UTS UNIVERSITY OF TECHNOLOGY SYDNEY

Configurational Pathways of Government Venture Capital and Their Impact on Regional Innovation: An Empirical Analysis of Chinese Cities

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Doctor of Philosophy

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CERTIFICATE OF ORIGINAL AUTHORSHIP

I, Zuanxu Chen, declare that this thesis is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the UTS Business school at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

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Abstract

Government venture capital (GVC) has emerged as a novel paradigm of government funding to support emerging and strategic technologies, ventures, and industries, distinct from traditional mechanisms such as government-sponsored loans, subsidies, and grants. Despite significant developments in both practice and academic discourse over recent decades, our understanding of GVC remains fragmented and limited. This thesis addresses critical gaps in GVC research through three interconnected studies. It is important and interesting to complete this study in the Chinese context, a special scenario of political-business interaction, because it can help observe the effectiveness of a series of government-led measures under the logic of a strong government. In other words, the existing empirical evidence based on Western contexts cannot well explain the practice of GVC in China.

Study 1 presents a systematic literature review, developing an integrated framework, highlighting research gaps, and proposing a future research agenda in GVC research. Particularly, the review emphasizes the need to examine GVC's impact at the regional level, specifically its roles in emerging economies, and identifies a lack of research on GVC's antecedents.

Study 2 investigates the determinants of GVC formation from a regional perspective. Using fuzzy-set qualitative comparative analysis (fsQCA) on data from 236 Chinese cities, this study explores the configuration of a set of regional enablers, including VC experience, entrepreneurship, development zones, technology expenditures, and government-business relationships, as well as identifies three configurational paths to GVC formation. These paths include the infrastructure-based market-driven path, the government-business relationship-based market-driven path, and the government support-driven path. The fsQCA analysis also reveals complementary relationships among regional enablers.

Study 3 addresses the debate over GVC's impact on regional innovation. Employing panel data from 237 Chinese cities (2004-2021), this study hypothesizes and confirms an inverted U-shaped relationship between GVC presence in a region and its impact on regional innovation. Additionally, it explores the moderating effects of government fiscal conditions and human capital at the regional level on this relationship. The findings indicate that local government fiscal constraints diminish GVC's impact on regional innovation, while an abundant talent pool will strengthen this relationship. At last, the regional difference analysis reveals that the inverted U-shaped relationship between GVC presence and regional innovation is more pronounced in areas with lower levels of innovation activities.

This research makes several theoretical contributions. First, this research develops an integrated GVC theoretical framework to consolidate existing fragmented studies, identify research gaps, and propose future research agendas. Second, this research moves beyond examining driving factors of GVC formation in isolation by adopting a novel configurational perspective and identifying key configurations that explain GVC formation. Finally, this research builds on previous studies and adds nuanced, nonlinear, and complex evidence between GVC presence and innovation from a regional perspective. Practically, this research extends the discourse about GVC's impact on regional innovation, adding perspectives from China – the world's largest emerging economy and the second-largest venture capital market. These findings offer valuable insights for policymakers in emerging economies seeking to leverage GVC for regional development, emphasizing its role in regional innovation and highlighting the conditions conducive to GVC formation and growth.

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Introduction

The establishment of the American Research and Development Corporation (ARDC) in 1946 marked the beginning of the modern venture capital (VC) industry, which is considered to play a catalysing role in the growth of innovation and entrepreneurship over subsequent decades (Lerner & Nanda, 2020). From the post-World War II (WWII) transition to civilian-focused industries to the internet boom towards the end of the 20th century, VC has not only fostered technological advancement and the development of high-tech enterprises but also expanded funding channels for high-risk and high-uncertainty startups (Timmons & Bygrave, 1986). However, driven by profit motives, traditional VC investors tend to prioritize projects with quick financial returns, often overlooking investments with broader social value (Engberg et al., 2021; Breschi et al., 2022). In response, the government venture capital (GVC), as an alternative venture funding method, emerged, reflecting policymakers' recognition of the pivotal role of this emerging funding method in driving strategic innovation and economic growth (Mason & Brown, 2013; Zhang, 2021; Devarakonda & Liu, 2024).

The rapid expansion of the VC industry after WWII and the resulting Silicon Valley phenomenon captured governments' attention throughout the 1980s, highlighting VC's potential as a policy instrument across political spectra (Murray, 2021). At the same time, as a newcomer to VC financing, GVC was largely novel to many governments until the early 2000s. GVC has been widely implemented globally in recent years and has rapidly become an essential tool in public financing (Bertoni & Tykvová, 2015; Zhang & Chen, forthcoming). However, the swift disconnect between practice and theoretical understanding has made comprehending GVC an issue that deserves scholarly attention and carries significant implications for policymakers (Bertoni et al., 2019). Due to limited knowledge about GVC's

principles, design, and implementation and the ambiguity of existing evidence, it presents significant challenges to its continued application (Guerini & Quas, 2016).

As a new paradigm in public financing, GVC diverges from subsidies and grants, drawing on traditional VC models but emphasizing social value realization (Zhang & Mayes, 2018; Devarakonda & Liu, 2024). Originally intended to address market failures as a public intervention mechanism (Cumming, 2014; Minola et al., 2017; Breschi et al., 2022), GVC aims to foster innovative industries (Grilli & Murtinu, 2014; Ge et al., 2024). Consequently, GVC often operates with public interest objectives, diverging from traditional VC, which prioritizes financial returns (Pahnke et al., 2015; Johansson et al., 2021). GVC can take various forms, including direct investment, guidance funds, and fund-of-fund structures (Engberg et al., 2021). Specifically, direct investment involves government capital alone, where state-managed companies oversee funds. In the case of guidance funds, mixed funds can be created with government and private capital, wherein the government leads, and private capital participates. This approach, which harnesses the social value of capital, has been widely favoured by governments (Murray, 2021). Additionally, another standard GVC structure in Europe involves governments as limited partners contributing to private VC funds, known as 'indirect GVC investment' (Alperovych et al., 2018). The fund-of-fund model operates similarly to guidance funds, though instead of investing directly in startups, it invests in other funds. The fundamental logic behind GVC is that governments can achieve financial and public policy goals through VC participation by addressing the market failures that hinder venture financing to support long-term projects with social benefits (Munari & Toschi, 2015; Suchard et al., 2021).

While the global GVC movement began in Western countries, emerging economies—particularly China—have increasingly adopted GVC practices. At the end of 2023, the China Securities Regulatory Commission (CSRC) emphasized the central government's directive to

“vigorously promote investment-end reform, cultivate a favourable environment for long-term investment, guide investment institutions to strengthen counter-cyclical layout, and develop ‘patient capital’”. The action plan of the Chinese State Council notably highlighted the cultivation of state-owned and government investment funds as ‘patient capital’ to play a leading role. This concept received further support from China’s top leadership during a Politburo meeting on April 30, 2024. Devarakonda & Liu, (2024) emphasized that GVC represents an important form of institutional endorsement, it grants startups social legitimacy within a transitional economy context, thereby positively influencing their development. Unlike in developed economies, the differences in institutions, cultures, and legal systems limit the applicability of foreign GVC practice in Chinese context, thus, underscoring the research opportunity to explore the unique role and the development paths of GVC in China (Luukkonen et al., 2013). Capturing this opportunity is significant in China’s GVC research for two reasons: due to the immaturity of China’s financial markets compared to developed countries, and startups in emerging markets like China have fewer avenues for private capital. Thus, an in-depth examination of GVC in the context of China, the most significant emerging economy, can provide evidence of how underdeveloped regions find practical pathways to effective GVC practices. Overall, China provides an interesting and unique context for exploring the dynamics of GVC research (Zhang & Mayes, 2018).

This thesis seeks to deepen the understanding of GVC’s big picture and explore its distinctive functions in emerging economies through three closely interconnected studies—a systematic review of the literature and two empirical analyses. This exploration addresses a novel and underexamined topic in academic research, offering theoretical foundations for GVC research and providing strategic insights into its future applications. Specifically, this thesis will answer the following three research questions based on the Chinese context:

- What is government venture capital and its future research agenda?

- What can promote the formation of government venture capital?
- What is the role of government venture capital in regional innovation development?

Addressing the above questions is important and interesting for the following reasons. First, due to the different institutional, cultural, and historical backgrounds, GVC research evidence from the Western context cannot fully explain the GVC practices of emerging economies like China (Brander et al., 2015; Suchard et al., 2021). China's unique 'government-business relationship' culture and the strong influence of the government in economic activities are obviously different from the regions where current GVC research mainly focuses, such as Europe and the United States (Bruton & Ahlstrom, 2003; Wu & Kirk Davidson, 2011). In other words, research based on the Chinese context can help scholars and authorities observe the differences in the emergence, development, and operation of GVC under different institutional environments, which is very important for improving the understanding of GVC. Second, China's rapidly expanding GVC industry provides a fertile test field for this study. Statistics show that China has become the second-largest venture capital market in the world, with the cumulative scale of GVC funds at all levels reaching 2.99 trillion CNY (CVINFO, 2023; Ge et al., 2024). Third, China's economic reforms have achieved remarkable success, becoming the world's largest emerging economy in less than 40 years (Hao et al., 2020). Scholars from different disciplines have tried to explain the antecedents of this miracle from their own perspectives (e.g., Song et al., 2011; Cai & Feng, 2021), and appropriate and effective public financing policies may be an important breakthrough. Therefore, answering these three research questions can not only enrich GVC theory and practice, but also provide new evidence and insights for exploring China's rapid development phenomenon.

As an exploratory investigation of a nascent phenomenon, Study 1 systematically reviews the fragmented GVC literature published in leading journals, identifying key research gaps. Studies 2 and 3 provide evidence from Chinese perspective: Study 2 examines the

determinants of GVC formation from a regional perspective, identifying three distinct configurational pathways that lead to the GVC formation. Study 3 explores the impact of GVC on regional innovation. **Figure 1.1** illustrates this approach.

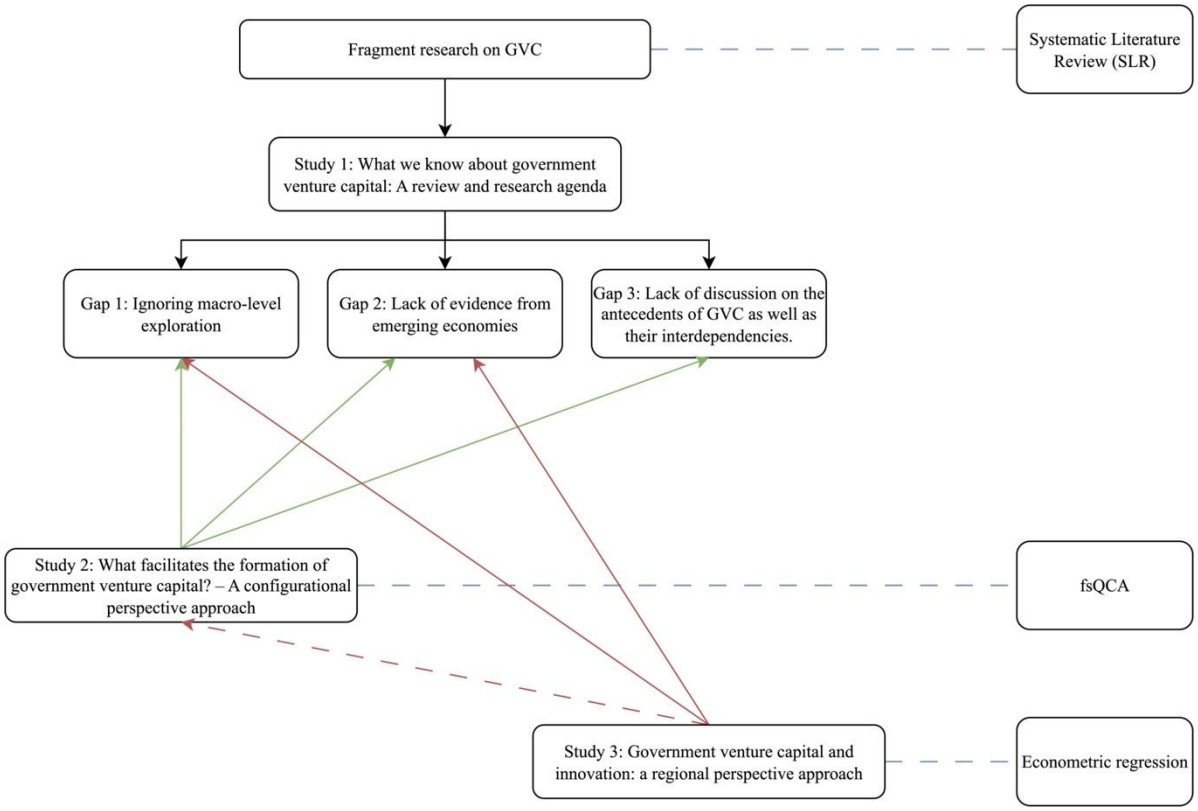

Figure 1.1 Structure of the thesis

Specifically, Study 1 provides an integrated framework by examining current GVC research progress and outlining future research agendas. Study 2, adopting a configurational perspective, identifies pathways for GVC formation across regions in China. Study 3 moves beyond the firm-level focus of prior research, uncovering a nonlinear impact of GVC on innovation at the region level.

2. Study 1: What we know about government venture capital: A review and research agenda

2.1 Introduction

Governments around the world are committed to applying financing tools to promote development, and their traditional methods include policy subsidies and government-supported bank loans (See Hong et al., 2016; Z. Huang et al., 2019; Y. Gao et al., 2021). As a new paradigm for public financing, GVC has garnered significant attention in recent years as an instrument to support innovation and entrepreneurial activities (Y. Zhang, 2021; Devarakonda & Liu, 2024). Between 2010 and 2019, governments worldwide implemented an average annual budget of $156 billion for entrepreneurial financing projects (Bai et al., 2021). Among them, the European, Chinese, and South Korean governments are representatives of deep government involvement (Y. Zhang & Mayes, 2018; Lee et al., 2023).

Compared to individual venture capital (IVC), a traditional VC model, GVC places greater emphasis on developmental benefits (Luukkonen et al., 2013; Grilli & Murtinu, 2014; J. Zhang et al., 2024), directing funds towards projects often overlooked by traditional financing channels (Alperovych et al., 2020; Breschi et al., 2022), characterized by public welfare and low investment returns (Croce et al., 2019; Johansson et al., 2021). On the other hand, IVC can provide firms with more specialized management advice and value-added services compared to GVC funds (Engberg et al., 2021; T. Li et al., 2024). This indicates that GVC and IVC are not substituting but rather complementary (Bertoni & Tykvová, 2015; Y. Zhang & Mayes, 2018). In other words, not only will GVC not crowd out IVC, but GVC and IVC will also support the invested enterprises in more financing and business guidance, respectively. The Organisation for Economic Co-operation and Development (OECD) emphasizes in its report “Government Venture Capital for Technology-Based Firms” that

direct equity investments by the public sector are the most advanced method of injecting venture capital into the economy (OECD, 1997).

Besides the increasing popularity of this phenomenon in research and practice, several other reasons necessitate a comprehensive analysis and discussion of the GVC literature. First, despite the global spread of GVC practices, there are few unified definitions of GVC. Scholars describe GVC by viewing it as an entity or a behaviour, examining its affiliations and fundraising methods (e.g., Cumming et al., 2017; Zhang, 2018). They also view GVC as an activity with specific functions, discussing its investment methods and goals (e.g., Standaert & Manigart, 2018; Alperovych et al., 2020). Second, GVC studies shed light on various aspects of GVC but lack a framework to integrate existing research and guide future agendas (Zhang & Mayes, 2018). Lastly, there is a scarcity of GVC-focused research reviews; only in reviews that cover a much broader VC context (e.g., Drover et al., 2017). These issues—a lack of unified definition and fragmented GVC research—present challenges for systematically consolidating current GVC knowledge and moving the field forward.

To address the gap, the objective of this review is to integrate existing theories and research results and then propose new propositions for GVC studies. Specifically, this study first illustrates representative cases of GVC globally to better understand the GVC phenomenon. Next, this study conducts an extensive and systematic literature search, followed by a descriptive analysis. Based on this systematic survey of the literature, this review identifies theories underlying GVC covering four main research streams, including definition, performance, decision-making, and design. This review develops an integrative framework of GVC research and proposes future pathways to address current gaps.

As a result of the review, this study found that current research primarily focuses on its impact, i.e., GVC performance, with only a few studies discussing the determinants of GVC

and its mechanisms as a mediating variable. Research conducted over the past 20 years across multiple disciplines and different institutional contexts shows that GVC research focused on its impacts in areas such as exit strategies, firm growth, industrial development, and innovation practices. Initially, scholars assessed the financial returns of GVC, the most traditional performance metric for VC financing (D. Cumming, 2007; Y. Zhang, 2021). After recognizing the unique role of GVC, more multidimensional performance metrics have been proposed (del-Palacio et al., 2012; Kovner & Lerner, 2015; Croce et al., 2019; Q. Du et al., 2024). Additionally, investment decision-making and fund design analyses related to performance research are emerging (e.g., Alperovych et al., 2020; Johansson et al., 2021). Therefore, this review offers key recommendations for future agendas, including broadening the research scope, focusing on GVC practices in emerging economies, and exploring the antecedents of GVC.

This systematic literature review develops an integrated framework, identifies research gaps, and proposes a future research agenda. It makes three key contributions. First, it examines GVC-related literature published in leading journals and integrates theoretical frameworks from existing GVC research. Second, it highlights the lack of research on GVC antecedents and emphasizes the need to assess the regional impact of GVC, particularly in emerging economies. Third, this review establishes a theoretical foundation on the history, developmental patterns, and impacts of GVC, setting the stage for the subsequent two empirical studies.

2.2 Background: global practices of GVC

GVC practices occur globally (Engberg et al., 2021; Devarakonda & Liu, 2024), notably in the United States, Canada, Europe, Australia, and China. **Table 2.1** illustrates GVC practices across different countries. Due to varying social environments, historical contexts, and

political systems, these practices exhibit differences (Suchard et al., 2021). Brander et al. (2015) suggest that analysing the roles of governments in different countries is necessary because their unique circumstances may influence how governments support VC. The purpose of this section is to draw a holistic big picture and provide a practical understanding of GVC.

The United States pioneered implementing GVC. As early as in the 1950s, the U.S. established the Small Business Administration to coordinate government support for start-ups. Since the 1980s, the rapid growth of the VC industry and the resulting Silicon Valley phenomenon have continued to draw government attention (Murray, 2021). The attractiveness of VC as a policy tool appears to transcend political spectrums, giving rise to notable GVC initiatives such as America's Seed Fund and Community Development Venture Capital. Unlike traditional VC funds, America's Seed Fund is an equity-free funding program (Rao et al., 2017) -- those programs not only provide reasonable financial returns to investors but also focus on development benefits, which paved the way for later imitators to catch up. Meanwhile, Canada introduced a unique GVC initiative, the Labour-Sponsored Venture Capital Corporations (LSVCCs). LSVCCs are a type of mutual fund led by local labour unions and attract private investors through tax incentives provided by the government (D. J. Cumming & MacIntosh, 2007).

Europe is one of the most active regions for GVC, with government investment accounting for around 30% of the total VC funds in the continent (Invest Europe, 2019). Besides the European Investment Fund, which is backed by the European Union, many countries and their local governments have established various types of GVC funds (Bertoni & Tykvová, 2015). A notable feature of European GVC is its distinct regional characteristics. For instance, in European countries such as Belgium, local governments are keen on establishing diversified regional GVC funds focused on boosting regional economies, which typically

have strict geographical investment boundaries (Munari & Toschi, 2015; Alperovych et al., 2020).

Similar to Europe, a notable feature of the VC market in South Korea is the significant government intervention (Lee et al., 2023). Following the 1997 Asian financial crisis and the 2000 dot-com bubble burst, the South Korean government established numerous GVC funds and directly injected public capital into the VC market. Among these, one typical example, the Fund of Funds, established in 2005, emphasizes balancing public interests with financial returns. In terms of profit distribution structure, the government pursues policy objectives, while the partnership funds aim to realize profits from returns on investment capital.

Furthermore, the most notable GVC fund in Australia, the Innovation Investment Fund (IIF) program, modelled after the U.S. 'equity enhancement' approach (D. Cumming, 2007; Jääskeläinen et al., 2007), is evaluated as a successful GVC initiative by Colombo et al. (2016). However, Murray et al. (2010) critiqued the IIF program for its overambition, arguing that it failed to cultivate a robust and flourishing VC industry in Australia. Murray (2021) reiterated this point in his subsequent work. In addition to the IIF, the Australian Government's notable GVC projects include the Pre-seed Fund (PSF) program, the Renewable Energy Equity Fund program, the Pooled Development Fund program, the Venture Capital Limited Partnership program, and the Early-Stage Venture Capital Limited Partnership program. D. Cumming & Johan (2009) pointed out that the PSF's partial overlap with the IIF resulted in mutual exclusivity, affecting the efficiency of both projects. Overall, Australia's GVC landscape is characterized by 1) a relatively small domestic VC market; 2) a lower proportion of VC in total private equity investment (only 9%); and 3) an underdeveloped VC industry that does not seem to correlate with the adequacy of Australia's academic scientific foundation (Lerner & Watson, 2008).

Like Europe and South Korea, Chinese government is also deeply involved in the operation of VC (Y. Zhang & Mayes, 2018). Despite its recent emergence, China's GVC has grown rapidly (J. Zhang et al., 2024), becoming an indispensable coordinator within its innovation ecosystem (Ge et al., 2024). Specifically, in the early 21st century, the 'Zhongguancun VC guidance Fund' was established by the Chinese government to explore the investment potential of companies within the science and technology park (J. Chen, 2023). From its establishment, the fund emphasized principles of "not prioritizing profit but focusing on guidance and leverage", setting a benchmark for the Chinese GVC industry. Subsequently, the GVC industry in China experienced explosive growth, with 865 GVC funds established between 2015 and 2017 (CVINFO, 2022). By the end of 2023, China had 1,557 government-guided funds with a total scale of 2.99 trillion CNY (CVINFO, 2023). A prominent China's GVC example is the Shenzhen Capital Group (SCG), a GVC fund backed by the local government, which has been one of the largest domestic VC firms since 2016 (Devarakonda & Liu, 2024; T. Li et al., 2024). Notably, unlike other countries, China's GVC is characterized by greater government ownership (Suchard et al., 2021), which introduces a new discussion that the theories developed from industrialized countries maybe not fit China's social, economic and institutional environment.

In summary, the implementation of GVC varies significantly across countries. Different authorities establish diverse GVC funds based on their unique social contexts and political objectives, which can appear somewhat 'messy' at first glance. Specifically, the capital structure of GVC funds can involve public sector funding alone or in collaboration with private investors. The government establishing these funds can range from central level to local level government. In addition, the GVC's objectives encompass both social development and financial returns (Standaert & Manigart, 2018).

Table 2.1 Global practices of GVC

Regions	Examples	Financer/management	Objectives
United States	America's Seed Fund (1977)	Federal funds (Small Business Administration & 11 federal agencies)	Technology commercialization; advance federal missions; foster innovation culture in the United States.
	Community Development Venture Capital (1993)	Federal and state allocations	Financial returns; job creation, wealth, and entrepreneurial capacity.
Canada	Labour-Sponsored Venture Capital Corporation (1982)	Public-private funds (labour unions lead multiple investors)	Boost growth and stimulate the Canadian economy; pursuit of profits.
United Kingdom	UK Infrastructure Income Fund (2009)	Public-private funds	Cleantech
	London Co-investment fund (2009)		
	Investment accelerator (2017)		
	Clean growth fund (2020)		
Europe	European Investment Fund (1994)	Public-private funds (European Investment Bank, European Union)	Fostering entrepreneurship, growth, innovation, R & D, employment, and regional development; generating returns for the shareholders.
	Belgium: ARKimedes (2005), Biotech Fonds Vlaanderen (1994), Brussels Regional Investment Company (1980), LRM NV (1994), Meusinvest (1985).		
	Finland: Suomen itsenäisyyden juhlarahasto (1967).		
	France: Alsace Creation, BPI France (2012).		
	Italy: Piemontech.		
	Germany: BIOM (1997).		
	Spain: Axis Participaciones Empresariales (1986), Enisa con el emprendimiento innovador (2014), NEOTEC Programme (2002), Sodiga Galicia (1972).		
	Sweden: Almi Invest (2009), Industrifonden (1979), Inlandsinnovation (2010), Fouriertransform (2009), Saminvest (2016).		
Australia	Innovation Investment Fund	Public-private funds	Stimulate the financing of small high-tech

	(1997)		companies in Australia.
Korea	Korea Fund of Funds (2005)	Government and partnership Funds	Industrial promotion, job creation, and support for SMEs and VC firms, realize profits.
China	Shenzhen Capital Group (1999)	Government and 6 SOEs	Discover potential companies, nurture innovation, and facilitate value creation.

2.3 Review methodology

This study followed the practices for literature reviews published in *Journal of Management* (e.g., Rodell et al., 2016; Foss & Saebi, 2017; Aguilera et al., 2021; Ozgen et al., 2024) for data collection, analysis, and synthesis. First, this study collected articles from the Core Collection in Web of Science (WOS). WOS was selected since it is known as the most extensive interdisciplinary knowledge base, offering academic publications dating back to 1900, which is considered an ideal database for literature review (Van Leeuwen, 2006). To comprehensively search for relevant literature about GVC, this study employed the following codes in the WOS advanced search: 'government* venture capital*' OR 'venture capital guid* fund*' OR 'public venture fund*' OR 'government-backed fund*' OR 'fund of fund' OR 'government* venture fund*' OR 'state-owned venture capital'. This study searches articles based on topics that cover the identified keywords in the title, abstract and keywords. The literature search time was April 25th, 2024, and 96 documents were initially collected.

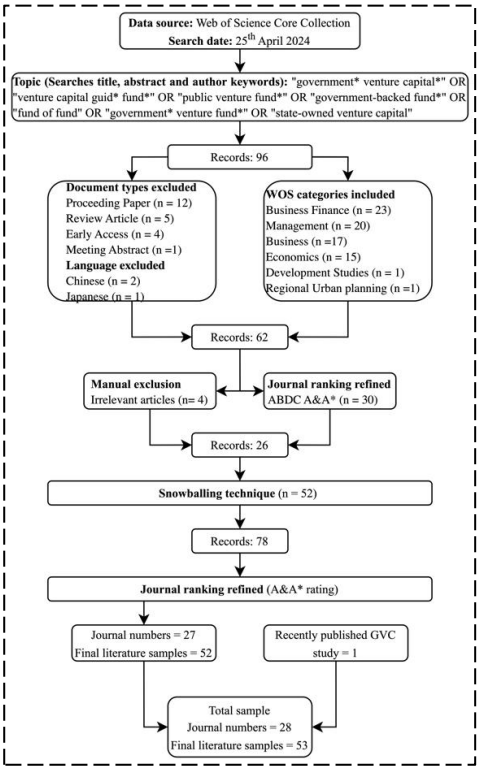

Figure 2.1 Workflow of articles searching phase

Subsequently, to refine and accurately obtain relevant literature data, this study conducted multiple rounds of screening under specific conditions. On the one hand, this review excluded document types such as proceeding papers and reviews, and non-English literature. On the other hand, the study selected WoS categories like business finance, management, and business as the areas of this review. A total of 62 records remained. Particularly, this study focuses on research articles published in leading journals, so the review only chose journals with an A and A* rating from the Australian Business Deans Council (ABDC) Journal Quality List. The ABDC list was selected since it is recognized by most business schools that focus on research quality (Grossmann et al., 2019), more importantly, it is commonly used as journal quality criteria in literature review research (e.g., Podgorodnichenko et al., 2020; Teoh et al., 2021; Redine et al., 2023). After applying the journal list, 30 articles were retained based on the relevance to the focus of the review which needs to focus on antecedents, mechanisms, and impacts of GVC research**.** However, after a brief reading, this

study found that 4 of them were not relevant to the topic, which focuses on financial mathematical modelling and risk management of private equity funds. As a result, a total of 26 documents were filtered. After collecting the first wave of articles, this study used a snowballing technique and collected all relevant articles that were cited in the retrieved articles in the second wave. In the second wave, this review followed the same inclusion and exclusion criteria as above and added an additional 26 articles. Lastly, during the review process, according to the recommendations of other management scholars, this study included a recently published GVC study from the *Strategic Management Journal* in the review collection. In total, the review finally sampled 53 articles from 28 journals during the years 2000 to 2024. The detailed literature search workflow in this review can be seen in **Figure 2.1**. Then, according to the method from Ozgen et al. (2024), this study systematically coded these 53 articles based on the following aspects: (a) type of paper; (b) descriptions/definitions of GVC; (c) topics (relationships examined); (d) theoretical foundations; (e) data sources, research samples, and study regions; and (f) variables and their measurements.

2.4 Scope of the literature

After five rounds of screening, this review selected 53 representative articles from leading journals. All the articles are based on empirical methodologies. Among these, regression analysis was the most common approach (D. J. Cumming et al., 2017; Lee et al., 2023), and some other researchers also used case study methods and mathematical modelling (e.g., Jääskeläinen et al., 2007; Malmström et al., 2017; Owen, 2023). On the research level, the majority of articles address firm-level studies, and there is very little research adopting an individual, macrolevel or multilevel approach. This study summarizes the publication trend and changes in sample regions in **Figure 2.2**. As shown in **Figure 2.2**, it is clear that the publication volume of representative articles on GVC has shown a general upward trend over

the past 25 years, with peaks in 2015 (9) and 2021 (6). This trend aligns with the practical involvement of governments in financing markets. Notably, 6 GVC articles were published in the first half of 2024, suggesting that another peak is expected this year. Besides the publication trend over time, the 53 identified articles are published across 28 journals. Among them, *Small Business Economics* (15.1%), *Research Policy* (11.3%), and *Journal of Business Venturing* (11.3%) have all published more than five research articles in the domain of GVC. Notably, these three are all leading journals in management studies.

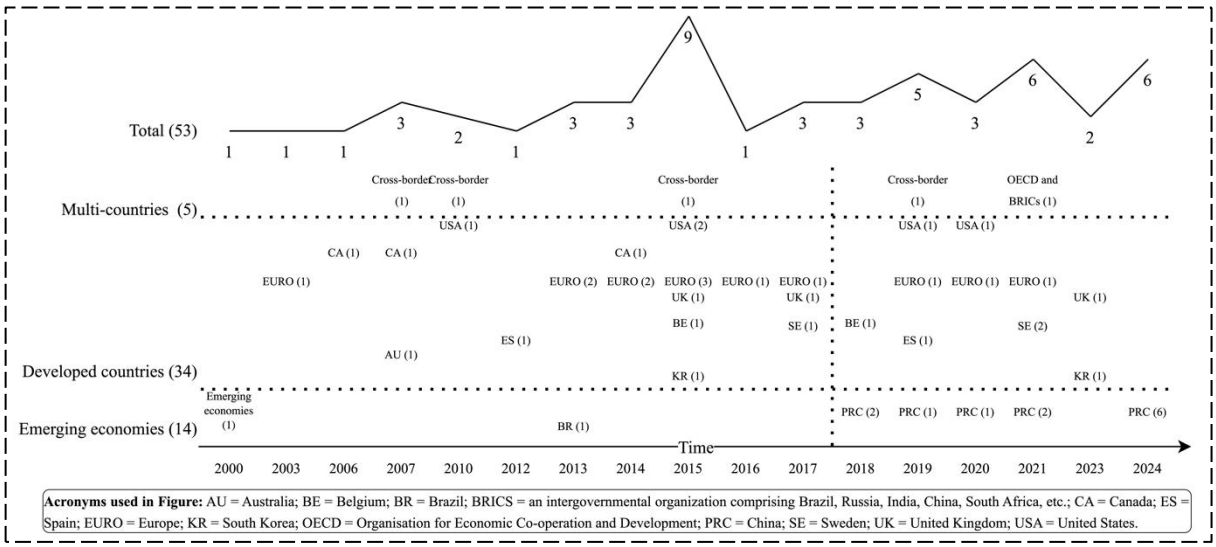

Figure 2.2 Publication on GVC by year and by region

A notable trend is the changes in research contexts. Overall, research spans dozens of countries worldwide, including Western developed countries and emerging economies, and some characteristics are worth highlighting. First, scholars mainly focus on GVC practices in Europe (43.4%), China (22.6%), and the United States (7.5%). This is closely related to the well-developed financial environments and vast market demands in these regions. Second, studies with a cross-border background are rare, and most research is conducted in a single country or among closely connected countries like the European Union, OECD, and BRICs. This could be because GVC practices are closely tied to each nation's social, cultural, and legal contexts (Brander et al., 2015; Suchard et al., 2021). More importantly, this study has

observed a shift in the sample contexts, meaning a transition from studying Western Europe and North America to focusing on emerging economies, particularly China. This shift may be related to changes in the performance and recognition of GVC by the authorities. Specifically, scholars begun to question the effectiveness of GVC (Y. Zhang & Mayes, 2018), particularly as its performance has not been markedly evident in studies conducted within Western contexts (e.g., Luukkonen et al., 2013; Alperovych et al., 2015; Pahnke et al., 2015).

This review also summarized the scope of empirical research on 53 GVC studies (see **Appendix A**). The total numbers exceed 53 since some studies examine multiple relationships. As illustrated in **Appendix A**, GVC is most frequently viewed as an antecedent influencing various outcomes (74), whereas fewer empirical studies discuss GVC as a moderator (7) or explore the determinants of GVC (8).

2.5 GVC field: underlying theories and research streams

2.5.1 Theories in GVC domain

According to the articles surveyed in this study, information asymmetry theory, market failure, agency theory, institutional theory, resource-based view, signalling theory, and crowding-out and crowding-in effects are the most common theoretical perspectives in current research on GVC. Information asymmetry refers to a condition where one party in a relationship has an informational advantage over the other (Akerlof, 1970), which is used to explain the financing constraints faced by start-ups. Information asymmetry between young firms/start-ups and the financial sector occurs when they generally lack historical records and strong tangible assets (Moore & Garnsey, 1993; Hottenrott & Richstein, 2020). Such an information gap severely limits their access to traditional VC (Lee et al., 2023), leading to severe adverse selection and moral hazard problems (Lim & Kim, 2015), and causing significant market failures at the early stages. Consequently, the financing market fails to

effectively provide the necessary funds to these young but promising firms, hindering their abilities to grow (Croce et al., 2019). This is why GVC plays a central role in fixing market failures by financing early-stage projects and remote areas (D. Cumming, 2014; Bertoni et al., 2019).

Agency theory (Jensen & Meckling, 1976) discusses the agency problems between the government, as the principal, and fund managers, and the implications of conflicting goals between two parties (i.e., management team and government) on GVC decisions (D. J. Cumming & MacIntosh, 2006; Standaert & Manigart, 2018; Q. Du et al., 2024). For instance, in some GVC cases, the government, acting as both investor and regulator, appoints the fund management team and oversees the investment decision-making process (Croce et al., 2019; Suchard et al., 2021). Politically connected firms may gain privileged access to funding opportunities (Y. Zhang, 2018; T. Li et al., 2024), which conflicts with the fund management team's financial performance goals, leading to inefficiencies in the allocation of financial resources and talent loss (Standaert & Manigart, 2018). Redesigning the GVC structure, especially regarding personnel authority, profit distribution, and compensation structure in hybrid funds, becomes a breakthrough for improvement (Jääskeläinen et al., 2007; Y. Zhang, 2021; Engberg et al., 2021; Lee et al., 2023). Furthermore, there are also agency issues between the GVC funds and the funded enterprises (Munari & Toschi, 2015), which are mainly reflected in the government agents forcing the enterprises to pursue certain political goals that may damage profitability (Murtinu, 2021). Finally, to enhance the effectiveness of investment behaviour, agency theory also emphasizes the importance of having a clear objective for VC funds (Bertoni & Tykvová, 2015).

Institutions are regarded as comprising regulative, normative, and cognitive logics that give meaning to, constrain, and guide social behaviour (Scott, 1995; Scott, 2013). Different institutional environments have different impacts on the development of GVC. Institutional

theory-based research aims to explain the differences between GVC and other types of venture capital, as well as the objectives of GVC. Devarakonda & Liu (2024) argued that GVC embodies an important type of institutional endorsement, which grants socially constructed legitimacy to start-ups in transitional economies, thereby positively influencing their development. Due to historical reasons and the uniqueness of legal and institutional environments, there is significant variation in the supply of venture capital across countries (D. J. Cumming et al., 2017). Similarly, providers of funds in the VC industry also can be categorized into venture capital, corporate venture capital, and government venture capital according to different institutional logics (Pahnke et al., 2015). GVC follows national institutional logic, often targeting the youngest companies at the seed stage and investing in sectors frequently overlooked by other VC funds, such as biomedical sciences and clean energies (Lazonick & Tulum, 2011; Bertoni et al., 2015; Polzin et al., 2021; Owen, 2023; Q. Du et al., 2024).

The resource-based view (Barney, 1991) suggests that GVC investments can help start-ups gain unique and key advantages in the market (Q. Du et al., 2024), particularly in securing more funding (Guerini & Quas, 2016), obtaining IPO approvals (Y. Zhang, 2018; Suchard et al., 2021), and maintaining good relationships with public institutions (Devarakonda & Liu, 2024). It is important to note that the non-financial resources provided by traditional VC do not overlap with those provided by GVC; at least to some extent, they are different (Bertoni & Tykvová, 2015).

Signalling theory is used to describe a range of behaviours that include both communicating information and signal interpretation (Connelly et al., 2011), which was initially proposed by Spence (1978). In GVC research, scholars adopt signalling theory to

discuss its certification effects (for invested firms)[1] and guiding (for other capitals) effects (D. Cumming, 2014). First, to mitigate information asymmetry and ensure external financing, start-ups must demonstrate their reliability, quality, and future prospects to potential investors (J. Chen et al., 2018). Based on this, GVC not only provides financial resources but, more importantly, acts as a certifier of a start-up's potential through its investment (Lerner, 2002), reducing the information gap for other investors. Additionally, GVC plays a guiding role by sending positive signals to private capital (Alperovych et al., 2020), resulting in multiple benefits, including lower corporate financing costs and uncertainty, increased investor confidence, and the promotion of new industries (Leleux & Surlemont, 2003; Guerini & Quas, 2016; Breschi et al., 2022; Ge et al., 2024). Overall, GVC not only helps companies attract external capital but also signals the industry to the public (Buzzacchi et al., 2013; Y. Zhang, 2018), drawing investment to sectors the government prioritizes, which are usually strategic industries (Luukkonen et al., 2013). Notably, this phenomenon is particularly prevalent in China, as evident in the official names of Chinese GVC programs, such as Industrial Development Funds or Venture Capital Guidance Funds.

The crowding-out and crowding-in effects are conflicting views that discuss the impact of GVC on the venture capital industry, specifically whether GVC acts as a catalyst or a deterrent (Wilson et al., 2023). The crowding-out effect argues that direct involvement by public institutions in venture capital may cause a 'crowding out' of private investors due to potential capital misallocation (Cull et al., 2015). Conversely, the crowding-in perspective supports that GVC will increase the total investment in the industry (Leleux & Surlemont, 2003; del-Palacio et al., 2012). More importantly, the investment goals and stages of GVC do not overlap with those of private investors (Bertoni et al., 2015), meaning that GVC does not

[1] It should be noted that the 'certification' here is not an official document with a government seal but an informal endorsement.

replace private investors but serves as an effective complement to them (Bertoni & Tykvová, 2015).

After careful comparative studies of these underscoring theories related to GVC, I mapped them into four streams that cover the definitions, performance, decision-making, and design of GVC (See **Table 2.2**). First, scholars try to provide a unified GVC definition to inform future studies better. Second, the current focus of GVC research is on discussing its multidimensional performance. Additionally, the design and investment decision-making process of GVCs also catch significant attention.

The table illustrates how interdisciplinary theoretical frameworks—ranging from institutional and agency theories to signalling and resource-based views—illuminate distinct dimensions of GVC. Key takeaways include:

Contextual variability: Institutional theory emerges as a central lens, emphasizing that GVC's definition, impact, and design are deeply shaped by national institutional contexts (e.g., regulations, cultural norms), highlighting its non-uniform global application.

Signalling and market bridging: Signalling theory recurs in both performance and investment decision-making, emphasizing GVC's role in reducing information asymmetry—for startups (signalling potential to investors) and for the market (influencing other VC capitalists' choices).

Agency dynamics: Agency theory is important across performance and design, revealing tensions between government objectives and fund managers' goals, as well as misalignments in personal cognition affecting investment choices, which stresses the need for alignment in governance structures.

Design and governance: The design of GVC is shown to be a product of broader institutional environments and internal structural/governance issues, with inefficiencies often stemming from misaligned interests or misfit with contextual norms.

Crowding effects and resource access: Theories like crowding-out/crowding-in and resource-based views highlight GVC's dual role—potentially stimulating or displacing private investment while enabling firms to access critical resources for performance.

In summary, the table 2.2 underscores that GVC's effectiveness is mediated by institutional, relational, and contextual factors, urging a nuanced understanding of how theory informs its role in innovation ecosystems.

Table 2.2 Links between theories and GVC research streams

Theme	Theoretical perspective	Description of intersection
Definition of GVC	Institutional Theory	GVC definitions vary across national contexts due to institutional embeddings, reflecting unique objectives and affiliations.
Performance of GVC	Information Asymmetry and Signalling Theory	GVC investments mitigate information asymmetry, signaling the potential of startups to potential investors, affecting performance.
	Market Failure	GVC funds bridge the financing gaps for start-ups ignored by private investors (e.g., early-stage, high-tech, and low-profitable).
	Agency Theory	Performance is influenced by the alignment or conflict between government objectives and fund managers' goals.
	Institutional Theory	GVC has different degrees of impact on the achievement of the same performance target in different national contexts.
	Crowding-out and Crowding-in	Governmental involvement can impact the size of the VC market.
	Resource-based View	GVC can enable firms to acquire the resources and capabilities necessary for performance targets.
Investment decision-making of GVC	Agency Theory	Personal cognition and individual characteristics of decision-makers influence GVC investment choices.
	Signalling Theory	GVC investments serve as market signals, impacting the investment

		decisions of other VC capitalists.
Design of GVC	Agency Theory	GVC design, including structure and governance, is analyzed for potential inefficiencies due to misaligned interests.
	Institutional Theory	The design of GVC is shaped by the broader institutional environment, such as regulations and cultural norms.

2.5.2 Research stream 1: definitions of GVC

The GVC lacks a unified definition (Grilli & Murtinu, 2015; Murtinu, 2021). **Table 2.3** summarizes GVC definitions proposed by 53 sample articles.[2] Existing literature typically defines GVC either as an entity (such as institutions or programs) or as a behaviour with specific targets. When GVC is defined as an entity, the focus is on its fundraising sources and its affiliations. For instance, Y. Zhang & Mayes (2018) defines GVC as "venture capital companies established, owned, and operated by the government", emphasizing the company's reliance on government budgets, its special relationship with the government, and its subjection to government management. A similar definition can be found in the GVC works of D. J. Cumming et al., (2017), who describes GVC as a VC fund set up and managed by a company entirely possessed by governmental (or public administration) bodies. On the other hand, scholars adopting a behaviour-based perspective define GVC as a set of activities, emphasizing its contributions to financial returns (D. J. Cumming et al., 2017), industrial development (Engberg et al., 2021), innovation practices (Bertoni & Tykvová, 2015). Additionally, some studies attempt to combine both perspectives to define GVC but often limit their characterization to the features of their sampled funds (too contextual dependent), resulting in incomplete descriptions. For instance, "Labour-Sponsored Venture Capital Corporations are a unique type of mutual fund in Canada designed to provide VC to small

[2] It is worth noting that since this study directly pasted the original text from the literature into the table, some expressions may be more like 'descriptions' rather than 'definitions', which also provides evidence of the current lack of definitions in GVC research.

and medium-sized enterprises and raise funds from individual investors" (Johan et al., 2014); "Government-backed VC funds provide public financing for early-stage, high-growth potential firms, particularly those aiming for social and environmental returns and the transition to a low-carbon economy" (Owen, 2023); and "Funds supported by public institutions to promote investment in alternative energy production innovation" (Q. Du et al., 2024).

Table 2.3 Definitions of GVC in existing research (ordered chronologically)

Authors	Definitions
Entity-view	
Jääskeläinen et al. (2007)	These vehicles by which independent venture capital firms are used to channel and allocate public financial support are termed 'hybrid funds'.
D. J. Cumming et al. (2017)	VC funds are set up and managed by a company entirely possessed by governmental (or public administration) bodies.
Pierrakis & Saridakis (2017)	Government backed funds are funds that have received some or all of their capital from the public sector, including regional development agencies, the European Union, devolved administrations or government schemes.
Y. Zhang (2018)	VC firms classified as GVCs if they are established by the government, with the main funding resource coming from the government and the CEO and directors appointed by the government.
Y. Zhang & Mayes (2018)	Government-established, owned and operated venture capital firms.
Bertoni et al. (2019)	Governmental venture capital (GVC) is a government-owned investment vehicle that is structured like a venture capital (VC) fund.
Breschi et al. (2022)	'GVC' both public investments in existing (private) funds and direct ownership of funds by state-owned entities.
Engberg et al. (2021)	Specifically, GVCs are VC companies that are either partly financed (what is known as 'hybrid' GVC) or entirely owned and run by the government ('direct' GVC).
Murtinu (2021)	The direct intervention of the government in venture investing by means of set-up, owned and actively managed VC funds.
T. Li et al. (2024)	Government venture capital (GVC)—a specific type of political connection.
J. Zhang & Gu	VC firms as GVC firms when their total shares held by public authorities or state-owned

(2024)	organizations exceeded 50%.
Behaviour-view (focusing the aims/goals of GVC)	
D. J. Cumming & MacIntosh (2007)	Labour-Sponsored Investment Funds were created with the intention of promoting investment in small and medium-sized entrepreneurial firms, with emphasis on the technology sectors.
Luukkonen et al. (2013)	Government venture capital (GVC) funds have been a common policy initiative in European countries to overcome funding gaps in the promotion of early-stage ventures.
Standaert & Manigart (2018)	Most government VC investment programs pursue a dual goal of adequate financial return and economic development.
Alperovych et al. (2020)	Governmental venture capital funds (GVCs) are created by policymakers around the world to support young innovative companies (YICs) with the aim of bridging the equity gap.

Ambiguities in the definitions of GVC can conflate GVC with other government financing, thus obscuring the uniqueness of GVC as an emerging issue and leading to fragmented research within the domain. Specifically, government subsidies and bank loans are common financing tools to promote development. Their different sources of funds determine the differences in strategies to facilitate industrial framework. On the one hand, government subsidies supported by fiscal funds tend to fund basic research (Branstetter & Sakakibara, 2002; Kleer, 2010), but face inefficiencies caused by bureaucracy (Fang et al., 2018). On the other hand, small firms are largely dependent on bank credit for external funding (Mkhaiber & Werner, 2021), but because the bank's funding source is social capital, they need to consider the financial solvency of enterprises (Kashif et al., 2016), so they are more likely to finance more mature projects to promote further development. Unlike the above two financing tools, GVC funds have a wider range of funding sources, including public and private funds, have a large amount of capital and focus on early financing, and will play a greater role in the industrial framework when agency conflicts are mitigated. Therefore, providing an objective and comprehensive definition of GVC is essential to offer scholars and authorities a reference for research and practice.

Building on previous fragmented definitions and the theoretical mapping of the underscoring theories, this study posits an integrated definition of government venture capital as follows:

Government venture capital refers to the equity financing behaviour undertaken by the public sector, either solely funded or co-funded with private capital, through the establishment of specific funds that invest in target enterprises directly or indirectly to pursue multiple goals.

This definition consists of three core components of GVC: fundraising model, investment method, and set objectives. Before specifying the details, it has to note that GVC is an equity financing behaviour, which is its fundamental attribute as venture capital, and it is crucial to distinguish it from other forms of government support such as subsidies or loans (Devarakonda & Liu, 2024).

Firstly, GVC highlights the role of the public sector, regardless of the proportion of public equity in the fund. The public sector is always the initiator or a significant participant (Johansson et al., 2021). The mainstream GVC funds adopt a hybrid model (Engberg et al., 2021), demonstrating GVC's leverage effect on private capital (Kovner & Lerner, 2015; Owen, 2023). It is notable that the public sector here narrowly refers to the government but can broadly refer to subordinate administrative departments or other public institutions. For instance, in the Chinese context, reputable universities and research institutions are affiliated with the government (Devarakonda & Liu, 2024), and their management teams consist of government officials. Therefore, university VC funds can be categorized under GVC in this specific context.

Secondly, there are two types of investment modes for GVC: direct investment and indirect investment. Direct investment refers to GVC funds directly seeking target enterprises in the

market and provide them with financing. Indirect investment involves GVC funds investing in third-party financial institutions such as private funds, which then select the investment targets, such as fund-of-funds arrangements.

Thirdly, a distinctive feature of GVC is its multidimensional objectives. In addition to the traditional financial return goals as pursued by VC, GVC funds place greater emphasis on seeking industrial development and innovation improvements aligned with the government's political objectives (Breschi et al., 2022; Ge et al., 2024). Based on the GVC's political objectives and distinct competencies, GVC is a different species from IVC because they occupy different niches (Bertoni et al., 2019).

In summary, GVC is an equity investment behaviour, different from traditional government subsidies and loan financing channels. In fact, it is a different species in VC; GVC is led by governments, and it often carries political missions when investing. This definition is also useful in further dividing the GVC research into subdivisions such as minority equity GVC, the government-owned GVC and government-supported GVC, the technology-oriented GVC and development-oriented GVC (Bertoni & Tykvová).

2.5.3 Research stream 2: performance of GVC

As the previous analysis has suggested, the majority of GVC research has focused on its impacts, that is, how GVC funds perform across multidimensional performance indicators, evaluating the effectiveness of the government's role in the VC market. Specifically, achieving successful exits is deemed as one of the goals of GVC investment. However, this view ignores the critical but sometimes hidden mission such as providing seed funding to resource-constrained enterprises and sending reliable signals to private investors, thereby supporting industrial development, job creation, and innovation cultivation (Pergelova & Angulo-Ruiz, 2014; Colombo et al., 2016; Abrardi et al., 2019). As a result, from the

perspective of GVC investments, this study categorizes these performance outcomes into financial returns, industrial development, and innovation performance (Kovner & Lerner, 2015; Wang & Wu, 2020). Financial returns represent internal performance, which benefits GVC funds, while industrial impacts and innovation output reflect the external spill-over benefits generated by GVC funds (Lerner, 2010; Owen, 2023). In addition, the comparisons among GVC, IVC, and syndicated forms are the feature in the GVC performance research.

2.5.3.1 Financial returns

Financial returns have traditionally been emphasized by VC capitalists, and exit performance is widely used as a clear and objective method of assessment (D. Cumming, 2007; Y. Zhang, 2021). Among these, IPOs and Mergers and acquisitions (M&A) represent positive returns, whereas write-offs are considered negative (Y. Zhang & Mayes, 2018; Breschi et al., 2022). For the positive exits, although IPOs are often preferred (as they allow entrepreneurs to regain control of the company), M&A is more common in practice (Brander et al., 2015). Additionally, capital gain refers to the amount of funds that GVC funds can obtain upon exit (D. J. Cumming & MacIntosh, 2007), which more directly reflects financial performance. In terms of measurements, exit performance is often assessed using dummy variables to determine whether a company has achieved an exit (D. J. Cumming et al., 2017; Suchard et al., 2021), while capital gain variables more intuitively use data such as IPO valuation (T. Li et al., 2024). **Table 2.4** illustrates the empirical results of the financial performances of GVC.

Table 2.4 GVC's financial performance

Performance	DV	Outcomes	Examples
Exits	IPO/M&A (positive)	Partially government-owned VCs increase the likelihood of a successful exit; higher government ownership reduces exit success.	Suchard et al. (2021)
		Politically connected VC-backed firms are more likely to exit success.	R. Wang & Wu (2020)
		GVC investments are less likely to exit than the IVC.	Munari & Toschi (2015); D. J. Cumming et al. (2017); Y. Zhang (2018); Y. Zhang & Mayes (2018)
		No statistically significant difference in the exit outcomes for GVC funds and other types of VC funds.	D. Cumming (2007)
		GVC-backed firms that did not receive IVC were listed and acquired at a significantly lower rate than the GVC-backed firms that received IVC.	Guerini & Quas (2016)
		A positive association between mixed GVC/IVC funds (syndication) and successful exits.	Brander et al. (2015); D. J. Cumming et al. (2017); Y. Zhang & Mayes (2018)
		Firms backed by syndication have better exit performance than GVC-backed firms.	Y. Zhang (2018)
	Write-off (negative)	Higher public ownership in GVC shows a lower incidence of write-offs.	Buzzacchi et al. (2013)
Share price returns		GVC backing lowers share price returns.	T. Li et al. (2024)
		No differences between GVCs and other VCs in share price returns.	D. Cumming (2007)
Return on investment (ROI)		GVC firms are likely to have a lower level of returns from their investment portfolio than non-GVC firms.	J. Zhang & Gu (2024)

Based on traditional VC performance evaluation methods, the role of GVC is not significant and may even be detrimental to exits (D. Cumming, 2007; T. Li et al., 2024). The proportion of state ownership moderates the impact of GVC on exits (Suchard et al., 2021). Furthermore, in the comparative performance analysis, GVC generally underperforms compared to IVC (Munari & Toschi, 2015; D. J. Cumming et al., 2017), while the financial performance of syndication not only better than that of GVC but also outperforms IVC (Y. Zhang, 2018; Y. Zhang & Mayes, 2018).

2.5.3.2 Industrial development

Industrial development focuses on firm growth in areas such as sales (Grilli & Murtinu, 2015), employment (Standaert & Manigart, 2018), and efficiency (Alperovych et al., 2015) that GVC activities bring to invested companies and the impacts of GVC funds on targeted industries and the VC ecosystem (Alperovych et al., 2020). These efforts are ultimately promoting societal progress (Soleimani Dahaj & Cozzarin, 2019; Bertoni et al., 2019). Compared to financial performance, industrial development performance encompasses broader ranges and represents the political interests of government involvement in the financing market. However, such investments aimed at generating social effects may undermine the maximization of pure financial pursues, particularly when examining the investment strategies of hybrid venture capital funds (Buzzacchi et al., 2013). **Table 2.5** illustrates the empirical results of the industrial performances of GVC.

Table 2.5 GVC's industrial development performance

Performance	DV	Outcomes	Examples
Firm growth	Employment	IVC exerts a higher impact on employment growth in invested companies than GVC during the crisis, whereas the opposite is found in the normal period.	Croce et al. (2019)
		GVC does not affect employment growth.	Grilli & Murtinu (2014)
		Companies backed by hybrid IVC show greater employment growth than those backed by syndication or hybrid GVC.	Standaert & Manigart (2018)
	Sales and employment	IVC positively impacts sales growth while GVC does not; a positive impact of syndication investments on sales growth is found, but only when led by IVC.	Grilli & Murtinu (2014); Grilli & Murtinu (2015)
		A stronger growth effect among IVC- and syndication-backed firms as compared to GVC-backed firms.	Engberg et al. (2021)
	Commercialization	GVC has no effect on product approvals.	Pahnke et al. (2015)
		The entrepreneurial risk that characterizes the SBIR program is, on average, slightly more than 50%.	Link & Scott (2010)
	Productivity	IVC-backed firms are more efficient than GVC-backed firms; GVC-backed firms are less efficient than non-VC-backed firms.	Alperovych et al. (2015)
		GVC-backed firms increase their productivity after the announcement of tax reform, but the amount of governmental ownership does not influence it.	Murtinu (2021)
	Value-adding activities (e.g., strategy; market position; professionalisation)	The value-added performance of IVC is significantly higher than that of GVC in specific categories.	Luukkonen et al. (2013)
		Public intervention may positively contribute to fostering the VC market.	del-Palacio et al. (2012)

VC industry advancement	Scale	GVC funds have not crowded out IVC investments.	D. Cumming (2014)
		Public participation leads to a reduction in the aggregate pool of VC.	D. J. Cumming & MacIntosh (2006)
		GVC funds do not crowd out IVC funds in the stage of investment selection.	J. Zhang et al. (2024)
		The mixed-structured is better than the pure-structured GVC investment in attracting domestic and international IVC to the VC market.	Soleimani Dahaj & Cozzarin (2019)
	Investment patterns	GVC investors in Europe specialize in investments that do not attract other types of VC funds.	Bertoni et al. (2015)
Industrial upgrading	High-tech and Early-stage investments	GVC is likely to be in earlier stage investments and in industries outside the VC mainstream.	Kovner & Lerner (2015)
	Aggregate investment	Firms funded by syndication obtain more investment than enterprises funded purely by IVC or GVC.	Brander et al. (2015)
	Targeted industry	GVC funds are more likely to invest in industries targeted by the industrial policy than non-GVC.	Ge et al. (2024)

Similar to GVC's financial performance, IVC's industrial development performance surpasses that of GVC (Luukkonen et al., 2013; Alperovych et al., 2015), with syndication remaining an important positive driver (Brander et al., 2015). However, the industrial development performance of GVC shows a more positive impact (del-Palacio et al., 2012), and the performance gap between syndication and IVC is gradually narrowing (Standaert & Manigart, 2018). Moreover, a special issue examining GVC industrial performance is its impact on the VC industry development. A critical question arises: Does GVC crowd out or crowd in private capital? The current literature has yet to reach a consensus on answers to this question.

2.5.3.3 Innovation performance

Innovation is a primary driver of long-term economic growth (Kogan et al., 2017) and a key objective of government venture capital funds (Engberg et al., 2021). Existing mainstream research focuses on two types of innovation: technological innovation and commercial innovation, with an emphasis on the former. Indicators for measuring technological innovation primarily derive from patent stock and patent citation data (Bertoni & Tykvová, 2015), with citation counts and the number of applications within patent stock being favoured for their more accurate reflection of innovation outcomes (Lee et al., 2023; Devarakonda & Liu, 2024). Additionally, commercial innovation, which refers to the approval of new products, is typically measured using dummy variables (Pahnke et al., 2015). **Table 2.6** illustrates the empirical results of the innovation performances of GVC.

Table 2.6 GVC's innovation performance

Performance (DV)	Outcomes	Examples
Patent application	GVC can positively influence the innovation performance of start-ups in transition economy contexts.	Devarakonda & Liu (2024)
	High-tech firms backed by GVC are innovative; syndication deals yield higher innovative productivity.	Alperovych et al. (2020)
	GVC funds are not significantly different from IVC funds in economic performance, and they are better than IVC in innovative performance.	J. Zhang et al. (2024)
	Although GVC funds have poorer financial performance, GVC funds outperform non-GVC funds to a greater extent in terms of fostering innovation when they support targeted firms.	Ge et al. (2024)
	IVC funds have a stronger impact on patent creation than GVC funds; GVC investments are strongly and negatively associated with patent applications.	Pierrakis & Saridakis (2017)
Patent granted	GVC exerts an inverted U-shaped effect on the performance of renewable energy innovation.	Q. Du et al. (2024)
	GVC funds have no effect on patent granted and patent citation; syndication increases patenting; development-oriented GVC funds are better at	Bertoni & Tykvová (2015)

	increasing a firm's patent granted, and technology-oriented GVC funds,	
Patent granted and patent citation	combined with IVC funds, support patent citations.	
	The positive association comes largely from IVC and marginally from government supported GVC funds, whereas government managed GVC funds have no discernible impact on corporate innovation.	Lee et al. (2023)

Although GVC performs less adequately in financial and industrial outcomes compared to IVC, it excels in innovation performance (Zhang et al., 2024; Ge et al., 2024). However, GVC can promote technological innovation and maintain robust results when using different categories of patent variables, especially in the long run.

Overall, purely GVC can yield some positive performance (del-Palacio et al., 2012)Suchard et al., 2021; Lee et al., 2023), but it is not prominent and sometimes even exhibits negative effects (Grilli & Murtinu, 2014; Pahnke et al., 2015; Pierrakis & Saridakis, 2017). To better assess the unique role of government in the VC market, most existing literature employs a comparative performance evaluation method (e.g., Luukkonen et al., 2013; Y. Zhang, 2018; Alperovych et al., 2020). The primary competitors in this assessment are GVC funds, IVC funds, and their syndication funds. Scholars hypothesize that due to the public welfare orientation of GVC funds (J. Zhang et al., 2024), investment decisions might be distorted (Buzzacchi et al., 2013), ultimately leading to inferior financial performance compared to IVC funds. Furthermore, given that a significant objective of GVC is to promote industrial development and innovation (Engberg et al., 2021), researchers focus more on the spill-over effects of GVC. Concerning performance comparison among the three types of VC funds, IVC generally outperforms GVC (Luukkonen et al., 2013; Munari & Toschi, 2015; Y. Zhang & Mayes, 2018). Nevertheless, scholars have also found that syndication funds tend to yield better returns (Brander et al., 2015; D. J. Cumming et al., 2017). These empirical results have

not entirely confirmed scholars' expectations (Y. Zhang, 2021), which raised questions about the effectiveness of GVC .

Some scholars attribute weaker performance of GVC to government's deep involvement in fund management. They argue that excessive administrative interference and a tendency toward risk aversion can affect fund managers' investment decisions (Dong et al., 2021; Q. Du et al., 2024), leading to poor performance (Y. Zhang & Mayes, 2018). Therefore, they advocate for the government to hold minority equities and reform the management and profit-allocation structures. Additionally, GVC is a long-run endeavour (Lerner, 2010; Bertoni & Tykvová, 2015), while the duration of government involvement is relatively short right now, with many investment outcomes yet to materialize (D. Cumming, 2007; Murray, 2021). More importantly, the focus of GVC on industrial development and innovation is not easily quantifiable (Y. Zhang & Mayes, 2018), with long-term impacts that are more similar to a 'trickle-down effect' and gradually spreading across various fields. Furthermore, agency theory suggests that unclear VC objectives lead to reduced effectiveness (Bertoni & Tykvová, 2015), providing an argument for the performance differences between GVC and IVC. Specifically, IVC funds have clear objectives—to provide financial returns for investors—while GVC funds often have more ambiguous, multidimensional, and sometimes conflicting goals, including financial and political objectives (Munari & Toschi, 2015). Finally, due to institutional logic, the realization of GVC objectives may exhibit geographical bias. For instance, recent studies based on the Chinese context further confirm the unique role of GVC (Devarakonda & Liu, 2024), which stems from their decades of government-led technology policies and a business system that is still in transition (White et al., 2005). Thus, even if firms funded by GVC are not as successful as those funded by IVC, government participation in the VC market remains worthwhile (J. Zhang et al., 2024).

This study found two related trends, as shown in **Table 2.4-2.6**: the focus on GVC performance appears to systematically evolve from financial returns to industrial benefits and innovation outputs; more recent studies, particularly those analysing innovation performance, increasingly support the positive role of GVC (e.g., Devarakonda & Liu, 2024; Ge et al., 2024; Q. Du et al., 2024). These two trends seem to validate that the original intent of GVC can be realized gradually.

2.5.4 Research stream 3: investment decision-making of GVC

The existing literature on GVC decision-making mainly focuses on the impact of characteristics of capitalists and entrepreneurs and their interactions on financing approvals. Among 53 sampled articles, only 2 address this issue, both authored by a research team led by Malin Malmström and Jeaneth Johansson. The 2017 study (Malmström et al., 2017), based on a Swedish case, examines the impact of entrepreneur gender on the allocation of public funds. Initially, the team uses frameworks such as Gender Stereotypes and Role Congruency Theory to theoretically explain why men might have a significant advantage over women in securing funding (Eagly et al., 2000; Eagly & Karau, 2002; Eagly, 2013). Further quantitative analysis reveals that not only do more male entrepreneurs receive funding approval, but female entrepreneurs also receive a lower proportion of their requested funding than their male counterparts (Lins & Lutz, 2016). Additionally, discourse analysis of decision-making meeting records suggests that capitalists rhetorically construct stereotypes towards female entrepreneurs, perceiving the ideal entrepreneur as male rather than female (Karlstrøm et al., 2024). Therefore, the emphasis on gender equality by venture capitalists or governmental policies supporting female entrepreneurship is not reflected in the distribution of funds.

Another study by the same team, from the perspective of GVC capitalists, explores the decision-making logic and influencing factors in GVCs when approving or rejecting funding

applications (i.e., Johansson et al., 2021). Observing investment decision meetings organized by seven Swedish GVC officials over two years, the team identifies four main forces driving GVC decisions: initial impressions, positive and negative emotional expressions, cognitive identity confirmation, and multiple perspective validation (Festinger, 1957). The study concludes that personal cognition influences GVC decision-making more than regulations and norms, expanding the understanding of investment decision mechanisms and institutional theory.

Overall, both studies, based on individual-level findings, emphasize that the personal characteristics of both recipients and providers of funding have a greater impact on GVC decision-making than the institutional logic (different institutional backgrounds impact investment decision-making) advocated by VC scholars. In other words, the cognitive process predominates in the evaluation of GVC applications and fund allocation.

2.5.5 Research stream 4: design of GVC

GVC scholars seek to explain why GVC underperforms compared to PVC, with their core argument revolving around the agency conflict between the public sector and professional fund managers. This conflict results in GVC funds failing to fully leverage VC profitability or achieve the government's political objectives. Traditional GVC designs, including incentive structures, management models, profit distribution, and compensation frameworks, are identified as key inefficiency reasons (Lu et al., 2013; Y. Zhang & Mayes, 2018; Y. Zhang, 2021). In specific, firstly, GVCs are established according to government tasks and norms rather than market-driven/efficiency-driven motivations like IVCs. Therefore, regardless of the GVC's form, the government wields significant influence, notably in investment decisions and human resource appointments, which are likely to compromise the efficiency purpose. Secondly, profit distribution refers to the benefits sharing among fund investors, while compensation structure refers to the remuneration received by employees.

Specifically, traditional GVC designs do not offer 'carry' benefits to cooperative funds like PVCs do, and employees receive only basic salaries and bonuses following conventional industry practices. Consequently, traditional GVC designs are not conducive to high efficiency. Using simulation models, Jääskeläinen et al. (2007) explored how traditional GVC designs impact the ability to mitigate market failures and attract private investors and professional managers. They argued that such asymmetric benefit-sharing models could only address relatively modest market failures unless these schemes also attracted high competent investors who can produce above average returns in market failure areas.

Taking the notable Chinese GVC, Shenzhen Capital Group (SCG), as an example, Y. Zhang (2021) examined the effects of the 2006 reform on mitigating agency issues. The new GVC model significantly improved SCG in areas such as benefit distribution (issuing carry-like bonus and launching co-investment plans), decision-making procedures (replacing government directives with voting procedures), and expansion strategies. Quantitative results indicated that the new scheme effectively mitigated agency problems and improved performance. However, this case study overlooks two issues: (1) Although SCG formally remains a GVC, its heavy imitation of PVC operations raises the question of whether it has essentially transformed into a PVC with government equity, thus diverging from the original governmental intent of establishing the fund. In other words, if GVC funds consistently generate substantial profits from their investments, their existence becomes less justified, as IVC could potentially make the same investments (Engberg et al., 2021); (2) While the reform scheme ostensibly resolved agency problems and boosted performance, it is possible that China's rapid development has obscured these issues. Specifically, post-reform China has seen substantial investments across various sectors, and the vast market has blurred the boundaries between the government's target industries (public welfare) and high-profit industries favoured by private investors (high returns). In other words, any form of VC

entering these sectors in recent times in China is likely to generate profits, thereby masking agency conflict. Thus, it remains uncertain whether the GVC design reform has truly resolved or merely temporarily obscured agency conflict issues, which necessitates further evidence.

2.6 Discussion and future research agenda

As an emerging category of the VC family, GVC was still in its infancy. It was not widely recognized by many governments, let alone adopted as an investment instrument before the early 21st century (Murray, 2021). As Guerini & Quas (2016) argued, current research on GVC is limited in understanding the principles, design, and implementation of GVC. However, the GVC practices are ahead of research indicating that researching this area has become an urgent task (Bertoni et al., 2019). This study bridges this gap by providing a comprehensive review that integrates the existing literature. A total of 53 papers published in leading peer-reviewed journals between 2000 and 2024 were identified and have been descriptively and thematically analysed. In the following, this review gaps in the existing studies and, accordingly, provides salient directions for future research to stimulate further thought, debate, and empirical research to advance the knowledge of this important topic.

Building on previous literature, this study proposes an integrated definition of GVC: "Government venture capital refers to the equity financing behaviour undertaken by the public sector, either solely funded or co-funded with private capital, through the establishment of specific funds that invest in target enterprises directly or indirectly to pursue multiple goals". In the analysis of GVC performance research, this study observed a shift in performance focus due to a progressively refined understanding of GVC. In addition, individual cognition dominates GVC investment decisions, and the well-designed GVC structure and governance model has a positive impact on performance. Overall, GVC plays a crucial role in addressing the funding gap for start-ups, especially in high-tech and innovative

sectors. Despite challenges related to institutional conflicts and inefficiencies, GVC funds provide critical non-financial resources and legitimacy, which can enhance the growth prospects of funded firms. The performance of GVC funds varies by region and industry and is influenced by institutional contexts and policy frameworks. The evolving nature of GVC practices, particularly the shift towards hybrid financing models and an increasing focus on social and innovation outcomes underscores the dynamic and complex landscape of government intervention in the VC market.

This study codes each collected research articles, focusing on clarifying the specific position of GVC as a variable, such as independent variable, dependent variable or intermediate variable (see Appendix A). On this basis, the antecedents and outcomes (impacts) of current GVC research are clarified. In addition, detailed information on GVC's own measurement indicators is also obtained through literature reading. Based on the above works, this study developed an integrative theoretical framework through which GVC research can be examined (see **Figure 2.3**). This framework emphasizes that deep understanding of GVC's antecedents and mechanisms provides pathways to improve the GVC research.

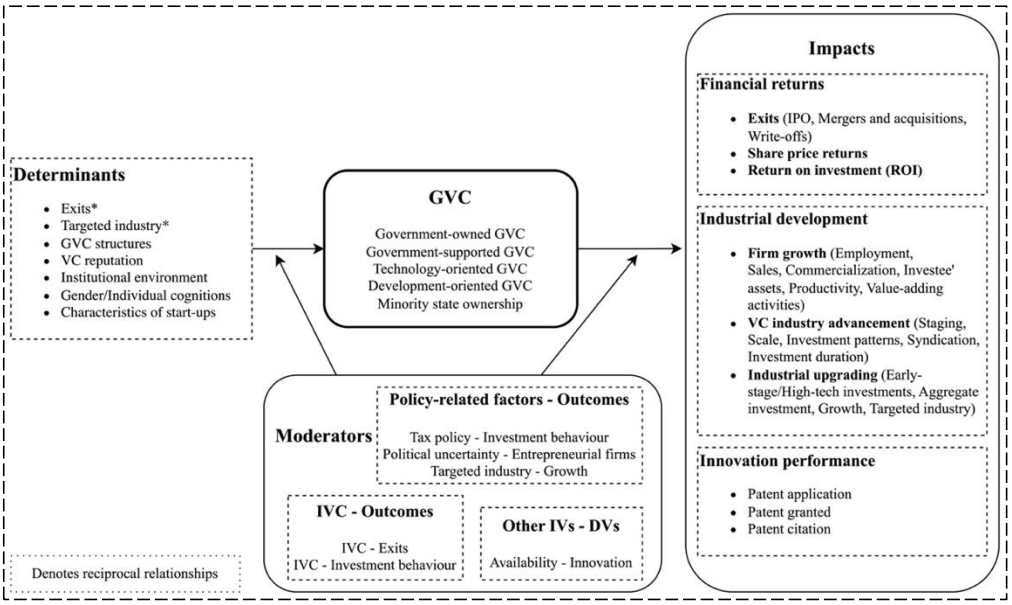

Figure 2.3 Integrative framework on GVC research

Figure 2.3 develops an integrative framework for GVC research based on the coding work and literature review, which provides some valuable information. First, overall, GVC research is relatively comprehensive, and GVC can serve as any variable, including independent variables, dependent variables, and intermediate variables. However, there are relatively few studies on the antecedents of GVC (GVC as a dependent variable). In other words, there is little exploration in academia on how to promote GVC. Second, there are relatively rich studies on the impact of GVC. In addition to traditional financial returns, the impact of GVC extends to areas such as industrial development and innovation progress. Third, GVC itself is also subdivided into government-owned GVC, government-supported GVC, technology-oriented GVC, development-oriented GVC, and minority state-owned GVC. Finally, as a mechanism, GVC is more widely used in areas such as public finance, corporate finance, and innovation management.

2.6.1 Focus on multi-level aspects of GVC

As revealed in the previous review, most of current GVC literature focused on firm-level, with a small portion conducted individual-level and regional-level studies. Among them, individual-level research is only used to examine the impact of personal characteristics on investment decisions (e.g., Malmström et al., 2017; Johansson et al., 2021), while regional-level studies are most applied to address whether public funding promotes or hinders the overall growth of the VC industry (e.g., Guerini & Quas, 2016; Breschi et al., 2022). Based on agency theory, more scholars analyse GVC from the perspective of the interaction (e.g., conflicts) between government and enterprises, believing that GVC, as a financing channel, primarily involves interactions between funds and firms. In other words, they focus on the dynamic evolution at the firm level during the investment process. However, the lack of evidence from macro-level data hinders our complete understanding of GVC research. For instance, it is hard to assess the unique role of GVC in the big picture by only relying on

micro-level data. Specifically, GVC aims to achieve both financial returns and developmental objectives (J. Zhang et al., 2024), but it emphasizes the latter (J. Zhang & Gu, 2024), including industrial advancement (Ge et al., 2024), VC sector development (Soleimani Dahaj & Cozzarin, 2019), and innovation enhancement (Q. Du et al., 2024). In other words, GVC, as a governmental support tool, not only retains the characteristics of traditional VC but also highlights the unique mission of the government as a special entity. To some extent, GVC is an extension of industrial and innovation policies. Therefore, more macro-level evidence is needed to support and test the impact of GVC on the region as a whole.

Future research could adopt a broader perspective to uncover the unique role of the public sector and the macro-level performance of GVC. In other words, the role and contributions of GVC funds still require further analysis using larger and more reliable datasets across different national contexts (Luukkonen et al., 2013). For instance, studies could explore the industrial and innovation performance of GVC based on city-level and sector-level data and examine the spillover effects of GVC performance in a region. It is worth noting that such macro-level studies on GVC should emphasize long-term effects since the institutional environment is not static, which adapts to social systems and often evolves over time (Johansson et al., 2021), a domain that remains unclear in most firm-level research.

2.6.2 Compare GVC across institutional contexts

On the one hand, evidence from developed countries accounts for a significant proportion of the current GVC studies, approximately 75% of 53 sample articles. On the other hand, recent studies based on the Chinese context exhibit results that differ from those of Western economies, particularly regarding the impact of GVC. For instance, GVC studies in the Western context often fail to capture the expected value of GVC, such as its potential to foster innovation and development (Pierrakis & Saridakis, 2017). However, these performances are more evident in the Chinese context. Therefore, this study argues that

research based on the phenomenon in industrialized countries cannot fully explain the phenomena in emerging economies such as China. In other words, due to different institutional settings, the role of and mechanisms by which GVC operates vary across institutional contexts, which requires scholarly attention and comparative research on GVC under different institutional backgrounds.

In fact, a trend of 'contextual shift' has already emerged, as shown in **Figure 2.2**, with an increasing number of studies focusing on emerging economies such as China. Notably, since 2024, all six GVC leading articles have been based on Chinese context. Based on this observation, this study tries to propose two suggestions for future research. First, it is imperative to pay more attention to emerging economies to explore the antecedents, mechanisms, and outcomes of GVC. For example, how do political connections more profoundly influence GVC decision-making? Can GVC act as a stronger signal to guide private capital in promoting development? Moreover, can GVC in emerging economies achieve positive financial returns? Here, this study briefly introduces the characteristics of Chinese GVC to aid in contextual judgment: most funds are concentrated in the developed coastal regions; local governments are more enthusiastic about such financial activities but manage funds smaller in scale than those established by the central government; there is a focus on investing in strategic emerging industries while also considering local characteristic industries; and attention is given to early or mid-stage financing needs of enterprises (CVINFO, 2020; CVINFO, 2022). Thus, Chinese GVC aligns with the research boundaries and provides adequate macro-level data. More importantly, China's unique political-business relationship highlights the government's role in economic activities, allowing scholars to better observe the effectiveness of this 'industrial policy'. The rapidly developing GVC market in China offers a fertile ground for future research discussions. Second, while current literature has conducted comparative analyses of different types of VC (e.g., IVC, GVC),

there is a lack of comparative studies on GVC under different institutional contexts. Some interesting questions could be: what heterogeneous impacts do institutions have on the use of GVC across different countries? What GVC in one country is successful while in other countries are not? Such studies can enhance the understanding of GVC phenomena.

2.6.3 Unpack antecedents that determine GVC

Although only a small proportion of the reviewed literature discusses the antecedents of establishing GVC funds, this does not imply that the topic is not important. On the contrary, it is a crucial issue in GVC research because it pertains to the rationale for establishing GVC and its unique role compared to other VC forms (Johansson et al., 2021; Zhang, 2021). Specifically, the conflict between the public welfare nature of projects and the profit-driven nature of private capital creates a funding gap that general social financing channels cannot fill for start-ups (Breschi et al., 2022). This provides a legitimate reason for government intervention in the VC market (Engberg et al., 2021). However, in addition to this, what other motivations might drive the government to act as a VC capitalist remains to be explored. For instance, analyses from the perspectives of public finance or international competition could provide insights. Specifically, infrastructure construction and public service provision require a large number of funding, yet governments worldwide are facing varying degrees of fiscal shortages. Traditional approaches, such as issuing government bonds, involve prolonged parliamentary discussions and political constraints (STASAVAGE, 2007), which hinder timely problem-solving. On the other hand, the operational logic of GVC is more market-oriented, allowing direct investment into selected projects without parliamentary deliberation. Therefore, future research could explore the impact of fiscal shortages on the establishment of GVC funds.

Second, global competition is driving the evolution of ecosystem cultivation from the firm level to the sectoral level. Traditional business ecosystems cantered around single enterprises,

such as Apple and Alibaba, can rely on their own strength for development. However, fostering strategic industry-level ecosystems requires more than just corporate efforts; the government's role should be more prominent. As a crucial public financing tool, the government might establish more specialized industry GVC funds to promote the innovation ecosystem at the industry level. Furthermore, government power can influence the operational logic of GVC funds. It is important to note that government power here refers not to the government's equity shares over a specific GVC fund, but to its overall control over the country (authoritarian power). Hence, public equity ratios are not suitable as GVC variables. Specifically, a powerful government may improve the performance of GVCs by providing additional support beyond funding, such as facilitating IPOs, approving bank loans, and offering special policy support (e.g., Y. Zhang & Mayes, 2018; Suchard et al., 2021). Conversely, a relatively weaker government might only be able to apply GVC and other tools to create an external nurturing environment based on strategic ecological niches for enterprise development. Overall, understanding the conditions under which GVC institutions emerge and the factors that influence GVC investment decisions represents a focus for future research on the antecedents of GVC.

2.6.4 Evaluate GVC performance from an input-output perspective

As the integrated framework in this study illustrates, performance analysis is a focal point in current GVC literature and has provided valuable insights. For instance, as shown in **Tables 2.4-2.6**, the results of GVC vary across different evaluation dimensions, exhibiting conflicting relationships (e.g., positive, negative, and no effect) between GVC and performance indicators. First, these differences in results may stem from scholars' diverse use of a matrix to evaluate the GVC effectiveness. A typical example is the shift in GVC research from focusing solely on financial returns to evaluating multidimensional performance, emphasizing social profits such as industrial development and innovation growth. This shift

indicates a growing recognition among scholars that the establishment of GVC funds aims not only for economic benefits but also for broader political goals (Ge et al., 2024; J. Zhang & Gu, 2024). Therefore, even if GVC funds do not perform ideally in traditional financial performance comparisons, it has not deterred governments from increasing their participation in the VC market. Specifically, GVC officials may invest in young enterprises or remote areas overlooked by traditional VC funds to achieve their developmental goals (Bertoni et al., 2019). However, while some literature often praises the 'selflessness' of the government, it does not measure the untended costs of such investment behaviour, presenting a new evaluation method for GVC performance research, namely, the input-output perspective. Specifically, compared to other VC funds, GVC funds invest not only simple funds but, more importantly, political resources (J. Zhang & Gu, 2024), including government endorsement, administrative simplification, and priority application approval. Meanwhile, whether the large-scale government resource input can achieve equivalent and expected 'development benefits' remains to be discussed. In other words, discussing the costs of government support helps to evaluate GVC performance more accurately. Since government resources are challenging to accurately quantify, case studies may be a feasible method.

2.6.5 Advance methodology in the field

First, as the key variable, the measurement of GVC is crucial in econometric analysis. Some literature primarily follows traditional VC research, using data sources such as funding size, investment amount, the number of funds, and investment rounds to measure GVC (Soleimani Dahaj & Cozzarin, 2019; Yang et al., 2022). Other scholars, based on institutional theory and GVC characteristics, use public equity ratios, whether it is GVC (a dummy variable), and the GVC classification (e.g., technology-oriented GVC and development-oriented GVC) to measure GVC (e.g., Buzzacchi et al., 2013; Bertoni & Tykvová, 2015; Ge et al., 2024). To enhance the richness of capturing GVC, future research can leverage

increasingly developed coding techniques, such as identifying GVC-related fields in government or industry documents and compiling word frequencies into new GVC variables. For example, the frequency of keywords such as 'promoting government-led VC market' mentioned in a local government's annual work report can be calculated and used as a GVC variable.

Second, GVC scholars need to adopt more rigorous methodological designs in their future work to identify and address endogenous issues, particularly those arising from simultaneous causality, present in GVC research. **Figure 2.3** highlights 'exit strategy' and 'target industry' as factors with reciprocal causality with GVC. Specifically, a large number of studies have validated the impact of GVC on firm exits (e.g., Guerini & Quas, 2016; Wang & Wu, 2020; Y. Zhang, 2021), while Abrardi et al. (2019) found that exit outcomes also influence GVC's strategic choices. Regarding the 'target industry' variable, GVC funds are likely to invest in target industries (Ge et al., 2024), and industries with social value tend to attract more GVC investment, thereby expanding GVC. However, existing studies have focused on the impact of individual factors on GVC but lack a configurational perspective. Specifically, the emergence and development of GVC are driven by pathways composed of multiple distinct conditions, which calls for further exploration by future researchers.

2.6.6 Introducing new theoretical perspectives

Based on the literature, this thesis finds that existing research mainly relies on institutional theory, agency theory or resource-based view to describe and explain the formation, operation and development of GVC, but integrating regional innovation system and knowledge spillover theory can provide a new path to deepen the understanding of the role of GVC in cultivating regional innovation ecosystems. These perspectives focus on spatial embeddedness, inter-organizational learning and the dynamics of knowledge flow,

responding to the key gap in current GVC research - the tendency to view GVC as a simple financial tool rather than a participant in regional innovation dynamics.

Regional innovation system (RIS) is defined as a network of enterprises, research institutions, intermediaries and policymakers within geographical boundaries, which promotes regional development by co-producing and diffusing knowledge (Cooke et al., 1997). According to Chung (2002), regional innovation system plays a vital role in promoting the generation and dissemination of new technologies, knowledge and products through a dynamic and complex network of interactions between different actors in the region (Chen et al., 2025). This perspective provides a structural framework for analysing how GVC interventions interact with local innovation ecosystems. Unlike traditional models that only focus on firm-level performance (e.g., Bertoni et al., 2015; Devarakonda & Liu, 2024), RIS emphasizes the contextual conditions of GVC operation and its spillover effects on the environment.

The knowledge spillover theory (Arrow, 1972) reveals the spillover mechanism of GVC's impact on regional innovation. By allocating public capital to high-potential start-ups, GVC not only provides financial support, but also plays the role of 'knowledge intermediary' to promote interaction between enterprises, researchers and policymakers. For example, GVC-supported enterprises often participate in collaborative R&D or talent mobility, and the resulting spillover effects can benefit existing enterprises, downstream industries and neighbouring regions (Yang et al., 2022; Chen et al., 2025). Introducing the knowledge spillover perspective will promote scholars and authorities to design more sophisticated GVC measurement tools.

In summary, RIS and knowledge spillover theory point to a core insight: the effectiveness of GVC depends not only on capital allocation, but also on its ability to activate the regional

innovation ecosystem. Therefore, embedding the relevant theoretical perspectives of economic geography in the future research agenda can more clearly observe the regional spillover value of GVC.

2.7 Conclusion

Since the 21st century, GVC research has progressed rapidly. The number of publications has shown overall growth aligned with the development of GVC practices, covering contexts from developed countries to emerging economies. The rationale behind GVC initiatives is rooted in several theoretical explanations, such as information asymmetry, institutional theory, agency theory, and signalling theory. Furthermore, this study links these underlying theories to the four main research streams on GVC for discussion. This review identifies several inadequacies in the existing GVC literature: it is overly reliant on firm-level evidence, lacks multi-level studies and comparative contextual analyses, and insufficiently addresses the antecedents of GVC. Based on this review, I will address these gaps in GVC research, by focusing on macro-level analyses in emerging economies, evaluating GVC performance from an input-output perspective, exploring the establishment of GVC funds from public finance and international competition perspectives, and adding new GVC variables using coding techniques. This first part of my PhD research contributes to clearly identifying new waves of GVC research, which not only provides insights but clear directions for my following empirical studies.

3. Study 2: What facilitates the formation of government venture capital? – A configurational perspective approach

Based on the academic gap in the lack of research on the antecedents of GVC highlighted in Study 1, I will attempt to supplement this literature through Study 2.

3.1 Introduction

There is growing attention from both researchers and practitioners on how to promote startup growth (e.g., Park et al., 2020; Del Sarto et al., 2022; Guo et al., 2022), due to the fundamental economic roles of these young firms (Criscuolo, 2014), such as driving development, increasing employment, and fostering innovation. However, the early-stage funding gap poses a significant challenge to the survival of startups (Soleimani Dahaj & Cozzarin, 2019; Alperovych et al., 2020). Traditional financing channels, such as venture capital (VC) and commercial bank loans, often may not be sufficient in providing seeding funds due to the inability of startups to offer verifiable track records and their inherent uncertainty (D. Cumming, 2014; Owen, 2023). A 1997 OECD report highlighted that direct equity investments by public sector represent the most advanced way to inject venture capital into an economy (OECD, 1997). In this context, an increasing number of governments have begun to participate directly in financing novel and small ventures, filling this gap left by the individual venture capital (IVC), adopting VC investment mechanisms while fulfilling their own political missions (D. Cumming, 2007; Luukkonen et al., 2013; Bertoni & Tykvová, 2015; Y. Zhang & Mayes, 2018), a model referred to as government venture capital (GVC).

As the practice of GVC has gained global traction, academic research on GVC has witnessed booming growth. As discussed in Study 1 of this thesis, existing literature provides evidence of the impact of GVC (e.g., Alperovych et al., 2015; Grilli & Murtinu, 2015; Pierrakis & Saridakis, 2017; Soleimani Dahaj & Cozzarin, 2019; Q. Du et al., 2024), however,

there is limited research exploring what determines GVC, under what conditions, and how GVC has become a new paradigm of public financing. For instance, Malmström et al. (2017) and Johansson et al. (2021) examined the impact of entrepreneur genders and individual cognitions of GVC officials on GVC investment decisions using Swedish cases. Moreover, there are some discussions on VC reputation, startup characteristics, and institutional environments that can influence GVC growth and transformation (Luo et al., 2019; Abrardi et al., 2019; Breschi et al., 2022).

Previous studies have primarily explored the linear effects of specific factors on GVC and have focused mainly on the firm and individual levels, which may have missed a comprehensive picture in GVC research, such as the antecedents of GVC. In addition, to my best knowledge, hardly any studies have directly examined the conditions for the genesis of GVC. In other words, the reasons underlying the formation of GVC funds, especially at the regional level, present a significant research gap in GVC studies. This study aims to fill this gap by investigating the synergy of different conditions under which GVC was formed and developed, using a configurational approach. This study conducted a fuzzy-set qualitative comparative analysis (fsQCA) method (Rihoux & Ragin, 2009) using cases from 236 cities in mainland China to explore the influence path and mechanism of GVC formation empirically. Additionally, this study identified complementary effects among different conditions. Unlike studies employing linear methods, this study explores and develops a typology where different configurations in various regions play equally significant roles in promoting GVC. Specifically, based on previous analyses of GVC antecedents, this study found that VC, entrepreneurship, and government factors can jointly influence GVC formation. Therefore, this study proposes that VC cases, VC amount, entrepreneurial demand, high-level development zones, fiscal expenditure on science and technology, and government-business relations, are all related to the formation of GVC.

This study contributes primarily to the GVC literature by expanding research on the determinants of GVC formation. Specifically, it identifies the configurational effects of various regional conditions under which GVC was formed, thereby enriching the understanding of the circumstances under which GVC can be created and developed. More importantly, this study has identified the driving pathways for GVC formation in emerging economies, expanding the discussion of GVC research to different institutional contexts, such as comparisons between developed industrialized nations and emerging economies. The findings have practical implications that can provide theoretical guidance for fostering an environment conducive to GVC growth in a region. Lastly, this study has significant policy implications such that policymakers can create conditions to foster GVC, including a GVC-friendly environment, supportive infrastructure, and complementary relationships between stakeholders for efficient resource allocation.

3.2 Theoretical background and research framework

3.2.1 GVC research

Since the advent of VC, this financing instrument has fostered the development of numerous esteemed enterprises by providing both funding and financial guidance, significantly promoting global entrepreneurial growth (Gu et al., 2018; Engberg et al., 2021). However, due to information asymmetry and the profit-driven nature of capital, many high-potential projects—particularly those requiring substantial initial investment and with longer development cycles—are often overlooked by VC institutions, leading to market failure in financing (Bertoni et al., 2019; Croce et al., 2019; Owen, 2023; Lee et al., 2023). In response, an increasing number of governments have begun participating in the VC market, utilizing GVC as a new paradigm distinct from traditional public financing tools, such as loans, subsidies, and grants (Bertoni & Tykvová, 2015; Invest Europe, 2019; Engberg et al., 2021;

Y. Zhang, 2021; Devarakonda & Liu, 2024). GVC aims to bridge the funding gaps left by traditional VC and further promote innovation and entrepreneurship (Malmström et al., 2017; Soleimani Dahaj & Cozzarin, 2019; Lee et al., 2023). As a new member of the VC ecosystem, GVC shares fundamental principles, investment models, and organizational structures with traditional VC (Bertoni et al., 2019). However, it distinguishes itself by embodying a public policy character, reflecting the unique role of government intervention in capital markets.

Following previous research and Study 1 (Jääskeläinen et al., 2007; Y. Zhang, 2018; Y. Zhang & Mayes, 2018; Murtinu, 2021; J. Zhang & Gu, 2024), this study defines GVC as an equity financing behaviour undertaken by the public sector, either solely funded or co-funded with private capital, through the establishment of specific funds that invest in target enterprises directly or indirectly to pursue multiple goals. This definition emphasized the connection between GVC and traditional VC while highlighting the distinctiveness of GVC in terms of funding models and strategic goals. Specifically, GVC belongs to the category of equity investment, aligning it with VC and distinguishing it from other forms of government support (Devarakonda & Liu, 2024). Although there are cases of fully government-funded GVC initiatives, the predominant financing model involves co-investment by government and private capital (Engberg et al., 2021), which is one of the primary goals of GVC-to leverage private investment (Kovner & Lerner, 2015; Owen, 2023). Moreover, GVC pursues multidimensional objectives. In addition to financial returns, which are the primary focus of traditional VC, GVC aims to achieve broader socio-economic development goals (Standaert & Manigart, 2018; Ge et al., 2024), reflecting the public nature of government involvement in VC activities.

Although studies on GVC have surged since the early 21st century, most of the existing literature focuses primarily on the impacts of GVC at the firm and individual level, such as exit strategies (Suchard et al., 2021), financial returns (T. Li et al., 2024), firm growth (Grilli

& Murtinu, 2014), industrial development (Kovner & Lerner, 2015), and innovation performance (Alperovych et al., 2020). However, scholars still know relatively little about the determinants of GVC. The limited research in this area highlights the importance of VC reputation, startup characteristics, and institutional environment in influencing GVC (Luo et al., 2019; Abrardi et al., 2019; Breschi et al., 2022). Nevertheless, these studies have not examined how these conditions interact and complement each other to foster GVC formation. To address this academic gap, this study applies the configurational approach to explore which combinations of conditions can sufficiently promote the formation of GVC.

3.2.2 Configurational conceptualization of GVC formation

The formation and stimulation of GVC are shaped by the synergy and interaction among multiple factors, making it a multifaceted, dynamic, and complex process. This study examines the configuration of conditions that promote the formation of GVC from three perspectives: technology, organization, and environment. Based on the meaning of different dimensions within the Technology-Organization-Environment (TOE) framework (Zhu & Kraemer, 2005; Awa & Ojiabo, 2016; Cruz-Jesus et al., 2019; Malik et al., 2021), as well as the interpretation of these dimensions in existing literature (Miao & Zhao, 2023; Tang et al., 2024; Li & Che, 2024), this study identifies six interrelated conditions: VC cases (scope), VC amount (intensity), entrepreneurial demand, high-level development zones, fiscal expenditure on science and technology, and government-business relations. Following this conceptual framework, **Figure 3.1** highlights the combinations of antecedents promoting GVC formation.

The TOE framework is also well-suited for analyzing GVC formation driving strategies. First, as the TOE framework primarily focuses on the antecedents of adoption or formation, it provides a applicable analytical method for research on how promoting GVC can be effectively achieved. Second, the TOE framework is a highly generalizable theoretical model and a comprehensive analytical tool grounded in its application context. The specific

manifestations of the technological, organizational, and environmental dimensions vary across research scenarios, allowing for flexibility and adaptability in its application. This integrative perspective provides scholars and authorities with a more comprehensive understanding of the challenges and opportunities they may encounter during the GVC formation process.

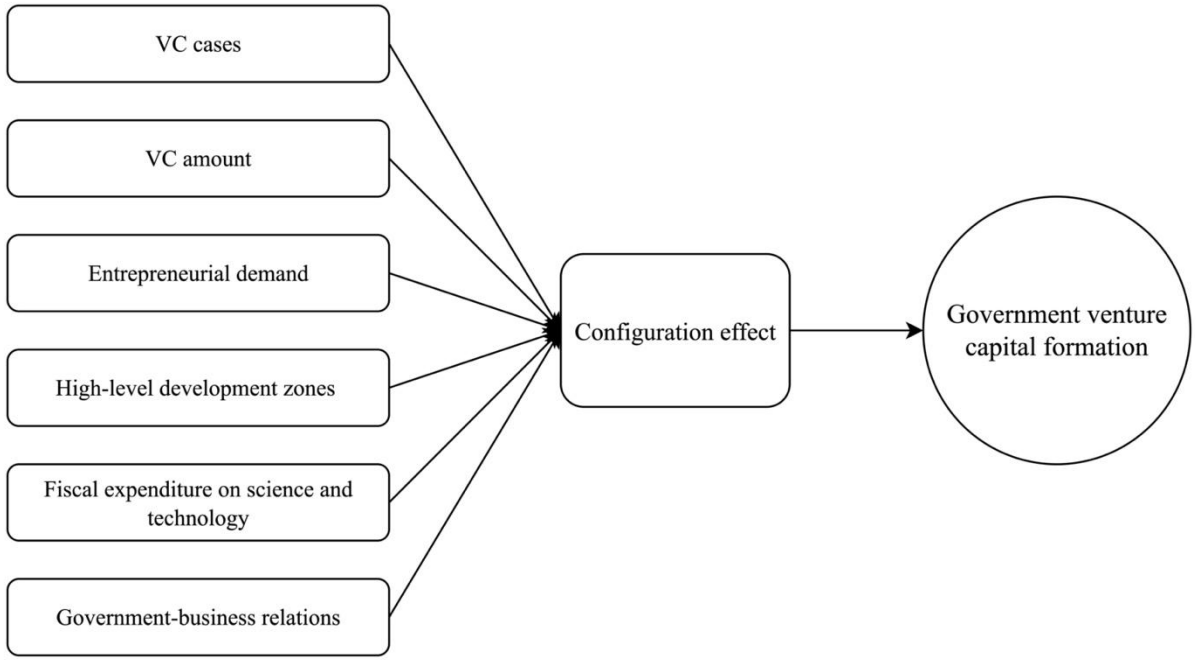

Figure 3.1 Conceptual model for government venture capital formation

3.2.3 VC cases and GVC formation

The number of regional VC cases reflects the level of activity and historical experience of the regional VC market (Grigorieva & Kuzmina, 2019; Harjoto et al., 2021). A high number of cases means that the region has formed a venture capital ecological and sharing environment (Gu et al., 2018). By observing successful cases, the government can reduce the cost of policy trial and error, enhance its confidence in establishing GVC funds, and make accurate investment decisions (Croce et al., 2013; Lee et al., 2023). At the same time, a large number of cases may form a demonstration effect, attract more social capital participation, and thus promote the government to further amplify the policy effect through funds. In

addition, the exit mechanism and experience feedback accumulated from cases can provide an operating template for government funds and reduce management risks.

This study proposes the following:

Proposition 1

A high volume of VC cases within a region supports the formation and development of GVC.

3.2.4 VC amount and GVC formation

The amount of the VC investment reflects the intensity of the local VC market and investor confidence. Large-scale investments indicate the presence of attractive projects in this region and investors' optimistic prospects on the market, which reduce risks for GVC formation and development.

This study proposes the following:

Proposition 2

Regions with larger total VC investment amounts are more conducive to the formation of GVC funds.

3.2.5 Entrepreneurial demand and GVC formation

Entrepreneurial demand will also stimulate the establishment and development of GVC. A high level of entrepreneurial demand reflects the vitality of the local economy and the willingness of entrepreneurs to start businesses, revealing a wealth of potential investment opportunities and a strong demand for capital (Lam, 2010). Demand drives supply, the increase in entrepreneurial demand encourages the concentration of capital resources in these regions, driving the activity and expansion of financial markets. Gupta & Shukla (2020) mentioned that VC is becoming an important financial source with the onset of start-up

culture. VC financing is also considered by scholars and practitioners as a suitable way for entrepreneurial businesses (Croce et al., 2013). Conversely, regions where entrepreneurial capital is scarce hinder the ability of individuals to start new businesses (Audretsch & Keilbach, 2008). The emergence and growth of GVC funds are precisely a response to this market signal.

Specifically, in regions with high entrepreneurial demand, both the quantity and quality of startups tend to increase (Xie et al., 2021). This trend not only intensifies the demand for early-stage capital but also highlights the limitations of traditional private investment institutions in meeting such funding demand. Due to the uncertainties and extended investment return cycles associated with startups, private capital tends to be cautious when investing in early-stage enterprises (Moore & Garnsey, 1993; Soleimani Dahaj & Cozzarin, 2019; Alperovych et al., 2020; Owen, 2023). In this context, GVC funds, as a public-sector complement, effectively fill this market gap (Bertoni et al., 2015; Johansson et al., 2021). By lowering financing thresholds and reducing capital acquisition costs for enterprises, GVC can provide seed funding for startups, provide guidance and certifications, and alleviate entrepreneurial bottlenecks caused by capital shortages (D. Cumming & Johan, 2009; Q. Du et al., 2024).

Furthermore, entrepreneurial demand reflects not only the immediate need for capital but also the potential for future economic growth. This demand stimulates high-growth projects by enabling innovative business ventures, which often lead to the creation of new jobs and technological advancements (Criscuolo, 2014). These projects attract the attention of policymakers and further accelerate the establishment and expansion of GVC funds in these areas to ensure that high-quality projects aligned with public policy goals receive the necessary financial support (Engberg et al., 2021; J. Zhang et al., 2024; Ge et al., 2024). The

surge in entrepreneurial demand provides a solid market foundation and logical support for the emergence of GVC funds, making it a crucial driver of GVC formation.

This study proposes the following:

Proposition 3

Regions with a high level of entrepreneurial demand are conducive to the formation of GVC funds.

3.2.6 High-level development zones and GVC formation

The development zones represent government-led industrial clusters equipped with well-developed infrastructure designed to attract enterprises (Zheng et al., 2016; Liu et al., 2023; Ma et al., 2023). The government's intention in establishing development zones is to concentrate resources in specific areas, thereby reducing operation costs and supporting local business growth. It is important to note that in the Chinese context, development zones take various forms and have different official names (Wong & Tang, 2005). The definition of development zones in this study primarily includes economic and technological development zones, high-tech industrial development zones, special customs supervision zones, and border/cross-border economic cooperation zones, etc. On the one hand, development zones promote entrepreneurship (Z. Li et al., 2024). More importantly, they serve as platforms and resource providers established by the government (Kong et al., 2021), aimed at promoting high-quality regional development (S. Gao et al., 2021), which aligns with the mission of GVC funds. Thus, cities with a higher number of development zones are more likely to promote GVC as a means to further development.

This study proposes the following:

Proposition 4

Regions with the presence of high-level development zones are conducive to the formation of GVC funds.

3.2.7 Fiscal expenditure on science and technology and GVC formation

The fiscal expenditure on science and technology is an essential form of support for innovation (Wei et al., 2023). On the one hand, governments with high levels of technology expenditures reduce the innovation costs of high-tech enterprises through subsidies and grants, encouraging corporate innovation (J. Chen et al., 2023). Since GVC funds primarily invest in high-tech, early-stage innovative startups (D. Cumming, 2007; del-Palacio et al., 2012; Lim & Kim, 2015), fiscal expenditure on technology can help share some of the risks, creating a stable investment environment for GVC funds. On the other hand, similar to the logic behind the number of development zones, support for innovation aligns with the core objectives and willingness of GVC. Therefore, increased fiscal expenditure on science and technology is likely to attract more establishments of GVC funds.

This study proposes the following:

Proposition 5

Regions with a high level of government fiscal investment in science and technology are conducive to the formation of GVC funds.

3.2.8 Government-business relations and GVC formation

The quality of government-business relations serves as a key indicator of local government governance and trust. Positive government-business relations reduce policy uncertainty, lower risks for private investors, and improve the efficiency of resource allocation (Dang et al., 2020; Y. Chen et al., 2023). As mentioned earlier, the prevalent model for GVC funds is a hybrid fund structure, where public and private capital jointly invest (Murray, 2021). A

favourable government-business environment attracts more private investors to participate in fostering GVC formation.

This study proposes the following:

Proposition 6

Regions with good political and business relations are conducive to the formation of GVC funds.

3.3 Research methodology

3.3.1 fsQCA

This study employs the fuzzy-set qualitative comparative analysis (fsQCA) method to explore the regional configurations foster GVC formation. fsQCA, based on Boolean algebra and fuzzy-set theory, is particularly effective in analysing complex causal relationships and multiple interactions (Fiss, 2011; Misangyi & Acharya, 2014; Pappas & Woodside, 2021). Unlike traditional quantitative methods, fsQCA conducts cross-case analysis to explore the effects of multiple paths and different combinations of conditions (Ragin, 2008a; Y. Du & Kim, 2021; Gong et al., 2024).

There are several reasons why fsQCA was chosen as a method for this study. First, unlike traditional regression methods, fsQCA conducts cross-case analyses to reveal the effects of multiple pathways and different combinations of conditions (Du & Kim, 2021; Gong et al., 2024), which makes it particularly suitable for identifying different configurations of antecedent conditions that drive GVC formation. Second, the GVC formation process involves different net effects of different factors, suggesting that there are multiple "equifinal" pathways to achieve GVC formation (Fiss, 2007; Rihoux & Ragin, 2009). The fsQCA method can use set-theoretic relationships to test the necessity and/or sufficiency of a single

condition or configuration for the existence of an outcome variable (Song et al., 2024). By acknowledging the coexistence of multiple causal pathways (Ragin, 2000), fsQCA breaks away from the emphasis on a single optimal solution in traditional quantitative methods and is more closely aligned with the complex reality of the research problem. Thirdly, the fsQCA method was initially developed as a tool for macro-comparative analysis and found extensive use in comparative politics and historical sociology (Rihoux & Ragin, 2009) and has recently attracted growing attention in the fields of innovation and entrepreneurship (Kraus et al., 2018; Vargas-Zeledon & Lee, 2024). Therefore, due to the complexity of antecedents, equivalence of outcome pathways, and applicability to the research context, fsQCA provides a suitable approach for studying the necessary and sufficient conditions for the formation of Chinese GVC funds using city-level data from China.

3.3.2 Research context

This study explores the configurational conditions that facilitate the formation of GVC within the Chinese context. Due to differences in institutional settings, including historical and cultural factors (Marquis & Bird, 2018), the GVC development pathways chosen by Western countries, such as the United States and Europe, differ from those of China. As a result, empirical evidence from these regions may not fully explain the mechanisms driving GVC formation in China. Moreover, given China's growing comprehensive national power, a deeper understanding of its unique trajectory is warranted (Duanmu et al., 2018; Jia et al., 2023).

Although the history of VC in China is relatively short, it has experienced explosive growth alongside the country's economic and social development. Currently, China is the second-largest VC market in the world, surpassed only by the United States, and GVC officially appears in this country at the beginning of the 21st century (J. Chen, 2023; Ge et al., 2024). As of the end of 2021, Chinese governments at various levels had collectively raised 2.47

trillion CNY in GVC funds (CVINFO, 2022). The vast scale and internal diversity of China's GVC industry provide fertile ground for research on GVC driving mechanisms. However, academic observations and theoretical insights regarding China's GVC development have struggled to keep pace with its rapid expansion. To date, there is no established scholarly consensus on the specific pathways through which GVC forms and develops in China.

This study aims to reflect the latest situation. This study selects data from 2020 (for condition variables) and 2021 (for outcome variable) based on two primary considerations: data availability and data stability. First, one of the key data sources in this study, the *China City Statistical Yearbook*, is only updated to 2021 at the time of writing this paper, which constrains the timeframe of this research. Additionally, if this study was to use 2021 data for the condition variables, the outcome variables would require data from 2022 (See Section 3.2.1 for the reasons). However, 2022 data may be significantly impacted by the new wave of the COVID-19 pandemic, introducing external shocks and affecting the validity of the results. It is worth noting that although the COVID-19 outbreak began in early 2020, China's strict control measures allowed the domestic economy to recover by April 2020 and maintain stability until the pandemic resurged in early 2022 (Jin et al., 2022; Zhai, 2023), leading to severe disruptions. Therefore, this study uses 2020 data for the condition variables and 2021 data for the outcome variable can ensure the reliability and accuracy of the findings.

Exploring the mechanisms behind GVC formation in the Chinese context not only contributes to the broader field of GVC research but also offers feasible insights for other emerging economies, such as India and Brazil, that aim to leverage this financial instrument to promote sustainable development.

3.3.3 Data collection and measurement

3.3.3.1 Data sources

To investigate the configurations conducive to GVC formation, this study first identified the outcome variable using the Zero2IPO VC database. From this database, this study confirmed 200 newly established GVC funds in 2021. First, Zero2IPO is a widely recognized VC database in China (J. Chen, 2023), and the GVC funds list this research confirmed from its 'Government Guidance Fund' sub-database ensures data completeness and reliability. Second, although these GVC funds were established by governments at various regional and administrative levels, they all operate within the Chinese context, satisfying the case selection criteria for fsQCA (Ragin, 2008a). At last, fsQCA is robust to outliers, as it does not assume that the data follows a specific distribution (Fiss, 2011; Vis, 2012).

Based on the discussion in section 3.2, the VC cases, VC investment amount, entrepreneurial demand, development zones, fiscal expenditures on S&T, and government-business relations are potentially sufficient conditions for GVC formation. The data for VC cases and investment amount is provided by Zero2IPO (https://zdb.pedaily.cn/inv/). Entrepreneurial demand data is mainly sourced from Qichacha (https://www.qcc.com/), a well-known Chinese business information platform. Data on development zones is primarily derived from the *China Development Zone Announcement List 2018* (https://www.gov.cn/zhengce/zhengceku/2018-12/31/content_5434045.htm) published by the Chinese government. As this study focuses on the year 2021, the research supplemented the data with the latest development zone list available on the Ministry of Commerce's official website (http://www.mofcom.gov.cn/). Data on technological expenditure comes from the *China City Statistical Yearbook*, and the government-business relationship index is provided by the National Academy of Development and Strategy (http://nads.ruc.edu.cn/zkcg/ndyjbg/3d654f89be5e4f618f004e37264aedfb.htm). It is

important to emphasize that the establishment of GVC funds exhibits a time lag. Therefore, this study used data from 2020 for all condition variables to ensure accuracy.

This study attempted to include all available urban cases; however, cities with missing data were excluded to ensure the reliability of the results. This yielded a final sample of 236 cities. The sample includes cities from diverse regions and varying levels of development, providing broad representativeness for the analysis.

3.3.3.2 Measures

GVC formation. Common GVC variables include the number of GVC institutes and the scale of GVC initiation (Yang et al., 2022; Du et al., 2024). This study does not use GVC fundraising data for two reasons: first, the relevant data in the Zero2IPO database is seriously missing, which will have an adverse impact on the results. Second, for political purposes, some local governments may exaggerate their total fundraising amount (Shanxi Audit, 2024), which is more obvious in the global value chain funds established by lower-level local governments. Therefore, this study examines the configurations conducive to GVC formation at the regional level by matching the registered locations of GVC funds with city-level data to construct the outcome variable. In other words, the number of newly established GVC funds in each city serves as the measurement indicator for the GVC variable.

VC cases and **VC amount.** This study derived the VC event data from Zero2IPO and matched it with city-level data based on the location of each investment. The number of cases (projects) and total amount of investment are used as indicators for measuring VC cases and amount, respectively (Sheng et al., 2024). Notably, since VC cases reflect the accumulation of experience, the indicator is measured by the sum of VC cases from 2004 to 2020. The selection of 2004 as the starting point is due to the introduction of a landmark document, the

Decision of the State Council on Reforming the Investment System, issued by the Chinese central government that year, which played a significant role in shaping the VC industry.

Entrepreneurial Demand. Following Bai et al. (2022), the indicator for entrepreneurial demand is measured by the number of newly registered companies per 100 residents. This reflects the extent to which a city seeks additional funding to meet rising entrepreneurial demand.

The data on **high-level development zones** is measured by the number of provincial-level or higher development zones present in each city, as published by the Chinese government. It should be noted that different government levels in China can establish development zones, but due to variations in their authority and resource allocation capacity, the level of support provided by these zones differs. Therefore, only development zones established by provincial or central government are used as the measurement indicator in this study (Zheng et al., 2016).

Fiscal expenditures on science and technology. Traditionally, this variable is measured as the proportion of science and technology expenditure to GDP or total fiscal expenditure (e.g., Chen et al., 2023; Liang et al., 2025). However, this study focuses on the comparison between different cases, which cannot be clearly reflected by proportional data. Therefore, the fiscal expenditures on science and technology data are taken directly from the original data provided in the *China City Statistical Yearbook* without mathematical processing.

The **government-business relations** are sourced directly from the 'Healthy Overall Index' provided in the *China City Government-Business Relations Rankings 2020* by the National Academy of Development and Strategy. This measurement method has been recognized in recent studies (Juntao & Haitao, 2023; Hu et al., 2024).

The specific information of the variables and data sources are listed in **Table 3.1**.

Table 3.1 Variable description and data sources

Variables	Variable description	Units	Data source
Condition variables			
VC cases	The cumulative number of VC events from 2004 to 2020	Number	Zero2IPO
VC amount	The amount of VC investment in 2020	Million CNY	Zero2IPO
Entrepreneurial demand	Number of newly registered enterprises per 100 residents in 2020	Number per 100 residents	Qichacha platform & China City Statistical Yearbook
High-level development zones	Number of national and provincial-level development zones in 2020	Number	China Development Zone Announcement List 2018 & Ministry of Commerce, PRC
Fiscal expenditures on science and technology	Amount of science and technology investment in public budget expenditure in 2020	10, 000 CNY	China City Statistical Yearbook
Government-business relations	Government-Business Relations Health Index in 2020	Index value (0.00-100)	China's City Government-Business Relations Ranking 2020
Outcome variable			
GVC formation	Number of newly established GVC funds in 2020	Number	Government Guidance Fund database (sub-database of Zero2IPO)

3.3.4 Calibration

Calibration involves transforming variables (conditions and outcome) into a set membership, ranging from full non-membership (equal to 0) to full membership (equal to 1), with 0.5 representing the crossover point, indicating maximum ambiguity (Ragin, 2008a; Schneider, 2012; Vargas-Zeledon & Lee, 2024). Given the lack of recognised external standards for defining the level of GVC implementation and regional enablers, this study applied direct calibration, following established practices (Y. Du et al., 2022; Y. Huang et al., 2023). This study sets the 75th percentile, mean, and 25th percentile of the descriptive statistics for outcome variable and the 75th percentile, median, and 25th percentile of the descriptive statistics for conditional variables as the anchor points for fully in, the crossover point, and full out, respectively (Fiss, 2011; Jia et al., 2023; Miao & Zhao, 2023; Gong et al.,

2024). Additionally, to avoid theoretical and software operation difficulties at maximum ambiguity (0.5), a constant of 0.001 was added to this value (Fiss, 2011). **Table 3.2** presents the calibration anchors and descriptive statistics for each variable.

Table 3.2 Fuzzy set membership calibrations and sample descriptive statistics

Variable	Fuzzy set calibrations			Measure description			
	Fully in	Crossover	Fully out	Mean	SD	Min	Max
VC cases	279.50	83.50	28.75	689.75	3201.66	1.00	38644.00
VC amount	1624.10	180.87	0.00	4575.18	19567.36	0.00	191589.72
Entrepreneurial demand	2.41	1.39	1.05	2.03	1.58	0.62	9.54
High-level Development zones	12.00	7.50	5.00	9.44	7.46	1.00	62.00
Facial expenditures on S&T	155182.50	70774.00	26830.00	212128.09	517678.35	2457.00	4109628.00
Government-Business Relations	43.53	33.64	24.04	35.28	15.85	0.00	100.00
GVC formation	1.00	0.84	0.00	0.84	1.49	0.00	9.00

3.4 Results

3.4.1 Necessary condition analysis (NCA)

Necessary Condition Analysis (NCA) identifies necessary conditions by examining the effect size of the necessary condition and its significance for antecedent conditions. The effect size ranges from [0, 1], with values closer to 1 indicating a stronger effect (Dul, 2016). NCA provides a Monte Carlo simulations of permutation test to assess the significance of these effects (Dul et al., 2020). The NCA method offers two estimation approaches—ceiling regression (CR) for continuous variables and ceiling envelopment (CE) for discrete variables. **Table 3.3** reports the results of NCA analysis, including accuracy, ceiling zone, scope, effect size, and p-values obtained through both CR and CE methods. When a condition's effect size (d) exceeds 0.1 and the p-value indicates significance, the condition is considered necessary for the outcome (Dul et al., 2020). The NCA results show that the necessity effect of VC amount is not significant ($p > 0.05$), indicating that this condition alone does not constitute a necessary condition for GVC formation. Although other conditions exhibit significant

necessity effects, their effect sizes are relatively small (d < 0.1), meaning they do not serve as necessary conditions for GVC formation either.

Table 3.3 Analysis results of necessary conditions of NCA method

Condition	Method	Accuracy	Ceiling zone	Scope	Effect size(d)[a]	P-value
VC cases	CR	100%	0.000	0.94	0.000	0.016
	CE	100%	0.000	0.94	0.000	0.016
VC amount	CR	100%	0.000	0.90	0.000	1.000
	CE	100%	0.000	0.90	0.000	1.000
Entrepreneurial demand	CR	100%	0.000	0.95	0.000	0.003
	CE	100%	0.000	0.95	0.000	0.003
High-level development zones	CR	98.7%	0.009	0.94	0.009	0.000
	CE	100%	0.010	0.94	0.011	0.000
Facial expenditures on S&T	CR	100%	0.000	0.95	0.000	0.029
	CE	100%	0.000	0.95	0.000	0.029
Government-Business Relations	CR	100%	0.000	0.95	0.000	0.002
	CE	100%	0.001	0.95	0.001	0.002

Note: a. $0.0 \leq d<0.1$: low level; $0.1 \leq d$: high level. permutation test=10000.

3.4.2 Single-factor necessity analysis

This study further conducts a necessity analysis for each individual variable by using fsQCA method (Ragin, 2000). Specifically, necessary consistency refers to the extent to which a conditional variable explains the outcome variable. If the necessary consistency of a conditional variable exceeds 0.9, that factor is considered a necessary condition for the outcome (Tóth et al., 2015; Fu et al., 2024). Consequently, it will be excluded from the subsequent configurational analysis (Ragin, 2008a; Jiao et al., 2020).

Table 3.4 presents the results of the single factor necessity analysis. The findings indicate that none of the consistency values for the conditions exceeded the threshold of 0.9 (Schneider, 2012), suggesting that no single condition (e.g., VC experience, fiscal expenditures on S&T, government-business relations, or entrepreneurial demand) is a necessary condition for GVC formation. Therefore, it is essential to bundle the conditions into subsets as configurations and examine the relationship between these configurations and GVC formation.

Table 3.4 Single factor necessity analyses

Condition	GVC formation			
	High		Low	
	Consistency	Coverage	Consistency	Coverage
VC cases	0.71	0.66	0.35	0.40
~ VC cases	0.36	0.30	0.71	0.75
VC amount	0.68	0.64	0.37	0.43
~ VC amount	0.40	0.33	0.70	0.73
Entrepreneurial demand	0.69	0.61	0.40	0.44
~ Entrepreneurial demand	0.37	0.33	0.65	0.72
High-level development zones	0.70	0.63	0.37	0.42
~ High-level development zones	0.36	0.32	0.67	0.74
Fiscal expenditures on S&T	0.74	0.67	0.35	0.39
~ Fiscal expenditures on S&T	0.32	0.28	0.70	0.77
Government-Business Relations	0.66	0.60	0.41	0.46
~ Government-Business Relations	0.40	0.35	0.64	0.70

Note: The symbol '~' denotes the absence of the condition.

3.4.3 Configuration strategy

Drawing on existing studies employing QCA (H. Fu et al., 2024), this study conducted a sufficiency analysis to identify which configurations of conditions are sufficient to achieve the outcome. First, following the minimization rule (Ragin, 2008b), this study retained at least 90% of the cases by setting the frequency threshold at 1. Second, the raw consistency

threshold was set at 0.75 (Rihoux & Ragin, 2009), while the PRI (Proportional Reduction in Inconsistency) consistency threshold was set at 0.65 (Greckhamer et al., 2018). Given the absence of conclusive evidence in the existing literature supporting a specific directional influence of individual conditions on the outcome, this study adopted a cautious approach in counterfactual analysis. Specifically, this study assumed that the presence or absence of any single condition could contribute to a high level of GVC formation. Furthermore, this study distinguished between core and peripheral conditions within each solution by comparing the nested relationships between intermediate and parsimonious solutions (Y. Du et al., 2022). Specifically, the condition that only appears in the intermediate solution is known as an edge (contributing) condition, indicating it provides auxiliary support to the outcome (Ragin, 2008a). As a result, this study identified three pathways leading to high GVC formation and five pathways associated with low GVC formation.

3.4.4 Results of the sufficiency analysis

The sufficiency analysis identified three configurations leading to the high-level of GVC formation (S1, S2, and S3) and five configurations leading to the low-level of GVC formation (NS1, NS2, NS3, NS4, and NS5), as shown in **Table 3.5**. Among them, the consistency values of configurations S1, S2, and S3 were 0.82, 0.82, and 0.83, respectively, indicating that all three are sufficient configurations for high GVC formation (Fiss, 2011; Jia et al., 2023). Based on the overall solution and the distinct characteristics of each configuration (Furnari et al., 2021), as well as insights from typical cases, this study named them: Infrastructure-based market-driven configuration, Government-business relationship-based market-driven configuration, and Government support-driven configuration (See Section 3.4.4 for the reasons).

Table 3.5 The configuration paths of high GVC formation and low GVC formation

Outcome	High GVC formation			Low GVC formation				
Conditions	S1	S2	S3	NS1	NS2	NS3	NS4	NS5
VC cases	●	●	⊗	⊗	⊗	⊗		⊗
VC amount	●	●	●			•	⊗	⊗
Entrepreneurial demand	●	●	⊗	⊗			⊗	⊗
High-level development zones	•		●	⊗	⊗	⊗	⊗	
Facial expenditures on S&T	●	●	●	⊗	⊗	⊗	⊗	⊗
Government-Business Relations		•	●		⊗		⊗	⊗
Consistency	0.82	0.82	0.83	0.84	0.83	0.79	0.84	0.82
Raw coverage	0.45	0.46	0.07	0.40	0.40	0.15	0.32	0.35
Unique coverage	0.04	0.06	0.03	0.07	0.06	0.01	0.01	0.04
Solution consistency		0.81				0.82		
Solution coverage		0.53				0.55		

Note: Core conditions are represented by image ● (presence) and image ⊗ (absence); contributing conditions are represented by image • (presence) and image ⊗ (absence), and blank spaces indicate a 'don't care' condition (Fiss, 2011).

3.4.5 Configurations for high GVC formation

Path S1 indicates that high levels of GVC formation can be sufficiently generated with high VC cases, high VC amount, high entrepreneurial demand, and high fiscal expenditures on S&T as core conditions, and high presence of high-level development zones as contributing condition. Path S2 takes high VC cases, high VC amount, high entrepreneurial demand, and high fiscal expenditures on S&T as core conditions, and high government-business relations as contributing condition. Comparing the core conditions of these tow configurations, S1 and S2 can be classified into the same category, constituting a second-order equivalent

configuration (Fiss, 2011). Specifically, both S1 and S2 include VC cases, VC amount, and entrepreneurial demand. These three conditions represent the supply and demand sides of the VC market—that is, the capital providers (project demanders) and the project providers (capital demanders). Accordingly, these two paths can be collectively referred to as market-driven configurations. Furthermore, the S1 path features the contributing condition of high-levels of high-level development zones, with S2 also including the contributing condition of high-levels of government-business relations, which are both related to government behaviours. Therefore, S1 is named the infrastructure-based market-driven configuration, while S2 is termed the government-business relationship-based market-driven configuration.

A typical case under **Infrastructure-based market-driven configuration** is **Shanghai City**. The region is one of the most important financial centres in mainland China and has the most mature market economy experience. As early as 1999, the Shanghai Municipal Government took the lead in investing 600 million CNY in accordance with market-oriented VC rules to establish the first local government-owned VC platform, Shanghai Venture Capital Co., Ltd. (now NewMargin Ventures). In addition, as China's economic and technological centre, Shanghai has a large number of start-ups emerging here, generating significant demand for capital. In particular, Shanghai has the largest number of development zones in China, such as the most famous Shanghai Lujiazui Finance and Trade Zone, which has become a huge engine driving China's economy. Historical experience and current needs have collectively accelerated GVC growth, with Shanghai establishing four new GVC funds in 2021, ranking among the top 5% nationally. Shanghai meets the typical characteristics of the infrastructure-based market-driven configuration in this study.

A typical case under **Government-business relationship-based market-driven configuration** is **Chengdu City**. As the capital of Sichuan Province, Chengdu not only concentrates the province's financial resources but also attracts investors and entrepreneurs

from surrounding provinces and autonomous regions, such as Yunnan, Guizhou, Tibet, and Gansu. Chengdu city is the leading innovation hub in Western China, it is home to the fourth-largest number of National Enterprise Technology Centres in the China and ranks 23rd globally in the Science and Technology (S&T) Cluster ranking of Global Innovation Index released by the World Intellectual Property Organization (WIPO) (https://www.wipo.int/web/global-innovation-index/2024/science-technology-clusters). The city has attracted major projects, such as the BOE 8.6th Generation AMOLED production line, with a total investment of 63 billion CNY, continuing to ignite its innovation momentum. In addition, Chengdu Industry Investment Group, co-sponsored by the Sichuan Provincial Department of Finance (10%) and the Chengdu State-owned Assets Supervision and Administration Commission (90%), operates under a purely state-owned framework. It includes a range of GVC entities, such as Chengdu Innovation Venture Capital Co., Ltd., which has made significant contributions to guiding Chengdu's industrial investment and promoting the city's industrial upgrading. More importantly, the Chengdu municipal government remains committed to enhancing its service capabilities. In the 2020 China Government-Business Relations Rankings, it ranked 11th, and in 2023, it was recognized as China's "2023 Benchmark City for International Business Environment Development". With a mature market at its core, an environment focused on enhancing the quality of government services to enterprises has fostered the development of more high-quality GVC institutions in Chengdu. Chengdu meets the typical characteristics of the Government-business relationship-based market-driven configuration in this study.

The **Government Support-Driven Configuration** takes high presence of high-level development zones, high fiscal expenditures on S&T, high government-business relations, high VC amount, and low VC cases as core conditions, and low entrepreneurial demand as a contributing condition to sufficiently realize high levels of GVC formation. Compared with

S1 and S2, S3 includes all three government-related conditions, so it is called government support-driven configuration. This path emphasizes that government support is sufficient to realize high GVC formation.

A typical case under this driving mechanism is Lu'an City, Anhui Province. Lu'an is an advanced city in China's scientific and technological progress, with a high proportion of scientific and technological investment. Lu'an is geographically close to the provincial capital Hefei, and vigorously promotes the construction of development zones to become the preferred supporting base for Hefei's electronic information industry. The Lu'an Municipal authorities positively create a good government-business environment, establish the government's leading group office for creating a first-class business environment, and propose benchmarking and improvement measures for creating an excellent business environment. Its business environment ranks as the top group in Anhui Province. This city meets the typical characteristics of government support-driven in this study.

3.4.6 Configurations for low GVC formation

Following existing research (Fainshmidt et al., 2022; Jia et al., 2023), fsQCA allows researchers to explore configurations associated with the low outcomes. Based on this approach, this study further examined the configurations leading to the low GVC formation. The results are presented in **Table 3.5**. This study identified five configurations. Specifically, in cities with limited VC experience and fewer high-level development zones, it is also challenging to establish new GVC institutions. In particularly, the NS3 configuration indicates that even if a city has a relatively high amount of VC investment, a lack of sufficient VC cases, inadequate government investment in technology, and an insufficient number of development zones can prevent the full realization of GVC formation. At last, this research found that all paths included the condition of fiscal expenditures on S&T, highlighting the importance of government emphasis on innovation in the GVC formation.

3.5 Discussion

This study systematically investigated the factors that determine the formation and development of GVC. Based on the GVC literature, this study identified six regional-level conditions: VC cases, VC amount, entrepreneurial demand, and the high-level development zones, fiscal expenditure on science and technology, and government-business relations, to examine their configurational effects on achieving highly GVC formation. Based on the fsQCA approach, this study discovered three configurations that promote GVC formation, which are named the infrastructure-based market-driven configuration, the government-business relationship-based market-driven configuration, and the government support-driven configuration. **Figure 3.2** illustrates these paths visually. Furthermore, the analysis of low GVC formation condition configurations confirm the critical role of fiscal expenditure on S&T in driving GVC formation.

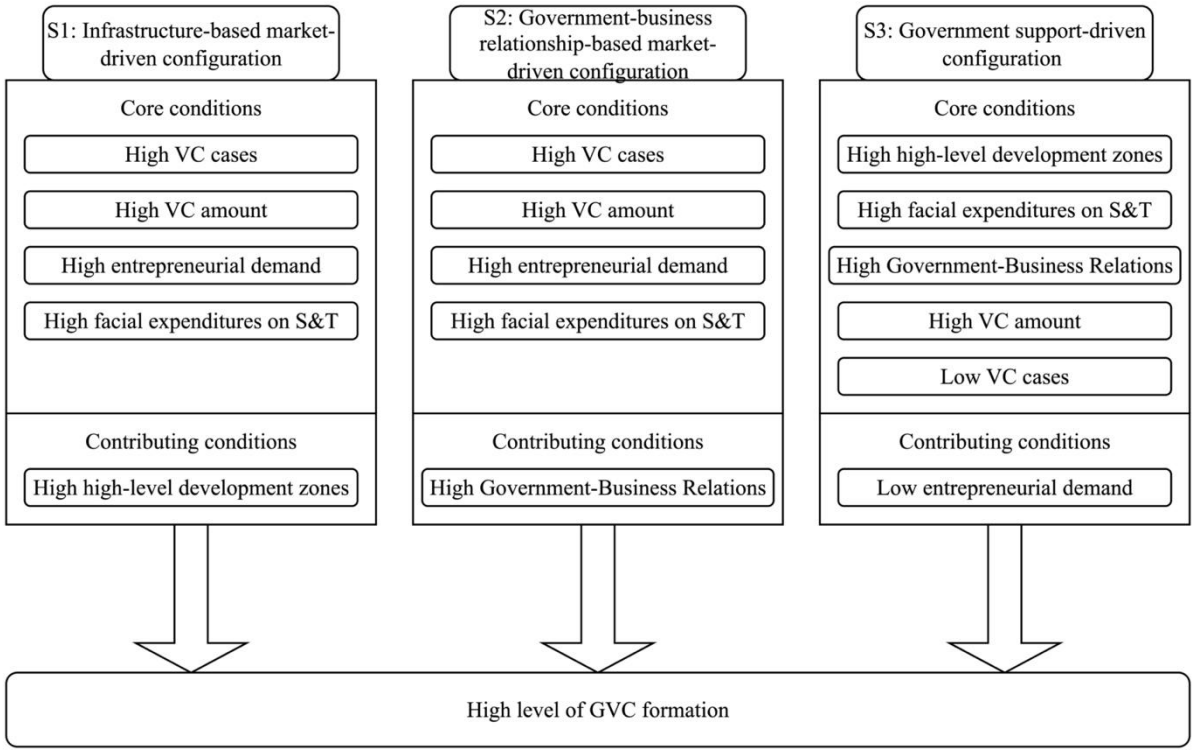

Figure 3.2 Three configurations to high GVC formation

3.5.1 Theoretical contribution

This study makes significant contributions to the understanding of the antecedents of GVC, particularly exploring the regional enablers of GVC formation. While existing literature has primarily focused on GVC performance, examining its impacts on financial returns, firm growth, and innovation (Guerini & Quas, 2016; Croce et al., 2019; Q. Du et al., 2024), relatively little attention has been paid to the factors that drive the formation of GVC. This research addresses this gap by answering the critical question: what conditions sufficiently promote GVC formation? Through a configurational analysis of multiple condition variables, this study reveals three paths to high levels of GVC formation, broadening the understanding of when and under what conditions GVC can be effectively established.

A key theoretical contribution of this research indicates that the factors promoting GVC formation are essentially configurational. That is, multiple factors work in concert through different combinations to impact GVC presence. Although prior studies have examined the effects of VC reputation, characteristics of startups, and institutional environments on GVC (Luo et al., 2019; Abrardi et al., 2019; Breschi et al., 2022), these discussions typically focus on the linear relationships between individual variables and GVC. Such approaches overlook the potentially complex interactions between different factors. By employing the fsQCA method, this study tries to explore these interactions and reveals the configurational effects of different conditions, helping to explain the complex process underlying the formation of GVC.

Moreover, this study expands the boundaries of GVC research by identifying important functional substitutability among conditions. Specifically, this study finds that when certain conditions are insufficient, other conditions can act as substitutes. For instance, in cities where government support is lacking, VC experience and entrepreneurial demand can serve as alternative conditions to achieving a high GVC formation. The discovery of these

substitution effects indicates that the conditions driving GVC formation are not independent but instead exhibit complementarities. By illustrating this dynamic, this study not only demonstrates the complementary nature of the configurations that promote GVC formation but also provides evidence of substitutive relationships between six conditions.

Another theoretical implication is related to the TOE framework. This study introduces the TOE framework into the analysis of GVC formation, enriching its knowledge contribution in the field of innovation and entrepreneurship. Specifically, while previous literature mainly uses the TOE framework to study the paths to promote high-quality development, green innovation or digital transformation (Zhang et al., 2021; Miao & Zhao, 2023; Lou et al., 2023; Li & Che, 2024), this study extends its application to the context of VC development based on the configuration analysis of GVC formation from a regional perspective.

In summary, this research contributes to three aspects. First, this study provides a configurational analysis of GVC formation from a regional perspective, offering new insights into the antecedents of GVC, particularly how multiple conditions work together at the city level to drive the establishment of GVC. Second, by revealing the configurational effects driving GVC formation, this study extends the literature beyond the limitations of linear analysis and offer a more nuanced understanding of how multiple conditions interact. Third, this study provides evidence of how conditions can substitute for one another under specific cases. Finally, this study introduces the TOE framework into the analysis of GVC formation, enriching the theoretical framework on the antecedents of GVC and offering valuable insights for scholars and practitioners.

3.5.2 Policy implications

This research indicates that the GVC formation can be depended on different combinations of regional-level enablers. Based on the findings, this study proposes the following

recommendations. First, through various means, create an atmosphere in the region that promotes the formation of GVC funds. This includes attracting more investment institutions, cultivating an entrepreneurial culture, advancing infrastructure development, increasing government funding support for the science and technology sector, and combating corruption to establish transparent and constructive government-business relationships. Moreover, the findings reveal that all three configurations leading to a high level of GVC formation include the 'VC amount' and 'fiscal expenditures on S&T' conditions, highlighting the critical role these variables play in promoting GVC formation. Thus, local governments should increase fiscal support for innovation sectors and promote the establishment of more large-scale VC projects, which can create publicity and demonstration effects. Finally, the results also highlight the complementary relationships between different conditions, which should serve as a key reference when cultivating GVC formation with resource constraints. For instance, in regions where attracting more investment institutions in the short term may be difficult, resources could be more effectively allocated to promoting entrepreneurship and fostering a positive government-business environment.

3.5.3 Limitations and future research

First, this research is based on the Chinese context, with all cases drawn from cities in mainland China. While this sample is representative, future researchers could test the availability of the findings in other national contexts, particularly in Western economies with institutional environments that differ from China's. It is worth noting that certain conditions common in the Chinese context, such as development zones, may not have exact counterparts in other economies. Thus, future researchers could adapt their studies by identifying similar conditions based on the national contexts of other countries to replicate the research. Second, the choice of city-level cases in this study was driven by the need to consider the heterogeneity across cases and data availability. However, future studies could test the

robustness of the results by examining smaller (county-level) or larger (province-level) geographical units. Third, although this study used year-lagged data for the condition variables, this approach is insufficient to fully reveal time effects. To explore the timely changes in configurations, future researchers could apply panel data QCA model once the technique becomes more advanced, to further consider the proposition. Finally, the condition variables this research proposed are mainly based on regional-level data, but micro-level factors, such as the personal characteristics of government officials, may also influence GVC formation. Therefore, future studies could explore how multi-level contextual factors impact GVC formation.

4. Study 3: Government venture capital and innovation: A regional perspective approach

4.1 Introduction

In the contemporary global economy, innovation has emerged as a pivotal force driving economic growth and competitiveness (Romer, 1990; Fan et al., 2020; Yu & Cai, 2021). The role of venture capital (VC) in nurturing entrepreneurial ventures and catalyzing technological advancements is well-documented (e.g., Florida & Kenney, 1988; Gu et al., 2018; Gu & Qian, 2019; Yi et al., 2023). However, the impact of government participation in the VC market, specifically government venture capital (GVC), remains a contentious issue, particularly at the regional level. While some argue that GVC is essential for addressing market failures and stimulating innovation (Guerini & Quas, 2016; Breschi et al., 2022), particularly in emerging economies (Y. Zhang, 2021; Q. Du et al., 2024), others contend that it may lead to inefficiencies and crowd out private investment (D. J. Cumming & MacIntosh, 2006; Brander et al., 2010; Engberg et al., 2021). This study aims to contribute to the ongoing debate by examining the nuanced relationship between GVC and regional innovation from a regional perspective.

As illustrated in Chapter 2 (Study 1) of this thesis, the evaluation of GVC performance has traditionally remained within the framework of conventional VC, which mainly focuses on financial returns (D. Cumming, 2007; Luukkonen et al., 2013; Johansson et al., 2021; Y. Zhang, 2021). This evaluation approach has limitations when applied to evaluating GVC performance, as GVC aims not only at capital gains but also at stimulating innovation, optimizing industrial structure, and promoting broader societal development (Lerner, 2009; Breschi et al., 2022; Owen, 2023; J. Zhang & Gu, 2024). A closer examination of the existing literature reveals that while some studies have begun to address the role of GVC in

innovation performance, these studies focus on firm-level performance (Alperovych et al., 2020; Devarakonda & Liu, 2024), neglecting the broader implications of GVC as a national innovation policy. According to the resource-based view and institutional theory, revenue or profit should not be the primary criteria for evaluating public policy outcomes (Pergelova & Angulo-Ruiz, 2014). GVC's impact likely extends beyond the boundaries of individual firms, potentially generating more extensive spillover effects at the regional level. Moreover, researchers often simplify GVC performance as either positive or negative since they overlook the institutional differences across economies and the diversity of GVC effects (Q. Du et al., 2024). This study seeks to fill these gaps by examining GVC's performance from a holistic perspective, considering its broader regional spillover effects on innovation in the context of emerging economies (i.e., China).

This study takes a feasible approach by constructing region-based innovation and GVC variables, making it possible to investigate the regional innovation spillover effects of GVC. There are two key factors that may have contributed to a lack of regional level studies of GVC innovation performance: the challenges of matching GVC institutions and firm innovation data with regional data, and the lack of a coherent framework to connect GVC activities with firm-level innovation at the regional scale. As a result, most of the existing literature on GVC innovation performance is conducted at the firm level (e.g., Bertoni & Tykvová, 2015; Alperovych et al., 2020).

To overcome these limitations, this study develops a unique regional GVC-innovation panel dataset by matching firm patent applications and GVC establishments based on their registered locations. This approach not only bridges the existing data gap but also enables a more comprehensive analysis of GVC's impact on regional innovation dynamics. Furthermore, this study recognizes the significant influence of institutional contexts on GVC effects, with a specific focus on emerging economies. While studies from developed

countries often conclude that GVC underperforms in terms of innovative outcomes, evidence from emerging markets, particularly China, suggests a more favourable view of GVC's impact on innovation (Devarakonda & Liu, 2024; Ge et al., 2024; Du et al., 2024). These contradictory findings highlight one of the critical gaps in the GVC literature: the experiences of Western industrialized nations cannot be wholly extrapolated to emerging economies, which operate under distinct institutional frameworks. Ignoring these contextual differences could lead to an incomplete or even misunderstandings of the relationship between GVC and innovation. In addition to contextual considerations, this paper advances the discourse on GVC performance by integrating both positive and negative effects within a unified framework. This study hypothesizes that the innovative impact of GVC is shaped by two opposing forces: one driving positive innovation outcomes and the other imposing constraints, leading to an inverted U-shaped relationship between GVC presence and regional innovation. Therefore, this study expects that as the number of GVC funds increases, regional innovation performance improves; however, beyond a certain threshold, additional GVC presence may hinder innovation. Furthermore, this study explores the boundary conditions that may modulate this relationship, emphasizing that factors including the level of government fiscal constraints and the availability of local talent resources that will respectively weaken or strengthen the inverted U-shaped effect. By examining these moderating factors, this study offers insights into how GVC can be optimized to maximize its innovative potential across different regional contexts.

By analysing a sample of 237 cities in China from 2004 to 2021, this research confirms an inverted U-shaped relationship between the GVC presence and innovation performance at the regional level. This finding not only emphasizes the nonlinear characteristics of GVC's impact on innovation but also highlights the regional spillover effects of GVC, offering evidence for and extending the literature on GVC. Moreover, the inclusion of moderating

effects enhances the understanding of the roles played by government fiscal constraints and talent resources in shaping the interaction between GVC and innovation. The evidence from China context provides valuable insights for policymakers in other emerging economies considering government participation in VC markets. This study thus contributes a nuanced perspective that expands the discourse on GVC's influence beyond firm-level impacts to encompass broader regional levels, offering a critical reference point for emerging market governments aiming to leverage GVC for innovation-driven growth in the country.

4.2 Research context and theorical background

4.2.1 GVC practice in China

Since the economic reforms, successive Chinese governments have prioritized innovation growth by introducing various financial support mechanisms, including government subsidies, bank loans, innovation financing and tax reductions (F. Liu et al., 2011; Tang et al., 2022). A pivotal moment occurred in 1998 when the China Democratic National Construction Association, one of China's eight democratic parties, submitted a proposal titled "Accelerating the Development of Venture Capital in China" to the Chinese People's Political Consultative Conference. This proposal formally introduced the concept of VC to China, igniting a wave of high-tech industry development and earning the title of the 'No. 1 Proposal' in China's VC industry. Prior to this, in 1985, the Chinese government had established the New Technology Venture Investment Company, a purely government-owned firm aimed at alleviating the financing challenges of small and medium-sized enterprises (SMEs) (H. Lu et al., 2013). However, this initiative was primarily a fiscal subsidy for technological innovation firms, reflecting the government-led technology policies and transitional economic system of the late 20th century, and thus represented only the nascent emergence of GVC funds in China (White et al., 2005).

Following the ‘No. 1 Proposal’, the Shanghai Municipal Government approved the establishment of the purely state-owned Shanghai Venture Capital Co., Ltd. (now NewMargin Ventures) in 1999. This institution operated under internationally recognized VC models, employing professional managers to oversee funds, thus marking the official entry of local governments into market-oriented VC operations in China. Since the onset of the 21st century, various sectors in China have experienced rapid development. To bridge the funding gaps in these industries and circumvent bureaucratic inefficiencies, the Chinese government has initiated more market-oriented VC experiments (Cheng, 1999). In early 2002, the Zhongguancun Venture Capital Development Centre launched the state-owned Zhongguancun Venture Capital Fund, aimed at exploring investment opportunities within technology parks (J. Chen, 2023). From its inception, the fund emphasized its guiding principle of “not for profit, but for guidance and leverage”, setting a precedent for China’s GVC industry.

The GVC industry in China has since grown rapidly, with 865 GVC funds established between 2015 and 2017 alone (CVINFO, 2022). According to the “Special Research Report on Government Guidance Funds”, by the end of 2023, the industry had raised a total of 2.99 trillion CNY (CVINFO, 2023). Currently, GVC funds in China are established by central or local governments, with funding sources including fiscal allocations, state-owned enterprises, financial institutions, and private capital. A distinctive feature of China’s GVC industry is the high proportion of public funds (Y. Zhang & Mayes, 2018). However, in recent years, regulations have increasingly restricted the proportion of state-owned capital to stimulate market dynamism (CVINFO, 2022).

Likewise, the institutional framework of China’s GVC system has been continuously refined. In 2005, the National Development and Reform Commission, the Ministry of Finance, and other key departments jointly issued the “Interim Measures for the

Administration of Venture Capital Enterprises", explicitly allowing central and local governments to establish GVC funds to channel private capital into the VC industry and support the growth of SMEs. In 2008, the State Council released the "Guiding Opinions on Regulating the Establishment and Operation of Venture Capital Guidance Funds", which helped align GVC development with market-oriented standards. Furthermore, China's 14th Five-Year Plan emphasizes the role of local governments in optimizing the use of fiscal funds to leverage private investment.

In summary, China's GVC goals extend beyond traditional financial returns, encompassing broader objectives such as industrial development, innovation promotion, and fostering a robust VC ecosystem. Although China's GVC initiatives began relatively late compared to global counterparts, they have expanded rapidly, with the extensive Chinese VC market providing a fertile testing ground for evaluating GVC performance. As GVC is a global phenomenon and governments worldwide anticipate significant roles for GVC, the insights derived from China's experience offer valuable lessons applicable to VC markets in other regions.

4.2.2 Theorical background

Innovation is the core element for enhancing regional vitality and competitiveness, with enterprises playing a critical role as key drivers of this process (Edeh & Prévot, 2024). This study aims to explore the role of public VC support under Chinese context, specifically examining whether the presence of GVC promotes or hinders regional innovation. To address this question, this research integrates multiple theoretical perspectives to review the relationship between GVC presence and regional innovation in previous literature.

On the one hand, the resource-based view (Barney, 1991) posits that a firm's competitive advantage stems from its unique resources and capabilities. The acquisition and utilization of

external resources can significantly enhance knowledge spillovers and technological advancements, thereby driving innovation (Pahnke et al., 2015; Miguelez & Moreno, 2018). Specifically, governments not only provide direct financial support but also contribute by introducing expertise and political leverage, which help firms enhance their internal capabilities and market competitiveness (Guerini & Quas, 2016; Y. Zhang, 2018; Suchard et al., 2021; Devarakonda & Liu, 2024). As a result, it enables firms to conduct research and development (R&D) activities more effectively and accelerates the commercialization of new products and technologies. Some existing studies use RBV to explore how GVC provides resources that enhance firm capabilities and innovation (Q. Du et al., 2024). Additionally, institutional theory (Scott, 1995; Scott, 2013) emphasizes that firm behaviour and performance are influenced by the institutional environment (Roszkowska-Menkes, 2023). As a provider of institutional systems, the government's public financing initiatives reflect its intent to promote political targets including innovation (North, 1990; J. Zhang et al., 2024). In China, under the state capitalism model, the government supports enterprise development not only through policies and regulations but also through equity investments and direct involvement in business operations, often driven by political motives (Wright et al., 2021). For example, the government's desire to stimulate regional innovation may lead to the allocation of public funds toward firms with high innovation potential (Engberg et al., 2021). Furthermore, government-led public financing sends a signal to the market, indicating that the supported firms have high potential and promising prospects (Söderblom et al., 2015; Islam et al., 2018). Given the authority and credibility associated with government investments, this signalling effect can enhance a firm's market credibility, attracting more private capital and partners to participate in the development of specific firms and industries (Lerner, 2002; J. Chen et al., 2018). In other words, the government acts as a certifier, sending positive signals to the market and guiding investment direction.

On the other hand, the presence of GVC may also have negative impacts on regional innovation. First, government-led public financing could trigger agency issues, which may reduce firm performance. Due to information asymmetry and conflicting interests between the government and firms, excessive government intervention may limit firms' autonomy and profitability (Standaert & Manigart, 2018). Moreover, in certain cases, government officials may engage in rent-seeking activities by allocating funds to firms with which they have vested interests, rather than those with the highest potential (T. Li et al., 2024). As a result, it not only distorts resource allocation efficiency but also potentially lead to waste of funds and diminished developmental dynamism (Cull et al., 2015). Specifically, firms that would otherwise benefit from GVC fail in entrepreneurship due to rent-seeking behaviour, which in turn reduces the overall local innovation capacity. The existence of agency problems and rent-seeking means that government investments, in some cases, may not only fail to promote development but could also negatively impact firm performance (Yang et al., 2022). Additionally, the presence of GVC might crowd out private capital investment, thereby weakening the support provided by market mechanisms. When the government provides substantial investments, the funding scale may suppress the enthusiasm of private investors, leading to a contraction of other financing channels in the market (D. J. Cumming & MacIntosh, 2006). Specifically, large-scale government investments might cause private investors to perceive that market opportunities have already been occupied by the government, thus reducing their willingness to invest in projects (D. Cumming, 2014). Therefore, despite the initial intent of government investments to support innovation, their actual effect could be counterproductive, potentially harming the vitality and sustainability of regional innovation.

4.3 Hypothesis development

4.3.1 GVC presence and regional innovation

As previously mentioned, the presence of GVC can have both positive and negative impacts on innovation. This study argues that these two opposing forces coexist and jointly influence regional innovation through different mechanisms.

The GVC presence brings benefits to regional innovation. When GVC is prevalent, indicated by an increasing number of newly established GVC funds within a region, more financing opportunities provided by the government become available (Brander et al., 2015). This allows more enterprises in need of capital for technological upgrades to benefit (Alperovych et al., 2020), thereby enhancing overall regional innovation. Specifically, GVC presence positively impacts regional innovation through three main mechanisms.

First, GVC funds can provide start-ups with additional resources to support their innovation activities. Specifically, the GVC funds can help firms gain unique and crucial resources in the market, promoting overall regional innovation (Q. Du et al., 2024). For instance, due to the uncertainties associated with startups and the lengthy investment cycles, traditional financing methods are often inadequate to meet the full range of funding needs (Alperovych et al., 2020), and the presence of GVC funds fill the financing gap left by social capital (Cecere et al., 2020), providing support to a broader range of enterprises and stimulating innovation (Guerini & Quas, 2016; Malmström et al., 2017). More importantly, GVC offers unique non-financial resources that differ from those provided by other financial institutions (Bertoni & Tykvová, 2015), such as helping firms maintain favourable relationships with public institutions, streamlining banking processes, and facilitating quicker approval for IPOs (Y. Zhang & Mayes, 2018; D. Zhang & Guo, 2019; Devarakonda & Liu,

2024). These unique resources enable firms to maintain a competitive edge in innovation within emerging economies, thus enhancing overall regional innovation.

Second, the 'political mission' inherent in GVC funds during the investment process can trigger positive innovation effects. Traditional VC institutions are profit-driven (Johansson et al., 2021; Engberg et al., 2021), which leads them to favour investments in relatively mature projects that can yield quick returns. As a result, some projects with high innovation potential but slow financial returns are often overlooked (Van Den Heuvel & Popp, 2023), particularly in the early stages of a firm's growth. This 'profit principle' embedded in traditional VC institutions systematically contributes to the failure of certain innovative projects, hindering regional innovation. However, from their inception, GVC funds are established with the political target of promoting innovation (Grilli & Murtinu, 2014; Breschi et al., 2022). When selecting projects, they prioritize the innovation benefits generated by firms over financial returns (Dong et al., 2021). Research suggests that GVC is more patient, favouring investments in young start-ups with high innovation potential but significant capital needs and slow returns (Buzzacchi et al., 2013; Bertoni et al., 2015; Bertoni & Tykvová, 2015). The involvement of GVC thus helps more startups overcome the 'early-stage financing challenge', rescuing more innovation-oriented projects and boosting regional innovation (Malmström et al., 2017; J. Zhang et al., 2024).

Finally, GVC promotes regional innovation through signalling effects. GVC 'certifies' the enterprises it invests in, helping them gain recognition from the financing market (D. Cumming, 2014; J. Chen et al., 2018). This effect is particularly pronounced in emerging economies, where governmental appeals play a more significant role (D. Zhang & Guo, 2019). Innovation-driven firms that receive public financing are more likely to attract private capital, further expanding their technological research (Breschi et al., 2022; Devarakonda & Liu, 2024). Additionally, repeated investments by GVC in firms within a specific industry

send positive signals to private investors, encouraging them to invest in related sectors (Luukkonen et al., 2013; K.-H. Wang et al., 2022). More importantly, GVC tends to favour high-tech industries (D. Cumming, 2007), and the private capital attracted through these investments also contributes to advancing innovation.

In contrast to the positive impacts, the negative effects of GVC presence on regional innovation are growing at an accelerating pace. Thus, this study argues that as the number of newly established GVC funds within a region surpasses a certain threshold, these counterbalancing forces will increase rapidly. In other words, the more GVC funds established locally, the faster they are likely to harm regional innovation development.

First, the excessive presence of GVC funds within a region can create supervision loopholes (corruption), leading to resource misallocation and thereby hurting innovation (Hao et al., 2020). In general, complex bureaucratic systems are prone to inefficiency and information transmission barriers (Cheng, 1999), resulting in regulatory blind spots. In China's current social and political system, GVC institutions are integrated into the administrative framework, with fund management teams often consisting of government officials who are subject to supervision and control by the Communist Party, government disciplinary departments, and senior officials (Y. Zhang & Mayes, 2018; Q. Du et al., 2024). In such a context, an excessive number of GVC funds administrative decentralization can overwhelm regulatory capacity, creating more opportunities for rent-seeking (J. Wu, 2023). For instance, senior officials may interfere in project selection, thus diverting GVC resources to enterprises with which they have vested interests (Cull et al., 2015), despite these enterprises lacking innovation potential. This misallocation of resources deprives real innovative firms of the funding they need, ultimately harming regional innovation. It should be noted that since the resources for supervising GVC are generally constant (i.e., the disciplinary inspection organs embedded in the superior leadership bodies and other forms of

social supervision), when a low level of GVC presence, these supervisory mechanisms are sufficient to fully supervise the operation and decision-making of GVC. Therefore, there is no risk of resource misallocation when a low level of GVC presence.

Second, the increase in GVC presence within a region can crowd out other types of VCs, thereby damaging innovation. Previous research suggests that enterprises and capital tend to exit highly competitive markets (Agarwal & Gort, 1996). Although GVC differs from other forms of social capital, its operational model is similar in that it involves VC investments in enterprises (T. Li et al., 2024). When a large number of GVC institutions operate within a region, private capital may perceive the local financing market as a 'red ocean' and choose to exit due to heightened competition (D. Cumming, 2014; Luo et al., 2019; Q. Du et al., 2024). The crowding-out of other VCs by GVC reduces the overall pool of funds available for venture investments in the region (D. J. Cumming & MacIntosh, 2006; Brander et al., 2010), which is harmful to local innovation. Therefore, this study proposes that as the number of GVC funds are beyond a certain threshold within a region, the crowding-out effect on social capital becomes more pronounced, leading to a reduction in regional investment and a corresponding decline in innovation performance.

As previously discussed, this research expects that a higher number of newly established GVC funds within a region (indicating a higher level of GVC presence) will generally promote local innovation activities and generate greater innovation performance. However, an excessively high level of GVC presence can also be harmful. Given that the benefits of GVC presence tend to diminish while the adverse effects of resource misallocation and the crowding-out effect increase at an accelerating pace, this research proposes an inverted U-shaped relationship between GVC presence and regional innovation performance. In other words, as GVC presence increases to a threshold level, the benefits—mainly driven by the positive effects of the three mechanisms (i.e., resource benefits, political targets, and

signalling effects), resulting in an overall positive net effect on regional innovation performance. However, once GVC presence exceeds a certain threshold, the downsides of resource misallocation and the crowding-out effect increase significantly, surpassing the benefits and leading to a net negative impact on regional innovation.

Thus, this paper proposes a hypothesis as follows,

Hypothesis 1. There is an inverted U-shaped relationship between GVC presence and regional innovation.

Haans et al. (2016) pointed out that if Y first increases with the independent variable X at a decreasing rate until it reaches a maximum value, and then Y decreases at an increasing rate, there is an inverted U-shaped relationship. Following his guidance, this study draws **Figure 4.1** to intuitively reflect the relationship between the GVC presence and regional innovation.

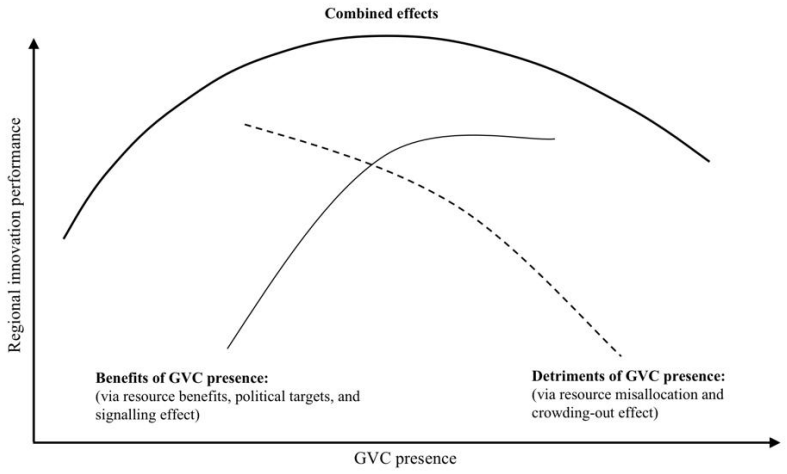

Figure 4.1 Inverted U-shaped relationship between GVC presence and regional innovation performance

The formation, operation and development of GVC funds need to rely on various resources including financial resources and human resources. From the perspective of resource supply,

this study discusses the moderating effect of public financial conditions and talent supply on the inverted U-shaped relationship between GVC presence and regional innovation.

4.3.2 The moderating effect of fiscal constraints

This study further proposes that the impact of GVC presence on regional innovation is moderated by the fiscal constraints of the region, resulting in a flattened inverted U-shaped relationship. Existing research suggests that public funding is a crucial source of R&D activities, a phenomenon especially evident in emerging economies (Meuleman & De Maeseneire, 2012; Lazonick & Tulum, 2011; Y. Zhang & Mayes, 2018). When regional governments face fiscal constraints, the funds available for promoting technological advancements become limited. In this context, this study anticipates that the previously discussed mechanisms that enhance regional innovation will be hindered.

First, the total amount of available resources will be restricted. Research indicates that firms in emerging markets tend to intensify their innovation efforts when they have sufficient cash reserves (F. Lu et al., 2022). When local government finances are tight, they are unable to provide sufficient funding or other public resources to support more start-ups. Consequently, the likelihood of innovative firms receiving public funding decreases, ultimately weakening the overall regional innovation capacity. Second, the government's ability and ambition to achieve its innovation objectives will be diminished, as fiscal stress directly affects the execution of public sector budgets. In other words, the government must prioritize the limited public fiscal resources for more critical areas, such as public security, which are compulsory by the law (Brien et al., 2021). Even if the government remains committed to promoting regional innovation, practical financial constraints will limit its capacity to act. Finally, the signalling effect will be weakened. Reduced fiscal support from the government diminishes the strength of the positive signals that GVC sends to other social capital sources, leading to fewer private investors participating in innovation development.

On the other hand, fiscal stress may also mitigate the negative effects of GVC presence, such as resource misallocation and crowding out. First, when government fiscal resources are constrained, public funding opportunity will attract more competitors and relatively greater public attention. Existing research suggests that competition can regulate the administrative power over economic order (Ye et al., 2022). In other words, robust competition enhances the transparency of the competitive process, thereby improving fairness in the allocation of public resources. As a result, public funds are more likely to be effectively allocated to firms that have high innovation potential. Second, fiscal constraints reduce the government's dominance in the financing market, allowing more private capital to enter and thereby increasing the diversity of funding sources for regional innovation.

In summary, when local governments face fiscal constraints, both the benefits and detriments of GVC presence are weakened, leading to a more flattened inverted U-shaped relationship between GVC presence and regional innovation performance. Thus, this paper proposes a hypothesis as follows,

Hypothesis 2. The inverted U-shaped relationship between the GVC presence and regional innovation becomes flattened when local government experiences a high level of fiscal constraints.

4.3.3 The moderating effect of talent pool

This study further argues that the increasing density of talents within a region can amplify the impact of GVC presence on regional innovation, leading to a steeper inverted U-shaped relationship. There are several characteristics associated with the employment preferences of Chinese university graduates. For instance, graduates tend to prefer employment in the public sector (J. Gao et al., 2019; Hao et al., 2020). In addition, China's research universities are almost government-owned (X. M. Fu et al., 2022), and their annual admissions plans for

specific disciplines are subject to government coordination and approval. Based on this logic, this research expects that the previously discussed mechanisms enhancing regional innovation will become more pronounced.

First, when a region has a higher density of high-quality talents, the intellectual support it provides will increase the overall resources available to drive innovation in that region. Existing study shows that human capital is a dominant factor in innovation, and the aggregation of highly skilled talent is key to enhancing urban innovation vitality (Yu & Cai, 2021). Consequently, firms are better able to recruit employees with the necessary skills and innovative capabilities to undertake technological advancements, thereby boosting the region's overall innovation capacity. Second, a large number of financial and industrial talent choosing to settle in a particular region can strengthen both the willingness and capacity of the government to fulfill its political objectives. On the one hand, talent requires a favourable socio-economic environment and sufficient employment opportunities (Couture & Handbury, 2020; Verginer & Riccaboni, 2021). The objective of retaining talent drives the government to accelerate the implementation of regional development strategies through GVC. On the other hand, the existing studies pointed out that organizational structures affect decision-making processes by allocating and distributing stimuli that channel managerial attention (Simon, 1997). Specifically, the presence of more specialized talent in institutions like GVC funds means that both policies and funding will be more innovation oriented. Lastly, the signalling effect will be strengthened. University admissions policies impact the educational experiences and employment outcomes of millions of colleges graduates each year (Y. Chen et al., 2020). Furthermore, private capital can collect insights from the annual university admissions plans about industries the government intends to prioritize for future development. This foresight encourages social capital to invest in these sectors, fostering innovation ecosystem.

On the downside, this argues that an abundance of talent pool can exacerbate the negative effects of GVC presence on regional innovation. On one hand, talent aggregation often leads to path dependency, especially when a particular industry becomes the primary focus of development, potentially marginalizing other innovative sectors (Stern & Valero, 2021; Su et al., 2021). Specifically, local governments play a key role in resource allocation, and policymakers may be inclined to support mature or advantageous sectors where professional talents are mostly concentrated, resulting in a 'winner-takes-all' distribution of resources, further intensifying the risk of resource misallocation (Hao et al., 2020). This bias could lead to an over-concentration of innovation resources in a few established projects, hindering the overall development of the regional innovation ecosystem. On the other hand, large enterprises and incumbents within a region monopolize most of the top talent through high salaries and attractive benefits, making it difficult for startups and emerging industries to access quality talent, ultimately crowding them out of the market, which harms long-run local innovation. Therefore, this research expects that talent clustering will exacerbate the negative effects on the diversity and novelty of regional innovation, as reflected in the resource misallocation and crowding-out effects associated with GVC presence.

In summary, I believe that when a region is rich in talent resources, both the positive and negative effects of GVC presence will be amplified. This leads me to propose the following hypothesis,

Hypothesis 3. The inverted U-shaped relationship between the GVC presence and regional innovation is intensified when the talent pool in the region is richer.

To summarize the above three hypotheses, this study proposes the following theoretical framework (see **Figure 4.2**), which aims to investigate the impact of GVC presence on regional innovation performance.

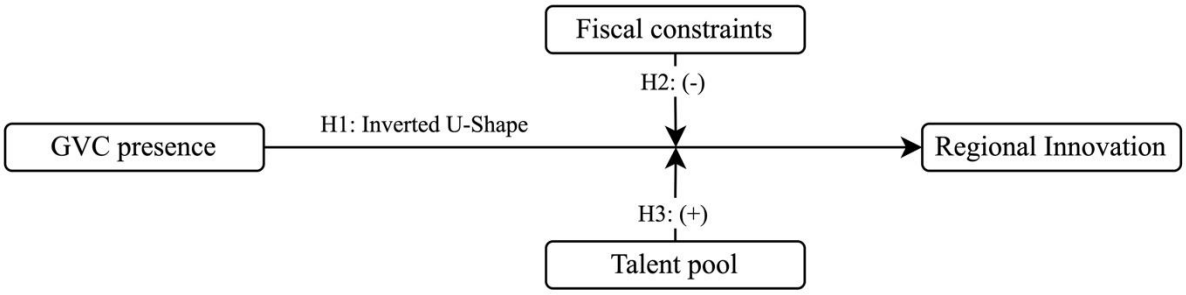

Figure 4.2 Theoretical framework showing the effects of GVC presence on regional innovation

4.4 Methodology

4.4.1 Sample and data

This study selects 237 Chinese cities as the research context for three reasons. First, although data from Western countries have discussed GVC performance issues (Bertoni & Tykvová, 2015; Alperovych et al., 2015; Murtinu, 2021), the unique cultural backgrounds and legal regulations mean that conclusions based on industrialized nations cannot fully explain the phenomena in emerging economies like China (Brander et al., 2015; Suchard et al., 2021). China's unique culture of 'government-business relations' and the strong influence of the government in economic activities are markedly different from the regions primarily focused on in current GVC research, such as Europe and the United States (Bruton & Ahlstrom, 2003; Wu & Kirk Davidson, 2011). In other words, research based on the Chinese context can assist scholars and authorities in observing the variances in the impact of GVC under different institutional settings, which is important to improve the understanding of GVC research. Second, China's rapidly expansive GVC industry offers a fertile testing ground for GVC performance research. Statistics indicate that China has become the world's second-largest VC market (Ge et al., 2024), with the cumulative size of various levels of GVC funds reaching 2.99 trillion CNY (CVINFO, 2023). Third, China's economic reforms

have achieved remarkable success, making it the world's largest emerging economy in less than 40 years (Hao et al., 2020; Ge et al., 2024). Scholars from various disciplines have attempted to explain the antecedents of this miracle from their respective perspectives (H. Cai & Treisman, 2006; Song et al., 2011; Y. Cai & Feng, 2021). Therefore, conducting GVC performance research within the Chinese context can not only enrich GVC research but also provide new evidence and insights into the exploration of China's rapid development phenomenon.

GVC investment is a long-term process, and thus, its impact on regional development takes time to unfold. Therefore, to evaluate GVC's regional innovation performance, the datasets with longer time spans should be utilized. In doing so, the sample period ranges from 2004 to 2021. This study chooses this period for the following reasons. First, according to the "Decision of the State Council on Reforming the Investment System" formulated by the Chinese central government in 2004, the authorities proposed the establishment and enhancement of the VC mechanism, thereby formally laying the institutional foundation for China's VC industry. Following this 'Decision', numbers of supporting policies emerged, including the "Interim Measures for the Administration of Venture Capital Enterprises", which has served as a guiding document for the development of China's VC industry over the past two decades. Consequently, this research selected 2004, the year this landmark document issued, as the starting point of the study. Second, most control variables for this study are sourced from the "China City Statistical Yearbook", which is currently updated only up to the 2022 edition, making 2021 the latest available year for data. To ensure the stability of the results, this study chose 2021 as the endpoint of the observation period. In addition, based on data availability, the sample covers 237 cities in mainland China.

This study aims to explore the innovative performance of GVC funds. Unlike traditional firm-level studies, this research will discuss this topic at the regional level. The data

collection in this study primarily involves gathering information on individual GVC funds and corporate patents and constructing a city-year panel dataset based on their registered addresses. This study hopes to observe the regional innovation performance of GVCs through this novel data processing approach. First, the research collected basic GVC information from Zero2IPO, a widely used VC database in China. Specifically, Zero2IPO offers a sub-database called the 'Government Guidance Funds', which covers basic information on GVC funds at different administrative levels in China, including fund names, managing institutions, fund levels, registered regions, establishment dates, and target scales. During the observation period, a total of 2,243 GVC funds were established in mainland China. Among them, there are 33 national-level GVC funds, 349 provincial-level GVC funds, 815 city-level GVC funds, 576 county-level GVC funds, and 470 GVC funds without a clearly defined level in the database. Based on the registered addresses of these funds, this study constructed a dataset of GVC numbers for each city and used the ArcGIS platform to spatially display the GVC data for the years 2004, 2015, and 2021 (see **Figure 4.3**). It is important to note that the GVC data in this study represents the number of newly established GVC funds each year rather than the accumulative number of GVC funds, as some GVC funds are written off after completing their missions, making the total count inaccurate. **Figure 4.3** indicates a growing trend in the interest of various levels of government in establishing GVC funds in China.

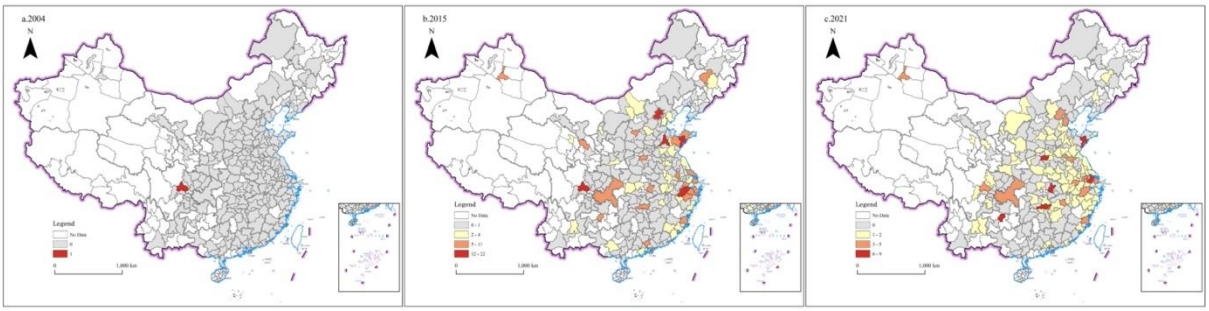

Figure 4.3 Spatial display of the newly established GVC Funds in 2004, 2015, and 2021of China

Secondly, this study collected corporate patent application information from the China National Intellectual Property Administration (https://www.cnipa.gov.cn/), obtaining a database with over 30 million patent records. This study excluded patent applications and grants registered in Hong Kong, Macau, Taiwan, and overseas, and matched the remaining patent data with cities that have GVC funds. This process resulted in a final dataset of 28,316,448 patent records, including 10,184,153 invention patents, 12,416,663 utility model patents, and 5,715,632 design patents. **Figure 4.4** provide a more detailed description of patent data across various regions in China.

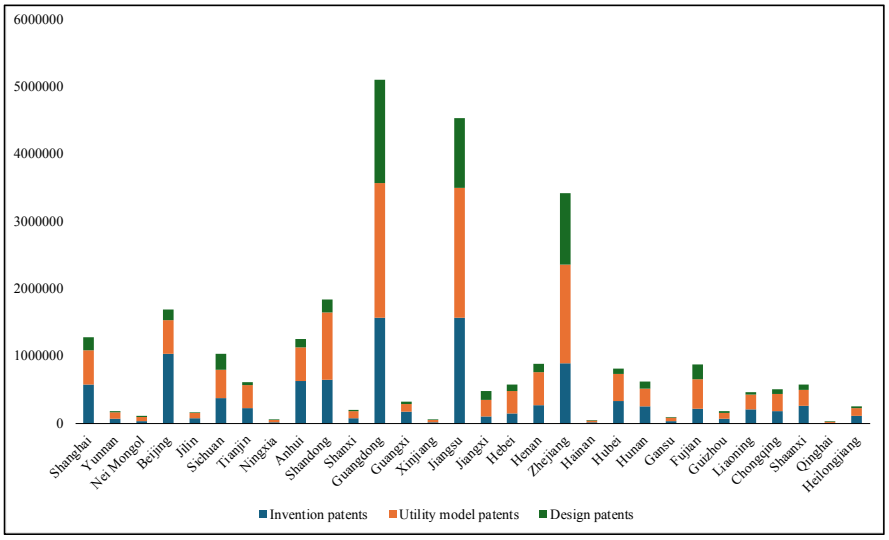

Figure 4.4 Number of three types of patent applications in each sample province

The data in this research is sourced from various public channels. Specifically, the dependent variables 'innovation' data is sourced from China National Intellectual Property Administration. The independent variable 'GVC' data is sourced from Zero2IPO. The moderating variable 'Fiscal constraints' and 'Talent pool' are sourced from the "China City Statistical Yearbook". At last, control variables are sourced from the "China City Statistical Yearbook", and "China Urban Construction Statistical Yearbook".

4.4.2 Dependent variable

This study matched the registered addresses from the collected Chinese corporate patent information with city names to construct the dependent variable for this study. First, current research that measures regional innovation using patent data often refers to the "Patent Application & Grant of Chinese Provinces and Cities" in Chinese Innovation Research Database (CIRD) from the Chinese Research Data Services Platform (CNRDS). However, the regional patent numbers the CNRDS provides include not only corporate patents but also patents from other institutions such as universities, which can introduce bias into the research results. Second, while traditional firm-level studies observing the impact of GVC on innovation provide an effective micro-perspective, the approach of this research offers new evidence from a macro-perspective (city-level) on the impact of GVC on regional innovation. Therefore, this study uses the number of firm patent applications per 10,000 people as the independent variable, as indicated in the following measurement:

$$Innovation = \frac{Invention\ patents\ (Number) + Utility\ model\ patents\ (Number) + Design\ patents\ (Number)}{Total\ population\ (10{,}000\ People)}$$

4.4.3 Independent variable

This study constructed the independent variable for this study based on the number of GVC funds in each city. The reason for not using the GVC fundraising scale data is due to missing values in the Zero2IPO database. Additionally, for political purposes, some local governments are likely to exaggerate their total fundraising amounts (Shanxi Audit, 2024), which is more pronounced for GVC funds established by lower-level local governments. Due to the lagged effect of newly established GVC funds, this study used the one-period lagged GVC as our independent variable.

4.4.4 Control variables

Based on existing literature, this study included a series of control variables with city-specific characteristics that could potentially influence regional innovation. Besides GVC funding channels, the amount of local governmental scientific and educational expenditures also impacts the level of regional innovation (Wei et al., 2023; Tan et al., 2023). This study constructed this variable by calculating the proportion of annual scientific and educational expenditures to GDP for each city, as indicated in the following measurement:

$$S\&T\ expenditure = \frac{Scientific\ expenditures\ (10{,}000CNY) + Educational\ expenditures\ (10{,}000CNY)}{GDP\ (10{,}000CNY)}$$

The level of urban development is crucial factor affecting regional innovation capacity. Following previous practices, this study used the logarithm of per capita GDP as a representation of the city's economic development level (J. Wang & Deng, 2022). The size of a city's financial pool represents its innovation potential, as enterprises can borrow funds from financial institutions to invest in technological improvement. This study constructed the 'financial convenience' variable using the logarithm of the balance of loans from financial institutions in each city for the year (Jiang et al., 2020; Li et al., 2023).

On one hand, consumption upgrades force enterprises to invest more funds in technological research to introduce market-appropriate products. On the other hand, increased consumption capability provides enterprises with more revenue, thereby supporting innovation funding. However, if the consumption capability becomes excessively high, customers might engage in out-of-region purchases, thereby diminishing local enterprises' incentive to innovate. This study measured this variable by calculating the proportion of total retail sales to GDP (Fan et al., 2021; Fan, Lian, et al., 2021; Li & Li, 2022), as indicated in the following measurement:

$$Consumption\ capability = \frac{Total\ retail\ sales\ of\ consumer\ goods\ (10{,}000CNY)}{GDP\ (10{,}000CNY)}$$

Urbanization trends facilitate the aggregation of resources, promoting regional innovation capability. This study represented the urbanization variable by the proportion of the urban permanent population to the total population (Yu & Cai, 2021). In certain areas, this is alternatively measured using the proportion of 'non-agricultural population' to 'total population' (han et al., 2024), as indicated in the following measurement:

$$Urbanization = \frac{Urban\ permanent\ population\ (10{,}000\ People)\ or\ non-agricultural\ population\ (10{,}000\ People)}{Total\ population\ (10{,}000\ People)}$$

In addition, based on previous literature, this study controlled for city infrastructure variables, including informatization, road construction, and living environment (Caragliu & Del Bo, 2019; Zou et al., 2022). These were measured by the number of internet users per 10,000 people, the kilometres of urban roads & bridges per 10,000 people, and the per capita area of park green spaces, respectively. The measurements are as follows.

$$Informatization = \frac{Number\ of\ international\ Internet\ users\ (Number)}{Total\ population\ (10{,}000\ People)}$$

$$Infrastructure = \frac{Urban\ road\ \&\ bridge\ (kilometres)}{Total\ population\ (10{,}000\ People)}$$

4.4.5 Moderating variables

One of the moderating variables in this study- the level of fiscal constraints - is measured as the ratio of the public fiscal expenditure to the public fiscal revenue. When expenditure exceeds revenue, that is, when the fiscal situation tends to be tight, the government's ability to intervene in social and economic activities will also decrease. The measurement for constructing this variable is as follows:

$$Fiscal\ constraints = \frac{Public\ fiscal\ expenditure\ (10{,}000\ CNY)}{Public\ fiscal\ revenue\ (10{,}000\ CNY)}$$

Another moderating variable in this study is talent pool, represented by the number of university students enrolled per 10,000 people. The number of university students in a region

reflects the local talent reserve, which influences the impact of government support on innovation. This study constructed this variable using the following measurement:

$$Talent\ pool = \frac{Number\ of\ university\ students\ enrolled\ (Number)}{Total\ population\ (10{,}000\ People)}$$

The measurements and data sources of all variables are shown in **Table 4.1**.

Table 4.1 Variable measurements and data sources

Variable	Measurement	Data sources
Innovation	Number of patent applications per 10,000 people	China National Intellectual Property Administration
GVC presence	The lagged one-period value of newly established GVC funds	Zero2IPO
Fiscal constraints	Public fiscal expenditure / Public fiscal revenue	China City Statistical Yearbook
Talent pool	Number of university students enrolled per 10,000 people	China City Statistical Yearbook
S&T expenditure	Science & education expenditure / GDP	China City Statistical Yearbook
GDP	The logarithm of per capita GDP	China City Statistical Yearbook
Financial convenience	The logarithm of the balance of loans from financial institutions	China City Statistical Yearbook
Consumption capability	Total retail sales of consumer goods/GDP	China City Statistical Yearbook
Urbanization	Urban population / total population	China City Statistical Yearbook
Informatization	Number of internet users per 10,000 people	China City Statistical Yearbook
Infrastructure	Kilometres of urban roads & bridges per 10,000 people	China Urban Construction Statistical Yearbook
Living environment	Park green space per capita (square metres)	China Urban Construction Statistical Yearbook

4.4.6 Analytical model

This study examines the innovation performance of GVC, which was conducted at the city-year level. Equation (1) tests Hypothesis 1, which emphasizes that GVC presence promotes regional innovation. Equations (2) and (3) test Hypotheses 2 and 3, respectively, which suggest that fiscal constraints and talent pool can moderate the relationship between GVC funds and regional innovation. It should be noted that the results of the Hausman test suggested that fixed effects are preferred over random effects (p = 0.000). This study used the Ordinary Least Squares (OLS) method for estimation and presented the estimation methods for each of the hypotheses below.

$$Innovation_{i,t} = \alpha_0 + \alpha_1 GVC_{i,t-1} + \alpha_2 GVC^2_{i,t-1} + \eta \bullet Control_{i,t} + \gamma_i + \mu_t + \varepsilon_{i,t-1} \quad (1)$$

$$Innovation_{i,t} = \alpha_0 + \alpha_1 GVC_{i,t-1} \times Fiscal\ constraints_{i,t} + \alpha_2 GVC^2_{i,t-1} \times Fiscal\ constraints_{i,t} + \alpha_3 GVC_{i,t-1} + \alpha_4 GVC^2_{i,t-1} + \alpha_5 Fiscal\ constraints_{i,t} + \eta \bullet Control_{i,t} + \gamma_i + \mu_t + \varepsilon_{i,t-1} \quad (2)$$

$$Innovation_{i,t} = \alpha_0 + \alpha_1 GVC_{i,t-1} \times Talent\ resources_{i,t} + \alpha_2 GVC^2_{i,t-1} \times Talent\ resources_{i,t} + \alpha_3 GVC_{i,t-1} + \alpha_4 GVC^2_{i,t-1} + \alpha_5 Talent\ pool_{i,t} + \eta \bullet Control_{i,t} + \gamma_i + \mu_t + \varepsilon_{i,t-1} \quad (3)$$

Where, $Innovation_{i,t}$ is the corporate patent application in each city in each year; $GVC_{i,t-1}$ represents the number of GVC firms (One-period lag); $GVC^2_{i,t-1}$ is the squared term of $GVC_{i,t-1}$; $Fiscal\ constraints_{i,t}$ and $Talent\ resources_{i,t}$ both are moderating variables; $Control_{it}$ indicates a series of control variables; γ_i and μ_t are the city and time fixed effect. In addition, $\varepsilon_{i,t-1}$ is the random error term; α_0 is the constant term; α_1, α_2, α_3, α_4, α_5 and η are the coefficient values of variables; *i* and *t* represent city and time, respectively.

4.5 Results

4.5.1 Correlation analysis

In **Table 4.2**, this study presents the results of the correlation analysis for all variables. Before conducting the regression analysis, the research performed a Variance Inflation Factor (*VIF*) test to mitigate potential multicollinearity among the independent variables, which could otherwise result in spurious regression outcomes. The *VIF* test results for the explanatory variables are reported in the last row of **Table 4.2**. This study found that all *VIF* values for the explanatory variables were below 10 (Ryan, 2008) with an average value is 2.86, showing that there is no significant multicollinearity issue in the analysis. Furthermore, the correlation analysis reveals significant positive relationships between GVC presence and regional innovation, providing preliminary support for Hypotheses 1.

Table 4.2 Descriptive statistics and correlation matrix

Variables	Mean	Std. Dev.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Innovation	12.69	31.013	1.000											
(2) GVC	0.507	1.497	0.450*	1.000										
			(0.000)											
(3) Fiscal constraints	2.558	1.579	-0.228*	-0.167*	1.000									
			(0.000)	(0.000)										
(4) Talent pool	194.275	244.001	0.310*	0.375*	-0.343*	1.000								
			(0.000)	(0.000)	(0.000)									
(5) S&E expenditure	0.031	0.015	-0.038*	-0.012	0.635*	-0.238*	1.000							
			(0.012)	(0.448)	(0.000)	(0.000)								
(6) GDP	10.417	0.888	0.547*	0.377*	-0.454*	0.503*	-0.212*	1.000						
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)							
(7) Financial convenience	16.189	1.355	0.522*	0.489*	-0.371*	0.596*	-0.064*	0.776*	1.000					
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)						
(8) Consumption capability	0.366	0.102	0.058*	0.170*	0.080*	0.216*	0.166*	0.031*	0.343*	1.000				
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.044)	(0.000)					
(9) Urbanization	0.519	0.172	0.493*	0.345*	-0.423*	0.559*	-0.199*	0.831*	0.674*	0.136*	1.000			
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)				
(10) Informatization	1942.208	2019.839	0.616*	0.363*	-0.254*	0.438*	-0.023	0.735*	0.664*	0.151*	0.688*	1.000		
			(0.000)	(0.000)	(0.000)	(0.000)	(0.125)	(0.000)	(0.000)	(0.000)	(0.000)			

(11) Infrastructure	2.561	3.513	0.532*	0.216*	-0.309*	0.436*	-0.215*	0.599*	0.372*	-0.060*	0.636*	0.593*	1.000
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	
(12) Living environment	12.348	5.007	0.207*	0.124*	-0.033*	0.087*	0.112*	0.478*	0.337*	0.046*	0.310*	0.326*	0.217*	1.000
			(0.000)	(0.000)	(0.030)	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)	(0.000)	
Observations			4266	4029	4266	4266	4266	4266	4266	4266	4266	4266	4266	4266
VIF			N/A	1.35	2.17	1.92	1.94	7.62	4.48	1.45	4.27	2.73	2.13	1.40

Notes: * $p < 0.05$; *Innovation* is the dependent variable and therefore does not have VIF value.

4.5.2 Baseline results

Table 4.3 estimates Equation (1) and reports the baseline regression outcomes regarding the impact of GVC presence on regional innovation. Models (1) and (3) include only the independent variables, while Models (2) and (4) report results incorporating all control variables. Additionally, Models (1) and (2) do not control for time and city-specific effects, whereas Models (3) and (4) account for both. Hypothesis 1 predicts an inverted U-shaped relationship between GVC presence and regional innovation. As shown in Model (4), the coefficient for the linear term of GVC presence is significant and positive (α = 7.285, $p \leq$ 0.001), while the coefficient for the squared term is significant and negative (α = -0.253, $p \leq$ 0.001), indicating an inverted U-shaped relationship. To further validate and interpret this inverted U-shape, this study applies the general framework proposed by Lind & Mehlum (2010). Based on Fieller's standard error, this study estimates the inflection point and calculate the confidence interval. The inflection point of GVC presence is 14.768, with a 95% confidence interval of [12.355298, 19.17634]. These findings consistently suggest a robust inverted U-shaped relationship between GVC presence and regional innovation. Specifically, as the number of newly established GVC funds increases from a low initial level, it benefits regional innovation. However, once the number of GVCs exceeds 14.768, further increases in the number of newly established GVC funds become detrimental to regional innovation. Therefore, Hypothesis 1 is supported.

Table 4.3 Main results: GVC presence and regional innovation

	Model 1	Model 2	Model 3	Model 4
Variables	*Innovation*	*Innovation*	*Innovation*	*Innovation*
GVC	15.836***	7.299***	7.529***	7.285***
	(1.148)	(0.928)	(0.729)	(0.701)
GVC squared	-0.669***	-0.246***	-0.255***	-0.253***
	(0.087)	(0.072)	(0.053)	(0.051)
S&E expenditure		102.672***		-10.394
		(30.524)		(54.538)
GDP		2.522*		-12.918***
		(1.279)		(3.086)
Financial convenience		3.767***		-2.140
		(0.554)		(1.773)
Consumption capability		-19.282***		-39.010***
		(5.029)		(6.806)
Urbanization		-22.130***		-46.190***
		(4.446)		(6.171)
Informatization		0.004***		0.002**
		(0.001)		(0.001)
Infrastructure		2.638***		-1.963**
		(0.431)		(0.721)
Living environment		-0.223**		-0.035
		(0.082)		(0.110)
Constant	6.967***	-75.110***	10.144***	221.576***
	(0.347)	(13.867)	(0.333)	(31.588)
Year fixed effect	No	No	Yes	Yes
City fixed effect	No	No	Yes	Yes
Adj-R^2	0.236	0.500	0.721	0.741
Observations	4029	4029	4029	4029

Notes: Robust standard errors are shown in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

4.5.3 Moderating effect of fiscal constraints and talent pool

Hypothesis 2 predicts that fiscal constraints negatively moderate the relationship between GVC presence and regional innovation. Model 1 in **Table 4.4** estimates Equation (2) and reports the moderating effect of the fiscal constraint variable. In Model 1, the interaction term between GVC presence and fiscal constraints exhibits a statistically significant negative effect (α = -4.826, $p \leqslant 0.001$), while the interaction term between the GVC presence squared and fiscal constraints is significant and positive (α = 0.153, $p \leqslant 0.01$). Thus, when local government finances are constrained, the curvature of the inverted U-shaped relationship between GVC presence and regional innovation subdues. Hypothesis 2 is therefore supported.

In addition, Hypothesis 3 proposes that talent pool will strengthen the relationship between GVC presence and regional innovation. Model 2 in **Table 4.4** estimates Equation (3) and illustrates how the talent variable influences this inverted U-shaped relationship. Model 2 indicates that the interaction term between GVC presence and talent pool shows a statistically significant positive effect (α = 0.006, $p \leqslant 0.001$), whereas the interaction term between the GVC presence squared and talent pool is significant and negative (α = -0.0003, $p \leqslant 0.01$). The regression results of Model 2 suggest that when a region is rich in talent pool, the inverted U-shaped relationship between the number of newly established GVC funds and regional innovation becomes steeper. Hypothesis 3 is supported.

Table 4.4 Moderating effect: fiscal constraints and talent pool

	Model 1	Model 2
Variables	*Innovation*	*Innovation*
GVC	3.616***	5.262***
	(0.656)	(0.811)

GVC squared	-0.202*	-0.120
	(0.083)	(0.085)
GVC × Fiscal constraints	-4.826***	
	(0.549)	
GVC squared × Fiscal constraints	0.153**	
	(0.056)	
GVC × Talent pool		0.006***
		(0.001)
GVC squared × Talent pool		-0.0003**
		(.0001)
Fiscal constraints	-3.251***	
	(0.410)	
Talent pool		0.020*
		(0.008)
S&E expenditure	48.311	-6.368
	(53.239)	(52.525)
GDP	-11.503***	-13.231***
	(3.038)	(3.082)
Financial convenience	-0.801	-2.627
	(1.733)	(1.799)
Consumption capability	-36.366***	-37.885***
	(6.572)	(6.757)
Urbanization	-43.517***	-43.450***
	(5.956)	(6.020)
Informatization	0.001**	0.002*
	(0.001)	(0.001)
Infrastructure	-2.029**	-2.259**
	(0.705)	(0.733)
Living environment	-0.002	-0.020
	(0.108)	(0.112)
Constant	189.563***	227.915***
	(31.018)	(32.018)
Year fixed effect	Yes	Yes

City fixed effect	Yes	Yes
Adj-R^2	0.755	0.746
Observations	4029	4029

Notes: Robust standard errors are shown in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

4.5.4 Marginal effects plots: baseline model and moderating effect

To further illustrate the findings visually, this study plotted **Figures 4.5** to **4.7**. **Figure 4.5** demonstrates the inverted U-shaped relationship between GVC presence and regional innovation, with the shaded area representing the 95% confidence interval. The results indicate that as the number of newly established GVC funds increases, regional innovation performance initially rises and then declines, supporting Hypothesis 1.

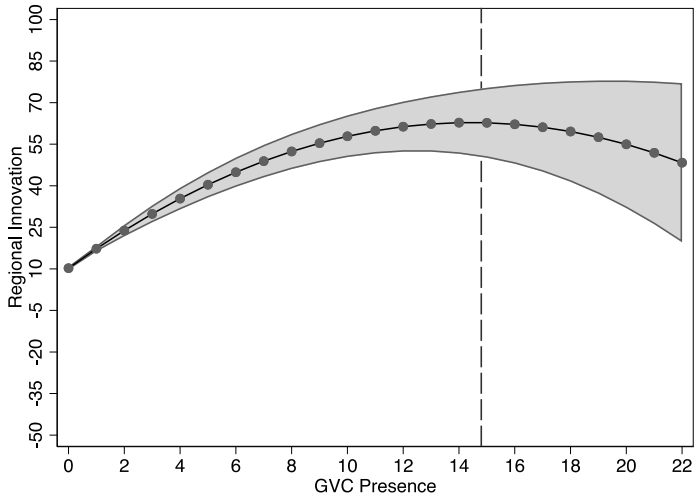

Figure 4.5 Effect of GVC presence on regional innovation

Furthermore, **Figures 4.6** and **4.7** illustrate the moderating effects of fiscal constraints and talent pool, respectively, on the inverted U-shaped relationship between GVC presence and regional innovation. Specifically, **Figure 4.6** shows that under conditions of low fiscal constraints (i.e., 1 S.D. below the mean), GVC presence has a significant inverted U-shaped effect on regional innovation. However, as fiscal constraints increase, this effect gradually weakens (i.e., the inverted U-shaped curve flattens). The results of the marginal effect

difference analysis show that when the fiscal constraint adjustment is increased from a low level to a high level, the marginal effect of GVC presence shows a significant downward trend, with a decrease of 14.753 units. Furthermore, the statistical significance test shows that the t statistic is about -9.141 and is significant at the 1% level, indicating that the difference has a very high statistical significance level. Thus, Hypothesis 2 is supported, confirming that fiscal constraints weaken the inverted U-shaped relationship between GVC presence and regional innovation.

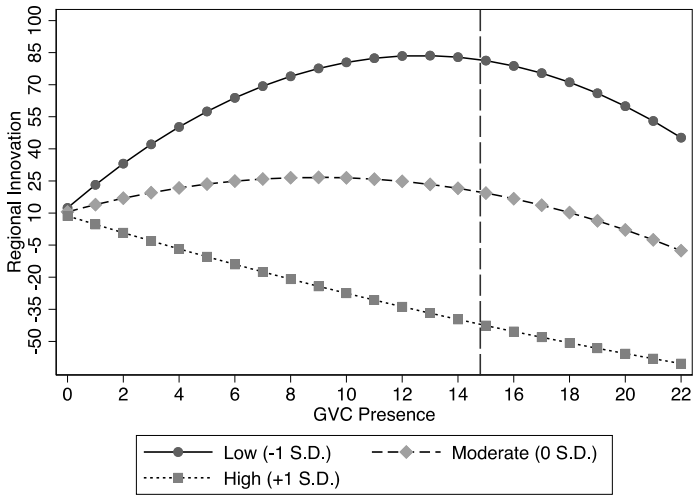

Figure 4.6 Moderating effect of fiscal constraints on the inverted 'U'-shaped relationship between GVC presence and regional innovation

Figure 4.7 reveals that when a region is rich in talent resources (i.e., 1 S.D. above the mean), the inverted U-shaped relationship becomes steeper, confirming the enhancing moderating effect of talent pool. In addition, the results of the marginal effect difference analysis show that when the talent pool adjustment is increased from a lower level to a higher level, the marginal effect of GVC presence shows a significant upward trend, with an increase of 2.752 units. Furthermore, the statistical significance test shows that the t statistic is about 4.006 and is significant at the 1% level, indicating that the difference has a very high statistical significance level. This further supports Hypothesis 3.

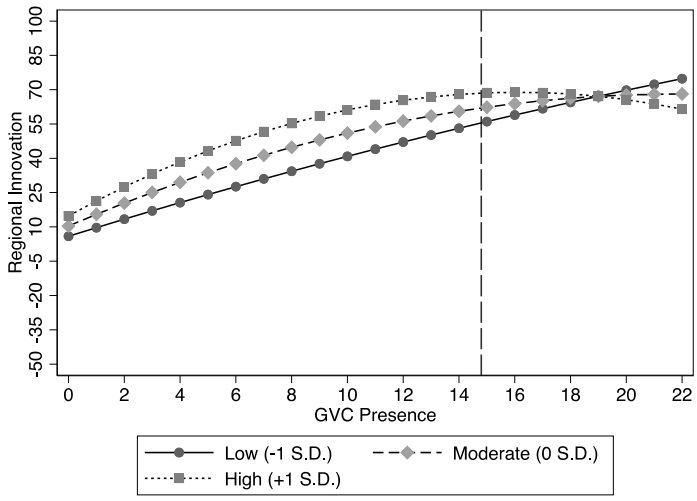

Figure 4.7 Moderating effect of talent pool on the inverted 'U'-shaped relationship between GVC presence and regional innovation

4.6 Regional difference analysis

Regional imbalance in innovation resources is one of the key characteristics of China's current development pattern (A. M. Wu et al., 2019). The quantile regression approach employed as an additional test in this study provides a more detailed perspective on the impact of GVC presence on regional innovation, particularly when heterogeneous effects may exist across regions with different levels of innovation. Models 1, 2, and 3 in **Table 4.5** correspond to the estimation results at the 0.25, 0.5, and 0.75 quantiles, respectively.

The quantile regression results reveal that the impact of GVC Presence on Regional Innovation varies significantly across regions with different innovation levels. At the lower innovation level (0.25 quantile), GVC Presence exhibits an inverted U-shaped relationship, which is similar to the baseline outcomes. In contrast, at the median (0.5 quantiles) and higher innovation levels (0.75 quantiles), GVC Presence consistently shows a significant positive effect, with the strongest impact observed at the highest innovation level (α = 6.589, $p \leq 0.001$). This suggests that moderate involvement in GVC is crucial for regions with lower

innovation capacity, while regions with higher innovation levels can further enhance their innovation through deeper integration into GVC. This suggestion aligns with the current realities of GVC practices in China: GVC funds are mainly concentrated in the developed eastern coastal regions and provincial capital cities (CVINFO, 2020; CVINFO, 2022). Additionally, financial convenience, informatization, and infrastructure demonstrate significant positive effects across all quantiles, emphasizing their critical roles in enhancing regional innovation.

It is worth noting that regions with higher regional innovation levels are more able to organize greater regulatory forces to supervise the operation of GVC funds, offsetting the resource misallocation problem caused by the lack of regulation, which is why a linear relationship rather than an inverted U-shaped relationship appears at high quantiles.

Table 4.5 Quantile regression results

	Model 1 (0.25 Quantile)	Model 2 (0.5 Quantile)	Model 3 (0.75 Quantile)
Variables	*Innovation*	*Innovation*	*Innovation*
GVC	2.910***	4.342***	6.589***
	(0.170)	(0.257)	(0.456)
GVC squared	-0.054***	0.081***	-0.010
	(0.014)	(0.021)	(0.037)
S&E expenditure	-4.094	-11.673***	-17.907
	(8.620)	(13.094)	(23.220)
GDP	-0.229	-1.189*	-2.770**
	(0.371)	(0.564)	(0.100)
Financial convenience	1.078***	1.246***	1.238**
	(0.172)	(0.262)	(0.464)
Consumption capability	0.327	3.158	-5.823
	(1.362)	(2.069)	(3.670)
Urbanization	-1.060	-1.255	-2.200
	(1.394)	(2.118)	(3.756)

Informatization	0.001***	0.003***	0.007***
	(0.001)	(0.000)	(0.000)
Infrastructure	0.634***	1.079***	1.878***
	(0.467)	(0.071)	(0.126)
Living environment	-0.024	-0.018	-0.038
	(0.028)	(0.042)	(0.075)
Constant	-14.133***	-6.736	8.469
	(2.938)	(4.463)	(7.916)
Pseudo R^2	0.203	0.309	0.437
Observations	4029	4029	4029

Notes: Standard errors are shown in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

4.7 Robustness checks

This study conducts several additional analyses to test whether the results generated from the baselines are robust.

4.7.1 Alternative model specifications

This study employed various estimation methods, including random effects model and mixed effects model (Multilevel Linear Regression Model), to run the robustness tests. Regression results in **Table 4.6** were highly consistent with the main findings, thereby confirming the robustness of the study.

It is worth emphasizing again that the fixed effect model was selected as the preferred research model based on the results of the Hausman test (p = 0.000). The alternative model here is used to test the robustness of the results of this study under other models.

Table 4.6 Random effects model and mixed effects model results

	Model 1 (random effects)	Model 2 (mixed effects)
Variables	*Innovation*	*Innovation*
GVC	7.884***	7.971***
	(1.233)	(1.254)
GVC squared	-0.280***	-0.286***
	(0.070)	(0.070)
S&E expenditure	83.899	122.208
	(57.549)	(65.949)
GDP	1.754	-0.678
	(1.608)	(2.257)
Financial convenience	4.935**	6.938**
	(1.690)	(2.919)
Consumption capability	-22.472***	-21.469***
	(12.472)	(12.018)
Urbanization	-12.441*	-19.339**
	(5.530)	(6.666)
Informatization	0.003***	0.003**
	(0.001)	(0.001)
Infrastructure	0.104	-0.725
	(0.815)	(1.029)
Living environment	-0.163	-0.085
	(0.224)	(0.224)
Constant	-80.899***	-84.552**
	(22.364)	(26.757)
City: var (_cons)		397.491
Year: var (_cons)		248.515
Residual: var (Residual)		44.458
R^2	0.303	
Observations	4029	4029

Notes: Standard errors are shown in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

4.7.2 Alternative measures of dependent variable

This study adopted one alternative dependent variable, regional patents, to test the robustness of the baseline model. The regional patents variable is defined as the number of patent applications per 10,000 people within the region. Patent data are sourced from CNRDS, including applications submitted by all institutions within the region, making this alternative variable distinct from, yet suitable for measuring, regional innovation as in the baseline model. **Table 4.7** report the estimation results after using the alternative dependent variable. The consistency of the result with the baseline model further confirms the robustness of this study.

Table 4.7 Estimation results after changing variables

	Alternative measures of DV
Variables	*Regional patents*
GVC	7.805***
	(0.676)
GVC squared	-0.317***
	(0.047)
S&E expenditure	-4.830
	(54.232)
GDP	-18.829***
	(3.765)
Financial convenience	0.911
	(1.960)
Consumption capability	-46.529***
	(7.369)
Urbanization	-60.806***
	(7.289)
Informatization	0.003**
	(0.001)
Infrastructure	-1.998**

	(0.711)
Living environment	-0.124
	(0.126)
Constant	245.406***
	(33.948)
Year fixed effect	Yes
City fixed effect	Yes
Adj-R^2	0.776
Observations	4029

Notes: Robust standard errors are shown in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

4.7.3 Endogeneity

This research may be subject to endogeneity issues, including potential reverse causality and omitted variable bias. Firstly, the level of regional innovation could influence the number of GVC funds established locally. Specifically, cities with well-developed innovation ecosystems tend to offer more investment opportunities and higher success probabilities, which may incentivize local governments to establish more GVC funds. Additionally, despite this study try to control for various variables, unobserved factors, such as administrative efficiency, salary level and housing prices, may still influence regional innovation, leading to omitted variable bias. To address potential endogeneity issues, this study applied a two-stage least squares regression (2SLS) model. This study adopted a total of four instrumental variables in the models. Inspired by Q. Du et al. (2024), this study used the lagged values of the independent variable, GVC, and its square term (GVC squared) as part of the instrumental variables. Moreover, this study selected a geographical variable of the cities—river length—as one of the instrumental variables in this study, since such geographical factors can influence institutional location choices but hardly affect innovation outcomes (W. Liu et al., 2024). Finally, data from cities designated as fintech pilot zones can also serve as an instrumental variable in this study. This pilot program is a crucial policy by the Chinese

government aimed at reforming financing channels, with a focus on advancing financial tools such as credit support, VC, capital market financing, and insurance services while this policy is not directly related to regional innovation.

Table 4.8 reports the results of the second stage, with Model 1 presenting results without control variables, while Model 2 includes them. This study found that the 2SLS estimation results align with the findings in the baselines. It is worth noting that in the first-stage results, whether control variables are included or not, a significant correlation is observed between the instrumental variables and the independent variable, which passes the 5% significance test. Additionally, this study assessed the quality of the instrumental variables through under-identification tests and weak identification tests. The results of the under-identification tests indicate that the instrumental variables are relevant level ($p \leq 0.001$) (Baum et al., 2007). The weak identification tests yielded a value of 17.326, which is above the 10% maximal instrumental variable size threshold (17.326 > 16.87), suggesting that weak instrumental variables are not a concern (Stock & Yogo, 2002). Therefore, the endogeneity issues in this study do not significantly affect the results.

Table 4.8 Two-stage least squares regression (2SLS) model results

	Model 1	Model 2
Variables	*Innovation*	*Innovation*
GVC	38.819***	26.333***
	(2.886)	(3.481)
GVC squared	-2.572***	-1.469***
	(0.362)	(0.368)
S&E expenditure		69.429*
		(33.967)
GDP		3.075*
		(1.481)
Financial convenience		-1.317

		(0.788)
Consumption capability		-23.897***
		(5.196)
Urbanization		-26.506***
		(5.398)
Informatization		0.004***
		(0.000)
Infrastructure		2.668***
		(0.176)
Living environment		-0.115
		(0.103)
Constant	-0.070	0.555
	(0.850)	(15.268)
F	543.62***	293.93***
Under identification test	100.603***	68.291***
Weak identification test	25.802	17.326
Observations	3792	3792

Notes: Standard errors are shown in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

4.8 Discussion and conclusions

This study explores the relationships between GVC presence and regional innovation. Using panel data from 237 cities in China from 2004 to 2021, this study identifies and confirms a significant inverted U-shaped relationship between GVC presence and regional innovation, with an inflection point at 14.768. This study also finds that the inverted U-shaped relationship between the GVC presence and regional innovation becomes flattened when local government experiences a high level of fiscal constraints, whereas this relationship is intensified in regions with abundant talent resources. The regional difference analysis reveals that the inverted U-shaped relationship is more pronounced in areas with lower levels of innovation. This research makes theoretical contributions and provides policy implications.

4.8.1 Theoretical contribution

The theoretical contributions of this study are multifaceted, rooted in its analysis of Chinese city-level panel data and the identification of a non-linear relationship between GVC presence and regional innovation. By integrating empirical findings with theoretical refinement, this study advances the literature in four key dimensions, addressing gaps in scope, mechanism, contextual embeddedness, and dynamic evolution.

First, this study expands the study scope of GVC innovation effects, which is from a 'fund-firm binary interaction to a 'Fund-firm-Region' value network system. Existing studies on GVC innovation effects primarily focus on micro-level firm dynamics, emphasizing how GVC embedding directly influences firms' absorptive capacity, knowledge spillovers, and innovation outcomes. While these works highlight GVC's role as a 'micro-innovation engine', they often overlook its systemic impacts at the regional scale—such as spatial spillovers and institutional interactions. This study shifts the analytical lens from a 'fund-firm' binary to a 'fund-firm-region' value network, leveraging city-level data to examine how GVC presence influences regional innovation as a system. Specifically, the city-level panel data enable us to capture GVC's spatial distribution and its systemic effects on regional innovation, rather than isolating individual firm performance. For instance, the observed inverted U-shaped relationship (with an inflection point at 14.768) suggests that beyond a critical threshold, GVC presence may trigger crowding-out effects. This finding transcends traditional firm-level analyses by revealing GVC's role as a 'spatial regulator' of innovation. Moreover, by situating GVC within China's 'strong government' context, this study reveals its function as a policy tool, that is local governments strategically deploy GVC funds to foster regional progress, extending the traditional 'fund-firm' VC model to a multi-level 'value transfer chain' that prioritizes regional development over individual firm growth.

Second, this study refines the non-linear relationship between GVC presence and regional innovation. A central debate in the GVC-innovation literature concerns whether GVC integration fosters or hinders innovation. This study resolves this ambiguity by demonstrating a significant inverted U-shaped relationship between GVC presence and regional innovation, conditional on contextual factors. Mechanistically, the inverted U-shape reflects a dynamic balance between GVC's innovation incentives and innovation costs. In early stages, GVC funds inject external capital and technology, activating local innovation inputs and generating spillover dividends. However, beyond the threshold, GVC expansion may induce resource misallocation due to the lack of supervision and crowd out other capital resources, while governments face diminishing returns on GVC supports, reducing regional innovation marginal benefits. This dual mechanism explains conflicting prior findings: positive effects often reflect early-stage GVC integration, while negative results stem from over-expansion. Contextually, this relationship is moderated by fiscal constraints and talent endowments. In regions with high fiscal constraints, limited government capacity to subsidize GVC weakens the innovation incentive curve (flattening the inverted U-shape). Conversely, talent-rich regions buffer against GVC risks, strengthening the upward phase by efficiently converting external GVC resources into endogenous innovation. These moderations emphasize GVC's innovation impact is not universal but contingent on institutional capacities and regional ecologies—an insight critical for emerging economies navigating 'government-market' dynamics.

4.8.2 Policy implications

The findings have significant implications for policymakers in emerging economies seeking to foster innovation through participation in VC initiatives. First, local governments should actively yet cautiously implement financing market participation strategies to maximize the innovation benefits of GVC. GVC has been shown to be a critical driver of

innovation, warranting serious consideration and involvement by authorities. However, this study suggests that the impact of GVC is not simply linear; rather, it features diminishing returns beyond a certain threshold. Therefore, policymakers must carefully calibrate the scale of GVC programs to ensure they remain within an optimal range, maximizing innovation outcomes.

Given heterogeneous impacts of GVC on regional innovation, differentiated strategies are essential. For regions with already high levels of innovation, policymakers should consider expanding GVC initiatives to further leverage their innovative capability. In contrast, for cities with relatively weaker innovation capabilities, a more cautious approach is necessary. While GVC can also serve as a channel to promote innovation in their cities, authorities must avoid the pitfalls of crowding out and resource misallocation that can arise from an overabundance of GVC projects.

In addition, it is crucial to develop talent attraction programs that can enhance the positive effects of GVC on innovation. These programs could include incentives such as settlement subsidies, tax breaks, and targeted training initiatives aimed at attracting and retaining highly skilled individuals. By strengthening the local talent pool, regions can better leverage GVC to drive sustained innovation growth. An integrated policy approach that combines GVC with targeted talent development and careful program calibration will be key to achieving the expected innovation outcomes in emerging economies.

4.8.3 Limitations and future research

This study has several limitations. First, the use of patent application counts as the measure of innovation may have biased against those regional that have less supportive patent application channels or those organizations that favour non-patent innovations such as basic research or patent commercialisations that require innovative business models and strategies.

However, without a comprehensive framework for regional innovation performance that should encompass not only patents as innovation outputs but also broader innovation inputs and innovation environments, patent data provides a systematic, comparable and reliable measures of regional innovation performance. In future research, Furthermore, for innovation outputs, it should be distinguished between various types of innovation (e.g., product, process, business model) and consider how GVC might differentially affect these. In general, future research could develop a more integrated innovation variable to test the findings, which may provide a more comprehensive view of regional innovation dynamics influenced by GVC.

Second, this study is based on data from China, which, despite being the largest and most representative emerging economy, may not fully capture the diversity of experiences across different developing nations. Just as findings from Western industrialized countries do not always generalize to the Chinese context, the impact of GVC observed in China may not necessarily apply to other developing countries without further empirical evidence. Future researchers are encouraged to replicate this study using cross-country data, which could not only facilitate the broader application of the Chinese experience but also reveal differences in how different emerging economies benefit from GVC during their development trajectories.

Third, the GVC variable constructed at the regional level in this study helps to observe its regional spillover effects. However, such a paradigm is not conducive to distinguishing the 'isolated effects' of different forms of capital on regional innovation. Due to the current difficulties in data collection and cleaning, this study provides this issue for future researchers to think about and supplement.

Lastly, while one of the key contributions of this study is the exploration of GVC's regional spillover effects, the focus has primarily been on innovation performance. Given that GVC initiatives are driven by government objectives, there may be additional goals that have

yet to be empirically tested, such as industrial development and employment growth. Future researchers should recognize that GVC's impact may not be uniform across sectors. High-tech and R&D-intensive sectors might respond differently to GVC investments compared to traditional industries. Future research could expand the scope to examine the broader regional impacts of GVC, thus providing a more comprehensive understanding of the multifaceted performance outcomes associated with government-driven VC programs.

References

Abrardi, L., Croce, A., & Ughetto, E. (2019). The dynamics of switching between governmental and independent venture capitalists: Theory and evidence. *Small Business Economics*, *53*(1), 165–188.

Agarwal, R., & Gort, M. (1996). The Evolution of Markets and Entry, Exit and Survival of Firms. *The Review of Economics and Statistics*, *78*(3), 489–498.

Aguilera, R. V., Aragón-Correa, J. A., Marano, V., & Tashman, P. A. (2021). The Corporate Governance of Environmental Sustainability: A Review and Proposal for More Integrated Research. *Journal of Management*, *47*(6), 1468–1497.

Akerlof, G. A. (1970). The Market for "Lemons": Quality Uncertainty and the Market Mechanism. *The Quarterly Journal of Economics*, *84*(3), 488–500.

Alperovych, Y., Groh, A., & Quas, A. (2020). Bridging the equity gap for young innovative companies: The design of effective government venture capital fund programs. *Research Policy*, *49*(10), 104051.

Alperovych, Y., Hübner, G., & Lobet, F. (2015). How does governmental versus private venture capital backing affect a firm's efficiency? Evidence from Belgium. *Journal of Business Venturing*, *30*(4), 508–525.

Alperovych, Y., Quas, A., & Standaert, T. (2018). Direct and indirect government venture capital investments in Europe. *Economics Bulletin*, *38*(2), 1219–1230.

Arrow, K. J. (1972). Economic Welfare and the Allocation of Resources for Invention. In C. K. Rowley (Ed.), *Readings in Industrial Economics* (pp. 219–236). Macmillan Education UK.

Audretsch, D. B., & Keilbach, M. (2008). Resolving the knowledge paradox: Knowledge-spillover entrepreneurship and economic growth. *Research Policy*, *37*(10), 1697–1705.

Awa, H. O., & Ojiabo, O. U. (2016). A model of adoption determinants of ERP within T-O-E framework. *Information Technology & People (West Linn, Or.)*, *29*(4), 901–930.

Bai, J. hong, Zhang, Y. xuan, & Bian, Y. chao. (2022). Does Innovation-driven Policy Increase Entrepreneurial Activity in Cities-Evidence from the National Innovative city Pilot Policy (创新驱动政策是否提升城市创业活跃度——来自国家创新型城市试点政策的经验证据). *China Industrial Economics (中国工业经济)*, *6*, 61–78.

Bai, J., Bernstein, S., Dev, A., & Lerner, J. (2021). *The dance between government and private investors: Public entrepreneurial finance around the globe*. National Bureau of Economic Research. https://www.nber.org/papers/w28744

Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, *17*(1), 99–120.

Baum, C. F., Schaffer, M. E., & Stillman, S. (2007). Enhanced Routines for Instrumental Variables/Generalized Method of Moments Estimation and Testing. *The Stata Journal*, *7*(4), 465–506.

Bertoni, F., Colombo, M. G., & Quas, A. (2015). The patterns of venture capital investment in Europe. *Small Business Economics*, *45*(3), 543–560.

Bertoni, F., Colombo, M. G., & Quas, A. (2019). The Role of Governmental Venture Capital in the Venture Capital Ecosystem: An Organizational Ecology Perspective. *Entrepreneurship Theory and Practice*, *43*(3), 611–628.

Bertoni, F., & Tykvová, T. (2015). Does governmental venture capital spur invention and innovation? Evidence from young European biotech companies. *Research Policy*, *44*(4), 925–935.

Brander, J. A., Du, Q., & Hellmann, T. (2015). The Effects of Government-Sponsored Venture Capital: International Evidence*. *Review of Finance*, *19*(2), 571–618.

Brander, J. A., Egan, E., & Hellmann, T. F. (2010). Government sponsored versus private venture capital: Canadian evidence. In *International differences in entrepreneurship* (pp. 275–320). University of Chicago Press. https://www.nber.org/system/files/chapters/c8226/c8226.pdf

Branstetter, L. G., & Sakakibara, M. (2002). When Do Research Consortia Work Well and Why? Evidence from Japanese Panel Data. *The American Economic Review*, *92*(1), 143–159.

Breschi, S., Johnstone, N., & Menon, C. (2022). Are start-ups funded by public venture capital different? New cross-country evidence from micro-data. *Industrial and Corporate Change*, *30*(6), 1615–1632.

Brien, S. T., Eger, R. J., & Matkin, D. S. T. (2021). The Timing of Managerial Responses to Fiscal Stress. *Public Administration Review*, *81*(3), 414–427.

Bruton, G. D., & Ahlstrom, D. (2003). An institutional view of China's venture capital industry: Explaining the differences between China and the West. *Journal of Business Venturing*, *18*(2), 233–259.

Buzzacchi, L., Scellato, G., & Ughetto, E. (2013). The investment strategies of publicly sponsored venture capital funds. *Journal of Banking & Finance*, *37*(3), 707–716.

Cai, H., & Treisman, D. (2006). Did Government Decentralization Cause China's Economic Miracle? *World Politics*, *58*(4), 505–535.

Cai, Y., & Feng, W. (2021). The Social and Sociological Consequences of China's One-Child Policy. *Annual Review of Sociology*, *47*(1), 587–606.

Caragliu, A., & Del Bo, C. F. (2019). Smart innovative cities: The impact of Smart City policies on urban innovation. *Technological Forecasting & Social Change*, *142*, 373–383.

Cecere, G., Corrocher, N., & Mancusi, M. L. (2020). Financial constraints and public funding of eco-innovation: Empirical evidence from European SMEs. *Small Business Economics*, *54*(1), 285–302.

Chen, J. (2023). Venture capital research in China: Data and institutional details. *Journal of Corporate Finance (Amsterdam, Netherlands)*, *81*, 102239-.

Chen, J., Heng, C. S., Tan, B. C. Y., & Lin, Z. (2018). The distinct signaling effects of R&D subsidy and non-R&D subsidy on IPO performance of IT entrepreneurial firms in China. *Research Policy*, *47*(1), 108–120.

Chen, J., Li, Y., Xu, Y., Vardanyan, M., Shen, Z., & Song, M. (2023). The impact of fiscal technology expenditures on innovation drive and carbon emissions in China. *Technological Forecasting & Social Change*, *193*, 122631-.

Chen, Y., Jiang, M., & Kesten, O. (2020). An empirical evaluation of Chinese college admissions reforms through a natural experiment. *Proceedings of the National Academy of Sciences - PNAS*, *117*(50), 31696–31705.

Chen, Y., Peng, Z., Peng, C., & Xu, W. (2023). Impact of new government–business relations on urban digital economy: Empirical evidence from China. *Finance Research Letters*, *58*, 104325-.

Chen, Z., Li, M., & Zhang, M. (2025). The Effect of Housing Prices on Urban Innovation Capability: New Evidence From 246 Chinese Cities. *The American Journal of Economics and Sociology*, *84*(2), 427–440.

Cheng, S. (1999). Actively and steadily promote the venture capital industry in China. *Manage. World*, *1999*(1), 2–7.

Chung, S. (2002). Building a national innovation system through regional innovation systems. *Technovation*, *22*(8), 485–491.

Colombo, M. G., Cumming, D. J., & Vismara, S. (2016). Governmental venture capital for innovative young firms. *The Journal of Technology Transfer*, *41*(1), 10–24.

Connelly, B. L., Certo, S. T., Ireland, R. D., & Reutzel, C. R. (2011). Signaling Theory: A Review and Assessment. *Journal of Management*, *37*(1), 39–67.

Cooke, P., Uranga, M. G., & Etxebarria, G. (1997). Regional innovation systems: Institutional and organisational dimensions. *Research Policy*, *26*(4–5), 475–491.

Couture, V., & Handbury, J. (2020). Urban revival in America. *Journal of Urban Economics*, *119*, 103267-.

Criscuolo, C. (2014). *The Dynamics of Employment Growth: New Evidence from 18 Countries*. https://www.oecd-ilibrary.org/content/paper/5jz417hj6hg6-en

Croce, A., Martí, J., & Murtinu, S. (2013). The impact of venture capital on the productivity growth of European entrepreneurial firms: 'Screening' or 'value added' effect? *Journal of Business Venturing*, *28*(4), 489–510.

Croce, A., Martí, J., & Reverte, C. (2019). The role of private versus governmental venture capital in fostering job creation during the crisis. *Small Business Economics*, *53*(4), 879–900.

Cruz-Jesus, F., Pinheiro, A., & Oliveira, T. (2019). Understanding CRM adoption stages: Empirical analysis building on the TOE framework. *Computers in Industry*, *109*, 1–13.

Cull, R., Li, W., Sun, B., & Xu, L. C. (2015). Government connections and financial constraints: Evidence from a large representative sample of Chinese firms. *Journal of Corporate Finance*.

Cumming, D. (2007). Government policy towards entrepreneurial finance: Innovation investment funds. *Journal of Business Venturing*, *22*(2), 193–235.

Cumming, D. (2014). Public economics gone wild: Lessons from venture capital. *International Review of Financial Analysis*, *36*, 251–260.

Cumming, D. J., Grilli, L., & Murtinu, S. (2017). Governmental and independent venture capital investments in Europe: A firm-level performance analysis. *Journal of Corporate Finance (Amsterdam, Netherlands)*, *42*, 439–459.

Cumming, D. J., & MacIntosh, J. G. (2006). Crowding out private equity: Canadian evidence. *Journal of Business Venturing*, *21*(5), 569–609.

Cumming, D. J., & MacIntosh, J. G. (2007). *Mutual Funds that Invest in Private Equity? An Analysis of Labour-Sponsored Investment Funds*.

Cumming, D., & Johan, S. (2009). Pre-seed government venture capital funds. *Journal of International Entrepreneurship*, *7*(1), 26–56.

CVINFO. (2020). *2020 Government Guidance Fund Special Research Report*. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://pic.chinaventure.com.cn/reportFiles/6733227582554112.pdf

CVINFO. (2022). *2021 Government Guidance Fund Special Research Report*. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://pic.chinaventure.com.cn/reportFiles/6890967722360832.pdf

CVINFO. (2023). *2023 Government Guidance Fund Special Research Report*. https://pic.chinaventure.com.cn/reportFiles/7137700947689472.pdf

Dang, Q. T., Jasovska, P., & Rammal, H. G. (2020). International business-government relations: The risk management strategies of MNEs in emerging economies. *Journal of World Business : JWB*, *55*(1), 101042-.

del-Palacio, I., Zhang, X. T., & Sole, F. (2012). The capital gap for small technology companies: Public venture capital to the rescue? *Small Business Economics*, *38*(3), 283–301.

Del Sarto, N., Cruz Cazares, C., & Di Minin, A. (2022). Startup accelerators as an open environment: The impact on startups' innovative performance. *Technovation*, *113*, 102425-.

Devarakonda, R., & Liu, A. (2024). A legitimacy-based view of the impact of government venture capital on startup innovation: Evidence from a transition economy. *Strategic Entrepreneurship Journal*, *18*(1), 55–90.

Dong, W., Li, Y., Lv, X., & Yu, C. (2021). How does venture capital spur the innovation of environmentally friendly firms? Evidence from China. *Energy Economics*, *103*, 105582.

Drover, W., Busenitz, L., Matusik, S., Townsend, D., Anglin, A., & Dushnitsky, G. (2017). A Review and Road Map of Entrepreneurial Equity Financing Research: Venture Capital, Corporate Venture Capital, Angel Investment, Crowdfunding, and Accelerators. *Journal of Management*, *43*(6), 1820–1853.

Du, Q., Li, Z., Du, M., & Yang, T. (2024). Government venture capital and innovation performance in alternative energy production: The moderating role of environmental regulation and capital market activity. *Energy Economics*, *129*, 107196.

Du, Y., & Kim, P. H. (2021). One size does not fit all: Strategy configurations, complex environments, and new venture performance in emerging economies. *Journal of Business Research*, *124*, 272–285.

Du, Y., Liu, Q., Chen, K., Xiao, R., & Li, S. (2022). Ecosystem of Doing Business, Total Factor Productivity and Multiple Patterns of High-quality Development of Chinese Cities: A Configuration Analysis Based on Complex Systems View. *Journal of Management World*, *9*, 127–144.

Duanmu, J., Bu, M., & Pittman, R. (2018). Does market competition dampen environmental performance? Evidence from China. *Strategic Management Journal*, *39*(11), 3006–3030.

Dul, J. (2016). Necessary Condition Analysis (NCA): Logic and Methodology of "Necessary but Not Sufficient" Causality. *Organizational Research Methods*, *19*(1), 10–52.

Dul, J., Van Der Laan, E., & Kuik, R. (2020). A Statistical Significance Test for Necessary Condition Analysis. *Organizational Research Methods*, *23*(2), 385–395.

Eagly, A. H. (2013). *Sex differences in social behavior: A social-role interpretation*. Psychology Press.

https://www.taylorfrancis.com/books/mono/10.4324/9780203781906/sex-differences-social-behavior-alice-eagly

Eagly, A. H., & Karau, S. J. (2002). Role Congruity Theory of Prejudice Toward Female Leaders. *Psychological Review*, *109*(3), 573–598.

Eagly, A. H., Woo, W., & Diekman, A. B. (2000). Social Role Theory of Sex Differences and Similarities: A Current Appraisal. In *The Developmental Social Psychology of Gender* (1st ed., pp. 123–174). Psychology Press.

Edeh, J., & Prévot, F. (2024). Beyond funding: The moderating role of firms' R&D human capital on government support and venture capital for regional innovation in China. *Technological Forecasting & Social Change*, *203*, 123351-.

Engberg, E., Tingvall, P. G., & Halvarsson, D. (2021). Direct and indirect effects of private- and government-sponsored venture capital. *Empirical Economics*, *60*(2), 701–735.

Fainshmidt, S., Smith, A. W., & Aguilera, R. V. (2022). Where Do Born Globals Come from? A Neoconfigurational Institutional Theory. *Organization Science (Providence, R.I.)*, *33*(4),

Fan, F., Dai, S., Zhang, K., & Ke, H. (2021). Innovation agglomeration and urban hierarchy: Evidence from Chinese cities. *Applied Economics*, *53*(54), 6300–6318.

Fan, F., Lian, H., Liu, X., & Wang, X. (2021). Can environmental regulation promote urban green innovation Efficiency? An empirical study based on Chinese cities. *Journal of Cleaner Production*, *287*, 125060-.

Fan, F., Lian, H., & Wang, S. (2020). Can regional collaborative innovation improve innovation efficiency? An empirical study of Chinese cities. *Growth and Change*, *51*(1), 440–463.

Fang, L., Lerner, J., Wu, C., & Zhang, Q. (2018). *Corruption, government subsidies, and innovation: Evidence from China*. National Bureau of Economic Research. https://www.nber.org/papers/w25098

Festinger, L. (1957). *A Theory of Cognitive Dissonance*. Stanford University Press. https://www.sup.org/books/sociology/theory-cognitive-dissonance

Fiss, P. C. (2007). A Set-Theoretic Approach to Organizational Configurations. *The Academy of Management Review*, *32*(4), 1180–1198.

Fiss, P. C. (2011). BUILDING BETTER CAUSAL THEORIES: A FUZZY SET APPROACH TO TYPOLOGIES IN ORGANIZATION RESEARCH. *Academy of Management Journal*, *54*(2), 393–420.

Florida, R. L., & Kenney, M. (1988). Venture capital-financed innovation and technological change in the USA. *Research Policy*, *17*(3), 119–137.

Foss, N. J., & Saebi, T. (2017). Fifteen Years of Research on Business Model Innovation: How Far Have We Come, and Where Should We Go? *Journal of Management*, *43*(1), 200–227.

Fu, H., Xu, M., Wu, Y., & Wang, W. (2024). What facilitates frugal innovation? – A configurational study on the antecedent conditions using fsQCA. *Journal of Innovation & Knowledge*, *9*(3), 100522-.

Fu, X. M., Harrison, R. T., & Li, D. F. (2022). Venture capital investment in university spin-offs: Evidence from an emerging economy. *Journal of Corporate Finance*, *74*, 102197.

Furnari, S., Crilly, D., Misangyi, V. F., Greckhamer, T., Fiss, P. C., & Aguilera, R. V. (2021). Capturing Causal Complexity: Heuristics for Configurational Theorizing. *Academy of Management Review*, *46*(4), 778–799.

Gao, J., Kong, D., & Kong, G. (2019). Who Secures Job Opportunities in the Chinese Government? Evidence Based on the First Jobs of Graduates from a Chinese College. *Pacific Economic Review (Oxford, England)*, *24*(3), 447–463.

Gao, S., Wang, S., & Sun, D. (2021). Development zones and their surrounding host cities in China: Isolation and mutually beneficial interactions. *Land*, *11*(1), 20.

Gao, Y., Hu, Y., Liu, X., & Zhang, H. (2021). Can public R&D subsidy facilitate firms' exploratory innovation? The heterogeneous effects between central and local subsidy programs. *Research Policy*, *50*(4), 104221-.

Ge, G., Xue, J., & Zhang, Q. (2024). Industrial policy and governmental venture capital: Evidence from China. *Journal of Corporate Finance*, *84*, 102532.

George, G., & Prabhu, G. N. (2000). Developmental Financial Institutions as Catalysts of Entrepreneurship in Emerging Economies. *The Academy of Management Review*, *25*(3), 620–629.

Gong, X., Li, L., Yao, N., & Guo, Q. (2024). Configurational paths of entrepreneurial activity: An analysis based on the technology–organization–environment framework. *The American Journal of Economics and Sociology*, *83*(4), 831–854.

Greckhamer, T., Furnari, S., Fiss, P. C., & Aguilera, R. V. (2018). Studying configurations with qualitative comparative analysis: Best practices in strategy and organization research. *Strategic Organization*, *16*(4), 482–495.

Grigorieva, S., & Kuzmina, S. (2019). Post-acquisition Value Effects of M&A Deals: A Comparative Analysis in Developed and Emerging Capital Markets. In *Strategic Deals in Emerging Capital Markets* (pp. 113–135). Springer International Publishing.

Grilli, L., & Murtinu, S. (2014). Government, venture capital and the growth of European high-tech entrepreneurial firms. *Research Policy*, *43*(9), 1523–1543.

Grilli, L., & Murtinu, S. (2015). New technology-based firms in Europe: Market penetration, public venture capital, and timing of investment. *Industrial and Corporate Change*, *24*(5), 1109–1148.

Grossmann, A., Mooney, L., & Dugan, M. (2019). Inclusion fairness in accounting, finance, and management: An investigation of A-star publications on the ABDC journal list. *Journal of Business Research*, *95*, 232–241.

Gu, W., & Qian, X. (2019). Does venture capital foster entrepreneurship in an emerging market? *Journal of Business Research*, *101*, 803–810.

Gu, W., Qian, X., & Lu, J. (2018). Venture capital and entrepreneurship: A conceptual model and research suggestions. *International Entrepreneurship and Management Journal*, *14*(1), 35–50.

Guerini, M., & Quas, A. (2016). Governmental venture capital in Europe: Screening and certification. *Journal of Business Venturing*, *31*(2), 175–195.

Guo, H., Guo, A., & Ma, H. (2022). Inside the black box: How business model innovation contributes to digital start-up performance. *Journal of Innovation & Knowledge*, *7*(2), 100188-.

Gupta, R., & Shukla, A. (2020). Evaluation of Factors That Affect Venture Capital Investment: Evidence from India. *Global Business Review*, 97215092097034-.

Haans, R. F. J., Pieters, C., & He, Z. (2016). Thinking about U: Theorizing and testing U - and inverted U -shaped relationships in strategy research. *Strategic Management Journal*, *37*(7), 1177–1195.

han, J., Chen, Z., Zeeshan, M., Rehman, A., Ullah, I., & Sarwar, S. (2024). The influence of civilized city honorary title on the urban innovation capacity. *Environment, Development and Sustainability*, *26*(8), 20841–20867.

Hao, Y., Gai, Z., & Wu, H. (2020). How do resource misallocation and government corruption affect green total factor energy efficiency? Evidence from China. *Energy Policy*, *143*, 111562-.

Harjoto, M. A., Rossi, F., Lee, R., & Sergi, B. S. (2021). How do equity markets react to COVID-19? Evidence from emerging and developed countries. *Journal of Economics and Business*, *115*, 105966-.

Hong, J., Feng, B., Wu, Y., & Wang, L. (2016). Do government grants promote innovation efficiency in China's high-tech industries? *Technovation*, *57–58*, 4–13.

Hottenrott, H., & Richstein, R. (2020). Start-up subsidies: Does the policy instrument matter? *Research Policy*, *49*(1), 103888-.

Hu, S., Cang, Y., Jie, Y., Wang, X., & Weng, L. (2024). How Business–Government Relationships Drive Digital Innovation and Entrepreneurship: A Study of 292 Cities in China Using NCA and TDQCA. *Sustainability*, *16*(16), 6718-.

Huang, Y., Li, K., & Li, P. (2023). Innovation ecosystems and national talent competitiveness: A country-based comparison using fsQCA. *Technological Forecasting & Social Change*, *194*, 122733-.

Huang, Z., Liao, G., & Li, Z. (2019). Loaning scale and government subsidy for promoting green innovation. *Technological Forecasting & Social Change*, *144*, 148–156.

Inoue, C. F. K. V., Lazzarini, S. G., & Musacchio, A. (2013). Leviathan as a Minority Shareholder: Firm-Level Implications of State Equity Purchases. *Academy of Management Journal*, *56*(6), 1775–1801.

Invest Europe. (2019). European private equity activity report 2018. *European Data Cooporative*.

Islam, M., Fremeth, A., & Marcus, A. (2018). Signaling by early stage startups: US government research grants and venture capital funding. *Journal of Business Venturing*, *33*(1), 35–51.

Jääskeläinen, M., Maula, M., & Murray, G. (2007). Profit distribution and compensation structures in publicly and privately funded hybrid venture capital funds. *Research Policy*, *36*(7), 913–929.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, *3*(4), 305–360.

Jia, J., Yuan, S., Wei, L.-Q., & Tang, G. (2023). When firms adopt sustainable human resource management: A fuzzy-set analysis. *Human Resource Management*, *62*(3), 283–305.

Jiang, X., Fu, W., & Li, G. (2020). Can the improvement of living environment stimulate urban Innovation?——Analysis of high-quality innovative talents and foreign direct investment spillover effect mechanism. *Journal of Cleaner Production*, *255*, 120212-.

Jiao, J., Zhang, X., & Tang, Y. (2020). What factors determine the survival of green innovative enterprises in China? -- A method based on fsQCA. *Technology in Society*, *62*, 101314–101314.

Jin, H., Li, B., & Jakovljevic, M. (2022). How China controls the Covid-19 epidemic through public health expenditure and policy? *Journal of Medical Economics*, *25*(1), 437–449.

Johan, S., Schweizer, D., & Zhan, F. (2014). The Changing Latitude: Labor-Sponsored Venture Capital Corporations in C anada. *Corporate Governance: An International Review*, *22*(2), 145–161.

Johansson, J., Malmström, M., Wincent, J., & Parida, V. (2021). How individual cognitions overshadow regulations and group norms: A study of government venture capital decisions. *Small Business Economics*, *56*(2), 857–876.

Juntao, L., & Haitao, L. (2023). Government-business Relationship and Strategic Transformation of Enterprises: Evidence from China. *Finance Research Letters*, *58*, 104614-.

Karlstrøm, B., Jansen, T. M., & Solheim, M. C. (2024). Talking with venture capitalists: Gender perceptions in investment decisions. *International Journal of Entrepreneurial Behaviour & Research*, *30*(7), 1867–1893.

Kashif, M., Iftikhar, S. F., & Iftikhar, K. (2016). Loan growth and bank solvency: Evidence from the Pakistani banking sector. *Financial Innovation (Heidelberg)*, *2*(22), 1–13.

Kleer, R. (2010). Government R&D subsidies as a signal for private investors. *Research Policy*, *39*(10), 1361–1374.

Kogan, L., Papanikolaou, D., Seru, A., & Stoffman, N. (2017). TECHNOLOGICAL INNOVATION, RESOURCE ALLOCATION, AND GROWTH. *The Quarterly Journal of Economics*, *132*(2), 665–712.

Kong, Q., Li, R., Peng, D., & Wong, Z. (2021). High-technology development zones and innovation in knowledge-intensive service firms: Evidence from Chinese A-share listed firms. *International Review of Financial Analysis*, *78*, 101883-.

Kovner, A., & Lerner, J. (2015). Doing Well by Doing Good? Community Development Venture Capital. *Journal of Economics & Management Strategy*, *24*(3), 643–663.

Kraus, S., Ribeiro-Soriano, D., & Schüssler, M. (2018). Fuzzy-set qualitative comparative analysis (fsQCA) in entrepreneurship and innovation research–the rise of a method. *International Entrepreneurship and Management Journal*, *14*, 15–33.

Lam, W. (2010). Funding gap, what funding gap? Financial bootstrapping: Supply, demand and creation of entrepreneurial finance. *International Journal of Entrepreneurial Behaviour & Research*, *16*(4), 268–295.

Lazonick, W., & Tulum, Ö. (2011). US biopharmaceutical finance and the sustainability of the biotech business model. *Research Policy*, *40*(9), 1170–1187.

Lee, K., Oh, F. D., Shin, D., & Yoon, H. (2023). Does venture capital investment enhance corporate innovation? Evidence from Korea. *Journal of Business Finance & Accounting*, *50*(1–2), 236–266.

Leleux, B., & Surlemont, B. (2003). Public versus private venture capital: Seeding or crowding out? A pan-European analysis. *Journal of Business Venturing*, *18*(1), 81–104.

Lerner, J. (2002). When Bureaucrats Meet Entrepreneurs: The Design of Effective `Public Venture Capital' Programmes. *The Economic Journal*, *112*(477), F73–F84.

Lerner, J. (2009). *Boulevard of broken dreams: Why public efforts to boost entrepreneurship and venture capital have failed and what to do about it* (Course Book). University Press.

Lerner, J. (2010). The future of public efforts to boost entrepreneurship and venture capital. *Small Business Economics*, *35*(3), 255–264.

Lerner, J., & Nanda, R. (2020). Venture Capital's Role in Financing Innovation: What We Know and How Much We Still Need to Learn. *The Journal of Economic Perspectives*, *34*(3), 237–261.

Lerner, J., & Watson, B. (2008). The public venture capital challenge: The Australian case. *Venture Capital (London)*, *10*(1), 1–20.

Li, J., & Li, B. (2022). Digital inclusive finance and urban innovation: Evidence from China. *Review of Development Economics*, *26*(2), 1010–1034.

Li, L., & Che, W. (2024). Internal logic and driving path of enterprise green innovation performance improvement under TOE framework: Based on linkage effect analysis of fsQCA and NCA. *Environment, Development and Sustainability*.

Li, T., Luo, J.-D., & Zheng, E. (2024). Revolving around political connections: The negative effect of government venture capital backing on IPO valuation. *Socio-Economic Review*, *22*(1), 395–440.

Li, Z., Chen, H., & Mo, B. (2023). Can digital finance promote urban innovation? Evidence from China. *Borsa Istanbul Review*, *23*(2), 285–296.

Li, Z., Pang, S., & Zhu, Z. (2024). The impact of pilot free trade zones on entrepreneurship: Evidence from a quasi-natural experiment in China. *Socio-Economic Planning Sciences*, *92*, 101801-.

Liang, Y., Xiong, C., & Zhang, B. (2025). Science and technology fiscal expenditure and urban green innovation——Mechanism analysis based on Fintech. *Applied Economics Letters*, 1–8.

Lim, S., & Kim, Y. (2015). How to Design Public Venture Capital Funds: Empirical Evidence from South Korea. *Journal of Small Business Management*, *53*(4), 843–867.

Lind, J. T., & Mehlum, H. (2010). With or Without U? The Appropriate Test for a U-Shaped Relationship*: Practitioners' Corner. *Oxford Bulletin of Economics and Statistics*, *72*(1), 109–118.

Link, A. N., & Scott, J. T. (2010). Government as entrepreneur: Evaluating the commercialization success of SBIR projects. *Research Policy*, *39*(5), 589–601.

Lins, E., & Lutz, E. (2016). Bridging the gender funding gap: Do female entrepreneurs have equal access to venture capital? *International Journal of Entrepreneurship and Small Business*, *27*(2–3), 347–365.

Liu, F., Simon, D. F., Sun, Y., & Cao, C. (2011). China's innovation policies: Evolution, institutional structure, and trajectory. *Research Policy*, *40*(7), 917–931.

Liu, W., Li, W. H., Yang, J. Y., & Zheng, L. J. (2024). Geographical proximity, foreign presence and domestic firm innovation: The micro-level evidence. *Regional Studies*, *58*(4), 787–804.

Liu, Y., Wu, Y., & Zhu, X. (2023). Development zones and firms' performance: The impact of development zones on firms' performance for a Chinese industrial cluster. *Regional Studies*, *57*(5), 868–879.

Lou, S., Yao, C., & Zhang, D. (2023). How to promote green innovation of high-pollution firms? A fuzzy-set QCA approach based on the TOE framework. *Environment, Development and Sustainability*.

Lu, F., Zhu, Z., Zhu, L., & Gao, H. (2022). Political tie hot potato: The contingent effect of China's anti-corruption policy on cash and innovation. *Research Policy*, *51*(4), 104476-.

Lu, H., Tan, Y., & Huang, H. (2013). Why do venture capital firms exist: An institution-based rent-seeking perspective and Chinese evidence. *Asia Pacific Journal of Management*, *30*(3), 921–936.

Luo, J.-D., Rong, K., Yang, K., Guo, R., & Zou, Y. (2019). Syndication through social embeddedness: A comparison of foreign, private and state-owned venture capital (VC) firms. *Asia Pacific Journal of Management*, *36*(2), 499–527.

Luukkonen, T., Deschryvere, M., & Bertoni, F. (2013). The value added by government venture capital funds compared with independent venture capital funds. *Technovation*, *33*(4–5), 154–162.

Ma, T., Cao, X., & Zhao, H. (2023). Development zone policy and high-quality economic growth: Quasi-natural experimental evidence from China. *Regional Studies*, *57*(3), 590–605.

Malik, S., Chadhar, M., Vatanasakdakul, S., & Chetty, M. (2021). Factors Affecting the Organizational Adoption of Blockchain Technology: Extending the Technology–Organization–Environment (TOE) Framework in the Australian Context. *Sustainability*, *13*(16), 9404-.

Malmström, M., Johansson, J., & Wincent, J. (2017). Gender Stereotypes and Venture Support Decisions: How Governmental Venture Capitalists Socially Construct Entrepreneurs' Potential. *Entrepreneurship Theory and Practice*, *41*(5), 833–860.

Marquis, C., & Bird, Y. (2018). The Paradox of Responsive Authoritarianism: How Civic Activism Spurs Environmental Penalties in China. *Organization Science*, *29*(5), 948–968.

Mason, C., & Brown, R. (2013). Creating good public policy to support high-growth firms. *Small Business Economics*, *40*(2), 211–225.

Meuleman, M., & De Maeseneire, W. (2012). Do R&D subsidies affect SMEs' access to external financing? *Research Policy*, *41*(3), 580–591.

Miao, Z., & Zhao, G. (2023). Configurational paths to the green transformation of Chinese manufacturing enterprises: A TOE framework based on the fsQCA and NCA approaches. *Scientific Reports*, *13*(1), 19181–19181.

Miguelez, E., & Moreno, R. (2018). Relatedness, external linkages and regional innovation in Europe: Reg. Stud. *Regional Studies*, *52*(5), 688–701.

Minola, T., Vismara, S., & Hahn, D. (2017). Screening model for the support of governmental venture capital. *The Journal of Technology Transfer*, *42*(1), 59–77.

Misangyi, V. F., & Acharya, A. G. (2014). Substitutes or Complements? A Configurational Examination of Corporate Governance Mechanisms. *Academy of Management Journal*, *57*(6), 1681–1705.

Mkhaiber, A., & Werner, R. A. (2021). The relationship between bank size and the propensity to lend to small firms: New empirical evidence from a large sample. *Journal of International Money and Finance*, *110*, 102281-.

Moore, I., & Garnsey, E. (1993). Funding for innovation in small firms: The role of government. *Research Policy*, *22*(5–6), 507–519.

Munari, F., & Toschi, L. (2015). Assessing the impact of public venture capital programmes in the United Kingdom: Do regional characteristics matter? *Journal of Business Venturing*, *30*(2), 205–226.

Murray, G. (2021). Ten meditations on government venture capital. *Venture Capital (London)*, *23*(3), 205–227.

Murray, G., Cowling, M., & Liu, W. (2010). *An independent econometric analysis of the "Innovation Investment Fund" Programme (IIF) of the Australian Commonwealth Government: Findings and implications*. https://ore.exeter.ac.uk/repository/handle/10036/3175

Murtinu, S. (2021). The government whispering to entrepreneurs: Public venture capital, policy shifts, and firm productivity. *Strategic Entrepreneurship Journal*, *15*(2), 279–308.

North, D. C. (1990). *Institutions, institutional change, and economic performance*. Cambridge University Press.

OECD. (1997). *Government venture capital for technology-based firms*. OECD Paris.

Owen, R. (2023). Lessons From Government Venture Capital Funds to Enable Transition to a Low-Carbon Economy: The U.K. Case. *IEEE Transactions on Engineering Management*, *70*(3), 1040–1054.

Ozgen, S., Mooney, A., & Zhou, Y. (2024). CEO Power: A Review, Critique, and Future Research Directions. *Journal of Management*, 01492063241241302.

Pahnke, E. C., Katila, R., & Eisenhardt, K. M. (2015). Who Takes You to the Dance? How Partners' Institutional Logics Influence Innovation in Young Firms. *Administrative Science Quarterly*, *60*(4), 596–633.

Pappas, I. O., & Woodside, A. G. (2021). Fuzzy-set Qualitative Comparative Analysis (fsQCA): Guidelines for research practice in Information Systems and marketing. *International Journal of Information Management*, *58*, 102310-.

Park, G., Shin, S. R., & Choy, M. (2020). Early mover (dis)advantages and knowledge spillover effects on blockchain startups' funding and innovation performance. *Journal of Business Research*, *109*, 64–75.

Pergelova, A., & Angulo-Ruiz, F. (2014). The impact of government financial support on the performance of new firms: The role of competitive advantage as an intermediate outcome. *Entrepreneurship & Regional Development*, *26*(9–10), 663–705.

Pierrakis, Y., & Saridakis, G. (2017). Do publicly backed venture capital investments promote innovation? Differences between privately and publicly backed funds in the UK venture capital market. *Journal of Business Venturing Insights*, *7*, 55–64.

Podgorodnichenko, N., Edgar, F., & McAndrew, I. (2020). The role of HRM in developing sustainable organizations: Contemporary challenges and contradictions. *Human Resource Management Review*, *30*(3), 100685-.

Polzin, F., Sanders, M., & Serebriakova, A. (2021). Finance in global transition scenarios: Mapping investments by technology into finance needs by source. *Energy Economics*, *99*, 105281.

Ragin, C. C. (2000). *Fuzzy-set social science*. University of Chicago Press. https://books.google.com/books?hl=zh-CN&lr=&id=nZC2dLUH-OAC&oi=fnd&pg=PA1&dq=Fuzzy-set+Social+Science&ots=9QlN2TuD_w&sig=2kX4qF1QNqEqBpFjmn2HrnbBKXc

Ragin, C. C. (2008a). *Redesigning social inquiry: Fuzzy sets and beyond*. University of Chicago Press.

Ragin, C. C. (2008b). User's guide to fuzzy-set/qualitative comparative analysis. *Department of Sociology, University of Arizona*.

Rao, G. N., Williams, J. R., Walsh, M., & Moore, J. (2017). America's Seed Fund: How the SBIR/STTR Programs Help Enable Catalytic Growth and Technological Advances. *Technology and Innovation*, *18*(4), 315–318.

Redine, A., Deshpande, S., Jebarajakirthy, C., & Surachartkumtonkun, J. (2023). Impulse buying: A systematic literature review and future research directions. *International Journal of Consumer Studies*, *47*(1), 3–41.

Rihoux, B., & Ragin, C. C. (2009). *Configurational comparative methods: Qualitative comparative analysis (QCA) and related techniques* (Vol. 51). Sage. https://books.google.com/books?hl=zh-CN&lr=&id=sAcIYzgO3nkC&oi=fnd&pg=PR1&dq=configurational+comparative+methods&ots=u_VLh80_tF&sig=gVRLyDiPiuMViA6ZrRhA2NGROYY

Rodell, J. B., Breitsohl, H., Schröder, M., & Keating, D. J. (2016). Employee Volunteering: A Review and Framework for Future Research. *Journal of Management*, *42*(1), 55–84.

Romer, P. M. (1990). Endogenous Technological Change. *Journal of Political Economy*, *98*(5, Part 2), S71–S102.

Roszkowska-Menkes, M. (2023). Institutional Theory. In S. O. Idowu, R. Schmidpeter, N. Capaldi, L. Zu, M. Del Baldo, & R. Abreu (Eds.), *Encyclopedia of Sustainable Management* (pp. 1983–1990). Springer International Publishing.

Ryan, T. P. (2008). *Modern regression methods* (Vol. 655). John Wiley & Sons. https://books.google.com/books?hl=zh-CN&lr=&id=ed_JPj2pqbMC&oi=fnd&pg=PA1&dq=Ryan,+T.+P.+(1997).+Modern+regression+analysis&ots=UDqi6_qXNB&sig=uHGWcbpa6MpEW6Ss2hlIVoIl2zs

Schneider, C. Q. (with Wagemann, C.). (2012). *Set-theoretic methods for the social sciences: A guide to qualitative comparative analysis*. University Press.

Scott, W. R. (1995). Institutions and organizations. Foundations for organizational science. *London: A Sage Publication Series*.

Scott, W. R. (2013). *Institutions and organizations: Ideas, interests, and identities*. Sage publications. https://books.google.com/books?hl=zh-CN&lr=&id=NbQgAQAAQBAJ&oi=fnd&pg=PP1&dq=Institutions+and+organizations&ots=hHPcjJlnUB&sig=JPdR6ZS4Qh4oYgCtEzUoBXwIMc4

Shanxi Audit. (2024). *Audit report on the implementation of the provincial budget and other fiscal revenue and expenditure in Shanxi Province in 2023 (关于２０２３年度省本级预算执行和其他财政收支情况的审计工作报告)*. https://sjt.shanxi.gov.cn/ggbg_280/bgjjd/202408/P020240813330111698830.pdf

Sheng, H., He, C., He, D., & Qi, F. (2024). Opportunities or risks? Venture capital investments and regional path creation: Evidence from China. *Papers in Regional Science*, *103*(5), 100048-.

Simon, H. A. (1997). *Administrative behavior: A study of decision-making processes in administrative organizations* (4th ed.). Free Press.

Söderblom, A., Samuelsson, M., Wiklund, J., & Sandberg, R. (2015). Inside the black box of outcome additionality: Effects of early-stage government subsidies on resource accumulation and new venture performance. *Research Policy*, *44*(8), 1501–1512.

Soleimani Dahaj, A., & Cozzarin, B. P. (2019). Government venture capital and cross-border investment. *Global Finance Journal*, *41*, 113–127.

Song, Y., Zhang, R., & Chen, H. (2024). Exploring the Paths for Chinese Manufacturing Enterprises to Control the Core Activities of Global Value Chain: A Fuzzy-set Qualitative Comparative Analysis (中国制造业企业控制全球价值链核心活动的路径探索). *Business and Management Journal (经济管理)*, *5*, 28–50.

Song, Z., Storesletten, K., & Zilibotti, F. (2011). Growing Like China. *The American Economic Review*, *101*(1), 196–233.

Spence, M. (1978). Job market signaling. In *Uncertainty in economics* (pp. 281–306). Elsevier. https://www.sciencedirect.com/science/article/pii/B9780122148507500255

Standaert, T., & Manigart, S. (2018). Government as fund-of-fund and VC fund sponsors: Effect on employment in portfolio companies. *Small Business Economics*, *50*(2), 357–373.

STASAVAGE, D. (2007). Partisan politics and public debt: The importance of the 'Whig Supremacy' for Britain's financial revolution. *European Review of Economic History*, *11*(1), 123–153.

Stern, N., & Valero, A. (2021). Innovation, growth and the transition to net-zero emissions. *Research Policy*, *50*(9), 104293–104293.

Stock, J. H., & Yogo, M. (2002). Testing for Weak Instruments in Linear IV Regression. *IDEAS Working Paper Series from RePEc*. https://www.proquest.com/docview/1698804054/abstract/?pq-origsite=primo

Su, Y., Hua, Y., & Deng, L. (2021). Agglomeration of human capital: Evidence from city choice of online job seekers in China. *Regional Science and Urban Economics*, *91*, 103621-.

Suchard, J.-A., Humphery-Jenner, M., & Cao, X. (2021). Government ownership and Venture Capital in China. *Journal of Banking & Finance*, *129*, 106164.

Tan, Q., Li, C., Qin, Z., Yu, S., Pan, Y., & Andrianarimanana, M. H. (2023). Impact of fiscal education expenditure on innovation of local listed enterprises: Evidence from China. *Finance Research Letters*, *57*, 104192-.

Tang, D., Li, Y., Zheng, H., & Yuan, X. (2022). Government R&D spending, fiscal instruments and corporate technological innovation. *China Journal of Accounting Research*, *15*(3), 100250-.

Tang, G., Wang, L., Zheng, T., & Wu, W. (2024). What types of business environment fosters the emergence of more specialized and sophisticated "little giant" enterprises?—An empirical study based on the TOE framework and configuration adaptation theory. *Managerial and Decision Economics*, *45*(3), 1557–1572.

Teoh, M. W., Wang, Y., & Kwek, A. (2021). Conceptualising co-created transformative tourism experiences: A systematic narrative review. *Journal of Hospitality and Tourism Management*, *47*, 176–189.

Timmons, J. A., & Bygrave, W. D. (1986). Venture capital's role in financing innovation for economic growth. *Journal of Business Venturing*, *1*(2), 161–176.

Tóth, Z., Thiesbrummel, C., Henneberg, S. C., & Naudé, P. (2015). Understanding configurations of relational attractiveness of the customer firm using fuzzy set QCA. *Journal of Business Research*, *68*(3), 723–734.

Van Den Heuvel, M., & Popp, D. (2023). The role of venture capital and governments in clean energy: Lessons from the first cleantech bubble. *Energy Economics*, *124*, 106877.

Van Leeuwen, T. (2006). The application of bibliometric analyses in the evaluation of social science research. Who benefits from it, and why it is still feasible. *Scientometrics*, *66*(1), 133–154.

Vargas-Zeledon, A. A., & Lee, S.-Y. (2024). Configurations of institutional enablers that foster inclusive entrepreneurship: A fuzzy-set qualitative comparative analysis. *Journal of Innovation & Knowledge*, *9*(4), 100549-.

Verginer, L., & Riccaboni, M. (2021). Talent goes to global cities: The world network of scientists' mobility. *Research Policy*, *50*(1), 104127–104127.

Vis, B. (2012). The Comparative Advantages of fsQCA and Regression Analysis for Moderately Large-N Analyses. *Sociological Methods & Research*, *41*(1), 168–198.

Wang, J., & Deng, K. (2022). Impact and mechanism analysis of smart city policy on urban innovation: Evidence from China. *Economic Analysis and Policy*, *73*, 574–587.

Wang, K.-H., Zhao, Y.-X., Jiang, C.-F., & Li, Z.-Z. (2022). Does green finance inspire sustainable development? Evidence from a global perspective. *Economic Analysis and Policy*, *75*, 412–426.

Wang, R., & Wu, C. (2020). Politician as venture capitalist: Politically-connected VCs and IPO activity in China. *Journal of Corporate Finance*, *64*, 101632.

Wei, L., Lin, B., Zheng, Z., Wu, W., & Zhou, Y. (2023). Does fiscal expenditure promote green technological innovation in China? Evidence from Chinese cities. *Environmental Impact Assessment Review*, *98*, 106945.

White, S., Gao, J., & Zhang, W. (2005). Financing new ventures in China: System antecedents and institutionalization. *Research Policy*, *34*(6), 894–913.

Wilson, W. W., Haiges, R., & Christe, K. (2023). *Contents Lists Available at Sciencedirect*. https://doi.org/10.2139/ssrn.4417034

Wong, S.-W., & Tang, B. (2005). Challenges to the sustainability of 'development zones': A case study of Guangzhou Development District, China. *Cities*, *22*(4), 303–316.

Wright, M., Wood, G., Musacchio, A., Okhmatovskiy, I., Grosman, A., & Doh, J. P. (2021). State capitalism in international context: Varieties and variations. *Journal of World Business : JWB*, *56*(2), 101160-.

Wu, A. M., Ye, L., & Li, H. (2019). The impact of fiscal decentralization on urban agglomeration: Evidence from China. *Journal of Urban Affairs*, *41*(2), 170–188.

Wu, J. (2023). Does Unified Pool Arrangement Trigger Healthcare Corruption? Evidence from China's Public Health Insurance Reform. *Risk Management and Healthcare Policy*, *16*, 2259–2261.

Wu, J., & Kirk Davidson, D. (2011). The business-government-society relationship: A comparison between China and the US. *The Journal of Management Development*, *30*(1), 112–125.

Xie, Z., Wang, X., Xie, L., & Duan, K. (2021). Entrepreneurial ecosystem and the quality and quantity of regional entrepreneurship: A configurational approach. *Journal of Business Research*, *128*, 499–509.

Yang, S., Ma, S., & Lu, J. (2022). Can government venture capital guidance funds promote urban innovation? Evidence from China. *Growth and Change*, *53*(2), 753–770.

Ye, G., Hu, M., & Chen, Y. (2022). On the Fair Competition Review System (以竞争政策促进有效市场和有为政府更好结合——论公平竞争审查制度). *Chinese Public Administration*, *11*, 18–25.

Yi, R., Wang, H., Lyu, B., & Xia, Q. (2023). Does venture capital help to promote open innovation practice? Evidence from China. *European Journal of Innovation Management*, *26*(1), 1–26.

Yu, L., & Cai, Y. (2021). Do rising housing prices restrict urban innovation vitality? Evidence from 288 cities in China. *Economic Analysis and Policy*, *72*, 276–288.

Zhai, Y. (2023). The Politics of COVID-19: The Political Logic of China's Zero-COVID Policy. *Journal of Contemporary Asia*, *53*(5), 869–886.

Zhang, D., & Guo, Y. (2019). Financing R&D in Chinese private firms: Business associations or political connection? *Economic Modelling*, *79*, 247–261.

Zhang, G., Wang, W., & Liang, Y. (2021). Understanding the Complex Adoption Behavior of Cloud Services by SMEs Based on Complexity Theory: A Fuzzy Sets Qualitative Comparative Analysis (fsQCA). *Complexity (New York, N.Y.)*, *2021*(1).

Zhang, J., Fan, Y., & Liu, Y. (2024). The effects of government venture capital: New evidence from China based on a two-sided matching structural model. *Journal of Corporate Finance (Amsterdam, Netherlands)*, *84*, 102521-.

Zhang, J., & Gu, Q. C. (2024). Unraveling the puzzling risk–return relationship: Distinctive roles of government involvement in venture capital investment. *Strategic Management Journal*.

Zhang, M. Y., & Chen, Z. (forthcoming). Public Financing for Science, Technology and Innovation. In *The Handbook of Public Finance in China*. Edward Elgar Publishing.

Zhang, Y. (2018). Gain or pain? New evidence on mixed syndication between governmental and private venture capital firms in China. *Small Business Economics*, *51*(4), 995–1031.

Zhang, Y. (2021). Improving the performance of governmental venture capital firms: Reforms at Shenzhen Capital Group. *Journal of Small Business Management*, *59*(2), 249–279.

Zhang, Y., & Mayes, D. G. (2018). The performance of governmental venture capital firms: A life cycle perspective and evidence from China. *Pacific-Basin Finance Journal*, *48*, 162–185.

Zheng, G., Barbieri, E., Di Tommaso, M. R., & Zhang, L. (2016). Development zones and local economic growth: Zooming in on the Chinese case. *China Economic Review*, *38*, 238–249.

Zhu, K., & Kraemer, K. L. (2005). Post-Adoption Variations in Usage and Value of E-Business by Organizations: Cross-Country Evidence from the Retail Industry. *Information Systems Research*, *16*(1), 61–84.

Zou, C., Huang, Y., Wu, S., & Hu, S. (2022). Does "low-carbon city" accelerate urban innovation? Evidence from China. *Sustainable Cities and Society*, *83*, 103954-.

Appendix A GVC in empirical research

GVC		Numbers	Examples
GVC as an Antecedent (IV) of Various Outcomes		74	
1	Exits	14	R. Wang & Wu (2020); Y. Zhang (2021)
2	Patent application	5	Pierrakis & Saridakis (2017)
3	Patent granted	5	Q. Du et al. (2024)
4	Staging	5	Guerini & Quas (2016)
5	Scale of VC industries	5	Leleux & Surlemont (2003)
6	Early-stage investments	5	Kovner & Lerner (2015)
7	High-tech investments	4	Lim & Kim (2015)
8	Employment	4	Croce et al. (2019)
9	Sales value	3	Grilli & Murtinu (2015)
10	Commercialization	3	Link & Scott (2010)
11	Investee's assets	3	Inoue et al. (2013)
12	Aggregate investment	3	Brander et al. (2015)
13	Share price returns	2	T. Li et al. (2024)
14	Investment patterns	2	(Bertoni et al. (2015)
15	Patent citation	2	Lee et al. (2023)
16	Firm productivity	2	Murtinu (2021)
17	Syndication	2	Munari & Toschi (2015)
18	Growth	1	Lerner (2010)
19	Value-adding activities	1	Luukkonen et al. (2013)
20	Write-offs	1	Buzzacchi et al. (2013)
21	Investment duration	1	Buzzacchi et al. (2013)
22	Targeted industry	1	Ge et al. (2024)
23	Return on investment (ROI)	1	J. Zhang & Gu (2024)
GVC as a Moderator of Various Relationships		7	
24	IVC - Exits	2	D. J. Cumming et al. (2017)
25	Tax policy - Investment behaviour	1	Johan et al. (2014)
26	IVC - Investment behaviour	1	Bertoni et al. (2019)
27	Political uncertainty - Entrepreneurial firms	1	Suchard et al. (2021)

28	Availability - Innovation	1	Devarakonda & Liu (2024)
29	Targeted industry - Growth	1	George & Prabhu (2000)
GVC as a DV That Is Affected by Various Antecedents		8	
30	Profit distribution structures	1	Jääskeläinen et al. (2007)
31	Fund governance structure	1	D. J. Cumming & MacIntosh (2007)
32	Gender differences	1	Malmström et al. (2017)
33	Exits	1	Abrardi et al. (2019)
34	VC reputation	1	Abrardi et al. (2019)
35	Institutional environment	1	Luo et al. (2019)
36	Individual cognitions	1	Johansson et al. (2021)
37	Characteristics of start-ups	1	Breschi et al. (2022)