capital influence different aspects of industrial path creation? These are the core question examined in this chapter. To answer them, I will conduct the analysis through the following steps:

1. Descriptive statistics, presenting the overall characteristics of the sample and the distribution of each variable.
2. Causal relationship testing, using the PSM model to verify the relationship between venture capital and clinical activities.
3. Core regression analysis to examine the relationship between total investment funding and corporate clinical trials.
4. Heterogeneity analysis, using alternative variables to verify the stability of the results, to analyse the variation in venture capital across different regions and evaluate the effects of different types of capital.
5. Regional analysis, exploring the different impacts of venture capital on path creation at the regional level.

In the regression model, firm innovation activities (measured by clinical trials) and their lagged terms will serve as dependent variables, with investment funding and type acting as core independent variables. Firm-level and regional-level control variables will be included, with fixed effects for firms, cities and years.

3.4.3 Step Three: Qualitative Analysis

This step will show how VC drives firm growth and shapes regional innovation pathways through resource integration and investment selection. The analysis draws on qualitative data from interviews and field observations to systematically explore the operational logic of VC in post-investment management and to understand behavioural differences and effects between capital types. The qualitative analysis will be conducted in three stages:

Stage 1: Inductive Theme Generation (Nowell et al., 2017). Open coding will be applied to all interview transcripts, identifying key themes such as capital resource integration, investment project selection, corporate governance and policy synergy support using a bottom-up approach to construct a preliminary coding framework.

Stage 2: Theory-Driven Theme Refinement (Braun and and Clarke, 2006; Naeem et al., 2023). Building on the inductive themes, the interview texts will recoded under theoretical guidance and refined into five core mechanisms: financial support, knowledge transfer, institutional legitimacy, market expansion and selection effects. This stage will also identify the strategies of different capital types from the perspectives of information asymmetry, trust and risk, focusing on their connections to regional innovation pathways.

Stage 3: Cross-Verification of Material Evidence (Carter et al., 2014; Arias Valencia, 2022). Key interview segments will be compared in depth, with iterative cross-checking of interview content to ensure consistency and differentiation in themes to guarantee the robustness of the analysis. Direct quotations will be used to maintain semantic accuracy, and interviewee materials will be transcribed meticulously to ensure fidelity to participants' perspectives.

3.5 Challenges and Limitations

3.5.1 Accessibility of Quantitative Data

Obtaining complete and comparable data resources in the study of China's medical industry often presents significant challenges, particularly regarding the integration of corporate financing data and clinical records. The Qichacha.com and the National Medical Products Administration's new drug application database used in this study have advantages, but the data acquisition process will still encounter certain obstacles.

Firstly, although clinical trial data is publicly available and reflects firms' innovation activities, there are mismatches in some cases – such as firm dissolution or name changes – between approval records and the Qichacha database. This could potentially affect sample

completeness in certain studies, requiring researchers to reconcile the data manually. Additionally, highly confidential financing information or unregistered investment transactions will result in some events being excluded from the analysis, and these omissions cannot be accurately quantified. Among all observations, there are 357 missing entries. The missing proportion is approximately 7%, which does not affect the analysis.

Secondly, Qichacha is a commercial paid database with a broad coverage, but it has some gaps, including missing details. To ensure data consistency, this study will standardise firm names, reconciling former names and brand names, perform full width to half width character conversions and implement automated and manual matching processes. Meanwhile, access to this database is restricted to entities within China, meaning that researchers must collaborate with Chinese institutions or possess Chinese citizenship.

To address data accessibility limitations, the study will use cross-validation and manual matching strategies to ensure one-to-one correspondence among financing records, firm IDs and years. It will also cautiously classified VC investor backgrounds (government vs. private) as well as investment models (syndication vs. single). While these rigorous processes will improve the technical reliability of the data, they cannot fully eliminate the impact of hidden data gaps on the results.

3.5.2 Identity and "Jargon" in Qualitative Research

In interviews concerning VC and the medical industry, the way researchers are perceived directly affects the quality and depth of the data obtained. In this study, the researcher's extensive investment experience and deep understanding of the medical industry enabled rapid trust-building with interviewees, while a professional consensus served as a critical bridge for gaining access to industry insiders (Shani et al., 2008).

Specifically, the researcher's familiarity with key VC terminology and industry development logic allowed in-depth discussions with VC practitioners and firm executives on strategic and operational matters. When addressing complex topics such as syndication strategies or government capital operational models, the researcher's adept use of industry jargon minimised identity differences with interviewees, who in some cases even perceived the researcher as a highly professional seasoned investor.

My doctoral background was also widely recognised by interviewees, particularly in the VC and medical R&D sectors, where strong academic credentials are prevalent. This academic identity enhanced the researcher's rapport during interviews. Given the industry's heavy reliance on

global capital and technology, the researcher's international experience also fostered a sense of shared identity with interviewees, reducing communication barriers.

The interview data in this study were sourced through specific formal and informal identity channels, strongly influencing the depth and breadth of the findings (Eppich et al., 2019). On one hand, the researcher established an initial formal network through senior and mid-level managers in large financial firms and medical industry parks. On the other, the study accessed decision-makers in core VC institutions and medical firms through their introductions, which was particularly useful for obtaining reliable insights into investment logic and policy information.

It should be noted that formal relationships often have a strong official nature. This is particularly evident in businesses and government, as these interviewees tend to present rational discourse that aligns with policy directions or corporate image. Informal networks established through interactions therefore played a crucial role. They allowed the researcher to access details about failed investments, bottlenecks faced by startups and real-world conflicts of interest between government-backed VC and private capital, providing critical evidence for understanding capital operational logic.

3.6 Chapter Summary

This chapter systematically outlined the research design, regional selection, data collection and analytical methods used in the thesis to explain the empirical research framework. At the research design level, the study focuses on the YRD medical industry from 2010 to 2019, as the region's industrial prominence during this period provides a typical sample for studying the interplay between VC and regional innovation pathways.

By adhering to a pragmatic paradigm, the study will integrate quantitative and qualitative methods to overcome the limitations of single method approaches to explain complex economic phenomena. Accordingly, two datasets were constructed. The first is a quantitative dataset, built through rigorous data processing and deep mining of sources such as Qichacha, the National Medical Products Administration and CNIPA to include firm innovation outputs, VC characteristics and firm and regional variables. The second is a qualitative dataset, comprising interview data from 28 interviewees, which is used to show the multifaceted impacts of VC on firm innovation through capital operations, corporate governance and policy interactions.

In terms of data analysis, the study uses a stepwise empirical deductive approach. Firstly, spatial econometric methods are used to analyse the agglomeration and evolutionary characteristics of VC within the YRD region, identifying spatial differentiation in regional

innovation capabilities. Secondly, high-dimensional fixed effects models are used to test the specific impacts of VC on firm innovation performance empirically, with robustness and heterogeneity analyses reinforcing the reliability of the results. Thirdly, semi-structured interviews are integrated to analyse the mechanisms of VCs in more depth from the perspectives of resource formation, selection effects, information and trust.

In the following chapters, the study follows this deductive logic. This chapter establishes the analytical framework for studying VC and regional pathway creation, while Chapter 4 validates the spatial-temporal characteristics of regional industrial development. Chapter 5 uses high-dimensional panel regression to measure the actual performance of VC and its various types. Chapters 6 and 7 introduce the interview materials, first discussing VC's specific resource formation and selection effects to systematically demonstrate the internal mechanisms and interconnections between different types of VC and regional development. In the following chapter, I will use the HHI index and degree of coupling-coordination to describe the spatial patterns of VC. I will then undertake a systematic comparison of entrepreneurial and innovation elements to describe the evolutionary history of the YRD medical industry in greater depth.

Chapter 4 A regional overview of venture capital in Yangtze River Delta's medical industry

4.1 Introduction

During the last two decades the accessibility of healthcare in China has significantly improved with the successive establishment of urban employee medical insurance, the new rural cooperative medical system and commercial insurance systems. Because of this, the demand for drug development and pharmaceutical services has been growing steadily. With its robust scientific research resources, comprehensive industrial support and highly developed economic network, the Yangtze River Delta has become one of the most active regions in China for investment and innovation in the medical industry. However, differences in resources and inherent characteristics between cities have led to spatial imbalances in medical innovation and capital flows that have given rise to various forms of regional differentiation and path dependency.

This chapter will systematically review the evolution of the medical industry in the YRD from 2001 to 2019, showing the coupling mechanisms and regional differences between venture capital and local innovation activities. It will start by examining the division of labour along the industrial chain and the innovation pathways, discussing the spatial-temporal characteristics of the pharmaceutical innovation layout in the region. The focus will then move to analysing the spatial asymmetry of VC in the region to decipher the interaction patterns and co-location relationships among sources of funding, managers and investment targets.

The chapter subsequently divides the development of the medical industry in the YRD into three time periods, as the medical industry showed distinct differences in growth and structure before and after key milestones under central-level reforms. By examining the opportunity spaces created by policy changes, it will analyse the structural characteristics of resource elements and key actors across different periods, exploring the development patterns of medical industry innovation and VC investment in each stage, discussing the evolution of the medical industry during these three main phases. Through this analysis, the chapter will offer empirical evidence to understand regional differentiation and path dependence in China's medical industry and provide valuable insights into the relationship between VC and the creation of medical industry pathways.

4.2 Spatial Distribution of Venture Capital

4.2.1 Empirical Setups

4.2.1.1.1 Herfindahl–Hirschman Index (HHI)

In this study, the Herfindahl–Hirschman Index (HHI) is used to quantify the geographical concentration of four entities – limited partners (LPs), general partners (GPs), investment activities and medical industry innovation (clinical trial approvals) – in the YRD between 2001 and 2019. The formula is as follows:

$$HHI = \sum_{i=1}^{N} S_i^2$$

where S_i represents the share of the i^{th} city in a given category (LPs, GPs, investments and innovation). The HHI is the sum of the squared shares of each region, with values ranging from 0 to 1. HHI values indicate higher concentrations of the category within the region.

4.2.1.1.2 Coupling and Coordination Degree

The coupling and coordination degree model is often used to assess the interactions and synergistic development levels among two or more subsystems quantitatively. (Tomal, 2021; Li and Hou, 2024). The coupling degree measures the strength of interactions among multiple subsystems within a spatial context, while the coordination degree evaluates the overall development level of these subsystems. A high degree of coupling shows that subsystems co-occur synchronously within a city, reflecting strong spatial interconnections between them. The coordination degree also reveals whether disparities in development levels among subsystems exist within a region, thereby indicating the consistency behind their co-location. The specific formulas are as follows:

$$C = \left[\frac{\prod_{i=1}^{n} U_i}{\left(\frac{1}{n}\sum_{i=1}^{n} U_i\right)^n} \right]^{\frac{1}{n}}$$

$$T = \sum_{i=1}^{n} \alpha_i U_i$$

Where C denotes the coupling degree, and T denotes the coordination degree. U_i represents the different subsystems (LPs, GPs, investment and innovation), and α_i is the weight coefficient, which is set equally at 0.25. When the coupling degree approaches 1, it indicates stronger

interconnections and greater co-location among subsystems within a city. When the coordination degree approaches 1, it suggests more balanced development among subsystems.

4.2.2 Concentration Patterns

Figure 4-1 shows the dynamic changes in the concentration of LPs, GPs, investment and innovation from 2001 to 2019. The HHI index is then used to analyse the degree of geographical agglomeration (O'Donoghue and Gleave, 2004). Firstly, the concentration (HHI index) of GPs is significantly higher than that of LPs, showing that the fund management side exhibits stronger concentration characteristics, while the regional concentration of LPs is comparatively lower, reflecting a more dispersed supply of capital. However, before 2004, both LPs and GPs experienced an upward trend in concentration, with the GP HHI index notably surging to 36.9% in 2004, showing that the fund management market reached a temporary peak in concentration at that time. Later, although the GP concentration fluctuated, it showed a slow overall downward trend, falling to 24.0% by 2019. This indicates increased competition in the fund management market and suggests that the number of market entrants in various regions has been steadily increasing.

In contrast, the concentration of investments showed more significant fluctuations during the period. Before 2003, the HHI index for investments was relatively high, indicating that investment decisions were primarily concentrated in a few regions. However, from 2003 to 2006, the investment concentration declined sharply, dropping from 43.8% to 17.9%, suggesting a significant expansion in the geographic scope of capital allocation and a gradual trend toward decentralization. Investment concentration subsequently remained at a lower level, with slight fluctuations between 2007 and 2019, but staying generally within the range of 17.5% to 19.3%, 4 percentage points higher than the HHI index for LPs. This shows that the trend toward diversification in investment regions gradually stabilized.

Secondly, innovation in the medical industry has always been highly concentrated, but after 2015 it began to show a pattern of evolution that was closely aligned with venture capital. From 2001 to 2005, there were virtually no clinical trials, resulting in extreme statistical values (an HHI of 100%). However, innovation activities took from 2006 off, and the HHI plunged from 80.2 percent in 2006 to 49.3 percent in 2010, reflecting an early trend towards a richer array of innovation regions as more and more cities engaged in innovative activity and geographic concentration fell sharply.

From 2011 to 2014, the regional concentration of innovation continued to decline, although at a slower pace. Notably, the HHI index for innovation showed a highly consistent trend with that of

GPs from 2015, with both declining in tandem. By 2019, the concentration of innovation had dropped to 25.4%, while the concentration of GPs fell to 24.0%. This suggests that as innovation activities matured, changes in capital investment became highly correlated with changes in innovation activities, demonstrating a degree of co-evolutionary characteristics between the two.

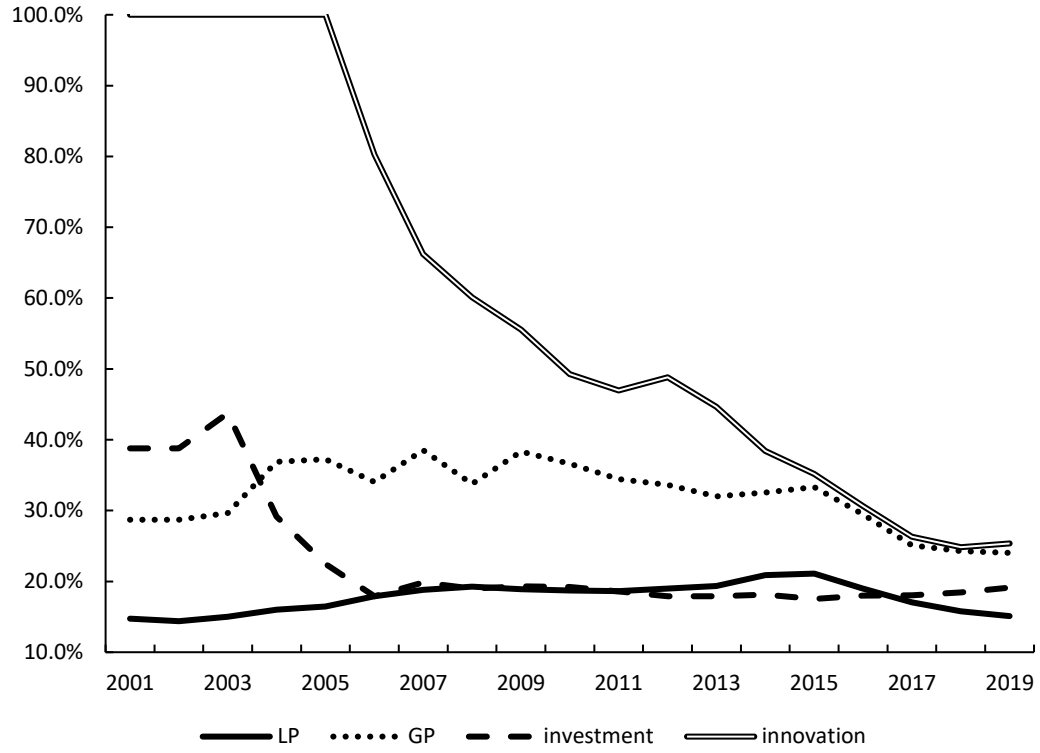

Figure 4-1: Changes in the HHI index for LP, GP, investment and medical innovation (clinical trial approval) in the YRD from 2001 to 2019 (Source: author's analysis of Qichacha)

4.2.3 Co-location Dynamics

Figure 4-2 shows the average degree of coupling coordination in the YRD from 2001 to 2019. The coupling coordination model was used to evaluate the degree of coordination among different subsystems within a unit (Tomal, 2021; Li and Hou, 2024). The data show that coupling and coordination both exhibited a significant upward trend between 2001 and 2019, with the increase in coupling markedly outpacing that of coordination. The coupling degree underwent a nonlinear leap during the study period, particularly after 2010, when its growth rate significantly accelerated, rising rapidly from 0.0688 in 2010 to 0.5459 in 2019. During the same period, the coordination degree also increased, but at a comparatively slower rate, rising from 0.0060 in 2010 to 0.0939 in 2019. This indicates that the interactions among the four subsystems – LP, GP, investment and innovation – in the YRD region gradually strengthened, although significant disparities in the development levels of these subsystems still remain.

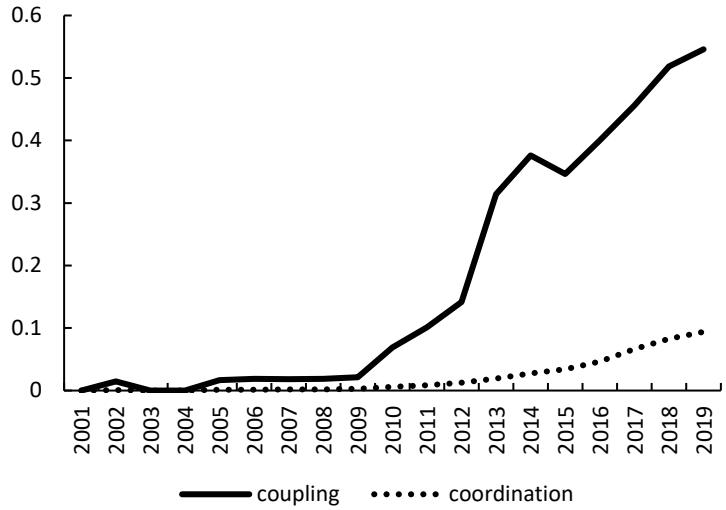

Figure 4-2: Average coupling coordination degree change in YRD from 2001 to 2019 (Source: author's analysis of Qichacha)

Figure 4-3 shows the coupling and coordination degree of cities in the Yangtze River Delta region. Most exhibited characteristics of high coupling but low coordination. Specifically, Shanghai, as the region's core city, achieved a coupling and coordination degree of 1, indicating that the four subsystems in this city have reached a state of high integration and coordinated development. In contrast, cities such as Hefei, Nanjing, Hangzhou and Suzhou have coupling degrees close to 1, but their coordination degrees are lower. This suggests strong interconnectivity between the four subsystems in these cities but a lag in the development of certain subsystems leading to overall uneven development. Some cities, such as Ningbo and Taizhou, have relatively lower coupling degrees, showing that the four subsystems have not yet formed close interactions. Meanwhile, some regions – such as Anqing, Chizhou, Chuzhou and Ma'anshan – exhibit coupling and coordination degrees of 0. This indicates that these regions are at a low level of development, or are even still undeveloped, across the four subsystems, reflecting their marginal status within the YRD.

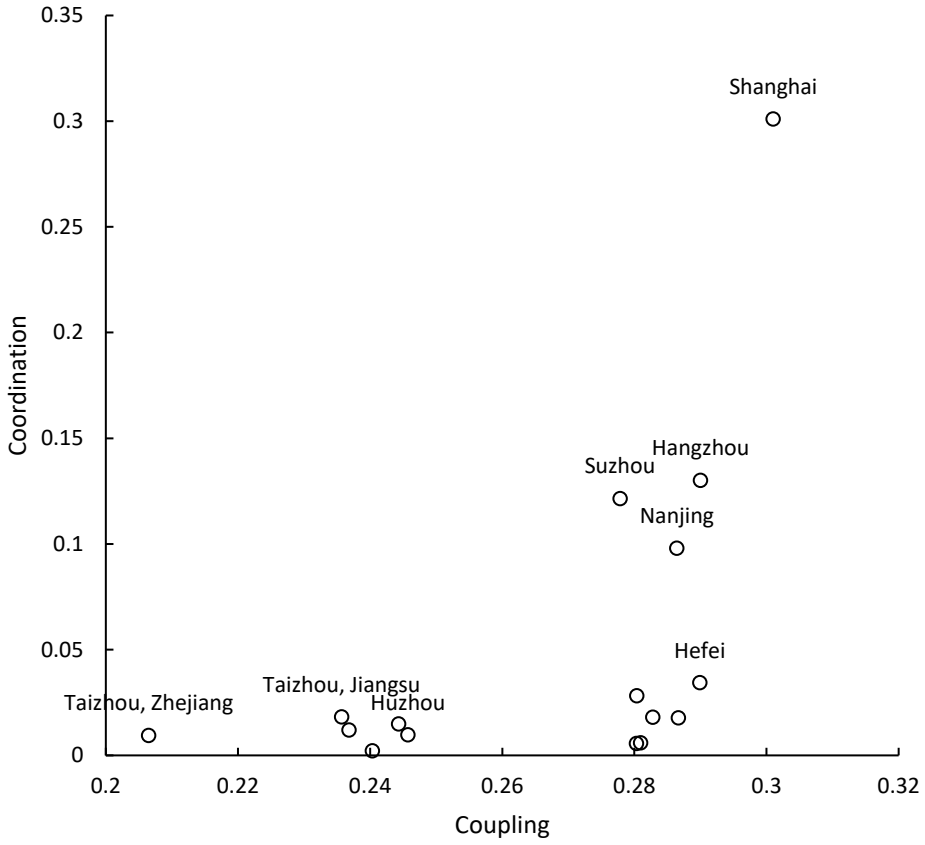

Figure 4-3: Coordination and coupling degrees in the YRD in 2019 (log10 standardization, Source: author's analysis of Qichacha)

To summarize, the results show that venture capital exhibits characteristics of spatial imbalance and path dependency. This imbalance is reflected in the fact that the sources of capital for VC are dispersed, whereas the capital managers are relatively concentrated. Fund managers invest capital across different regions, thus re-forming a relatively dispersed pattern (albeit with a concentration degree that is higher than that of the capital sources). Meanwhile, there is evidence of co-evolution between the concentration of capital managers and the degree of innovation within industries. This asymmetrical pattern was also verified in the United Kingdom, where venture capital in the Southampton area was found to be predominantly sourced from the United States (Pinch and Sunley, 2009).

More specifically, while a high coupling degree indicates the co-location of different subsystems, significant variations in the coordination degree suggests that only a few cities have achieved coordinated development. Within the region, only Shanghai exhibits high coupling and high coordination, reflecting its advantage in venture capital development and a potential trend of cumulative reinforcement. In the next subsection, I will identify which areas in the Yangtze River Delta have created pathways for the healthcare industry.

4.3 The Location of New Paths

The YRD region formed distinct regional characteristics and a clear division of labour based on the development of the medical industry chain. According to data from Qichacha, in 2019 Shanghai was at the forefront of development, with a total of 248 enterprises, showing a relatively balanced development pattern in the manufacturing of chemical drug active pharmaceutical ingredients and formulations, biopharmaceutical products, as well as in medical research and experimental development. Zhejiang (231 firms) and Jiangsu (207 firms) followed closely. Both provinces held significant shares in the production of chemical drug active ingredients, chemical drug formulations and biopharmaceutical products, and each developed distinctive advantages – Zhejiang in technology promotion services and industrial design, and Jiangsu in the wholesale of pharmaceuticals and medical devices. Although the overall number in Anhui was comparatively smaller (135 firms), it maintained a considerable scale in key segments such as the manufacturing of chemical drug active ingredients, chemical drug formulations and biopharmaceutical products. In a sense, the YRD region established a complementary pattern within the medical industry, with Shanghai as the innovation core, Jiangsu as the pharmaceutical production base, Zhejiang as the biopharmaceutical and technology service centre and Anhui supporting pharmaceutical manufacturing and related industries.

The YRD showed significant spatial disparities in medical innovation activities between 2001 and 2019 (Figure 4-4). Overall, medical innovation showed a gradual upward trend, with Shanghai in particular gradually establishing its position as a centre for medical innovation in China during this period. In terms of the total number of clinical trials, Shanghai led overwhelmingly with 1,331 trials to secure a dominant position and underscoring its role as a core regional city. Nanjing and Hangzhou also showed high levels of innovation activity, ranking second and third with 524 and 205 clinical trials respectively, indicating the strong medical research and development capabilities as the capital cities of Jiangsu and Zhejiang provinces. Apart from Shanghai, Nanjing, and Hangzhou, Suzhou (193 trials) and Taizhou (120 trials) also showed notable innovation capabilities. However, the number of approved trials in most other cities was relatively low, and innovation activities in cities such as Anqing and Zhoushan were almost negligible.

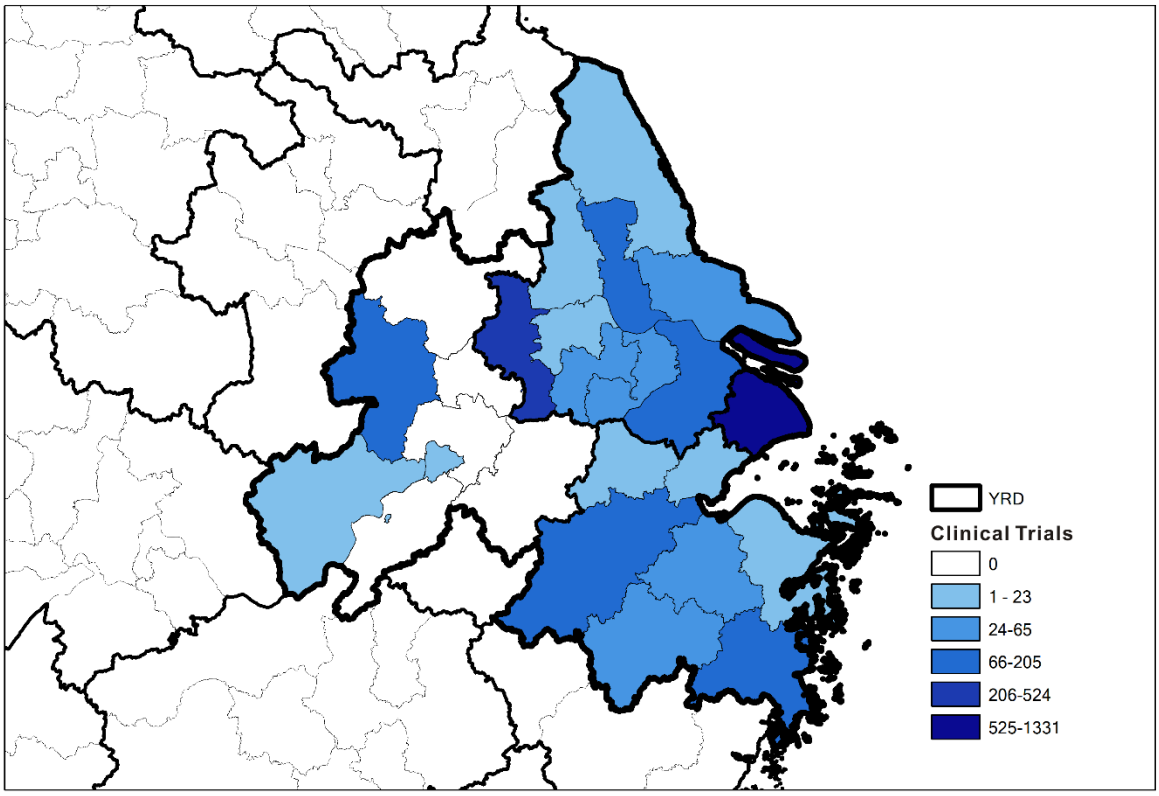

Figure 4-4: Distribution Pattern of all Medical Industry Innovations in the YRD, 2001-2019 (Source: chinadrugtrial.com)

More specifically, the medical innovation pathways in the YRD region exhibit two distinct patterns of differentiation. Based on per capita clinical trials in the region from 2001 to 2019 and using the mean as a threshold for analysis, the Yangtze River Delta cities can be divided into two groups (Figure 4-5).

Group 1 includes Anqing, Chizhou, Chuzhou, Huzhou, Jiaxing, Jinhua, Ma'anshan, Nantong, Ningbo, Tongling, Wuxi, Wuhu, Xuancheng, Yancheng, Yangzhou, Zhenjiang, Zhoushan, Shaoxing and Changzhou.

Group 2 includes Hangzhou, Hefei, Nanjing, Shanghai, Suzhou, Taizhou Zhejiang, Taizhou and Jiangsu.

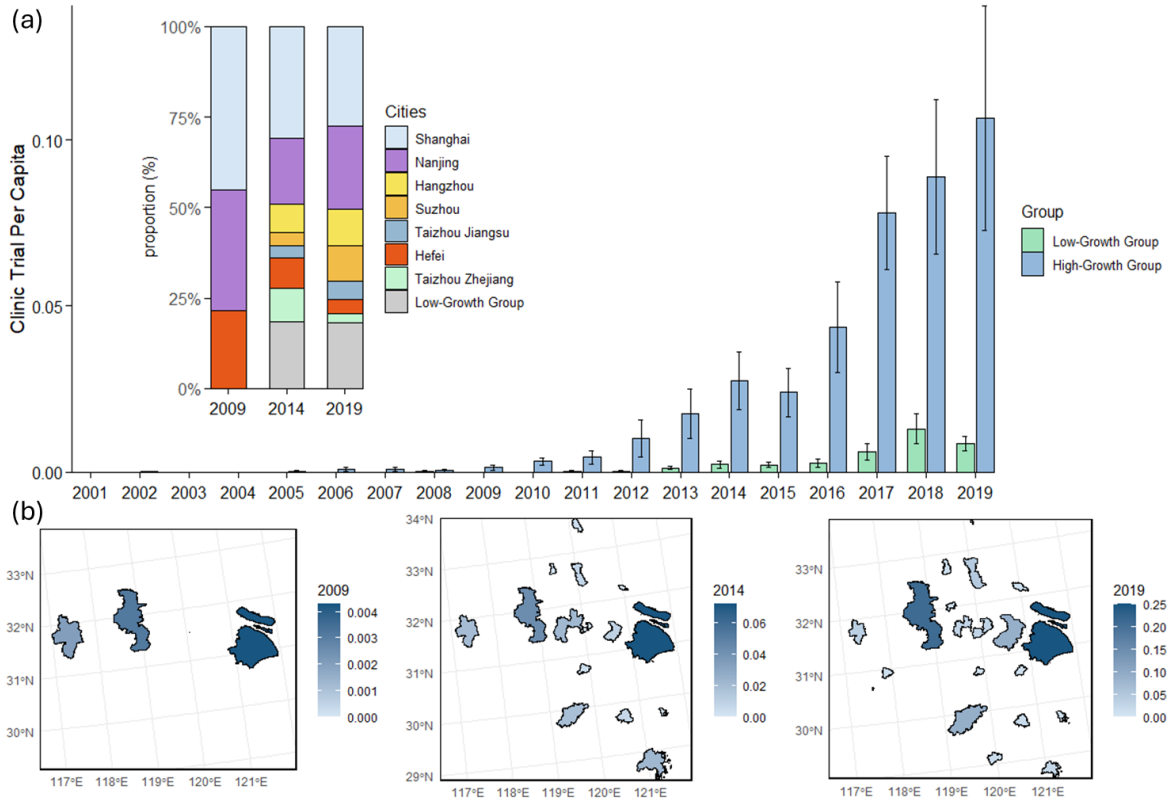

Figure (a) depicts the evolution of the means and standard errors of Clinical Trial across different groups, including the proportional distribution in the last year of each period. Figure (b) is a non-contiguous cartogram of clinical trials at different time points, with the horizontal axis representing longitude and the vertical axis representing latitude. Data sourced from PubMed, CNIPA, the China City Statistical Yearbook, and chinadrugtrial.com.

Figure 4-5: Spatial-Temporal Differentiation of Path Creation in the Medical Industry (Source: author's analysis of Qichacha)

The cities in Group 1 generally showed a low-level and slow-growth trajectory of innovation. I define this as the low-growth group, where clinical trial activity remained consistently low and showed no significant breakthroughs during the 19-year period. In contrast, the cities in Group 2 showed rapid growth and highly active clinical trial activities, showing particularly significant exponential growth in the later stages. I define this as the high-growth group, which still occupies a central position in the YRD's medical innovation system. This divergence reflects the regional imbalance of medical innovation development within the region, which is closely related to the level of each city's entrepreneurial ecosystem. Figures 4-6 compare the inter-group differences in the elements and actors of the entrepreneurial ecosystem as well as the evolution of innovation activities and their distribution. Appendix B looks at the detailed conditions of different stages.

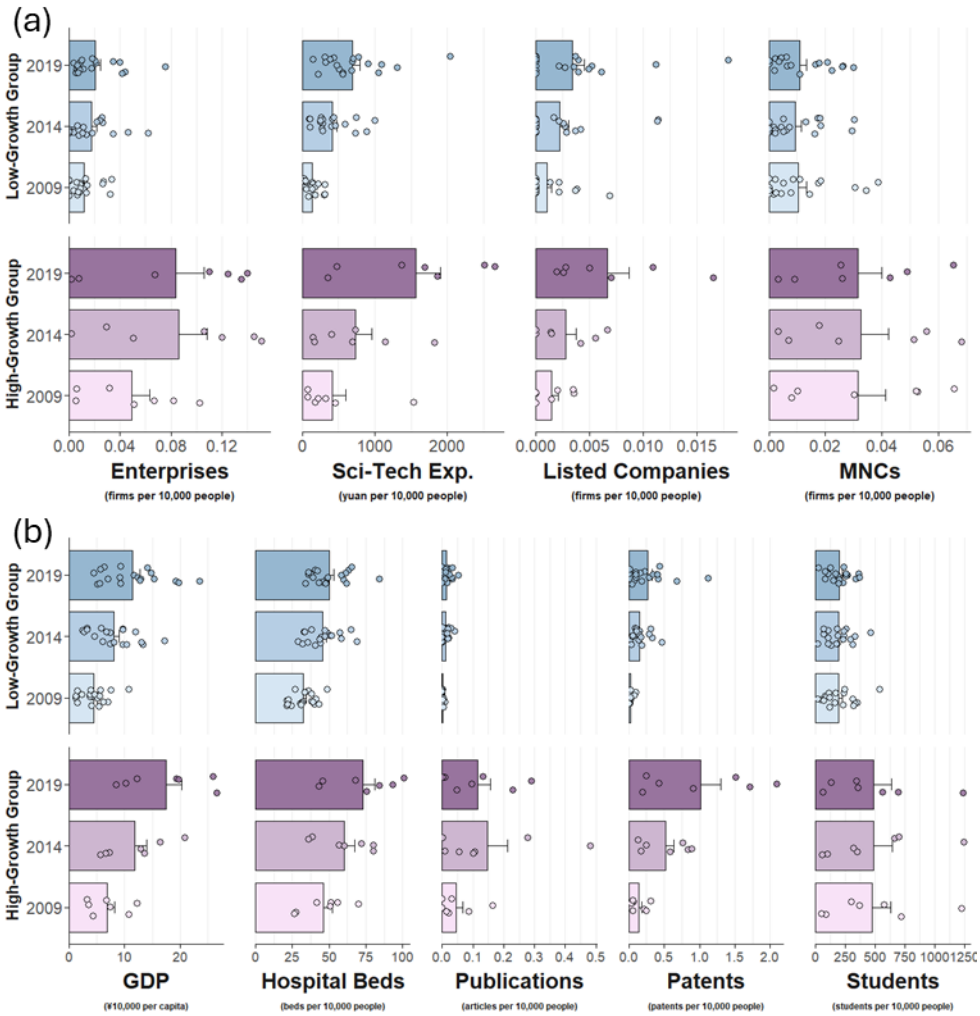

Figure (a) shows the trends in the standardized values and error terms of the key elements in the Yangtze River Delta medical industry entrepreneurial ecosystem for 2009, 2014, and 2019; the points represent the values for each city in the respective year. MNC is the multinational corporation. Figure (b) illustrates the changes in the actors within the entrepreneurial ecosystem over these three years.

Figure 4-6: Panoramic Analysis of the Entrepreneurial Ecosystem

Below, I discuss the evolution of the Yangtze River Delta's medical industry in detail from 2001 to 2019 in stages from four aspects, including the opportunity space for regional development, policy and institutional changes, the evolution of the entrepreneurial ecosystem and trends in venture capital investment.

4.4 Stage I (2001-2009): Reform and Industry Emergence

4.4.1 Opportunity Spaces

Before 2009, China's healthcare reform was still in its early stages. During this period, the ageing population trend began to emerge, with the proportion of the population aged 60 and above rising from 8.3% in 1991 to 12.8% in 2010. Against this backdrop, the core of China's

institutional reforms sought to establish a basic medical insurance system. From the introduction of the Urban Employee Basic Medical Insurance (UEBMI) in 1998 to the implementation of the New Rural Cooperative Medical Scheme (NRCMS) in 2002 and the establishment of Urban Resident Basic Medical Insurance (URBMI) in 2007, China progressively built a medical insurance framework that would include urban and rural populations. As a result, medical insurance coverage expanded rapidly, with the insured population growing from 4.017 million in 1998 to 1.234 billion in 2008 (Figure 4-7). This marked a transformation in China's healthcare system from partial coverage to nationwide access. The institutional change improved healthcare accessibility significantly, while driving a rapid expansion of healthcare services and medical markets, laying the market foundation for subsequent industrial transformation.

However, rapid growth of the industry was accompanied by several structural challenges. Firstly, hospitals and doctors relied on commissions from drug sales as a primary revenue source, leading to the widespread phenomenon of funding healthcare through drug sales, which undermined the quality of medical services. Secondly, most firms prioritised aggressive sales strategies to capture a bigger market share rather than investing in long-term technological innovation. Overall, while the pre-2009 reforms established a basic framework for the healthcare market at a macro level and spurred industry growth, the medical industry remained in an early stage of development and faced dual challenges of institutional constraint and insufficient innovation capacity. However, some local governments recognised the growth potential of the regional medical industry and began formulating targeted policies to channel resources towards its development.

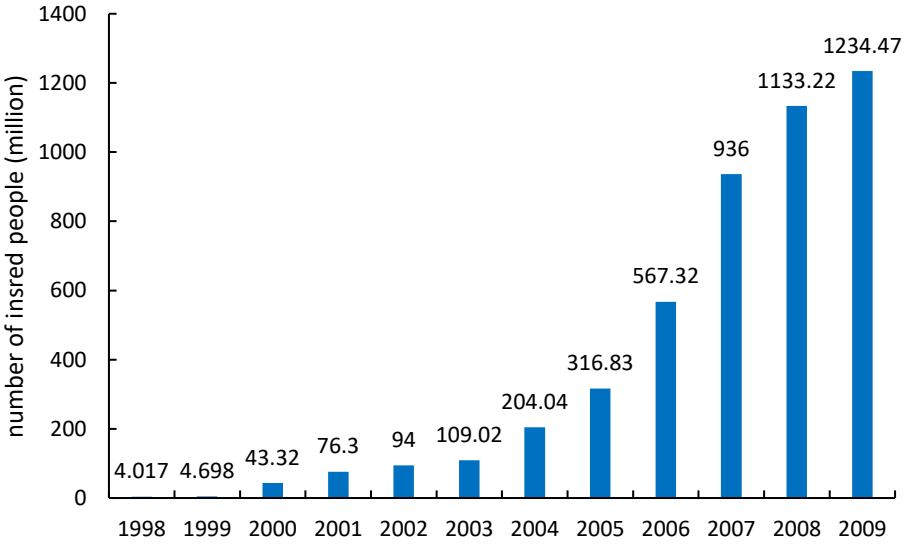

Figure 4-7: The number of insured people from 1998 to 2008 (Source: China yearly statistics of the development of Medicare)

4.4.2 Policy and Institutional Change

During this phase, although most cities in the YRD region had not yet designated the medical industry as a priority sector, Shanghai and Suzhou had already introduced forward-looking policies. These were aimed at fostering industrial foundations and attracting external resources, thereby shaping the regional entrepreneurial ecosystem. The establishment of the Zhangjiang Science City in 1992 and the Suzhou Industrial Park in 1994 provided early institutional frameworks for both cities. Local governments subsequently allocated resources preferentially in project approvals, financial support and land allocation, gradually establishing a park-led development model. A pivotal moment came in 2005, when Zhangjiang was upgraded to a national high-tech industrial development zone, significantly enhancing its institutional status and reinforcing policy continuity and resource agglomeration effects.

To solidify their regional niche further and raise agglomeration levels, both cities adopted a "park-within-park" strategy for spatial development. In 1994, Shanghai established the Zhangjiang Pharma Valley, and in 2006, Suzhou launched the Bio-Nano Park. Both were designated as core functional zones for the medical industry. This highly specialised development path placed greater demands on the local accumulation of knowledge and talent. Since 1998, Zhangjiang has successively introduced national-level research institutions, including the Shanghai New Drug Research and Development Centre (1998), the National Human Genome Southern Research Centre and the Shanghai Institute of Materia Medica of the Chinese Academy of Sciences (2001). Pudong also launched the Overseas Returnee Entrepreneurship Subsidy and the Green Card Fast-Track in 2002 to provide institutional incentives for high-calibre overseas talent. Suzhou initiated a Talent Introduction Programme in 2006 to recruit high-level innovation talent globally, strengthening the synergy between research and entrepreneurship in the park further.

At this time, both cities also placed significant emphasis on nurturing local entrepreneurial ecosystems. On one hand, Zhangjiang and Suzhou made substantial investments to support enterprises along the industrial chain. In 2008, Zhangjiang's Biomedical Service Outsourcing Park (CRO/CDMO cluster) was officially launched, and in the same year Suzhou invested hundreds of millions of yuan to establish a public technical platform for biomedicals and nanotechnology, complemented by services such as business support, human resources and technical regulatory training. On the other, Zhangjiang and Suzhou began to augment the role of VC in the medical industry. In 2001, the government-led China-Singapore Suzhou Industrial Park Venture Capital Company was established, and in 2007 it was restructured and renamed Suzhou Venture Capital, operating according to a market-oriented strategy. Two years later, in

2009, Zhangjiang introduced the VIC model (VC + Incubation + CRO) to create an integrated industrial chain that included investment, incubation and outsourcing services.

National-level institutional opportunities, particularly the widespread adoption of medical insurance coverage, created sufficient opportunity spaces for local governments. The model adopted by leading local governments centred on the development of industrial parks and public technology platforms, transforming industry opportunity spaces into regional opportunity spaces and providing Shanghai and Suzhou with a first-mover advantage in the development of their entrepreneurial ecosystems.

4.4.3 Evolution of Entrepreneurial Ecosystems

From the perspective of ecosystem elements, the YRD's entrepreneurial ecosystem demonstrates significant spatial agglomeration effects. Between 2001 and 2009, high-growth cities outperformed low-growth cities in research output (average per capita publication rate of 0.04; Nanjing 0.16, Hangzhou 0.09) and technological innovation (average per capita patent grants of 0.14; Shanghai 0.31, Hangzhou 0.22). This advantage was reflected in the rapid increase in the quantity of academic research and the sustained accumulation and diffusion of innovation capabilities. High-growth cities also held a superior position in terms of economic foundations and public resource allocation: per capita GDP reached 68,900 yuan (Suzhou 122,200 yuan, Shanghai 107,400 yuan), hospital beds per capita stood at 46.05 (Shanghai 69.95, Suzhou 55.91) and the number of university students per 10,000 people was 474.43 (Nanjing 1,228.06, Hefei 716.46). These factors provided strong material support and reserves of talent for local innovation activities, further reinforcing the uneven distribution of regional resources.

From the perspective of actors, the development of capital markets and technological entities did not form full path dependence in the early stages, but the clustering effect of innovative entrepreneurship was already evident. Although the difference in per capita listed company density between high- and low-growth groups was minimal (0.0015 vs. 0.0011 respectively), the per capita density of technology firms in the high-growth group was approximately 0.05, compared to only 0.01 in the low-growth group, with Hangzhou (0.08), Suzhou (0.10) and Shanghai (0.07) leading significantly. This underscores the first-mover advantage of these cities in fostering entrepreneurial incubation and the development of the technology industry. The disparity in internationalisation (per capita multinational company presence: 0.03 vs. 0.01) and government science and technology funding (per capita approximately 4.09 million yuan vs. 1.41 million yuan) strengthened the scale effects and global connectivity of entrepreneurial actors further to create favourable conditions for the agglomeration of innovation activities and the growth of venture capital.

In terms of innovation output, the spatial distribution of clinical trial numbers in the medical industry is particularly indicative of ecosystem maturity dependence. Although the high-growth group started slowly in 2001, their average application volume had accumulated to 0.00136 by 2009, with a significantly widened standard error that pointed to growing divergence in innovation vitality among cities. In contrast, low-growth cities remained near zero in terms of applications throughout the period, reflecting the objective reality of limited penetration of entrepreneurial resources. By 2009, Shanghai (45.1%), Nanjing (33.4%) and Hefei (21.4%) were collectively driving the core momentum of regional medical innovation, closely tied to their high concentration of prestigious universities and educated labour. This highlights the deep spatial links between innovation elements, actors and outcomes.

4.4.4 Venture Capital Investment Trends

Between 2001 and 2009, venture capital investment in the medical industry in the Yangtze River Delta showed significant spatial divergence (Figure 4-8). In high-growth cities, the average number of investments rose from 0.71 in 2001 to 3.57 in 2009, an almost fivefold increase. In contrast, low-growth cities saw a modest rise from 0.11 to 0.95, with many cities receiving little to no investment for many years. By 2009, the internal variation in investment distribution within the high-growth group was more pronounced, with a standard error of 5.22, compared to only 2.20 for the low-growth group, indicating that while overall investment levels were low, the limited investments in low-growth cities were relatively evenly distributed. Shanghai and Suzhou attracted 13 and 9 investments respectively, accounting for 30.2% and 20.9% of the regional total and establishing them as absolute centres of capital agglomeration. Meanwhile, other high-growth cities like Nanjing and Hefei received almost no venture capital support throughout the study period, highlighting significant internal disparities in development.

This phenomenon shows that the flow of venture capital in the medical industry relies heavily on existing innovation foundations and industrial clusters. Capital tended to flow toward the high-growth group, while cities in the low-growth group remained on the peripheries of investment. In 2009, only a few low-growth group cities – including Wuxi, Nantong and Shaoxing – received venture capital investment. Among these, Wuxi benefited from the rise of WuXi AppTec, with investment surging significantly after 2006, reaching nine deals in 2009, which was on a par with Suzhou. However, the investment growth in the low-growth group was not enough to alter the overall pattern of regional capital flows, suggesting that the capital agglomeration effect not only reflects disparities in regional innovation capabilities but also further exacerbates spatial differentiation in the development of the medical industry.

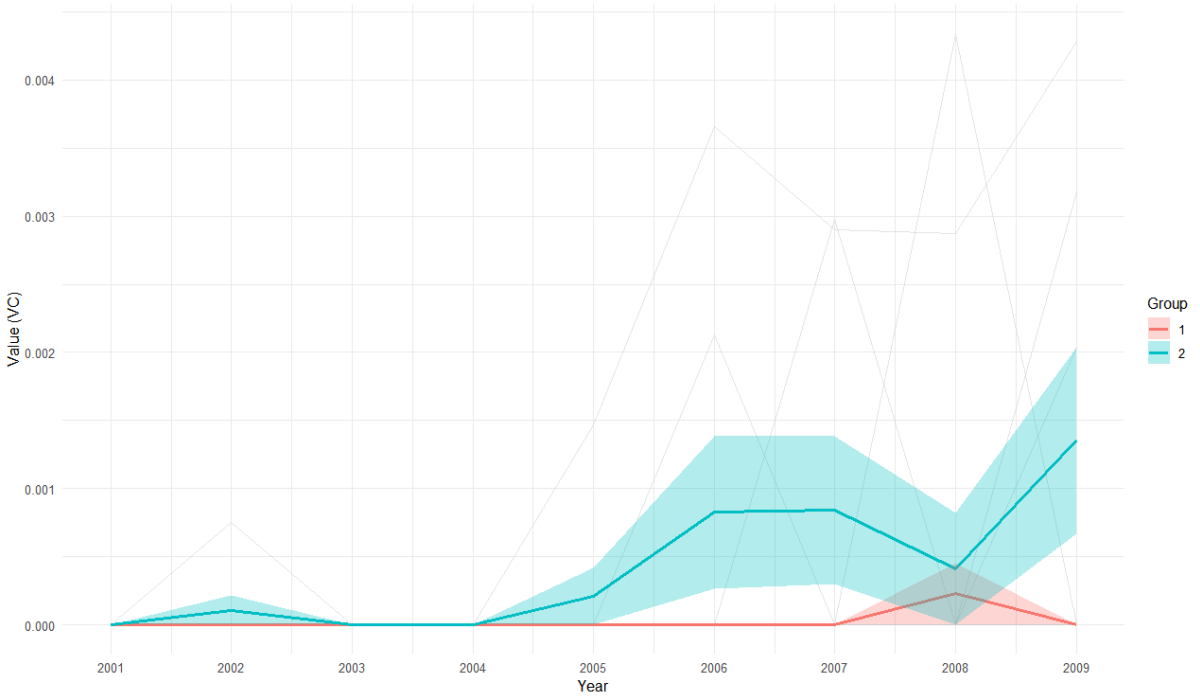

Figure 4-8. Changes in the number of venture capital investments and 95% confidence interval for different groups from 2001 to 2009 (Source: Qichacha)

4.5 Stage II (2010-2014): Generic Drugs and Early Path Signals

4.5.1 Opportunity Spaces

The social landscape of the YRD underwent further changes between 2010 and 2014. Firstly, China's ageing population rate continued to rise during this period, with the proportion of the population aged 60 and above reaching 15% by 2014. Second, new drugs emerged rapidly at the global level, notably the market entry of PD-1/PD-L1-targeted cancer therapies. This technology was epoch-making as it blocked the ability of tumour cells to suppress T-cells, allowing patients' immune systems to recognise and attack cancer cells. This advanced the development of next-generation immunotherapy strategies significantly, introducing new perspectives and methods of treating cancer.

Meanwhile, the medical insurance system reforms initiated in the previous phase were deepened further during this period, leading to the continued expansion of the healthcare market. On one hand, the insured population reached 1.43979 billion by 2014, meaning nearly the entire Chinese population was covered. On the other, China began piloting a major disease insurance system in 2013 and 2014, providing policy support for the expansion of high-cost medical services and a more specialized pharmaceutical market.

The arrival of the patent cliff created opportunities for the generic drug market. According to an industry report by the China Pharmaceutical Innovation and Research Development Association

(PhIRDA) and LEK Consulting, patents for 631 originator drugs expired in the Chinese market around 2014, creating significant opportunities for generic drug manufacturers and accelerating the rise of niche markets in the specialty generics sector.

China created opportunity spaces for the medical industry to move towards innovation-driven development through a series of institutional reforms. In 2010, Anhui Province's pioneering drug centralised procurement policy marked a significant turning point for the development of the medical industry. The Implementation Plan for Centralised Procurement of Essential Drugs in Anhui Province's Primary Healthcare Institutions introduced the "double-envelope system" for the first time, leading to an average price reduction of more than 40% for drugs that entered centralised procurement. This model was subsequently replicated and tested in various provinces nationwide, and this pilot reform not only intensified price competition in local drug markets but also disrupted the profitability model that relied heavily on high pricing for conventional drugs. This prompted some pharmaceutical companies to adjust their strategies and explore the development of more innovative drug products.

The government's stronger regulation of drug use shaped the market environment further. The 2011 Draft Measures for the Clinical Use of Antibacterial Drugs imposed strict controls on the clinical use of antibiotics, with penalties for doctors who abused antibiotics that included suspension of practice or even criminal charges. This policy curbed the long-standing issue of antibiotic overuse and encouraged pharmaceutical companies to gradually reduce their reliance on the antibiotic market and move their resources towards drug R&D. Under the influence of institutional reforms and market demand, a growing number of Chinese pharmaceutical companies therefore entered the generic drug sector, providing new directions for regional policy adjustments.

4.5.2 Policy and Institutional Change

During this phase, local government policy arrangements developed two prominent characteristics. Firstly, Shanghai and Suzhou displayed clear divergence in their industrial policy. Shanghai, during this period, largely refrained from direct policy interventions in regional industrial development, and its policy rhetoric, expressed in official statements, came to emphasise market-driven growth and a relatively restrained government role instead. In stark contrast, Suzhou deepened its institutional support for the local entrepreneurial ecosystem. In 2010 it introduced the Leading Talent programme, providing selected talents with comprehensive support packages worth up to 10 million RMB that covered funding, housing and entrepreneurial platforms, reflecting the government's strong commitment to attracting high-calibre talent.

In the same year, Suzhou brought in the Cold Spring Harbour Asia, significantly improving the region's visibility and academic influence in the global medical industry through international conferences and academic seminars. Also in 2010, Suzhou's BioBAY was elevated to the level of a National Technology Business Incubator, marking a further strengthening of the city's capacity to integrate innovation resources. In 2011, BioBAY established a wholly-owned subsidiary, BioTop Biotech, which was dedicated to operating a public technical service platform. In 2013, BioBAY initiated YuanSheng Venture Capital, focusing on early- to growth-stage investments in the medical sector and promoting the capitalisation pathways of regional startups.

Secondly, the agency of governments in other cities within the high-growth group began to strengthen, and they started to formulate policies targeting the medical industry. In 2010, as well as implementing the centralised drug procurement pilot, Anhui established the Biopharmaceutical Industry Technology Innovation Strategic Alliance to promote collaborative innovation between provincial enterprises. In 2014, Hefei established an incentive mechanism for the transformation of enterprise technological achievements, providing one-time financial rewards to biomedical enterprises that obtained clinical and registration approvals or passed GMP/GSP certification. Hangzhou established the Hangzhou Future Tech City (Zhejiang Overseas High-Level Talent Innovation Park) in 2010, simultaneously launching the Hangzhou High-Tech Zone High-Level Talent Entrepreneurship Support Programme which offered substantial financial subsidies for selected projects and allocated an annual 150 million yuan special fund for talent incentives from 2014 onwards. Meanwhile Nanjing included the biopharmaceutical industry as a key development area in 2012, introducing the Nine Science and Technology Policies to cover support for researchers starting businesses and intellectual property equity participation. These policies allocated between 60 and 95% of invention proceeds to researchers and allowed intellectual property to account for 50 to 70% of equity, significantly encouraging the enthusiasm of science and technology talents for entrepreneurship.

Overall, because of significant improvements in market-driven forces in the opportunity space during this stage, local government strategies began to diverge. A common feature of Shanghai and Suzhou was a shift away from relying solely on industrial park development as the core strategy, and the cities turned their focus to the aggregation of resource elements and greater reliance on market-oriented mechanisms. Meanwhile, policies in other high-growth cities continued to centre on industrial park development.

4.5.3 Evolution of Entrepreneurial Ecosystems

From the perspective of ecosystem elements, high-growth cities consolidated their agglomeration advantages in research, technology and economic foundations further between 2010 and 2014. The per capita publication rate in the high-growth group surged from 0.045 to 0.147 (a 3.27-fold increase, averaging 0.15), far surpassing the low-growth group's 0.01, with international academic output led by Nanjing (0.48) and Hangzhou (0.28). The number of technical patent grants in the high growth group rose from 0.141 to 0.516 (a 3.67-fold increase, averaging 0.52), compared to only 0.15 in the low-growth group. Meanwhile, per capita GDP in the high-growth group increased from 68,900 to 118,900 yuan (a 75% increase, led by Suzhou at 208,200 yuan and Shanghai at 163,800 yuan), and public health and education resources remained strong. The number of hospital beds per capita reached 60.46, a 31% increase, with Shanghai at 80.17 and Suzhou at 80.00), while the number of university students per 10,000 people stood at 488.99 (Nanjing 1,241.46, Hefei 697.68). The continued strengthening of these elements resulted in a deepening of disparities in regional resource endowments.

From the perspective of actors, capital markets and technology-driven enterprises in the high-growth group showed more pronounced differentiation and agglomeration effects. Although per capita listed company density only increased slightly (from 0.0015 to 0.0028 in the high-growth group and from 0.0011 to 0.0022 in the low-growth group) and remained low and comparable, the density of enterprises in the high-growth group rose from 0.05 to 0.09 (a 75% increase), far outpacing the low-growth group's increase from 0.01 to 0.02 (a 48% increase). Hangzhou (0.15), Shanghai (0.15) and Suzhou (0.11) emerged as core hubs for enterprises. More crucially, the high-growth group continued to increase investments in internationalisation and policy support. Per capita multinational company presence remained high at 0.03 compared to 0.01 for the low-growth group, and government R&D expenditure grew from 4.0938 million to 7.3050 million yuan (a 78% increase), led by Shanghai (18.2311 million yuan), Suzhou (11.4656 million yuan) and Hangzhou (7.3216 million yuan). This highlighted the profound role of policy resources in shaping the form and scale of entrepreneurial actors.

In terms of innovation output, clinical trials in high-growth cities achieved a more significant growth in scale, with internal differentiation also intensifying. Between 2010 and 2014, the average clinical trials in the high-growth group surged from 0.003 to 0.027 (an 8.4-fold increase, with the standard error rising from a low level to 0.023). This reflected an explosive growth in the maturity and development of innovation systems in core cities, but while the low-growth group achieved an early growth of 0.002 by 2014, its overall increase and variability remained far behind the high-growth group, with a standard error of only 0.005. At the individual city level, Shanghai (30.7%), Nanjing (18.4%), Hefei (8.4%) and Hangzhou (7.7%) continued to form the

backbone of the regional innovation hub, while more gradual growth in cities like Suzhou and Taizhou signalled the early stages of new industrial agglomeration. This pattern of divergence in innovation indicates that with policy tilts and the development of ecosystems, the synergistic agglomeration effects of elements, actors and innovation in the high-growth group continuously reinforced their relative development advantages and exhibited path dependence.

4.5.4 Venture Capital Investment Trends

The advantages of entrepreneurial ecosystems reinforced the geographical agglomeration of venture capital. Between 2010 and 2014, total investment funding in the YRD's medical industry expanded significantly, with the divergence between high-growth and low-growth cities intensifying further (Figure 4-9). The average number of investments in the high-growth group soared from 7.71 to 23.71, an increase of more than threefold, while the low-growth group only saw a modest rise from 1.32 to 2.21, with an overall investment base remaining low. However, the investment disparities within cities of the high-growth group also increased significantly, with a standard error of 24.25 in 2014, compared to 3.97 for the low-growth group. This indicated greater internal variation in the high-growth group but demonstrated a stronger overall capacity to attract capital, while the low-growth group, though comparatively more balanced, struggled to accumulate significant capital.

Further analysis at the city level shows that investments were increasingly concentrated in a few core cities. By 2014 Shanghai, Suzhou and Hangzhou had attracted 64, 50 and 25 investments respectively, accounting for approximately 67% of the regional total and forming a clear capital agglomeration effect. Other high-growth cities like Nanjing and Taizhou saw some growth, but their totals remained a long way below those of the top three. Among the low-growth group cities, only Wuxi saw an increase from 12 to 16 cases, accounting for 7.7%. Other cities such as Changzhou, Nantong and Ningbo made smaller breakthroughs, but their growth was generally limited, with many cities still seeing little to no inflow of venture capital during the research period. This shows that VC flows depend heavily on existing innovation foundations and industrial agglomeration effects, with the regional VC pattern concentrating increasingly in core cities.

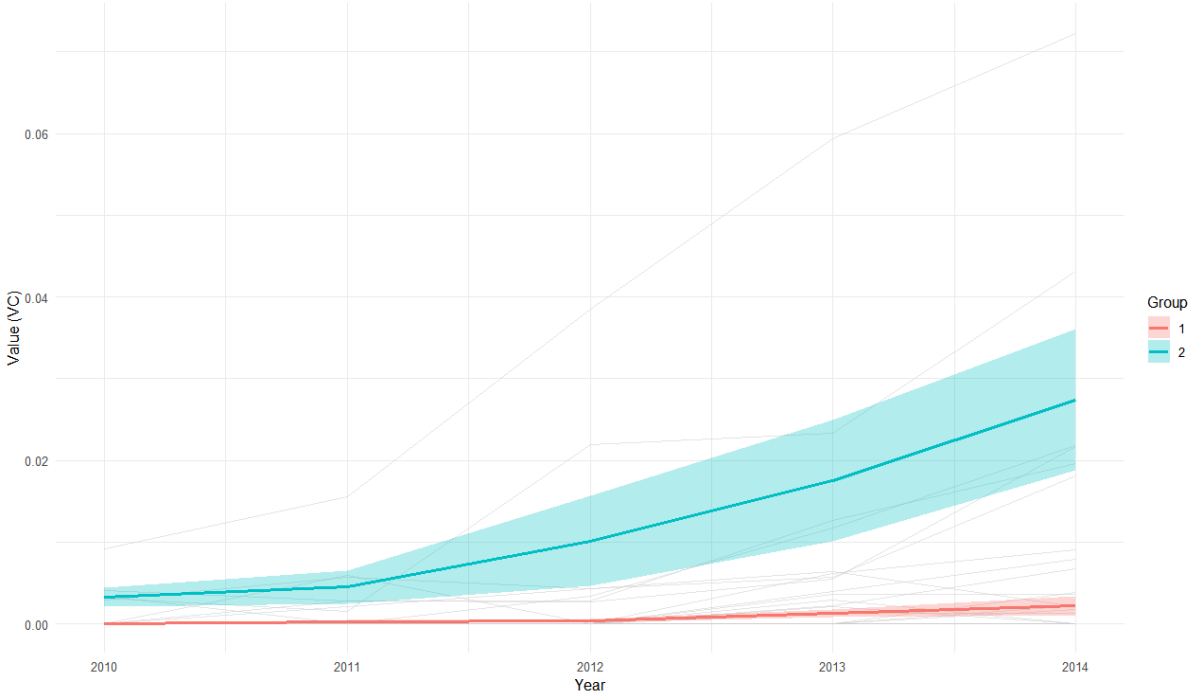

Figure 4-9: Changes in the number of venture capital investments and 95% confidence interval for different groups from 2010 to 2014 (Source: Qichacha)

4.6 Stage III (2015-2019): Market Reform and Innovative Drugs

4.6.1 Opportunity Spaces

Pressure from the changing social landscape intensified during this period. Firstly, following the universal adoption of medical insurance, the proportion of China's population aged 60 and above had increased by 5% over the decade, reaching 17.6% by 2019 (Figure 4-10). The continuously rising rate of ageing placed increasing pressure on the payment capacity of medical insurance. Secondly, the Chinese medical industry continued to face structural conflicts. On one hand, commercial bribery scandals involving large domestic and international medical companies were widely exposed during the previous phase, reflecting systemic irregularities within the industry, particularly in drug pricing, market access and physician promotion practices. On the other, lag times in the drug regulatory system posed a significant barrier to firms' innovation-driven transformation. Because of its imperfect approval system, the average approval cycle for clinical trials exceeded 1.5 years in 2015. Meanwhile, approval bottlenecks were exacerbated by incomplete or even fraudulent applications that weakened the competitiveness of innovative firms and significantly delayed technological progress. Thirdly, the outbreak of the US-China trade war in 2018 complicated the industry landscape further.

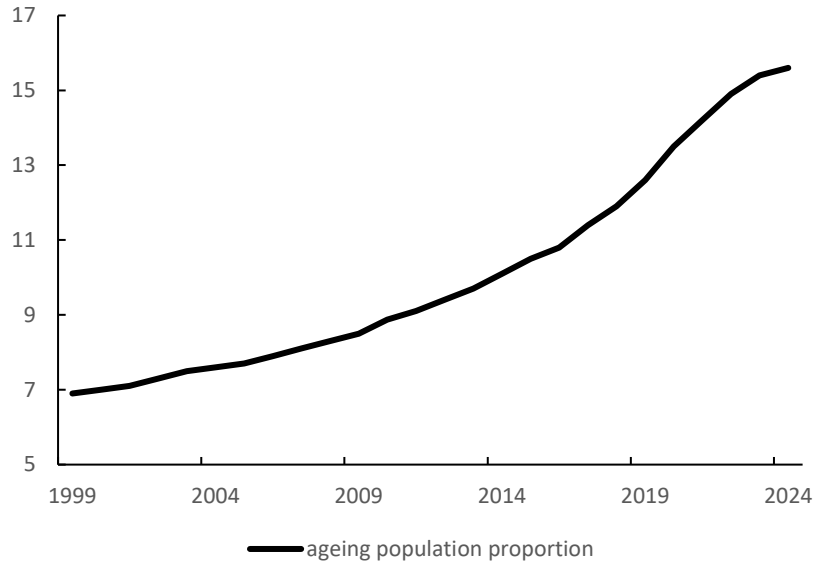

Figure 4-10: Proportional Trend of China's Population Aged 60 and Above (1999-2024, Source: United Nations)

During this period, China implemented a series of coordinated institutional reforms that improved the innovation efficiency of the medical industry and encouraged the development of a more innovative drug market. The reforms began by addressing deep-rooted issues in the regulatory system, particularly the backlog of drug registration applications and the widespread falsification of data. The 2015 "722 Incident" marked a turning point[1], as the new high-pressure regulatory environment eliminated fraudulent applications, shortening approval cycles from years to months and improving the credibility of the system. Innovators benefited from this streamlined process, enabling more efficient investment in drug R&D.

Another significant reform was the introduction of the Generic Drug Consistency Evaluation in 2016, which laid the foundation for a market share allocation system that was focused on quality (General Office of the State Council, 2016). This policy distinguished between generic and innovative drugs, improving the quality and efficacy standards for generics. By compressing the market share of low-quality generic drugs, it also forced smaller and less competitive firms out of the market. As a result of this reallocation, large firms with advanced technologies gained greater market space in the generics sector. This reform also provided pharmaceutical

[1] The "722 Incident" refers to the announcement by the National Medical Products Administration (NMPA) on July 22, 2015, entitled the Notice on Conducting Self-Inspection and Verification of Clinical Trial Data (Notice No. 117 of 2015). This notice required companies to rigorously self-inspect the authenticity of their clinical trial data. During the following months, regulatory authorities launched multiple rounds of unannounced inspections, imposing severe penalties for non-compliance to achieve the goal of standardising the industry.

companies with more stable cash flows while encouraging a strategic shift toward innovation-driven product markets.

The 2018 launch of the National Volume-Based Procurement (VBPT) reform reshaped the drug market (National Medical Products Administration, 2018). The pilot policy tested in Anhui in the initial phase was scaled up to the national level, and through centralised procurement and aggressive pricing competition, the government reduced the prices of conventional drugs significantly, with some experiencing price cuts of up to 93%. This lowered consumer healthcare costs substantially and alleviated the financial burden on medical insurance funds, improving drug accessibility for patients. The policy also had a significant impact on pharmaceutical manufacturers that lacked sufficient innovation capabilities, and their market space rapidly shrank. The VBPT reform encouraged pharmaceutical companies to shift from a scale-driven model to niche markets that were centred on innovation. However, the policy had its disadvantages, with critics arguing that excessive cost compression led to a decline in the quality of drugs included in the procurement.

Alongside healthcare reforms, significant institutional changes in the capital market during this period fuelled the medical industry's growth further. In 2018, China introduced several capital market innovations, including the Hong Kong Stock Exchange's (HKEX) Chapter 18A and the establishment of the STAR Market. These allowed unprofitable biotech firms to list in Hong Kong and Shanghai, opening critical financing channels for early-stage innovation projects, significantly improving primary market liquidity and boosting investor confidence by creating more predictable exit pathways. As a result, VC investment in the medical industry surged. The reforms created fertile ground for medical innovation, providing the medical industry with an opportunity to transition toward an innovation-driven path.

4.6.2 Policy and Institutional Change

During this phase, differences in policy approaches towards the medical industry among cities in the YRD became more pronounced. Firstly, core cities such as Shanghai and Suzhou gradually shifted their policy focus towards institutional innovation, specifically in terms of exploring reforms related to intellectual property and market access mechanisms. The most notable example of this was the pilot implementation of the Marketing Authorization Holder (MAH) system. For a long time, China's drug regulatory framework enforced a research-production integration policy which required the drug registration holder and manufacturer to be the same entity. This stifled the market-driven flow of technology and licences within the industry to some extent, limiting the flexibility of innovation actors. In 2016, Shanghai and Suzhou simultaneously launched MAH system pilots, allowing research institutions to hold drug

marketing authorisations and outsource production, thereby dismantling systemic barriers that has previously aligned research with manufacturing. In 2017, Shanghai also piloted the Medical Device Registrant system, which expanded the scope of institutional innovation. These measures marked a profound shift in the policy paradigms of both cities, moving from traditional industry-guided policies to institutional supply-oriented policies in a way that reflected their pioneering advantage in regional governance and the optimisation of their institutional environments.

Secondly, other relatively developed cities continued and deepened their efforts to nurture local industrial ecosystems. In 2016, Nanjing was approved as one of the first pilot cities for the National Health Commission's National Health and Medical Big Data Centre and Industrial Park, which aimed to build Asia's leading health and medical big data cluster, promoting technological integration and application expansion in related industries. In the same year, Hangzhou released its 13th Five-Year Plan for the Development of the Health Industry, explicitly outlining a systematic approach to healthcare services, pharmaceutical manufacturing and wellness industries. In 2017, Hangzhou relaunched the construction of the Pharma Port with the goal of establishing a regional hub for medical innovation. In 2018, the city issued the Implementation Opinions on Promoting the Innovative Development of the medical Industry in Hangzhou, providing comprehensive policy support for fiscal incentives, land resources, talent attraction and technology transfer. This reflected the city's holistic commitment to supporting innovation elements in the industry.

Thirdly, some less developed cities began to allocate policy resources selectively to the medical industry, striving to optimise industrial structures in order to achieve economic transformation. In 2015, the Ningbo municipal government collaborated with the Shanghai Institute of Materia Medica, Chinese Academy of Sciences, to establish the Ningbo Biomedical Industrial Park, which was put into operation as an initial regional platform for medical innovation. In the same year, Yangzhou established the Yangzhou High-Tech Zone Biomedical Health Industrial Park, and complemented this by hosting annual industry conferences to build local brands and improve its industry influence. In 2017, Wuxi partnered with AstraZeneca to build the Wuxi International Life Science Innovation Park, which focussed on developing an R&D incubation platform. In 2018, Ningbo introduced a series of new policies (Document No. [2018] 113), providing targeted financial support to companies that obtained innovative drug certifications, thereby accelerating the development and marketisation of innovative drugs by local enterprises.

Changes in environmental policy triggered structural transformations in cities with traditional medical industries, with Taizhou (Zhejiang) serving as a prime example. Since the 1990s,

Taizhou used its strategic infrastructural location and its robust chemical industry foundation to develop into a core production base for active chemical pharmaceutical ingredients and intermediates in China. However, the revised Environmental Protection Law of the People's Republic of China, enacted in 2015, introduced a daily continuous penalty mechanism that significantly increased the economic cost of environmental violations and put pressure on Taizhou's chemical pharmaceutical enterprises. Firms were compelled to expedite upgrades to environmental facilities or face the risk of market exit. In 2016, Zhejiang Province released the 13th Five-Year Plan for the Pharmaceutical Industry, encouraging the extension of active pharmaceutical ingredient (API) companies towards higher-value segments such as formulations, innovative drugs and medical devices. In 2018, the second round of central environmental inspections began, leading to all 33 enterprises in Taizhou's Jiaojiang District signing rectification agreements, while Linhai, Sanmen and other areas accelerated measures for phased closures and relocations. The intensification of environmental policies drove Taizhou's medical industry towards a strategic transformation from low-value to innovation-driven development.

4.6.3 Evolution of Entrepreneurial Ecosystems

From the perspective of ecosystem elements, high-growth cities continued to exhibit significant agglomeration effects between 2015 and 2019 in research, technological innovation and economic and public resource allocation. Although the per capita publication rate in the high-growth group declined slightly from 0.12 in 2015 to 0.09, it remained far above the low-growth group's increase from 0.01 to 0.02. Meanwhile, the number of technical patent grants in the high-growth group almost doubled, rising from an average of 0.47 to 0.90 (Nanjing 2.09, Hangzhou 1.71, Shanghai 1.51 and Suzhou 0.91) and significantly outpacing the low-growth group's 0.24. Regional economic and social resources also showed a continued divergence. The per capita GDP in the high-growth group rose from 117,900 yuan to 171,900 yuan (Suzhou 266,100 yuan and Shanghai 259,700 yuan), per capita hospital beds rose from 58.73 to 68.72 (Hangzhou 100.57 and Shanghai 93.04), and the number of university students per 10,000 people grew from 433.2 to 446.09 (Nanjing 1,236.47 and Hefei 696.42). In contrast, while the low-growth group saw growth in these indicators during the same period, it struggled to close the absolute gap between it and the high-growth group.

The high-growth group also exhibits more pronounced characteristics of path dependence. In per capita listed company density, the high-growth group rose from 0.0028 to 0.0056, while the low-growth group increased from 0.0022 to 0.0036, with the absolute gap beginning to widen. This reflected the high-growth group's growing capacity for capital return. Government support widened the gap further, with government R&D expenditure rising from 7.31 million yuan to

13.75 million yuan (Shanghai 26.52 million yuan, Suzhou 25.11 million yuan and Hangzhou 18.64 million yuan), while the low-growth group's increase from 4.14 million yuan to 6.89 million yuan was comparatively modest. Although the high-growth group saw varying degrees of decline in enterprise and multinational company density, their totals remained significantly higher than the low-growth group. Enterprise density, despite dropping from 0.086 to 0.068, was still 3.2 times higher than the low-growth group's 0.021, with Hangzhou, Suzhou and Shanghai maintaining high-density incubation environments. Meanwhile, per capita multinational company presence declined slightly to 0.027 in the high-growth group, compared to 0.011 in the low-growth group.

In terms of innovation output, the clinical trial volume in the YRD's medical industry continued to show a cumulative trend of reinforcement between the high- and low-growth groups. The high-growth group's average application volume surged from 0.024 in 2015 to 0.107 in 2019 (a 4.4-fold increase, with the standard error rising to 0.0893), indicating a sudden widespread growth within the group. In contrast, the low-growth group, while increasing from 0.002 to 0.009 (a nearly fourfold increase), maintained a lower absolute level and variability (with a standard error of 0.0095). In 2019, Shanghai (27.5%), Nanjing (23.2%) and Hangzhou (9.9%) continued to dominate regional clinical innovation, with Suzhou (9.7%) emerging as a new hub. However, apart from modest contributions from Changzhou, Wuxi and Shaoxing, most of the low-growth cities remained at zero applications. Overall, the innovation output advantage of the high-growth group continued to strengthen, and while there has been some progress in spillover and diffusions toward the low-growth group, it was difficult to bridge the regional development gap quickly.

4.6.4 Venture Capital Investment Trends

Venture capital investment in the medical industry in the Yangtze River Delta entered a period of rapid expansion from 2015 to 2019. Total investment funding increased significantly during the period and the differentiation between the high-growth group and the low-growth group intensified further (Figure 4-11). The average number of investments in high-growth cities soared from 34.43 in 2015 to 120.57 in 2019, an increase of more than 3.5-fold, while the low-growth group only rose from 2.68 to 7.21, a notable increase but still far below the high-growth group. In 2019, the standard error for the high-growth group reached 115.19, significantly higher than the low-growth group's 9.72, reflecting a growing trend of divergence in investments among core cities, with capital increasingly flowing to a few innovation hubs. The low-growth group, while relatively evenly distributed, struggled to form significant capital accumulation effects.

At the individual city level, Shanghai, Suzhou and Hangzhou solidified their positions further as regional investment centres for the medical industry. In 2019, these three cities attracted 329, 201 and 151 investments respectively, accounting for nearly 70% of the regional total and showing an increasingly pronounced capital agglomeration effect. In contrast, while other high-growth cities like Nanjing, Taizhou and Hefei saw incremental growth, it was far less than the top three. In the low-growth group, only a few economically stronger cities – including Wuxi, Nantong, Changzhou and Ningbo – sustained growth, while the rest remained almost entirely without venture capital inflows, staying on the periphery of investment. This shows that the investment pattern during this phase exhibited stronger path dependence, with a few core regions continuously absorbing resources, deepening regional imbalances further.

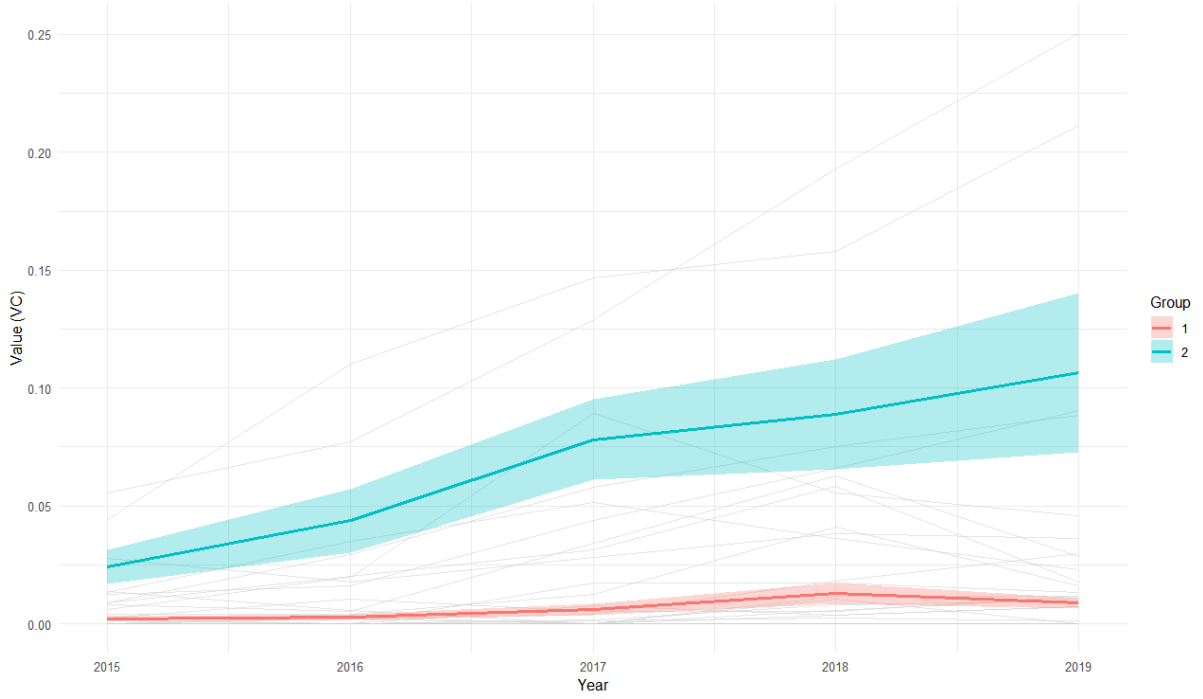

Figure 4-11: Changes in the number of venture capital investments and 95% confidence interval for different groups from 2015 to 2019 (Source: Qichacha)

4.7 Chapter Summary

This chapter has analysed the spatial evolution of venture capital and medical innovation in the Yangtze River Delta, addressing Research Question 1: "What are the characteristics of the spatial-temporal distribution and phased development of venture capital in the medical industry of the Yangtze River Delta?" The findings show that capital supply is dispersed, while management is highly centralized, with investment concentration higher for GPs than for LPs. After 2006, the concentration of medical innovation decreased, and this was synchronized with GP concentration. Although interactions between subsystems within cities have strengthened, overall coordination remains weak, with only Shanghai achieving high levels of coupling and

coordination. The YRD has formed a pattern with Shanghai as the innovation core, Jiangsu as the production base, Zhejiang as the service centre and Anhui as the manufacturing support. Shanghai leads in the number of enterprises and clinical trial approvals, while Nanjing and Hangzhou represent innovation hubs. Regional innovation divergence is clear, and is categorized into high-growth cities (Shanghai, Nanjing, Hangzhou and Suzhou) and low-growth cities (Anqing, Wuxi and Ningbo), exhibiting path dependency characteristics.

The study divided the development of the YRD's medical industry into three phases. The first of these was 2001-2009, the foundational phase in which national healthcare coverage expansion drove Shanghai and Suzhou to aggregate innovation resources through policies and industrial parks, widening the gap with other cities. The second was 2010-2014, marked by the rise of generic drug development in which population aging and healthcare reforms provided new opportunities, with Shanghai emphasizing market orientation and Suzhou strengthening its innovation ecosystem, leading to a concentration of innovation and venture capital in high-growth cities. The third phase was 2015–2019, characterized by the rapid development of innovative drugs, where drug review and capital market reforms facilitated firms' transition from imitation to innovation. Shanghai and Suzhou moved towards institutional innovation, while Nanjing and Hangzhou accelerated industrial ecosystem development. The capital intensification and concentration effect was evident in high-growth cities, while low-growth cities remained on the margins. Regional development showed an evolutionary trajectory from differentiation to agglomeration, and from there to greater path dependence.

Overall, the pattern of venture capital intervention in the region is reflected in the medical industry of the Yangtze River Delta. From 2001 to 2009, the scale of regional VC was limited, and it was generally in a wait-and-see state. Although the high-growth group began to receive investments of VC during this period, the number was small, while the low-growth group received almost no venture capital investment at all. However, venture capital investment in the region expanded rapidly from 2010 onwards. Benefiting from the local entrepreneurial ecosystem, Shanghai, Suzhou and Hangzhou consistently accounted for roughly 70% of the total regional investment share, with VC tending to concentrate in high-growth group cities, leading to the accumulation of regional capital and enterprises. For the low-growth group, although most cities remained outside the scope of venture capital, signs of diffusion began to emerge, and a small number of cities, supported by regional governments, saw gradual increases in venture capital investment, which grew more quickly after 2015. Combined with regional characteristics, this shows that the medical industry in the Yangtze River Delta was in a phase of accelerated development from 2010 to 2019. During this process, there was some degree of co-location between VC and regional industries, with some cities exhibiting the characteristics of co-evolution. In the following chapter, I will therefore conduct a quantitative

analysis of this period to examine the effectiveness of VC in the Yangtze River Delta's medical industry.

Chapter 5 Quantitative Analysis of Venture Capital and Path Creation

5.1 Introduction

Following the previous chapter's exploration of the evolutionary characteristics of the medical industry in the Yangtze River Delta, this chapter will analyse whether venture capital promotes corporate innovation and examine its impact on regional path creation. The analysis uses panel data from enterprises in the Chinese medical industry between 2010 and 2019 covering a total of 5,111 observational samples. The data includes enterprise financing records, clinical trial conditions and enterprise characteristics, as well as indicators of the regional entrepreneurial ecosystem. The analytical approach uses a high-dimensional fixed effects regression model combined with propensity score matching (PSM) to address issues of endogeneity and improve the robustness of causal inference. Specifically, the analysis examines the impact of VC on enterprises' clinical trials to confirm a potential causal relationship between the two, validating the lagged effects and regional variations of venture capital and revealing the relationship between different types of venture capital and corporate innovation. The study also investigates the contribution of VC to various aspects of regional path creation at the regional level.

5.2 Empirical Analysis

5.2.1 Data and descriptive statistics

In this study I constructed variables to explore the impact of VC on healthcare firms (Table 5-1). All data, apart from binary variables, were logarithmically transformed (with a +1 adjustment for values between 0 and 1). I included the cumulative number of clinical trials in the next three years, two years and one year (ln_Clinic_t3, ln_Clinic_t2 and ln_Clinic_t1) as response variables, with total investment funding (ln_InvSize) as the core explanatory variable. I incorporated the number of financing rounds (ln_round), whether the firm received venture capital (hasVC), and policy impact (the interaction term between policy and investment funding, invsize_policy). I also introduced a set of dummy variables, including local investment presence (hasLocal), syndicated investment (hasSynd), and government venture capital (hasGVC).

The model controlled for a series of firm-level and city-level variables to improve the robustness of the results and address endogeneity. At the firm level, I included variables such as patent ownership (hasPatent), firm size (ln_captl) and prior clinical trial applications (past_clinic) to

reflect the firm's technological capability and scale. At the city level, I considered regional technological resources and economic development conditions, including technical knowledge density (ln_tik), scientific knowledge density (ln_sik), hospital bed density (ln_hospital), per capita GDP (ln_gdp), private sector labor share (ln_private), university student density (ln_students), startup density (ln_startups), listed company density (ln_pubFirms), multinational company density (ln_mnc) and local government expenditure level (log_gov). These variables capture differences in firm characteristics and regional ecosystems from various dimensions to facilitate a more nuanced depiction of regional attractiveness for entrepreneurial investment as well as the external conditions for firm growth. Table 1 shows the statistical summary for each variable, and Appendix C presents the collinearity relationships among the variables.

Table 5-1: Descriptive statistics of the variables

	Variable	Obs	Mean	Std. dev.	Min	Median	Max
Firm level	ln_Clinic_t3	5,111	0.201	0.537	0	0	4.489
	ln_Clinic_t2	5,111	0.140	0.443	0	0	4.394
	ln_Clinic_t1	5,111	0.074	0.312	0	0	3.526
	ln_InvSize	4,754	0.030	0.211	0	0	3.296
	hasVC	5,111	0.213	0.410	0	0	1.000
	ln_round	5,111	0.181	0.367	0	0	1.792
	invsize_policy	4,754	0.030	0.210	0	0	3.296
	hasLocal	5,111	0.036	0.186	0	0	1.000
	hasSynd	5,111	0.125	0.331	0	0	1.000
	hasGVC	5,111	0.019	0.137	0	0	1.000
	hasPatent	5,111	0.185	0.388	0	0	1.000
	ln_captl	5,111	6.953	2.078	0	0	13.105
	past_clinic	5,111	0.029	0.167	0	0	1.000
City Level	ln_gdp	5,111	2.700	0.478	0.670	2.796	3.318
	ln_students	5,111	0.268	0.154	0.016	0.246	0.693

ln_hospital	5,111	0.095	0.046	0.028	0.094	0.670
log_gov	5,111	10.041	1.063	6.836	9.999	11.818
ln_startups	5,111	0.653	0.311	0.038	0.718	1.044
ln_pubfirms	5,111	0.003	0.002	0	0.001	0.013
ln_tik	5,111	0.259	0.203	0	0.209	0.693
ln_sik	5,111	0.403	0.374	0	0.371	1.390
ln_mnc	5,111	0.038	0.022	0	0.043	0.068
ln_private	5,111	0.338	0.134	0.006	0.341	0.562

Figure 5-1 shows that the total investment count and total investment amount in the YRD's medical industry during the observation period showed a clearly staged upward trend across different years, reflecting the gradual increase in regional entrepreneurial investment activities over time. It should be noted that because some investments did not disclose their amounts, there are 357 missing values for investment amounts among the observations. The missing proportion makes up roughly 7%, and does not affect the analysis. From 2010 to 2014, the regional investment frequency remained steady at around 10 times per year, with investment amounts ranging from 100 to 300 million yuan, indicating an overall low level of activity and a limited supply of capital. In 2015, investment entered a rapid development phase, with investment frequency surging to 78 times and investment amounts reaching 870 million yuan. During the next few years, investment frequency and amounts continued to rise. In 2018, the investment count peaked at 153, with a total investment amount of 18.6 billion yuan.

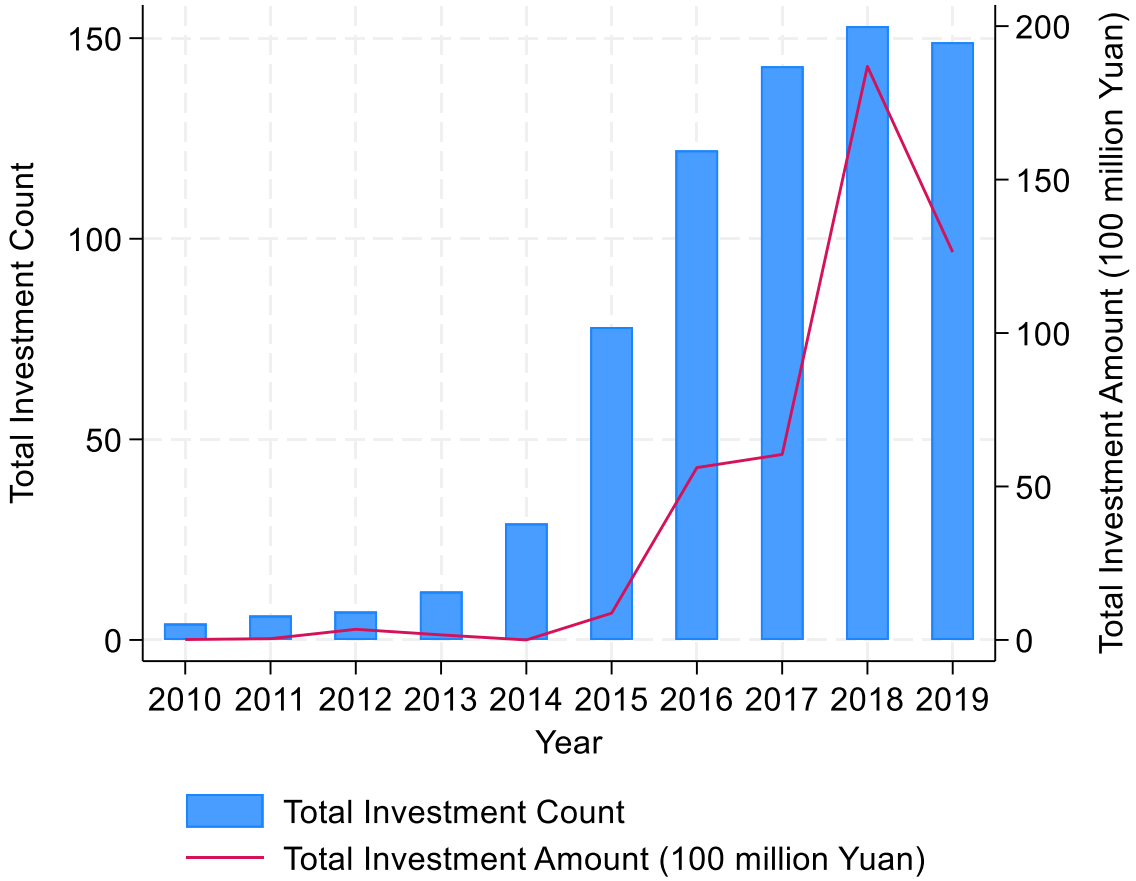

Figure 5-1: Trends of total Investment Count and total Investment Amount by Year from 2010 to 2019 (Source: Qichacha)

From the perspective of total investment count and average investment amount across different rounds of financing (Figure 5-2), financing exhibited a regular pattern of decreasing quantity and funding. The first round of financing was the most common, occurring 437 times with an average investment amount of 79.6 million yuan per round, suggesting that early-stage financing is dominated by smaller investments. As financing rounds progress, the frequency of investments decreases, with 178 instances in the second round and 65 in the third. However, the average investment amount rises significantly and stabilizes at around 150 million yuan. By the fourth and fifth rounds, the frequency of investments drops sharply to 18 and 4 instances respectively, while the average investment amounts increase to 342.1 million yuan and 855.6 million yuan respectively. As project certainty improves and ventures enter a scaling phase coupled with valuation inflation, the scale of later stage investment fundings grows significantly, with individual investment amounts steadily increasing.

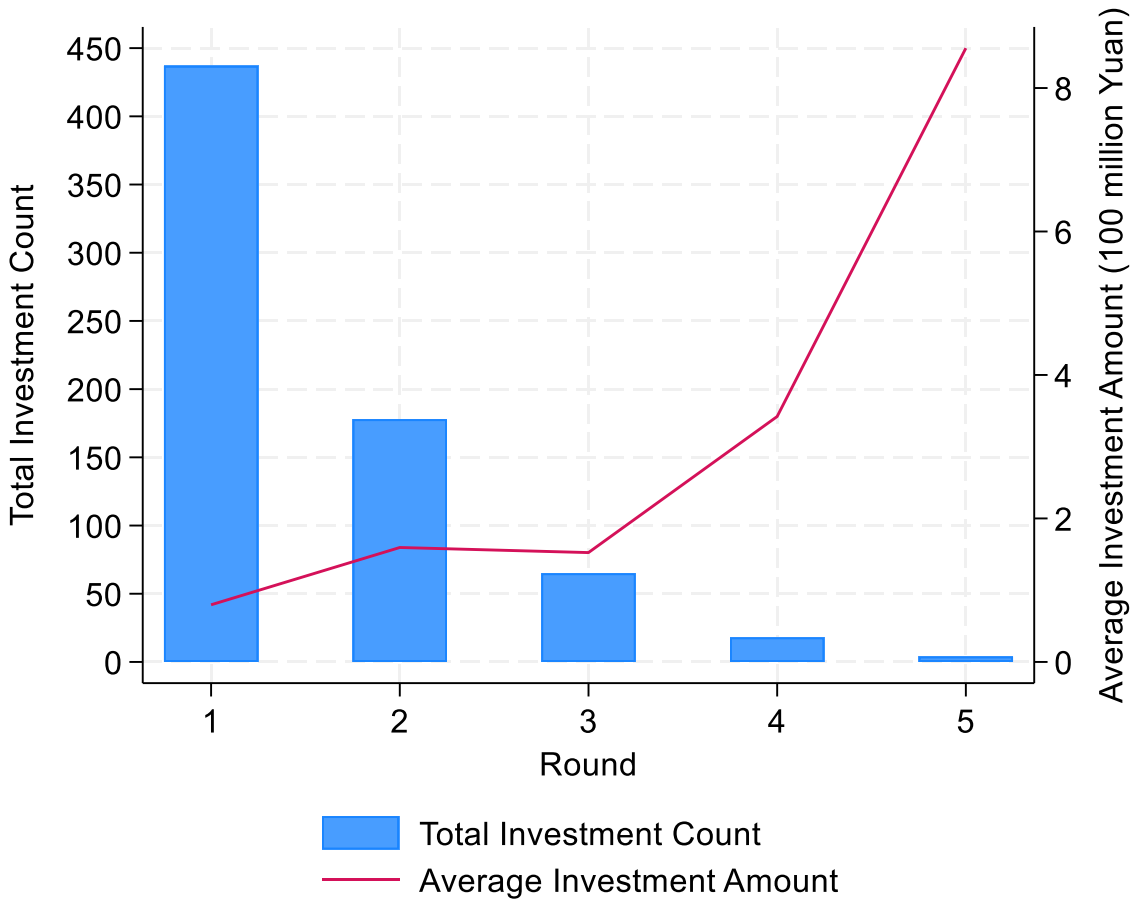

Figure 5-2: Changes in total investment count and Average Investment Amount by Financing Round (Source: Qichacha)

From the perspective of financing characteristics by firm size, small firms significantly outperformed large firms in total investment frequency and average investment amount, showing a phenomenon that contradicts traditional capital allocation expectations (Figure 5-3). According to Announcement No. 12 of 2023 by China's Ministry of Finance and State Taxation Administration, the total asset value of small and micro enterprises must be less than 50 million yuan. Because of the extremely limited disclosure of data for non-listed enterprises, the registered capital is used here as a proxy for total asset value. In specific terms, small firms recorded a total investment frequency of 1,992, markedly higher than the 884 for large firms, indicating a capital market preference for smaller enterprises. However, the average investment amount per transaction for small firms was only 3 million RMB, far below the 23 million RMB for large firms, which suggests that while the capital market in the medical industry strongly supports large firms, small firms face disadvantages in securing larger individual investment amounts.

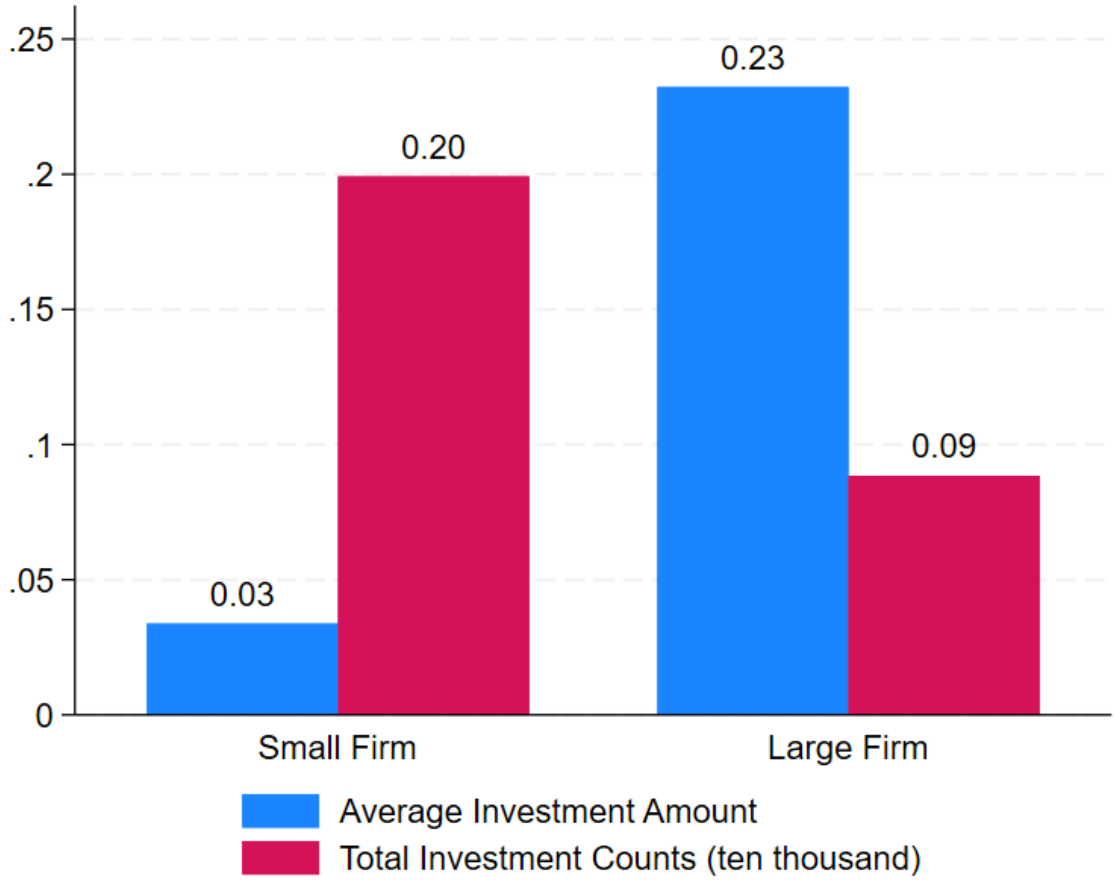

Figure 5-3: Comparison of Average Investment Amount and Total Investment Frequency by Firm Size

5.2.2 Empirical setups

5.2.2.1 High-Dimensional Fixed Effects Panel Model

In this study, a high-dimensional fixed effects regression model was employed as part of the empirical setup, focusing on firms in order to examine the impact of VC on the number of clinical trials from 2010 to 2019. The analysis also explores the relationship between VC and firm innovation based on the stages and regional divisions outlined in Chapter 4. As such, the empirical regression model is as follows:

$$Y_{ict} = \beta X_{ict} + \gamma C_{ict}^{T} + \alpha_i + \delta_c + \mu_t + \omega_{ict}$$

Where Y_{ict} represents the response variable for firm i in city c at year t, with the nominal total investment funding for that year as the core variable. The impact of inflation is consistent across all years in the sample and has been absorbed by the time fixed effects. To improve the robustness of estimation, the study also included the number of clinical trials lagged by one and two years as alternative dependent variables.

X_{ict} denotes the observed variables for firm i in city c at year t, with the core variable being the investment funding received during that year. In the robustness analysis, the study includes whether financing was received in the given year (a binary variable), the number of financing rounds and interaction terms with policy as alternative independent variables. I also introduced heterogeneity analysis here to show whether local investors, syndication or government venture capital are involved.

C_{ict}^{T} represents a set of control variables that include firm-level factors such as patents, firm size and R&D activities, as well as city-level entrepreneurial ecosystem characteristics. α_i, δ_c, and $\mu_t$represent firm, city, and year fixed effects respectively. ω_{ict} is the robust variance clustered at the firm level.

To improve the robustness of the results and identify the causal relationship between VC and firm innovation, the study incorporated PSM analysis for validation.

5.2.2.2 PSM Matching Analysis

This study was based on a core hypothesis that VC investment is a primary driver of changes in firms' innovation capabilities. PSM was used to test this hypothesis (Dehejia and Wahba, 2002; Leuven and Sianesi, 2003). If a firm belongs to the treatment group (i.e., it received VC investment), the dependent variable is assigned a value of 1; otherwise, it is 0 (Rosenbaum and Rubin, 1983). All the firms that received no VC investment were used as the control group.

This study's matching characteristics are based on firm and city levels. At the firm level, patent ownership, firm size and prior clinical trial experience directly reflect a company's capabilities in technological innovation and capital resources (Balachandran, 2024; Lin, 2020). Firms with patents and prior clinical experience are more likely to attract investor favour, while larger capital funding influences project execution efficiency (Hoenig and Henkel, 2015). These factors affect the likelihood of obtaining venture capital and determine the potential for conducting clinical trials within the next three years.

At the city level, technical knowledge density, scientific knowledge density, hospital bed density, per capita GDP and local government expenditure level collectively constitute innovation capacity, market potential and policy support strength (Cui et al., 2024; Gai et al., 2024; Zhang et al., 2024). Meanwhile, private sector labour share, university student density, startup density and listed company density reflect local market vitality and the supply of talent and enterprises (Kim, 2023; Nguyen et al., 2021; Fritsch and Schroeter, 2011; Cho et al., 2022). These regional level characteristics influence the regional layout decisions of venture capital institutions and the likelihood of firms to conduct clinical trials through medical resources and policy support. Incorporating these variables into propensity score matching helps to eliminate

potential common drivers in financing and innovation, thereby identifying the causal effect of venture capital on clinical activities more reliably. Specifically, the propensity score model is specified as follows:

$$logit(e_i) = \alpha + \beta X_{i,t-1}^{T}$$

The propensity score $e_i = P\left(D_{i,t} = 1 \middle| X_{i,t-1}\right)$ represents the probability of firm i receiving VC investment in year t, given a set of firm- and regional-level covariates $X_{i,t-1}$. To address the issue of reverse causality, I took the year of each firm's first financing and used the preceding year as the matching baseline period. The model was estimated only on observations that could be successfully merged with lagged covariates to ensure that the calculation of propensity scores was not affected.

Within the common support interval, I implemented radius matching with a calliper of 0.0001 for the treatment group and the control group based on propensity scores, with no replacement to minimise matching bias. After matching, balance tests such as standardised mean differences were used to assess the distribution of covariates between the treatment and control groups before and after matching. The matching design was considered valid only when all key covariates achieved a balance level of 0.05 after matching (Rosenbaum and Rubin, 1983). The matching results were used to estimate the Average Treatment Effect (ATE), directly measuring the causal effect on innovation activity indicators of receiving venture capital financing (e.g. ln_Clinic_t1, ln_Clinic_t2, ln_Clinic_t3).

5.2.3 Propensity Score Matching

To check the balance between the treatment and control groups, I calculated the mean differences before and after obtaining venture capital. The total sample size was 5,111. After matching, the treatment group consisted of 521 samples, and the control group consisted of 521 samples. The unmatched samples totalled 4069. Figure 5-4 shows that the treatment and control groups were largely balanced in terms of observable pre-treatment characteristics. After matching, the differences in observable characteristics were reduced significantly and were no longer statistically significant, indicating that the matching process had effectively reduced biases related to these characteristics.

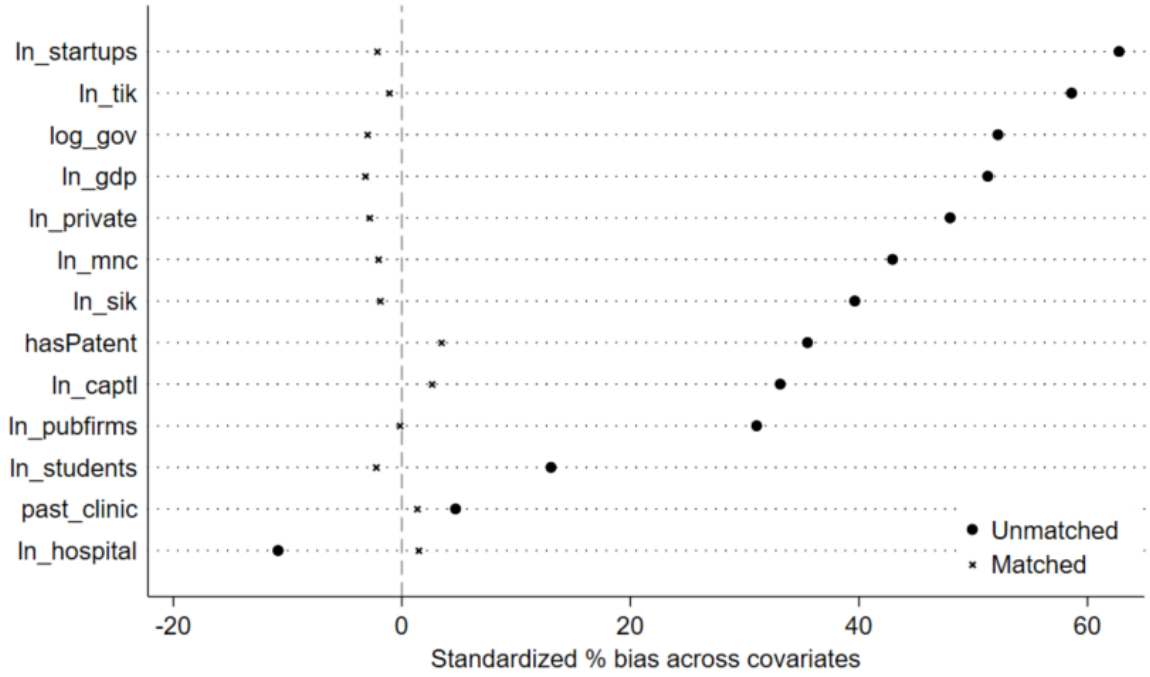

Figure 5-4: Matching Quality Assessment

I used 1:1 nearest neighbour matching with a calliper restriction, setting the calliper distance to 0.01 and ensuring that matched control samples could not be reused for other treatment samples. Further results show that PSM successfully aligned the propensity score distributions of firms in the treatment and control groups. To demonstrate the effectiveness of PSM visually, Figure 5-5 shows the propensity score distributions of the two groups. The figure clearly shows sufficient overlap in the propensity score distributions between the treated and untreated groups, with consistent trends and density peaks, thus satisfying the assumption of common support.

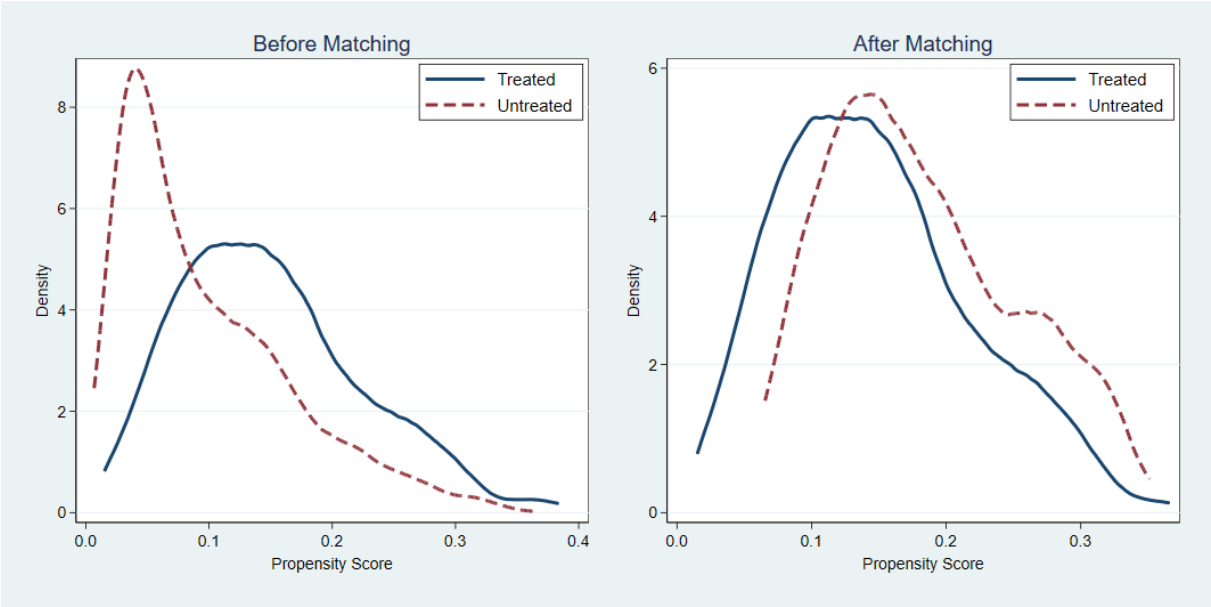

Figure 5-5: Propensity score kernel density curve before and after matching

Table 5-2 summarizes the mean values and balance test results for multiple firm- and region-level covariates in 2011 for the treatment and control groups. The table shows the percentage bias, t-statistics and corresponding two-tailed significance levels for the unmatched and matched stages. The matching process eliminated extreme observations with no overlap, and the analysis was conducted by sorting propensity scores from high to low in order to control further for minor differences due to matching order.

The matching results show that in the unmatched stage (U), the treatment group significantly outperformed the control group in indicators such as economic scale, government size, high-growth firms, large firms, technology and service intensity and private sector economy, indicating a more favourable entrepreneurial environment for the treatment group in 2011. After matching (M), these biases were substantially reduced, and t-tests were no longer significant, showing that the matching process successfully eliminated systematic differences in key covariates between the two groups. Overall, after matching in 2011 the treatment and control groups achieved statistical balance on the covariates listed in Table 2, effectively ruling out confounding factors and providing a more reliable estimation of the causal relationship between venture capital investment and clinical trials.

Table 5-2: Difference in means between treated and control group in 2011

	Unmatched	Mean	t-test

Variable	Matched	Treated N = 420	Control N = 1142	%bias	t	p>t
hasPatent	U	0.320	0.170	35.5	8.46	0.00
	M	0.315	0.424	-25.8	-2.38	0.02
ln_captl	U	7.537	6.886	33.1	6.83	0.00
	M	7.511	7.582	-3.6	-0.39	0.70
past_clinic	U	0.036	0.028	4.7	1.08	0.28
	M	0.036	0.023	7.8	0.78	0.44
ln_gdp	U	2.900	2.677	51.3	10.21	0.00
	M	2.897	3.011	-26.3	-3.25	0.00
ln_students	U	0.285	0.266	13.0	2.72	0.01
	M	0.286	0.303	-11.3	-1.25	0.21
ln_hospital	U	0.091	0.095	-10.8	-2.01	0.05
	M	0.091	0.092	-3.1	-0.43	0.67
log_gov	U	10.511	9.987	52.2	10.80	0.00
	M	10.503	10.698	-19.4	-2.20	0.03
ln_startups	U	0.811	0.635	62.8	12.54	0.00
	M	0.810	0.904	-33.4	-4.12	0.00
ln_pubfirms	U	0.004	0.003	31.0	6.43	0.00

	M	0.004	0.004	-9.9	-1.13	0.26
ln_tik	U	0.361	0.248	58.6	12.35	0.00
	M	0.360	0.417	-29.2	-3.25	0.00
ln_sik	U	0.533	0.388	39.6	8.48	0.00
	M	0.533	0.630	-26.3	-2.78	0.01
ln_mnc	U	0.046	0.037	42.9	8.78	0.00
	M	0.046	0.049	-15.2	-1.76	0.08
ln_private	U	0.392	0.332	48.0	9.87	0.00
	M	0.392	0.428	-29.3	-3.32	0.00

I then conducted a balance test on the matching results (Table 5-3). This included clinical trials for the next 1, 2 and 3 years. The results show that overall, the number of clinical trials in the treatment and control groups increased as the lag time extended, with significance levels reaching 1%. The coefficient of the effect of venture capital increased from 0.097 to 0.195, and further to 0.274.

Table 5-3: Average Treatment Effect on the Treated Group

Variable	Difference	S.E.	T-stat
ln_Clinic_t1	0.097***	0.011	9.20
ln_Clinic_t2	0.195***	0.043	4.59
ln_Clinic_t3	0.274***	0.061	4.48

To examine the dynamic effects before and after venture capital investment further, I used an event study design and restricted the sample to a relative event window of [-4, +3] years, with k

= -1 as the baseline period in order to analyse relative change trends. To better observe changes before and after the event window, I limited the observation period to 2012-2017. The regression equation used was as follows:

$$\ln\left(Clinic_{i,c,t}^{3}\right) = \sum_{k=-4, i\neq -1}^{3} \beta_k D_{i,c,t}^{k} + X_{i,c,t}\beta_X + \gamma_i + \delta_c + \vartheta_t + \varepsilon_{i,c,t}$$

Here, the response variable $Clinic_{i,c,t}^{3}$ represents the number of clinical trials of firm i in region c during year t. $D_{i,c,t}^{k}$ is a dummy variable for event time k. β_k measures the impact of the financing event on entrepreneurial output in the k year before and after the event. In the analysis, I control for firm, region, year, and industry fixed effects through $X_{i,c,t}$. All variables are transformed using the natural logarithm (ln). Additionally, I cluster standard errors by firm, region, and year—corresponding to γ_i, δ_c, and ϑ_t, respectively—to obtain robust standard errors. $\varepsilon_{i,c,t}$ denotes the error term. Figure 5-6 shows that before receiving venture capital, firms' clinical trial activity was generally lower than the baseline year, but after investment clinical trials increased steadily. This further confirms the positive impact of venture capital on the innovation activities of medical firms.

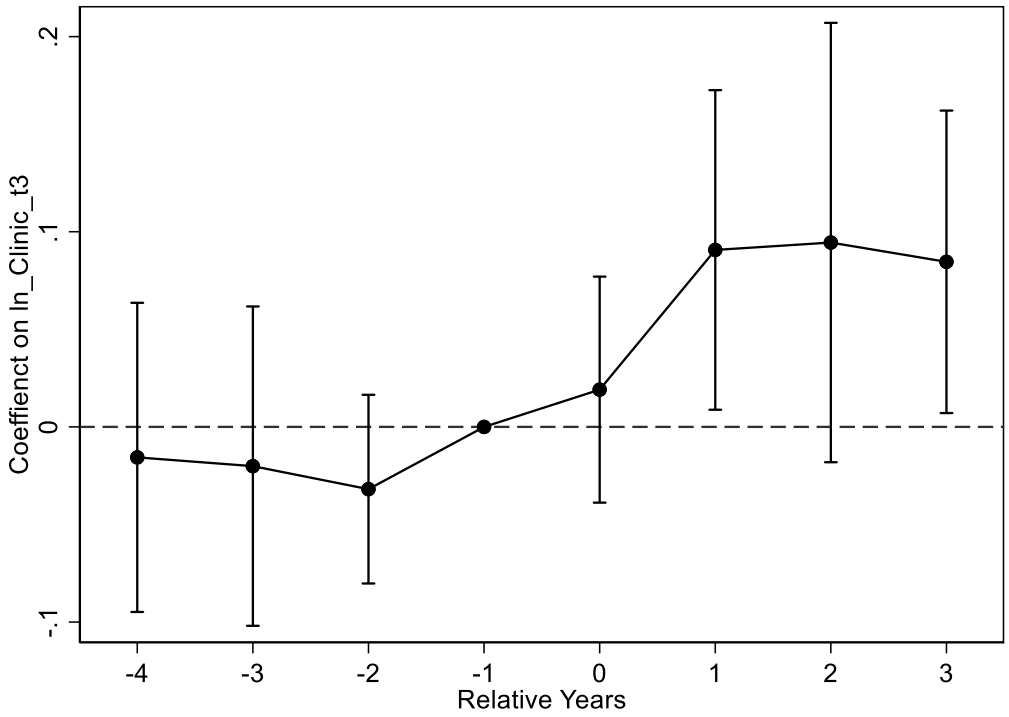

Figure 5-6: Impact of Venture Capital Investment on the Number of Firm Clinical Trials

Note: Firms that did not receive venture capital investment serve as the control group. Standard errors are at the 90% confidence interval, with estimated values relative to the baseline year.

5.2.4 Regression Analysis

Table 5-4 shows the regression results for the number of clinical trials (ln_Clinic_t3) conducted by firms over the next three years from 2010 to 2019. Three models (columns 1 to 3) progressively incorporate firm-level and regional-level control variables to examine the relationship between various factors and clinical trials. Column 1 includes only the core firm-level variable "total investment funding"; column 2 adds firm characteristic variables and column 3 expands to include a full set of regional-level controls.

It should be noted that because of missing data on investment amounts in the original dataset, this study applied sample selection processing when calculating the investment funding variable. Firstly, firms with available investment amount data were identified, and all years of data for these firms were retained. Secondly, for firms that received no investment, all years of their data were also retained. An analysis was then conducted on the combined sample of these two groups to ensure the explanatory power and consistency of the investment funding variable. This approach partially mitigated sample selection bias due to missing data and improved the robustness of the empirical results.

From the regression results shown in column 1, the investment funding is significantly positively correlated with the number of clinical trials in the next three years, with a coefficient of 0.136, which is significant at the 1% level ($p<0.01$). After including firm-level control variables in column 2, the venture capital variable coefficient decreases to 0.131 but remains significant at the 1% level ($p<0.01$). The further inclusion of regional-level control variables in column 3 resulted in a coefficient of 0.124, significant at the 5% level ($p<0.05$). These results support the hypothesis that VC promotes firms' R&D investment and facilitates clinical trials by providing funding.

Three control variables were included in column 2: patent ownership (hasPatent), firm size (ln_capital) and clinical trial approval records for the past three years (past_clinic). The results showed that the patent ownership variable had a coefficient of 0.078, significant at the 10% level ($p<0.1$); the firm size coefficient is 0.0302, which was not significant, and the past three years' clinical trial approval records have a coefficient of 0.307, significant at the 5% level ($p<0.05$). This demonstrates that a firm's prior success in clinical trials significantly predicts its future clinical activity, while patent ownership to some extent suggests the likelihood of future clinical trials, while firm size does not reflect the ability to conduct future clinical trials.

Column 3 further introduced a series of regional-level variables to examine the impact of regional characteristics on firm innovation activities. The results show that the regional scientific knowledge stock (ln_sik) has a coefficient of −0.264, which is significant at the 5%

level (p<0.05), and the regional technical knowledge stock (ln_tik) has a coefficient of 0.651, which is significant at the 5% level (p<0.05). These results suggest that while regions with higher levels of scientific research do not drive firms' clinical trials directly, they are more likely to be related to regional technical reserves. The per capita GDP (ln_gdp) has a coefficient of −0.0990, significant at the 5% level (p<0.05), indicating that economically developed regions do not correspond to more clinical trial activities. Meanwhile, other regional variables (such as the number of regional students, private enterprises, listed companies, hospital beds, multinational companies and government fiscal expenditure) do not significantly affect the number of clinical trials in the model.

Table 5-4: The relationship between venture capital investment funding and firms' clinical trial approvals (over the next three years) during 2010 to 2019.

	(1)	(2)	(3)
VARIABLES	ln_Clinic_t3	ln_Clinic_t3	ln_Clinic_t3
ln_InvSize	0.136***	0.131***	0.124**
	(0.0466)	(0.0458)	(0.0455)
hasPatent		0.0780*	0.0779**
		(0.0397)	(0.0363)
ln_captl		0.0302	0.0349
		(0.0226)	(0.0232)
past_clinic		0.307**	0.287*
		(0.147)	(0.147)
ln_gdp			-0.0990**
			(0.0449)
ln_students			0.638
			(0.494)
ln_hospital			0.0895

			(0.277)
log_gov			0.201
			(0.120)
ln_startups			0.328
			(0.352)
ln_pubfirms			-4.113
			(7.018)
ln_tik			0.651**
			(0.286)
ln_sik			-0.264**
			(0.0953)
ln_mnc			-2.734
			(4.751)
ln_private			-0.0908
			(0.141)
Year	YES	YES	YES
Firm	YES	YES	YES
Industry	YES	YES	YES
City	YES	YES	YES

Constant	0.197***	-0.0364	-2.112*
	(0.00142)	(0.160)	(1.211)
Observations	4,631	4,631	4,631
R-squared	0.748	0.755	0.759

Robust standard errors in parentheses

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

Table 5-5 shows the regression results of total investment funding (ln_InvSize) on the number of clinical trials in the next 1 year (ln_Clinic_t1) and 2 years (ln_Clinic_t2). The results demonstrate that totazl investment funding is significantly associated with the clinical trials at both time horizons. For the next year, the coefficient is 0.0989, which is significant at the 5% level, and for the next 2 years, the coefficient increases to 0.180, which is significant at the 1% level. Combined with the main regression results, this indicates that venture capital investment effectively increases firms' clinical activities in the subsequent period.

Table 5-5: The relationship between venture capital financing and firms' clinical trial approvals in the next 1 and 2 years during 2010 to 2019

	(1)	(2)
VARIABLES	ln_Clinic_t1	ln_Clinic_t2
ln_InvSize	0.0989**	0.180***
	(0.0415)	(0.0475)
Year	YES	YES
Firm	YES	YES

Industry	YES	YES
City	YES	YES
Constant	-0.860	0.235
	(0.968)	(1.698)
Observations	4,631	4,631
R-squared	0.623	0.682

Robust standard errors in parentheses

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

5.2.5 Heterogeneous Analysis

Table 5-6 shows the regression analysis results of firms' venture capital financing on the number of clinical trials in the next 3 years between 2010 and 2019. The core explanatory variables include whether financing was obtained (hasVC), the number of financing rounds (ln_round) and policy impact (invsize_policy). Here, the policy impact was expressed through its interaction term with total investment funding. The results show that in column 1, obtaining financing was positively associated with the clinical trials and was significant at the 1% level (with a coefficient of 0.0534, $p < 0.01$), indicating that firms with financing conduct more clinical trials. In column 2, the number of financing rounds was significantly positively correlated with the number of clinical trials in the next 3 years at the 10% level (with a coefficient of 0.131, $p < 0.1$), suggesting that more financing rounds increase the likelihood of conducting clinical trials.

Table 5-6: Regional heterogeneity analysis of the impact of binary variable, financing rounds, policy impacts on firms' clinical trial approvals (next three years) from 2010 to 2019

	(1)	(2)

VARIABLES	ln_Clinic_t3	ln_Clinic_t3
hasVC	0.0534***	
	(0.0182)	
ln_round		0.131*
		(0.0642)
Year	YES	YES
Firm	YES	YES
Industry	YES	YES
City	YES	YES
Constant	-1.912*	-1.739
	(1.108)	(1.070)
Observations	5,002	5,002
R-squared	0.755	0.757

Robust standard errors in parentheses

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

Table 5-7 presents the regression analysis results of policy interaction terms on the number of clinical trials in the next three years from 2010 to 2019. The analysis includes interaction terms

for policy with total investment funding, whether an investment was received and the financing round. The results show that after the 2015 clinical application system reform, companies receiving VC investment showed a significant increase in clinical activities over the following three years. This validates the PSM results further and indicates that the policy improved the positive impact of VC on firms' clinical activities. However, it should be noted that the interaction terms for policy with investment funding and financing round were not significant. This means that after the institutional reform, increasing investment funding or participating in later-stage financing did not guarantee more clinical activities for projects.

Table 5-7: Relationship Between Policy Interaction Terms and Corporate Clinical Trials (Next 3 Years) between 2010 and 2019

	(1)	(2)	(3)
VARIABLES	ln_Clinic_t3	ln_Clinic_t3	ln_Clinic_t3
ln_InvSize	-1.291		
	(0.900)		
invsize_policy	1.429		
	(0.946)		
hasVC		-0.142	
		(0.0936)	
hasVC_policy		0.219**	
		(0.0970)	
ln_round			0.0536
			(0.0661)
round_policy			0.0790
			(0.0652)
Year	YES	YES	YES

Firm	YES	YES	YES
Industry	YES	YES	YES
City	YES	YES	YES
Constant	-1.983	-1.813	-1.705
	(1.222)	(1.162)	(1.072)
Observations	4,631	5,002	5,002
R-squared	0.763	0.757	0.757

Table 5-8 shows the relationship between venture capital investment (ln_vcFin) and the number of clinical trials in the next 3 years from 2010 to 2019, with separate regression analyses for cities in the low-growth group (Group 1) and high-growth group (Group 2) based on the groupings set out in Chapter 4. In the low-growth group, venture capital investment showed no significant correlation with firms' clinical trials (with a coefficient of -0.0771, $p > 0.1$). In the high-growth group, venture capital investment was significantly positively correlated with firms' clinical trials at the 10% level (with a coefficient of 0.117, $p < 0.1$). This result shows that the more developed the entrepreneurial ecosystem was, the more likely venture capital investments were to translate into corporate R&D activities, which was harder to achieve in the comparatively weaker regions.

Table 5-8: Regional heterogeneity analysis of the impact of venture capital financing on firms' clinical trial approvals (next three years) between 2010 and 2019

	(1)	(2)
VARIABLES	Group 1	Group 2

ln_InvSize	0.0771	0.117*
	(0.0907)	(0.0493)
Year	YES	YES
Firm	YES	YES
Industry	YES	YES
City	YES	YES
Constant	-2.436**	3.194
	(0.981)	(2.286)
Observations	1,306	3,325
R-squared	0.821	0.755

Robust standard errors in parentheses

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

Table 5-9 shows in column 1 that local investment (haslocal) is significantly positively correlated with clinical trials in the next 3 years, with a coefficient of 0.0568, which is significant at the 1% level ($p < 0.01$). This indicates that firms funded by local VC are more likely to conduct more clinical trials during the subsequent 3 years. In column 2, the inclusion of the syndication (hasSynd) yields a coefficient of 0.0534, which is significant at the 1% level ($p < 0.05$), suggesting that projects with multiple venture capital investors effectively promote firms' clinical trial activities. Column 3adds the government venture capital (hasGVC) variable, with a coefficient of 0.100, which is significant at the 5% level ($p < 0.05$), indicating that support from GVC has a more pronounced effect on increasing the number of clinical trials in the next 3 years. These

results highlight the importance of geographic proximity to firms' R&D activities, the positive role of syndications in firm R&D and the significant role played by government venture capital.

Table 5-9: Heterogeneity analysis of the impact of different kinds of venture capital financing on firms' clinical trial approvals (next three years) during 2010 to 2019

	(1)	(2)	(3)
VARIABLES	ln_Clinic_t3	ln_Clinic_t3	ln_Clinic_t3
haslocal	0.0568***		
	(0.0124)		
hasSynd		0.0534***	
		(0.0182)	
hasGVC			0.100**
			(0.0433)
Year	YES	YES	YES
Firm	YES	YES	YES
Industry	YES	YES	YES
City	YES	YES	YES
Constant	-1.930	-1.912*	-1.924*
	(1.134)	(1.108)	(1.117)
Observations	5,002	5,002	5,002

R-squared	0.755	0.755	0.755

Robust standard errors in parentheses

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

5.2.6 Regional Analysis

Regional-level data was aggregated from firm data. It is worth noting that I introduced the "diversification" indicator as a dependent variable at the regional level. This indicator is characterized based on the observation of the sub-industries of all medical enterprises in the region within the year, with industry classifications following the major and minor categories of the Chinese National Standard System. Firms with missing industry data were excluded. Within region *r*, the relative share of each minor category *i* under major category *j* is calculated as $p_{r,i,j} = \frac{x_{r,j,i}}{\sum_{j=1}^{j}\sum_{i=1}^{i} x_{r,j,i}}$) and the total share of major category *j* was computed as $p_{r,j} = \sum_{i \in I_j} p_{r,i,j}$. Based on the minor category shares, the entropy (i.e., diversity index) for major category j was calculated as $H_{r,j} = -\sum_{i \in I_j} \frac{p_{r,j,i}}{p_{r,j}} \ln\left(\frac{p_{r,j,i}}{p_{r,j}}\right)$.

Table 5-10 shows the descriptive statistical results of the regional-level variables. The sample includes 260 cities, with variables log-transformed. The dependent variables include the number of clinical trials and new firms started in the next three years, as well as the industrial diversification of regional enterprises. The core variable is total investment funding, and the explanatory variable is the frequency of financing. Overall, the indicators for dependent and independent variables exhibited a right-skewed distribution, from which we can conclude that a small number of regions account for more innovation and firms, with total investment funding showing a similarly concentrated pattern. The analysis incorporated regional-level control variables, including technical knowledge density (ln_tik), scientific knowledge density (ln_sik), hospital bed density (ln_hospital), per capita GDP (ln_gdp), private sector labour share (ln_private), university student density (ln_students), startup density (ln_startups), listed company density (ln_pubFirms), multinational company density (ln_mnc) and local government expenditure level (log_gov).

Table 5-10: Descriptive statistics of the variables on regional level

Variable	Obs	Mean	Std. dev.	Min	Max

ln_Clinic_t3	260	0.0095897	0.0317839	0	0.2803942
ln_startup_t3	260	0.017351	0.0289506	0	0.2256301
ln_diversity	260	1.004413	0.4272601	0.4250634	2.215124
ln_invsize	260	0.2678675	0.7841179	0	4.254425
ln_financing	260	0.5551947	0.9417455	0	4.127134
ln_gdp	260	2.161112	0.560311	0.6696535	3.318026
ln_students	260	0.1802775	0.1387696	0.0140231	0.6931472
ln_hospital	260	0.1253719	0.1029568	0.0279635	0.6699816
log_gov	260	8.880537	0.8815863	6.836393	11.81791
ln_hgf	260	0.2995632	0.2531136	0.0203053	1.278861
ln_pubfirms	260	0.001575	0.0024543	0	0.0130935
ln_tik	260	0.082905	0.1191167	0	0.6931472
ln_sik	260	0.1194421	0.2425183	0	1.389809
ln_mnc	260	0.0157492	0.0171767	0	0.0676535
ln_private	260	0.2221528	0.1259645	0.005903	0.5617743

Table 5-11 shows the correlation analysis between regional investment funding and three dependent variables – the number of clinical trials, the number of newly established firms and diversity of medical enterprises – over the period between 2010 and 2019, using fixed effects for city and year, with robust standard errors clustered at the city level. Before this, I examined the relationship between a binary variable indicating whether VC was received and regional clinical trials, and the results showed no significance (for details see Appendix C). This may have been due to the reduced sample size, which smoothed out the heterogeneity of the binary variable. I therefore introduced a continuous variable for validation here.

Model 1 focused on the core relationship between investment funding and regional clinical activities. The results showed a positive correlation between investment funding in a region and the number of clinical trials in the subsequent three years, with a coefficient of 0.0155, significant at the 1% level. This supports the hypothesis that increased regional investment

enhances regional innovation capacity. The results also show a negative correlation between regional economic conditions and clinical activities, with the coefficient for ln_gdp at -0.0185, which is significant at the 5% level. Regions with abundant student resources show more active clinical activities, with the coefficient for ln_students at 0.193, significant at the 10% level. Areas with higher technological knowledge density are more likely to have clinical activities, with the coefficient for ln_tik at 0.288, significant at the 5% level. Conversely, scientific knowledge density shows a significant negative correlation with regional clinical activities.

Models 2 and 3 focus on the relationship between investment funding and the number and diversity of regional enterprises. The results show that an increase in investment funding in a region does not significantly lead to more new enterprises but is significantly positively correlated with regional diversity (coefficient of 0.0333, which is significant at the 1% level). This indicates that the expansion of venture capital mainly promotes the diversity of regional industries rather than directly driving the growth of enterprise numbers. Regional technological intensity is strongly positively correlated with an increase in the number of startups. Notably, higher per capita GDP and a greater presence of multinational corporations are negatively correlated with new enterprises. In terms of regional diversity, the number of high-tech enterprises is to some extent positively correlated with regional industrial diversity, while an increase in regional knowledge reserves is more significantly associated with the improvement of regional industrial diversity.

Table 5-11: Correlation Analysis of Regional Investment Funding with Regional Clinical Trials (Next 3 Years), Number of Newly Established Firms (Next 3 Years), and Diversity, 2010–2019

	(1)	(2)	(3)
VARIABLES	ln_Clinic_t3	ln_startups_t3	ln_diversity
ln_invsize	0.0155***	0.00116	0.0333***
	(0.00485)	(0.00329)	(0.00869)
ln_gdp	-0.0185**	-0.0244**	0.0271
	(0.00755)	(0.0103)	(0.0428)
ln_students	0.193*	0.0775	0.385

	(0.108)	(0.0853)	(0.278)
ln_medical	-0.0768	0.00832	-0.0991
	(0.0498)	(0.0503)	(0.156)
log_gov	0.00852	0.0196	0.0582
	(0.0146)	(0.0134)	(0.0950)
ln_hgf	0.00691	-0.00175	0.0789*
	(0.0150)	(0.00785)	(0.0383)
ln_bigfirm	-0.772	-1.094	5.500
	(1.363)	(1.015)	(7.339)
ln_tik	0.288**	0.228***	-0.433
	(0.104)	(0.0546)	(0.287)
ln_sik	-0.0784**	-0.0102	0.252**
	(0.0363)	(0.0304)	(0.105)
ln_mnc	-1.608	-1.279*	3.166
	(1.121)	(0.695)	(3.121)
ln_private	0.0225	0.0275	0.165
	(0.0328)	(0.0285)	(0.227)
Constant	-0.0504	-0.121	0.250
	(0.133)	(0.124)	(0.895)
City	YES	YES	YES
Year	YES	YES	YES

Observations	260	260	260
R-squared	0.761	0.800	0.947

Table 5-12 also incorporates the frequency of regional VC investments into the analysis. In a regression model controlling for city and year fixed effects and including the control variables, the frequency of regional investments showed a significant positive correlation with the number of clinical trials in the following three years, with a coefficient of 0.160, which is significant at the 1% level. This indicates that a higher number of investment projects in a region leads to more clinical activities. However, the marginal effect of investment frequency on the number of newly established firms is not significant, further confirming the limitations of VC in promoting the formation of new firms in the region. It is worth noting that an increase in the frequency of investments significantly promotes the development of regional diversity within the medical industry at the 1% significance level. In other words, the more frequent VC investments are in a region, the more likely the region's industrial structure is to develop towards greater diversity. This indicates that venture capital supports the growth of enterprises in specific sectors.

Table 5-12: Correlation Analysis of Regional Venture Capital Investment Frequency with Regional Clinical Trials (Next 3 Years), Number of Newly Established Firms (Next 3 Years), and Diversity, 2010-2019

	(1)	(2)	(3)
VARIABLES	ln_Clinic_t3	ln_startups_t3	ln_diversity
ln_financing	0.0160***	-0.00171	0.0572***
	(0.00467)	(0.00332)	(0.0187)
Control	YES	YES	YES
City	YES	YES	YES

Year	YES	YES	YES
Constant	-0.126	-0.136	0.159
	(0.149)	(0.125)	(0.908)
Observations	260	260	260
R-squared	0.748	0.800	0.984

5.3 Discussion of Quantitative Findings

Since 2010, the medical industry in the YRD has shown a phased upward trend in both the number and the amount of investments, entering a period of rapid development after 2015, with investment frequency and volume peaking in 2018. This validates the view that the institutional environment significantly influences venture capital investment (Collins, 2008). Specifically, a series of regulatory policy reforms implemented in China after 2015 greatly stimulated the development of industry and facilitated the influx of venture capital. The 722 Incident accelerated clinical trials, providing a pathway for innovation. The generic drug consistency evaluation also increased innovation activities within the industry, generating substantial capital demand. The launch of the STAR Market in 2018 and Hong Kong's 18A listing rules pushed the enthusiasm for VC to a climax. However, the concurrent centralized procurement reforms also introduced greater uncertainty for the medical industry in the following years, making 2018 the peak year of the 2010s.

However, from the perspective of funding rounds, early-stage financings were more frequent but smaller in size, while later rounds saw fewer transactions but significantly larger individual investment amounts. This differs from observations in developed regions (Fleming, 2015), possibly because China's medical industry was in a phase of early path-creation between 2010 and 2019. This suggests that the industry offered numerous low-hanging fruit opportunities for investors, making early-stage projects highly attractive because of the assured success rates. When categorised according to company size, small enterprises secured more frequent funding but with much smaller individual investment amounts compared to large enterprises. This aligns with fundamental understandings of the industry (Cooke, 2004; Cooke, 2003), which are that venture capital is crucial for the financing of small enterprises.

This study analysed the impact of VC on corporate clinical trials, and found a significant positive correlation between the two, with notable effects on clinical trials over the next one and two years. The study also explored variations in the impact of venture capital on clinical trials across different time periods (2010-2014 and 2015-2019) as well as regional types (high-growth and low-growth groups). The results show that the strength of the impact of VC significantly increased over time and exhibited structural differentiation across regions. These findings refine our current understanding of the relationship between VC and regional path creation (Sheng et al., 2024).

Firstly, venture capital is significantly positively correlated with corporate clinical trials. On one hand, companies that receive VC investments are more active in clinical trials. On the other, the larger the investment funding amount a company receives, the more likely it is to conduct clinical trials. This suggests that VC promotes innovation and R&D in medical enterprises by providing direct financial support, enabling the recruitment of scientists and managers (de Carvalho et al., 2008; Wen et al., 2018). With increased capital, companies also enjoy higher cash flow levels and greater risk tolerance, allowing them to allocate more capital to drug pipeline development, thus improving innovation activity (Liu et al., 2023; Alperovych and Hübner, 2013).

Secondly, the impact of VC shows a time-lag effect. On one hand, the significance level and coefficient of the impact of VC on clinical trials during the next two years are higher than in the next one year. On the other, the more funding rounds a company secures, the more clinical activities it is likely to undertake. The average treatment effect in the PSM analysis supports this conclusion. The number of funding rounds also reflects to some extent the potential resources a company may access (Hochberg et al., 2015), indicating that post-investment management provided by venture capital promotes corporate innovation. VC offers strategic guidance during the drug discovery phase, facilitates connections with R&D service providers and links companies with local government resources (Manigart and Sapienza, 2017). However, due to long development cycles in biotech companies, these effects are not immediately apparent, resulting in a time-lag effect (Yu et al., 2024; Khan et al., 2021).

Thirdly, the positive correlation between firm characteristics and clinical activities partly reflects the selection effect of VC. As discussed earlier, VC conducts rigorous screening before investing, targeting not only the industry as a whole but also the innovative capabilities of individual companies (Streletzki and Schulte, 2013; Manigart and Sapienza, 2017). While PSM results partially confirm the causal role of venture capital, companies that are already engaged in innovation are more likely to pursue further R&D activities, and venture capital selects these firms (Zook, 2008). Companies with patented technologies and clinical trial experience

accumulate significant advantages in R&D capabilities and regulatory compliance, making it easier for them to initiate new clinical trial projects (Miloud et al., 2012). From another perspective, this finding aligns with evolutionary economic geography theories, which suggest that a company's past R&D activities improve its future capabilities for innovation and its competitive advantage in new drug development (Messeni Petruzzelli et al., 2015).

Fourthly, the impact of venture capital on corporate innovation shows regional heterogeneity across different types of cities. In regions with well-developed entrepreneurial ecosystems, venture capital drives corporate innovation activities more effectively. Such regions possess abundant entrepreneurial resources as well as technological reserves which collectively encourage a larger number of high-quality entrepreneurial projects (Malecki, 2018). Because of the generally high quality of projects, investors are more inclined to seek investment opportunities locally, as this effectively reduces information asymmetry and management costs associated with non-local investments (Mason, 2007a). These cities also host a large number of venture capital firms and angel investors, forming capital-dense clusters (Guerini and Tenca, 2018). The dense networks between institutions allow investors to share project information (Wang and Noe, 2010). Meanwhile, government policies in these regions provide stronger guidance, with fiscal expenditures creating a favourable environment for corporate development, improving the region's attractiveness to venture capital (Keuschnigg and Nielsen, 2001). This mature ecosystem, coupled with higher returns, reinforces the path dependence of VC in these areas, further enhancing the innovation clustering capacity of high-growth cities (Clayton et al., 2024).

In contrast, venture capital investments struggle to translate into R&D outputs in regions with weaker entrepreneurial ecosystems (Luukkonen et al., 2013; Sorenson and Stuart, 2001). Possible reasons for this are that low-growth regions often lack mature industrial chains and sufficient entrepreneurial resources, making it difficult for VC to achieve scale effects, and even with capital injections, local firm innovation remains limited (Mason, 2007a). Meanwhile, the medical industry foundation in these regions is weak, leading to lower valuations in capital markets and prompting VC firms to favour regions with proven success and mature clusters while remaining cautious toward innovation projects in less developed areas (Boasson and Boasson, 2015). Projects in underdeveloped ecosystems therefore often lack core market validation (Luukkonen et al., 2013; Sorenson and Stuart, 2001).

It is worth noting that high-growth cities do not necessarily correspond to high economic development levels. For instance, Taizhou (Zhejiang) and Taizhou (Jiangsu) show below-average economic development in the Yangtze River Delta, yet they play significant roles in regional R&D due to mature pharmaceutical clusters – Taizhou (Jiangsu)'s chemical drug cluster and Taizhou

(Zhejiang)'s API cluster. This highlights the importance of clusters in industrial development. Meanwhile, the absence of a significant correlation between per capita hospital beds and clinical trials supports the view that medical industry demand is not locally driven (Li et al., 2023; Vogler et al., 2022). In other words, the niche for medical firms lies in capturing national or even global market demand.

Fifthly, different modes of VC show significant positive correlations with firm clinical trials. The analysis identified a co-evolutionary relationship between venture capital investment and firm innovation activities. Furthermore, local VC exhibits a positive relationship in the regional context, which can be explained through embeddedness. Local investors, who are deeply engaged in specific regions, possess sharper insights and unique information advantages regarding local innovation ecosystems and early-stage projects (Fritsch and Schilder, 2008). They can therefore prioritise high-potential innovation projects more effectively (Cumming and Dai, 2010). GVC also tends to focus on early-stage R&D projects (Berger and Udell, 2006). However, compared to market-driven VC, GVC often prioritises policy-driven goals and social impacts, focusing on long-term scientific innovation and industrial upgrading rather than short-term commercial returns (Lerner, 2009).

Syndications consistently promote clinical trial numbers because of their unique multi-party collaboration and resource integration characteristics (Bygrave and Timmons, 1992; Brander et al., 2002). Firstly, VC in syndicated investments screens projects through the mutual exchange of information, indicating a strong correlation between syndicates and more innovative firms (Jääskeläinen, 2012). Secondly, multi-party investments reduce individual investor risk exposure, allowing firms to secure sufficient funding in early stages (Sahlman, 2022). Thirdly, syndications integrate different regulatory resources, fostering firm innovation (Fritsch and Schilder, 2012). With investors' backgrounds and expertise, firms that receive syndications can adjust and optimise R&D strategies through collaborative mechanisms (Hopp, 2010). Finally, as multiple investors share risks, syndicated structures are often seen externally as strong endorsements of project value and R&D potential, attracting further capital to drive innovation (Stuart et al., 1999).

The regional results show that regions with high human capital and patent density show increases in regional clinical trial activities. Human capital-intensive regions provide the necessary pool of professional talent for firms' clinical research and trials (Vogel et al., 2023). The higher number of patents suggests that regions foster new ideas, which are protected by intellectual property barriers and incorporated into clinical trials by firms. Meanwhile, regions with a high number of patents indicate greater R&D investment in the medical sector, which corresponds to more competitive industrial clusters and increases regional clinical activities

further. Notably, regions with strong economic foundations do not necessarily display more clinical activities. This confirms the path classification results from the previous chapter, indicating that some smaller economies will benefit from medical industry clusters by possessing resources and supporting services that larger economies may lack.

The positive correlation between regional VC and clinical activities corroborates firm-level findings. VC investment provides cash flow to regional medical firms, offering critical support for early-stage projects (Lehoux et al., 2016a; Marangos, 2014). Start-ups in the medical sector often require substantial investment in terms of clinical trials, with funding being their primary constraint. The R&D process in the medical industry is notably protracted (Smietana et al., 2016), and VC operates under investment period constraints (Tucker et al., 2011), which means that it will prioritize firms that are capable of advancing clinical activities in the short term (Peneder, 2010). VC investment also strengthens the scale effects of regional entrepreneurial ecosystems (de Wit-de Vries et al., 2019). To access VC, some entrepreneurs concentrate in regions with dense VC activity and conduct early clinical activities (Fleming, 2015). VC therefore drives the creation process of new technology domains within regional industrial paths.

Another key finding is that an increase in regional VC investment does not correspond to a higher number of newly established medical firms. This validates the discussion in the literature review which noted that VC does not directly expand the technological base of regional entrepreneurial firms (MacMillan et al., 2022). In the medical industry faces higher costs (Nwaka and Ridley, 2003), leading VC to favour firms that have achieved early animal testing results or even small-scale human trials before investing (Fleming, 2015). This implies that while VC invests in small biotech firms, it does not directly incubate firms or necessarily increase the number of regional firms.

The increase in regional VC investment shows a significant positive correlation with the diversity of branches within the medical sector. VC tends to diversify risk via investment portfolios and does not therefore allocate capital to a single branch (Zider, 1998). Meanwhile, VC actively seeks niche technological fields and market growth opportunities within industries (Ghosh and Nanda, 2010; Pierrakis, 2010). This is particularly pronounced for VC that focusses on the medical industry, as they possess richer information and deeper research on sub-sectors (Dimov and Shepherd, 2005). As a result of VC investment, service providers and providers of various components are becoming more comprehensive in the YRD region.

5.4 Rationale for Qualitative Investigation

Quantitative analysis revealed a positive correlation between venture capital and clinical trials at the firm and regional level, but struggled to explore the deeper mechanisms of the role of VC in regional innovation processes – specifically, how VC conducts post-investment management and how this shapes regional industrial path creation. In fact, VC provides and transfers diverse resources to firms during the post-investment phase, and the application of these resources fosters agglomeration locally, promoting the formation of new industrial paths. Interviews with venture capitalists and entrepreneurs can provide more detailed insights into which resources were mobilised during project development and how these resources were formed and aggregated locally, thereby illuminating the process mechanisms of regional path creation.

Although the PSM method mitigates concerns about the causal relationship of venture capital, further research is needed to clarify the boundaries of selection effects in regional industrial path creation. More precisely, selection effects are manifested as path dependence in the process of path development. On one hand, the significant performance of VC in high-growth cities reflects its regional bias. On the other, firms in high-growth regions are more likely to have stronger innovation capabilities, and VC's firm selection reinforces regional path dependence. At the regional level, the results also indirectly confirm the existence of this phenomenon, namely that venture capital investment does not significantly increase the number of regional enterprises. Clearly, what quantitative research cannot explain is how this cumulative reinforcement effect is achieved, how VC identifies promising projects in a region and how regions interact with VC to reinforce its path dependence.

In particular, relational capital in regions is difficult to capture using quantitative models. However, in-depth interviews can highlight the importance of networks and trust in venture capital behaviour, analysing the indirect role of geographic proximity in VC investments. In the syndication process, venture capital relies heavily on relational capital, with private exchanges and recommendations among investors providing shared information to reduce risks. These syndication relationships enable resource sharing further by integrating more resources locally. However, quantitative studies do not reveal the operational details, and in-depth interviews can help us to understand the practical processes of these non-representational factors.

The positive correlation between GVC and increased clinical trials contrasts with existing research that sees GVC as a government tool, the multi-objective nature of which sacrifices efficiency for equity, leading to bureaucratic inefficiencies and a lack of favour among innovative firms (Lerner, 1999; Leleux and Surlemont, 2003). However, Chinese GVC shows stronger supportive roles, which should be understood within China's specific political-

economic context in ways that quantitative studies cannot accomplish. Qualitative research can reveal how Chinese GVC balances market and local strategies and how it amplifies its impact and success rate to promote regional path creation.

5.5 Chapter Summary

This chapter addressed Research Question 2: "Are firms that receive venture capital investment more innovative than others?" The study characterized the innovation development of the medical industry and the role of venture capital in creating industrial pathways by introducing clinical trials data for the first time, filling the empirical gap in the characterization of industrial activities.

The chapter firstly revealed a significant turning point in VC investment in the medical industry of the Yangtze River Delta since 2015, with a sharp increase in the number of investments and the total amount of these invesments, peaking in 2018. The financing rounds exhibited a pattern of decreasing frequency and increasing funding, whereby smaller enterprises received more frequent investments but with lower amounts per deal, while larger enterprises showed the opposite. I used PSM to confirm a causal relationship between venture capital and corporate clinical trial activities. Further regression analysis showed that total investment funding significantly improved corporate innovation performance, and this impact was further validated by the number of financing rounds. The study also revealed the time-lag effect and spatial heterogeneity of venture capital. Clinical trials significantly increased within three years post-investment, with innovation growth particularly pronounced in high-growth cities, while low-growth regions struggled to benefit. The analysis confirmed a positive relationship between different types and patterns of VC and corporate clinical trials. Finally, regional-level analysis indicated that venture capital promoted innovation growth and increased diversity in regional path creation, although it had no significant effect on firm growth.

However, while quantitative analysis revealed a positive correlation between venture capital and clinical trial activities at firm and regional levels, it struggled to explore the intrinsic mechanisms of venture capital in the process of regional industrial pathway creation in any depth. For example, it could not fully explore how post-investment management promotes localized resource agglomeration, how the selection effect of VC exacerbates regional path dependency or how relational capital indirectly strengthens investment decisions through networks and trust. Quantitative methods also failed to explain why geographic proximity is critical for venture capital and how syndications shape regional pathway creation, nor could they explain the positive role of government-backed venture capital in China's unique political-economic context. Qualitative interview studies are therefore indispensable to uncover the

specific practices of VC resource mobilization, cumulative reinforcement mechanisms and regional interaction patterns, and will effectively address the limitations of quantitative methods by exploring mechanisms and capturing non-representational factors.

The next two chapters will introduce interview data to provide a more nuanced explanation of how venture capital creates regional industrial pathways. Chapter Six will analyse the way VC integrates resources to drive regional pathway formation from the dimensions of finance, knowledge, institutions and markets, while also discussing the role of selection effects in regional pathway choices. Chapter Seven will then focus on the behavioural logic behind geographic proximity, syndication and government capital to explain how specific capital structures interact with regional activities to create new industrial pathways.

Chapter 6 Qualitative Insights: Selection Effect and Resource Formation

6.1 Introduction

The study discussed the overall impact of venture capital on corporate clinical trials and provides a detailed analysis of the lag effects and spatiotemporal differentiation present therein using quantitative analysis. However, the findings still demonstrated shortcomings. Firstly, quantitative analysis cannot explain how the selection effect of VC influences regional path creation, which requires discussion from the firm level to the regional level. Secondly, quantitative analysis fails to reveal the specific mechanisms through which post-investment management affects regional path creation, which needs to be understood from the perspective of regional resource formation. Thirdly, quantitative analysis struggles to analyse the inherent contradictions between venture capital and regional development in any great depth, and this needs further explanation.

This chapter provides answers to the above questions by incorporating material from interviews. The chapter begins by emphasizing that venture capital prioritizes investment in the most promising subsectors and enterprises within a region, which improved regional variety and endogenous development. The regional selection of VC also leads to enterprise transplantation, thereby influencing local path creation. The study also examines how the post-investment management phase of VC promotes regional resource formation from four aspects – financial, knowledge, institution and market resources – showing distinct agency characteristics. Finally, the chapter looks at how the inherent contradiction between venture capital's pursuit of returns and investment cycle limitations as well as the innovation needs of the medical industry makes the role of VC more complex.

6.2 Selection Effects in Path Creation

6.2.1 Endogenous Growth

VC investments within a region are concentrated in specific niche markets. SZ-GVC-1 elaborates:

> "From a regional perspective, the medical industry is just one of many industrial directions. However, from an investor's perspective, the medical industry is our key

> focus. This allows us to more accurately identify which projects in a region are worth investing in." (SZ-GVC-1)

In other words, while regional industrial structures are characterised by diversity, the professional expertise of VC prioritises industries that exhibit higher growth potential and stronger innovation capabilities within a region. Firstly, VC has exceptionally high expectations for investment returns. SH-MNC-1 stated:

> "Investors have high return expectations, typically requiring at least a doubling of investment within 1-2 years and a tenfold increase within 5-7 years ... If a project cannot achieve returns exceeding 40 million in the short term, it has little investment value." (SH-MNC-1)

SH-VC-4 noted that investors prefer industries with "broad tracks and strong future scalability" over highly niche markets that have limited profit potential. This aligns with existing findings (Tyebjee and Bruno, 1984). SH-GVC-1 illustrates the importance of the competitive landscape in industry selection further:

> "In the field of neuromuscular degenerative diseases... Novartis launched a gene therapy, Zolgensma, one of the world's most expensive drugs, costing over $2 million per dose... It generated over $1 billion in sales in its first year, later growing to around $2 billion... We were very interested in a company in this field but ultimately did not invest, mainly because the competition was too intense. Several domestic companies were advancing innovations, but their valuations were extremely high, making the investment returns unattractive." (SH-GVC-1)

The competitive landscape influences the investment costs of VC as wellas the competitiveness of subsequent exits:

> "If a team is built to develop a product independently, the product's complexity determines the investment cost. Generally, early-stage drug development requires investments of around 5 to 10 million RMB ... For many large companies, they prefer in-house development over acquiring external products. Thus, to gain market recognition and achieve a successful exit through acquisition, having a product alone is insufficient; it must also possess a competitive edge in the industry." (SZ-GVC-2)

The assessment of an industry is so important that it largely determines VC investment behaviour. An investment manager from a multinational VC institution in Shanghai stated:

> "We have not invested heavily in innovative drugs, mainly because historically we lacked sufficient experience and our knowledge background was also deficient, so we did not choose this field." (SH-VC-2)

This view was corroborated by another angel investor, who said:

> "I believe it is partly related to my own knowledge background. Since I do not come from this industry and do not have a sufficiently accurate or in depth understanding of the mechanisms and future development trends of many innovative drugs, I dare not invest in the innovative drug field." (SH-AG-1)

As mentioned above, the medical industry has very high knowledge barriers, so the professional capability of investors is just as critical. Many interviewees have PhDs in medicine, biology or chemistry, and they unanimously emphasised the importance of academic qualifications in VC work, especially when dealing with the medical industry. SH-VC-1 stated:

> "Our team's R&D personnel and primary investors typically have industry backgrounds, often holding doctoral degrees. While a doctorate does not necessarily equate to a deep understanding of the entire industry ... they possess a methodological framework that enables them to determine how each project should progress and ensure its logical coherence ... Doctors in life sciences or technology fields have strong capabilities in reading and comprehending literature. Particularly in early-stage projects, data is often scarce, sometimes almost non-existent ... Thus, it is necessary to conduct in-depth literature reviews to understand the technical mechanisms of a project and assess whether any issues exist." (SH-VC-1)

The professional expertise of VC helps investors to screen competitive enterprises for investment. However, in reality, many excellent technologies and ideas fail to materialize and ultimately fail (Zider, 1998). This is especially true in the medical sector, where the attrition rate of clinical trials is very high (SH-GVC-1). Early project screening is therefore crucial, and VC focuses particularly on the effectiveness and reliability of a new drug, which requires professional knowledge and clinical data support. SH-VC-1 explains the risk control behind the venture capital screening mechanism:

> "As long as the technical aspects of a project are ensured to have no major issues... subsequent stages largely involve procedural work following established processes, so the risks are relatively manageable... I primarily invest in Series B projects because my team has a strong industry background, which often provides a deeper understanding of early-stage projects compared to those with purely financial backgrounds... I can offer projects abundant resources and value-added services... Since Series B valuations are typically not too high, they offer a higher margin of safety." (SH-VC-1)

After the screening and investment stages, only a portion of projects manages to capture the interest of VC firms. At that point, venture capital companies begin a more detailed process of due diligence after an initial meeting with the firm. Financial due diligence is a critical component here. Investors must fully understand a company's financial information and ensure its accuracy in order to assess the firm's financial health (Nanda et al., 2020), identify potential financial risks and provide a basis for later valuation. As part of this process, investigating and

discussing the company's supply chain and its upstream and downstream partners serves as an important supplementary measure. Customer interviews are a critical component of pre-investment due diligence. According to NV-GVC-1:

> "I will visit the customers and suppliers of the invested companies to confirm their collaboration with the target enterprise, understand the target enterprise's performance in the industry and assess their financial condition... Sometimes, these interviewees are also my investment targets. Additionally, I conduct industry research through my own industry connections." (NV-GVC-1)

Such in-depth vertical investigations provide VC investors with a clearer understanding of the actual market dynamics of the industry in which a firm operates and its associated technology. By researching upstream and downstream suppliers, VCs can cross-verify a firm's financial statements, assess potential market demand, evaluate the firm's reliance on its suppliers and determine the scalability and application scenarios of its technology.

Venture capital must also conduct legal due diligence on a firm. Some investors have found from past investment experience that firms in the medical field may be exposed to higher legal risks stemming from intellectual property issues and from guarantees and credit arrangements. SZ-BK-1 recounted a case in which a company, having mortgaged the same piece of land to multiple banks, was refused further loans by those banks, resulting in cash flow problems and eventual near bankruptcy, which was ultimately resolved through government intervention. Clearly, not every company is as fortunate as that one, so conducting a comprehensive legal assessment is of paramount importance. According to SH-MNC-1, venture capital firms conduct in-depth due diligence on the management team:

> "We have dedicated finance teams, risk control directors and legal departments to ensure due diligence is thoroughly carried out. During the due diligence process, we obtain all of the company's financial data and personnel information and carefully review all contracts and legal documents, especially those contracts signed in the past." (SH-MNC-1)

From the perspective of VC investors, a start-up's success depends largely on its founder and entrepreneurial team. Venture capitalists therefore need to thoroughly understand the professional expertise, industry experience, entrepreneurial spirit and execution capabilities of the founder and team members (Hoenig and Henkel, 2015). SH-MNC-1 noted:

> "When making investments, we arrange one-on-one in-depth interviews with the team of the target company, with each executive questioned individually. If any members of the executive team are overseas, venture capital conducts interviews online, while domestic executives are interviewed face-to-face. Each interview lasts more than half an hour, and the entire interview process typically spans 1 to 2 days, with no fewer than 3 to 4 due diligence team members participating." (SH-MNC-1)

Such investigations are comprehensive, providing investors with a thorough understanding of the founding team. The process also involves communicating with their families, as investors place significant emphasis on whether the founder has a harmonious and supportive family background. SH-MNC-1 elaborated on how family might influence investment returns:

> "I once encountered such a situation. An entrepreneur was having conflicts with his wife. When the company was about to go public, his wife filed for divorce, ultimately leading to the failure of the company's listing." (SH-MNC-1)

Finally, investment managers will draft an investment proposal and submit it to the investment committee, which will make the final decision. SZ-GVC-3 explained that:

> "Throughout the decision-making and operational process, there is first an internal team discussion, followed by a departmental discussion, during which the legal and risk control departments review the materials. During this process, some issues may be raised. Finally, the project is submitted to the investment committee, where the leadership makes the final decision" (SZ-GVC-3)

This process is like a chain, and while it cannot eliminate mistakes entirely, the company's overall risk control, legal and internal control systems ensure that projects only move forward if most agrees they are feasible. SH-MNC-1 further explains the function of the investment committee:

> "If a company is assessed as worthy of investment, the proposal is submitted to the internal investment committee for review. The committee consists of the company's executives, partners and LP. Once the committee makes a decision, the venture capital firm presents the company with a detailed list of terms. This list includes the investment amount, company valuation, and other post-investment management arrangements. Terms negotiation is the final, and one of the most critical, steps in the transaction. The company's valuation determines the future return on investment for the venture capital firm and how much ownership the firm can acquire." (SH-MNC-1)

The above discussion helps to explain the relationship between VC and path creation. Through the careful evaluation of enterprises and a deep understanding of the industry, VC investors select technology directions with broad market prospects and competitiveness for the region, directing resources toward relatively more promising entrepreneurial projects and thereby influencing the process of regional industrial development.

6.2.2 Firm Relocation

Venture capital may require companies to relocate when necessary. On one hand, VC tends to prefer companies to move to regions where it has more business resources. SH-VC-1 noted:

> "My industrial and government resources are more abundant in the Yangtze River Delta, so I naturally hope that projects are as close to the Yangtze River Delta as possible... If a company is not in my desired region, I would suggest they relocate... This way, we can respond quickly." (SH-VC-1)

On the other, VC is sensitive to region-specific business conditions. SH-VC-1 also stated:

> "There are some places where I'm hesitant to invest, such as [a certain place] where regulatory efficiency is low and government management is bureaucratic. Changing business registration information can take half a month, and the founders we invest in have even been suddenly labelled with inexplicable accusations." (SH-VC-1)

Institutional uncertainty in certain regions brings in additional risk variables, which undoubtedly increase the likelihood of investment losses for venture capital. Consequently, VC naturally develops risk aversion toward regions where it lacks political resources, which directly influences its location preferences for companies.

More specifically, this means that local government profoundly influences the spatial choices of VC investments. Firstly, the spatial density of government policy resources directly affects the clustering effect of VC (Yang et al., 2023b). When selecting investment locations, VC investors will prioritise regions with abundant fiscal resources and strong policy implementation capabilities to reduce investment uncertainties (Erdogan et al., 2023). GZ-BIO-1 remarked:

> "Several financial advisors warned me: Never go to small places, as policies they promise there are often not implemented. Moreover, since these areas are not first-tier cities, your company's valuation could plummet." (GZ-BIO-1)

In other words, local governments can provide more stable financial support in economically developed regions with strong fiscal capacities, making VC more inclined to invest in start-ups in these areas (NB-VC-1). In contrast, regions with limited fiscal resources because of inadequate policy execution exacerbate the financial pressures faced by start-ups, rendering them less attractive to investors. This contributes to VC's path dependence on specific regions.

Secondly, government resource allocation also influences VC's spatial decisions. On one hand, physical infrastructure is indispensable for firm R&D. SH-GOV-1 noted that Zhangjiang Pharma Valley established R&D buildings and an industrial park spanning 20-30,000 square metres. This met the demand for experimental equipment in research projects and enabled firms to handle time-sensitive or highly confidential tasks through internal coordination within the same park. SH-GOV-1 described the Zhangjiang story:

> "Zhangjiang Pharma Valley, as a government platform, began operations around 2004... Due to the lack of service providers in the market at the time... Zhangjiang Pharma Valley established companies to provide services, including experimental equipment and services... such as using spectroscopy, chromatography, and other

> technologies for the separation and detection of chemical reagents... Although the platform generates tens of millions in revenue annually, due to its state-owned background, profit is not the primary goal." (SH-GOV-1)

It is evident that by fostering a local innovation ecosystem, Zhangjiang provided essential technical services as well as infrastructure support, filling gaps in the industrial chain and promoting the early development of the region's medical industry. In high-risk technical fields, where innovation outcomes are more uncertain, private capital tends to be cautious (Chemmanur et al., 2011; Kaplan and Strömberg, 2003). At this stage, some regions allocated more resources locally through policies to promote the formation of industrial clusters and attracting venture capital investment.

The transformation of government functions toward innovation creates a favourable environment for VC investment. Jinhua adopted a one-on-one service and a rapid response mechanism, helping firms to establish direct communication channels with higher authorities, reducing time and financial costs in policy coordination (JH-BIO-1). Industrial parks that were co-established by private firms and local governments set up medical device registration stations, offering one-stop services to alleviate firms' administrative burdens (HZ-CVC-1). Suzhou Industrial Park hosts a sub-centre of the Jiangsu Drug Administration, which allows firms to access approval services directly within the park, improving efficiency significantly (SZ-GOV-1).

> "Zhejiang implements a lifelong accountability system for officials which prevents the government from pursuing short-term gains... As a result, the government places greater emphasis on the social impact that enterprises can generate in three to five years... We jointly established a joint venture with the local government, with the government holding 40% of the shares and me holding 60%... This shareholding structure ensures the commercial operation of the company... Despite changes in government leadership, the overall policies and strategic goals of the government remain consistent." (HZ-CVC-1)

Overall, regions with more abundant fiscal resources are more attractive to investors, as local governments can reduce uncertainties by shaping the regional entrepreneurial ecosystem. As a result, VC increases investments in advantageous regions and may even relocate enterprises to these areas.

6.3 Post-Investment Resource Formation

During the post-investment management phase of VC, investors do more than just provide financial support to enterprises. More importantly, they mobilize various resources to help startups gain a competitive advantage in rapidly changing markets. These resources are

internalized as enterprise capabilities and help to shape resource elements in a broader geographical space, thereby influencing regional path creation. This section will explore the role of VC in resource formation in detail from four dimensions: financial resources, knowledge resources, institutional resources and market resources.

6.3.1 Financial resources

Venture capital requires companies to channel acquired funds into research and development. Startups face funding bottlenecks in their early development stages, making venture capital investment essential (Metrick and Yasuda, 2021). This is particularly evident in the medical industry. HZ-BIO-1 stated that their funding is aimed at supporting clinical trial registration for new drug development and product market certification. SH-MNC-1, who previously worked at a VC firm, noted that in the high-investment medical industry, VC is used primarily for facility acquisition, clinical research and trial recruitment to drive product iteration and market expansion.

> "Every founder has a unique style. Some are extravagant, chasing the high-end image of top-tier listed companies. Others are extremely frugal, avoiding any expense if something can be obtained for free. As investors, we want funds to be used effectively. If a company that isn't yet profitable starts hosting lavish annual events or investing in costly renovations, we're bound to feel dissatisfied." (SH-VC-3)

SH-VC-3's stance shows that venture capitalists monitor the use of funds obtained by companies. This is corroborated by HZ-AG-1, who stated that they strictly control the use of a company's funds to focus efforts on producing verifiable results quickly. This perspective is also confirmed from the company's viewpoint. SZ-BIO-2 elaborated:

> "Investors primarily focus on R&D investment for the current year, major expenditures, and related financial statement data... If the disclosed financial report is not clear enough, investors require the company's finance team to address questions... The opinions of capital providers significantly influence the use of funds" (SZ-BIO-2).

Based on this, companies adjust the distribution of financial resources across different R&D projects according to investors' opinions. If necessary, investors may even require companies to reduce investment in non-core projects and prioritise pipeline trials that are progressing more smoothly and are likely to generate cash flow returns more quickly.

Meanwhile, as companies expand, their demand for capital increases, leading to a greater need for refinancing (SZ-BIO-1). In this process, funds from different sources come with varying expectations, and are further complicated by factors such as fund duration and investor

demands (HZ-AG-1). From the perspective of venture capital, the purpose of providing refinancing to companies is multifaceted.

> "If I invest in 10 projects with an initial total valuation of 200 million and after several rounds of financing the total valuation reaches 500 million, I can showcase this progress to the LPs, thereby enhancing their satisfaction with the fund and contributing to the building of the fund's brand." (HZ-AG-1)

On one hand, successive financing rounds provide investors with exit opportunities. If they enter a project at an early stage with lower costs, they may not need to wait for the firm to go public and can choose an appropriate time to exit during subsequent financing rounds. This offers venture capital investors more flexible exit channels (Guo et al., 2015). In this process, professional investment institutions often list a firm's refinancing performance as a key performance indicator for fund managers, as successful successive financing rounds can validate a project's growth potential (SZ-GVC-3).

On the other, for investors, successive financing demonstrates project success to their LP. As successive financing helps to increase firm valuation, it creates the right conditions for investors to showcase investment performance to their LPs, thus improving the fund's brand reputation (HZ-AG-1). Some large institutions even establish dedicated post-investment management departments to support refinancing by helping with business plan revisions, connecting with new investment institutions and organising greater industry exposure opportunities (SZ-GVC-3).

It is clear that VC plays a significant role in capital flows. Under the limited partnership model of VC – where LPs do not directly manage investments but rely instead on GP for professional investment operations (Lerner et al., 2022) – capital flows from LPs to GPs. However, the project selection and post-investment management capabilities of GPs directly impact LP returns (SH-MNC-1), resulting in spatial biases in LP capital flows.

Firstly, it is worth noting that LPs are comparatively spatially dispersed, as shown in Chapter Four's analysis. This is due to the diverse sources of LPs, which include high-net-worth individuals, industrial capital, government funds, pension funds and other investment entities (SH-VC-1). This implies that even smaller cities or economically less developed regions can still generate significant demand for VC investment as long as they have accumulated some industrial capital.

In contrast, the spatial distribution of GPs is more concentrated because of two main factors. Financial agglomeration zones attract a large pool of high-end financial talent, forming mature regional financial ecosystems (SZ-GVC-2). As a financial hub with highly specialised financial

services and concentrated industrial resources, Shanghai is widely regarded as the industry's gold standard (SH-VC-2). An interviewee from Ningbo corroborated this view:

> "Investors in Shanghai are more professional. They don't have concerns like going home to cook or pick up the kids, which makes them appear more professional... There's also a difference in the quality of practitioners; Shanghai excels in this regard... Compared to me, they have access to more project resources." (NB-VC-1)

This regionally advantaged professional investment capability to some extent contributes to the path dependence of VC in certain regions. It also encourages the deeper embeddedness of VC in local networks (Luukkonen et al., 2013; Sorenson and Stuart, 2001). On one hand, such social networks enhance VC's post-investment service capabilities. The CEO of a medical industry firm in Hangzhou (HZ-BIO-1) noted:

> "They [venture capitalists] recommend talent for key positions, especially technical personnel with experience in the technical field... Their support in human resources helps me fill critical internal vacancies." (HZ-BIO-1)

SH-VC-1 elaborated on the sources of these suitable candidates:

> "Firms rely on the investor's network to recommend reliable candidates. In such cases, I would make recommendations through classmates, friends, or industry networks I know." (SH-VC-1)

This network-based approach strengthens the financing capacity advantage of VC in advantaged regions (Cumming and Dai, 2010). SZ-GVC-3 pointed out that local investment institutions that are embedded in local networks can access high-quality project resources earlier. As a result, larger investment institutions tend to establish teams in regions with dense financial resources (SZ-GVC-1).

> "Our company set up a branch in Xi'an to tap into the high-net-worth investor groups accumulated from local traditional industries. As Xi'an's entrepreneurial investment ecosystem is relatively underdeveloped, local investors often direct their capital to external markets with greater innovation resources." (GZ-VC-1)

This pattern of cross-regional capital flow shows that while capital sources may be widely distributed, the role of GPs as capital managers leads to capital concentration in regions with higher capabilities for professional investment. Building on the previous discussion, capital tends to flow into regions with more developed entrepreneurial ecosystems under the management of GPs. This strengthens the advantages of these regions by providing a more abundant supply of funds, thus accelerating local industrial formation.

6.3.2 Knowledge resources

Talent mobility and firm spin-offs are critical components of local knowledge development. SH-UNI-1 noted that the company they previously worked for experienced a 70% staff turnover rate within a few years, showing an exceptionally high employee departure rate. Given the abundance of related firms, employees frequently move between companies, as staying in one company for too long often results in lower salaries, while job-hopping offers a quick way to obtain salary increases. According to SH-UNI-1:

> "Many people not only take data with them but also the company's analytical methods, processes and technical expertise. Two salespeople left and each started their own companies. The operational model for such new firms is quite simple: acquire a few laboratory instruments, hire a few lab technicians, establish standardised processes, employ a few staff to handle basic issues and have salespeople bring in clients. With this, a small contract service firm can be quickly incubated." (SH-UNI-1)

From this perspective, the phenomenon of firm spin-offs facilitates the secondary dissemination of local knowledge (Cusmano et al., 2014). In this process, newly established startups convert their parent companies' knowledge resources into their own capabilities, thereby enriching the local technical knowledge base.

VC plays a significant role in developing local knowledge resources. Firstly, by investing in new firms – particularly those involving scientists from outside the region or overseas – it strengthens the local knowledge base (Wong, 2007). Chinese VC has focused heavily on facilitating the local establishment of projects led by overseas Chinese scientists for a long time. SH-GVC-2 remarked:

> "The talent and technical accumulation of many early-stage start-ups largely relied on expertise cultivated abroad – their founders earned doctorates overseas, gained a few years of industry experience, and then returned to China. The products they developed were primarily replications of mature foreign products." (SH-GVC-2)

While this implies that most early-stage firms were in a fast-follower mode with limited innovation, they had a positive impact on local knowledge accumulation. By identifying the investment value of external scientists, VC localised this knowledge, thereby enriching the local knowledge system.

Secondly, VC facilitates knowledge integration at the local level through its network resources. As well asa supporting individual firms, VC promotes knowledge and experience sharing by organising exchange activities between portfolio companies (Hyun and Lee, 2022). The case of SZ-GVC-2 illustrates VC's unique function:

> "We regularly organise industry conferences and established the Suzhou Listed Companies Association, which includes all listed and pre-listed companies in Suzhou. This association, spearheaded by our company, aims to share resources and industry updates, fostering collaboration among firms." (SZ-GVC-2)

HZ-BIO-1 highlighted that VC acts as a bridge in coordinating resource connections between firms, enabling access to valuable external technical and market information and improving absorptive capacity. This integration of local knowledge resources not only boosts firms' innovation capabilities but also strengthens the competitiveness of regional industrial clusters.

As mentioned above, the professional capabilities of venture capitalists rely heavily on their regional social capital (Alexy et al., 2012). These network relationships shape knowledge flows within the region further. Specifically, VC provides management knowledge to portfolio firms, and by sharing this management knowledge it improves firms' competitiveness (De Clercq and Manigart, 2007; Gerasymenko et al., 2015). SH-VC-2 emphasised:

> "While the founder's efforts are important, VC provides actionable strategic insights, offering systematic support for firm growth and playing a key role in the firm's maturity." (SH-VC-2)

The entrepreneurial knowledge accumulated through VC's long-term experience helps firms to navigate risks in complex environments. SH-VC-1 explained how VC imparts management knowledge:

> "I arrange for industry managers or other management talent to join the team to collaboratively advance the project. I also encourage founders to leverage their technical strengths. This close collaboration allows both sides to complement each other's weaknesses, forming a strong synergy to drive project success." (SH-VC-1)

However, when delivering management knowledge through appointed managers, VC must strike a delicate balance. SH-VC-1 explained:

> "If a project is overly idealistic, I might consider measures to guide the founder back to academia, handing complex management tasks to more suitable professional managers." (SH-VC-1)

However, they added:

> "If a founder's understanding of a field far surpasses others, their persistent, uncompromising style can lead the team forward. To match their pace, I can pair them with exceptional partners or team members to compensate for management shortcomings." (SH-VC-1)

In summary, VC plays a vital role in advancing local development of knowledge. Employee mobility and firm spin-offs facilitate knowledge dissemination locally (Tambe and Hitt, 2013; Cusmano et al., 2014). VC investments in new projects – particularly those involving overseas

talent – promote local knowledge development to build on this process. Meanwhile, by injecting technical and entrepreneurial management knowledge into portfolio firms, VC internalises knowledge within development of regional firms' innovation.

6.3.3 Institution resources

VC enhances the capabilities and the legitimacy of firms within a region by engaging in board governance, legal compliance and decision-making processes. VC typically secures board seats to gain greater control over a firm's strategic direction and daily operations (Amornsiripanitch et al., 2019). SH-VC-1 highlighted the multifaceted role of the board:

> "In the agreements signed between VC and firms, the functions of the board are clearly stipulated. For instance, in major procurement matters, when a firm needs to purchase equipment exceeding a certain price (which varies depending on the firm's stage), board approval is required. For managing the employee stock option pool, board consent is necessary. In external collaborations, if significant sums or patent licensing are involved, board approval is also needed." (SH-VC-1)

The standardisation of legal and decision-making processes is part of the way in which VC instils legitimacy in firms (Amornsiripanitch et al., 2019). By introducing strong compliance mechanisms, VC ensures that firms maintain industry standards in drug development, patent applications and market promotion. This not only safeguards lawful operations but also reduces potential legal risks, thus improving firms' resilience in highly regulated environments. This is an indispensable step for securing subsequent financing rounds. HZ-AG-1 stated:

> "Compliant operations effectively reduce a company's operational risks. If planning to pursue further financing, the firm must move toward standardisation, as subsequent investors impose high requirements for financial compliance… In fact, when the company was first established, I had already hired legal advisors and secured support for audits." (HZ-AG-1)

Through institutional control over firms' strategic development and operational processes, VC investments interact with the regional legitimacy of projects. VC also plays an active role in shaping the regional legitimacy of a firm's technology (de Lange and Valliere, 2020).

It is important to note that the institutional legitimacy of a technology within a region significantly affects firm development, particularly in specialised technical fields. SH-VC-4 mentioned that nuclear medicine technology, because of its low societal awareness, faces limited acceptance from local governments – including in Shanghai – making it challenging for VC to introduce firms in this field locally. HZ-BIO-1, the general manager of a prominent nuclear medicine firm funded by a well-known VC in Hangzhou, explained the impact of government recognition on firm development:

> "Initially, I planned to negotiate with Shanghai, but the Hangzhou government took the initiative – the district mayor and other leaders personally came to the hotel in Shanghai to intercept me, expressing strong support and commitment... Upper Town district hosts 133 hospitals, which significantly boosts my firm's clinical trials and market promotion for nuclear medicine. As the only project of its kind in Zhejiang Province, I also received significant attention from provincial authorities. This is a form of exclusive support." (HZ-BIO-1)

This shows that government orientation is a decisive factor for firms in highly regulated subsectors. Once local governments recognise the legitimacy of a technology, VC can flow into the region, accelerating the development of that industry locally.

One approach venture capitalists use is investing in projects that are aligned with local planning to secure policy support and resource allocation, thereby enhancing firms' local institutional legitimacy. SH-MNC-1 noted that when investing in firms, VC considers whether local governments have relevant plans and can provide corresponding financial support. This model is mutually beneficial:

> "Firms gain funding and policy support, while governments fulfil their investment attraction goals and achieve industrial layouts." (SH-MNC-1)

SZ-GOV-1 clarified this interactive relationship further:

> "We [the government] travel with some VCs to inspect projects. They handle investments, we handle investment attraction, and together we achieve synergy, aligning local strategic goals with VC investments." (SZ-GOV-1)

In other words, when the direction of innovation of emerging technologies aligns with local policy priorities, VC can secure greater government resources for firms, improving the institutional legitimacy of the region's technology.

For local governments, VC investment behaviour serves to validate a technology's feasibility and market potential by providing feedback on its local legitimacy. As market-driven investors, VC's investment and firms' development practices test the commercial viability and economic feasibility of new technologies. SZ-GVC-1 noted that:

> "Governments focus on the overall direction of an industry but lack the capacity to delve into specific subsectors. Thus, they prefer private VC to invest, as private teams are typically more professional and capable of making commercial judgments." (SZ-GVC-1)

However, as a market actor, VC can provide governments with feedback on practical issues in technology development based on firm operations and industry dynamics, thus promoting policy and regulatory optimisation (Poh et al., 2024). SH-GOV-1 further stated:

> "The government ensures ongoing communication with the market to avoid disconnection. Sometimes, VC investment hotspots attract government attention and may even be incorporated into industrial planning." (SH-GOV-1)

This was corroborated in interviews with other VC investors:

> "Take drug approvals and policy adjustments as examples. The government is continuously learning. They take note of feedback from VCs but also refer to international peers' practices for adjustments." (SH-VC-1)

SH-VC-1 added that governments typically do not adjust policies based on a single entity's suggestions, but rely on collective feedback from multiple stakeholders to determine whether certain policies or rules need to be optimised. In other words, if a technology gains widespread recognition among VCs, governments may engage in frequent exchanges with market actors, potentially leading to the technology gaining legitimacy within government institutions.

VC shapes firms' institutional legitimacy and forms a close interactive relationship with local governments to promote the regional legitimacy of emerging technologies. Governments attract VC investment by recognising and supporting specific technologies, and VC validates their commercial feasibility through market-driven investments, providing feedback to governments on industry developments and facilitating policy optimisation. When VC investment aligns with local policy priorities, firms will gain greater resource support, and specific industries in the region develop more rapidly.

6.3.4 Market resources

VC captures local niche markets by investing in firms and facilitating the practical application of their technologies (Miloud et al., 2012; Streletzki and Schulte, 2013). SH-VC-4 noted that in the medical industry, VC focuses on unmet clinical needs, especially potential market segments that display significant growth potential and sustained momentum. According to SH-VC-4, communication with clinicians is a vital channel for understanding patient needs and assessing whether a product can genuinely meet them. SH-MNC-1 also explained that after identifying and investing in such firms, VC provides additional resources to these portfolio companies, nurturing their growth and enabling them to realise market value.

Meanwhile, VC builds a comprehensive local investment portfolio to shape an industry system that can be targeted at niche markets. For many venture capital institutions, constructing an investment portfolio that covers different fields is an important strategic choice (Colombo and Murtinu, 2017; Patzelt et al., 2006). Since venture capital investments tend to be geographically biased, the diversity of the investment portfolio largely mirrors the local environment. The

geographic outcome is that local industries become more focused, and the diversity of key players along the local industrial value chain is enriched (Lehner, 2023). As SZ-GVC-1 remarked,

> "One of our funds introduces three to five related projects, which can help locally to form a preliminary clustering effect … When dozens of funds support hundreds of projects, a scale effect is formed, which in turn drives the development of the entire industry chain." (SZ-GVC-1)

In the long-term investment plan, a diversified investment strategy is irreplaceable. More specifically, its importance is manifested in several aspects. Firstly, SH-VC-1 noted that focusing solely on one specific niche – such as small molecule drugs or a particular type of cancer treatment – may limit the ability to capture future innovative directions that possess the greatest potential for growth. Because of the inherent uncertainty of market preferences and the extreme difficulty of predicting new niche markets accurately, diversified investment allocation improves adaptability during industrial evolution and allows capital to be deployed to emerging areas more effectively.

Secondly, different niche markets have different entry barriers, competitive mechanisms and regulatory environments, all of which have profound implications for investment returns. Highly regulated industries often require longer periods for approval and market acceptance, whereas industries with low technological barriers rely more largely on capital and expansion strategies (GZ-VC-1). In industrial investment practice, cross-track capital allocation must therefore be considered to optimise investment returns.

Meanwhile, VC portfolios encourage networks to develop between firms, reducing upfront capital investment and improving resource efficiency for portfolio companies (Zider, 1998). SH-VC-4 emphasised that commercialisation is a key focus of firm development, and VC closely monitors product market demand and sales performance while connecting firms with relevant market resources. HZ-CVC-1 elaborated on the role VC plays:

> "VC-invested contract research organisations (CXOs) provide R&D support to portfolio firms, while the CXOs themselves profit from their services, creating a revenue cycle within the investment portfolio. In the sales phase, VCs use their investment networks to help companies promote new products and provide market insights and strategic guidance during the commercialization process." (HZ-CVC-1)

By addressing unmet local clinical needs through investments, VC will encourage the practical application of technologies. By building diversified local investment portfolios that span various domains, VC shapes regional industrial ecosystems oriented toward niche markets. Diversified investments not only improve the adaptability of VC to market uncertainties but also reduce upfront capital requirements for portfolio firms, improve resource efficiency and promote

commercialisation through internal resource synergy. This encourages industrial clustering and pathway creation locally.

6.4 Tension between Venture Capital and Path Creation

A prominent contradiction is that the operating model of VC generally centres on the pursuit of short-term high returns, which conflicts inherently with the long-term investment requirements of industries in the medical sector (Mazzucato, 2013; Criscuolo and Menon, 2015; McNamee and Ledley, 2017). JH-BIO-1 stated:

> "Venture capital typically pursues short-term high returns, but this does not conform to the realities of the medical industry... medical projects often require long-term accumulation, taking at least five or six years and sometimes more than ten years from project initiation to market launch; this naturally conflicts with the fast-in, fast-out approach of venture capital." (JH-BIO-1)

This short-term orientation leads capital to favour investments in projects that are approaching late clinical stages with shorter return cycles, while showing limited interest in high risk early stage projects. As SZ-BIO-2 explained:

> "The closer a project is to the late clinical stage, the easier it is to secure investment because the uncertainty is reduced and the investment return cycle is more controllable."

This preference may therefore result in severe funding constraints for early-stage projects, causing them to fall into a "valley of death."

> "We encountered difficulties in securing financing, with everyone telling me: 'Once the IT experimental results are out, we will invest in a second round. As long as you have the chickens, I can help you lay the eggs,' yet now we have neither chickens nor eggs." (GZ-BIO-1)

Some entrepreneurs remarked that venture capital in the medical industry often lacks the specialised knowledge to assess project value. GZ-BIO-1 pointed out that many small investment institutions:

> "...have neither a team of scientists nor a basic understanding of medical industry. They even cannot understand what we are talking about." (GZ-BIO-1)

This information asymmetry makes it hard for some VC investors to grasp the technological barriers and long-term potential of innovative drugs. JH-BIO-1 further criticised:

> "Many venture capitalists are accustomed to investing in real estate or other fast-turnover industries, focusing solely on financial metrics and failing to understand our technological barriers and long-term value." (JH-BIO-1)

This phenomenon stems partly from the fact that many venture capital firms have backgrounds that are concentrated in finance rather than technology and therefore lack professional interdisciplinary support. This limitation increases investment risks and may also manifest as a herd effect (Zhang et al., 2021).

The herd mentality of VC is manifested in investment actions that overemphasise the pursuit of market hotspots at the expense of allocating resources based on independent judgment (Li et al., 2010; Li et al., 2021; Nguyen et al., 2023). As mentioned above, most venture capital firms lack the ability to accurately assess projects in the medical industry due to their lack of specialised knowledge. GZ-PHA-1 noted,

> "After the Hong Kong Stock Exchange relaxed the listing requirements for unprofitable medical companies in 2018, the medical industry attracted a large influx of funds in a short period." (GZ-PHA-1)

This reflects the idea that when capital lacks independent evaluation capabilities, it tends to follow policy trends or popular sectors, leading to an overconcentration of resources in a few areas (for example, during Phase 3 a large amount of venture capital was invested in PD-1 and PD-L1 targets), while less popular long-term value projects are marginalised. This exacerbates the risk of market bubbles, and once the hotspot subsides, many companies may fail due to subsequent funding shortages, causing VC asset returns to fall sharply (Nicholas, 2019).

At the same time, venture capital may intervene in firms through contractual clauses or governance structures in its pursuit of returns, thereby undermining the autonomy of management (Lehoux et al., 2016a). JH-BIO-1 observed that:

> "Venture capital not only demands financial returns, but also intervenes in company management through agreements, earn-out clauses, board seats and other means... We (the firms) prefer to maintain control over our own development and are unwilling to lose control of our future direction due to short-term capital involvement" (JH-BIO-1).

Venture capital often imposes a Valuation-Adjustment Mechanism (VAM)[2] to place firms under strict constraints. Such mechanisms are particularly disadvantageous for innovative firms with high uncertainty. HZ-BIO-1 criticised this practice sharply:

> "VAM is almost set according to traditional industry thinking, requiring us to achieve certain mandatory performance or milestone targets within two to three years. This

[2] A valuation adjustment mechanism (VAM) – also known as bet-on agreement – is a provision in an investment agreement whereby the investor and the investee agree on certain "if...then..." conditions based on future performance or events, aiming to balance risks and returns.

> short-term evaluation mechanism is highly unsuitable for a technology startup like mine." (HZ-BIO-1)

VAM clauses impose the uncertainty inherent in scientific R&D on management, requiring them to take responsibility for factors that cannot be controlled. This not only increases operational pressure on the firm but may also lead to resources being diverted to meet short-term indicators, thus hindering effective R&D activities (Stuck and Weingarten, 2005; Klonowski, 2015). According to GZ-BIO-1:

> "In essence, the relationship between venture capital and entrepreneurs is one of mutual game-theory and confrontation... Capital wants to enter at a low price and exit at a high price, while entrepreneurs hope to exchange as little equity as possible for as much money as possible." (GZ-BIO-1)

This conflict of interest is particularly evident in earn-out clauses and may even lead to outright antagonism between the parties.

In summary, the core paradox in financing medical entrepreneurship lies in the misalignment between VC's pursuit of high short-term returns and the typically five-year or longer R&D cycles required for innovative drugs. This creates a cascade of effects: capital gravitates toward late-stage clinical projects with lower uncertainty, leaving early-stage, high-risk R&D in a "valley of death". Meanwhile, investors' lack of professional evaluation capabilities leads to information asymmetry, triggering a herd effect of blindly chasing trends, which exacerbates bubbles and resource misallocation. At the governance level, short-term valuation adjustment mechanisms (VAMs) transfer the uncertainties of scientific R&D to firms, restricting management autonomy and forcing firms to prioritise financial metrics over long-term R&D investment. These structural conflicts undermine the ability of VC to support original innovation effectively but also intensify the tension and opposition between firms and investors, potentially slowing the technological progress and value realisation of the entire industry.

6.5 Chapter Summary

By incorporating interview materials, this chapter shows the agency of venture capital and its mechanisms of influence on regional path creation. Specifically, the chapter first addressed the relationship between selection effects and path dependence in venture capital investment. It pointed out that VC tends to invest in companies within industries with large potential market sizes and clear competitive landscapes. The professional expertise and background of investors significantly influence investment decisions. During this process, VC prefers to invest in regions with abundant resources and strong policy support. Meanwhile, because the professional capabilities and knowledge of VC investors rely heavily on their local social networks, this

exacerbates regional imbalances in industrial development. This process helps us to address the mechanisms of selection effects that quantitative analysis cannot explain, revealing the path dependence of venture capital in promoting regional path creation and clarifying the interactive mechanisms between VC and regional conditions.

The findings show that through financial support, VC effectively alleviates firms' financing constraints on innovation development, significantly improving the region's capital aggregation effect. VC also promotes talent mobility and firm spin-offs, facilitating a deeper integration of local knowledge resources and boosting the competitiveness of regional industrial clusters. From the institutional perspective, VC encourages firms' compliance by engaging in governance structures and decision-making processes while actively responding to and shaping regional institutional legitimacy. In terms of market resources, VC builds varied industrial investment portfolios locally and integrates internal collaborative networks, thus achieving industrial clustering and scale effects.

The chapter also discussed the temporal structural contradictions of VC in path creation. Because of misaligned investment cycles, VC may adopt a more conservative stance in the preclinical research and development of enterprises, pushing projects into the "valley of death." Investors also exhibit a herd mentality in chasing hotspots which accelerates capital accumulation in specific emerging fields but leads to valuation bubbles. The short-term evaluation mechanisms of VC may also pressure enterprises to exit original product development. These findings confirm the potential constraints of VC on regional path creation and provide a significant critical extension to existing theories.

In conclusion, by analysing the specific mechanisms of VC's selection and management effects, this chapter explained the central role and limitations of VC in driving regional industrial path creation. It systematically addressed key unresolved issues using quantitative research – namely how VC creates regional industrial pathways, the interactive mechanisms between VC and local governments and the structural contradictions between short- and long-term dynamics that underlie the lagged effects of VC. In the next chapter, I will analyse the roles played by different types and models of venture capital further.

Chapter 7 Qualitative Insights: Local Investment, Syndication and Government Venture Capital

7.1 Introduction

I have explored in depth the impact of different patterns and types of venture capital, including Geographical Distance, Syndication and Government Venture Capital (GVC), on firm innovation in the heterogeneity analysis section. However, these analyses are still subject to the following shortcomings.

Quantitative analysis confirmed a positive relationship between local investment and firm innovation. I highlighted the path dependency of venture capital in previous analyses which suggested a close connection between VC and geographic distance. However, these analyses fail to explain why geographic distance is so critical to venture capital investment. In fact, while geographic distance does not directly affect regional innovation activities, it constrains the behaviour of VC, thereby influencing regional path creation.

Quantitative analysis also identified the positive role of syndicates in firm innovation but did not explain why syndicates are important or how they influence the mechanisms of regional path creation. The importance of social networks in venture capital investment is undeniable. As a contractual cooperation mechanism, syndicates extend social networks into complementary relationships among venture capitalists, shaping the resource formation mechanisms in regional path creation significantly.

Finally, in the quantitative study I identified a positive correlation between government venture capital and firm innovation. However, this did not explain the intrinsic mechanisms linking the two. The role of government venture capital has long been questioned, particularly by researchers from liberal market backgrounds. Whether China's government venture capital plays a more active role remains an unresolved question. What needs to be addressed here is how China's government venture capital balances market and regional strategies as a key policy tool and contributes to path creation.

This chapter aims to address these issues through interview analysis, and will provide in-depth explanations. Firstly, the chapter analyses the dual role of geographical distance in venture capital investment – its central role in facilitating trust building and information flow – to explain why geographical proximity contributes to the sustained interaction between venture capital

and regional industries. Secondly, the research in this chapter will explore how syndication, through the complementary resources of co-investors, alleviates the information asymmetry brought about by geographical distance. By addressing the selection and cooperation mechanisms of investors in syndicates, the chapter will show why syndications help foster the development of a regional innovation ecosystem. Finally, the chapter will focus on the role of GVC in shaping regional industrial paths. Through field cases and interview analyses, it will uncover the constraints faced by GVC and how it finds a balance between market-driven mechanisms and local government strategies, as well as the specific pathways by which it supports the formation of regional industrial ecosystems. The chapter will not only systematically explain the scientific questions left unanswered in Chapter 5 but will also provide new perspectives for understanding the long-term impact of venture capital on the creation of local industrial paths.

7.2 Local investment in Path Creation

7.2.1 Distance Constraints

Although the widespread adoption of modern communication technologies (such as online meetings and video calls) has to some extent alleviated communication barriers caused by geographical distance, these technologies do not overcome the problem of information asymmetry in long-distance investments completely. Some studies believe that with the increasing popularity of online meetings, the impact of geographical distance on investment decisions is gradually diminishing, particularly in the field of venture capital, where cross-national and even cross-regional investments are becoming more feasible (Han et al., 2021b). These studies argue that the application of online communication tools enables investors to screen projects and conduct investment negotiations across regions more efficiently, reducing the time and cost burdens imposed by travel restrictions. An answer from an interviewee at a startup in Hangzhou illustrates the limitations of communication technology:

> “Because we are often unfamiliar with projects, the most effective way is face-to-face communication to thoroughly discuss matters... The first impression from meeting in person is crucial. Whether the team or the founder possesses entrepreneurial spirit can often be discerned from their demeanour and actions... Phone communication always feels distant, whereas visiting the site allows us to observe whether there is staff turnover and to intuitively sense the overall atmosphere and spirit of the company” (NB-VC-1)

This indicates that communication using digital tools finds it harder to build trust in a company than through body language and overall atmosphere. The general manager of a startup in Hangzhou (HZ-BIO-1) shared that they had reached a preliminary agreement with an important

investor online. However, because of unavoidable restrictions, the potential investor was unable to conduct an on-site visit to their company, ultimately leading to the failure of the collaboration.

The role of geographical distance has been described by some investors as something that can be overcome. One interviewee, GZ-GVC-1, stated that they prefer to visit project sites only when they have to, because even when researching a company it is not necessary to stay for several months. A short-term trip back and forth is sufficient. In other words, for institutions with a relatively low volume of long-distance investments, short-term business trips reduce the long-term stationary costs associated with a specific location, allowing investment managers to mitigate the impact of geographical factors by using more flexible arrangements.

> "Geographical location does not affect us much, but sometimes we do need to go to those places to communicate with the team. For example, going to Guangzhou or Beijing might not be just for one project; it is usually combined with due diligence or follow-up communications on other projects. We wouldn't specifically make a special long-distance trip for a single project unless it is necessary for a face-to-face meeting, such as a board meeting, which usually involves some major decisions." (SZ-GVC-2)

From the perspective of time costs, geographical distance significantly increases the implicit burden of on-site visits. The travel time required for more distant investments weakens the timeliness and frequency of management responses, thus affecting venture capital's direct control over the project (Mason, 2007a; Metrick and Yasuda, 2011).

Geographical distance limits direct contact between investors and the companies in which they invest, making it difficult for them to gain a full understanding of a company's operations and increasing monitoring costs (Gompers, 1995, Green, 1991). SH-VC-1 noted:

> "Whether it's a regular service company or a key project, you need to invest a lot of time. Since we have a good personal relationship with the founders, they will contact me directly when they encounter problems. At such times, I may need to assist them, sometimes dealing with issues from several companies simultaneously ... The greater the geographical distance, the lower the flexibility for investors to make visits, especially when high-frequency interactions or urgent decisions are needed" (SH-VC-1)

The geographical factor is therefore extremely significant.

Although investors believe that the most important aspect of investing is the target company, and that geography is only one factor, perhaps not the most critical, they acknowledge the undeniable impact of distance. They pointed out that by setting up branches and forming local teams in different regions, they can root themselves in the local market to improve the

efficiency of information gathering (SH-VC-2). This reflects the irreplaceable significance of geographical distance for investment institutions precisely.

> "Large institutions may have a wider coverage, even investing nationwide... However, the responsibilities of a single investment manager are not extensive. If an investment firm has multiple managers, each may be responsible for different regions... Although there are fewer geographical restrictions, and they can even invest in foreign projects, they still need to be clear about their capabilities and financial feedback, focusing on the areas in which they perform well." (HZ-AG-1)

This points to the idea that even if institutions achieve broader coverage through geographical expansion, investment decisions still require a balance between resource allocation and information asymmetry. As a consequence, VC tends to invest in local markets where resources are concentrated and the cost of obtaining information is lower (Fritsch and Schilder, 2012). In other words, geographical distance continues to influence investors' decision-making processes by shaping the information environment and operational efficiency.

7.2.2 Social Networks and Local Investments

Local investment significantly affects trust-building and information transfer by improving the frequency and effectiveness of face-to-face interactions (Cumming and Dai, 2010). On one hand, local social networks help investors to establish trust. SH-AG-1 stated that they typically build initial trust in entrepreneurial teams through acquaintance relationships, using introductions from friends to understand the social background of investees to assess their reliability and effectively reduce the risk of information asymmetry. This mechanism of trust makes them more inclined to invest in local or familiar projects. On the other, geographic proximity facilitates the consolidation of trust through frequent face-to-face interactions. SH-VC-3 noted that VC tracks the progress of startups in real-time and addresses uncertainties in operations and development through regular (quarterly or semi-annual) on-site visits and continuous communication with management. This trust-building strategy exhibits systematic and deliberate characteristics.

Driven by the needs for trust-building and information transmission, companies and resources therefore tend to cluster in VC hubs. HZ-BIO-1 noted:

> "Some capital resources may be limited to specific regions; for example, the capital circle in Suzhou is mainly concentrated around Suzhou." (HZ-BIO-1)

When projects are implemented, the local resource advantages of capital may become more pronounced. Another advantage of local investment is that investors can obtain and verify information more easily, reducing the risk of information asymmetry while improving the efficiency of monitoring and managing investment projects (Alexy et al., 2012). Despite

significant advancements in communication technology that have increased the feasibility of cross-regional investment, investment institutions therefore still need to seek a balance in the effective integration of capital and resources.

Social networks reinforce this agglomeration effect, as they provide a key channel for venture capital to acquire projects and influence companies' subsequent financing (Shane and Cable, 2002). Early-stage projects carry higher risks and information tends to be less clear, so as well as relying on their professional expertise, investors depend on information exchange within social networks for decision-making (Zook, 2004). SH-VC-1 noted that on one hand, mutual trust between investors and referrers effectively filters out high-risk or unclear projects, improving investment efficiency. On the other, as investment opportunities in high-potential projects are often limited, network referrals become the primary means for investors to access such projects. For early-stage financing, including angel investments, investor choices often rely on acquaintance referrals or classmate connections (SZ-GVC-3).

Social networks are built on long-term industry experience and career accumulation and therefore have a localized nature. Prolonged local engagement strengthens ties between practitioners, firms and institutions to foster a long-term, stable clustering effect for VC in specific regions (SZ-GVC-2). As the information acquisition capabilities of venture capitalists are closely tied to the breadth and depth of their social networks, VC continually reinforces its dependence on local ecosystems through information and resource exchanges. SH-VC-3's case illustrates the importance of this embeddedness:

> "Due to the close relationship between the heads of two fund companies, they jointly rented an office space when founding their firms... Sharing office space led to frequent project discussions. With limited capacity, we focus on different channels and scopes for project coverage, and these differences enable effective resource complementarity through exchange and collaboration. We not only refer projects to each other but also discuss and offer suggestions based on our respective experiences." (SH-VC-3)

Social networks among VC exhibit "small-world" characteristics locally (Gu et al., 2019). Despite the vast scale of the medical industry, its internal connections are tight, with industry practitioners forming highly structured social networks based on their academic backgrounds, professional experiences and long-term collaborations (Freeman, 1999). According to SH-VC-1:

> "The medical industry circle is actually very small, with members closely interconnected. In Shanghai's circle, most graduated from Jiao Tong University or Fudan, though there are also those from Peking University, Tsinghua or Concord, and they generally know each other. Through shared acquaintance channels, I can obtain evaluations of founders. While these evaluations may not be 100% accurate, cross-verifying information from multiple sources helps." (SH-VC-1)

Influenced by local social networks, VC reinforces path dependency to advantaged regions, contributing further to spatial imbalances in resource and enterprise agglomeration. Once investors lack an in-depth understanding of the local environment, they face higher costs in project screening and greater uncertainty. Driven by the pursuit of maximizing resource utilization efficiency, VC instinctively avoids areas of uncertainty, and capital flows towards regions that are rich in resources and information. HZ-AG-1 said:

> "In the Yangtze River Delta, especially in Zhejiang, we are more familiar with the region, so we choose to focus our efforts there." (HZ-AG-1)

However, this also leads to spatial imbalances in VC investment, potentially resulting in fewer high-quality projects in regions with higher valuations.

> "Among the projects we invest in, about half are concentrated in the Yangtze River Delta... The infrastructure for the medical industry in the Pearl River Delta is relatively weak... Teams and technological capabilities in the Yangtze River Delta are usually stronger than those in Shenzhen, resulting in higher quality projects that are more aligned with our fund's investment needs... There are fewer quality projects in Shenzhen, and the competition is fierce – everyone is scrambling for them. Naturally, the valuations of projects at the same level get pushed up." (SH-VC-4)

Overall, as geographical distance inevitably constrains trust-building and the efficiency of information transmission between entities, local investment effectively mitigates these issues through social networks. However, this does not address the ways in which venture capital can alleviate the limitations caused by increased geographical distance in long-distance investments. In the next section, I will discuss the importance of syndicates' complementary mechanisms for information and resources, as well as their role in the formation of local resources.

7.3 Syndication in Path Creation

7.3.1 Information Complementarity

An important feature of syndicated investment is the sharing of knowledge and information (Dimov and Milanov, 2010; Ferrary, 2010). As different investors possess their own professional backgrounds, industry experience and project channels, Syndications allow all parties to benefit from a richer set of references in project evaluation and investment decision-making, thus mitigating the information asymmetry caused by long-distance investments (Dimov and Milanov, 2010; Fritsch and Schilder, 2012). NB-GVC-1 emphasized that the comprehensiveness

and accuracy of project evaluation can be improved through complementary expertise and in-depth industry experience:

> "In syndication, the first step is to jointly search for and screen projects. For example, if we encounter a project where the judgment is uncertain and a partner firm has deep research and experience in that field, we will invite them to inspect and evaluate the project together... This approach can provide us with more references." (NB-GVC-1)

Different investment firms vary in their coverage channels and focus areas, so frequent information sharing tends to create a complementary flow of information between investors. This information sharing permeates the entire process of project screening and evaluation, where joint analysis and mutual suggestions help each party to make better investment decisions, effectively reducing the risks associated with information asymmetry:

> "The communication between our two companies on projects is actually quite frequent... Sometimes, we even discuss certain projects together, analysing them jointly... providing each other with relevant suggestions to help make better decisions." (SH-VC-3)

Against a framework of syndicated investments, multiple investors participate in the same project, each sharing a small proportion of the investment amount. This effectively reduces the risk exposure for any single investor (Sahlman, 2022; Wang et al., 2002; Kaiser and Lauterbach, 2007). This multi-party participation process means that the capital exposure of each investor is relatively small. Even if a project fails, the losses are distributed among multiple investors, thus reducing the financial risk faced by any single investor.

SZ-GVC-2 pointed out that generally, if a company needs to raise 2-300 million RMB, the lead investor may be expected to contribute more than 100 million RMB. Although investment institutions may have the financial capability to do this, they might not be willing to concentrate too much capital in a single project. In such cases, acting as a co-investor becomes a more flexible strategy:

> "Although we have the capacity to undertake it, such an amount may not be within our most comfortable range. Under these circumstances, we tend to prefer participating as a co-investor." (SZ-GVC-2)

Investors mitigate risk by diversifying capital allocation and relying on institutional arrangements (such as contracts and voting rights designs) to ensure smooth collaboration. Specifically, the allocation of risk and authority in contracts and terms guarantees the stability of syndicated investments. Co-investors, because of the smaller proportions they invest, typically have limited or no voting rights in major decisions, while lead investors hold greater

decision-making authority but bear more responsibility for the investment. SZ-GVC-3 elaborated on why syndication enables risk diversification among venture capitalists:

> "The lead investor, bearing greater financial commitment and decision-making pressure, must assess project feasibility more cautiously. Co-investors, on the other hand, can participate in potentially high-return projects with smaller capital contributions and without significant decision-making responsibilities, thereby reducing risk while sharing in the returns." (SZ-GVC-3)

SH-GVC-1 noted that lead investors are responsible for negotiating key terms in the investment agreement, while co-investors can offer advisory input. Based on this approach, lead investors diversify financial risk and project exposure by involving co-investors, while co-investors, without the primary burden of negotiations, use the lead investor's expertise and information advantage to participate in the investment. They retain certain consultation and expression rights, thereby mitigating the risk of over-investing in a single project (Sahlman, 2022; Wang et al., 2002; Kaiser and Lauterbach, 2007).

Syndicated investment therefore alleviates the vulnerabilities of information asymmetry and the fragile trust relationships caused by geographical distance through information complementarity and institutionalized risk sharing. More importantly, this cooperative mechanism allows investors to identify and screen projects more effectively, thereby optimizing their investment portfolio and balancing returns with risk.

7.3.2 Resource Complementarity

Syndications help VC to provide complementary resources to regions. Syndication cooperation emphasizes the strategic integration of resources between investors to seek greater business value for companies (Keil et al., 2010). According to GZ-GVC-1, partner institutions must possess unique resources or capabilities in certain areas to compensate for the shortcomings of other investors, supporting the above viewpoint. SH-MNC-1 mentioned that:

> "The benefits of group investments lie not only in having a broader perspective on project evaluation but also in accelerating the project's growth through resource sharing. … By joining forces with other resource-rich investors, we can introduce upstream and downstream companies, helping the enterprise rapidly expand its market and enhance its value." (SH-MNC-1)

HZ-BIO-1 emphasized the importance of value-added services from the enterprise's perspective:

> "We do indeed consider resources. Our project falls into a high-end category, and it is impossible to push it forward solely by one entity making arbitrary decisions; it must rely on systematic and industrialized cooperative operations." (HZ-BIO-1)

He believes this kind of cooperation is usually built on the coordinated foundation of six elements, namely government, business, industry, academia, research and healthcare services. In other words, providing the necessary technical, market and management support during the incubation or early growth stages of the enterprise is particularly critical.

> "If an enterprise requires industrial resources, then during the financing stage they tend to prefer bringing in CVC. For example, for enterprises in the biotech reagents sectors, they expect that CVC can truly bring about the integration of upstream and downstream resources to help them penetrate the supply chain... These industrial capital providers themselves have rich channels and sales resources, which can offer substantial business support to the enterprise." (SZ-GVC-2)

Another interviewee discussed the importance of this resource complementarity further.

> "If we partner with an institution, at least in some respects, they can provide resources or assistance to the enterprise that we cannot offer... Inevitably, issues will arise during the operation of a company. Most companies face certain challenges, and that is when the role of the investor comes into play. We need to help the enterprise resolve these issues, facilitate resource connections, and help the company overcome difficulties." (SH-VC-1)

In other words, from the investors' perspective, the syndications brought about by this complementarity not only improve the enterprise's overall resource acquisition capability but also strengthen its ability to respond to inevitable challenges during operations, thereby enabling the investors to obtain higher returns from the project (Lerner, 1994). This synergistic effect of resources helps to boost the company's competitiveness and potential for development, and even becomes one of the key criteria for evaluating potential partners (Wang and Tan, 2024).

Prestigious institutions help to form syndicates and attract more resources, thereby accelerating regional development. The attitudes of good-reputation VC are often seen as a key indicator of project quality. This is not only because professional institutions have the capability and experience to conduct systematic due diligence, but also because they have significant advantages in integrating industry resources and exchanging information (Hochberg et al., 2007). According to SZ-GVC-2, once a professional institution expresses approval for a certain enterprise or project, other potential investors are more inclined to follow suit. Whether top institutions choose to invest therefore forms an important benchmark for market evaluation, which has a directional selection effect on the enterprise's subsequent financing and development.

> "After one company rejected our investment, they later approached us... During our discussions with Sequoia, we learned about the problems within that company and the specific reasons for their withdrawal... In the end, we also did not invest... The

> decisions made by these leading institutions serve as a significant reference for us." (SZ-GVC-2)

In fact, well-known large institutions and smaller niche firms both play important signalling roles. NB-VC-1 pointed out that large, comprehensive funds often have strong brand endorsements and cross-industry resources, which enables them to provide multi-faceted empowerment to the investee in terms of subsequent financing connections and market promotion. Meanwhile, "small and excellent" specialized institutions hold more precise resources and deeper industry knowledge in specific segments.

This signalling effect may evolve into a herding effect, further promoting capital formation in a region. The entry of large, well-known institutions is often seen as a high-level endorsement, while investments from smaller and more specialized institutions may convey more targeted and professional recognition. From the perspective of regional industrial development, this diversified signalling plays a significant role in attracting the attention of other venture capital, leading to herding behaviour (Stuart, 2000; Gulati and Higgins, 2003). SH-VC-1 pointed out that when market sentiment is high or a certain sector becomes a hotspot, various institutions tend to compete more keenly for high-quality projects, resulting in a large influx of capital in the short term. This behaviour contributes significantly to regional capital accumulation.

Meanwhile, syndicates also amplify the impact of the herding effect, driving the clustering of projects in a region. SH-VC-3 noted that:

> "For highly attractive projects, large firms will try to compete for a larger share. Founding teams are also happy to see competition among investors, as it gives the company the power of reverse selection." (SH-VC-3)

Within syndicates there is an allocation of shares, and because of the limited shares, transactions can become overly crowded during periods of high liquidity. Competition for popular projects can be extremely intense, leading ultimately to valuation bubbles. However, the momentum of herding primarily stems from the blind following of leading institutions and hot sectors, and heightened market expectations can lead to excessive crowding of transactions, ultimately giving rise to valuation bubbles (Della Rossa et al., 2020a; Choi et al., 2015). SH-VC-1 stated:

> "Hotspots are often driven by unexpected events, which are typically hard to predict. For example, mRNA vaccines were barely noticed before the pandemic, but the sudden outbreak made them a market hotspot, with related companies' market valuations soaring to 160 billion or even nearly 200 billion at one point. Since hotspots are hard to predict, I believe the best strategy is broad deployment, which means casting a wide net across various sub-industries, hoping that one day a certain sector will explode due to an unexpected event." (SH-VC-1)

In other words, the herding effect is short-term in nature, and since specific events cannot be predicted precisely, some investors adopt a more diversified investment strategy, as there will always be a sector that hits the hotspot. The herding effect therefore leads to an investment spillover in venture capital which locally contributes to the formation of related industrial chains, thus promoting the creation of regional industrial paths.

In summary, syndicates mitigate the information asymmetry caused by long-distance investments through complementary relationships. Meanwhile, they bring resource complementarity effects and promote the correlated development of regional industrial paths further through the herding effect. However, as discussed above, the constraints of geographical distance encourage venture capital to invest in specific regions, resulting in spatial imbalances in projects and resources. Government venture capital is therefore particularly important for the creation of regional industrial paths. In the next section, I will discuss its role in more depth.

7.4 Government Venture Capital in Path Creation

7.4.1 Local-First Principle

There is a close link between a VC firm's shareholder structure and its investment decisions. The presence of local state owned shareholders gives VC a preference for investing in its home region (Tsui, 2011; Wu, 2023). The primary reason for this is that one of the core goals of local governments as shareholders is to achieve sustainable regional economic development by promoting local economic growth, innovation, job creation and the integration and upgrading of the local industry chain (Karsai, 2018). The experiences of the interviewees confirm this:

> "In our company, 80% of the shareholders come from local government, and another 20% come from the provincial government... From the shareholders' perspective, they naturally hope that the funds they invest will promote local development, which is a reality we cannot avoid. This is why we focus more on local projects in our daily work... Currently, about half of our projects are with Suzhou-based companies, and of those, 50% are concentrated in the Suzhou Industrial Park." (SZ-GVC-2)

As a result, GVC often adopts a local priority policy, meaning that they pay more attention to regional projects and are more likely to invest in them. GVC prioritizes the promotion of local economic development by supporting innovative local companies and SMEs (Colombo et al., 2016; Cumming and Johan, 2013; Hood, 2000). In other words, GVC is more focused on the growth potential of local companies, and aims to improve the competitiveness of local

industrial clusters and promote technological advance and the development of emerging industries.

According to the interviewees, GVC takes a more cautious approach to projects outside their local region. SZ-GVC-2 also pointed out that external projects face stricter requirements in comparison to local projects. External projects must demonstrate outstanding performance and offer stable or higher expected returns in order for them to be prioritized by GVC. However, these companies are less likely to relocate to the local area because of their size and maturity.

GVC's particular focus on local companies is also reflected in their efforts to ensure that these companies remain rooted locally and develop over the long term. SZ-GVC-3 believes that many regional state-owned venture capital funds have an element of attracting investment. Although there are no fixed requirements or terms demanding that companies stay local, GVC handles this flexibly based on specific circumstances to ensure companies remain in the area over the longer term. If a company considers relocating, GVCs may exert pressure – such as voting against the move at shareholder meetings or board meetings to prevent the company from leaving the region (SZ-GVC-2). Another interviewee elaborated on the relationship between GVCs and the government, highlighting their consideration of regional development planning:

> "We are an important tool of the municipal government, though not the only one, but we are certainly the largest state-owned capital platform… When the city government has relevant needs, we maintain long-term interaction and contact with the mayor, the city's investment promotion office and the investment departments of the counties and districts. We jointly evaluate projects… If a project belongs to a growing industry and aligns with Ningbo's overall planning, we will definitely increase our support." (NB-GVC-1)

In this process, local governments collaborate with GVC to provide support to help companies grow. According to GZ-GVC-1, this represents a "development strategy of attracting through investment." By investing capital, companies are required to establish roots in the local area, set up factories or establish companies. Local governments attract potential companies by offering tax incentives, government subsidies, land discounts and talent support policies. The stronger the policy support, the greater the likelihood of investment success.

7.4.2 Balancing Markets and Government

GZ-GVC-1 pointed out that in the early stages, companies often lack sufficient collateral assets and market recognition, so introducing state-backed venture capital helps to strengthen external investors' and potential partners' confidence in the company's development. A government endorsement to some extent improves its credit rating and its ability to secure capital. This finding contrasts with some researchers' opinions (Lerner, 1999; Mason and

Harrison, 2003). More importantly, state-owned capital can not only bring direct financial support but also advantages in leveraging governmental policy benefits and subsidies, which provide crucial assistance in supporting enterprises. Some early-stage entrepreneurial teams, when facing funding gaps or strategic development needs, therefore tend to seek government investment proactively to gain a first-mover advantage. However, not all companies respond positively to this.

> "The upstream and downstream industrial chains of a company are usually clustered near its current location. If government investment requires the company to relocate elsewhere, it will inevitably affect the existing industrial chain. ... Companies may have already invested a large amount of cost in their current location, with factories and equipment already built. Relocating due to government investment would inevitably incur significant sunk costs." (SH-VC-3)

when attracting investment, many GVC funds tend to favour siting or relocating quality projects locally to stimulate regional economic development. However, for some companies, such policy-driven relocation requirements may conflict with their existing supply chains and fixed asset investments (Bornert and Musolino, 2024). Consequently, when evaluating whether to introduce government investment, management tends to weigh the options carefully, sometimes even rejecting it. HZ-BIO-1 further noted that:

> "GVC sometimes acts with excessive impatience... During the angel round of investment, the government often sets rather strict earn-out conditions. For example, GVC might require the company to reach certain milestones within a specified period. If these are not met, it will trigger repurchase clauses or other liability provisions. ... This is also why many entrepreneurial teams prefer to seek venture capital that can tolerate failures and offer long-term support." (HZ-BIO-1)

Earn-out agreements are commonly used as an incentive and a protection mechanism in venture capital. However, because of concerns about safeguarding state-owned assets and achieving short-term returns, some GVCs tend to design the terms more severely. Although this can lower the investment risk for the government side, it restricts the company's flexibility in R&D innovation and business expansion and might even force the company to focus excessively on short-term milestones at the expense of long-term strategic planning. Some startup teams favour market-based venture capital in the early stages, with its higher tolerance for innovation and institutions with strong reputations. Such investments not only reflect a hierarchy of capital but also serve as a powerful signal (Alperovych et al., 2020).

> "Precisely because government funds often come with numerous local requirements and policy conditions, when given a choice we prefer to avoid capital with a government background. ... In terms of market-based funds, we tend to prioritize internationally renowned investment institutions such as Sequoia Capital or Hillhouse Capital. These top-tier funds not only have strong financial power but

> can also enhance the company's profile through brand endorsement and market reputation." (SZ-BIO-3)

When selecting GVC as a partner, market-oriented VC focuses on whether the project shows sufficient market prospects and operational feasibility. NB-VC-1 stated:

> "Whether to co-invest primarily depends on the project's quality and degree of market orientation... Although GVC has become more market-driven, and some government-led investment projects exhibit strong market competitiveness, I tend to be more cautious if I find a project is forcibly driven by the government and lacks a market-based foundation." (NB-VC-1)

NB-GVC-1 explained why market-oriented VC needs to evaluate GVC projects carefully:

> "When aligning with government investment needs, the will of local leaders can influence investment decisions to a certain extent. ... When the government believes that a particular industrial sector has strategic value, GVC usually pays special attention and conducts in-depth evaluations of related projects. ... In strategic investments, the government typically has diversified objectives. For example, driving regional economic growth by introducing quality enterprises, promoting employment, or improving industrial chain layouts. ... Such projects are often based on government directives rather than purely on market logic." (NB-GVC-1)

This means that the evaluation and execution of some projects are typically integrated with the directives of government officials and are no longer solely market driven. Instead, they have to strike a balance between economic benefits and government macro-planning. This is particularly challenging for investment teams within GVC because they must balance returns with regional development needs to ensure a project's feasibility and sustainability.

In fact, GVC has an inherent market-oriented tendency. According to GZ-GVC-1:

> "The government has very high requirements for preventing the loss of state assets, so when GVC invests, it takes into account both the effects of attracting investments and economic benefits. ... Projects usually undergo strict scrutiny to ensure that the target quality is relatively high, especially at certain stages of the project when a clear development prospect is required." (GZ-GVC-1)

Compared with private capital, GVC has to balance fiscal supervision and social responsibility, and therefore establishes multiple review processes and approval checkpoints to ensure the safety of funds and the feasibility of projects.

> "This also makes the process more complex and sometimes causes us to miss the best opportunities" (SZ-GVC-2)

However, it also makes GVC investments more robust.

Although the more diversified objectives of GVC impose numerous constraints on its investment decisions (Grilli and Murtinu, 2014), which may lead to some companies' resistance, its direct access to government resources means that it has more opportunities to reach quality local projects, which to some extent alleviates the situation. SZ-GVC-2 mentioned:

> "Locally, we strive for full coverage of all innovation and start-up enterprises, so we employ a 'grid-based' visitation approach. "'Grid-based' means that each year we visit the talent enterprises introduced to Suzhou and establish a system for regular follow-up visits" (SZ-GVC-2).

In summary, because of the local government background of GVC's shareholder structure, GVC tends to prioritise supporting local projects to promote regional economic development. GVC maintains close coordination with local governments, using measures such as financial guidance and complementary policies to encourage firms to establish or remain in the region. However, this policy orientation may conflict with firms' existing industrial chain layouts, cost considerations, and pursuit of flexibility and long-term development, leading some firms to adopt a more cautious stance toward accepting government capital. Meanwhile, to safeguard state-owned assets, GVC often imposes stricter VAMs and approval processes which, while improving investment stability, may result in missing high-quality projects or stifling firm innovation. Against this backdrop, I will discuss how GVC supports the development of regional industrial pathways in more detail below.

7.4.3 Key Mechanisms

GVCs promote local development through the following mechanisms firstly by amplifying resources through reinvestment clauses, which attract external capital to the local area; secondly by creating agglomeration effects through the establishment of different funds that invest in related industries, enriching and strengthening the local ecosystem, and thirdly by providing long-term support through alignment with regional long-term goals and local development planning.

Firstly, reinvestment clauses are very common in China's GVC industry and play a role in amplifying government capital and facilitating project localization (Ge et al., 2024; Suchard et al., 2021). According to SZ-GVC-1,

> "Government funds are often established to support early-stage projects, especially in the angel investment phase, where government support fills the gap when other capital is reluctant to step in. However, when projects advance to larger financing stages, such as raising 30 million, 50 million, or even several hundred million,

> government funds are limited and need to rely on institutional power to amplify the effect of the investment." (SZ-GVC-1)

According to SZ-GVC-2 and SH-VC-3, GVCs sometimes set up specialized guiding funds, which operate as parent funds. These funds invest in management teams with proven track records, and the government subscribes to portions of the new fund by attaching a reinvestment clause. This clause requires the fund to invest a certain proportion of the capital in local projects. The example provided by SZ-GVC-1 helps illustrate the significance of the reinvestment mechanism:

> "For example, if the government gives you 1 million yuan, they will require you to invest 2 million yuan locally. This way, the original 1 million yuan can generate greater value. So, according to the requirement, you need to raise another 1 million or more to meet the 2-million-yuan local investment requirement." (SZ-GVC-1)

In the medical industry, GVCs favour the reinvestment mechanism because of the long investment return cycle. In this case, the government prefers private capital to take over, as private capital teams are typically more professional (SZ-GVC-1). As a result, private capital will accept GVC investment along with the attached conditions, and the invested company can either relocate its headquarters or set up a subsidiary locally to meet the requirements of GVC. This achieves the local government's goal of attracting investment and amplifies the effect of government investment, thus increasing the local capital pool and helping the region to create new industrial paths.

Secondly, to achieve genuine industrial localization and sustainable development, GVC aims to create economies of scale and agglomeration effects in the local area (Alperovych et al., 2020). On one hand, some projects have funding levels that reach tens or even hundreds of billions of yuan, and these strategic regional investments sometimes account for more than 90% of a GVC's portfolio (NB-GVC-1). On the other, to promote the development of the local medical industry, the government invests in dozens of funds through fund-of-funds (FOF) structures. The reinvestment mechanism gives them the chance to concentrate hundreds of projects in the region, forming economies of scale and driving rapid local industrial growth (SZ-GVC-1).

GVCs not only consider the growth of individual companies but also focus on the complementary relationships and synergies between local companies. According to SZ-GVC-2, they are primarily interested in Contract Development and Manufacturing Organizations (CDMOs). By investing in local CDMO companies, GVC facilitates collaboration between pharmaceutical companies and CDMO firms, ensuring that the invested firms become customers of the CDMO companies and helping innovative drug companies to solve production issues. This complementary relationship between industries creates a positive interaction that encourages the agglomeration effect of the entire sector within the local ecosystem.

NB-GVC-1 noted that GVC also creates the necessary conditions for local industrial clustering by attracting high-end talent and large enterprises. Many projects in the biomedical industry originate from universities and research institutions, and GVC attracts high-calibre talent such as academicians through support from national and provincial talent programmes, significantly improving the region's talent competitiveness and encouraging the coordinated development of the regional economy and talent pool. Meanwhile, by facilitating the establishment of relatively mature projects, GVC drives the agglomeration of upstream and downstream industrial chains, thus promoting sustained growth in regional employment and talent demand and forming a long-term competitive advantage.

Lastly, some leading GVCs will adopt long-term support strategies, ensuring the continuity of local development strategies. SZ-GVC-1 believes that the government has developed a fairly mature investment model, as this work has been ongoing for over a decade. Unlike typical funds, which often have a lifespan of 7 to 9 years, some GVC projects have no such limitations (SZ-GVC-3). This is because these GVCs' initial funds came from local government finance departments, and they have already repaid those initial funds through early investments. In other words, the capital is now fully owned by the firm. With subsequent investments, this capital continues to accumulate and expand in a snowball effect (SZ-GVC-2). As a result, the funds can be recycled, with exits from one project leading to reinvestment in others.

> "In the past 21 years, we have directly invested in about 300 projects, of which more than 50% were held for over 10 years. The longest-held project went public last year, and we had held it for 17 years. (For our own funds), we have no strict requirement for how long we must hold the investment. Since we don't have the pressure to liquidate or settle with investors, we can hold it as long as we need to. The rolling use of our own funds also gives us greater operational flexibility with no specific time constraints." (SZ-GVC-2)

To summarise, GVCs play a role in building and amplifying resources that are matched to the local area. Since local governments are the main shareholders of these venture capital firms, GVCs tend to focus more on local development, innovation and job growth. As such, they impose stricter requirements on projects outside their region, while local governments work with GVCs to offer policy support to the companies GVCs invest in, increasing the likelihood of their success. GVCs have a significant impact on local development, which is amplified through a series of mechanisms to achieve long-term growth. Firstly, reinvestment clauses amplify local resources. Secondly, GVCs create economies of scale as well as talent and industry clusters by investing in related projects. Finally, GVCs anchor long-term goals in promoting local economic development. In the following section, I will critically examine the roles of syndication, geographical proximity, and GVCs.

7.5 Chapter Summary

Through qualitative interviews, this chapter explored the complex mechanisms by which geographical distance, syndication and GVC influence corporate innovation and the creation of local industrial paths, explaining processes that quantitative research was unable to address. The analysis in this chapter firstly addressed the fundamental question of "Why is geographical distance so crucial to venture capital in creating regional industrial paths and maintaining long-term local interactions?" The role of geographical distance in shaping regional industrial paths is reflected via three aspects: trust building, information asymmetry, and management efficiency.

Firstly, geographical distance directly affects the establishment of trust between investors and investee companies. Although modern communication technologies have to some extent alleviated this issue, they cannot fully compensate for the lack of trust caused by distance, so local social networks and face-to-face interactions remain irreplaceable. Secondly, geographical distance influences the availability of information. In a close-proximity investment environment, investors conduct more frequent on-site visits, thereby reducing the risks associated with information asymmetry, whereas long-distance investments exacerbate the difficulties involved in verifying information. Thirdly, geographical distance also affects capital efficiency by influencing management response speed and resource integration capabilities.

These findings explain the core reason why geographic distance is critical to regional path creation. Meanwhile, the time costs and management burdens associated with long distances make investors more inclined to concentrate investments in regions with local resource advantages, thereby forming a capital agglomeration effect. This capital flow pattern also shapes regional industrial pathways, continuously reinforcing the development potential of capital-intensive regions while capital-scarce regions face challenges to growth. Geographic distance therefore not only shapes the spatial distribution of venture capital but also influences the formation and long-term development of local industrial clusters through path dependency mechanisms.

Syndicated investment plays a significant role in alleviating the constraints imposed by geographical distance and shaping regional development, with its impact primarily reflected in information complementarity and risk sharing as well as selection effects and resource integration. This addresses the question of "How does syndication alleviate the constraints imposed by geographical distance and shape regional development, and why are more investors more likely to promote innovation?"

On one hand, syndication reduces the capital exposure risk for individual investors in long-distance projects through multi-party participation and risk sharing. Because risks are spread among multiple investors, the financial impact on any single institution is minimized even if a project fails. Different investors, using their complementary expertise and market insights, assess project quality jointly and share information during subsequent management, effectively reducing cognitive biases and errors of judgment caused by geographical distance, thus alleviating the problem of information asymmetry in long-distance investments. On the other, the selection of partners in syndication helps integrate diverse resources further to promote innovation and growth in regional enterprises. Different investors not only expand the regional capital pool but also help investee companies in market expansion and supply chain construction through their unique resource advantages. This cooperative mechanism improves the diversification of regional industries and promotes agglomeration. The signalling effect of top-tier capital in a region reinforces this trajectory development mechanism further. Therefore, in comparison to single investors, multi-party cooperation through syndication is more likely to promote innovation in regional enterprises and drive the development and strengthening of regional industrial paths.

Finally, the quantitative study identified a positive correlation between government venture capital and firm innovation; however, this did not explain the intrinsic mechanisms linking the two. The role of government venture capital has long been questioned, particularly by researchers from liberal backgrounds, and whether China's government venture capital plays a more active role remains an unresolved question. This chapter addressed how, as a key policy tool, China's GVC balances market and regional strategies and contributes to path creation.

I systematically addressed the question of "how government venture capital balances market mechanisms and regional strategies, and through what pathways it shapes regional industrial development," to address the questions that quantitative research could not answer. GVC is strongly influenced in its decision-making by local government stakeholders, and tends to adopt a local priority principle, concentrating investments in local projects to promote regional industrial development and serve regional strategic goals. However, the stringent earn-out conditions and mandatory relocation requirements imposed by GVC may conflict with companies' market-oriented aims, highlighting the dilemmas that arise from pursuing dual objectives. In this context, GVC balances market and regional strategies in the following ways: On one hand, GVC ensures investment safety and returns through rigorous review processes and earn-out clauses, thereby emphasizing market-based mechanisms. On the other, it improves resource supply capabilities through policy support mechanisms such as tax incentives and land discounts, thereby attracting external capital and quality projects to settle locally.

More specifically, GVC shapes regional industrial development through three mechanisms: Firstly, reinvestment clauses amplify the local capital pool, driving local project concentration; secondly, GVC creates economies of scale and agglomeration effects that strengthen local ecosystems by establishing guiding funds and investing in related industries, and thirdly, GVC anchors regional planning objectives to ensure the sustainability of industrial paths through long-term support strategies such as extended holding periods and capital recycling. In summary, GVC plays a key role in shaping regional industrial paths, although its effectiveness is contingent upon the alignment of market orientation and local governmental support.

Chapter 8 Conclusion

8.1 Integrating Quantitative and Qualitative Findings

This study used quantitative models to address the "when," "where," and "what" questions, and qualitative analysis to answer the "why" and "how" questions. Quantitative results identified a causal relationship between venture capital and regional path creation but struggle dto explain the underlying mechanisms and causes in any depth. Through interview data, the qualitative analysis emphasized the understanding of micro-mechanisms and complex processes to address the theoretical shortcomings of the quantitative research and highlight the richness and complexity of the role of venture capital. Table 8-1 summarizes the contributions of quantitative and qualitative results in addressing the research questions.

Table 8-1: Quantitative and Qualitative Responses to Research Themes

Research Theme	**Quantitative Findings**	**Qualitative Findings**
Spatial Distribution and Evolutionary Characteristics	Revealed the uneven spatial distribution in the Yangtze River Delta's medical industry and confirmed the co-evolutionary relationship between venture capital and regional ecosystems.	Described the windows of opportunity under institutional transitions and local government actions to explain the differences in development processes between high-growth and low-growth cities.
Role of Venture Capital	Empirical evidence shows that venture capital has a near-causal impact on enterprises' clinical trial activities, accompanied by the expansion of regional innovation activities and increased industrial diversity.	In-depth interviews showed how the selection effect of venture capital influenced the regional path creation process and analysed its role in the formation of regional resources.
Different Modes of Capital Investment	Empirical models show that different types of venture capital have a significant positive effect on path creation.	Interviews highlighted the impact of geographic distance on trust, information flow, and management efficiency, showing that syndicated investments mitigated information asymmetry caused by distance and

		enabled resource complementarity, while government venture capital promoted regional development by balancing returns.

Quantitative analysis revealed spatial imbalances in the Yangtze River Delta's medical industry, categorizing cities into high- and low-growth groups. Using the HHI index and coupling coordination degree, the study found that due to the high concentration of venture capital fund managements in a few cities, the geographic distribution of venture capital investment activities does not align with the sources of venture capital funds, and innovation activities appear more concentrated within the industry. The quantitative analysis uncovered the temporal evolution trends of entrepreneurial ecosystems in different regions and the co-evolutionary relationship between VC and these ecosystems.

The qualitative analysis, by adopting a multi-level perspective, first discussed the changes in institutions and niche markets under landscape pressures, revealing the temporal opportunity windows in the development process of China's medical industry. The study examined the differences in policy and institutional changes between regions, identifying path-dependent characteristics in the development of the medical industry in different areas. It further explained that the transformation of temporal windows of opportunity into local windows of opportunity depended on the foundation of local entrepreneurial ecosystems and the policy orientation of the region.

The quantitative analysis confirmed the promoting effect of VC on clinical trial activities in the YRD. Specifically, empirical model results verified a potential causal relationship between investment fundings and enterprise clinical trials. The impact of venture capital exhibited time-lag effects and regional heterogeneity. Regional-level analysis further demonstrated that VC contributes to expanding the scale of innovation activities and enhancing industrial diversity.

The qualitative study explained the specific mechanisms through which venture capital influences the regional innovation process in more depth. It highlighted the selection effect and path dependency in venture capital investment decisions, noting that investors tend to prioritize industries with greater potential market as well as more competitive enterprises. This leads them to focus their investments in specific regions, confirming their capabilities for endogenous growth. VC also gravitates toward regions with stronger policy support, and its heavy reliance on social networks exacerbates investment imbalances further.

Interview materials clarified how venture capital facilitates the regional formation of financial, knowledge, institutional, and market resources during the post-investment phase in greater detail. As VC prioritizes investments in niche markets, new enterprises are more likely to cluster in specific regions, encouraging the formation of knowledge and technology in those areas. Institutional legitimacy is also improved through VC's local political network resources. Ultimately, through the interplay between the agency of VC and regional structures, regions gradually form new industrial paths.

Finally, empirical models confirmed the positive role of different modes and types of venture capital in path creation, while qualitative interviews provided deeper insights into how they influence regional innovation and path creation. Geographic distance affects trust-building, information availability, and management efficiency, thereby shaping the spatial distribution of capital as well as regional industrial pathways. Syndicated investments effectively mitigate the limitations of geographic distance through multi-party collaboration and resource complementarity, reducing information asymmetry and cognitive biases in long-distance investments and promoting regional firm innovation and industrial agglomeration. Meanwhile, GVC seeks a balance between investment returns and regional development, with its decision-making and operational practices showing distinct regional characteristics and policy orientations that reflect unique path creation mechanisms.

This chapter will discuss the research findings in detail. In the next section, I will examine the study's findings in the light of the research questions, covering three aspects: the regional development of VC, the role of VC in path creation, and the impact of different types of VC. This will be followed by a critical reflection on the role of VC. Building on this, I will propose the broader implications of this study, including academic and policy dimensions. Finally, I will address the limitations of this study and offer directions for future research.

8.2 Answers to Research Questions

8.2.1 The Regional Development of Venture Capital

Specifically, institutional changes and the accumulation of venture capital can be viewed as a dynamic process of co-construction between multi-level structures and opportunity spaces in the evolution of the medical industry in the Yangtze River Delta. From 2001 to 2009, the Chinese government opened niche markets for the medical industry and constructed region-specific opportunity spaces through institutional innovations such as establishing Urban Employee Basic Medical Insurance, New Rural Cooperative Medical Scheme and Urban Resident Basic Medical Insurance. During this phase, macro-institutional support provided a protected

foundation for niche innovations, with cities boasting significant research resources while local fiscal advantages took the lead in forming preliminary differentiation in entrepreneurial ecosystems. However, the overall development level of VC was low, with only a few core cities with international perspectives and potential for technological spillovers accumulating capital under institutional empowerment. Between 2010 and 2014, regional policies that were aimed at resource aggregation advanced further, with local governments using multi-level collaborative platforms and innovation park support systems to strengthen industrial innovation paths strategically. The ecological differences between high- and low-growth city groups were pronounced, with venture capital investments concentrated more highly in core clusters, showing strong path dependence effects. From 2015 to 2019, leading regions shifted from merely pursuing resource expansion to optimising underlying institutional frameworks alongside capital market reforms and improvements in drug approval efficiency. High-growth cities continued to accumulate entrepreneurial resource advantages, while low-growth cities focused on improving park infrastructure and support systems. The entrepreneurial ecosystem across the entire Yangtze River Delta became more robust at a broader scale, with industrial innovation capabilities beginning to diffuse into surrounding areas. VC investment typically evolved from high concentration to a multi-node distribution, highlighting a positive feedback accumulation mechanism of co-evolution between regional equity supply and entrepreneurial ecosystems. Overall, the medical industry in the Yangtze River Delta was in an acceleration phase between 2010 and 2019.

High-growth cities capitalised on local industrial parks, attracted resource agglomeration, and implemented approval system reforms, transforming the temporal opportunity spaces of the three phases into regional opportunity spaces for local industries. This strategy facilitated the development of elements and actors within regional entrepreneurial ecosystems. As a result, VC showed significant concentration in the high-growth group. The preference of venture capital for high-quality projects reinforced investment behaviour in mature entrepreneurial ecosystems, forming a continuously strengthening path dependence that enabled high-growth regions to maintain their lead.

Low-growth cities, despite having access to the same temporal reform opportunities as high-growth cities, lacked sufficient local government support, preventing them from effectively amplifying institutional opportunities. In fact, the local ecosystems of low-growth groups were comparatively limited. Insufficient knowledge reserves, coupled with a lack of incubation and service platform resources, made it difficult for these regions to achieve collaborative innovation. As such, low-growth groups struggled to attract venture capital and failed to establish synergistic mechanisms between capital and innovation, leading to prolonged stagnation in terms of their industrial development.

8.2.2 The Role of Venture Capital in Path Creation

The study showed the spatial-temporal evolutionary characteristics of venture capital. On one hand, it discussed the co-evolutionary mechanisms between VC and regional industrial development. On the other, it highlighted the "dispersed-concentrated-dispersed-concentrated" pattern of venture capital, from capital providers to capital managers, to capital recipients, and finally to innovation activities. These findings expand our understanding of the dynamic evolutionary mechanisms of VC, providing critical insights into the relationship between it and local development.

This study also confirmed the impact of venture capital on corporate innovation activities during the acceleration phase of regional industry, as well as their potential causal relationships, and discussed the enhanced role played by venture capital. It found that the effect of VC on firm clinical trials strengthened over time, with the most significant innovation activity observed in the third year after financing. This showed the cumulative effect of venture capital in path creation, underscoring its role in post-investment management during firm development. The study also confirmed structural differences in industrial path development between regions, indicating that regional entrepreneurial ecosystems exert a strong selection effect on VC, which was reinforced further during development. Notably, high-growth groups are not tied only to economic activity; industrial clusters can also drive regions toward path creation, as seen in Taizhou (Zhejiang) and Taizhou (Jiangsu). This offers valuable policy references for less developed regions that seek to create new industrial paths.

Qualitative research further explored how, in the path creation process of the Yangtze River Delta's medical industry, VC used its unique professional capabilities and capital allocation logic to play an active role in shaping the technological direction and industrial cluster formation of emerging regional industries through pre-investment selection and post-investment management. On one hand, VC rigorously screened firms and industry potential, prioritising resource allocation to the most promising subsectors and competitive firms within the region. On the other hand, VC continuously shapes firm capabilities post-investment, accelerating the evolution of regional paths by integrating financial, knowledge, institutional and market resources.

At the financial resource level, VC alleviates early-stage funding bottlenecks in clinical R&D for medical startups through multiple rounds of financing and refinancing. Based on the limited partnership model, capital flows continuously to the Yangtze River Delta as a financial and innovation hub to provide a foundation for the growth of medical firms. In terms of knowledge resources, VC improves the reserves of regional technical knowledge with its extensive social networks and academic backgrounds by introducing projects led by overseas returnee

scientists, facilitating employee mobility and fostering firm spin-offs. Meanhilw, VC also organises regular industry seminars and business association activities, sharing experience and management knowledge to help portfolio firms accumulate expertise. From an institutional resource perspective, VC strengthens the operational standardisation of portfolio firms through board seats and governance compliance mechanisms. This accumulation of institutional resources is also evident in policy alignment and interactions with local governments, securing greater policy support for technological legitimacy. Finally, VC focuses on unmet clinical needs and builds diversified local investment portfolios by nurturing market resources, driving the rapid transition of medical innovation from laboratories to clinical and market applications. The portfolio-based investment strategy also accelerates the agglomeration of upstream and downstream industry chains, promoting regional path creation.

8.2.3 Variants of Venture Capital and Path Outcomes

In the Yangtze River Delta's medical industry, VC embedded in localised networks reduces information asymmetry and trust-building costs, facilitating the initial formation of regional innovation pathways. Enabled by geographic proximity, the efficiency of face-to-face interactions allows local venture capital firms to establish early trust with entrepreneurial teams using familiar networks. By integrating government and industry resources, these VC firms provide value-added services to their portfolio companies, accelerating the incubation of innovative medical technologies and business models within structured operations. However, long-distance investments pose challenges for venture capital, meaning that the syndicate investment model is particularly significant.

The model plays a crucial role in enabling information and institutional risk-sharing, thereby encouraging path creation in the YRD's medical industry. Different venture capital firms contribute channel resources and industry expertise via joint investments, providing references for project screening and evaluation. This reduces decision-making risks for individual firms due to distance or knowledge gaps. Meanwhile, the clear delineation of responsibilities between lead and follow-on investors in contract design ensures more robust capital participation, improving the efficiency of enterprise R&D. Moreover, the signalling effect from investors of varying scales and sectors guides substantial social capital to converge rapidly on high-potential medical subsectors in the Yangtze River Delta, accelerating the development of the regional medical industry chain through market bandwagon and adverse selection mechanisms.

GVC acts as an amplifier in the long-term process of path creation in the YRD's medical industry through local-first policies and reinvestment mechanisms. On one hand, GVC leverages local

government resources within its shareholder structure, using reinvestment clauses, parent funds and fund-of-funds (FOF) models to attract market capital to amplify the impact of government funds and facilitate the establishment of large-scale pharmaceutical innovation projects in the region. On the other, GVC uses policy coordination and investment attraction mechanisms to promote talent acquisition and industry clustering. Some regions use indefinite holding periods and reinvestment cycles to balance institutional resource redistribution with long-term regional goals, ensuring sustained development and path creation within the local medical industry.

8.3 The Limits of Venture Capital in Path Creation

Although this study emphasizes the positive role of VC in path creation, it is undeniable that this role is a complex one (Lerner and Nanda, 2020). During interviews, some respondents noted that for a long time, particularly between 2015 and 2019, primary market investors often focused on a few tracks, such as PD-1 and PD-L1, leading to significant overinvestment in the industry. In fact with global low-interest rates, financing was readily available during this period, and vast amounts of VC flooded into a few technical fields, undoubtedly inflating their valuation levels (Mason, 2023). The post-2021 Yangtze River Delta healthcare industry further shows that, as interest rates rose, the primary market for healthcare investments became more chaotic, and many projects faced intense competition for commercialization, while tighter IPO policies pushed these companies into a dead end.

However, this catastrophic blow reinforced VC's risk aversion, making investors more inclined to concentrate on mature technology projects (Klonowski, 2018; Mason and Harrison, 2015). Many interviewees explicitly admitted their reluctance to face uncertainty, and there was a widespread industry reluctance and fear of supporting disruptive innovation. Many VC firms concentrated their funds on short-term commercialization projects rather than riskier innovative technologies. This suggests that new path creation may be constrained by encouraging VC to focus more frequently on the acceleration phase of regional industrial development rather than the initiation stage. This is because the infrastructure and industrial support systems in the region are relatively well-developed during the acceleration phase (Smith et al., 2017; Trippl et al., 2020), and the technologies of enterprises have also undergone early validation (Simmie, 2012), making VC investments in this phase far less risky. The role of venture capital in the region is therefore not inductive, and serves instead as secondary reinforcement.

Equally importantly, VC invests in only a small fraction of firms in a region and has a high failure rate (Gregson et al., 2017; Zider, 1998). As China's healthcare industry has been in a path-

creation phase for the past two decades, VC investors believed that low-hanging fruit was easy to pick during the research phase. This meant that early-invested firms could survive and grow in the region. However, competition intensified as the industry grew, and investment success rates declined. This raises questions about whether VC can continue to play a positive role in the future. Notably, I found that investors were reluctant to discuss failed cases during the interviews. However, information suggests that VC investors clearly cannot achieve returns on all projects. Both macro factors and micro-governance issues contribute to this, as not all VC firms have robust knowledge resources in the healthcare sector.

VC tends to invest in a small number of well-developed ecosystems, potentially destroying path creation in less-developed regions (Lerner, 2010a; Mason and Kwok, 2010; Cumming, 2014). This study found that many emerging regions lack local industry talent and resources. On one hand, this causes VC in core regions to overlook peripheral areas – a bias that was confirmed in interviews. On the other, as some interviewees mentioned, when potential investment projects arise, VC may require firms to relocate from their initial location. If peripheral regions lack private VC, new firms are harder to identify and retain, exacerbating spatial imbalances in industrial development further (Owen and Mason, 2019).

This raises another issue based on the significance of government VC for peripheral regions (Mason and Brown, 2013). GVC can to some extent alleviate financing constraints for regional firms, but this assumes the presence of many investable high-growth SMEs, which may not hold true in peripheral regions (Nightingale et al., 2009). Some interviewees noted that peripheral regions lack suitable investment projects, meaning that simply injecting capital on the supply side cannot generate sufficient deal flow due to the lack of local projects. More critically, this limited project supply, combined with demand driven by GVC, leads to the overvaluation of regional investment targets. Interviewees indicated that government VC often offers higher premiums for more certain projects to preserve state-owned assets. As a result, private VC perceives limited potential returns and withdraws from investing.

It is worth noting that the role of GVC depends largely on the preferences of local administrators (Sun and Tian, 2024). When I raised related questions, interviewees from state-owned capital institutions became evasive, often politely declining to comment. While this does not provide direct evidence of administrative interference, it indirectly highlights the conflict between market profit goals and administrative objectives. This limitation restricted the study's ability to reveal the constraints on GVC fully, but suggests a "mission drift" issue (Munari and Toschi, 2015; Leleux and Surlemont, 2003). In fact many local governments face positioning issues in the Yangtze River Delta. Some cities, with industrial bases in automobiles, machinery and

electronics manufacturing and lacking relevant research institutions, are aiming to develop medical industries under such conditions. This planning is likely to waste local fiscal resources.

VC skills may constrain path creation in peripheral regions' industries (Mason, 2009). GVC institutions in Suzhou and Shanghai have investment managers with highly professional industry backgrounds and some with overseas experience. In contrast, GVC in peripheral regions lacks such professional expertise, often relying on advice from other investment institutions. This is not unique to local government VC; private VC faces similar constraints, and venture capitalists are more concentrated in large cities than in peripheral regions, limiting the impact of VC on local path creation. It cannot therefore be simply assumed that government VC's management capabilities are inferior to private VC, as peripheral regions are more inclined to establish GVC. In the context of a relative lack of private VC locally, it is unfair to criticize their compensation as uncompetitive. Therefore, the difference in management capabilities may not stem from ownership but from regional imbalances in the distribution of talent.

8.4 Theoretical and Policy Implications

8.4.1 Theoretical Implications

Unlike much of the previous research focusing on green industries and the internet sector (Maiti, 2022; Jiang and Liu, 2022; Zook, 2002), this study concentrated on the medical industry, which is characterised by long R&D cycles and stringent regulatory requirements. Because of the high-risk, high-reward nature of the medical sector, venture capital emerges as a key driver of industry development, although the findings retain a broader relevance.

Several insights emerge from the regional development of venture capital. Firstly, macro-level changes at the national or global level, such as population ageing, exert pressure on existing socio-technical regimes, loosening institutional lock-ins (Geels and Schot, 2007; Rip and Kemp, 1998; Geels, 2002). These institutional shifts create a time-specific opportunity space for market niches, providing the foundation for innovation pathways in the medical industry (Granovetter, 1985; Garud et al., 2010). Secondly, regional policies and institutional arrangements collectively form regional opportunity spaces (Grillitsch and Trippl, 2014; Moodysson and Zukauskaite, 2014). These institutional supports interact with industry structures to shape institutional frameworks and resource allocations that benefit local innovators (Asheim et al., 2019; Martin and Moodysson, 2011; Asheim et al., 2011a). This helps to incubate a protective and supportive entrepreneurial ecosystem for local niche innovations, stimulating regional entrepreneurial development (Trippl and Otto, 2009; Grillitsch et al., 2017; Isaksen and Karlsen, 2013). Thirdly, venture capital exhibits pronounced path dependency

driven by geographic proximity, prioritising investments in core nodes with established entrepreneurial ecosystems (Miloud et al., 2012; Streletzki and Schulte, 2013; Gompers et al., 1998). This co-evolutionary relationship is reinforced by positive feedback from investment returns, exacerbating spatial disparities in innovation and capital across regions.

This study extends the theoretical framework of path creation by highlighting the role of path dependency in venture capital investment, explaining the selective nature of venture capital towards firms and regions and identifying the internal mechanisms of coordinated local development between innovation activities and venture capital investments (Miloud et al., 2012; Streletzki and Schulte, 2013; Manigart and Sapienza, 2017). The research underscores the deep involvement of VC in enterprise operations and R&D, playing a resource integration role through social networks (Zook, 2008; De Clercq and Manigart, 2007). Consequently, venture capital accelerates regional resource formation and actor concentration to foster the creation of regional industrial pathways (Manigart and Sapienza, 2017; Amornsiripanitch et al., 2019). These findings enrich path creation studies from an the perspective of actors. The study also provides a micro-level explanation of the relationship between different venture capital models and path creation, confirming the critical role of social networks in VC investment (Cumming and Dai, 2010: Agrawal et al., 2015) and highlighting the indirect role of geographic proximity in shaping local industrial pathways, thereby addressing a gap in understanding the role of geographic distance in path creation mechanisms (Mason, 2007a: Metrick and Yasuda, 2011). Meanwhile, the study revealed the optimising role of formal and informal governance in syndicate investment structures for resource complementarity and risk-sharing through empirical interviews (Dimov and Milanov, 2010; Ferrary, 2010), enriching our understanding of the relationship between VC, governance and local path creation.

Syndicate investments effectively help venture capitalists mitigate information asymmetry through information sharing and resource integration, improving project screening and management capabilities. Information sharing is pivotal; lead investors provide decision-making insights by sharing proprietary information (such as market insights, technology trends and financial forecasts), guiding partners into new domains and addressing their information gaps. This is particularly crucial in cross-regional investments, as it compensates for investors' lack of experience in target markets (Dimov and Milanov, 2010; Fritsch and Schilder, 2012). In other words, syndicate investments help venture capital firms to overcome capability gaps by providing complementary knowledge and information, accessing larger deal opportunities and expanding the scope of investment flows (Jääskeläinen, 2012; Bygrave, 1987).

Firms that are centrally positioned in industry networks can access high-quality investment opportunities more easily because of their strong reputation and extensive connections. VC

firms at the core of the network gain more information on deals through broader investment connections and exhibit higher survival rates (Hochberg et al., 2007). Their prominent structural position and status attract invitations from other actors, improving opportunities for cross-regional and cross-industry investments (Wang and Tan, 2024). This is because reputable investors confer greater legitimacy and visibility upon startups, which is critical for early-stage development (Stuart et al., 1999). VC firms with high centrality are therefore more likely to fund geographically more distant target firms and serve as syndicate investment partners.

It is worth noting that scholars in liberal market contexts argue that GVC suffers from institutional flaws, leading to lower investment efficiency and reluctance on the part of firms to accept GVC funding (Alperovych et al., 2020; Lerner, 1999; Mason and Harrison, 2003). They contend that political objectives interfere with institutional decision-making, and that GVC investment structures are tied to political cycles (Meyer and Mathonet, 2005). GVC also lacks incentives, with fund managers prioritising risk aversion or administrative goals over maximising effort, resulting in limited professional expertise (Cumming et al., 2017; Murray and Lingelbach, 2009). The findings of this study confirm some of these views but highlight the overall success of GVC in the Yangtze River Delta's medical industry, thus contributing to the broader theory of GVC and regional development. This success stems from the region's GVC blending market mechanisms with government objectives effectively. Reinvestment mechanisms enhance the operational efficiency of government funds while expanding project pipelines and resource integration by introducing market-based venture capital managers. Leading GVCs gain independence and optimise fund lifecycles, thereby improving investment continuity. Although resource allocation distortions occur, they predominantly favour high-tech industries. These factors make the story of Chinese GVC unique. Figure 8-1 is the theoretical framework.

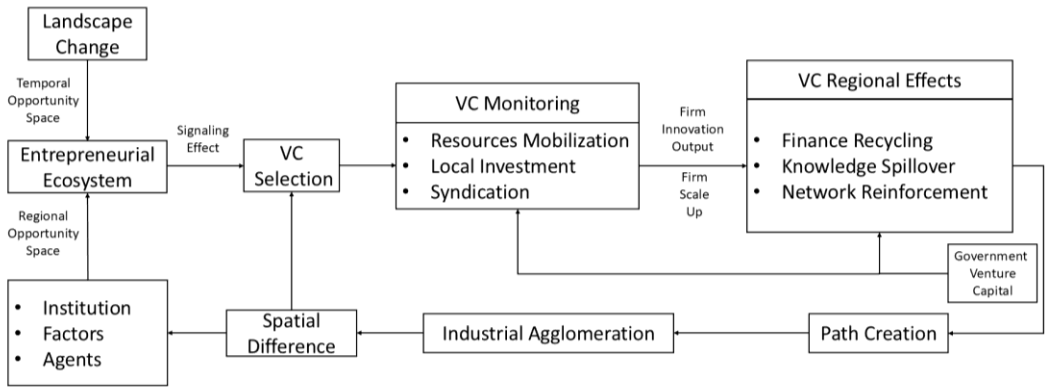

Figure 8-1: Theoretical Framework

8.4.2 Policy Implications

Policymakers must recognise local institutionalism as a key driver of the interplay between temporal and regional opportunity spaces. However, they should also be cautious of the cumulative reinforcement effects that path dependency in VC may have on regional development (Martin et al., 2002). The concentration of capital in specific regions can exacerbate disparities in entrepreneurial resources and innovation capacity across regions (Cumming and Dai, 2010; Dimov et al., 2012; Chen et al., 2010). Policy design should therefore focus on the development of venture capital and integrate it into policy framework. On one hand, macro-level institutional changes provide the necessary opportunity space for niche innovations. However, this temporal opportunity space needs to be tranformed into a regional opportunity space by local governments, for instance through industrial park development, resource allocation and the optimisation of industry regulations (Trippl and Otto, 2009; Grillitsch et al., 2017). Local government agency therefore plays a pivotal role. On the other, the effectiveness of regional policies depends heavily on the abundance of local resources. Regions with robust entrepreneurial ecosystems improve the capabilities of local entrepreneurial actors and further attract venture capital concentration by actively responding to national institutional changes (Feld, 2020). In contrast, low-growth regions, although they face the same institutional window, struggle to seize opportunities due to weak entrepreneurial ecosystems and insufficient capacity for institutional implementation, thus hindering endogenous development (Moodysson and Zukauskaite, 2014). Policies and institutions alone are therefore not sufficient for regional development, and local government agency should extend to the broader domain of entrepreneurial ecosystems. This would allow regions to align governance with entrepreneurial resources when opportunity spaces arise, fostering local industrial pathways and encouraging VC development.

Given the uneven spatial distribution and positive role of venture capitalism, policies should focus on developing local entrepreneurial ecosystems and strengthening support for VC. The spatial asymmetry in venture capitalism and the co-evolutionary relationship between VC and regional innovation underscore the critical role of ecosystems (Luukkonen et al., 2013; Sorenson and Stuart, 2001). Administrative mandates cannot compel venture capital to invest in less advantaged regions, so governments should prioritise the development of regional entrepreneurial ecosystems. Empirical evidence confirms the positive role of VC in enterprise innovation, showing that governments should pay close attention to its impact on regional development (Fritsch and Schilder, 2008; Fritsch and Schilder, 2012). Governments should consider policies that would aggregate venture capital and help it to identify unmet regional investment needs, thereby promoting the clustering and development of local industrial chains.

The Chinese government should focus on fostering the diversity of specific industries within the Yangtze River Delta and provide necessary support for the resource integration of VC. The study highlights the path dependency of VC on specific regions and firms, particularly its role in selecting advantaged industries in advantaged regions (Asheim et al., 2011b; Manigart and Sapienza, 2017, Zook, 2004). The government should therefore focus on the development of advantageous industrial sectors, propose support strategies for specific industry clusters and expand the foundation for future regional development, thereby maximizing the potential for venture capital investment (Miloud et al., 2012; Streletzki and Schulte, 2013). The study also reveals the critical role of VC in integrating diverse resources. Governments should institutionally provide flexible spaces for venture capital, such as clear but moderately relaxed regulatory environments, to facilitate capital inflows to regions (Lerner and Tåg, 2013). Governments can also strengthen their engagement with venture capital, align policies and provide resources that are lacking in venture capital's value-added services when necessary. Meanwhile, governments should support the recruitment of overseas scientists as well as entrepreneurship among local tech talent, offering VC more project options and driving local industrial growth.

Finally, the study confirms the constraining role of geographic distance in VC investment at a micro level. While policymakers cannot determine the feasibility of syndicate investment models directly, policy design can encourage and facilitate opportunities for VC interaction by organising temporary industrial cluster events (Maskell et al., 2006) such as venture capital conferences, startup summits and academic forums. Establishing fund towns to aggregate capital would also improve the likelihood of syndicate cooperation (Yang et al., 2023a). This study underscores the importance of market-oriented operations for government venture capital. Local governments should consider encouraging the independence of government funds within a supervisory framework and optimising operational funding cycles to ensure that government venture capital supports long-term regional industrial path creation, thereby fostering sustained local economic development (Karsai, 2018; Lerner, 2009).

8.5 Limitations and Future Directions

This study was grounded in an evolutionary perspective. It examined the opportunity space for regional development under institutional change and systematically delineated the evolutionary trajectory of the Yangtze River Delta's medical industry and the differentiation of regional venture capital. However, it faces significant theoretical limitations. Firstly, the study approaches the topic primarily from the perspective of macro-institutional changes and capital supply, and lacked an in-depth analysis of the agency and strategic interactions of diverse

actors such as government officials, local park managers, investment institutions and innovative firms in the formation and transformation of opportunity spaces. Secondly, it did not fully explain the internal mechanisms through which different stakeholders acquire and shape regional opportunity spaces via institutional embedding, resource mobilisation and network coordination. This limits the study's ability to identify the micro-level drivers of ecosystem evolution through actor interactions, making it harder to construct detailed causal chains and process-based explanations. Future research could use case studies and interviews to dissect the strategic interactions and micro-level driving mechanisms of various actors further in the generation and transformation of opportunity spaces.

The empirical framework of the study also has certain limitations. Firstly, it lacks a detailed depiction of the spatial-temporal flow paths of venture capital. Due to the absence of data on capital flows, the study was unable to establish a network analysis to track the direction and scale of capital movements dynamically. Meanwhile, because of the limitations of the industry observation period, the study lacked an analysis of the role of VC in the consolidation phase of regional industrial development. Secondly, regression analyses focussed primarily on firm characteristics and local ecosystems at the expense of soft factors such as cultural context, social networks and trust mechanisms. This made it difficult to capture the impact of implicit relationships and network spillover effects on capital attraction and path creation. Finally, although external linkage indicators such as multinational corporation investments were introduced to reflect the connection between regional and global capital systems, the study lacks comprehensive openness parameters (such as cross-border talent flows, international collaboration project numbers and regional trade complementarity). This constrained the theoretical explanation of how regional openness influences the deployment of VC and the evolution of the YRD's innovation ecosystem. Future research could use new databases to construct dynamic capital flow networks and incorporate social network analysis and extra-regional indicators to explore the relationship between VC and regional development.

While this study systematically revealed how VC's pre-investment screening and post-investment management shaped the path creation mechanisms of the Yangtze River Delta's medical industry, it had several shortcomings. The study focussed heavily on how venture capital shapes ecosystems, emphasising the path dependency of its selection effects, but overlooked the role of portfolio firms and local entrepreneurial ecosystems in shaping venture capital decisions through interactive mechanisms. The lack of discussion on how portfolio firms and ecosystems inversely influence capital flows and governance logic limits a more comprehensive understanding of the evolutionary mechanisms. Future research could adopt a stronger evolutionary perspective to show the continuous role of venture capital in path creation.

Finally, while the study highlighted the central role of geographic proximity in the path creation of the Yangtze River Delta's medical industry, elaborated on the value of syndicate investments in cross-regional risk-sharing and information complementarity and affirmed the amplifying function of government venture capital in regional industrial clustering, significant theoretical blind spots remain. Firstly, the study does not thoroughly explain the boundary conditions and specific mechanisms by which modern communication technologies mitigate geographic distance constraints, nor does it define the relative importance of face-to-face interactions in the digital era. Secondly, beyond the syndicate model, VC firms commonly establish local branches or representative offices to enable long-distance investments and regional embedding, but this study lacked discussion on this strategy, limiting a multidimensional understanding of investment network spatial evolution. Lastly, while the amplifier effect of government venture capital is prominent, the study overlooks the contributions of foreign capital and industrial capital – particularly from pharmaceutical giants and overseas venture capital – in providing funding, technology and market access during the early stages of industrial development, thus falling short in revealing the complex impacts of cross-regional capital flows. Future research could explore these directions to investigate the mechanisms of different models and types of venture capital in more detail.

Appendix A

Table A-1: Theme domains, interviewees, and the sample questions

Theme domains	Interviewees	Sample questions
Industry's evolution	Government officer; Companies; VC; Scholars	·what are the general characteristics and evolution of biomedical industry in the last 10 years? ·what are the important policies concerning the biomedical industry in the last 10 years?
Regional contexts	Government officer; Companies; VC; Scholars	·how do you think about this city's and region's innovation environment? ·why do you or your companies choose to operate business in this city? (Service providers, infrastructure, innovation environment, tax advantage)
General link between VC and biomedical firm	Companies; VC	·to your knowledge, please briefly talk about your view on the relationship between venture capital and biomedical industry. What assistances do venture capitalists provide to biomedical companies? What do they usually do after investments? How long is an investment? ·to your knowledge, please briefly introduce the venture capital investments in local biomedical industry and its effects. When do VC begin rapidly increasing commitments on local biomedical clusters? Have you built a close link with the VC investors? Has VC improved local industry' innovation performance?
VC location bias	Companies; VC	·(VC) do you prefer committing on the start-ups in YRD or outside? Which city the companies in do you think is your first option? What is the maximum distance that you can tolerate in investments? ·(companies) do you think VC has local bias when they choose investment? Do you think your firm's distance to VC capital is important? Why?

VC syndication effects	Companies; VC	·(VC) have you collaborated with other VC in biomedical industry before? How do you establish collaboration with them? where are the collaborators commonly from, other region or local peers? How do you collaborate with the other VC in biomedical companies? ·(companies) do you think invested by one or more VC is common or not? How does syndication engage in companies' daily operation? Is it more effective?
Public/private VC	Companies; VC	·(VC) how do you think your public/private counterpart, do you think public VC perform as good as private? If you are a public venture capitalist, expect the projects' return, are there any other objectives for you to consider? ·(companies) how do you think about the difference between public and private VC? Does public VC frequently meet your companies as private VC? Which kind of VC commitment is more likely for you to receive? Which kind of VC commitment do you expect to receive?
Weakness of industry	Government officer; Companies; VC	· can you briefly describe the problems that you meet recently? Can VC investment solve the above problems? If no, why? The problems can be business operation, financial constraints, industrial regulations, drugs' internationalization, and others. · how do your firms plan solving these above problems? Do you think is there any assistances need be obtained from others? Are there any problems caused by VC investments?
Prediction on industry	Government officer; Companies; VC; Scholars	·can you briefly predict the industry's next five years from the view of technology, products, market, as well as the governance? ·what is your company's plan in the next five years? Would you consider keep expending your companies to biopharma or big pharma in the next phase's plan?

		Do you think the drug's internationalization is your company's priority in the next five years?

Appendix 2

Table A-2: Statistics of Respondent Categories and Cities

		SHANGHAI	SUZHOU	HANGZHOU	JINHUA	NINGBO	GUANGZHOU	Total
Investors	VC	4				1	1	6
	GVC	1	3			1	1	6
	CVC			1				1
	Angel	1		1				2
Companies	Biotech		3	1	1		1	6
	Pharma						1	1
	MNC	1						1
Others	Bank		1					1
	Government	1	1					2
	University	1		1				2
Total		9	8	4	1	2	4	

Table A-3: Interview Data Statistics

	City	Type	Coded name	date	Duration	Words
1	SHANGHAI	UNIVERSITY	SH-UNI-1	230729	1:53:47	35167
2	SHANGHAI	MNC	SH-MNC-1	230906	2:11:58	35001
3	SUZHOU	BIOTECH	SZ-BIO-1	230907	0:43:31	12722
4	SUZHOU	BIOTECH	SZ-BIO-2	230907	1:00:18	17035
5	HANGZHOU	UNIVERSITY	HZ-UNI-1	230909	1:01:17	19398
6	SUZHOU	GVC	SZ-GVC-1	230911	0:57:51	16287
7	SHANGHAI	GVC	SH-GVC-1	230912	1:20:41	23647
8	SHANGHAI	GOVERNMENT	SH-GOV-1	230912	1:49:38	27586

9	SUZHOU	GVC	SZ-GVC-2	230913	1:31:49	23943
10	GUANGZHOU	PHARMA	GZ-PHA-1	230921	1:04:44	19990
11	SUZHOU	BIOTECH	SZ-BIO-3	230921	1:21:05	23898
12	JINHUA	BIOTECH	JH-BIO-1	230926	1:24:37	23230
13	SHANGHAI	VC	SH-VC-1	230927	3:48:38	63082
14	GUANGZHOU	BIOTECH	GZ-BIO-1	231007	1:26:21	25391
15	HANGZHOU	BIOTECH	HZ-BIO-1	231017	1:54:24	30161
16	SUZHOU	BANK	SZ-BK-1	231018	1:08:29	19104
17	SUZHOU	GVC	SZ-GVC-3	231020	1:36:03	27480
18	SHANGHAI	ANGEL	SH-AG-1	231023	0:39:29	9350
19	SUZHOU	GOV	SZ-GOV-1	231102	1:07:15	18776
20	NINGBO	GVC	NB-GVC-1	231106	1:13:33	20621
21	NINGBO	VC	NB-VC-2	240124	0:59:05	16306
22	SHANGHAI	VC	SH-VC-2	240124	0:31:10	9000
23	SHANGHAI	VC	SH-VC-3	240126	0:48:55	12340
24	HANGZHOU	CVC	HZ-CVC-1	240126	1:22:32	22300
25	HANGZHOU	ANGEL	HZ-AG-1	240127	1:15:01	19886
26	SHANGHAI	VC	SH-VC-4	240127	1:05:43	20688
27	GUANGZHOU	VC	GZ-VC-1	240202	1:08:51	17699
28	GUANGZHOU	GVC	GZ-GVC-1	240205	1:02:05	15716
Total					35:17:54	592389

Appendix B

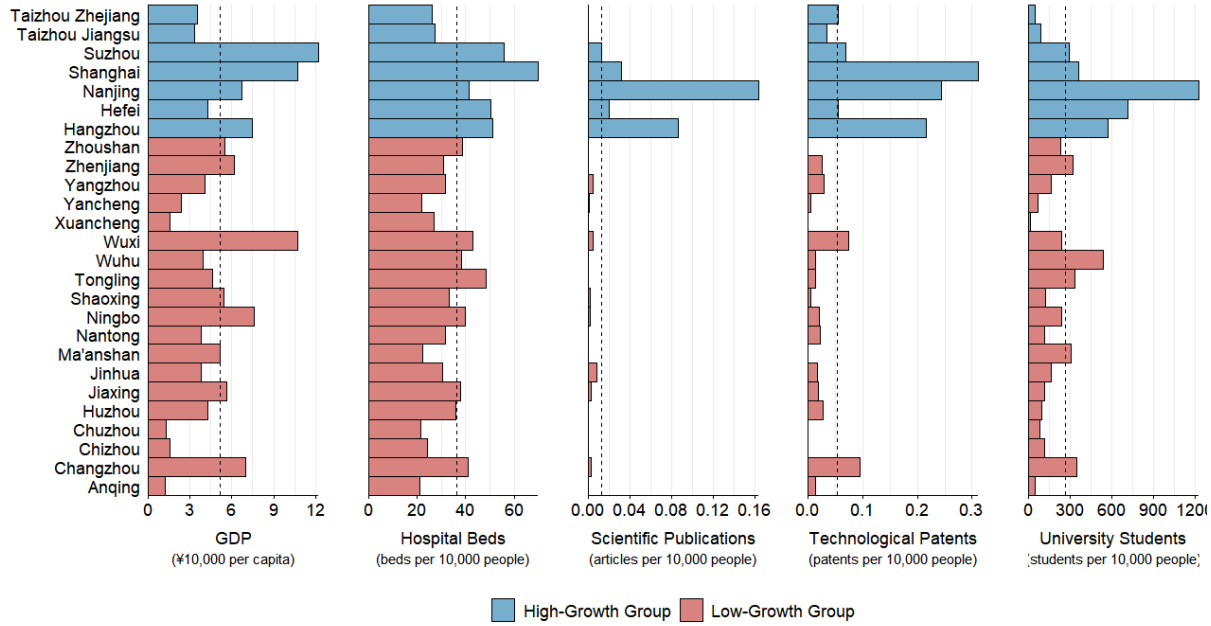

Figure B-1: Comparison of Entrepreneurial Resources in Yangtze River Delta Cities in 2009 (Sources: PubMed; CNIPA; China City Statistical Yearbook)

[Note: The blue dashed box represents the high-growth cities (Group 2); the red dashed line indicates the average for each indicator]

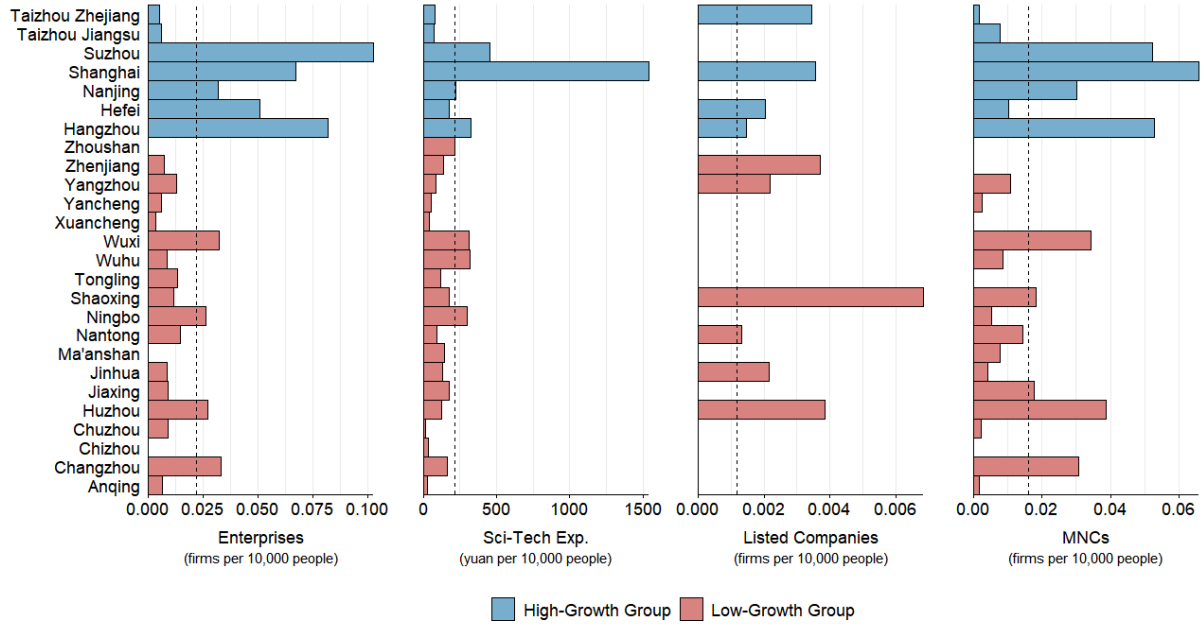

Figure B-2: Comparison of Entrepreneurial Agents in Yangtze River Delta Cities in 2009 (Sources: Qichacha; China City Statistical Yearbook)

[Note: The blue dashed box represents the high-growth cities (Group 2); the red dashed line indicates the average for each indicator]

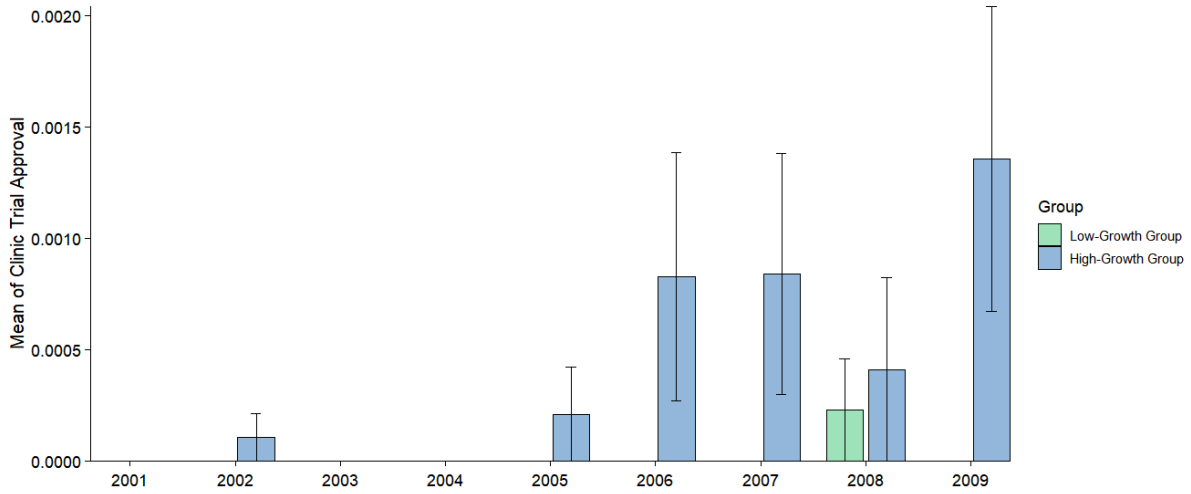

Figure B-3: Mean clinic trial values and their error bars for different groups from 2001 to 2009

[Note: Group 1 is the low-growth cities; Group 2 is the high-growth cities.]

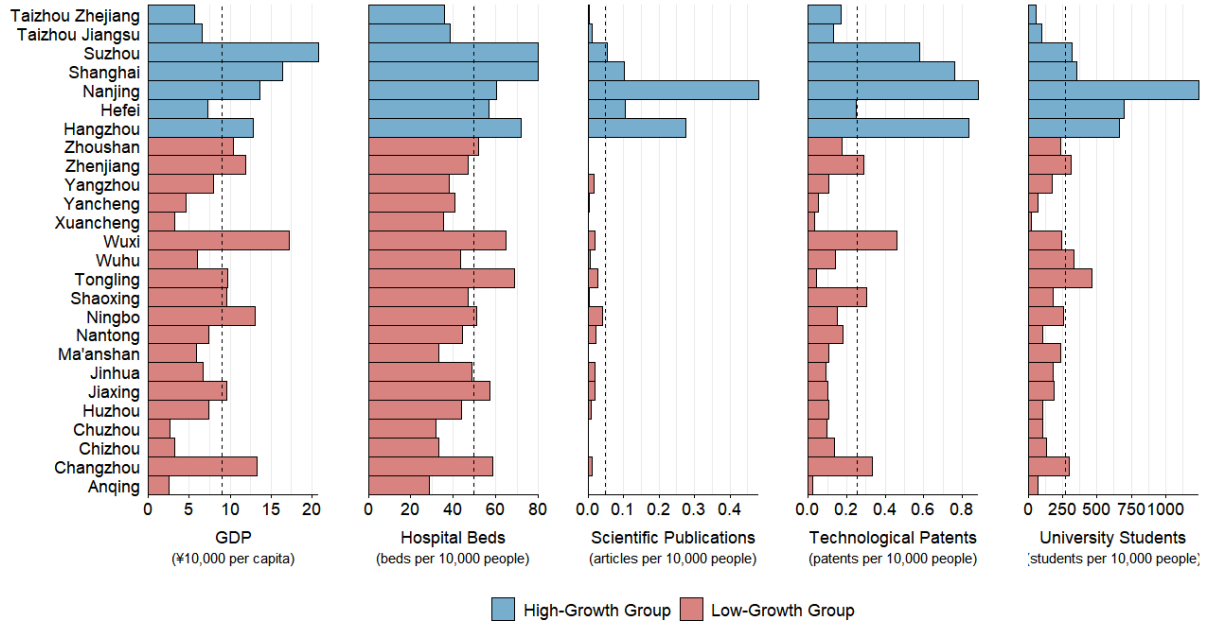

Figure B-4: Comparison of Entrepreneurial Resources in Yangtze River Delta Cities in 2014 (Sources: PubMed; CNIPA; China City Statistical Yearbook)

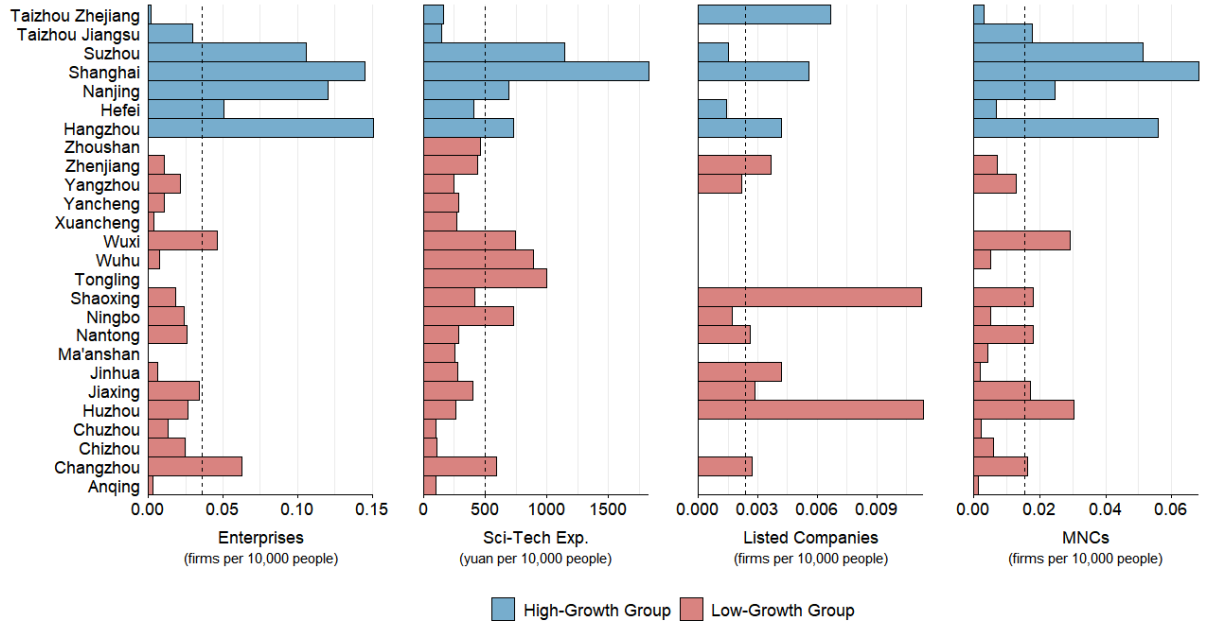

Figure B-5: Comparison of Entrepreneurial Agents in Yangtze River Delta Cities in 2014 (Sources: Qichacha; China City Statistical Yearbook)

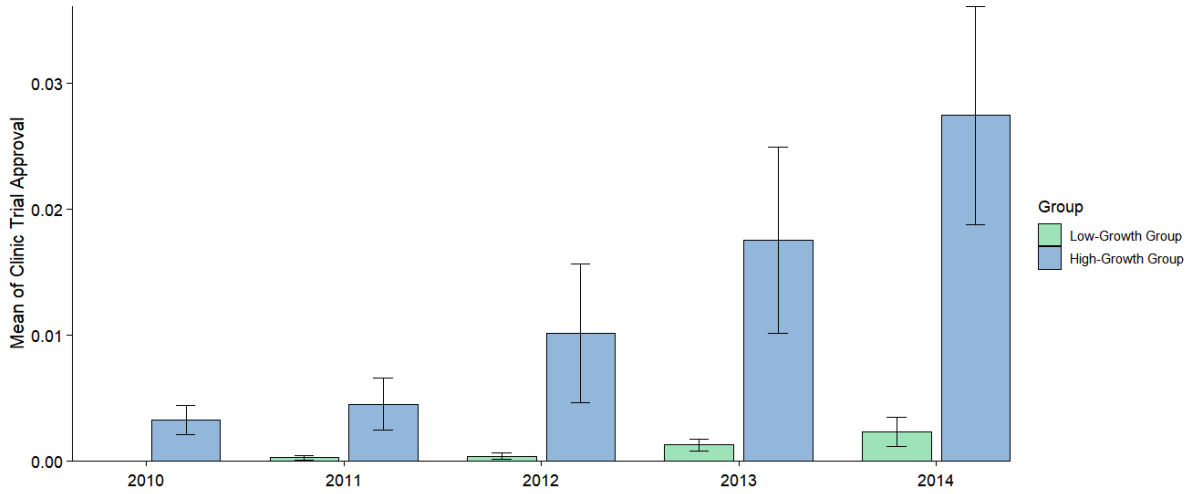

Figure B-6: Mean clinic trial values and their error bars for different groups from 2010 to 2014

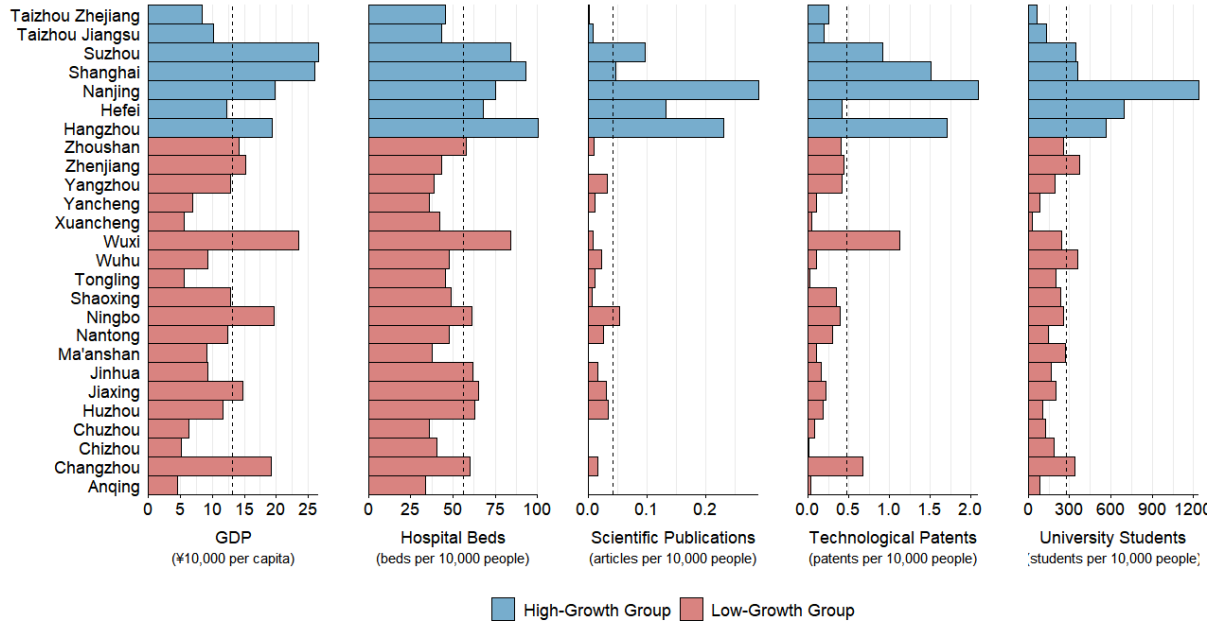

Figure B-7: Comparison of Entrepreneurial Resources in Yangtze River Delta Cities in 2019 (Sources: PubMed; CNIPA; China City Statistical Yearbook.)

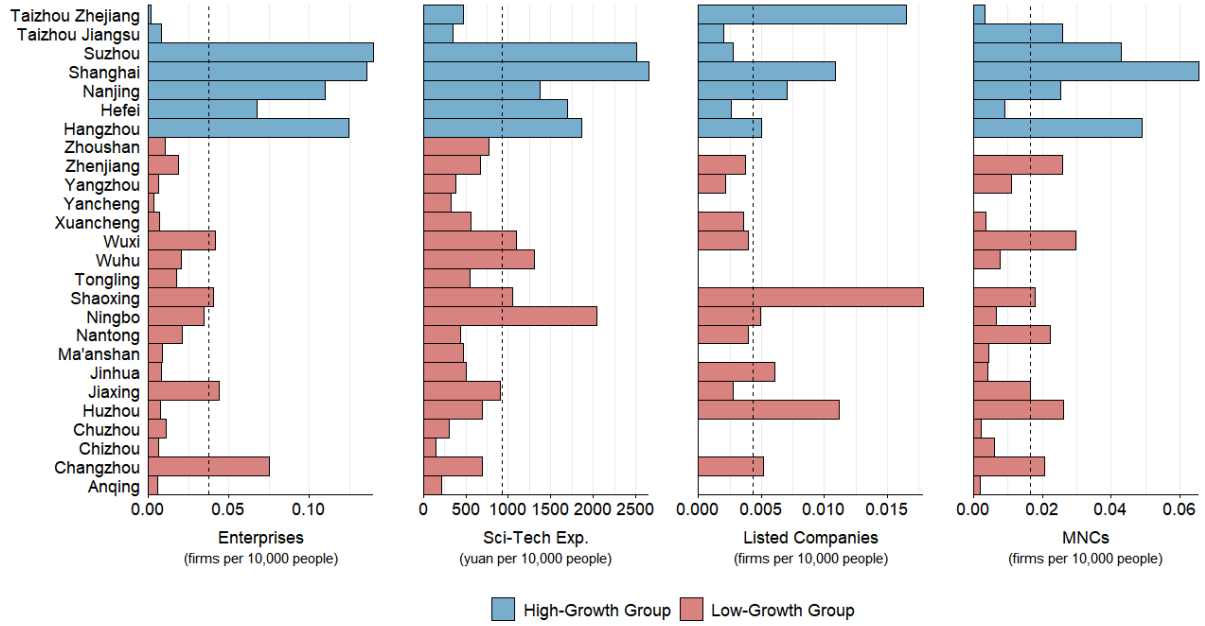

Figure B-8: Comparison of Entrepreneurial Agents in Yangtze River Delta Cities in 2019 (Sources: Qichacha; China City Statistical Yearbook.

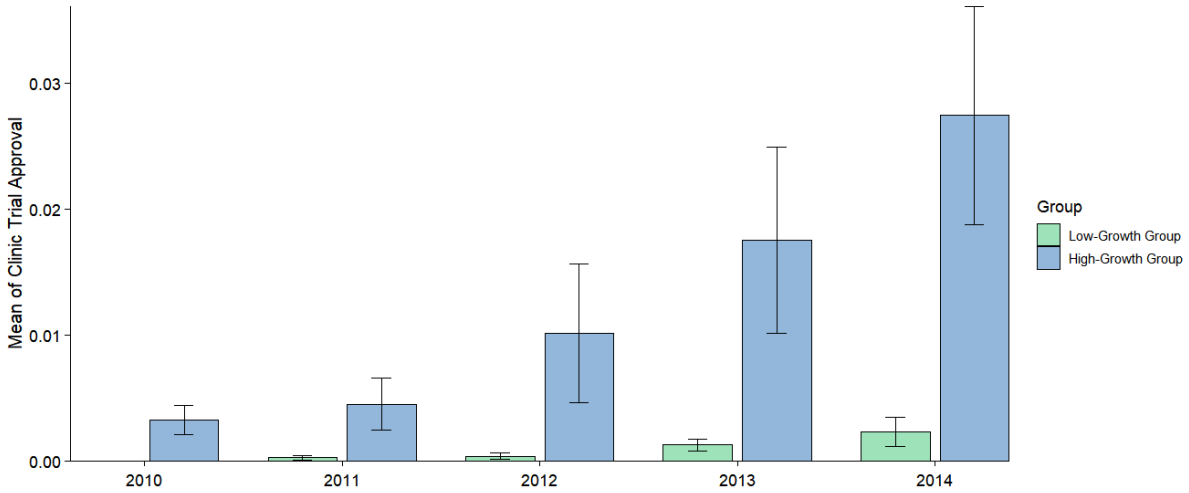

Figure B-9: Mean clinic trial values and their error bars for different groups from 2015 to 2019

Appendix C

Table C-1: Collinearity Matrix

	ln_Clinic_t3	ln_InvSize	hasPatent	largeFirm	pastIND	ln_gdp	ln_students	ln_medical	log_gov	ln_hgf	ln_bigfirm	ln_tik	ln_sik	ln_mnc	ln_private
ln_Clinic_t3	1														
ln_InvSize	0.188	1													
hasPatent	0.0914	0.0119	1												
largeFirm	0.2376	0.1263	0.1301	1											
pastIND	0.4776	0.0871	0.0657	0.133	1										
ln_gdp	0.1765	0.0918	0.0844	-0.0294	0.0921	1									
ln_students	0.0091	-0.0007	0.0019	-0.0579	0.0136	0.3138	1								
ln_medical	-0.0588	-0.0279	0.0535	-0.0854	-0.0441	-0.0075	0.0365	1							
log_gov	0.2011	0.1013	0.055	0.024	0.1096	0.7358	0.1756	-0.4517	1						
ln_hgf	0.1949	0.1065	0.098	-0.019	0.0966	0.8537	0.406	-0.1204	0.8092	1					
ln_bigfirm	0.163	0.0691	0.111	0.0669	0.0834	0.4049	0.0552	-0.0744	0.436	0.4167	1				
ln_tik	0.2224	0.1115	0.0994	0.0353	0.1271	0.7075	0.5052	-0.1627	0.7461	0.8381	0.553	1			
ln_sik	0.1059	0.0546	0.0965	-0.006	0.0638	0.4809	0.8094	0.001	0.3748	0.6542	0.3134	0.7845	1		

ln_mnc	0.1465	0.0866	0.0211	0.0157	0.0721	0.6841	0.1352	-0.2847	0.8392	0.8077	0.3206	0.5917	0.2984	1	
ln_private	0.1595	0.0726	0.1022	-0.0347	0.0799	0.7724	0.3085	0.0996	0.5043	0.7335	0.3426	0.6387	0.483	0.1595	1

Table C-2: Relationship Between Receiving Venture Capital Investment Before and After Matching and Corporate Clinical Activities in Different Years

	ln_Clinic_t1		ln_Clinic_t2		ln_Clinic_t3	
	Unmatched	Matched	Unmatched	Matched	Unmatched	Matched
hasVC	0.033*	0.045***	0.099***	0.113***	0.148***	0.158***
	-1.88	-3.89	-5.84	-4.2	-6.16	-6.26
Observation	2072	1619	2072	1619	2072	1619
R^2	0.386	0.319	0.353	0.269	0.311	0.24

Table C-3. Impact of Receiving Venture Capital Investment from 2010–2019 on Regional Innovation, Entrepreneurship, and Diversity

	(1)	(2)	(3)
VARIABLES	ln_Clinic_t3	ln_startups_t3	ln_diversity
hasvc	0.216	-0.00147	0.0141
	(0.162)	(0.00182)	(0.0198)
ln_gdp	-0.279	-0.0240**	0.0391
	(0.403)	(0.0103)	(0.0410)
ln_students	6.224	0.0874	0.441
	(3.825)	(0.0796)	(0.299)
ln_medical	-1.680	0.00445	-0.146
	(1.801)	(0.0487)	(0.157)
log_gov	0.386	0.0206	0.0826
	(0.533)	(0.0140)	(0.0932)
ln_hgf	1.056	-0.000766	0.0930*

	(0.748)	(0.00870)	(0.0491)
ln_bigfirm	76.94	-1.087	4.722
	(56.82)	(1.031)	(7.172)
ln_tik	2.849	0.235***	-0.167
	(1.942)	(0.0513)	(0.271)
ln_sik	2.139	-0.00967	0.201
	(1.384)	(0.0307)	(0.121)
ln_mnc	5.562	-1.264*	2.882
	(32.38)	(0.698)	(3.605)
ln_private	1.310	0.0257	0.139
	(1.783)	(0.0298)	(0.236)
Constant	-4.227	-0.132	-0.00159
	(5.037)	(0.129)	(0.868)
Observations	260	260	260
R-squared	0.885	0.800	0.982

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