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Finance Beyond Funding: The Strategic Effects of Venture Capital and Corporate Dominance on Innovation and Exit

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Declaration of authenticity and author's rights

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Abstract

This dissertation explores how financial capital does more than just provide funding—it plays a central role in shaping firm strategy, survival, and innovation. Across three empirical chapters, the study examines how venture capital and corporate dominance affect firm decisions after going public, influence access to early-stage funding, and alter innovation behavior in competitive industries. The findings challenge the idea that finance is a neutral tool, showing instead that it can steer outcomes in powerful and sometimes unintended ways.

The first chapter investigates the impact of post-IPO venture capital investment. These investments are often seen as a sign of support and confidence. However, firms that receive them are more likely to leave public markets within a few years. The analysis suggests that even when capital is available, its strategic influence can increase short-term pressure and reduce long-term stability.

The second chapter turns to the rise of unicorn firms—startups valued at over $1 billion—and their effects on others in the same sector. While unicorns attract investor interest and may signal growth potential, they also concentrate funding and attention, making it harder for smaller startups to secure backing from top-tier investors. This pattern shows how financial visibility can become a barrier to entry, limiting who gets a chance to grow.

The third chapter looks at large, dominant firms in China, and how their presence affects innovation among smaller competitors. The results show that these firms can discourage everyday innovation but may promote green innovation by setting industry

norms and influencing supply chains. Their strategic weight means they help decide not just what gets made, but what kinds of ideas move forward.

Taken together, the three chapters argue that financial and corporate power now shape the paths firms take, often before any product reaches the market. The ability to raise money, stay public, or develop new ideas increasingly depends on how firms are positioned within broader networks of influence. Finance, in this sense, has become part of a firm's strategy, not just its support system.

This research highlights the need to rethink common views about venture capital and firm growth. It shows that funding can open doors, but it can also close them—depending on timing, structure, and who controls the flow. By tracing how capital interacts with strategy, this dissertation offers a grounded look at how financial systems affect who survives, who innovates, and who exits.

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1 . Introduction

In today's economy, the relationship between finance, technology, and corporate organization has become more intertwined than ever. Areas such as early-stage investment, innovation planning, and industry structure used to be treated as separate topics. Today, however, these areas are closely connected, and the old boundaries between them no longer explain how firms or markets actually operate. Firms are no longer simply agents operating within pre-existing structures—they are products of financial engineering, regulatory influence, and market narratives shaped by investors, policymakers, and institutional actors (Braun, B. 2022). Innovation is no longer limited to what happens inside a company's research and development department. Instead, it is shaped by access to funding, patterns of ownership, and whether a firm has the chance to remain active long enough to develop new ideas (Mazzucato, 2018)

What was once a relatively linear path from founding to listing to maturity has now fractured into a series of looping, recursive patterns. Firms may raise billions in capital before ever issuing a public share. Private companies can acquire the influence of multinationals without ever stepping into public markets. Venture capital, historically confined to the early stages of firm growth, now seeps into mature phases, influencing decisions that would once have been left to boards and managers of publicly listed entities. Meanwhile, the category of the "dominant firm" has expanded. Once defined by market share or industrial output, today's corporate giants exercise authority through control over digital infrastructure, proprietary data, cross-sector investment positions, and the ability to shape innovation priorities in entire industries (Autor et al., 2020; Bessen, 2020;)

These developments raise doubts about long-standing beliefs regarding how capital is distributed and how firms develop over time. They collectively point to a central, unresolved tension in modern capitalism: finance and corporate power are no longer merely supporting actors but have become central architects that pre-structure the paths firms can take. This reconfiguration of influence operates through subtle channels—shaping investor perceptions, redirecting capital flows, and altering the perceived returns to innovation—often long before any product reaches the market.

This overarching dynamic gives rise to three critical and interconnected empirical puzzles that this dissertation seeks to address:

The first puzzle concerns the evolving role of venture capital. If the traditional lifecycle model, where an IPO marks the exit and success of venture investment, is breaking down, what strategic logics drive continued VC involvement in public firms? More pointedly, why would firms that receive post-IPO VC backing—a supposed signal of confidence and support—demonstrate such a pronounced tendency to exit public markets prematurely? This paradox challenges the benign view of "smart capital" and forces an examination of how investor incentives in the liquid public market environment may paradoxically increase firm fragility.

The second puzzle lies in the selective allocation of early-stage capital. The spectacular rise of unicorn firms concentrates not only market share but also investor attention. This creates a fundamental ambiguity for other startups: does the presence of

a unicorn serve as a beacon that validates the sector and attracts capital for all, or does it act as a black hole, crowding out funding and talent for potential competitors? Understanding this is crucial to determine whether the unicorn phenomenon fosters a vibrant, competitive ecosystem or leads to an oligarchic concentration of opportunity.

The third puzzle involves the impact of corporate dominance on the direction of innovation, particularly in an emerging economy like China. While dominant "superstar" firms might stifle general competition, their influence on mission-oriented innovation, such as green technology, is less clear. Do these giants suppress green innovation by raising entry barriers, or do they stimulate it by setting new standards, restructuring supply chains, and creating knowledge spillovers? The answer has profound implications for how industrial structure interacts with public goals like environmental sustainability.

This dissertation is grounded in the view that the topics discussed above are not only relevant but also require careful, sustained investigation using empirical methods. Rather than proposing a single unified theory to explain the broader shifts in modern capitalism, the goal is to use detailed, data-driven studies to examine how financial resources and corporate dominance influence firm decisions in practice. While traditional theories offer useful foundations, they often assume neutral markets and equal access to capital—assumptions that may not hold in today's more complex and uneven business environment. This research takes a closer look at situations where those imbalances are particularly visible and likely to affect outcomes in meaningful ways. These include, for example, how venture capital continues to influence firms after they go public, how large

private startups—often called unicorns—affect funding opportunities for others in the same sector, and how dominant firms in emerging markets shape innovation activity among their competitors. Together, these chapters aim to offer a more grounded understanding of how firms operate when their growth and choices are shaped by external pressures they cannot fully control.

The first chapter turns the spotlight on an often-overlooked segment of the venture capital lifecycle: investments made after a company has gone public. Traditionally, IPOs have been viewed as the final act in the venture capital narrative, marking the exit point for early investors and the transition to market-based governance. However, evidence suggests that venture capital firms are increasingly extending their involvement beyond IPOs, sometimes through private placements in public firms, such as Private Investments in Public Equity deals (Iliev & Lowry, 2020). These transactions are frequently interpreted as a vote of confidence by knowledgeable insiders and are expected to ease financing constraints while bringing governance expertise. Yet, an unexpected empirical regularity emerges: a large proportion of firms that receive post-IPO VC investment are delisted from the stock exchange within a few years, at a rate substantially higher than comparable firms without such backing. This chapter asks a direct question: why would firms that benefit from supposedly "smart capital" disappear from public markets at such a rapid pace? This analysis builds on ideas from agency theory and research on financial contracts. It suggests that, after a company goes public, changes in ownership and weaker monitoring in public markets may lead investors to focus more on short-term returns than on the company's long-term success. Using survival analysis and matched samples, this chapter examines how financial ties that are meant to support firm growth

can, under certain conditions, instead increase the likelihood of an early exit from the market. Thus, Chapter 2 fundamentally reframes the role of venture capital in public markets. It extends agency theory by showing how the unique liquidity and incentive structures of the post-IPO environment may amplify risk-shifting behavior, turning a purported signal of confidence into a source of fragility. By documenting that firms receiving such "smart capital" face a significantly higher hazard of delisting, the chapter challenges the benign view of VC certification and reveals a critical paradox: financial backing in the public markets can, counter-intuitively, predetermine and shorten a firm's tenure, proving that VC's strategic influence profoundly extends beyond the mere provision of funding.

The second chapter shifts focus to the world of private markets and considers the influence of so-called “unicorn” firms—startups that reach valuations exceeding $1 billion without listing—on the funding opportunities available to other startups in the same industry. While unicorns are often celebrated as success stories, their expanding market presence and concentration of investor attention may have unintended consequences. The chapter examines whether the existence of a unicorn in a given sector reduces or enhances the likelihood that peer startups will secure investment from high-reputation venture capital firms. Although unicorns may signal the profitability of a sector and attract more capital overall, they may also discourage entry by absorbing a disproportionate share of financing, customers, and talent. This tension is examined using a difference-in-differences strategy that exploits the 2017 U.S. Tax Cuts and Jobs Act as a quasi-exogenous shock to capital supply in private markets. The study finds that in sectors where unicorns dominate, smaller startups face measurable disadvantages in attracting

top-tier VC funding. The implications are both academic and practical: market success stories may contribute to a more unequal distribution of early-stage capital, raising concerns about the erosion of competitive entry and the consolidation of influence in the hands of a few oversized private firms.Therefore, Chapter 3 contributes to the core theme by illustrating how the mere visibility and concentration of financial success (in the form of unicorns) can become a strategic barrier, systematically shaping investor behavior and determining which startups get a chance to grow long before their products are judged in the market.

The third empirical chapter turns to a different national context—China—and explores how the growing prominence of “superstar firms” affects innovation by their competitors. Unlike the unicorns in the U.S., Chinese corporate giants often operate with strong connections to the state, benefit from explicit industrial policy, and dominate their industries not only through market-based strategies but also via institutional support. Using firm-level data from Chinese manufacturing firms, this study investigates whether the presence of superstar firms dampens or stimulates green innovation—a type of innovation that requires long-term commitment, involves regulatory coordination, and often lacks short-term profitability. The findings reveal that while superstar firms do limit ordinary innovation by reducing the perceived return on new investment among smaller firms, they may also play a more complex role in encouraging environmentally motivated innovation through knowledge spillovers, supply chain restructuring, and normative pressure. The chapter also identifies two important moderating variables: a firm’s performance on corporate social responsibility measures and its technological proximity to the leading firms. These factors appear to influence whether the dominance of

superstar firms crowds out innovation or instead facilitates imitation and learning. By situating the analysis in the Chinese institutional setting, the chapter raises broader questions about the generalizability of Western-based theories of market concentration and innovation, and points to the importance of context-specific mechanisms in understanding innovation outcomes. Consequently, Chapter 4 reveals that corporate and financial power shapes not only "who innovates" but, more profoundly, "the direction of innovation." It shows how the strategic weight of superstar firms—through their market power, supply chain control, and normative influence—helps set the industry's innovation agenda, deciding which types of ideas, such as green innovation, gain traction.

This dissertation questions the common view that venture capital and business growth always have positive effects. Instead, it shows that their impact can vary across situations—sometimes helping, but in other cases limiting opportunities for certain firms. The research also speaks to a growing policy concern. In both developed and developing economies, there is increasing interest in how concentrated financial relationships and firm dominance affect market entry, regional development, and the direction of technological progress. The findings across the three studies suggest that well-intentioned capital injections or policy-facilitated firm expansion can have exclusionary effects, depending on how incentives are structured and how other market actors respond. This perspective has implications for the design of capital access policies, competition frameworks, and innovation subsidies. For regulators, the studies underscore the need for vigilance not only around firm behavior but also around investor incentives. For entrepreneurs and smaller firms, the findings highlight the importance of strategic

positioning—not just in terms of product or technology, but also in relation to the competitive and investment environment shaped by outsized players.

Collectively, the three empirical chapters build a cohesive argument around the dissertation's central theme: finance and corporate power have evolved from a support system into a strategic architecture that pre-structures firm pathways. Chapter 2 shows this through the strategic influence of capital in public markets, Chapter 3 through its selective allocation in private markets, and Chapter 4 through its power to shape innovation priorities. Together, they demonstrate that the ability to raise money, stay public, or develop new ideas is increasingly determined by a firm's position within broader networks of influence, often long before any product reaches the market."

The structure of the dissertation is as follows. Chapter 2 investigates the post-IPO survival patterns of firms that receive venture capital in public markets, combining insights from finance and governance. Chapter 3 examines how unicorn presence within an industry affects other startups' chances of attracting prestigious VC investment, using a policy-induced natural experiment. Chapter 4 studies how the expansion of Chinese superstar firms influences the innovation behavior of their rivals, with particular emphasis on green technology development. The final chapter synthesizes the findings, reflects on their implications for theory and policy, and offers directions for future research.

2. Blessing or Curse? The Impact of Post-IPO VC Investment on Firm Fragility

2.1 Introduction

In the years following an initial public offering (IPO), it is not uncommon for venture capital (VC) firms to maintain an active presence in the companies they once supported during the private stage. Contrary to the traditional perception that IPOs mark the exit point for venture capitalists, recent research highlights a growing trend of VC involvement in public firms through mechanisms such as Private Investment in Public Equity (PIPE) transactions (Iliev & Lowry, 2020). This extended commitment is often interpreted as a signal of continued confidence, where venture capitalists leverage their informational advantages to provide capital to firms that may struggle to access traditional public markets.

These investments may appear promising at first glance. VC investors bring not only capital but also strategic guidance, governance expertise, and signaling power which can reduce information asymmetry and improve firm performance (Bernstein et al., 2019; Wilson et al., 2012). Moreover, the involvement of VCs post-IPO is often seen as a form of certification that reassures other market participants, including creditors and retail investors. These dynamics suggest that post-IPO VC investments should enhance a firm's financial stability and long-term prospects.

But the data reveals a surprising pattern that contradicts assumption: firms that receive post-IPO VC are significantly more likely to delist from the public market—and

they do so surprisingly quickly. In a sample of U.S. firms between 2000 and 2025, nearly half of those that received post-IPO VC financing were delisted within a median time frame of only four years, with over 75% exiting the public markets within five years. By contrast, the delisting rate among firms without such VC involvement stands at just 37%. This unexpected outcome raises a fundamental question: if venture capitalists remain involved to support growth and reduce financial constraints, why do these firms disappear from public exchanges so soon after receiving support?

This research begins with this paradox. While existing literature has examined the benefits of VC investment in pre-IPO stages (Tykvová & Borell, 2012; Metrick & Yasuda, 2010), and a limited body of work examines post-IPO VC (Iliev & Lowry, 2020), few studies have directly tackled the phenomenon of early delisting following such investments. Even studies on PIPE financing, which share structural similarities with post-IPO VC, tend to emphasize firm distress and capital access challenges (Floros & Sapp, 2012) without addressing the strategic implications of VC involvement. The combination of high delisting rates and fast exit timing suggests that the financial pathway of these firms may be shaped by forces not yet fully understood in the existing literature.

One potential explanation draws from agency theory, which highlights the conflict of interest between equity holders and creditors (Jensen & Meckling, 1976; Fama, 1980). Venture capital investors, particularly in the public market where they face fewer exit constraints, may push firms toward high-risk strategies that benefit shareholders at the expense of long-term stability. The incentive structure of VC funds—especially the presence of convex performance-based compensation such as carried interest—further amplifies this tendency (Metrick & Yasuda, 2010; Robinson & Sensoy, 2013). These

incentives may encourage leverage-driven growth or speculative investments aimed at short-term equity value maximization.

Empirical evidence also underpin this view. PE- and VC-backed firms often employ higher levels of leverage than non-sponsored firms, exposing them to elevated risk of financial distress (Axelson et al., 2013; Hotchkiss et al., 2021). Even when access to debt is improved—due to VCs' relationships with lenders (Ivashina & Kovner, 2011; Bharath et al., 2014)—the accompanying increase in debt load may strain firm balance sheets during downturns. This risk is particularly pronounced in sectors like Health Care and Information Technology, which dominate the population of post-IPO VC recipients and are more volatile and capital-intensive.

PIPE literature further reveals that firms accessing this financing are often small, underperforming, and financially constrained (Floros & Sapp, 2012; Wu, 2004). While PIPEs provide an avenue for liquidity, they often come with discounted pricing and terms favoring investors, such as warrants or price protection (Chaplinsky & Haushalter, 2010; Chen et al., 2010). Although VC-led PIPEs outperform hedge fund-led deals in some metrics (Dai, 2009), the fact remains that firms issuing PIPEs demonstrate a consistent pattern of financial decaling

This raises the possibility that VC participation post-IPO is not purely a value-adding intervention, but rather a reaction to or exploitation of structural weaknesses in these firms.Another perspective considers the evolving commitment of venture capitalists in public firms. IPOs, long regarded as a natural exit channel for VC funds, also function as a liquidity mechanism that reduces the need for long-term monitoring (Gompers & Lerner, 1999; Lerner, 1994). Once public, the costs of divesting are dramatically lower,

and the incentives for intensive oversight diminish. As a result, the post-IPO phase may mark a strategic shift in VC behavior— ranging from strategies aimed at promoting long-term growth to those focused on short-term value extraction, such as cost reductions, asset disposals, or high-risk R&D initiatives. While these strategies may improve certain financial metrics temporarily, they can also increase return volatility (Campbell et al., 2008; John et al., 2008), reduce liquidity buffers, and destabilize capital structure.

Consistent with this view, this study documents that post-IPO VC-backed firms exhibit weaker operating fundamentals, lower profitability, and higher Altman Z-scores than comparable non-VC-backed firms. Additionally, survival analysis using a Cox proportional hazards model shows that post-IPO VC significantly increases delisting risk, even after controlling for leverage, liquidity, and profitability. The effect remains significant even after applying propensity score matching, indicating that it is the involvement of venture capital—rather than the firm's prior characteristics—that contributes to financial fragility.

Furthermore, the structure of the VC investment also matters. Subsample analyses reveal that firms receiving a greater number of post-IPO VC deals tend to survive longer. This pattern suggests that repeat investments may be related with stronger monitoring and alignment, whereas large equity blocks may enable risk-shifting behavior or more aggressive investor control. These findings resonate with agency theory, which posits that concentrated ownership increases the potential for actions misaligned with creditor interests (Anderson, Mansi & Reeb, 2003)

This study contributes to the literature by examining how venture-backed firms evolve after going public, bridging a notable gap in both venture capital and corporate finance research.While prior work has emphasized how VC investment ease financing constraints and promotes innovation during the private stage, few studies investigate what happens after the IPO, particularly when VC involvement continues through PIPE-like transactions. I extend this literature by systematically analyzing how post-IPO VC investments influence public firm survival—an outcome that challenges conventional wisdom about the role of venture capital in enhancing firm resilience.

This paper contributes to the literature in three distinct ways. First, it provides novel empirical evidence that post-IPO VC involvement is associated with a significantly higher risk of delisting, despite the common perception that VC signals certification and governance quality. Second, it deepens the theoretical understanding of agency problems in public firms, showing how the liquidity and incentive structures unique to the post-IPO environment can amplify risk-shifting behavior and reduce long-term stability. This extends classic agency theory beyond its typical application in private equity or pre-IPO settings. Third, by examining the structure of VC involvement, such as the number of deals and the equity share per deal, this study highlights the heterogeneity among venture capital investors, demonstrating that their involvement are related with differing effects on firm fragility.

Together, these contributions reframe our understanding of venture capital's role in public markets. Rather than uniformly enhancing firm performance, post-IPO VC may create conditions for strategic misalignment and premature market exit—especially when concentrated ownership and weak governance interact. These findings not only provide

theoretical insight but also offer practical implications for entrepreneurs, institutional investors, and regulators, who must weigh the short-term advantages of post-IPO VC financing against its longer-term consequences for firm survival. It is worth nothing that that the research is designed to examine the relationship between post-IPO venture capital involvement and firms' survival outcomes, the objective of this chapter is not to establish strict causal identification. Given the observational nature of the data and the challenges associated with fully addressing endogeneity in post-IPO financing decisions, the analysis are interpreted primarily as documenting robust associations and exploring plausible mechanisms through which post-IPO financing may relate to firm fragility. The use of matching procedures and survival models aims to reduce observable selection bias, but causal interpretation remains cautious and limited.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature on venture capital, PIPE financing, and financial vulnerability, and develops the study's hypotheses based on agency theory and investment structure considerations. Section 3 describes the data, variable construction, and sample characteristics, including delisting rates and sectoral distributions. Section 4 presents the empirical strategy and main results. It first applies a Cox proportional hazards model to assess the effect of post-IPO VC on firm survival, and then conducts an event-window analysis to evaluate performance-related outcomes. Section 5 concludes by summarizing the findings, outlining the study's contributions and limitations, and suggesting directions for future research.

2.2 Related Literature

This section reviews research on the effects of venture capital on firms, and highlights other factors that contribute to financial vulnerability. The first part discusses how venture capital influences leverage, financial distress, and firm performance during downturns. While VC may increase financial risk through higher debt, experienced investors can help firms manage these challenges. The second part examines post-IPO venture capital and its relation to PIPE financing, both of which provide capital to firms with limited access to traditional funding.

This section not only reviews how venture capital and financing methods affect firms, but also examines other key factors that contribute to financial vulnerability. Poor operating performance, earnings manipulation, and weak corporate governance increase financial risk. Market indicators such as declining stock prices and high volatility often signal distress. Firms in cyclical industries or those exposed to economic shocks are also more likely to experience instability. These factors, together with financing choices, help explain the broader causes of corporate financial fragility.

2.2.1 Venture Capital Investment and Firms‘ Financial Stability

The impact of venture capital on firms, particularly its effects on financial instability, has been the subject of significant research (Kaplan & Strömberg, 2003; Metrick & Yasuda, 2010; Bernstein et al., 2019; Hotchkiss et al., 2021). A key concern in evaluating the influence of venture capital on firm stability lies in its potential association with heightened financial leverage. Several studies argue that the level of leverage employed frequently surpasses what would be considered optimal for maximizing firm value and returns to VC investees after VC transactions. As a result, substantial debt levels may

heighten the risk of financial distress and insolvency (Axelson et al., 2013; Ivashina & Kovner, 2011; Hotchkiss et al., 2021; Bernstein et al., 2019).

For instance, Tykvová & Borell (2012) examine the influence of VC on financial distress risks in European firms during the 2000–2008 buyout era. The results demonstrate that PE/VC involvement raises distress risk following a buyout, although some experienced VC investors can properly manage the risk, maintaining the default at a low level. Axelson et al. (2013) examine the factors influencing leverage and pricing in buyout deals. They find that PE firms often use leverage levels that exceed those suggested by traditional capital structure theory. Their results show that credit market conditions, rather than firm-specific factors, primarily drive these decisions. As a result, firms may face higher financial distress risk, especially during economic downturns. More recently, Hotchkiss, Smith, and Strömberg (2021) examine how private equity firms manage financial distress in highly leveraged companies. Using a sample of leveraged loan borrowers from 1997 to 2010, they find that PE-backed firms default more often but restructure more efficiently so that they can avoid costly bankruptcies and reducing liquidation rates. PE sponsors often provide capital infusions, enabling firms to recover faster.

The debt increase is incentivized by distinct motivations. Scholars argue that a primary motivation for venture capital fund managers to increase leverage lies in the structure of their compensation, which typically includes a significant performance-based component, such as carried interest (Metrick & Yasuda, 2010; Kaplan & Strömberg, 2009)

This structure aligns managers' financial incentives with the fund's overall returns. It also encourages them to employ higher leverage in portfolio companies to magnify

equity returns. Metrick and Yasuda (2010) conduct a comprehensive analysis of private equity fund contracts and compensation structures. They find that the convex nature of carried interest encourages fund managers to pursue riskier strategies that can increase potential returns. One such strategy includes the use of higher leverage at the portfolio company level. They highlight how performance-based incentives can distort risk preferences and promote financial decisions which may not align with long-term firm stability. Robinson and Sensoy (2013) also argue that the structure of private equity compensation, particularly the link between carried interest and fund performance, encourages managers to increase the expected value of the fund's equity by taking on greater financial risk at the portfolio company level.

Another reason is the typically close relationships between venture capital firms and banks, which allow VC firms to reduce information asymmetries between their portfolio companies and financial institutions. This, in turn, lowers the cost of capital and enhances the ability of portfolio companies to secure higher levels of debt financing (Hellmann, Lindsey, & Puri, 2008; Bottazzi, Da Rin, & Hellmann, 2008). IVashina and Kovner (2011) provide empirical evidence that private equity sponsors maintain strong ties with lenders, which enable their portfolio firms to secure debt under more favorable terms. Such relational advantages increase the likelihood of obtaining higher levels of leverage compared to non-sponsored firms. Likewise, Bharath, Dittmar, and Sivadasan (2014) find that firms backed by private equity sponsors gain improved access to debt financing after going private. This advantage partly stems from the sponsors' relationships with financial institutions, which help reduce information asymmetries and alleviate lenders' concerns.

On the other hand, certain studies suggest that VC investment may improve the resilience of portfolio companies, particularly during financial crisis. Bernstein, Lerner, and Mezzanotti (2019) examine the impact of private equity on financial fragility during economic turmoil. They find that PE-backed companies reduced investments less than non-PE-backed firms. These companies also experienced higher equity and debt inflows, asset growth, and market share. The positive effects were stronger for financially constrained companies and those backed by PE investors with more resources at the start of the crisis. Likewise, Wilson et al. (2012) investigate the performance of private equity -backed firms during the global recession, comparing them with non-buyout private firms and public companies in the UK. The study reveals that PE-backed firms outperformed their counterparts in profitability, productivity, and sales growth during the recession. The authors attribute this resilience to active PE management practices, including close monitoring, operational restructuring, and improved working capital management. Lerner, Sorensen, and Strömberg (2011) provide additional evidence that PE-backed firms demonstrate greater strategic resilience. Studying long-term innovation outcomes, they find that firms acquired by private equity investors maintain or even increase their patenting activity, suggesting that PE ownership does not lead to short-termism, but can support long-term investment even under financial constraints.

Overall, the impact of VC and PE investment on firm stability is twofold. Although higher leverage increases the risk of financial distress, the guidance and strategic support provided by experienced investors can play a critical role in helping firms manage and mitigate such risks. The ability of VC and PE-backed firms to secure funding, implement strategic management practices, and adapt during economic downturns suggests that

their influence extends beyond financial risk, potentially strengthening firm resilience in the long run.

2.2.2 Post- IPO VC and PIPE

There is a very limited number of studies on post-IPO VC investment. The most direct research on this topic is by Iliev and Lowry (2020), who explore the phenomenon and argue that post-VC investments can be explained by the information asymmetry between invested companies and external investors. This hypothesis posits that venture capitalists persist in financing firms post-IPO due to their ability to mitigate information asymmetry that often impede newly listed companies from accessing external financing.. Venture capitalists, possessing prior knowledge and industry expertise, hold a comparative advantage in assessing these firms and can provide financing under more favourable conditions. Additionally, Lliev and Lowry further prove these investments are associated with significant abnormal stock returns and improved access to capital. Although the authors provide valuable insights into the motivations behind post-IPO VC investments and their positive impact on stock returns, their paper does not fully address why some companies quickly delist after receiving VC financing.

Despite the fact that there are very few studies that directly examine post-IPO VC, a highly related topic is Private Investments in Public Equity. Many characteristics of PIPE transactions, such as their role in providing funding to public firms facing financial constraints, overlap with the motivations behind post-IPO VC.

Private investments in public equity involve the sale of restricted or freely tradable shares by public companies to a limited group of institutional or accredited investors through private placements (Chaplinsky, S., & Haushalter, D. 2010; Chen, H., Dai, N., &

Schatzberg, J. D. 2010). Chaplinsky, S., & Haushalter, D. (2010) highlight that PIPEs offer companies a faster and more flexible financing option compared to secondary public offerings, allowing firms to secure funding without extensive regulatory delays. However, the downside is that PIPE transactions often involve substantial discounts on the stock price. These features reflect the higher risks perceived by investors. Chen, H., Dai, N., & Schatzberg (2010) discuss how the negotiation process in PIPEs is typically less transparent than in public markets, giving sophisticated investors the opportunity to gain favorable terms which includes warrants or price protections. Dai (2007) further explores how investor identity influences the outcomes of PIPE transactions. She finds that firms backed by venture capital investors tend to have better post-issuance performance compared to those supported by hedge funds, mainly due to the stronger certification effects and longer investment horizons associated with VCs.

Although PIPE financing is theoretically accessible to all public firms, many studies argue that it is primarily employed by firms facing significant financial distress and severe external financing constraints. These companies often struggle to obtain follow-on capital through traditional public equity markets under favorable conditions. For instance, Floros and Sapp (2012) examine firms that engage in repeated PIPE transactions and explore whether such financing behavior reflects deeper financial concerns. Their empirical analysis reveals that firms issuing multiple PIPEs are typically small, highly levered, and consistently unprofitable, with declining cash positions and worsening financial health over time. As these firms continue to raise capital through PIPEs, indicators of financial distress—such as Altman Z-scores—deteriorate further, and market reactions to new PIPE announcements diminish significantly. Similarly, Wu (2004) analyzes the choice of

equity issuance mechanisms and shows that PIPE issuers are typically small, underperforming firms with limited analyst coverage and institutional ownership, in other words, most PIPE issuers are unable to raise capital through conventional public offerings. Iliev and Lowry (2020) also emphasize that PIPE issuers often have poor financial health and weak governance. These characteristics increase their vulnerability to financial distress. These firms often use PIPE proceeds to meet immediate liquidity needs rather than for long-term strategic growth. Meanwhile, Dimitris and Styliani (2021) show that despite the high costs, PIPEs can serve as a lifeline for struggling companies by providing crucial capital that would otherwise be unattainable in public markets. Brophy, Ouimet, and Sialm (2009) provide further evidence that PIPE financing is frequently associated with firms in deep financial distress. Focusing on investor composition, they show that hedge funds—who often lead PIPE transactions—tend to invest in firms facing severe financing constraints and declining financial performance. These investors are typically less involved in governance and more focused on short-term gains, which the authors argue enthesis the role of PIPEs as a last-resort funding mechanism rather than a strategic financing tool. Collectively, these studies suggest that PIPEs serve as an alternative financing channel for firms with constrained access to public equity markets. Although prior research shows that financially distressed firms are more likely to use PIPE financing, few studies have explored whether such financing further increases financial vulnerability. This underexplored area highlights a clear gap in the literature.

2.2.3 Other Contributing Factors to Financial Vulnerability

Corporate financial vulnerability arises not only from excessive leverage but also from a broader set of firm-level and market-based factors. This section reviews several key determinants of financial destress identified in the empirical literature.

Poor Operating Performance

Weak operating performance significantly impacts a firm's ability to generate internal cash flow and meet its financial obligations. Altman and Hotchkiss (2006) emphasize that declining profitability, especially negative operating income and underperforming return on assets, is a primary driver of distress. Andrade and Kaplan (1998) show that among distressed firms, poor performance often combines with high leverage, which indicates that operational inefficiency amplifies financial risk. Similarly, Gatchev, Spindt, and Tarhan (2009) find that consistent operating losses reduce firms' ability to attract equity or debt capital.

Earnings Management and Financial Reporting Quality

Aggressive earnings management can mask financial destress and delay corrective action, and increase the likelihood of sudden failure. Dichev and Skinner (2002) find that firms that engage in income-smoothing and earnings manipulation are more likely to breach debt covenants, which leads to refinancing difficulties or default. Dechow, Sloan, and Sweeney (1996) provide evidence that earnings manipulation is a common indicator to financial restatement and firm collapse. Carcello and Nagy (2004) further show that weak internal controls and poor audit oversight are linked to a higher probability of fraudulent reporting and subsequent financial distress.

Ineffective Corporate Governance

Firms with poor governance structures often face higher financial fragility due to misaligned incentives and weak oversight. Bebchuk, Cohen, and Ferrell (2009) demonstrate that entrenched management is associated with weaker firm value and greater vulnerability in downturns. Larcker, Richardson, and Tuna (2007) find that poor board composition and low director independence are correlated with higher credit spreads and lower credit ratings. Denis and Kruse (2000) also show that weak governance mechanisms reduce managerial discipline during financial restructuring and lead to an extended duration of financial hardship

Market-Based Risk Indicators

Market-based indicators provide timely and forward-looking signals of corporate financial distress. These indicators capture investor expectations and adjust quickly to changes in firm-specific risk. Shumway (2001) develops a hazard model and shows that firms with high stock return volatility and shrinking market capitalization face significantly higher bankruptcy risk. Campbell, Hilscher, and Szilagyi (2008) support this finding by showing that companies with poor stock performance, high idiosyncratic risk, and low market-to-book ratios are much more likely to default. Their results suggest that decreasing market confidence often precedes financial collapse. Bharath and Shumway (2008) combine market data with accounting information and find that models including equity volatility and firm size predict distress more accurately than traditional approaches such as the Altman Z-score.

Exposure to Macroeconomic and Industry Shocks

Firms operating in cyclical or highly volatile industries are particularly vulnerable to financial distress during periods of economic contraction. Opler and Titman (1994)

analyze firm performance during recessionary periods and find that financially distressed companies in cyclical sectors, such as manufacturing and retail, lose significantly more market share compared to their financially healthier counterparts. This suggests that exposure to industry-level demand shocks can amplify the adverse effects of financial fragility. Similarly, Campello, Graham, and Harvey (2010) conduct a large-scale survey of chief financial officers during the global financial crisis and report that companies that were more exposed to changes in the broader economy were among the first to cut capital spending, pause hiring, and postpone long-term plans when credit conditions became tighter. These reactions indicate a heightened risk of operational contraction under external pressure. In a complementary study, Hadlock and Pierce (2010) find that firms operating in sectors experiencing industry-specific downturns—particularly energy, automotive, and traditional manufacturing—face an increased likelihood of financial distress, even when their balance sheets appear stable.

2.2.4 Gap in Existing Literature

In summary, existing research provides a solid foundation for understanding how venture capital and PIPE financing influence firm behavior, particularly in terms of capital access, financial risk, and short-term market performance. Studies have shown that post-IPO VC can ease financing constraints and generate positive stock returns, even when information asymmetry is high. However, the literature does not adequately explain why some firms, after receiving post-IPO VC, choose to delist within a short period. This phenomenon raises important questions about the long-term implications of such investments and whether they may signal deeper structural or strategic issues within the firm. As a result, there remains a significant gap in understanding the post-investment

strategy of these firms and the conditions under which post-IPO VC may lead not to growth, but to early exit from public markets

2.3 Hypothesis Development

2.3.1 The Relation between Post-IPO-VC Investment and Firms' Time to Delist.

The principal-agent framework offers a useful lens to examine the effects of post-IPO venture capital on portfolio firms. This theory emphasizes the conflict of interest between equity and debt holders where shareholders have incentives to pursue riskier strategies to maximize returns, while creditors bear most of the downside risk (Jensen & Meckling, 1976). In the post-IPO venture capital setting, this tension becomes particularly salient. Venture capital investors, seeking to maximize returns and achieve successful exits, may encourage aggressive growth strategies and higher-risk projects to boost short-term firm value. Consequently, creditors perceive an increase in risk exposure due to potential wealth transfer from debt holders to equity holders, leading them to demand a higher required return to compensate for the additional risk. This results in an increased cost of debt for the firm. The elevated cost of debt, in turn, constrains the firm's financial flexibility, raises refinancing difficulties, and amplifies financial distress, thereby increasing the firm's overall vulnerability. As financial fragility accumulates, the firm becomes more susceptible to external shocks and operational setbacks, which ultimately elevates its risk of delisting. Thus, through the channel of heightened creditor risk perception and increased cost of capital, post-IPO venture capital involvement is associated with exacerbated financial fragility and a higher likelihood of delisting.

Axelson et al. (2009) have shown that financial sponsors, particularly venture capitalists, frequently rely on risky investment projects to boost equity returns. These findings underpin the incentive that when creditors confront firms backed by post-IPO

venture capital, they may perceive the agency problem to be more severe, given the heightened likelihood of equity holders pursuing risk-shifting strategies. As a result, creditors have stronger motivation to demand higher required returns or impose more stringent contractual covenants, thereby raising the cost of debt financing for post-IPO venture-backed firms.more conservatively. Anderson, Mansi, and Reeb (2003) also provide empirical evidence that such agency conflicts increase the cost of debt, especially when ownership is dispersed and dominated by non-founding institutional investors.

Additionally, the strategic incentives and risk tolerance of venture capital investors evolve significantly when they engage in post-IPO financing. In the pre-IPO stage, VCs operate under considerable exit constraints, often adopting more conservative approaches to ensure a successful public offering (Gompers & Lerner, 1999; Barry et al., 1990). However, once the company is listed, the urgency to achieve an IPO exit dissipates. The availability of liquid public markets enables VCs to divest more freely, thereby reducing their incentive for long-term stewardship (Lerner, 1994). This shift encourages a preference for shorter-term, higher-risk strategies—such as aggressive expansion, elevated financial leverage, or speculative projects—that aim to maximize returns prior to exit. Although these strategies may temporarily enhance equity value, they also amplify the firm's exposure to financial volatility and operational instability (Kaplan & Strömberg, 2003). Over time, such risk-taking can compromise corporate sustainability, raising the probability of financial distress and, ultimately, delisting due to sustained underperformance or governance failures.

Therefore, I propose the following hypothesis:

Hypothesis 1: There is a negative association between post-IPO VC investment and a firm's survival probability.

2.3.2 Heterogeneous Effects of Post-IPO VC on Firm Fragility

While post-IPO VC investment may increase a firm's financial fragility through risk-shifting and agency conflicts, as posited in Hypothesis 1, the magnitude of this effect is likely to vary significantly across firms. A key moderating factor lies in the structure and intensity of VC involvement, particularly reflected in the number of follow-on VC deals a firm receives after its IPO. A greater number of such deals signifies not only sustained investor commitment but also enhanced monitoring and governance mechanisms (Hochberg, 2012; Chemmanur, Krishnan, & Nandy, 2011). From an agency theory perspective, this heightened oversight can mitigate equity-debt holder conflicts by curbing excessively risky short-term strategies, thereby promoting better alignment between shareholders and creditors. Furthermore, repeated VC investments serve as a positive signal to the market regarding the firm's quality and performance consistency, potentially lowering perceived risk among creditors and other stakeholders. Consequently, firms with a higher volume of post-IPO VC deals are likely to experience attenuated negative effects on their survival probability, as the benefits of strengthened governance and credible signaling counterbalance the inherent risks associated with VC presence.

Based on this reasoning, I propose the following hypothesis:

Hypothesis 2: The number of post-IPO VC deals is negatively related to the strength of the association between post-IPO VC investment and firm fragility.

In contrast to the signaling and monitoring benefits associated with the number of deals, the average equity share acquired per post-IPO VC deal presents a distinct and potentially countervailing influence on firm fragility. While a substantial equity stake grants a VC significant influence and control, which could theoretically be used for effective monitoring, it may also intensify the very agency conflicts outlined in Hypothesis 1. According to agency theory, a dominant equity position, coupled with the enhanced liquidity of a public market, can align the VC's incentives disproportionately with short-term stock price appreciation. This concentrated power and shortened exit horizon may encourage the VC to advocate for strategies that transfer wealth from creditors to shareholders—such as leveraged recapitalizations or unsustainable share buybacks—thereby exacerbating the risk-shifting problem. From the creditors' perspective, a large, influential VC investor is a signal of heightened risk, as the potential for aggressive, equity-favoring actions is perceived to be greater. Consequently, while multiple deals may diffuse influence and promote governance, a high equity share per deal is likely to amplify the negative relationship between post-IPO VC presence and firm survival probability,

strengthening the primary effect proposed in Hypothesis 1, therefore, I propose the following hypothesis:

Hypothesis 3: The average equity share per post-IPO VC deal moderates the relationship between post-IPO VC investment and firm fragility, such that a higher average equity share is associated with a stronger negative relationship.

2.4 Data and Empirical Design

2.4.1 Data

2.4.1.1 Post-IPO-VC Identification

I construct my sample of firms that receive post-IPO venture capital investments from the Refinitiv database.

I specifically define Post-IPO-VC investments as Private Investment in Public Equity transactions involving investors identified as venture capitalists.[I]

This definition distinguishes post-IPO VC from other financing forms: unlike general PIPEs, which may involve hedge funds or other institutional investors, post-IPO VC focuses specifically on venture capital involvement; unlike other private placements or public secondary offerings, these investments are targeted at sustaining the venture relationship beyond the IPO; and unlike open-market VC purchases, they represent negotiated equity infusions that provide capital directly to the firm rather than secondary market trading.

This classification enables me to isolate the subset of PIPE transactions that demonstrate ongoing venture capital engagement in publicly traded companies. In this step, I identified 430 US companies that received VC investment after Flotation from 2000 to 2025. I further require the firms identified to have Compusta annual accounting fundamental data to enable the subsequent analysis. In the final sample I have 411 US companies which received Post-IPO-VC investments out of 26327 US firms from 2000 to 2025.

I This is In line with the definition given by Iliev & Lowry (2020), who also distinguish post-IPO VC financing from other forms of capital raising. In their framework, post-IPO VC rounds are identified separately from PIPEs, secondary equity offerings, and syndicated loans. Crucially, PIPEs are defined as private placements without venture capital participation**,** which highlights that post-IPO VC investments represent a distinct category where venture capitalists continue to provide direct equity financing to newly public firms.

2.4.1.2 Delisting Event

I obtained the sample of delisted firms from the Center for Research in Security Prices database. I limits the delisting reason to cases of liquidation during the period from 2000 to 2025. Similarly, I require these firms to have available annual financial data from the Compustat database. In the final sample, 9834 companies were delisted during the examining period. Among them, 195 firms received post-IPO venture capital investment prior to delisting.

2.4.2 Descriptive Statistics

2.4.2.1 Delisting Rate and Survival Times

Table 2.1 Panel A provides descriptive statistics on delisting across the full sample and subgroups based on post-IPO VC involvement.

/Table 2-1 here/

Out of 26,327 firms, 9,834 were delisted during the sample period, an overall delisting rate is 37.35%. Among the 411 firms that received post-IPO venture capital, 195 were delisted, corresponding to a delisting rate of 47.44%. In contrast, firms without post-IPO VC show a lower delisting rate of 37.19%. The gap suggests that delisting is more common among firms with post-IPO VC, which points out the potential differences in risk profile or strategic behavior.

Panel B presents the distribution of survival times for firms receiving post-IPO venture capital investments, measured from the date of the initial VC financing to eventual delisting. The average time to delisting is 5.72 years, with a median of 5 years, showing

a moderately right-skewed distribution. The shortest observed survival time is zero, it highlights the fact that some firms were delisted within the same year of receiving the investment. Notably, the 25th percentile survival time is just 2 years, meaning that at least one-quarter of the firms exited the public market within two years of receiving post-IPO VC. This concentration of early exits—combined with the fact that half of the sample delisted within five years—points to a substantial risk of premature market exit following such investments. These findings support the broader empirical pattern that post-IPO VC, while often framed as a mechanism to alleviate financial constraints, may coincide with increased financial vulnerability and shortened public market tenure.

4.4.2.2 Sectoral Distribution

2-2 shows the sectoral distribution of firms that received post-IPO venture capital based on the Global Industry Classification Standard (GICS)

/Table 2-2 here/

Among the 411 firms identified as having received post-IPO venture capital, GICS sector classification is available for 393 firms and there are 8 firms whose GICS sector are unclassified. Table 2-2 summarizes their industry distribution. The data show a highly skewed pattern. More than half of these firms—199 out of 393—belong to the Health Care sector (GICS code 35), accounting for 50.64% of the sample. The next most common sector is Information Technology (GICS code 45), with 84 firms, or 21.37%. Together, these two sectors represent over 70% of the total. Other sectors, such as Financials (5.60%), Industrials (5.09%), and Consumer Discretionary (5.09%), each contribute a

much smaller share. A few sectors, including Utilities and Real Estate, are almost absent from the sample. Based on the distribution, post-IPO VC activity is concentrated in industries characterized by innovation, high growth potential, and elevated capital needs—such as biotechnology and tech-driven businesses.

Among the 195 firms that both received post-IPO VC and were later delisted, GICS sector data is available for 191 firms and 4 firms are unclassified. As with the broader post-IPO VC sample, these delisted firms are heavily concentrated in a few sectors. Health Care (GICS 35) remains the dominant industry, accounting for 49.74% of the group. Information Technology (GICS 45) follows with 27.23%. The rest of the sample is spread thinly across sectors such as Consumer Discretionary, Industrials, and Financials. The lack of significant representation in capital-intensive or utility-based sectors again points to the nature of firms attracting post-IPO venture capital—typically younger, growth-oriented companies with higher technological or research-driven risk. That nearly half of these firms come from Health Care suggests that this sector carries both high investor interest and elevated exit risk, reinforcing the fragile survival profile documented earlier.

4.4.2.3 Firm Characteristics by Post-IPO VC Status

Table 2.3 compares key financial characteristics of firms with and without post-IPO venture capital investment.

/Table 2-3 here/

Firms with post-IPO VC are, on average, significantly smaller in size ($p < 0.05$). They generate lower sales ($p < 0.01$), and report significantly lower profitability (ROA, $p < 0.01$). They also hold less cash ($p < 0.01$), suggesting more limited internal liquidity, and are significantly younger ($p < 0.01$), consistent with the profile of early-stage, growth-oriented firms.

Although leverage is lower for VC-backed firms, the difference is not statistically significant. Differences in intangibility and R&D intensity are modest, with only weak significance for the former. Firms with post-IPO VC exhibit significantly lower Altman Z-scores ($p < 0.01$), indicating greater financial distress. They also have substantially higher amounts of long-term debt due within one year ($p < 0.01$), this numbers emphasis the heightened short-term repayment pressure of firms issuing Post-IPO-VC shares , though differences in longer-term debt maturities are not significant.

Overall, the results suggest that post-IPO VC tends to be associated with firms that are less mature, financially weaker, and more exposed to near-term risk—an observation that supports the broader narrative of heightened fragility among VC-backed public firm

2.5 Empirical Design and Results

2.5.1 Cox Proportional-Hazards Model for Survival Analysis

To examine the relationship between post-IPO venture capital investments and firm survival, this study employs a Cox Proportional-Hazards Model. This method is commonly used in survival analysis to estimate the conditional probability of an event occurring over time, conditional on survival up to that point. In this context, the treatment event is the firm's announcement of receiving post-IPO VC investment, which serves as the starting point for measuring survival. The dependent variable is the duration until delisting, which is treated as the failure event. Firms that remain listed by the end of the observation period are treated as right-censored. The hazard function is specified as:

$$h(t|X) = h_0(t)\exp(\beta X)$$

where $h(t|X)$ is the hazard rate at time t, $h_0(t)$ is the baseline hazard function, and X represents firm-level covariates including Long-debt due in the first, second, third and fourth year, Size, ROA, Age, R&D Intensity, Cash Holding, LnSale, Leverage, Current Ratio, Intangibity and Altman Z-score in this study

Since firms receiving post-IPO VC are not randomly assigned, selection bias may distort the estimation. To address this concern, Propensity Score Matching is applied prior to estimating the Cox model. Firms with post-IPO VC investment are matched to similar firms without such investment based on observable characteristics. In addition, matches are restricted to firms within the same year and industry to better account for time-varying

and sector-specific factors. Year and industry fixed effects are included in the survival model to further control for unobserved heterogeneity.

To generate the propensity scores, a Probit regression is first estimated on the full sample, with post-IPO VC investment as the dependent variable.

/Table 2-4 here/

Table 2-4 compares the results before and after matching. Most covariates become statistically insignificant after matching, which indicates the improved balance between treated and control groups. Although firm size and R&D intensity remain significant, both variables are included in the Cox model as additional controls. Notably, the Altman Z-score loses its significance after matching, which reduces concerns regarding potential reverse causality and endogeneity. This strengthens the credibility of the identification strategy.

Table 2-5 presents the results of the survival analysis based on the Cox Proportional-Hazards model.

/Table 2-5 here/

Columns (1) to (6) report estimates from progressively specified models. The baseline model in Column (1) includes only the treatment variable, post-IPO VC investment. In subsequent columns, controls are added step by step: Column (2) and (3) accounts for short-term debt maturing within one and two years; Column (4) and (5) extend the control set to include debt maturing in the third and fourth years. Column (6)

includes the full set of control variables, covering firm-level characteristics such as size, profitability (ROA), age, R&D intensity, and cash holdings, as well as financial indicators including leverage, sales, current ratio, intangibility, and the Altman Z-score to reflect overall financial health.

The first takeaway from Table 2-5 is that the coefficient on post-IPO VC remains positive and statistically significant across all model specifications. This consistent result suggests that firms receiving post-IPO venture capital face a higher risk of delisting compared to their matched counterparts. To interpret the economic magnitude, we consider the fully specified model in Column (6), where the coefficient on the post-IPO VC dummy is 0.453. This translates to a hazard ratio of exp(0.453) which it is around 1.573, indicating that the presence of post-IPO VC investment is associated with a 57.3% increase in the instantaneous hazard of delisting for an average firm in our sample, holding other variables constant.

The effect holds even after accounting for a wide range of control variables, including firm size, profitability, leverage, liquidity, and financial health, all of which are included in the fully specified model in Column (6). While the coefficient on post-IPO VC remains significant, it shows a clear downward trend across specifications. As more firm-level controls are introduced, the size of the estimated effect declines, but it never becomes statistically insignificant. This pattern suggests that part of the increased delisting risk can be explained by observable characteristics such as leverage and liquidity. However, the remaining unexplained portion points to other underlying mechanisms. Prior studies often attribute the financial fragility of VC-backed firms to higher leverage (Axelson et al., 2013; Ivashina & Kovner, 2011; Hotchkiss et al., 2021),

but the persistence of the effect after controlling for debt levels indicates that leverage alone does not account for the full risk. It is possible that the presence of VC investors brings about changes in firm strategy or governance—such as prioritizing rapid growth or taking on higher operational risk—that increase vulnerability even in the absence of excessive borrowing.

A second observation from the results concerns the role of debt maturity structure in shaping firm survival. When debt due within the first to fourth years is included in the model, only the amount maturing in the first year shows a statistically significant association with delisting risk. The positive coefficient on short-term debt suggests that immediate repayment obligations are more relevant for firm vulnerability than longer-term liabilities

As for the other control variables, the results align with general expectations. Firm size is negatively associated with the risk of delisting, consistent with the idea that larger firms have more stable operating environments and better access to capital. Cash holdings also appear to reduce delisting probability indicating that liquidity buffers play a protective role. Profitability is weakly significant in some specifications, while variables such as R&D intensity, firm age, and current ratio do not show consistent effects. The Altman Z-score is positively related to survival in the final model, confirming its usefulness as a summary measure of financial health.

To further assess the model fit and examine whether the proportional hazards assumption holds for the treatment variable, Figure 2-1 plots the observed and predicted survival functions by post-IPO VC status.

/Figure 2-1 here/

The graph shows a persistent divergence in survival probabilities between the two groups, with VC-backed firms consistently exhibiting lower survival rates. The predicted curves closely track the observed outcomes in both groups, the Cox model adequately captures the key differences in hazard rates. Moreover, the relatively stable gap between the survival paths over time provides visual support for the validity of the proportional hazard's assumption. This figure shows the robustness of the empirical findings and the credibility of the estimated treatment effect. Therefore, hypothesis 1 is accepted.

In addition to the baseline analysis, a subsample analysis is conducted using only firms that received post-IPO venture capital. This specification introduces two new variables: the total number of VC deals received by the firm and the average equity stake per deal. Table 2-6 shows the output.

/Table 2-6 here/

The results, presented in Table 2-6, suggest that a higher number of deals is associated with a lower hazard of delisting. Within this subsample of VC-backed firms, a higher number of deals is associated with a lower hazard of delisting. Economically, the coefficient of -0.546 in Column (3) corresponds to a hazard ratio of exp(-0.546) ≈ 0.579. This suggests that, among firms that have already received post-IPO VC funding, each additional VC deal is associated with a substantial 42.1% reduction in the instantaneous hazard of delisting.

One possible interpretation is that firms that were able to attract repeated investments over time are less likely to exit, either because they demonstrated stronger post-investment performance or because they developed mechanisms to manage the risks introduced by venture capital involvement more effectively. Another explanation may lie in the ownership structure created through multiple deals. A greater number of transactions often implies participation by a wider set of investors, which could reduce concentration of control and mitigate conflicts between equity and debt holders. In this context, more dispersed VC ownership may help to alleviate concerns about risk shifting or opportunistic behavior, thereby lowering the agency costs of debt. Therefore, Hypothesis 2 is accepted.

While the coefficient on average equity per deal is significant when considered alone, it loses significance after controlling for the number of deals. This suggests that its observed effect may actually be driven by the deal frequency rather than the ownership size per deal. One possible reason why average equity per deal does not increase the delisting risk, as initially hypothesized, is that greater ownership concentration does not necessarily lead to higher agency costs. Although larger equity stakes may give investors more control, they may also lead to closer monitoring and better alignment of interests. Therefore, the expected increase in delisting risk due to potential conflicts between investors and other stakeholders may not materialize. Based on the empirical results, Hypothesis 3 is rejected.

2.5.2 Event-Window Analysis of Post-IPO VC Effects on Firm Performance

This section examines the impact of post-IPO venture capital investment on firm outcomes using a series of symmetric event windows. For each outcome variable, the analysis compares firm performance before and after the investment over five-time windows, ranging from one year before and after to five years before and after the investment year. Each column in the regression tables corresponds to a different event window, allowing for the assessment of both short-term and longer-term effects. The analysis is based on a series of multiple linear regressions that incorporate firm, year, and industry fixed effects to account for unobserved heterogeneity. The outcomes examined include cost of debt, risk-taking behavior, and firm valuation, each discussed in the following subsections.

2.5.2.1 Cost of Debt

The first matric that I choose is cost of debt, cost of debt provides insight into whether external creditors perceive changes in the firm's risk profile following VC involvement. Compared to equity-based metrics, cost of debt is particularly informative in capturing the pricing of financial risk (Fama & French, 2002).

Table 2-7 reports the output, the dependent variable is constructed as the ratio of long-term interest expense to long-term debt.

/Table 2-7 here/

Based the results. the key finding lies in the short-term windows. In the (-1,1) and (-2,2) event periods, the coefficient on the post-investment indicator ("after") is negative

and statistically significant at the 10% level, indicating that cost of debt declines following the receipt of post-IPO VC. This pattern suggests that venture capital backing may improve credit market perceptions in the short run. One poetical explanation could be that the presence of reputable VC investors helps reduce information asymmetries between the firm and lenders, which could lower perceived credit risk. In addition, venture capitalists often maintain strong relationships with financial institutions, which may improve their portfolio firms' access to debt under more favorable terms.

However, the decline in borrowing cost appears to be transitory. From the (-3,3) window onward, the coefficient becomes statistically insignificant, and its magnitude declines further in the wider windows. This suggests that the short-term benefits associated with VC certification may fade over time. As the investment horizon extends, concerns about agency conflicts may become more salient. As discussed earlier, VC investors may encourage risk-taking behavior that benefits equity holders but increases the risk exposure of creditors. In such cases, lenders may adjust by demanding higher risk premiums, thereby offsetting any earlier gains in credit terms. The results therefore point to a trade-off: while post-IPO VC may temporarily reduce borrowing costs, these advantages may diminish as lenders respond to long-term risk-shifting incentives embedded in the firm's evolving capital and governance structure.

2.5.2.2 Stock Return Volatility

The second metric is return volatility, calculated as the standard deviation of daily stock returns. This measure reflects a firm's risk-taking behavior and has been widely used to capture managerial attitudes toward uncertainty and exposure to financial distress (John, Litov, & Yeung, 2008). Firms with higher volatility are more likely to pursue

aggressive strategies and face a greater probability of bankruptcy, as shown in Campbell, Hilscher, and Szilagyi (2008). Return volatility thus offers a market-based view of firm-level risk that complements balance-sheet-based indicators. Table 2-8 presents the results.

/Table 2-8 here/

The results reveal a delayed but robust effect of post-IPO venture capital on return volatility. The coefficient on the post-investment indicator becomes statistically significant beginning in the (-3,3) window and remains so in the wider windows. Specifically, in the (-3,3), (-4,4), and (-5,5) windows, the “after” coefficient is positive and significant at the 1% level, in other words, firms experience increased return volatility in the years following VC investment. This shift indicates a change in the firm’s strategic risk profile over the medium term, consistent with the notion that venture-backed firms may engage in more aggressive or uncertain initiatives after securing funding.

While VC support may initially help stabilize credit perceptions, its longer-term effect appears to be an increase in firm-level uncertainty. This may happen due to that VC involvement alters managerial incentives or imposes performance pressure that encourages riskier growth paths. As venture capitalists seek outsized returns, they may support high-variance strategies that increase equity volatility. This change may not immediately register in credit markets but becomes evident in equity market behavior over time. A further explanation relates to the nature of post-IPO VC investment. Because investors can exit through public markets, they face fewer constraints compared to traditional private equity stakes. As noted in the earlier hypothesis development, this

flexibility may incentivize venture capitalists to pursue more aggressive strategies that elevate stock prices in the short term, increasing return volatility as a byproduct.

2.5.2.3 Cash Holding

The third outcome examined is cash holding, measured as the ratio of cash and equivalents to total assets. This variable captures how firms manage liquidity in response to external financing and perceived risk. The motivation for including cash holding as a dependent variable stems from its earlier significance in the survival analysis, where higher cash levels were associated with a lower probability of delisting. If post-IPO VC influences a firm's risk posture, funding structure, or internal control over liquidity, it may also shape the firm's cash policy. Table 2-9 presents the results across event windows.

/Table 2-9 here/

In the shorter windows, the coefficient on the post-investment is negative but statistically insignificant. However, from the (-3,3) window onward, the coefficient becomes negative and significant at conventional levels. This suggests that cash holding tends to decline in the years following post-IPO VC investment.

One take away is that VC involvement reduces the need for precautionary cash reserves, either by improving access to external funding or by promoting more aggressive capital deployment. This would be consistent with earlier findings that VC backing increases risk-taking and reduces financial slack. Alternatively, it may reflect a shift in governance influence, with VC investors exerting pressure to minimize idle cash and improve capital efficiency. This is especially likely when investors have shorter horizons

or clear plans to exit. In such cases, holding large cash reserves may be seen as a sign of inefficiency. VC-backed firms may therefore redirect cash toward expansion, R&D, or acquisitions. This behavior is consistent with the earlier finding that VC investment increases return volatility. Together, the decline in cash holdings and the rise in volatility suggest that firms take on a more aggressive posture after receiving post-IPO VC.

2.5.2.4 Size

The final metric examined is firm size, measured as the logarithm of total assets. Size reflects a firm's operational scale, resource capacity, and market presence. It also plays a critical role in financial stability. In the earlier survival analysis, firm size was one of the most significant predictors of delisting risk, with larger firms showing greater resilience. This motivates a closer look at how post-IPO VC involvement may alter the firm's growth path. The results are shown in table 2-10

/Table 2-10 here/

Rather than prompting expansion, the results suggest a temporary contraction in scale. The regressions show a consistent decline in size immediately after VC entry, with negative and statistically significant coefficients in the (-1,1), (-2,2), and (-3,3) windows. These effects fade in the longer windows, pointing to a short-lived adjustment.

One interpretation is that VC investors may initially push firms to refocus strategy, reduce excess capacity, or divest assets that do not align with high-growth objectives. These steps often reflect a broader effort to streamline operations and concentrate resources on core business segments. As a result, firms may shrink their asset base not

because of underperformance, but as part of a deliberate repositioning. Such restructuring can lead to temporary reductions in scale, even if the long-term goal is to enhance growth efficiency and profitability.

In this context, a smaller balance sheet may signal tighter capital discipline and more selective investment, rather than financial constraint. VC investors—especially those involved post-IPO—often emphasize performance metrics that support market revaluation rather than pure asset accumulation. Their focus tends to shift from size-based expansion to return-driven strategies, where asset efficiency and capital productivity are more important than absolute scale. This can lead firms to cut underperforming segments, delay large fixed investments, or prioritize asset-light models which generate higher margins. The decline in size observed in the early post-investment years may thus reflect a realignment of firm priorities under external influence, where short-term contraction supports longer-term strategic clarity. Instead of spreading resources across multiple lines, firms may concentrate efforts on a narrower set of high-profitability activities. This transition period can involve adjustments that reduce reported asset levels, even if growth ambitions remain unchanged. In that sense, size reduction should be interpreted not as retreat, but as a signal of sharper focus and greater accountability introduced by VC oversight.

2.5.3 Robustness Check

To assess the robustness of the main findings, I re-estimate the relationship between post-IPO VC investment and firm survival using a series of exponential Accelerated Failure Time (AFT) models. While the baseline analysis employs the Cox proportional hazards model, AFT models serve as a useful alternative by directly

modeling the expected survival time, rather than the hazard rate. The AFT approach offers a fully parametric framework and allows for an interpretation of coefficients in terms of time acceleration or deceleration, which provides a complementary perspective on the exit dynamics of public firms.

The exponential distribution is adopted for its simplicity and consistency with the assumption of a constant hazard over time. This assumption aligns with the institutional context in which post-IPO firms operate under stable market rules and listing requirements. Moreover, AFT models are particularly useful when the proportional hazards assumption may not strictly hold across all covariates.

Table 2-11 presents six AFT model specifications with progressively richer sets of control variables.

/Table 2-11 here/

Across all specifications, the coefficient on post_ipo_vc remains negative, large in magnitude, and statistically significant at the 1% level. These results indicate that firms receiving post-IPO VC investments tend to experience significantly shorter durations before delisting. The estimated effect is stable across models, with coefficients ranging from −3.485 to −3.698. The LR chi-squared statistics confirm good model fit and increase with added controls.

These findings are consistent with the baseline Cox results and further substantiate the conclusion that post-IPO VC is associated with increased exit risk. The robustness of the results under an alternative survival modeling framework strengthens

the credibility of the empirical evidence and supports the interpretation that post-IPO VC involvement may amplify firm fragility in public markets

2.5.4 Anecdotal Evidence: The Affymax Case

In this section, a real-world example is briefly presented to provide practical context for the empirical patterns documented above.

Affymax was a U.S. biotechnology company focused on therapies for anemia in dialysis patients and entered public markets while still relying on a limited development pipeline. A notable post-IPO capital event occurred in February 2009, when the firm raised approximately $42 million through a private placement (PIPE). The transaction was led by ProQuest Investments, with participation from existing investors including Sprout Group and Bessemer Venture Partners, alongside new investor Biotechnology Value Fund.

Following this financing, the company accelerated its commercial strategy around a single product, Omontys, which gradually became the central driver of expected future growth. The additional capital provided the resources needed for a rapid transition from development to large-scale commercialisation, including expansion of marketing efforts and operational commitments tied specifically to the product's launch. Rather than pursuing broader diversification across its drug pipeline or maintaining a more balanced allocation of resources, Affymax increasingly concentrated managerial attention and financial capacity on the success of a single therapeutic asset. This strategic choice effectively increased the firm's exposure to idiosyncratic risk, as future cash flow expectations became closely linked to the performance and regulatory stability of one product.

The risks embedded in this strategy became apparent in early 2013, when serious safety concerns emerged shortly after the commercial rollout. Reports of severe adverse reactions led to a nationwide recall of Omontys, forcing the company to suspend its primary revenue source. The market reaction was immediate and severe, Affymax's share price declined by approximately 85% within a single trading session following the recall announcement. With limited alternative assets capable of supporting near-term revenue recovery, the firm faced a rapid deterioration in financial flexibility. In the following weeks, Affymax announced workforce reductions of roughly 75% and began evaluating restructuring alternatives, including potential bankruptcy-related options

Taken together, the sequence from post-IPO private capital support to increased strategic concentration, followed by a sharp decline after adverse information emerged, points to a broader dynamic that is consistent with the patterns observed in the empirical analysis. Access to additional private capital after listing may ease immediate financing constraints and enable firms to pursue expansion strategies that would otherwise be difficult to implement under tighter resource limits. However, the availability of such funding can also reduce incentives to maintain diversification or gradual scaling, particularly when growth expectations become tied to a single commercial objective. In the case of Affymax, capital availability appears to have coincided with a strategic shift toward rapid commercial deployment, increasing the firm's exposure to product-specific shocks and leaving limited capacity to absorb unexpected regulatory or safety outcomes.

This sequence also reflects a tension between short-term growth incentives and long-term survival considerations. Once substantial resources were committed to a single high-variance asset, the firm's operational flexibility narrowed, making its survival

increasingly sensitive to external information shocks. The abrupt decline following the product recall therefore reflects not only the immediate impact of negative news but also the cumulative effects of strategic concentration built during the post-financing period. While a single case cannot establish causality, the Affymax trajectory provides a concrete example of how risk exposure may gradually intensify between post-IPO capital injection and eventual market exit, offering qualitative context for the elevated volatility and reduced survival duration documented in the broader sample.

2.6 Conclusion

This study investigates the relationship between venture capital investment after initial public offerings and the long-term survival of publicly listed companies. Our findings present a complex picture that both complements and challenges existing research. While Iliev and Lowry's (2020, Journal of Finance) work demonstrates positive short-term market responses to post-IPO VC investments, our analysis reveals these immediate benefits may mask significant long-term costs. Where prior research emphasizes the certification value of such investments, our evidence shows post-IPO VC backing correlates with substantially higher delisting risk, with more than half of recipient firms leaving public markets within five years.

The tension between short-term advantages and long-term outcomes requires careful examination. Iliev and Lowry's findings regarding informational benefits and temporary certification effects appear valid in the immediate aftermath of investment. However, our longer-term evidence indicates these same investments may eventually introduce strategic vulnerabilities. The companies in our sample exhibit financial patterns indicating increased fragility—combining smaller size with higher market volatility and limited liquidity. These characteristics, when coupled with agency-driven investment behavior, seem to hasten rather than prevent corporate failure in public markets.

My research extends agency theory to help explain this divergence between short-term benefits and long-term outcomes. The post-IPO environment, characterized by distinctive liquidity conditions and performance demands, appears to convert the informational advantages documented by Iliev and Lowry into drivers of risk-shifting behavior. Although VC investors may initially reduce information asymmetry, their

incentive structures ultimately foster conditions where short-term thinking overshadows long-term stability. The evidence demonstrates that investor incentive arrangements—beyond just informational advantages—can meaningfully contribute to corporate fragility in public markets, heightening tensions not only between shareholders and creditors but also among investors with different time horizons.

These findings also prompt reconsideration of the traditional venture capital lifecycle model. The initial public offering should not be automatically viewed as the final exit event. For numerous companies, it constitutes an intermediate stage where continuing VC influence—while potentially advantageous initially—may eventually lead to an alternative exit path through delisting. This development obscures the conventional distinctions between private and public corporate governance, requiring theoretical approaches that more effectively address the recursive, non-linear development trajectories of modern firms.

The moderating influence of investment structure adds important dimension to this understanding, indicating that negative outcomes are not predetermined. The risk-reducing function of multiple VC deals separates simple capital provision from sustained governance involvement, advancing the discussion beyond basic yes-or-no evaluations of VC presence toward more refined examination of influence processes.

Taken together, these insights reshape how we understand venture capital's function in public equity markets. They point toward a more nuanced interpretation than previously recognized—one where short-term certification and long-term stability may conflict rather than align. This development raises significant questions for researchers examining the transformation of corporate ownership structures and provides practical

direction for market participants who must weigh the evident short-term advantages of post-IPO venture capital against its possible long-term strategic implications.

Despite its contributions, this study is subject to several limitations. First, while survival analysis and event-window regressions provide robust correlational evidence, they cannot fully rule out residual endogeneity, especially given the potential for unobserved firm-specific characteristics to influence both VC investment and survival outcomes. Although propensity score matching and extensive controls help mitigate these concerns, causal inference remains a challenge. Second, the measure of post-IPO VC relies on PIPE transaction classifications, which may not capture informal or indirect forms of VC engagement.

Future research could build on this study in several directions. A promising avenue involves unpacking the role of VC heterogeneity by incorporating data on fund vintage, stage focus, or reputational capital to assess how different types of investors affect post-IPO firm behaviors. Prior studies have highlighted that fund vintage may influence investment strategies and risk tolerance, with older funds under pressure to exit investments more quickly as they approach the end of their lifecycle (Gompers & Lerner, 2000). Stage focus also plays a significant role, as early-stage VCs often provide intensive support and take higher risks compared to late-stage investors, who may prioritize quicker returns and lower uncertainty (Gupta & Sapienza, 1992). Furthermore, VC reputational capital significantly shapes investment behavior—reputable VCs are more selective in investment choices and often exert greater influence on firm strategy to protect their track record (Nahata, 2008). These dimensions of heterogeneity could collectively shape the governance, strategic decisions, and long-term orientation of

portfolio firms, especially after IPO. In addition, cross-country comparisons could reveal how institutional environments, such as investor protection laws or capital market depth, moderate the relationship between post-IPO VC and firm survival. Prior research has shown that stronger investor protection is associated with better governance outcomes and lower agency costs, which may mitigate the destabilizing effects of external equity financing (Doidge, Karolyi, & Stulz, 2007). Similarly, capital market development influences exit opportunities and investment timing, with deeper markets providing more liquidity and better pricing mechanisms that can shape VC behavior and firm performance (Ball, Chiu, & Smith, 2011)

Table 2- 1 Delisting Rate and Time to Delisting by Post-IPO VC Involvement

Panel A

	Firms	Firms(delisted)	Ratio
All sample	26327	9834	37.35%
Without Post-IPO-VC	25916	9639	37.19%
With Post-IPO-VC	411	195	47.44%

Panel B

	Mean	Std.Dev	25%	50%	75%	Min	Max
Time to delisting	5.72	4.19	2	5	8	0	22

Panel A reports the number of firms and delisting rates for the full sample and for subsamples based on whether firms received post-IPO venture capital (VC) financing. The delisting rate is calculated as the percentage of firms that exited the public market during the sample period (2000–2025). Panel B presents summary statistics on the number of years between the first post-IPO VC investment and delisting for the affected subsample. The data show that firms with post-IPO VC exhibit higher delisting rates and shorter survival periods relative to their non-VC-backed counterparts.

Table 2- 2 Industry Distribution and Delisting Rates of Firms with Post-IPO-VC Backing

Sectors	Freq (Post-IPO VC)	Percent	Freq (Post-IPO VC & Delisted)	Percent
10	8	2.04	4	2.09
15	5	1.27	4	2.09
20	20	5.09	8	4.19
25	20	5.09	12	6.28
30	13	3.31	4	2.09
35	199	50.64	95	49.74
40	22	5.6	6	3.14
45	84	21.37	52	27.23
50	14	3.56	6	3.14
55	1	0.25	0	0
60	7	1.78	0	0
Total	393	100	191	100

This table reports the number and percentage of firms that received post-IPO venture capital (VC) financing across Global Industry Classification Standard (GICS) sectors, along with the number and percentage of those firms that were subsequently delisted. Sectors are identified by GICS codes:
10 = Energy, 15 = Materials, 20 = Industrials, 25 = Consumer Discretionary, 30 = Consumer Staples, 35 = Health Care, 40 = Financials, 45 = Information Technology, 50 = Communication Services, 55 = Utilities, and 60 = Real Estate.
Health Care (code 35) and Information Technology (code 45) received the highest number of post-IPO VC-backed firms and also account for a large share of the delisted subsample.
It is worth noting that there are 18 firms are unclassified in terms of their GICS sector (4 with Post-IPO-VC). Therefore, the total observations are in line with the numbers shown in table 2-1

Table 2- 3 Comparsion of Firm Features by Post-IPO-VC Involvement

	Firm without Post-IPO-VC	Firm with Post-IPO-VC	Difference
Size (Ln)	5.7724	5.6521	0.1203**
Sales (Ln)	5.2223	4.7891	0.4332***
ROA	-0.1692	-0.3106	0.1413***
Leverage	0.3647	0.1972	0.16750
Intangibility	0.1333	0.1396	-0.6249*
Cash holding	0.1588	0.2948	-0.1351***
R&D intensity	0.3919	0.2734	0.1184
Current ratio	4.1205	4.7640	-0.6434
Age	9.0756	12.5828	-3.5071***
Altman Z-score	1.1529	0.1432	1.0096***
Long-Term Debt Due in One Year	303.1718	777.6770	311.8484***
Long-Term Debt Due in Two Year	187.5554	155.5676	31.98781
Long-Term Debt Due in Three Year	178.9706	186.3613	-7.3907
Long-Term Debt Due in Four Year	155.8721	177.3913	-21.5192

This table compares firm characteristics between two groups: firms that received post-IPO venture capital (VC) funding and those that did not. The first two columns show the average values for each variable by group. The third column reports the difference in means, along with significance levels based on t-tests (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). Variables include firm size and sales (log-transformed), profitability (ROA), leverage, intangibility, cash holdings, R&D intensity, liquidity (current ratio), firm age, and financial health (Altman Z-score). The table also reports the average amount of long-term debt due in one to four years. Statistically significant differences are observed in firm age, ROA, Altman Z-score, cash holdings, and short-term debt, indicating structural distinctions between VC-backed and non-VC-backed post-IPO firms

Table 2- 4 Propensity Score Matching Before and After Balancing

	Before Matching	After Matching
ROA	0.0559***	-0.0396
	(0.0198)	(0.0452)
size	-0.0144**	0.0375**
	(0.00648)	(0.0146)
leverage	-0.0842***	-0.0530
	(0.0238)	(0.0392)
RD_intensity	0.394***	0.287***
	(0.0369)	(0.0868)
Cash_holding	1.067***	-0.0462
	(0.0475)	(0.0880)
Z_socre_	-0.0109***	-0.00196
	(0.00195)	(0.00334)
_cons	-1.972***	-0.234**
	(0.0437)	(0.0943)
N	48074	3480
PseudoR2	0.0738	0.0056
Wald Chi^2	1224.28	15.57

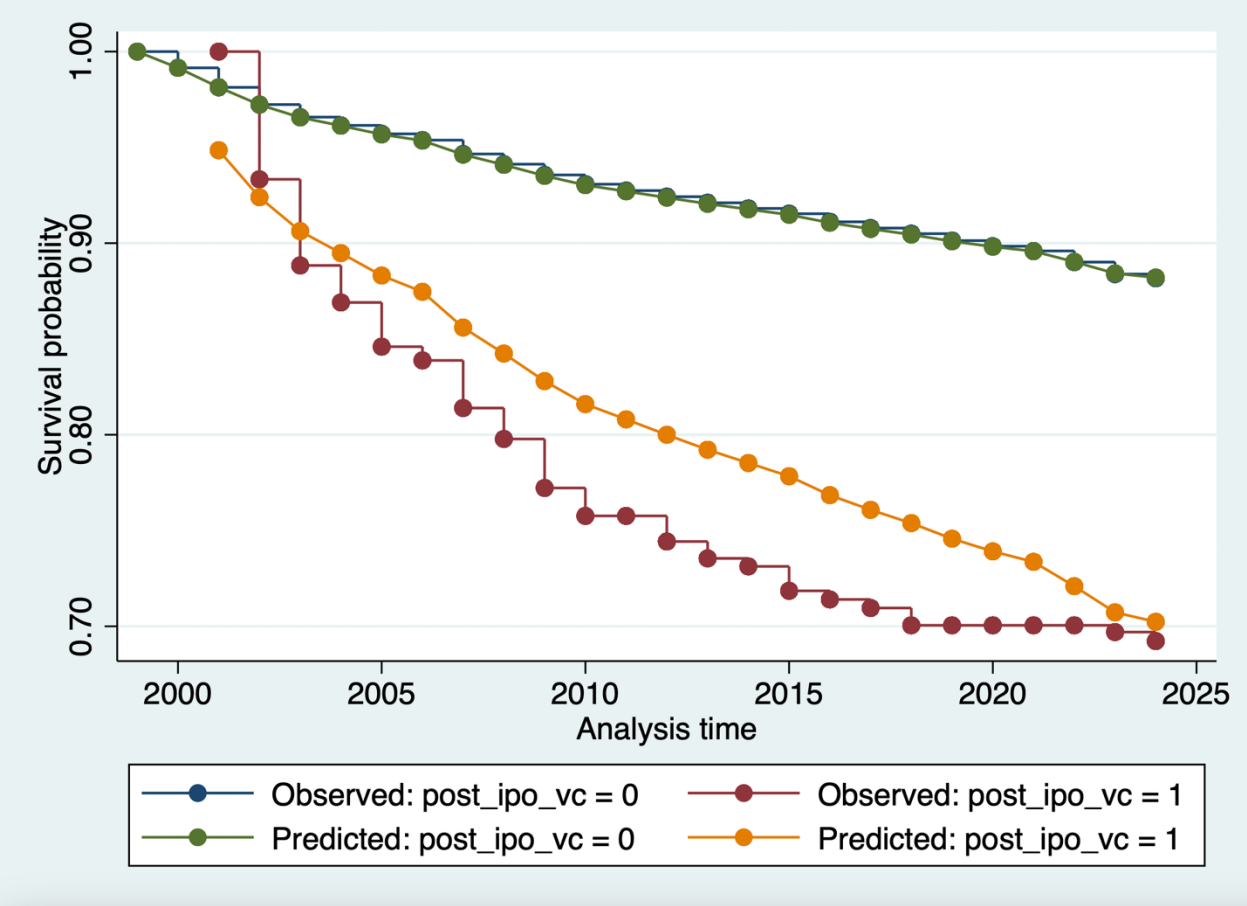
This table presents Probit estimates used to generate propensity scores for matching firms with and without post-IPO VC investments. Columns “Before Matching” report coefficient estimates (and standard errors) from a Probit regression on the full sample (N = 48,074), where the dependent variable equals one if the firm received post-IPO VC financing. Columns “After Matching” report the same Probit model estimated on the matched subsample (N = 3,480) obtained via nearest-neighbor matching within industry and year. Regressors include return on assets (ROA), firm size (Ln Total Assets), leverage (total debt over assets), R&D intensity (R&D over sales), cash holdings (cash over assets), and Altman Z-score. Asterisks denote significance levels: * p < 0.10; ** p < 0.05; *** p < 0.01. After matching, all covariates are statistically indistinguishable between treated and control groups, indicating effective balance

Table 2- 5 Cox Proportional-Hazards Estimates of the Effect of Post-IPO-VC Investment on Firm Delisting

	(1)	(2)	(3)	(4)	(5)	(6)
post_ipo_vc	1.040***	0.594***	0.670***	0.685***	0.688***	0.453**
	(6.72)	(3.72)	(3.95)	(4.04)	(4.06)	(2.13)
Debt - Due in One Year		0.000*	0.000***	0.000***	0.000***	0.000***
		(1.84)	(3.96)	(4.10)	(4.36)	(5.32)
Debt - Due in 2nd Year			-0.000	0.000	0.000	
			(-0.25)	(0.75)	(1.04)	
Debt - Due in 3rd Year				-0.000	-0.000	
				(-0.87)	(-0.14)	
Debt - Due in 4th Year					-0.000	
					(-1.23)	
Size						-0.449***
						(-8.21)
ROA						-0.000*
						(-1.72)
Age						-0.003
						(-0.41)
R&D intensity						-0.000
						(-0.54)
cashholding						-0.008***
						(-3.20)
lnsale						0.111**
						(2.46)
leverage						-0.000
						(-1.42)
current ratio						-0.009
						(-0.30)
intangibity						-0.001
						(-0.33)
Z						0.000**
						(2.56)
N	3480	3480	3480	3480	3480	3480
Wald-chi2	45.15	18.06	37.36	37.12	41.65	364.99

This table presents results from Cox proportional-hazards models evaluating the relationship between post-IPO VC investment and the probability of firm delisting. The dependent variable is the time from post-IPO VC investment to delisting. Column (1) includes only the post-IPO VC indicator as the treatment variable. Columns (2)– (5) progressively control for debt obligations due in one to four years. Column (6) includes all firm-level financial characteristics: firm size (log assets), return on assets (ROA), firm age, R&D intensity, cash holding, sales, leverage, current ratio, intangibility, and Altman Z-score. Post-IPO VC investment is consistently associated with a significantly higher hazard of delisting across all model specifications. Among the maturity controls, only short-term debt (due in one year) is statistically significant. Other firm-level variables behave as expected

Figure 2- 1 Survival Curves by Post-IPO-VC Status



This figure plots the observed and predicted survival probabilities for firms with and without post-IPO venture capital investment, estimated using a Cox proportional hazards model. Firms that received post-IPO VC (red and orange lines) show significantly lower survival rates over time than non-VC-backed firms (blue and green lines). The persistent gap between the two groups supports the main hypothesis that post-IPO VC investment is associated with increased delisting risk. The close alignment between observed and predicted curves indicates good model fit and validates the proportional hazards assumption.

Table 2- 6 Cox Proportional-Hazards Estimates of the Effect of Post-IPO-VC Deal Intensity on Firm Delisting Risk

	(1)	(2)	(3)
No. of Deals	-0.358*	-0.017**	-0.546**
	(-1.88)	(-2.16)	(-2.07)
Avg Equity Per Deal			-0.007
			(-0.65)
size			-0.410*
			(-1.95)
roa			-0.0002
			(-0.44)
lnsale			0.139
			(0.94)
Leverage			-0.001
			(-0.58)
currentratio			-0.316*
			(-1.95)
Z			-0.017***
			(-2.60)
N	2441	2441	2441
Wald-chi2	24.15	27.98	46.61

This table reports the results from Cox proportional-hazards models that examine the relationship between the intensity of post-IPO VC involvement and the likelihood of firm delisting. The main explanatory variable is the number of post-IPO VC deals. Column (1) includes only this count variable. Column (2) adds controls for average equity stake per deal, firm size, profitability (ROA), sales, and leverage. Column (3) includes additional controls such as current ratio and Altman Z-score. Across specifications, a higher number of post-IPO VC deals is associated with an increased hazard of delisting. The effect is statistically significant at the 10% level or better. The table also shows that firms with weaker liquidity (lower current ratio) and lower Altman Z-scores face higher exit risk. z-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 2- 7 Impact of Post-IPO-VC Investment on Firm Cost of Debt Across Varying Event Windows

	(1) Window (-1,1)	(2) Window (-2,2)	(3) Window (-3,3)	(4) Window (-4,4)	(5) Window (-5,5)
after	-0.511*	-0.348*	-0.144	-0.110	-0.020
	(-1.95)	(-1.80)	(-0.86)	(-0.56)	(-0.11)
size	-0.333	-0.358***	-0.259***	0.113	0.112
	(-1.56)	(-2.93)	(-2.79)	(1.15)	(1.32)
roa	0.004	0.003**	0.002**	-0.006***	-0.005***
	(1.46)	(2.04)	(1.98)	(-6.53)	(-6.19)
age	0.424**	0.285***	0.152***	0.077	0.033
	(2.56)	(3.59)	(2.90)	(1.56)	(0.86)
lev	0.046***	0.063***	0.051***	0.045***	0.053***
	(2.99)	(7.23)	(7.82)	(6.08)	(8.30)
currentratio	-0.006	-0.002	-0.002	0.003	0.003
	(-0.32)	(-0.23)	(-0.21)	(0.40)	(0.45)
cashholding	-0.007*	-0.004	-0.004	-0.002	-0.001
	(-1.71)	(-1.41)	(-1.56)	(-0.72)	(-0.23)
intangibity	0.015	0.007	0.001	0.009	0.008
	(1.21)	(0.80)	(0.20)	(1.30)	(1.32)
_cons	0.111	0.791	0.989**	-0.914*	-0.713*
	(0.10)	(1.26)	(2.12)	(-1.92)	(-1.76)
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	298	452	571	683	776
R2	0.148	0.221	0.173	0.169	0.175

This table reports the results of firm-level regressions examining changes in cost of debt following post-IPO VC investment events. The key explanatory variable, after, is a dummy equal to one if the observation falls after the VC event date. Columns (1) to (5) show results using event windows of different lengths: (−1, +1), (−2, +2), (−3, +3), (−4, +4), and (−5, +5) years around the VC transaction. All regressions control for firm size (log assets), return on assets (ROA), age, leverage, current ratio, cash holdings, and intangibility. Firm, industry, and year fixed effects are included throughout. All standard errors are clustered at the industry level. t-statistics are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The negative and statistically significant coefficients on after in Columns (1) and (2) suggest that firms experience a reduction in cost of debt in the short-term following VC involvement. This effect diminishes and becomes statistically insignificant as the event window widens.

Table 2- 8 Impact of Post-IPO-VC Investment on Firm Stock Return Volatility Across Varying Event Windows

	(1) Window (-1,1)	(2) Window (-2,2)	(3) Window (-3,3)	(4) Window (-4,4)	(5) Window (-5,5)
after	0.003	0.002	0.003***	0.003***	0.003***
	(1.46)	(1.51)	(2.83)	(3.16)	(3.09)
size	-0.001	-0.001	-0.002**	-0.003***	-0.003***
	(-0.74)	(-0.83)	(-2.07)	(-4.70)	(-4.73)
roa	-0.000	-0.000**	-0.000***	-0.000***	-0.000***
	(-1.49)	(-2.13)	(-2.90)	(-3.45)	(-3.89)
age	-0.000	-0.000	0.000	0.001**	0.000*
	(-0.10)	(-0.67)	(1.07)	(2.28)	(1.75)
lev	-0.000	0.000*	0.000	0.000	0.000
	(-0.06)	(1.74)	(1.57)	(0.49)	(0.58)
currentratio	0.000	0.000	0.000	0.000	0.000
	(0.45)	(0.05)	(1.03)	(1.39)	(0.39)
cashholding	0.000	0.000	0.000	0.000**	0.000**
	(0.45)	(1.42)	(1.34)	(1.99)	(1.99)
intangibity	0.000	0.000*	0.000**	0.000**	0.000**
	(1.26)	(1.78)	(2.36)	(2.52)	(2.36)
_cons	0.032***	0.032***	0.032***	0.038***	0.037***
	(2.76)	(4.78)	(6.15)	(9.41)	(11.25)
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	498	747	950	1137	1293
R2	0.088	0.060	0.056	0.076	0.076

This table reports firm-level regressions assessing changes in stock return volatility surrounding post-IPO VC investment events across symmetric event windows. The dependent variable is the standard deviation of daily stock returns, serving as a proxy for firm risk-taking behavior. The key explanatory variable, after, is a dummy equal to one if the observation falls after the VC investment year. Columns (1) to (5) display results for five event windows: (−1, +1), (−2,+2), (−3,+3), (−4,+4), and (−5,+5) years around the investment. The models include firm, year, and industry fixed effects, and control for firm size, ROA, age, leverage, liquidity, cash holdings, and intangibility. Firm, industry, and year fixed effects are included throughout. All standard errors are clustered at the industry level. t-statistics are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Results show that return volatility significantly increases in the medium- and long-term following VC investment, suggesting heightened strategic uncertainty and risk exposure consistent with risk-shifting behavior.

Table 2- 9 Impact of Post-IPO-VC Investment on Firm Cash Holdings Across Varying Event Window

	(1) Window (-1,1)	(2) Window (-2,2)	(3) Window (-3,3)	(4) Window (-4,4)	(5) Window (-5,5)
after	-1.232	-1.079	-2.332	-2.635*	-3.208**
	(-0.48)	(-0.55)	(-1.37)	(-1.71)	(-2.24)
size	0.512	0.070	-1.828**	-1.983***	-2.079***
	(0.28)	(0.06)	(-2.12)	(-2.88)	(-3.35)
roa	0.034***	0.010**	0.011***	0.000	0.000
	(3.22)	(2.44)	(2.93)	(0.23)	(0.25)
age	-1.345	-1.063	-0.181	0.003	0.229
	(-0.87)	(-1.45)	(-0.38)	(0.01)	(0.82)
lev	0.034	-0.046***	-0.060***	-0.071***	-0.066***
	(1.14)	(-2.69)	(-3.79)	(-4.98)	(-4.79)
currentratio	-0.027	0.055	0.177*	0.285***	0.258***
	(-0.12)	(0.47)	(1.78)	(3.24)	(3.18)
intangibity	-0.480***	-0.535***	-0.527***	-0.462***	-0.443***
	(-5.18)	(-8.73)	(-10.61)	(-10.73)	(-11.19)
_cons	48.243***	49.331***	53.119***	50.736***	49.413***
	(4.52)	(8.80)	(13.07)	(15.98)	(17.66)
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	806	1262	1636	1948	2204
R2	0.089	0.108	0.126	0.119	0.111

This table reports results from firm-level regressions examining how post-IPO venture capital investment affects firm cash holdings, measured as the ratio of cash and equivalents to total assets. The key explanatory variable, after, is a post-investment dummy indicating whether the observation occurs after the VC financing year. Columns (1) to (5) display results across symmetric event windows: (−1, +1), (−2, +2), (−3, +3), (−4, +4), and (−5, +5) years. The models include firm, year, and industry fixed effects, and control for firm size, ROA, age, leverage, liquidity, cash holdings, and intangibility. Firm, industry, and year fixed effects are included throughout. All standard errors are clustered at the industry level. t-statistics are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Results show that post-IPO VC investment is associated with a statistically significant reduction in cash holdings in the medium and long-term windows, suggesting that VC-backed firms may adopt more aggressive capital allocation strategies following investment. The decline in cash holdings supports the hypothesis that VC involvement reduces precautionary liquidity buffers and potentially increases financial risk.

Table 2- 10 Impact of Post-IPO-VC Investment on Firm Size Across Varying Event Windows

	(1) Window (-1,1)	(2) Window (-2,2)	(3) Window (-3,3)	(4) Window (-4,4)	(5) Window (-5,5)
after	-0.175*** (-2.67)	-0.129** (-2.17)	-0.097* (-1.73)	-0.058 (-1.02)	-0.030 (-0.55)
roa	-0.000 (-0.31)	0.000 (0.80)	0.001*** (4.14)	-0.001*** (-5.21)	-0.001*** (-5.20)
age	0.233*** (6.09)	0.185*** (8.67)	0.159*** (10.54)	0.147*** (11.74)	0.136*** (13.25)
lev	-0.001 (-1.31)	0.000 (0.49)	0.001 (1.34)	-0.002*** (-3.64)	-0.002*** (-3.48)
currentratio	0.046*** (8.73)	0.023*** (6.76)	0.022*** (7.14)	0.025*** (8.11)	0.024*** (8.19)
cashholding	-0.000 (-0.10)	-0.001 (-0.57)	-0.002*** (-2.68)	-0.003*** (-3.61)	-0.004*** (-4.35)
intangibity	0.009*** (4.03)	0.010*** (5.46)	0.011*** (6.43)	0.012*** (7.25)	0.013*** (8.39)
_cons	3.105*** (13.20)	3.546*** (26.96)	3.754*** (38.94)	3.727*** (44.56)	3.796*** (52.33)
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	722	1132	1468	1749	1973
R2	0.482	0.433	0.456	0.399	0.404

This table reports firm-level regressions evaluating changes in firm size (log of total assets) around post-IPO VC investment events, across symmetric event windows ranging from (−1,+1) to (−5,+5) years. The key explanatory variable, after, equals one if the observation occurs after the year of VC investment. The models include firm, year, and industry fixed effects, and control for firm size, ROA, age, leverage, liquidity, cash holdings, and intangibility. Firm, industry, and year fixed effects are included throughout. All standard errors are clustered at the industry level. t-statistics are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Results show a statistically significant reduction in firm size immediately following VC involvement, particularly in the short-term windows. The negative effect diminishes and becomes insignificant over longer windows, suggesting a temporary contraction in firm scale. This pattern is consistent with the hypothesis that VC investors may initially push for strategic realignment, divestitures, or operational streamlining, rather than immediate expansion.

Table 2- 11 Exponential AFT Estimation: Effect of Post-IPO-VC on Firm Survival Time

	(1)	(2)	(3)	(4)	(5)	(6)
post_ipo_vc	-3.698***	-3.561***	-3.486***	-3.489***	-3.485***	-3.514***
	(-24.57)	(-23.11)	(-21.22)	(-21.24)	(-21.21)	(-14.03)
dd1		-0.000***	-0.000***	-0.000***	-0.000***	-0.001***
		(-2.97)	(-3.58)	(-3.18)	(-2.78)	(-7.12)
dd2			-0.000**	-0.000	-0.000	0.001***
			(-2.06)	(-0.59)	(-0.59)	(3.12)
dd3				-0.000	0.000	0.001*
				(-0.38)	(1.60)	(1.82)
dd4					-0.000	0.000
					(-0.61)	(1.35)
dd5					-0.000***	-0.000
					(-2.62)	(-0.48)
size						0.376***
						(7.94)
roa						-0.000
						(-0.68)
age						-0.101***
						(-22.33)
RDintensity						-0.001***
						(-2.94)
cashholding						-0.000
						(-0.08)
lnsale						-0.168***
						(-3.77)
lev						-0.000
						(-1.01)
currentratio						0.029*
						(1.88)
intangibity						-0.019***
						(-7.13)
_cons	10.038***	9.666***	9.574***	9.577***	9.574***	9.123***
	(483.37)	(439.51)	(371.88)	(370.05)	(367.18)	(79.16)
LR	244.250	226.664	221.267	219.630	226.139	667.117

This table reports the results from exponential Accelerated Failure Time (AFT) models that assess the effect of post-IPO venture capital (VC) investment on firm survival duration. The dependent variable is the time from the receipt of post-IPO VC investment to firm delisting. The key explanatory variable, post_ipo_vc, is a treatment indicator equal to one for post-investment observations. Columns (1) to (6) progressively add control variables including short-term and long-term debt obligations (dd1 to dd5), firm size, profitability (ROA), age, R&D intensity, cash holdings, sales, leverage, current ratio, and intangibility. Z-statistics are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Across all model specifications, post-IPO VC involvement is associated with a significantly shorter time to delisting, supporting the main findings from the Cox proportional hazards model. The results are robust to alternative survival model specifications, suggesting that post-IPO VC financing increases exit risk.

3. The Effect of Unicorns on The Early-Stage Success of Start-ups

3.1 Introduction

In recent years, the emergence of unicorn companies—privately held startups valued at over $1 billion—has fundamentally reshaped the entrepreneurial and investment landscape. These firms have become increasingly common in global markets, with the United States and China leading in terms of unicorn creation and valuation (Zhai & Carrick, 2019; Brown & Wiles, 2020). By 2020, the total valuation of U.S. unicorns surpassed $1.37 trillion, and many remained private for over nine years on average, allowing founders and early investors to realize significant returns (Brown & Wiles, 2020). Similarly, in China, strategic government support, infrastructure development, and aggressive venture capital inflows have driven the growth of 68 unicorns as of 2018, many of which operate in technology-intensive sectors like healthcare and infrastructure (Zhai & Carrick, 2019). This trend signals not only a transformation in how startups scale and attract capital but also a significant shift in how competition unfolds in the startup ecosystem.

Unicorns often enjoy several advantages that allow them to secure dominant market positions. These include early market entry, access to substantial private financing, and rapid brand development. Their ability to attract high-profile investors, secure industry partnerships, and build customer trust creates high barriers for new entrants. As these firms become industry leaders, they set standards that competitors must meet or surpass. Their growth is further supported by factors such as network effects, scale advantages, and consistent media exposure, which together strengthen their market position and

enhance their appeal to potential investors (Katz & Shapiro, 1985; Lieberman & Montgomery, 1988).

At the same time, these features raise concerns about the downstream impact of unicorn dominance on peer startups, especially regarding access to funding from prestigious venture capital firms.While the rise of unicorns has received significant scholarly attention, the majority of existing research focuses on the conditions under which startups attain unicorn status. Studies have emphasized the importance of investor reputation, founder characteristics, location in innovation clusters, and strategic growth models as key drivers of unicorn formation (Kaplan & Strömberg, 2004; Bernstein et al., 2016; Hammer et al., 2017). Scholars also note that unicorns prefer to stay private longer, largely due to the need to protect intangible assets such as organizational capital, which may be vulnerable during the IPO process (Chemmanur & Fulghieri, 2014). This strategic behavior allows unicorns to accumulate more value privately and strengthens their industry foothold before going public.

However, there is still a significant gap in the literature regarding the broader ecosystem effects of unicorns, particularly their influence on other startups in the same industry. Existing research rarely investigates how the presence of unicorns might alter the ability of competing startups to secure funding from top-tier VC firms. This omission is important because high-reputation VC funding plays an important role in startup success. Such investors bring not only capital but also strategic advice, professional networks, and signaling value that can enhance a startup’s credibility and growth potential (Bernstein et al., 2017).

A central question remains unanswered: Does the presence of unicorn competitors increase or decrease a startup's likelihood of receiving investment from prestigious venture capital firms? There are strong theoretical reasons to believe that unicorn presence may affect this outcome, but the direction of the effect is ambiguous.

On the one hand, unicorns may discourage VC investment in competing startups. Their market dominance and investor backing may crowd out opportunities for others. The "first-mover advantage" allows unicorns to lock in critical resources such as customers, talent, and partnerships (Lieberman & Montgomery, 1988). VCs may interpret the existence of a unicorn as a signal that the market is already saturated, which increases perceived risk for late entrants. This can result in a "crowding-out" effect where newer startups receive less attention, fewer resources, and lower valuation expectations. Moreover, unicorns often lower prices aggressively, integrate vertically, and acquire potential competitors, all of which make it more difficult for smaller firms to establish a distinct market position. Gans, Hsu, and Stern (2003) highlight how new entrants often face a binary choice: compete with dominant incumbents or collaborate through acquisition. In industries where unicorns prevail, the opportunity for standalone growth may appear limited, discouraging external investment.In addition, unicorns' dominance can raise the cost of due diligence for VCs. When a startup operates in a unicorn-dominated market, investors must evaluate whether the new firm can differentiate itself meaningfully and withstand direct competition. This evaluation process is complex and resource-intensive, often leading VCs to favor safer, less contested investments (Chemmanur & Fulghieri, 2014). Furthermore, unicorns may monopolize attention within

the VC community, redirecting capital flows toward firms with proven scale and reducing interest in smaller, unproven competitors.

On the other hand, unicorns may stimulate VC investment in competing startups. The success of unicorns often signals the viability of the industry, encouraging VCs to seek the “next unicorn.” This phenomenon, often referred to as the “halo effect,” suggests that the presence of one high-performing firm increases the perceived attractiveness of others in the same domain (Thorndike, 1920). From this perspective unicorns tend to attract rather than deter VC interest, as their success often serves as a signal that the market holds real potential. Venture capitalists, motivated by the fear of missing out, may actively search for competitors who can offer differentiated products, tap into overlooked customer segments, or provide better value propositions.Moreover, startups that follow unicorns into a market may enjoy second-mover advantages. Unlike first movers, these startups can learn from the unicorn’s strategies, refine business models, avoid early-stage mistakes, and better align with market demands (Hoppe, 2003; Khurana et al., 2022). In dynamic industries, second movers can exploit niches that unicorns ignore, particularly in underserved markets or segments that require customization and flexibility. Christensen, Raynor and McDonald (2015) argue that disruptive innovation often emerges from smaller firms that target neglected customer bases. These dynamics suggest that unicorn competition may not always suppress new ventures. In fact, it may create conditions that make differentiated startups more attractive to high-reputation VCs.

Given these competing theoretical perspectives, the empirical relationship between unicorn competition and VC investment remains unclear. Few studies have addressed this issue directly, and even fewer have used causal identification strategies

to estimate the impact. Most research continues to treat unicorns and early-stage startups as isolated subjects, failing to account for how dominance in one part of the ecosystem can reshape opportunities in another.

This study addresses this critical gap by investigating how the presence of unicorn competitors affects the likelihood that startups will receive investment from high-reputation VC firms. The research draws on a unique dataset of U.S.-based startups and unicorns from 2013 to 2019. A difference-in-differences (DID) framework is used to identify causal effects, taking advantage of the 2017 Tax Cuts and Jobs Act (TCJA) as a quasi-experimental policy shock. The TCJA reduced corporate tax rates, introduced deductions for pass-through income, and increased capital availability for private investment, all of which significantly altered the venture capital environment. These changes make the post-2017 period an appropriate setting to study changes in investor behavior and startup funding dynamics.

Furthermore, the analysis investigates two potential moderators: (1) the number of unicorn competitors within an industry, and (2) the presence of startups in designated Opportunity Zones (OZs). The number of unicorns may determine whether their dominance is centralized or fragmented. A single unicorn may exercise more market control than multiple competing unicorns, potentially leading to different effects on startup funding. Meanwhile, OZs provide tax benefits for investors and are designed to attract capital to underdeveloped areas. Startups located in OZs may be less affected by unicorn dominance due to favorable tax treatment and weaker direct competition. These additional layers of analysis enhance the robustness and policy relevance of the findings.

This study makes several distinct contributions to the literature on entrepreneurial finance. First, it moves beyond the conventional emphasis on unicorn formation or performance by examining their systemic impact on the broader startup environment. This shift in emphasis shows how the rise of unicorns affects where venture capital goes and changes competition within the innovation system. Second, the study enhances our understanding of venture capital allocation by demonstrating how market concentration and inter-firm competition influence investor behavior—especially regarding capital access among non-unicorn startups. Third, the study provides evidence on startup inequality, showing how a small number of leading firms can deepen gaps in funding and limit opportunities for other entrepreneurs. Finally, the study offers actionable insights for both startup founders and policymakers. For entrepreneurs, the findings underscore the importance of strategic differentiation and signaling to attract prestigious venture capital in the shadow of unicorns. For policymakers, the study highlights the role of targeted spatial incentives—such as Opportunity Zones—in counteracting capital concentration and promoting investment in underdeveloped regions.

To provide a comprehensive analysis, the remainder of this study is structured as follows: Chapter 2 presents a detailed literature review, covering the emergence of unicorns, the drivers behind their success, and their relationship with peer startups. Chapter 3 outlines the empirical strategy, including data sources, identification methods, and variable construction. Chapter 4 discusses the results of the econometric analysis, including robustness checks for the role of multiple unicorn competitors and spatial policy interventions. Chapter 5 concludes by summarizing key findings, outlining practical implications, and proposing directions for future research.

3.2 Related Literatures

This section synthesizes prior research to contextualize the study's core questions. By reviewing existing work on unicorn firms, startup financing, and competitive dynamics, it aims to identify what is known, where gaps remain, and how this study contributes to the literature.

3.2.1The Unicorn Wave and Staying Private

There is a limited body of literature focusing on unicorn companies, particularly in terms of examining the broader impact these firms have on the startup ecosystem as a whole. In the literature on unicorn companies, most scholars focus on studying the overall evolution trends of unicorn companies and the key drivers that enable companies to achieve unicorn status.

In recent years, the rise of unicorn companies has become increasingly frequent, many scholars explore the phenomenon and the underlying reason. Brown and Wiles (2020) analyzed the evolution of unicorn companies in the US over the past decade, highlighting their rapid growth and diversification. By 2020, unicorns' total valuation surpassed $1.37 trillion, far outpacing public market growth. On average, these companies remain private for 9.5 years, enabling founders and early investors to achieve significant returns, often six times their initial investment. The study suggests that private investors capture more value during the growth phase compared to public shareholders.

Not only have developed countries experienced this wave, but unicorn companies in emerging markets have also undergone rapid growth. China is experiencing rapid unicorn growth as well. Zhai and Carrick (2019) report that by August 2018, China had

68 unicorns, ranking second after the U.S. They focus on technology, healthcare, and infrastructure. Government policies, such as subsidies and tax incentives, have helped their expansion. Strategic partnerships and venture capital investments have also played a key role. Many unicorn founders have strong industry backgrounds and business connections, which support their growth.

In addition to the steadily growing number of unicorn companies, some studies have highlighted their preference for staying private rather than going public.Research by Davydova, Fahlenbrach, Sanz, and Stulz (2022) suggests that unicorns often stay private due to their reliance on organizational capital. One explanation is that companies with high organizational capital are more vulnerable to the risks of expropriation when going public, especially before solidifying their market position. Empirical evidence shows that when organizational capital becomes more fragile, firms are less likely to go public. This suggests that staying private helps unicorns safeguard this valuable asset. Additionally, achieving unicorn status provides access to alternative funding sources, allowing these firms to delay or avoid public listing. Studies also find that unicorns and their respective industries have a higher organizational capital intensity than typical startups, further supporting their tendency to stay private to safeguard this critical asset (Ewens, Nanda, & Rhodes-Kropf, 2018).

In summary, the rapid rise of unicorn companies has become a global trend, with significant growth in both developed and emerging markets. Many unicorns choose to remain private to protect their organizational capital and avoid risks associated with public listing. This preference for staying private allows them to secure alternative funding and maintain a competitive edge.

3.2.2 Drivers of Unicorns

Numerous studies have explored the key drivers behind companies achieving unicorn status.

Investor reputation plays an essential role in a startup's journey to becoming a unicorn. High-reputation investors bring extensive industry experience, vast networks, and robust operational support, which enhance a startup’s value through strategic guidance and operational assistance (e.g., financial advice, business development). In addition, prestigious investors also have advantages in attracting additional high-quality investors in subsequent funding rounds, increasing valuation (Bernstein et al., 2016).

Another critical factor influencing whether a startup can achieve unicorn status is its geographic location within innovation clusters. These clusters support the growth of promising startups by connecting them with skilled talent from nearby universities and research centers, while also encouraging innovation and the exchange of ideas. (Calcagnini et al., 2016). In addition, being near early users helps startups gather feedback faster, which allows them to improve their products and better meet market needs. (Gilbert et al., 2008). The availability of abundant venture capital within these clusters further accelerates the development process by providing startups with the necessary funding to scale their operations (Castilla, 2003).

The growth plan of a startup is also a crucial core element that profoundly affects its likelihood of achieving unicorn status. Startups often use fast-paced growth strategies—such as acquiring competitors or related firms—to quickly expand their market share and strengthen their position in the industry. These tactics improve asset usage and create operational efficiencies, leading to increased valuations (Hammer et al.,

2017). Furthermore, a "winner-takes-all" strategy is particularly useful for platform-based business models. As achieving market leadership often fuels accelerated growth and helps sustain a competitive advantage (Stayton and Mangematin, 2018).

The quality of the management team is another essential determinant of a startup's success. A competent and diverse management team is better equipped to identify market opportunities, navigate challenges, and implement innovative solutions. These abilities are particularly important in dynamic and competitive environments, where swift and strategic decision-making is essential. High-caliber teams not only drive operational success but also instill confidence in investors, further increasing the likelihood of a startup achieving unicorn status (Bernstein et al., 2017).

3.2.3 The Early Success of Start-up

As previously mentioned, the involvement of prestigious VC investors is a crucial factor in determining whether a start-up company can evolve into a unicorn enterprise. This raises the question: what factors influence a start-up's ability to attract investment from prestigious VC? Several studies have explored the factors that determine a start-up's attractiveness to prestigious venture capital firms.

Internal factors can impede a start-up's capacity to obtain venture capital financing. Kaplan and Strömberg (2004) underline the importance of the founding team's entrepreneurial experience, industry understanding, and leadership qualities. Furthermore, Gompers et al (2020) state that the scalability of the business model and its potential for substantial returns are critical factors in VC decision-making. Intellectual property and technology advantages, such as patents, unique technical capabilities, and

creative employees are also important in attracting investors (Dimmock et al., 2024). Finally, early market performance measures such as customer acquisition, revenue growth, and market share are also important for proving initial traction and increasing a start-up's appeal to venture capital companies (Chemmanur and Fulghieri, 2014).

External environmental factors also significantly influence a start-up's capacity to secure venture capital financing. Market factors such as industry developments and competitive dynamics, can profoundly affect venture capitalists' propensity to invest. VCs are more likely to fund start-ups in growing industries. Geographic proximity between start-ups and VC companies has typically influenced investment decisions since it improves monitoring and collaboration (Sorenson & Stuart, 2001). Globalisation and virtual communication are easing this barrier, allowing start-ups from emerging markets or remote places to seek financing. Government policies and regulatory frameworks shape investment as well. Supportive policies like tax advantages or start-up subsidies can boost investment in a region (Lerner, 2009).

Venture capital funding also depends on social and cultural elements like entrepreneurial startup environment, local talent pools, and network access. Entrepreneurial ecosystems provide support through incubators, accelerators, and mentorship, enhancing start-ups' growth potential. Local talent pools signal a start-up's ability to build strong teams, while access to professional networks bring connections with industry leaders and investors, which enhances credibility and attractiveness to VCs. These factors collectively create an environment conducive to innovation and investment. (Malecki, 1997).

Incubators, accelerators, and co-working facilities boost start-ups' investor appeal. Hochberg, Ljungqvist, and Lu (2007) note that mentorship, funding networks, and collaborative environments fuel innovation and growth. Startups benefit from incubators' office space, technical support, and experienced advisors, lowering entrance barriers and increasing survival rates. Through organized programs, accelerators provide strategic counsel, cash, and direct access to venture capitalists to accelerate scaling. Startups discuss ideas and form collaborations in co-working spaces. These features boost operational efficiency and credibility, making a startup more appealing to top VCs (Cohen 2014; Hochberg, 2016).

In addition to internal factors and external industry environment factors, the ability of start-ups to attract prestigious venture capital is also influenced by other factors such as strategic planning and industry alignment. Hsu (2004) demonstrates that entrepreneurs are often willing to accept lower valuations in exchange for affiliation with more reputable venture capitalists, largely due to the strategic value and industry connections such investors offer. Bernstein, Giroud, and Townsend (2016) demonstrate that venture capitalists, particularly when able to monitor closely, significantly influence firm strategies such as acquisitions and innovation. While the study focuses on the effects of post-investment monitoring, it indirectly suggests that start-ups with clearer strategic directions and alignment with investor expertise may be better positioned to benefit from such active involvement.

3.2.4 The Relationship between Unicorns and Other Start-ups

Although few studies directly examine the relationship between unicorns and other firms, a closely related topic—the dynamics between incumbents and new entrants—has

been widely explored in the literature. Scholars have analyzed how market power, innovation, and competition shape interactions between dominant firms and smaller startups. Aghion et al. (2005) propose an inverted-U relationship between competition and innovation, suggesting that moderate market competition fosters innovation, while excessive dominance by large firms can stifle smaller competitors. Unicorns, due to their rapid scaling and strong financial backing, can reshape. market dynamics Gans, Hsu, and Stern (2002) discuss how new entrants must decide between direct competition with incumbents or collaboration through strategic alliances and acquisitions. This framework is relevant for unicorns, as unicorns mature, they themselves increasingly adopt incumbent-like behaviors—such as forming market entry barriers and leveraging size advantages—which can further reshape the competitive dynamics (Cramer & Krueger, 2016). These incumbent-like strategies not only consolidate unicorns' market positions but also create significant challenges for emerging startups, who often struggle to compete for resources, market attention, and investor funding. This dynamic may lead to a concentration of innovation within dominant firms, while simultaneously raising entry barriers for newer ventures (Kenney & Zysman, 2019). Moreover, unicorns' ability to influence industry standards and control critical platforms can shift the balance of power in favor of large players, thereby altering the path of innovation and entrepreneurial opportunity (Parker et al., 2016).

Another important mechanism through which unicorns influence the startup companies is their aggressive use of mergers and acquisitions. By acquiring high-potential startups—sometimes even before they become competitive threats—unicorns consolidate their market position while simultaneously eliminating emerging rivals. This

acquisition-oriented behavior reduces the number of independent competitors and may discourage VCs from investing in startups perceived as likely acquisition targets rather than rapid-growth firms (Cunningham, Ederer, & Ma, 2021).

3.2.5 Gap in Existing Literatures

While prior studies have extensively examined unicorn formation and the broader effects of market competition, few have empirically assessed how unicorn firms influence the funding prospects of peer startups within the same industry. In particular, there is a lack of causal evidence on whether unicorn dominance deters or encourages investment from prestigious venture capital firms. Existing research often treats unicorns and early-stage startups as separate analytical units, overlooking the direct and indirect interactions that may shape capital flows within an industry. This omission is notable, given that venture capital is a critical—and scarce—resource in early-stage firm development. Moreover, the potential moderating roles of market structure—such as the number or intensity of unicorn competitors—and institutional context, including spatial incentives like Opportunity Zones, remain largely unexplored. A more nuanced understanding of these dynamics is essential for evaluating how unicorn-driven concentration may reconfigure not only product markets, but also the investment environment that underpins innovation.

3.3 Hypothesis Development

3.3.1 First-Mover Advantage of Unicorns

Unicorn companies leverage first-mover advantage to establish significant competitive strengths within their respective industries, thereby securing their dominant market positions. As pioneers, these firms are able to build strong brand recognition and loyalty early on, which not only fosters consumer trust but also sets industry standards that later entrants must adhere to (Lieberman & Montgomery, 1988). This early establishment of brand equity creates high entry barriers, making it challenging for subsequent competitors to gain similar levels of consumer acceptance and access to financing (Keller, 1993). In other words, the presence of unicorn companies increases the costs for venture capitalists investing in other related start-ups, particularly in terms of higher due diligence expenses. This is because investors need to conduct more comprehensive evaluations of market dynamics, competitive risks, and the unique value propositions of potential investments to ensure they can compete against the established industry leader. As a result, it might make other start-ups less attractive to VCs. Additionally, unicorns often achieve economies of scale more rapidly due to their initial market capture, allowing them to reduce costs per unit and offer more competitive pricing, helping them maintain a dominant position (Porter, 1985). Furthermore, unicorns' dominance in their respective markets can have a significant impact on the investment decisions of VCs, particularly those with established reputations. Unicorns' market leadership and rapid growth frequently indicate saturated opportunities in specific aera, which lower the perceived growth potential and competitive viability of comparable start-ups in the same industry. One of the critical mechanisms driving this market dominance

is the network effect, which significantly strengthens unicorns' competitive advantages. Network effects occur when the value of a product or service increases with the number of its users (Katz & Shapiro, 1985). For unicorns, gaining more market share makes their platforms or services increasingly attractive to both current and new users, which in turn drives further growth. Furthermore, network effects promote the establishment of industry standards, making it difficult for new entrants to compete. This standardization pressures consumers and businesses to adopt the incumbent service, leaving little room for emerging start-ups to differentiate themselves or gain a foothold in the market. Therefore, we have the following hypothesis

H1a: The presence of unicorn companies decreases the likelihood of prestigious venture capitalists investing in other start-ups within the same industry.

3.3.2 Second Mover Advantage of Other Start-Ups

On the other hand, other start-ups entering the market after unicorns can also leverage certain second-mover advantages. Unlike first movers who often face significant uncertainties and higher costs in developing new markets, second movers benefit from observing the successes and failures of their predecessors. This allows them to update their strategies, avoid costly mistakes, and capitalize on proven demand (Lieberman & Montgomery, 1988; Hoppe 2003).

One key advantage of second movers lies in their ability to adopt and improve upon the technologies, business models, or practices established by unicorns (Geroski, 2005) Second movers can integrate advanced innovations at a lower cost by leveraging existing industry standards and frameworks. Additionally, second movers can identify gaps or underserved segments within the market that unicorns may have overlooked,

allowing them to position themselves as differentiated or specialized alternatives. For instance, Khurana, Dutta, and Ghura (2022) examine how small and medium enterprises built resilience capabilities during the COVID-19 pandemic. They found that second movers possess significant advantages. They revealed that later adopters could leverage existing digital technologies and industry frameworks established by early adopters to achieve innovation and business transformation at a lower cost.

Moreover, second movers can use the presence of unicorns to their advantage by targeting dissatisfied customers or those seeking alternatives to dominant players. This strategy is particularly effective in markets where customer preferences are diverse or where unicorns' dominance has led to standardization but limited flexibility. Christensen, Raynor, and McDonald (2015) in their seminal work on disruptive innovation, outline how late entrants, or second movers, can leverage opportunities in the market by targeting underserved or overlooked customer segments. The authors emphasize that disruptive innovation often emerges when smaller, less resource-intensive companies introduce simpler, more affordable, or more flexible solutions that address specific needs ignored by established incumbents. These advantages make second movers particularly appealing to venture capitalists, especially those seeking to minimize risk while maximizing returns.

The presence of unicorns in an industry may increase the likelihood of venture capitalists investing in other start-ups within the same sector, also driven by the halo effect. Halo effect refers to the cognitive bias where the positive performance or attributes of one entity influence perceptions of others within the same context (Thorndike, 1920). When a unicorn emerges, it signals the potential profitability and scalability of the industry,

creating a perception among VCs that other similar start-ups may also have the potential to achieve comparable success. This optimism encourages VCs to view the sector as a fertile ground for high returns, prompting them to allocate more capital toward identifying the "next unicorn." Additionally, unicorns often bring increased attention and validation to the industry, attracting more resources, talent, and innovation, which further enhances the attractiveness of investing in other companies within the same industry. Thus, the success of unicorns can catalyze a virtuous cycle of heightened VC interest and funding activity in the industry. Therefore, another hypothesis is proposed

H1b: The presence of unicorn companies increases the likelihood of prestigious venture capitalists investing in other start-ups within the same industry.

3.3.3 The Moderating Role of Multiple Unicorn Competitors

While the presence of a single unicorn competitor can shape the startup funding landscape in various ways, the effects may change when multiple unicorns compete within the same industry. The number of unicorn competitors could influence how their presence impacts the ability of other startups to attract investment from prestigious venture capitalists.

When multiple unicorns operate in the same sector, their competition can lead to greater market fragmentation and reduced dominance of any single firm (Kenney & Zysman, 2019; Cutolo & Kenney, 2021). Unlike a scenario where a single unicorn enjoys first-mover advantages and strong network effects, multiple unicorn competitors may limit each other’s ability to fully control market standards and customer bases. This dynamic could create new entry points for other startups, which allows them to find unoccupied

gaps, leverage differentiated business models, or position themselves as alternative solutions to VC investors.

The presence of multiple unicorn competitors may also indicate that the industry is thriving and growing rapidly. When several highly valued firms achieve success, venture capitalists are more likely to view the sector as promising. As a result, they may become more willing to invest in additional startups, hoping to identify the next high-growth opportunity. Therefore, the following hypothesis is argued

H2a: The presence of multiple unicorn competitors within the same industry weakens the negative effect of unicorn competition on a startup's likelihood of receiving investment from prestigious venture capital firms.

On the other hand, when multiple unicorns dominate an industry, they may intensify competitive pressures and raise barriers to entry for new startups. As discussed in H1a, unicorns benefit from economies of scale, strong brand equity, and solid backing from top-tier investors—all of which make it more difficult for new entrants to compete for market attention and financial support. In industries with several unicorns, these firms may engage in aggressive competitive tactics, such as underpricing, forming exclusive partnerships, or acquiring key talent, which further limits the growth potential of smaller startups. Rather than opening up the market, the presence of multiple dominant players may crowd out early-stage firms, reducing both their visibility and perceived viability in the eyes of venture capitalists. As a result, the negative effect of unicorn competition on peer startups' ability to attract prestigious VC investment may become even more pronounced. Investors might view such markets as saturated or winner-takes-all environments, and

thus be more hesitant to back new entrants who face entrenched, well-resourced competitors. Therefore, the following hypothesis is argued

H2b ： The presence of multiple unicorn competitors strengthens the negative effect of unicorn competition on a startup's likelihood of receiving investment from prestigious venture capital firms.

3.4 Data and Empirical Design

3.4.1 Sample Selection

This study mainly focuses on the US market covering the period from 2013 to 2019. To identify unicorn companies, this study follows the standard criteria used in existing literature. (Gornall & Strebulaev, 2020; Lerner & Nanda, 2020). A firm is classified as a unicorn if it has its headquarters in the United States and has reached a valuation exceeding $1 billion while remaining privately held. Companies that have gone public, been acquired, or fallen below the valuation threshold are excluded from the unicorn sample. Additionally, to ensure data accuracy, we cross-check company status with industry reports and media sources. The primary data source is Pitchbook for identifying unicorn firms

To identify all startups that received VC funding, we collect data on venture capital deals from Crunchbase, focusing on deals that occurred between 2013 and 2019. We filter the dataset to include only companies with their headquarters in the United States. To ensure that the sample consists of active private startups, we exclude companies that have gone IPO, been acquired, or declared bankruptcy during the observation period. This selection process ensures that the dataset captures startups that remained operational and continued seeking growth opportunities after receiving VC investment. The final dataset consists of 147 unicorns and 2448 startups with 3560 venture capital deals.

The study focuses on unicorns that emerged after 2013. There are several key reasons for this selection. Recent success may create more powerful "halo effect" that draws investor attention. In another word, newly established unicorns may have a stronger impact on the ability of other firms in the same industry to attract VC investments.

Moreover, the second-mover advantage is more evident for firms emerging soon after a unicorn is formed. Also, unicorns play a key role in reducing trial-and-error costs for other companies. Their market validation, resource attraction, and established business models create clearer paths for followers. This effect exists for all unicorns, but it is more pronounced for newly emerged ones. Recent unicorns operate in industries experiencing rapid growth, where their influence on market trends, investor confidence, and competitive dynamics is strongest.

On the other hand, if the presence of unicorn companies reduces the likelihood of VC investment in other similar firms, this effect is supposed be stronger for newly emerged unicorns. One key reason is that market entry barriers tend to be highest when a unicorn is first established. In the early stages, these companies rapidly secure critical resources such as key partnerships, customer trust, and regulatory advantages, making it difficult for new entrants to compete. However, as time passes and more firms enter the industry, these barriers gradually decrease. Established business models, improved industry infrastructure, and knowledge diffusion lower the risks for new entrants, making the market more accessible over time. Additionally, from a VC perspective, newly formed unicorns themselves become highly attractive investment targets. Their rapid growth and strong market positioning make them a safer and more promising option compared to smaller and less-established competitors.

3.4.2 Matching Strategy and Variables Measurement

3.4.2.1 Identification of Start-ups Competing with Unicorns

To examine the impact of unicorn companies on the ability of peer startups to attract VC investment, a crucial first step is to operationalize the concept of "direct competition." In this study, we identify a startup as competing with a unicorn if it meets two concurrent criteria: (1) sharing the same headquarters location (e.g., San Francisco, Boston) and (2) operating in the same core business sector, as determined by keyword matching using Crunchbase industry classifications. The rationale for this two-pronged approach is twofold. First, geographic co-location is a strong proxy for competition within venture capital and high-tech industries. Startups within the same innovation hub (e.g., Silicon Valley) compete directly for a localized pool of specialized talent, face similar costs of living and operation, and, most importantly for this study, are vying for attention from a dense but finite network of regional venture capitalists (Sorenson & Stuart, 2001). An investor in Menlo Park is far more likely to be aware of and compare all local startups in a given sector than those dispersed across the country.

Second, sectoral alignment, identified through business description keywords, ensures that the firms are pursuing analogous market opportunities and technologies. While this method may not capture the granularity of direct product-market rivalry, it effectively identifies firms that investors would likely perceive as operating in the same "problem space" or technological domain.

Applying this approach, I identify 315 startups (421 VC deals) that meet these conditions, confirming that they compete directly with at least one unicorn.

3.4.2.2 Measurement of Early-Stage Success of Start-Up

Following the method of Stephen et al (2019) the early-stage success of a startup is measured based on whether it receives investment from a high-reputation venture capital firm. This approach, which distinguishes prestigious VCs from the broader population of venture investors, is grounded in both theoretical and empirical literature. The decision to focus on high-reputation VCs, rather than all VC investors, is justified by the significant qualitative differences in the resources and signaling effects they provide. Prestigious VCs—typically defined by their long track records, extensive networks, and successful exit histories—are not merely capital providers; they offer a bundle of value-added services that are critical for early-stage startups navigating the "liabilities of newness" (Stinchcombe, 1965). Their investment serves as a powerful certification signal to the market, reducing information asymmetry for subsequent investors, potential partners, and customers (Megginson & Weiss, 1991; Nahata, 2008). This signal is particularly crucial in the context of this study, which investigates competitive dynamics: a startup's ability to attract a top-tier VC, despite the presence of a unicorn competitor, is a strong indicator of its perceived quality and viability. In contrast, receiving funding from a lesser-known VC may not confer the same competitive legitimacy or resource advantages.

High-reputation VCs are identified using three criteria in each given year

(1) the VC firm is in the top decile in terms of age

(2) the firm is in the top decile by the number of completed deals

(3) the firm is in the top decile for the number of IPO exits.

A startup that secures funding from a VC meeting any of these criteria is classified as having achieved early-stage success. All VC information are obtained from Crunchbase as well.

3. 4.2.3 Control Variables

Since most startups do not publicly disclose detailed accounting information, the selection of control variables is highly limited. Following the method of Stephen et al. (2019), this study incorporates key variables to account for firm-level heterogeneity. The selected control variables include the number of prior financing rounds, the total amount raised in previous funding ($M), the time elapsed since the first financing round (months), and the time since the most recent financing round (months). These variables serve as proxies for a startup's financial maturity, fundraising capability, and investment history.

3.4.3 Empirical Design

This study employs a Difference-in-Differences approach to examine the impact of unicorn competition on startups' likelihood of receiving venture capital investment. The exogenous shock used for identification is the Tax Cuts and Jobs Act of 2017.

3.4.3.1 The Tax Cuts and Jobs Act of 2017

On December 22, 2017, President Donald Trump signed the Tax Cuts and Jobs Act (TCJA) into law, marking the most comprehensive reform of the U.S. tax code in over three decades. The legislation aimed to promote economic growth, encourage business investment, and enhance the global competitiveness of U.S. companies.

One of the most significant changes under the TCJA was the permanent reduction of the corporate tax rate from 35% to 21%, the lowest level since 1939. This change was

intended to lower the tax burden on U.S. businesses, making them more competitive in the global market and freeing up capital for reinvestment. Additionally, the TCJA introduced full expensing for capital investments, allowing businesses to deduct certain capital expenditures immediately rather than depreciating them over time. This provision aimed to encourage companies, particularly startups, to invest more actively in expansion, technology, and infrastructure.

The TCJA introduced a 20% deduction on qualified business income for pass-through entities, such as partnerships, S-corporations, and sole proprietorships. These business structures are commonly used by startups. The deduction lowered the tax rate for many small businesses, helping them retain earnings and reinvest in growth.

The TCJA also changed how venture capital and private equity investments were taxed. It doubled the exemption amount for the estate tax, which increased the available capital for high-net-worth individuals to invest in startups. The act also extended the required holding period for carried interest to three years to qualify for long-term capital gains treatment. This change affected how VC firms structured compensation and incentives.

At the individual level, the TCJA reduced marginal tax rates, nearly doubled the standard deduction, and eliminated personal exemptions. These changes increased disposable income for many taxpayers. As a result, investor behavior and capital allocation to startups may have shifted.

In summary, the TCJA made the investment environment more favorable for startups. It lowered tax burdens, increased after-tax earnings, and made early-stage

companies more attractive to investors. By reducing corporate and pass-through tax rates, the act expanded the availability of capital for venture funding in general

3.4.3.2 Opportunity Zone

This study further examines how place-based policy incentives can reshape the competitive dynamics between unicorns and other startups by focusing on a subsample of ventures located in Opportunity Zones (OZs). The OZ program was introduced as part of the TCJA, providing substantial additional tax incentives for investments in designated economically distressed areas. Under the program, investors can defer—and potentially reduce—capital gains taxes by reinvesting those gains into Qualified Opportunity Funds, which in turn finance eligible businesses and properties within these zones. Consequently, startups operating in OZs benefit from enhanced fiscal advantages, increasing their attractiveness to investors independently of their underlying business prospects.

I leverage the OZ framework as a natural laboratory to test the boundaries of our main hypothesis. If the dampening effect of unicorn competition stems primarily from market-based mechanisms—such as perceived investment risk and resource crowding—then the introduction of strong countervailing tax subsidies should attenuate that effect. The OZ incentives may lead investors to prioritize tax efficiency and regulatory compliance over traditional competitive analysis, thereby altering their fundamental calculus.

This subsample analysis speaks directly to the core of our research question: how unicorn dominance reconfigures the startup competitive landscape. It allows us to distinguish whether the observed crowding-out effect is an inherent outcome of market

competition, or whether it can be mitigated by targeted policy interventions. A weaker or non-existent unicorn effect within OZs would suggest that the competitive pressure exerted by dominant players is not immutable, but can be counterbalanced by sufficiently strong external incentives.

3.4.3.3 Empirical Model

The empirical model is specified as follows:

$$Y_i(probit) = \alpha + \beta_1 Post_i + \beta_2 Treatment_i + \beta_3 (Post_i \times Treatment_i) + X'_i\gamma + \varepsilon_i$$

where:

Y_i is a performance dummy that equals 1 if the deal $i's$ corresponding investor is high-ranked VC and 0 otherwise.

$Post_i$ is a time dummy that equals 1 if the deal i occurred after 2017 and 0 otherwise.

$Treatment_i$ is a treatment dummy, which equals 1 if the deal $i's$ corresponding startup had at least one unicorn as a direct competitor at the same time in and 0 otherwise.

$Post_i \times Treatment_i$ captures the interaction effect, which identifies whether startups facing unicorn competition were less likely to secure funding from top-tier VCs after 2017.

X'represents a set of control variables, including the number of prior funding rounds and total previous funding amount, which account for differences in firm characteristics.

ε_i is the error term.

3.4.4 Descriptive Statistics

3.4.4.1 The Distribution of Unicorns and VC Deals

The Figure 3-1 illustrates the number of newly formed unicorn companies from 2013 to 2019.

/Figure 3-1 here/

The data reveal a noticeable upward trend, particularly after 2017. While the number of unicorns fluctuated at relatively lower levels from 2013 to 2017, a significant increase occurred in 2018 and 2019, with the number of new unicorns more than tripling compared to earlier years.

Figure 3-2 shows the annual distribution of venture capital deals among 2,448 startups, totaling 3,560 deals from 2013 to 2019.

/Figure 3-2 here/

Over this period, the number of deals exhibited fluctuations, with certain years, such as 2016, experiencing slight declines. However, a clear upward trend emerges, particularly in 2018 and 2019, when VC activity saw a significant increase

These figures collectively highlight a significant increase in both the number of unicorn companies and VC-backed startup deals after 2017. This parallel growth pattern suggests a potential link to the TCJA, which may have influenced investor enthusiasm.

More importantly, this trend lends support to the validity of using 2017 as the policy year in the DID framework. The effectiveness of this method relies on the assumption that the TCJA broadly boosted VC investment in startups, and the observed descriptive statistics align with this premise. However, further rigorous empirical tests are necessary to establish a more rigorous conclusion.

Figure 3-3 presents the distribution of unicorn related total capital invested and deal count across various industries

/Figure 3-3 here/

Based on figure 3-3, certain industries, such as Specialty Retail, Business/Productivity Software, and Application Software, attract substantial investment, unicorn firms are not confined to just a few sectors. Instead, they are spread across a diverse range of industries, including Financial Software, Aerospace and Defense, Automotive, and Logistics, among others. This broad distribution reduces concerns about endogeneity driven by industry-specific factors, ensuring that the observed effects are not solely attributed to industry concentration.

3.4.4.2 Descriptive Statistics of Main Variables

Table 3-1 reports summary statistics for the key variables used in the empirical analysis.

/Table 3- 1 here/

Approximately 11.8% of the startup observations in the sample have at least one unicorn competitor, indicating that unicorn-related competition, while not universal, is non-negligible. The average startup raised approximately $50.94 million in its most recent funding round, with a substantial variation across firms. Startups received on average about 1.91 rounds of funding, reflecting their early-stage status. The average time since the last funding round is 2.26 years, while the average time since the first round is 4.94 years, which suggests that most firms have some fundraising track record but remain relatively young.

3.5 Empirical Results

3.5.1 The Effect of Unicorn on Highly Reupdated VC Investment

This section examines how the presence of unicorn competitors affects the likelihood of startups securing venture capital investment. The key dependent variable in the first table is a binary indicator, taking a value of 1 if the startup successfully receives VC funding and 0 otherwise. To ensure robustness, three different estimation methods are used. Columns (1) and (2) apply a Linear Probability Model (LPM), which estimates marginal effects in a linear framework. Columns (3) and (4) use a Probit model, and columns (5) and (6) employ a Logit model, both of which account for the binary nature of the dependent variable and allow for nonlinear probability estimations. For each estimation method, the first column presents results without control variables, while the second column incorporates a set of firm-level controls to account for observable differences across startups.

Before estimating the Difference-in-Differences model, it is necessary to examine whether the parallel trends assumption is plausible. Figure 3-4 provides an event-study representation of the dynamic treatment effects, where coefficients are estimated relative to the year immediately prior to the policy shock (2016), which is omitted as the reference period. The figure plots point estimates together with confidence intervals across relative event years, allowing a direct visual assessment of pre- and post-treatment dynamics.

/Figure 3-4 here/

The coefficients in the pre-treatment period (t−4 to t−2) remain close to zero and are statistically indistinguishable from zero, indicating that treated and control firms followed similar trends before the emergence of the policy shock. This pattern supports the validity of the parallel trends assumption and suggests that systematic differences between the two groups were limited prior to treatment.

Starting from the treatment year (2017), the estimated coefficients become increasingly negative, indicating a gradual decline in the probability that startups exposed to unicorn competition receive investment from prestigious VC firms. The magnitude of the negative coefficients grows over time, which is consistent with an adjustment process rather than an immediate one-off effect. Overall, the event-study evidence supports the identification strategy adopted in this chapter and strengthens the interpretation of the DID estimates.

Table 3-2 presents the results and the dependent variable in the table is measured based on the number of VC investments that have successfully exited through IPOs. The results for the other two dimensions—VC age and total number of completed deals—are consistent with this measure. Detailed results for these alternative specifications can be found in the roundness check section.

/Table 3-2 here/

Across all specifications, the results consistently show that startups competing with unicorn firms face significant disadvantages in attracting VC investment. The coefficient on Unicorn is negative and highly significant in all models, with the strongest effect

observed in the Logit estimates (columns 5 and 6), where the coefficients are -1.032 ($p < 0.01$) and -1.054 ($p < 0.01$). This suggests that the presence of unicorn competitors significantly reduces a startup's probability of securing funding. Similar results appear in the Probit model (columns 3 and 4), with coefficients of -0.634 ($p < 0.01$) and -0.644 ($p < 0.01$), confirming the conclusion that unicorn competition discourages investment in smaller startups. Even in the LPM framework (columns 1 and 2), where linearity assumptions hold, the coefficients remain negative and highly significant (-0.236, $p < 0.01$; -0.235, $p < 0.01$). It indicates a robust and consistent downward effect.

Importantly, the inclusion of control variables across all models slightly reduces the magnitude of the coefficients, but the negative effect remains statistically significant, indicating that unicorn competition plays an independent role in shaping startup funding outcomes.

The DID coefficient, as the primary parameter in this difference-in-differences framework, provides a more precise and rigorous measure of the effect of unicorn competition on startups' ability to attract high-reputation VC investment. The results show a consistently negative and statistically significant effect across all model specifications.

To interpret the economic magnitude, we compute the average marginal effects for the Probit and Logit models to ensure comparability with the Linear Probability Model. The AME for the DiD coefficient is xxx for the Probit model and xxxx for the Logit model,

both closely aligning with the LPM estimate of -0.160. This consistency across models indicates that, on average, the presence of a unicorn competitor after the TCJA reduced the probability of a startup securing funding from a prestigious VC firm by approximately 16 percentage points.

This represents a substantial relative decline. Given that the baseline probability of receiving such funding for a startup without unicorn competition post-2017 was xxx the effect of unicorn competition erased nearly one-third of the funding advantage that a comparable startup would otherwise have enjoyed in the post-TCJA environment. The strong concordance in the estimated economic magnitude across three distinct estimation strategies underscores the robustness and economic significance of the crowding-out effect.

One potential explanation for this pattern is capital concentration among industry leaders. The presence of unicorn firms signals market maturity and reduced risk to venture capitalists, leading them to allocate resources disproportionately to established unicorns rather than investing in new, unproven competitors. This could result in a crowding-out effect, where startups in the same industry struggle to attract investment because VCs prefer backing larger, more stable firms with demonstrated market traction and scaling potential. Another mechanism driving this outcome may be increased due diligence costs for VCs considering investments in competing startups. When a unicorn firm dominates an industry, investors must carefully assess whether a new entrant has

the potential to compete or differentiate itself, which requires more extensive market analysis and risk evaluation. This added complexity could discourage VCs from investing in startups facing unicorn competition. Additionally, the findings indicate that barriers to entry have become more restrictive in industries dominated by unicorn firms. Startups now face greater challenges when trying to enter markets where one or more unicorn competitors already exist. The significant negative DID effect across all models suggests that the TCJA contributed to accelerating these competitive dynamics. This policy change may have provided tax incentives or investment advantages that disproportionately favored larger, well-funded firms. As a result, smaller startups seeking early-stage financing may have encountered increased difficulties in securing venture capital.

3.5.2 The Moderating Effect of Multiple Unicorns

In this section, we extend the baseline analysis by examining the moderating effect of having multiple unicorn competitors on a startup's ability to attract prestigious VC investment. To capture this effect, the DID variable is interacted with morethan1, a dummy variable indicating whether the startup faces more than one unicorn competitor in its industry. This interaction term allows us to assess whether the negative impact of unicorn competition varies when multiple unicorns are present. Results are presented in table 3-3

/Table 3-3 here/

The results show that the interaction term morethan1_did is positive and statistically significant across all estimation methods, in other words, the negative impact of unicorn competition on VC funding weakens when multiple unicorns are present. This

effect is consistently observed in the LPM, Probit, and Logit models, with the magnitude of the interaction term increasing when firm-level controls are included.

In the LPM model, column (1) reports a coefficient of 0.584 ($p < 0.01$), while column (2), which includes firm-level controls, produces a similar estimate of 0.581 ($p < 0.01$). These results suggest that when startups face more than one unicorn competitor, their likelihood of securing VC funding increases compared to those in industries dominated by a single unicorn.

When switching to nonlinear probability models, the results remain consistent, emphasizing the conclusion that the presence of multiple unicorn competitors reduces the negative impact of unicorn competition on startup funding. In the Probit model the interaction term is 1.884 ($p < 0.01$) in column (3) and slightly increases to 1.906 ($p < 0.01$) in column (4) after adding firm-level controls. Similarly, in the Logit model, the coefficient is 3.250 ($p < 0.01$) in column (5) and rises to 3.294 ($p < 0.01$) in column (6) when controls are included. The persistence of this positive and significant effect across both Probit and Logit models confirms that the moderating role of multiple unicorn competitors is not driven by linearity assumptions but holds even when accounting for the nonlinear relationship between competition and funding likelihood. Therefore, hypothesis 1 is accepted

The results suggest that the underlying mechanisms driving the negative impact of unicorn competition on startup funding remain consistent with those identified earlier. However, the moderating effect of multiple unicorn competitors provides additional insight into how the structure of competition within an industry influences these dynamics. Previously, the crowding-out effect was identified as a key mechanism through which

unicorn firms reduce funding opportunities for competing startups. The presence of unicorn firms' signals market maturity and reduced investment risk, causing VCs to allocate resources disproportionately toward established unicorns with proven market traction and scaling potential rather than backing newer, unproven startups. The current results do not contradict this mechanism but suggest that when multiple unicorns compete within the same industry, their collective dominance weakens. It reduces the extent to which they can monopolize investor attention. As a result, the crowding-out effect becomes less severe, allowing startups a better chance of securing investment.

Another previously identified mechanism was the increased due diligence costs faced by VCs when evaluating startups in unicorn-dominated industries. Investors must assess whether a new entrant has the potential to compete or sufficiently differentiate itself, which requires extensive market analysis. This additional complexity discourages VCs from funding startups that directly compete with unicorn firms. The latest findings suggest that when multiple unicorns operate in the same industry, this evaluation process may become more ambiguous, leading investors to adopt a more diversified funding strategy rather than concentrating capital into a single dominant player. This may explain why startups in industries with multiple unicorns face a less severe funding disadvantage compared to those competing against a single unicorn.

Additionally, prior findings indicated that barriers to entry intensify in industries dominated by unicorn firms, particularly following policy changes like the TCJA, which may have amplified advantages for well-funded incumbents. The current results align with this argument but suggest that these barriers are less rigid when market dominance is fragmented across multiple unicorns. When a single unicorn dominates, it can leverage

its market power to block new entrants more effectively. However, competition among multiple unicorns may introduce strategic uncertainties that reduce their ability to exert complete control over industry dynamics, leaving room for startups to navigate competitive pressures more effectively.

3.5.3 The Case of Opportunity Zone

To further examine the moderating effect of OZs, I restrict the sample to startups whose headquarters are located within designated Opportunity Zones, as defined under the 2017 TCJA. These zones were established to encourage private investment in economically distressed areas through substantial tax incentives. Given that startups in OZs benefit from additional policy support—such as capital gains deferral, step-up basis treatment, and tax exclusions on long-term holdings—it is theoretically plausible that these incentives could affect venture capital allocation patterns and potentially intensify the influence of unicorn competition. Therefore, re-estimating the main DID model on this restricted sample provides a useful robustness check and helps explore heterogeneity in the competitive effects across different policy environments. The results are presented in table 3-4

/Table 3-4 here/

The regression results using the OZ subsample show that the DID coefficient, which captures the interaction between unicorn presence and post-TCJA investment outcomes, becomes statistically insignificant across all specifications. This marks a departure from the baseline findings, where the presence of unicorn competitors

consistently and significantly reduced the likelihood of securing VC funding from prestigious investors. The disappearance of significance in the OZs sample suggests that the mechanisms identified earlier—such as capital concentration, crowding-out effects, and increased due diligence costs—may be attenuated in policy-incentivized regions.

One possible explanation may lie in the altered investment logic of VCs operating within OZs. In these areas, capital is often deployed not purely based on traditional competitive dynamics but also to capture favorable tax treatment. As a result, VCs may be less sensitive to the presence of unicorn competitors when evaluating potential investments, prioritizing tax benefits or policy compliance instead. The incentives embedded in the OZs program may also reduce the salience of competitive risk, making VCs more willing to fund startups even when dominant unicorns exist in the same sector.

Moreover, startups in OZs may differ systematically from those in the broader sample. These firms are often located in underinvested regions and may operate in industries or markets that are less directly affected by unicorn-driven competition. The relatively lower density of unicorn firms in these areas also reduces the intensity of competitive pressure. In this context, the crowding-out effect that is observed in more competitive, capital-concentrated environments may not fully materialize.

Finally, it is important to note that while the DID estimates become insignificant, this does not necessarily contradict the earlier findings. Rather, it highlights how policy environments can moderate the effect of market-based competition, especially when those policies are designed to reallocate capital toward disadvantaged regions. These results underscore the need to account for spatial and institutional heterogeneity when analyzing how competitive forces influence entrepreneurial finance.

3.5.4 Robustness Check

To ensure the robustness of the primary findings, this section presents additional analyses by employing alternative measures for identifying high-reputation venture capital firms. While the baseline analysis defines high-reputation VCs based on IPO exit experience, this robustness check substitutes that criterion with two alternative proxies: (1) the age of the VC firm and (2) the number of completed deals. Following the same empirical strategy outlined in the methodology section, startups are reclassified as having achieved early-stage success if they received funding from VCs ranked in the top decile by either age or total deal count in a given year. Results are presented in table 3-5 and table 3-6

/Table 3-5 & 3.6 here/

The estimation results remain consistent with the main findings. Specifically, the presence of unicorn competitors continues to exhibit a statistically significant and negative impact on a startup's likelihood of securing investment from prestigious VCs, regardless of which alternative proxy for VC reputation is employed. In both the Probit and Logit models, the coefficients for unicorn competition remain negative and significant, confirming the robustness of the crowding-out effect. This finding implies that even when prestige is defined through alternative metrics, startups facing unicorn competition are consistently disadvantaged in attracting elite VC funding.

These findings strongly support the main idea of the study. They show that startups have a harder time getting investments from top venture capital firms when they compete with unicorn companies. This result doesn't just depend on how "reputation" is defined—it holds true even when using different ways to measure VC reputation. Overall, the data suggests that unicorn companies make it harder for smaller startups to get high-quality funding, highlighting the strong impact unicorns have in the startup investment world.

3.6 Conclusion

This research uncovers a clear pattern in how unicorn firms reshape the financial opportunities for new startups. By analyzing the ripple effects of the 2017 Tax Cuts and Jobs Act, we see that startups vying directly with a single unicorn company become less likely to attract investment from top-tier venture capital firms. The data points to a crowding-out effect, where the dominance of one major player seems to constrain the flow of capital to others. Yet the story grows more interesting in sectors with several unicorns. Here, the competitive pressure relaxes; the presence of multiple large firms appears to create openings for new entrants, lowering barriers and offering startups a chance to secure a foothold.

A lone unicorn does more than outcompete rivals; it changes the game. Its presence rewrites the rules of resource allocation, making elite funding a scarcer commodity for everyone else. This aligns with the idea that a concentrated market structure can systematically divert investment away from promising, but smaller, players. When multiple unicorns coexist, however, the ecosystem changes. No single company can fully dominate investor attention or strategic direction, which gives startups room to navigate and even thrive. The findings push us to see unicorns not just as competitors, but as architects of the venture capital environment, actively shaping which new ventures get the resources to grow.

The practical consequences of this are real and immediate. Entrepreneurs making crucial decisions about which market to enter can use this insight strategically. Choosing

to challenge a sector with an established unicorn demands a plan to overcome the capital gap—perhaps by building a distinctive narrative or targeting a niche. In contrast, a space with several unicorns might offer more strategic pathways, even opportunities to leverage the competition among the larger players. For investors, these findings invite a fresh look at sectors they might have overlooked. A market dominated by one unicorn could hide undervalued startups operating in its shadow, while a crowded field of unicorns might signal a vibrant, expanding sector with more varied entry points. For those shaping public policy, the lesson is that encouraging a diversity of leading firms may foster a healthier economic environment than betting everything on a single national champion. Building an ecosystem where multiple high-growth companies can emerge helps ensure that the success of a few does not block the path for the many.

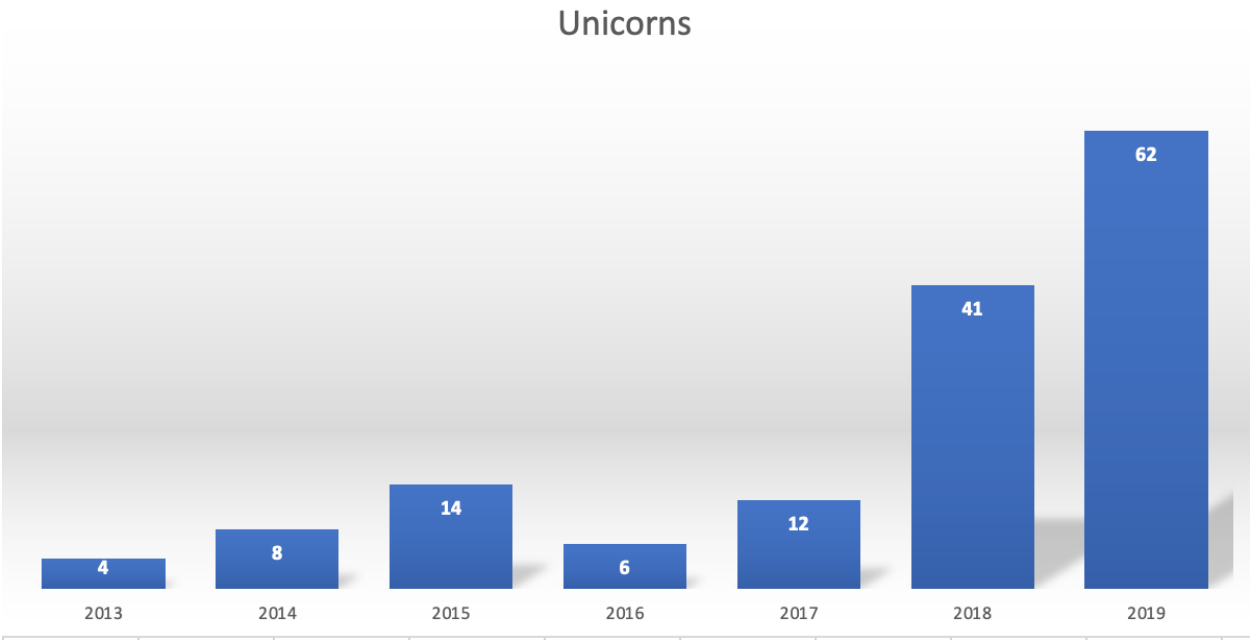
Nonetheless, several limitations must be acknowledged. As the dataset primarily covers startups that remain private and operate within the U.S. market, the generalizability of the findings to other national contexts or post-IPO firms remains limited. More critically, because the study focuses on early-stage startups—many of which are young and unlisted—the availability of firm-level data is inherently constrained. Key financial indicators, strategic metrics, and organizational variables are often missing, which narrows the range of control variables that can be included. This limitation may introduce omitted variable bias and restricts a more granular analysis of heterogeneity among startups. Despite these limitations, this study offers important insights for founders, investors, and policymakers seeking to navigate and shape a startup environment increasingly characterized by winner-takes-all dynamics.

Table 3- 1 Descriptive Statistics of Main Variables

Variable	Obs	Mean	Std. dev.	Min	Max
Has Unicorn as Competitor	3,560	0.1182584	0.3229592	0	1
Last Funding Amount	3,560	50.93553	26.73201	0.721003	157.0462
Funding Rounds	3,560	1.907303	1.079505	1	5
Year since Last Funding	3,560	2.260507	0.8233445	0.0069699	4.833827
Year since First Funding	3,560	4.936053	1.455323	0.1055949	10.13537

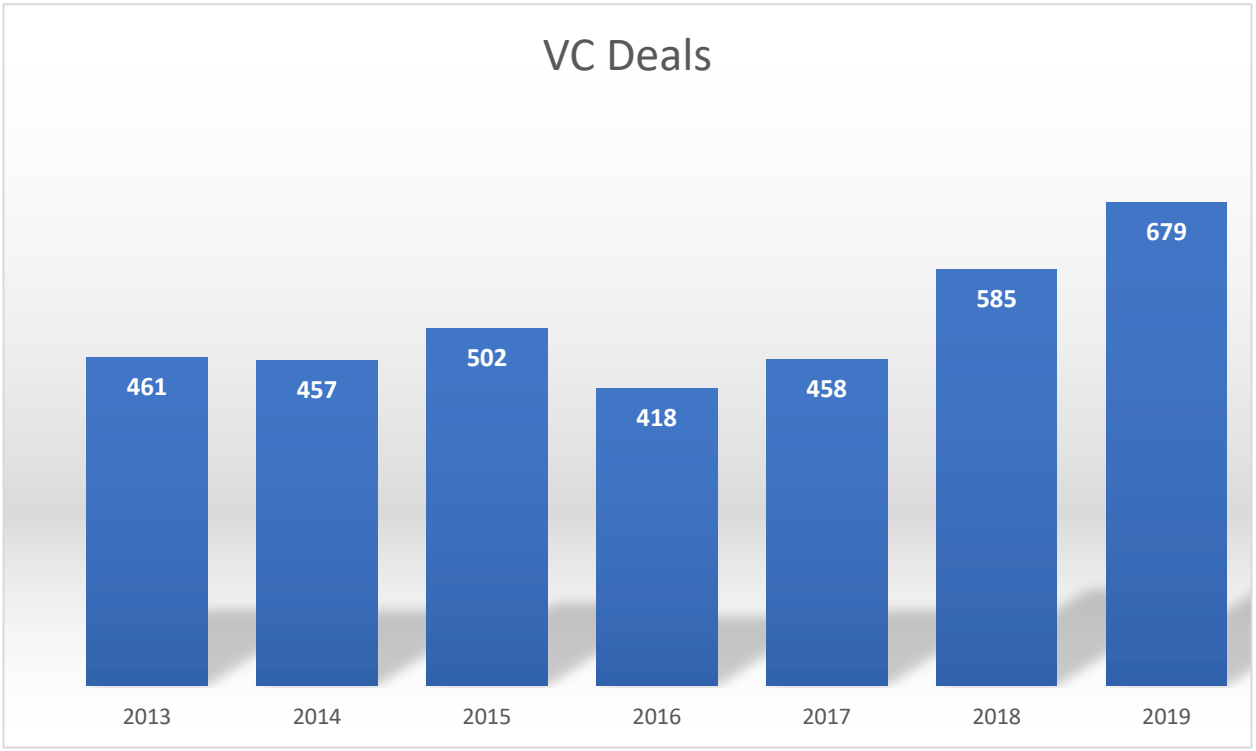
This table reports the descriptive statistics of the main control variables used in the empirical analysis. The sample consists of 3,560 venture capital deals from 2,448 U.S.-based startups between 2013 and 2019. The variables include whether a startup has a unicorn competitor, the amount raised in the last funding round (in million USD), the number of funding rounds, and the years since the first and most recent funding rounds. These variables serve as proxies for a startup's financial maturity, fundraising history, and exposure to unicorn competition.

Figure 3- 1 Annual Number of Newly Formed Unicorn Companies. (2013-2019)



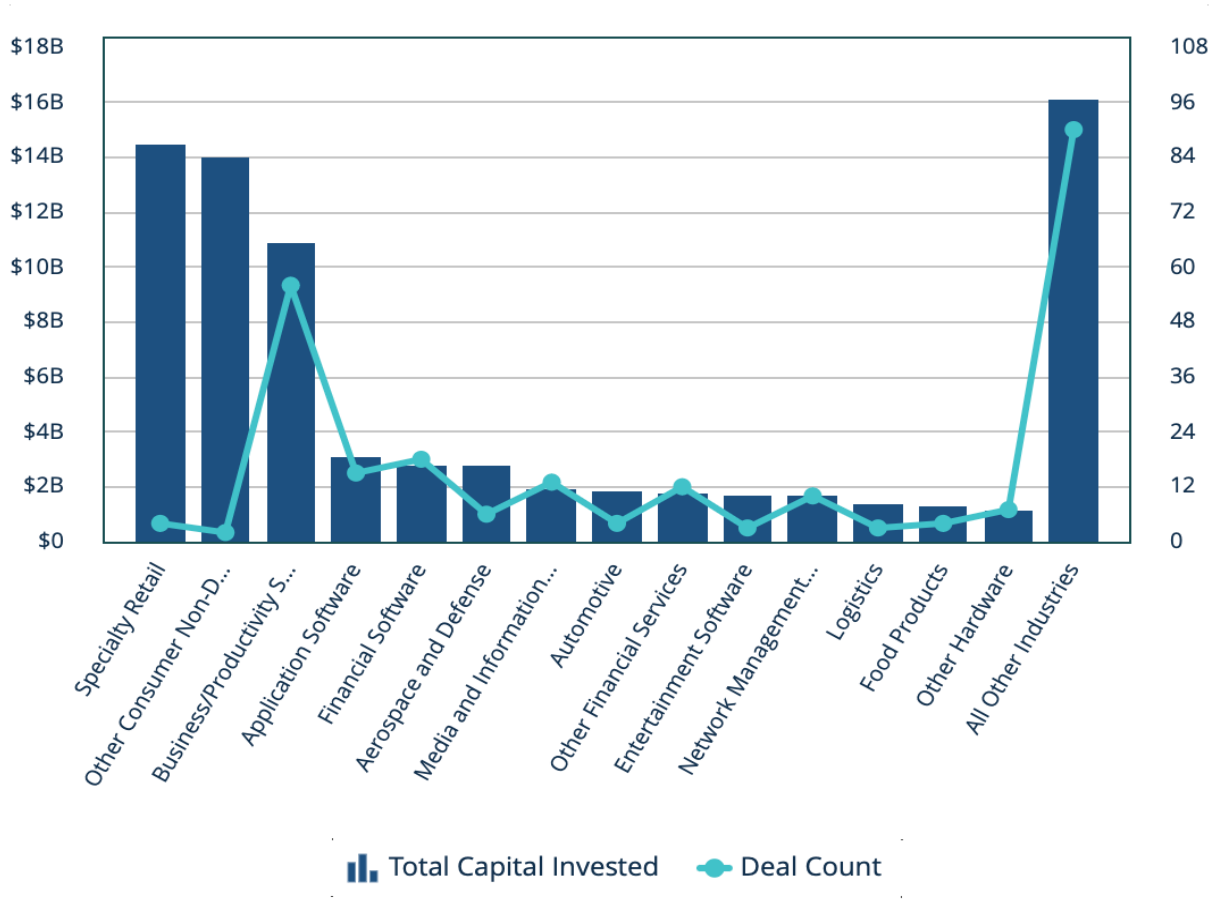
This figure illustrates the yearly number of unicorn startups founded in the United States from 2013 to 2019. The data show a significant upward trend after 2017, with notable surges in 2018 and 2019. This pattern supports the use of the 2017 Tax Cuts and Jobs Act as a quasi-experimental policy shock in the empirical analysis, as the post-2017 environment coincides with a sharp increase in unicorn emergence.

Figure 3- 2 Annual Distribution of Venture Capital Deals Among Start-ups (2013-2019)



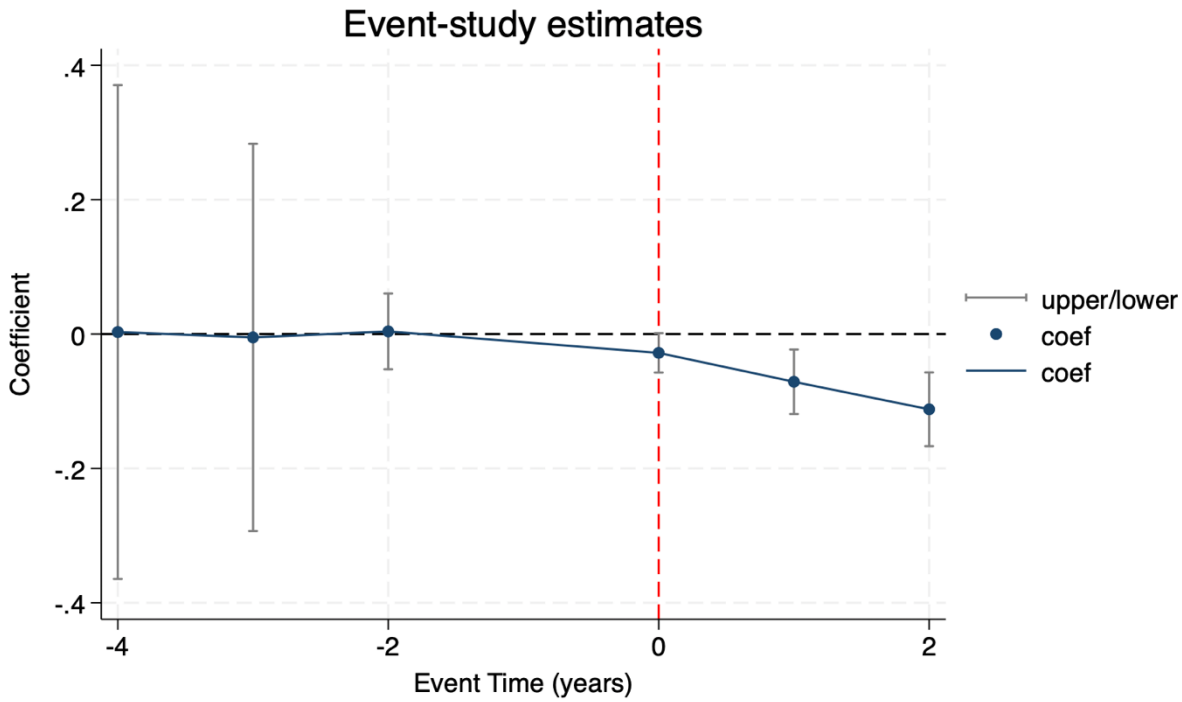
This figure presents the number of venture capital deals received by U.S.-based startups each year from 2013 to 2019, totaling 3,560 deals. While the deal volume fluctuates across years, a clear upward trend is visible after 2017, particularly in 2018 and 2019. This increase parallels the surge in unicorn creation and reflects a more favorable investment climate following the 2017 Tax Cuts and Jobs Act.

Figure 3- 3 Distribution of Total Capital Invested and Deal Count by Industry for Unicorn-Related VC Deals



This figure illustrates the industry-level distribution of venture capital investment associated with unicorn companies. While sectors such as Specialty Retail, Business/Productivity Software, and Application Software attract the highest capital inflows, unicorn-related deals span a diverse set of industries, supporting the argument that the empirical results are not driven solely by sector-specific dynamics.

Figure 3- 4 Event-Study Estimates and Parallel Trends Test



This figure presents event-study estimates from the difference-in-differences framework examining the effect of unicorn competition on startups' probability of receiving investment from prestigious VC firms. Coefficients are plotted relative to the year prior to the policy shock (2016), which serves as the omitted baseline period. The vertical bars represent 95% confidence intervals, and the red vertical line marks the treatment year (2017). The coefficients in the pre-treatment period are close to zero and statistically indistinguishable from zero, providing visual support for the parallel trends assumption. Post-treatment coefficients illustrate the dynamic evolution of treatment effects following the policy shock. Estimates are obtained from the linear probability model with firm-level controls and year-by-sector fixed effects.

Table 3- 2 Impact of Unicorn Competition on the Likelihood of Receiving Investment from Prestigious VCs

	(1)	(2)	(3)	(4)	(5)	(6)
	LPM		Probit		Logit	
HasUnicornCompetitor	-0.236***	-0.235***	-0.634***	-0.644***	-1.032***	-1.054***
	(-7.30)	(-7.36)	(-7.13)	(-7.18)	(-6.90)	(-6.97)
DID	-0.160***	-0.151***	-0.424***	-0.406***	-0.687***	-0.660***
	(-3.08)	(-2.93)	(-2.92)	(-2.78)	(-2.79)	(-2.66)
after2017	0.135***	0.134***	0.344***	0.350***	0.551***	0.561***
	(7.40)	(7.44)	(7.24)	(7.30)	(7.20)	(7.24)
FundingRounds		0.047***		0.125***		0.202***
		(6.23)		(6.19)		(6.16)
LastFundingAmountM		-0.002***		-0.005***		-0.008***
		(-5.98)		(-5.99)		(-5.93)
YearsSinceLastFunding		-0.016		-0.043		-0.069
		(-1.63)		(-1.63)		(-1.63)
YearsSinceFirstFunding		0.002		0.004		0.007
		(0.29)		(0.27)		(0.30)
cons	0.492***	0.524***	-0.019	0.065	-0.030	0.102
	(45.61)	(12.47)	(-0.69)	(0.58)	(-0.69)	(0.57)
N	3560	3560	3560	3560	3560	3560
adj. R2	0.050	0.069				
Pseudo. R2			0.0376	0.0533	0.0376	0.0533

This table reports regression results estimating the effect of unicorn competition on a startup's probability of securing funding from top-tier VC firms, using Linear Probability Model, Probit, and Logit specifications. The key variable of interest, the interaction term DID, is negative and statistically significant across all models, indicating that after 2017, startups facing unicorn competitors were significantly less likely to attract prestigious VC investment. Control variables include prior funding rounds, funding amount, and funding history to account for firm-level heterogeneity. Robustness across models supports the presence of a crowding-out effect from unicorn firms. Z-statistics (Probit&Logit) and t-statistics (LPM) are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3- 3 Moderating Effect of Multiple Unicorn Competitors on the Likelihood of Receiving Investment from Prestigious VCs

	(1)	(2)	(3)	(4)	(5)	(6)
	LPM		Probit		Logit	
HasUnicornCompetitor	-0.236***	-0.235***	-0.634***	-0.644***	-1.032***	-1.055***
	(-7.35)	(-7.41)	(-7.13)	(-7.18)	(-6.90)	(-6.98)
DID	-0.324***	-0.313***	-1.183***	-1.176***	-2.109***	-2.093***
	(-5.70)	(-5.57)	(-5.87)	(-5.78)	(-5.27)	(-5.20)
after2017	0.135***	0.134***	0.344***	0.349***	0.551***	0.561***
	(7.44)	(7.48)	(7.24)	(7.30)	(7.20)	(7.24)
morethan1_did	0.584***	0.581***	1.884***	1.906***	3.250***	3.294***
	(6.94)	(6.97)	(7.26)	(7.28)	(6.78)	(6.82)
FundingRounds		0.047***		0.125***		0.203***
		(6.25)		(6.17)		(6.16)
LastFundingAmountM		-0.002***		-0.005***		-0.008***
		(-6.01)		(-6.05)		(-5.96)
YearsSinceLastFunding		-0.015		-0.039		-0.065
		(-1.53)		(-1.50)		(-1.54)
YearsSinceFirstFunding		0.003		0.008		0.013
		(0.52)		(0.56)		(0.53)
_cons	0.492***	0.515***	-0.019	0.040	-0.030	0.068
	(45.91)	(12.34)	(-0.69)	(0.35)	(-0.69)	(0.37)
N	3560	3560	3560	3560	3560	3560
adj. R2	0.062	0.081				
Pseudo. R2			0.0497	0.0655	0.0497	0.0655

This table presents regression results examining whether the presence of multiple unicorn competitors alters the negative effect of unicorn competition on startup funding outcomes. The interaction term morethan1_did is positive and statistically significant across all models (LPM, Probit, Logit), suggesting that the crowding-out effect of unicorns is weakened in industries with more than one unicorn. These findings imply that fragmented unicorn dominance may reduce barriers to entry and create more favorable conditions for peer startups seeking elite VC investment.Z-statistics (Probit & Logit) and t-statistics (LPM) are reported in parentheses. ***, *, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3- 4 Effect of Unicorn Competition on VC Funding within Opportunity Zones

	(1)	(2)	(3)	(4)	(5)	(6)
	LPM		Probit		Logit	
HasUnicornCompetitor	-0.686***	-0.679***	-2.430***	-2.423***	-4.346***	-4.335***
	(-20.70)	(-20.40)	(-12.40)	(-12.26)	(-9.98)	(-9.92)
DID	-0.069	-0.071	-0.203	-0.217	-0.333	-0.358
	(-1.24)	(-1.29)	(-0.64)	(-0.67)	(-0.47)	(-0.51)
after2017	0.070*	0.073*	0.223	0.238	0.378	0.403
	(1.89)	(1.96)	(1.52)	(1.61)	(1.51)	(1.59)
FundingRounds		0.021*		0.089		0.167*
		(1.77)		(1.63)		(1.73)
LastFundingAmountM		-0.000		-0.002		-0.004
		(-1.03)		(-1.07)		(-0.99)
YearsSinceLastFunding		-0.016		-0.085		-0.134
		(-1.03)		(-1.13)		(-1.02)
YearsSinceFirstFunding		-0.006		-0.033		-0.049
		(-0.65)		(-0.84)		(-0.69)
_cons	0.718***	0.763***	0.576***	0.865***	0.934***	1.329**
	(34.18)	(11.51)	(7.24)	(2.89)	(7.03)	(2.52)
N	720	720	720	720	720	720
adj. R2	0.049	0.050				
Pseudo. R2			0.0434	0.0440	0.0434	0.0440

This table reports regression results using a restricted sample of startups headquartered in designated Opportunity Zones (OZs), to examine whether policy incentives moderate the impact of unicorn competition. Across all models (LPM, Probit, Logit), the DID interaction term is statistically insignificant, suggesting that the crowding-out effect observed in the full sample weakens in OZs. This implies that tax incentives and spatial policy instruments may offset competitive disadvantages posed by unicorn dominance. Z-statistics (Probit & Logit) and t-statistics (LPM) are reported in parentheses. ***, *, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3- 5 Robustness Check Using VC Age as an Alternative Proxy for Reputation

	(1)	(2)	(3)	(4)	(5)	(6)
	LPM		Probit		Logit	
HasUnicornCompetitor	-0.222***	-0.221***	-0.588***	-0.595***	-0.954***	-0.969***
	(-6.85)	(-6.88)	(-6.69)	(-6.73)	(-6.52)	(-6.56)
DID	-0.167***	-0.159***	-0.450***	-0.435***	-0.734***	-0.710***
	(-3.20)	(-3.06)	(-3.12)	(-2.99)	(-3.01)	(-2.89)
after2017	0.122***	0.122***	0.311***	0.315***	0.498***	0.504***
	(6.68)	(6.70)	(6.56)	(6.60)	(6.53)	(6.55)
FundingRounds		0.041***		0.108***		0.174***
		(5.40)		(5.37)		(5.36)
LastFundingAmountM		-0.002***		-0.004***		-0.007***
		(-5.26)		(-5.28)		(-5.23)
YearsSinceLastFunding		-0.015		-0.039		-0.063
		(-1.51)		(-1.49)		(-1.51)
YearsSinceFirstFunding		0.002		0.004		0.007
		(0.29)		(0.26)		(0.29)
_cons	0.498***	0.527***	-0.006	0.073	-0.009	0.115
	(45.99)	(12.49)	(-0.20)	(0.66)	(-0.20)	(0.64)
N	3560	3560	3560	3560	3560	3560
adj. R2	0.045	0.059				
Pseudo. R2			0.0337	0.0458	0.0337	0.0458

This table replicates the baseline analysis by redefining high-reputation venture capital firms as those in the top decile by firm age. Results from LPM, Probit, and Logit models confirm the main findings: the presence of unicorn competitors significantly reduces the probability that a startup secures investment from prestigious VCs. The DID interaction term remains negative and statistically significant, indicating a persistent crowding-out effect even under alternative reputation metrics. Z-statistics (Probit & Logit) and t-statistics (LPM) are reported in parentheses. ***, *, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3- 6 Robustness Check Using Number of Completed VC Deals as an Alternative Proxy for Reputation

	(1)	(2)	(3)	(4)	(5)	(6)
	LPM		Probit		Logit	
HasUnicornCompetitor	-0.190***	-0.189***	-0.492***	-0.496***	-0.792***	-0.802***
	(-5.83)	(-5.85)	(-5.72)	(-5.74)	(-5.62)	(-5.65)
DID	-0.145***	-0.137***	-0.379***	-0.364***	-0.613***	-0.589**
	(-2.76)	(-2.63)	(-2.71)	(-2.59)	(-2.65)	(-2.53)
after2017	0.112***	0.112***	0.286***	0.290***	0.459***	0.465***
	(6.11)	(6.15)	(6.04)	(6.09)	(6.02)	(6.05)
FundingRounds		0.033***		0.088***		0.141***
		(4.41)		(4.40)		(4.39)
LastFundingAmountM		-0.002***		-0.004***		-0.006***
		(-4.93)		(-4.94)		(-4.91)
YearsSinceLastFunding		0.002		0.004		0.007
		(0.16)		(0.16)		(0.16)
YearsSinceFirstFunding		0.002		0.005		0.008
		(0.35)		(0.33)		(0.35)
_cons	0.509***	0.508***	0.022	0.021	0.034	0.031
	(46.76)	(11.95)	(0.78)	(0.19)	(0.78)	(0.17)
N	3560	3560	3560	3560	3560	3560
adj. R2	0.034	0.045				
Pseudo. R2			0.0255	0.0344	0.0255	0.0344

This table reports regression results using an alternative definition of prestigious venture capital firms—those in the top decile by the number of completed deals. Consistent across LPM, Probit, and Logit models, the presence of unicorn competitors significantly reduces the likelihood that a startup secures elite VC funding. The DID term remains negative and statistically significant, reaffirming the robustness of the main findings under varying definitions of VC reputation. Z-statistics (Probit & Logit) and t-statistics (LPM) are reported in parentheses. ***, *, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

4. Do Superstar Firms Suppress or Stimulate Innovation? Evidence from General and Green Innovation in China

4.1 Introduction

In recent years, the global economy has witnessed the rapid emergence of "superstar firms"—a small cohort of exceptionally productive and dominant companies that wield disproportionate influence over market structures and competition dynamics. These firms are characterized by their exceptional productivity, extensive use of digital technologies, and ability to benefit from economies of scale and network externalities, allowing them to accumulate significant market share while simultaneously raising entry barriers for potential competitors (Autor et al., 2020; De Loecker et al., 2020). As these firms continue to expand across industries and borders, concerns have grown over their capacity to reshape competitive dynamics and potentially discourage innovation, particularly among smaller or less technologically advanced firms.

The increasing dominance of superstar firms is not limited to developed economies. In emerging markets like China, large companies are also starting to show similar patterns (Zhai & Carrick, 2019). However, the regulatory systems and institutional settings in China differ significantly from those in Western countries. Although many studies have focused on the U.S. context and have found that superstar firms often suppress general innovation by using their market power and concentrating resources (Barkai, 2020; Grullon et al., 2019), there is still limited understanding of how these firms operate in China. In the Chinese market, government intervention, industrial policy, and institutional dynamics play a much more influential role. This raises important questions about the

generalizability of existing findings to non-Western contexts, particularly in sectors where innovation is crucial for long-term growth.

A growing body of empirical research has sought to examine the relationship between market competition and firm-level innovation, but findings remain contested. On one hand, proponents of the “competition-enhances-innovation” view argue that competitive pressure incentivizes firms to innovate as a means of differentiation and survival (Nickell, 1996; Schmitz, 2005). On the other hand, several studies have shown that excessive market concentration, particularly in the presence of dominant players, leads to reduced innovation incentives among peer firms due to lower expected returns, increased entry barriers and diminished resource access (Cunningham et al., 2021; Hashmi, 2013). Moreover, the emergence of “killer acquisitions” and talent hoarding by dominant firms further undermines the foundations of technological progress by eliminating potential challengers and concentrating critical capabilities (Cunningham et al., 2021)

Within this broader discourse, the role of green innovation (GI) remains underexplored. Defined as innovations that aim to reduce environmental harm while delivering economic value (Kemp & Pearson, 2007), green innovation is increasingly essential for addressing global sustainability goals. Unlike general technological innovation, green innovation often involves longer time horizons, greater regulatory involvement, and higher initial investment risks (Horbach et al., 2012; Berrone et al., 2013). As such, the factors that drive or inhibit green innovation can differ significantly from those affecting general innovation. Prior studies suggest that intense market competition may discourage green innovation due to firms' preference for short-term

returns, while supportive policy environments and corporate sustainability commitments play a more decisive role (Guo et al., 2022; Ma & Li, 2025). However, the influence of superstar firms—whether suppressive or enabling—on green innovation remains largely uncharted territory in current research.

This leads to a critical gap in the literature, most studies focus on how superstar firms impact general innovation through the lens of market competition, overlooking the nuanced dynamics of green innovation, especially in emerging markets. Compared with conventional innovation, green innovation is more strongly linked to environmental regulation and typically requires larger upfront investment with a longer horizon before commercial returns can be realised. These features make firms' innovation choices under competitive pressure more complex, as managers must weigh immediate performance concerns against investment decisions whose benefits may only materialise over time. Competition may therefore influence green innovation differently from other forms of technological innovation, particularly when firms face constraints related to risk tolerance and strategic flexibility. In the Chinese context, the behavior and impact of superstar firms may diverge from their Western counterparts due to factors such as state ownership, industrial policy, and differing levels of market concentration. While dominant U.S. firms may crowd out competitors and stifle innovation, Chinese superstar firms might facilitate innovation through supply chain integration, government collaboration, or technology diffusion. Moreover, the strategic role of green innovation in China's industrial upgrade and carbon neutrality agenda suggests that its relationship with superstar firms may not mirror that of general innovation.

To address these gaps, this study explores how the presence of superstar firms in Chinese industries influences the innovation behavior of their peers, with a particular focus on green innovation. By integrating market structure theory, stakeholder theory, and knowledge spillover theory, the research investigates both the suppressive and stimulative channels through which dominant firms affect their competitors. It further examines the moderating effects of corporate social responsibility (CSR) performance and technological proximity—two factors that may alter the impact of superstar firms by shaping resource access, absorptive capacity, and strategic orientation.

The study makes several contributions. First, it extends existing theories on market concentration and innovation by introducing green innovation as a distinct analytical category. Second, it provides a contextualized understanding of superstar dynamics in China, offering comparative insights into how institutional environments shape innovation outcomes. Third, it identifies key organizational and technological conditions—such as strong ESG performance and high technological proximity—that may allow firms to mitigate the negative effects of dominant competitors. These findings offer valuable implications for policymakers aiming to support innovation in concentrated markets, and for firms seeking strategic pathways to sustain innovation under competitive pressure. For instance, the research shows that while superstar firms may suppress general innovation, they may paradoxically stimulate green innovation by setting new environmental standards or facilitating knowledge spillovers, especially for firms with aligned ESG goals.

In summary, this study offers a detailed and comprehensive exploration of how superstar firms influence innovation outcomes in the Chinese context. By distinguishing

between general and green innovation, and by accounting for organizational resilience factors such as CSR engagement and technological similarity, the research sheds new light on the evolving role of corporate giants in shaping innovation in emerging economies. The rest of this paper is organized as follows. Section 2 reviews the relevant literature and develops the research hypotheses. Section 3 describes the data, variable construction, and summary statistics. Section 4 presents the empirical methodology and discusses the main findings, including robustness checks and heterogeneity analysis. Section 5 concludes with a summary of the results, theoretical and practical implications, and directions for future research.

4.2 Related Literature

To better understand the topic of this study, the following sections review key research from the existing literature. The focus is on how large and powerful firms—often called “superstar” or “superstar” companies—are changing market competition and innovation. This review is divided into several parts, including how these firms emerge, how they affect other companies, and how they influence both general and green innovation. These discussions help to build a foundation for the research questions and highlight what is still missing in the current literature.

4.2.1 The Emergence of Superstar Company

The emergence of "superstar firms"—a limited group of highly productive companies that secure increasing market shares and exert substantial influence over industry dynamics—marks a significant trend in contemporary economies (Autor et al., 2020; Bajgar et al., 2025). These firms typically leverage scale, network effects, and technological edges to strengthen their positions and outperform smaller competitors. In empirical terms, such dominance is observable in tightly concentrated markets where leading players control considerable portions of industry sales.

De Loecker et al. (2020) argue that rising markups over the past few decades reflect the growing market power of the relatively small cohort of dominant companies. Their empirical results suggest that as markups increase, these firms gain greater latitude to influence prices and output, thus reshaping market structures. Research by Autor et al. (2020) and Rossi-Hansberg et al. (2021) highlights that combining industry-wide concentration metrics with firm-level market share offers a clear method for identifying

these dominant entities. Firms that lead in already concentrated markets possess the kind of market power that lets them alter competitive landscapes and reshape innovation incentives among rivals (Gutiérrez & Philippon, 2017). This study's measure of superstar firms, detailed in the variable definition section, builds directly on this approach.

The growing dominance of superstar companies is changing key aspects of the global economy, from labor markets to innovation environment. Research paints a concerning picture of how these corporate giants are altering economic landscapes. In the U.S., Barkai's (2020) reveals a troubling trend: as workers' share of economic output shrinks, an increasing portion of wealth is flowing to corporate profits, particularly among industry leaders. Barkai further notes that this reallocation is not simply a neutral shift between labor and capital, but often reflects "pure profits". In other word, dominant firms are accruing outsized returns unrelated to productive investment or wage growth. This pattern isn't confined to the United States. Karabarbounis and Neiman's (2014) global analysis shows similar shifts in labor income distribution worldwide. They highlight how these changes are intertwined with broader factors such as technological advancement, the declining relative price of investment goods, and evolving production practices. Their findings suggest that as firms increasingly substitute capital for labor, the labor share declines, magnifying the market power of a select group of large corporations. Consequently, these superstar companies may leverage their cost advantages, economies of scale, and network effects to capture an even larger share of profits—further amplifying the global trend away from wages and toward concentrated corporate earnings. What is more, the consolidation of corporate power appears to be accelerating. Grullon et al. (2019), analyzing a large sample of U.S. public firms from 1972 to 2014,

find that over 75% of U.S. industries experienced an increase in concentration levels over the past two decades. Specifically, the authors document that the share of sales attributed to the top firms in each sector has risen significantly. It indicates that fewer companies are capturing a larger portion of overall market activity. They also note that this rise in concentration is associated with higher profit margins and a decline in firm entry.

4.2.2 Superstar Company and Market Competition

The presence of superstar firms has a profound impact on market competition and industry structure. The most direct connection between superstar firms and market competition is explained by market structure theory, which emphasizes how market concentration affects competitive dynamics (Kamien and Schwartz, 1982). As superstar firms expand, they dominate larger portions of the market, driving smaller competitors out and raising significant entry barriers. This growing concentration reduces competition and allows dominant firms to strengthen their market power further, creating a self-reinforcing cycle that reshapes entire industries.

Numerous empirical studies have shown that these dominant companies have significantly reduced market competion. De Loecker and Eeckhout (2020) focus primarily on the United States, analyzing firm-level data from multiple industries over several decades to study the impact of rising market power. Their findings reveal that the increase in markups is particularly pronounced in U.S. industries dominated by superstar firms, leading to weakened competition and greater market concentration. Bessen (2020) explores how advancements in information technology have contributed to the rise of superstar firms and increased industry concentration. Their study shows that IT-intensive industries, such as software, finance, and e-commerce, exhibit significantly higher

concentration levels compared to others. Superstar firms in these sectors leverage technology to gain competitive advantages, such as operational efficiency, data-driven decision-making, and improved scalability. These advantages create substantial entry barriers for smaller competitors, reducing market competition over time. Similarly, Cheng et al. (2024) reveal that the rise of superstar firms significantly reduces market competition by increasing the financial vulnerability of competing firms. Using U.S. publicly listed firms from 1988 to 2018, the authors find that firms with high exposure to superstar competitors are 42% more likely to experience bankruptcy. Superstar firms dominate through high and growing market power, creating a "winner-takes-all" dynamic that raises entry barriers and intensifies competition in product markets.

4.2.3 Market Competition and Firm Innovation

Innovation is widely regarded as a critical driver of firm competitiveness and economic growth. Scholars have long been interested in understanding the factors that facilitate or impede the capacity of firms to innovate, yielding a rich body of research. Among the numerous factors influencing corporate innovation, the most relevant one to superstar companies is market competition.

Several studies highlight the role of market competition in shaping the level and direction of firms' innovation with mixed findings. Some scholars believe that increased market competition can enhance corporate innovation. Nickell (1996) demonstrates that higher competition, measured by market share, entry threats, and price-cost margins, is associated with faster productivity growth, supporting the positive role of competitive pressure on firm performance. Schmitz (2005) examines how increased foreign competition influenced productivity in the U.S. and Canadian iron ore industries during

the 1980s crisis. The study highlights that heightened competition from forced significant changes in work practices leading to dramatic improvements in labor, material, and capital productivity. In addition, Blundell, Griffith, and Van Reenen (1999) also provide empirical evidence to support the claim that higher levels of market competition can stimulate corporate innovation. Using a panel of British manufacturing firms, they find that firms facing greater competitive pressure tend to have higher innovation output, as measured by patenting activity and market value.

On the other hand, several scholars believe that market competition is negatively correlated with corporate innovation. Hashmi (2013) revisits the findings proposed by Aghion et al. (2005), using data from U.S. manufacturing firms between 1976 and 2001. The U.S. data shows a mildly negative relationship between competition and innovation. More recently, Autor et al. (2020) analyze how rising Chinese import competition affects US firms' innovation, using U.S. patent and corporate data from 1975 to 2013. The study finds that increased import exposure reduces firms' R&D spending and patent output of US companies.

However, some scholars hold a different view. They argue that the relationship between competition and innovation is more dynamic. Carlin et al. (2004) investigate how competition influences innovation and growth in transition economies, based on a survey of nearly 4,000 firms in 24 countries. Their study reveals that moderate competition leads to higher innovation and sales growth, while too little or too much competition limits performance. They emphasize that the presence of a few competitors promotes better resource utilization and innovation, making competition a key driver of firm development during economic transitions. Likewise, Aghion et al. (2005) propose an "inverted-U"

relationship between competition and innovation. They argue that low competition stifles innovation due to lack of rivalry, while excessive competition reduces resources for R&D. Moderate competition fosters the most innovation as firms seek differentiation. Bos et al. (2013) investigate the relationship between competition and innovation in the U.S. financial services industry, consistent with Aghion et al. (2005), they revel an inverted-U relationship: moderate competition boosts innovation, while excessive competition hinders it. Aghion et al. (2018) explore the causal effects of competition on step-by-step innovation through laboratory experiments. Their study highlights that increased competition boosts R&D investments by neck-and-neck firms (escape-competition effect) but reduces R&D investments by laggard firms.

4.2.4 Green Innovation

Among various types of innovation, green innovation stands out as a unique form of innovation that focuses on both economic and environmental benefits. Kemp and Pearson (2007) define green innovation as innovations that reduce environmental harm through new products, processes, or organizational methods aimed at improving resource efficiency and sustainability. This type of innovation is increasingly recognized as essential for sustainable development and corporate environmental management.

Green innovation plays a vital role in balancing environmental sustainability and business competitiveness. Caracuel and Mandojana (2013) highlight that firms implementing GI strategies enhance their reputation, reduce regulatory risks, and gain competitive advantages. Over the past decades, research in this field has increased significantly, driven by environmental regulations, consumer demand for sustainable products, and corporate social responsibility commitments (Chen, 2008; Chen et al., 2012).

Prior studies emphasize multiple drivers of green innovation, including government regulations, market demand, and technological capabilities. Horbach et al. (2012) argue that regulatory pressure is one of the strongest drivers, compelling firms to adopt greener technologies to comply with environmental laws. Additionally, Berrone et al. (2013) suggest that market forces, such as consumer preference for eco-friendly products, play a crucial role in pushing firms toward sustainable innovation. Furthermore, technological advancements enable firms to develop cost-effective green solutions, making sustainability a viable business strategy (Zhang et al., 2021).

It is worth noting that scholars have found market competition to be an important determinant of green innovation as well , but its impact follows a different story compared to general innovation. Green innovation differs from general innovation in several key aspects, particularly in its impact on firm performance. Traditional innovation often yields immediate competitive advantages, such as increased efficiency, cost reduction, or product differentiation（Porter, 1985）On the other hand, green innovation tends to generate benefits over the long term.Investments in environmentally friendly technologies and sustainable practices typically require high upfront costs, and their returns may take years to materialize. (Chen, Lai, & Wen, 2006; Horbach, 2008)

Market competition affects general innovation and green innovation through different mechanisms. Under intense competition, firms prioritize general innovation to gain immediate advantages, such as cost reduction and product differentiation, as these yield quick returns. In contrast, green innovation becomes less attractive in highly competitive markets with its long-term payoffs and high upfront costs. Firms may instead focus on short-term survival strategies like price cuts or efficiency improvements. As a

result, while competition stimulates general innovation, it discourages green innovation, especially when firms face strong pressure for immediate profitability (Porter & van der Linde, 1995; Ambec & Lanoie, 2008; Del Río et al., 2010)

Using data from China's listed manufacturing firms since 2009, Guo et al. (2022) examine how market competition and financialization influence corporate green innovation. The findings suggest that intense market competition suppress green innovation in the Chinese market, as firms prioritize cost-cutting and short-term profitability over long-term environmental investments. Additionally, managers tend to prioritize financial returns in the short run, often at the expense of long-term green innovation. Likewise, Ma and Li (2025) reveals that intense market competition generally discourages green innovation efforts. The study confirms that firms facing strong competition prioritize short-term financial performance over long-term sustainability investments, which leads to a decline in eco-friendly innovations. Additionally, their findings highlight that the negative impact of competition on green innovation is more pronounced in state-controlled enterprises and in industries with strong monopolistic structures but low technological intensity.

4.2.5 Gap in Literture.

Existing studies primarily examine the impact of market competition on firm innovation, rather than directly investigating the role of superstar firms in shaping innovation outcomes. The prevailing view in the literature is that the presence of superstar firms reduces market competition, which in turn weakens innovation incentives for other firms. However, most of these studies focus on the U.S. market, where superstar firms are highly dominant and market concentration is significantly stronger. Research on

superstar firms in China remains limited, leaving open the question of whether similar competitive dynamics apply in an emerging market context.

Unlike in the U.S., where superstar firms exhibit extreme market power, China's superstar firms are still evolving and may not necessarily suppress market competition to the same extent. Given that China's market structure, regulatory environment, and industrial policies differ from those of developed economies, the assumption that superstar firms universally reduce competition—and consequently innovation—may not fully apply. This distinction raises an important gap in the literature: do Chinese superstar firms reduce market competition and innovation in the same way as their U.S. counterparts, or do they function differently in a less concentrated, policy-driven market? Furthermore, while existing studies extensively explore the relationship between market competition and general innovation, little attention has been given to how superstar firms influence green innovation. Green innovation differs from general innovation in its drivers and mechanisms—rather than being solely shaped by competitive pressures, it is strongly influenced by government policies, regulatory incentives, and long-term sustainability goals. This distinction suggests that the impact of superstar firms on green innovation may not follow the same pattern as for general innovation. If market competition primarily drives general innovation, green innovation may instead depend more on firms' strategic investments and compliance with environmental policies. Whether the presence of superstar firms in China suppresses green innovation due to reduced competition or facilitates it through resource advantages and regulatory adaptation remains an open question.

4.3 Hypothesis Development

In this section, I present the development of hypotheses to explore how superstar firms affect the innovation of their competitors and the moderating roles of CSR performance and technological proximity. First, I discuss the dual impact of superstar firms on competitors' innovation, which can either reduce or stimulate innovation under different conditions. Next, I propose that CSR performance may mitigate the negative effects or amplify the positive effects of superstar firms on competitors' innovation. Finally, I examine how technological proximity influences this relationship by enhancing knowledge spillovers or intensifying competitive pressure.

4.*3.1* The Relationship between Superstar and Other Firm's Innovation Incentive

The impact of superstar firms on the innovation of other companies can be analyzed through multiple channels. One channel is innovation blocking channel. Dominant firms often invest heavily in R&D to maintain their leadership positions, as Aghion et al. (2005) show, they leverage their market power in ways that ultimately dampen competition. What's more, as superstar firms strive to maintain their industry dominance, they are driven not only to enhance their own innovation efforts but also to suppress the innovation of their competitors through various strategic actions. For instance, Cunningham et al. (2021) find that a notable fraction of acquisitions—termed "killer acquisitions"—lead to the discontinuation of promising drug development pipelines, effectively stifling competition and diminishing the overall rate of innovation. Such strategies illustrate the duality of market power: while it can enable dominant firms to funnel substantial resources into research and development, it also equips them with tools

to neutralize competitive threats, thereby affecting both short-term market dynamics and long-term technological progress. Under such innovation-blocking strategies by superstar firms, other companies encounter higher barriers to innovation. It becomes harder for them to access key markets, secure resources, and gain consumer recognition. This discourages smaller firms and startups from pursuing ambitious innovations, reducing overall market diversity and technological progress.

In addition, Superstar firms have a stronger ability to capture key resources for innovation, such as top talent, funding, and data. This makes it harder for other firms to access these resources or increases the cost of acquiring them. According to TalentSeer (2020), five major tech giants—Google, Microsoft, Apple, Amazon, and IBM—employ 20% of the world's artificial intelligence experts. Meanwhile, smaller firms in other industries struggle to compete for this limited pool of highly skilled talent. This uneven access to resources also limits the innovation potential of smaller firms and strengthens the competitive position of superstar companies.

From the perspective of superstar firms' competitors, the presence of these dominant companies may also have a negative impact on their innovation returns. Gu (2016) examines how market structure affects the relationship between R&D investment and stock returns. The study highlights that in highly concentrated markets, the returns from R&D are significantly lower compared to more competitive markets. Using a real options model, Gu finds that firms in competitive industries benefit more from R&D investments, which translate into higher stock returns. In contrast, in markets with high concentration, the positive relationship between R&D and returns diminishes or even turns negative.

Therefore, I propose my first hypothesis:

H1a: The presence of superstar firms reduce the innovation of their competitors

However, the impact of superstar firms on the innovation of their competitors may not always be negative. The presence of these dominant firms could stimulate innovation among their peers. Competitive pressure created by superstar firms might push smaller companies to differentiate themselves by investing more in R&D and developing new technologies. Aghion et al. (2005) propose the "escape competition effect," where firms facing intense competition are motivated to innovate to maintain or improve their market position.

H1b: The presence of superstar firms increases the innovation of their competitors

In the case of green innovation, the effects of superstar firms may differ from general innovation. If the presence of superstar firms discourages competitors from engaging in general innovation due to the difficulty of capturing market share in the short term, firms may shift their focus toward long-term strategic investments such as green innovation. Unlike general innovation, which often aims at immediate competitive advantages, green innovation offers a different pathway for differentiation. Facing strong market dominance from superstar firms, smaller firms might perceive green innovation as

a way to establish a unique market position, attract environmentally conscious investors, and comply with evolving regulatory standards.

On the other hand, if the presence of superstar firms stimulates the innovation incentives of other companies, then investment in green innovation may decrease. When firms are motivated to engage in innovation due to competitive pressure, they may prioritize general technological advancements that yield immediate market benefits rather than long-term sustainability-oriented innovations (Guo et al, 2022; Ma and Li ,2025)

Given that green innovation typically requires significant upfront investment and offers delayed returns, firms in highly competitive environments may allocate resources toward innovation projects with quicker payoffs. As a result, the presence of superstar firms could lead competitors to focus on short-term technological improvements rather than long-term green innovation, reducing their commitment to environmentally sustainable initiatives. Based on the discussion above, the following hypotheses are proposed:

H2a: The presence of superstar firms increases competitors' incentives to engage in green innovation

H2b: The presence of superstar firms reduces competitors' investment in green innovation

4.3.2 The Moderating Effect of Firm's CSR Performance

Corporate Social Responsibility performance may play a crucial role in moderating the impact of superstar firms on the innovation of their competitors. According to stakeholder theory (Freeman & Phillips, 2002) companies with strong CSR practices prioritize broader stakeholder interests, including environmental sustainability, social well-being, and ethical governance. These companies tend to build stronger reputations and foster higher levels of trust with consumers, suppliers, and investors. Trust and goodwill generated through CSR efforts can improve stakeholder engagement, which in turn enhances firms' access to key resources such as capital, skilled labor, and strategic partnerships (Luo and Bhattacharya, 2009). This improved resource access allows these firms to mitigate the competitive pressures exerted by superstar firms.

Furthermore, strong CSR performance can bring a culture of innovation and adaptability, encouraging employees to contribute creative ideas and solutions. Firms that integrate CSR into their business strategy are often more proactive in addressing industry changes and market demands, making them more resilient to external competition (Cheung,2016). As a result, competitors of superstar firms with robust CSR practices may be better positioned to respond to competitive threats through enhanced collaboration, increased stakeholder support, and stronger innovation capabilities, ultimately turning external pressure into an opportunity for growth. Therefore, I propose the following hypothesis

H3a: Higher CSR performance reduce the negative impact of superstar firms on competitors' innovation

In the case of that superstar firm might increase the incentive of its competitors to innovate, the following hypothesis is proposed

H3b:Higher CSR performance increase the positive impact of superstar firms on competitors' innovation

4.3.3 The Moderating Effect of Technological Proximity

Technological proximity, which reflects the degree to which firms operate on similar technological frontiers, may significantly moderate the impact of superstar firms on their competitors' innovation. Knowledge spillover theory (Jaffe, 1986) suggests that firms with similar technological capabilities are more likely to benefit from each other's knowledge and innovation activities. When competitors share a high level of technological proximity with superstar firms, they are better positioned to absorb external knowledge, enhancing their own innovation efforts. This proximity allows them to learn from industry leaders' technological advancements, boosting their own R&D performance (Cohen & Levinthal, 1990).

Additionally, when firms operate near the technological frontier, innovation investment offers greater potential returns for competitors of superstar firms. According to technology diffusion theory (Rogers, 1962), firms that are far from the frontier face diminishing returns on R&D investments because their initial efforts are primarily focused on catching up rather than achieving breakthroughs. In contrast, firms already positioned near the frontier have a higher likelihood of making significant technological advances.

These advances can help them leap beyond the frontier, enabling them to capture innovation rents and close the gap with superstar firms (Aghion et al., 2005).

For companies at the frontier, each additional investment in innovation provides opportunities for first-mover advantages, allowing them to pioneer new markets and technologies. This increases the chances of disrupting the existing dominance of superstar firms. Consequently, competitors near the technological frontier are more incentivized to innovate aggressively, as the potential rewards are far greater compared to firms that are still catching up technologically. Thus, I propose the following hypothesis:

H4a:Higher technological proximity reduces the negative impact of superstar firms on competitors' innovation

In the case of that superstar firm might increase the incentive of its competitors to innovate, the following hypothesis is proposed

H4b:Higher technological increases the positive impact of superstar firms on competitors' innovation

4.4 Data and Descriptive Statistic

In this section, I describe the data sources, sample selection process, and the identification criteria for superstar firms. The analysis begins with the data collection and the method used to classify firms as superstar companies as well as the measurement of other variables. Descriptive statistics are then provided to summarize the characteristics of the sample.

4.4.1 Data Collection and Sample Selection

My initial dataset consists of all publicly listed firms on the Shanghai Stock Exchange and Shenzhen Stock Exchange from 2007 to 2023, covering all industries except the financial sector. The sample period begins in 2007 to ensure the consistency of accounting data, as a new accounting standard was introduced that year. Following prior studies, I apply several filtering criteria. First, I exclude firms in the financial industry due to their distinct regulatory and financial reporting frameworks. Second, we remove firms under special treatment by stock exchanges (marked as ST/PT). Third, observations missing essential regression variables are excluded. After applying these criteria, the final sample consists of 12,653 firm-year observations.

I obtain innovation data from the Chinese National Intellectual Property Administration. Financial and corporate governance data come from the China Stock Market & Accounting Research database and ESG data are sourced from the Bloomberg Terminal.

4.4.2 Measurement of Variables

4.4.2.1 Identification of Superstar Firm

The concept of "superstar firms" captures a small cohort of exceptionally productive and dominant companies that wield disproportionate influence over market structures (Autor et al., 2020; Bajgar et al., 2025). To empirically identify such firms, this study adopts a two-dimensional measure based on industrial organization research, which assesses a firm's dominance through both overall market concentration and its individual market share.

Following the methodology of Autor et al. (2020) and Rossi-Hansberg, Sarte, and Trachter (2021), we first calculate the Herfindahl-Hirschman Index (HHI) for each industry (classified by CSRC codes) to gauge the level of market concentration. A high HHI indicates a concentrated market structure, which often signifies the presence of firms with significant market power that can shape competition and innovation (Gutiérrez & Philippon, 2017). A firm is subsequently classified as a superstar if it meets a specific market share threshold within its industry's corresponding HHI bracket, as detailed below:

(1) If $1500 \leq HHI < 2500$ which indicates moderately concentrated market with some dominant firms. A firm holding ≥ 25% of the industry’s total market share is considered a l superstar.

(2) If $HHI \geq 2500$ which indicates a Highly concentrated market, typically characterized by oligopoly or monopoly. A firm with ≥ 30% market share qualifies as a superstar with significant industry influence.

(3) If HHI ≥ 5,000 which suggests an extremely concentrated market, approaching monopoly. Firms with ≥ 40% market share are classified as near-monopoly superstars.

(4) If HHI ≥ 7,500, which means a monopoly market structure. A firm with ≥ 50% market share is considered an absolute industry leader.

I further generate a dummy variable to indicate whether firm i in year T has a superstar firm as a competitor within the same industry. This variable takes a value of 1 if a superstar firm is present in the industry and 0 otherwise.

4.4.2 2 Measurement of Innovation

We measure firm innovation output using patent data, which is a well-established proxy for innovative activity in the literature. The data on patent applications and grants are sourced from the Chinese National Intellectual Property Administration (CNIPA). To account for the substantial heterogeneity in the economic value and technological significance across different types of patents, we construct a weighted patent count measure instead of relying on simple raw counts. This approach is particularly crucial in the context of China's patent system, which features three distinct types of patents with varying levels of inventiveness and examination rigor：

(1) Invention Patents: These require substantive examination and possess the highest degree of technological novelty and inventiveness. They are most comparable to utility patents in the U.S. system and are generally considered the most valuable.

(2) Utility Model Patents: These protect smaller, incremental innovations related to the shape or structure of a product. They are granted after a preliminary formalities

examination without substantive review, making them easier and faster to obtain but typically of lower commercial value and technological impact than invention patents.

(3) Design Patents: These protect the aesthetic appearance of a product. They involve no technical assessment and are generally considered the least technologically significant of the three types.

Given this hierarchy of quality and significance, a simple count that treats one design patent as equal to one invention patent would introduce significant measurement error. To address this, we follow the established practice in studies on Chinese innovation (e.g., Fisch, 2019) and apply a 3:2:1 weighting scheme.

For each firm-year observation, we calculate the weighted patent count as follows:

$$Weighted\ Patent = \frac{(3 \times Invention_{it}) + (2 \times Utility_{it}) + (1 \times Design_{it})}{6}$$

This formula assigns the greatest weight (3) to invention patents, a moderate weight (2) to utility model patents, and the lowest weight (1) to design patents. The resulting composite measure provides a more accurate and economically meaningful reflection of a firm's total innovative output.

This weighting approach finds strong justification in China's unique patent environment. First, the weights align with the statutory hierarchy of the Chinese patent

system, where invention patents undergo the most rigorous examination and thus receive the highest weight. Second, it reduces noise from strategic patenting behaviors, as Chinese firms sometimes file large volumes of utility models and designs primarily to meet administrative targets or secure government subsidies. Third, the weighting approximates underlying economic value, since empirical evidence consistently shows invention patents correlate more strongly with firm performance than other patent types. Finally, this methodology enhances comparability with prior research on Chinese innovation. For our empirical analysis, we apply the natural logarithm of (1 + the weighted patent count) to correct for skewness and construct separate measures for innovation

To distinguish green innovation from general innovation, I follow the established methodology employed in environmental innovation research. My approach relies on the International Patent Classification (IPC) system to identify patents specifically related to environmental technologies. For green innovation, we selectively identify patents falling within environmental technology domains using the widely recognized classification framework developed by the World Intellectual Property Organization in its "IPC Green Inventory." This inventory systematically categorizes patent documents related to environmental management, climate change mitigation, and sustainable technologies through specific IPC codes covering areas such as renewable energy generation, energy efficiency, pollution control, waste management, and water conservation. For general innovation, we measure a firm's patent filings in all technological domains excluding those classified as green innovations

This classification approach enables us to construct two distinct dependent variables. The general innovation measure captures the firm's broad technological activities, while the green innovation measure specifically tracks its environmentally oriented technological developments. Both measures are calculated using the same 3:2:1 weighting scheme described previously, ensuring consistency in measurement while accurately reflecting the different nature of these innovation types.

4.4.2.3 Measurement of CSR Performance and Companies' Technological Proximity

To test Hypothesis 3 and Hypothesis 4, this study measures CSR performance using ESG scores and evaluates technological proximity through innovation efficiency.

CSR Performance

CSR performance is assessed using a firm's ESG score, a widely recognized indicator of corporate sustainability efforts. The ESG measure used in this study is obtained from Bloomberg ESG Scores, which provide standardized assessments of firms' environmental, social, and governance practices based primarily on publicly disclosed information. The dataset covers the full observation window of the empirical sample, spanning from 2007 to 2023, and is matched to firm-year observations using unique company identifiers. Bloomberg's ESG score ranges from 0 to 100, with higher values indicating more extensive disclosure and stronger performance across ESG dimensions.

The scoring methodology relies on a quantitative aggregation of disclosed ESG indicators reported in annual reports, sustainability reports, and regulatory filings. Rather than relying on analyst opinions or subjective assessments, the Bloomberg framework

evaluates firms based on the breadth and consistency of reported ESG information across multiple dimensions, including carbon emissions, resource management, labour practices, corporate governance structures, and shareholder rights. The standardised construction of the score allows comparability across firms and industries, which makes it suitable for the heterogeneity analyses conducted in this chapter.

Technological Proximity

Bloom, Schankerman, & Van Reenen (2013) and Cohen & Levinthal (1990) highlight the ratio of R&D investment and patent output in defining technological capabilities. They argue that firms operating at similar technological levels should exhibit comparable R&D efficiency. If companies within the same industry are at a similar stage of technological advancement, their ratio of R&D expenditure to patent output is expected to be at a relatively consistent level. Significant deviations from this benchmark may indicate differences in absorptive capacity, innovation efficiency, or strategic focus on R&D investment. Therefore, I measure the technological proximity between firms based on their innovation efficiency.

This approach is preferred over alternative measures, such as those based on R&D expenditure or raw patent counts, for several conceptual and empirical reasons. The

primary rationale for using innovation efficiency is that it more accurately captures a firm's underlying technological capabilities and competencies. While R&D spending reflects input efforts and simple patent counts reflect output volume, innovation efficiency gauges a firm's effectiveness in transforming research investments into commercially viable and legally protected knowledge. Two firms with similar high innovation efficiency are likely to possess comparable processes for managing research, development, and commercialization, implying a closer alignment in their core technological competencies, even if their absolute sizes differ. This shared efficiency profile makes them more relevant peers and potential sources of knowledge spillovers. In contrast, alternative proximity measures have significant limitations in this context. Proximity based on R&D intensity can be misleading, as high R&D spending does not guarantee successful innovation and may signal inefficiency rather than capability. Proximity based on raw patent counts ignores the critical resource inputs required to generate those outputs, potentially conflating a large, inefficient firm with a small, highly efficient one.

In contrast, alternative proximity measures have significant limitations in this context. Proximity based on R&D intensity can be misleading, as high R&D spending does not guarantee successful innovation and may signal inefficiency rather than capability. Proximity based on raw patent counts ignores the critical resource inputs required to generate those outputs, potentially conflating a large, inefficient firm with a small, highly efficient one. Finally, proximity based on technology class co-occurrence (e.g., Jaffe's method) captures overlap in research fields but fails to account for the quality or efficiency with which firms operate within those fields.

In this research, technological proximity is determined using innovation efficiency (InnoEff2). It is calculated using the following equation

$$\text{InnoEff2} = \frac{Patent2}{Ln(1 + R\&D\ Expenditure)}$$

where:

Patent2 represents the total number of patent applications, including invention patents, utility models, and design patents, weighted in a 3:2:1 ratio.

R&D Expenditure is the firm's annual research and development spending.

To quantify technological proximity, the similarity between firms' InnoEff2 scores is computed using the normalized difference method. This approach ensures that differences in innovation efficiency are measured on a comparable scale. The formula for normalized difference is as follows:

Where i and j represent two firms within the same industry. A value closer to 1 indicates higher technological similarity, while a lower value suggests greater divergence in innovation efficiency

4.4.3 Descriptive Statistics

4.4.3.1 Year Distribution of Firms Meeting the Superstar Firm Criteria

Table 4-1 presents the number of firms that meet the criteria for being classified as superstar firms for each year from 2007 to 2022.

/Table 4-1 here/

The data shows fluctuations in the number of superstar firms over the years. The highest number was recorded in 2008, with 58 firms meeting the criteria, followed by a relatively high count in 2009 (44 firms) and 2010 (42 firms). However, after peaking in the early years, the number of superstar firms started to decline, particularly after 2015. In recent years, the number has decreased significantly, reaching its lowest point in 2021, with only a slight increase to 26 firms in 2022. This pattern suggests a downward trend in the presence of superstar firms over time. While there are some minor fluctuations, the overall decline indicates that fewer firms have been able to maintain or achieve superstar status in recent years.

4.4.3.2 Summary Statistics of Key Variables

Table 4-2 reports the descriptive statistics for the key variables used in this study.

/Table 4-2 here/

The sample includes over 33,000 firm-year observations. The mean of log R&D spending is 17.84, with a standard deviation of 1.58, suggesting that while most firms engage in R&D activities, there is considerable variation in their innovation investment intensity. The average number of patent applications and patent awards is approximately 3.29, reflecting relatively low levels of formalized innovation output among Chinese listed firms. In contrast, the average number of green patent applications is 2.18, with a large standard

deviation of 14.62 and a maximum value of 941, indicating that while most firms have limited green innovation activities, a small subset shows high engagement in this area. The key explanatory variable, Superstar, has a mean of 0.0163, implying that only around 1.6% of firms in a given year operate in industries where superstar firms are present. This low frequency reflects the rarity of dominant firms in the Chinese market under the classification criteria. Control variables also display expected patterns. The average firm size (log of total assets) is 22.10, with limited variation. The average ROA is 4.5%, but the minimum is as low as -185.9%, suggesting the inclusion of loss-making firms in the sample. The average leverage ratio is 0.397, and the average Tobin's Q is about 2.06, indicating moderate growth expectations.

Some variables show substantial dispersion. For example, Cash Ratio has a wide range, from -4.36 to 167.5, indicating extreme differences in liquidity conditions across firms. Similarly, Growth shows a high standard deviation (12.17) and maximum value over 1800%, reflecting the presence of firms undergoing rapid expansion. Female leadership (CEO gender) is relatively rare in the sample, with a mean of 0.094, suggesting that less than 10% of the observations have a female top executive.

Overall, the descriptive statistics confirm considerable heterogeneity in firm characteristics and innovation behavior, which highlights the necessity of controlling for firm-level factors in the regression analysis. It also suggests the importance of examining how the presence of superstar firms may differentially affect firms with varying innovation capacities and organizational structures

4.5 Empirical Design and Empirical Results

4.5.1 The Effect of Superstar Company on Peer's Innovation.

To examine the effect of superstar company on its peers' innovation, a multivariate OLS regression analysis is conducted firstly. The results are presented in table 4-3

/Table 4-3 here/

The first two columns of the regression table examine the relationship between the presence of superstar firms and R&D investment. The dependent variable in both specifications is the natural logarithm of R&D spending, which captures the intensity of innovation investment by firms.In column (1), the model estimates the impact of superstar firms without incorporating additional firm-level controls. The coefficient on L.Superstar, the key explanatory variable, is negative and statistically significant at the 1% level (β = -0.630, t = -6.24), suggesting that firms facing superstar competitors tend to reduce their R&D expenditures. This result provides initial evidence that the presence of dominant industry players may discourage competitors from making long-term innovation investments.

Column (2) extends the analysis by including firm-specific controls such as firm size, profitability (ROA), leverage, and market share, while also accounting for firm, industry, and year fixed effects. The coefficient on L.Superstar remains negative and statistically significant (β = -0.157, t = -2.17), though its magnitude decreases compared to column (1). This indicates that even after controlling for firm characteristics, the negative impact of superstar firms on competitors' R&D spending persists. The reduction

in magnitude suggests that some of the observed effect in column (1) may be explained by firm-specific factors, but the presence of superstar firms still plays an independent role in shaping competitors' innovation incentives.

In columns (3) and (4), the measure of innovation has been replaced with the number of patent applications, which includes invention patents, utility models, and design patents, weighted in a 3:2:1 ratio. This alternative measure captures firms' actual innovation output rather than merely their R&D expenditures. It provides a more direct assessment of technological progress.

In column (3), the coefficient on L.Superstar is -0.180 with a t-statistic of -1.85, indicating a negative impact on patent applications that is statistically significant at the 10% level ($p < 0.1$). This suggests that firms facing competition from superstar firms tend to file fewer patents, reinforcing the earlier findings in columns (1) and (2), where R&D spending was used as the innovation measure. The reduction in patent applications implies that the presence of dominant firms discourages competitors from investing in formalized innovation outputs.

In column (4), the coefficient on L.Superstar becomes more negative (-0.260) and is statistically significant at the 1% level ($p < 0.01$, $t = -2.75$). Compared to column (3), this result suggests that after incorporating additional firm-level controls, the negative impact of superstar firms on competitors' patenting behavior remains strong and even intensifies.

In the last two columns, the dependent variable is the number of approved patents, which reflects firms' successful transformation of innovation efforts into legally recognized intellectual property. Compared to R&D spending and patent applications, this measure

provides a more concrete indicator of innovation output since not all patent filings result in approvals.

In column (5), L.Superstar has a coefficient of -0.106 with a t-value of -1.22. Although negative, this result is not statistically significant, suggesting that the presence of superstar firms does not strongly influence the number of approved patents in this specification. However, in column (6), the coefficient becomes -0.157, with a t-value of -1.86, achieving significance at the 10% level ($p < 0.1$). This indicates that after including additional firm-level controls, superstar firms still exhibit a discouraging effect on competitors' ability to secure patent approvals, albeit at a weaker level than their impact on R&D spending or patent applications.

Superstar firms negatively affect firms' innovation activities, though the impact varies across measures. The strongest effect appears in columns (1) and (2), where firms significantly reduce R&D expenditures. In columns (3) and (4), firms also file fewer patent applications, reinforcing the adverse impact on innovation. While the negative effect persists in columns (5) and (6) for patent approvals, it weakens, suggesting that firms may prioritize higher-quality innovations. Overall, the findings support Hypothesis 1a, leading to its acceptance.

4.5.2 The Effect of Superstar Company on Peer's Green Innovation

I also investigate how superstar firms influence their peers' engagement in green innovation. To capture this effect, I examine green patent applications and awards as alternative measures of innovation output. The results are presented in the regression table, with the first two columns focusing on the number of green patent applications. This measure captures firms' efforts in environmentally friendly innovation. Compared to

general patenting, green innovation demands higher investment, takes longer to develop, and faces stricter regulatory requirements (Horbach et al., 2012; Berrone et al., 2013). These factors make it more difficult to achieve but also more significant for technological progress.

/Table 4-4 here/

The results reveal a notable contrast to the findings in the previous table. The coefficient on L.Superstar is 1.526 in column (1) and 1.428 in column (2), both significant at the 5% level ($p < 0.05$). Unlike its negative impact on general R&D spending and patenting, superstar firms appear to positively influence green innovation activities among competitors.

In columns (3) and (4) the dependent variable is the number of awarded green patents. This measure indicates the successful transformation of environmentally friendly innovation efforts into legally recognized intellectual property. Compared to green patent applications, approvals reflect a higher standard of innovation quality, as they must pass a rigorous examination process.

The findings reveal that superstar firms positively influence green patent approvals. In column (3), L.Superstar has a coefficient of 0.826, with a t-value of 3.93, demonstrating strong significance at the 1% level ($p < 0.01$). A comparable effect emerges in column (4), where the coefficient is 0.764, and the t-value reaches 3.66, also significant at the 1% level. These results indicate that firms operating in industries with superstar competitors have a higher likelihood of obtaining approval for green patents. Therefore, the hypothesis 2a is accepted.

These results show a striking contrast in how superstar firms influence different types of innovation. While their presence discourages general innovation, as seen in Table 1, it appears to foster green innovation, particularly in terms of patent approvals. This divergence suggests that the mechanisms through which superstar firms shape innovation are not uniform across all technological domains. One possible explanation lies in the nature of competition and differentiation strategies. In traditional innovation activities, superstar firms dominate markets through superior resources, brand recognition, and economies of scale, making it difficult for competitors to justify large R&D investments. The negative coefficients in Table 1 suggest that firms facing these industry leaders reduce overall innovation efforts, likely due to concerns over low returns and heightened market concentration. However, green innovation operates under a different set of incentives. As sustainability gains regulatory and consumer importance, firms may view green patents as a strategic niche where they can compete more effectively, even in industries dominated by superstar firms. Rather than directly challenging industry leaders in conventional technology, competitors may shift their focus toward specialized areas such as energy efficiency, emissions reduction, and eco-friendly materials.

A second explanation centers on regulatory pressure and policy-driven innovation. Many governments provide financial incentives, tax breaks, and subsidies for green technologies, which may counteract the discouraging effect of superstar firms. Unlike general innovation, where firms must navigate market-driven competitive pressures alone, green innovation benefits from external support mechanisms that can make investment in sustainability more viable. If dominant firms also engage in green initiatives, they may indirectly encourage industry-wide adoption by influencing supply chain standards,

setting sustainability targets, or shaping regulatory frameworks that require all firms to comply with stricter environmental standards. This could explain why competitors in industries with superstar firms are more likely to secure green patent approvals, as observed in Table 4-4.

Another factor is knowledge spillovers and technological diffusion. Superstar firms invest heavily in R&D and often lead in breakthrough technologies, including those related to sustainability. Even if smaller firms struggle to compete in general innovation, they may still benefit from knowledge diffusion, either through direct collaboration, employee mobility, or industry-wide best practices. The significant positive coefficients in Table 2 suggest that these spillovers may be particularly relevant for green innovation, where firms can adopt and refine existing technologies rather than develop entirely new ones from scratch.

4.5.3 The Moderating Role of ESG Performance

To further explore how firms' environmental, social, and governance performance influences the relationship between superstar firms and innovation, I conducted a subsample regression analysis. Firms were divided into four quartiles based on their ESG scores: the bottom 25%, 25%-50%, 50%-75%, and the top 25%. Separate regressions were performed for each group to examine whether the impact of superstar firms varies depending on a firm's commitment to ESG principles. The results are presented in table 4-5 and 4-6. The results reveal significant heterogeneity in the effect of superstar firms across different ESG quartiles in both general and green innovation

/Table 4-5 & 4-6 here/

In terms of general innovation, among firms with low ESG scores (column 1,5,9), the coefficient on L.Superstar is significantly negative, suggesting that superstar firms strongly suppress innovation in firms that do not prioritize ESG. These firms may lack access to sustainability-driven resources, regulatory incentives, or stakeholder support, making them more vulnerable to competition from industry leaders. In contrast, among firms with moderate and high ESG scores (second, third and fourth quartile) the negative impact of superstar firms weakens, with smaller and statistically insignificant coefficients. This pattern suggests that as firms improve their ESG performance, they become less susceptible to competitive pressures, potentially due to better access to ESG-focused investment, reputational benefits, or regulatory advantages. Firms with stronger ESG commitments not only withstand competition better but may even benefit from the presence of superstar firms, possibly by leveraging sustainability initiatives for differentiation, securing partnerships, or capitalizing on regulatory alignment. These results highlight the role of ESG engagement as a strategic shield against competitive pressures, allowing firms to sustain innovation despite industry concentration. High ESG firms may also differentiate themselves by focusing on sustainability-driven innovation rather than competing directly with superstar firms in conventional technological domains. Concerning green innovation, within companies in the lowest ESG quartile, L.Superstar exhibits a positive yet weakly significant impact on green patent applications and no significant influence on green patent approvals. This indicates that while prominent firms may exert influence, companies with inadequate ESG commitments fail to translate this pressure into successful innovation. These firms may be deficient in requisite regulatory

backing, market credibility, or strategic emphasis on sustainability to fully capitalize on potential spillovers from leading firms.

For firms in the middle ESG quartiles (25%-50% and 50%-75%), the impact of superstar firms remains inconsistent across patent applications and approvals. The weaker significance suggests that moderate ESG efforts do not substantially change how firms respond to superstar competition in green innovation. These firms may have adopted some sustainability practices but still lack the resources or strategic direction to maximize the benefits of competing in an industry with superstar firms.

The effect of superstar firms becomes strongest in the highest ESG quartile. In this group, L.Superstar shows a larger and statistically significant positive effect, particularly for green patent approvals. This indicates that firms with strong ESG commitments are not only more resilient to competition but also more capable of securing approvals for green patents. These firms likely have better access to sustainability-driven funding, stronger regulatory alignment, and more opportunities for collaboration, allowing them to turn the presence of superstar firms into an advantage.

4.5.4 The Moderating Role of Technological Similarity

This section examines how technological similarity moderates the impact of superstar firms on competitors' innovation. Specifically, I measure the technological distance between firms with superstar competitors and the superstar firms themselves. Based on this measure, firms are divided into four quartiles, where a smaller quartile indicates higher technological similarity. I conduct separate regressions for each subsample to analyze how the effect of superstar firms varies across different levels of technological similarity. Resulted are shown in table 4-7

/Table 4-7 here/

The results show that the innovation-suppressing effect of superstar firms weakens as technological similarity increases. In other words, firms with greater technological similarity to superstar firms experience less innovation suppression, while those with greater technological distance are more significantly affected.

For the firms in the lowest quartile (most technologically similar), the negative effect is weakest. The coefficient for L.Superstar is not significant for R&D spending (-0.458, not significant) and patent applications (0.162, not significant), while it is even positive and weakly significant for patent approvals (0.386, $p < 0.1$). These results suggest that firms with high technological similarity to superstar firms are the least affected by competition and may even benefit from knowledge spillovers or collaborative opportunities. Instead of facing strong innovation suppression, these firms might leverage their similarity to access shared resources and industry networks.

For Firms in the second Quartile (relatively high technological similarity), the negative impact of superstar firms becomes more pronounced. The coefficient on L.Superstar becomes significantly negative for cpatent applications (-1.280, $p < 0.01$) and patent approvals (-0.558, $p < 0.05$). This suggests that firms in this group still face substantial competition from superstar firms, but they may lack the collaboration or spillover benefits enjoyed by the closest competitors. The stronger innovation suppression in this quartile implies that these firms experience competitive disadvantages without access to the same level of technological synergy.

For firms in the Third Quartile (Moderate Technological Distance), the negative impact of superstar firms remains, though the effects weaken further. The coefficient for patent applications becomes insignificant, and while patent approvals remain positive, they lack statistical significance. These findings suggest that as technological distance increases, firms begin to escape direct competition with superstar firms. However, the remaining suppression indicates that firms in this category are still somewhat constrained in their innovation efforts.

For firms in the Highest Quartile (Least Technologically Similar) experience the strongest negative impact. The coefficient on L.Superstar is highly significant and negative for patent applications (-2.213, $p < 0.01$) and patent approvals (-2.254, $p < 0.01$). Unlike firms in the first quartile, these companies lack direct technological competition with superstar firms, but they also do not benefit from any potential spillover effects. Their innovation suppression may result not from direct rivalry but from structural disadvantages, such as difficulties in catching up with advanced industry leaders.

The results confirm that the innovation-suppressing effect of superstar firms is not uniform across all competitors. Instead, it depends significantly on technological similarity: Firms with high technological similarity to superstar firms are the least affected by innovation suppression. These firms may benefit from collaboration, spillover effects, or shared industry ecosystems, which counterbalance the competitive pressure from superstar firms. As technological distance increases, the negative effect of superstar firms becomes stronger. Firms that are somewhat different from superstar firms may still face competitive pressure without access to similar technological advantages, making innovation investment riskier. Firms with the greatest technological distance experience

the strongest suppression. These firms are often less competitive and may lack the necessary resources or market recognition to sustain innovation, leading to the most significant decline in patenting and R&D spending.

4.5.5 Difference in Difference Design for the Endogeneity Issue.

To address potential endogeneity concerns, I designed a natural experiment using a difference-in-differences approach. To construct the Difference-in-Differences (DID) identification strategy, I selected two closely related industries—G58 (Multimodal Transport and Freight Forwarding) and G59 (Handling, Loading, and Warehousing). Prior to 2013, the number of superstar firms in these two industries was comparable, and both sectors exhibited stable trends in superstar firm prevalence. However, starting in 2013, a notable divergence emerged: while the number of superstar firms in G58 remained relatively stable, G59 experienced a sudden and sustained increase in the number of superstar firms. This sharp change in G59 provides a quasi-experimental setting for identifying the impact of superstar firms. Therefore, I designate G59 as the treatment group and G58 as the control group. The key advantage of this design lies in the fact that, under the study's stringent criteria for defining superstar firms, most firms only qualify as "superstars" intermittently—i.e., they may meet the threshold in one year but fall below it the next. As a result, the appearance of superstar firms within a given industry can be considered largely exogenous and idiosyncratic, making it behave like a plausibly random shock rather than a deterministic trend.

Before interpreting the difference-in-differences results, it is important to assess the validity of the parallel trends assumption. I plot year average patent awards of both industries in figure 4-1

/Figure 4-1 here/

As illustrated in Figure 4-1, both the treatment group (G59) and the control group (G58) exhibited similar trends in average patent awards prior to the treatment year. The trajectories for both groups rose steadily and almost in parallel from 2010 to 2013, suggesting no significant pre-treatment divergence in innovation outcomes. This visual evidence supports the key assumption that, in the absence of treatment, the two groups would have continued to follow similar innovation trends—thereby lending credibility to the identification strategy used in this analysis.

The regression outputs are presneted in table 4-8. Based on table 4-8, the dependent variables in columns (1), (2), and (3) represent log R&D spending, patent applications, and patent approvals, respectively. The key coefficient of interest is “did” which captures the difference-in-differences effect, measuring how the innovation outcomes in the treatment group (G59) changed relative to the control group (G58) after 2012.

/Table 4-8 here/

The coefficient on did is negative in all three columns, suggesting that the rise in superstar firms weakened innovation in the treatment group. In column (1), did has a coefficient of -1.388 and is statistically significant at the 1% level ($p < 0.01$). This indicates that firms in G59 reduced R&D spending after 2012 compared to those in G58. The strong significance and magnitude of this effect suggest that the increased presence of superstar firms discouraged competitors from investing in research, possibly due to reduced innovation incentives or concerns about market dominance.

In column (2), the coefficient on did is -2.087 and significant at the 10% level ($p < 0.1$). This suggests a decline in patent applications, although the effect is weaker than for R&D spending. Firms may have reduced R&D investment but still attempted to protect existing innovations by filing patents, leading to a less pronounced effect. However, the negative sign suggests that overall, firms in the treatment group became less likely to engage in patenting.

In column (3), the coefficient on did is -0.877 but not statistically significant. This suggests that while firms reduced R&D spending and patent filings, their ability to secure patent approvals did not change significantly. One possible explanation is that firms that continued to pursue patents focused on high-quality innovations, maintaining approval rates despite filing fewer patents. Another possibility is that the smaller sample size made it harder to detect a statistically significant effect.

The DID results align with the main findings from the previous analyses, which reinforces the conclusion that the presence of superstar firms reduces innovation investment. The negative and significant impact on R&D spending and patent applications is consistent with earlier results. Although the effect on patent approvals is not statistically

significant, the overall trend remains unchanged. This consistency indicates that even after addressing potential endogeneity concerns, the core conclusion holds: superstar firms discourage innovation among their competitors.

4.5.5. Does Innovation Help Firms Escape Superstar Competition?

Previous results suggest that when firms face competition from superstar firms, they tend to reduce their R&D investment and innovation activities. This raises an important question: Is reducing innovation an effective strategy for firms trying to avoid direct competition with superstar firms, or could innovation actually help firms escape their dominance? To address this, I examine whether firms' innovation strategies influence their likelihood of facing superstar competitors in the future. Specifically, I use a probit model where the dependent variable indicates whether a firm competes with a superstar firm in a given year. The key explanatory variables are lagged innovation indicators, including log R&D spending, patent applications, patent approvals, green patent applications, and green patent approvals from the previous year. This approach allows me to assess whether investing in innovation makes firms more or less likely to compete with superstar firms in the following year. Table 4-9 shows the results

/Table 4-9 here/

The results indicate that firms with higher R&D investment and patenting activity are less likely to compete with superstar firms in the following year. In column (1), the coefficient on lagged log R&D spending is -0.126 ($p < 0.05$), which suggests that firms

that allocated more resources to R&D in the previous year had a significantly lower probability of facing a superstar competitor. This finding implies that R&D investment may help firms develop unique technological advantages or differentiate their products and services, allowing them to move into less directly competitive market segments.

A similar pattern appears in column (2), where the coefficient on lagged patent applications is -0.074 ($p < 0.1$). This result suggests that firms that filed more patents in the previous year had a reduced likelihood of encountering a superstar firm as a competitor. Since patents represent formalized innovation efforts, firms that actively secure intellectual property rights may be more successful in carving out distinct technological domains or securing exclusive market positions, which could limit their direct exposure to competition from dominant industry players.

In column (3), the coefficient on lagged patent approvals is -0.065 and is not statistically significant. This suggests that while filing patent applications may help firms reduce direct competition with superstar firms, obtaining patent approvals does not necessarily have the same effect. One possible explanation is that patent applications serve as a proactive innovation strategy, signaling a firm's intent to differentiate or expand into new technological areas, which may help it avoid direct rivalry with superstar firms. However, once a patent is granted, it does not automatically change a firm's competitive positioning. Some firms may receive patents but continue operating within the same competitive space as superstar firms, while others may use patents primarily for defensive purposes or licensing rather than as a means of escaping direct competition.

In contrast, green innovation does not show a significant effect. In columns (4) and (5), the coefficients on lagged green patent applications (0.000, not significant) and

lagged green patent approvals (0.001, not significant) indicate that firms focusing on green innovation do not experience a notable change in their likelihood of facing superstar competition. This suggests that green innovation may not serve as an effective strategy for firms to reposition themselves away from direct competition with superstar firms, possibly because sustainability-driven innovation is shaped by broader regulatory and market forces rather than competitive dynamics alone.

Overall, these findings suggest that reducing innovation investment in response to superstar competition may not be the best long-term strategy. While previous results show that many firms facing superstar competitors tend to cut R&D spending and patenting activity, the current analysis indicates that firms that maintain strong innovation efforts—particularly in R&D investment and patent applications—are actually less likely to compete with superstar firms in the following year. This implies that innovation may provide firms with a pathway to differentiate themselves, move into less contested market segments, or establish technological niches that reduce direct competition with industry leaders. Instead of scaling back innovation in response to competitive pressure, firms may benefit more from strategically investing in innovation to reshape their competitive positioning and avoid direct rivalry with dominant firms.

4.6 Conclusion

This study investigates how the presence of superstar firms affects the innovation behavior of peer companies in the Chinese market, with a particular focus on the distinction between general innovation and green innovation. Drawing on a comprehensive firm-level dataset and grounded in market structure theory, stakeholder theory, and knowledge spillover theory, the findings reveal a nuanced and asymmetric influence. While superstar firms significantly suppress general innovation among their competitors—evidenced by reduced R&D investment and fewer patent filings—they appear to stimulate green innovation, particularly in terms of green patent approvals. This divergence underscores the complex role dominant firms play in shaping innovation incentives within evolving market contexts.

The study contributes to the existing literature in several important ways. Theoretically, it extends the discourse on superstar firms by examining their impact beyond traditional innovation, incorporating environmental and sustainability dimensions often overlooked in prior research. By distinguishing green innovation from general innovation, the study emphasizes the importance of recognizing heterogeneity in innovation types and their responsiveness to competitive pressures. Empirically, the use of a DID framework, combined with extensive heterogeneity analysis—particularly the moderating roles of CSR performance and technological proximity—provides robust evidence for the contingent nature of superstar effects.

However, the external validity of these findings is likely shaped by China's unique institutional and policy environment. The observed dual effect may be driven by the normative pressure that superstar firms exert under national strategic mandates like the "dual carbon" goals, which can compel industry-wide adoption of higher environmental standards. Concurrently, competitors might strategically pivot towards green innovation as a state-sanctioned domain for differentiation when facing insurmountable competition in general innovation. This specific interplay of policy-driven corporate goals and strategic adaptation may be more pronounced in China than in liberal market economies. Similarly, the moderating role of CSR is often a response to policy signals in China, differing from the investor- or consumer-driven CSR dynamics in the West. Therefore, while the analytical framework is portable, the direct transferability of the specific results to other countries or periods requires careful validation.

From a policy perspective, the results suggest that while market dominance may crowd out general innovation, it does not inevitably inhibit sustainability-oriented technological progress. In fact, when supported by appropriate policy instruments—such as green finance, ESG disclosure mandates, or targeted subsidies—superstar firms may indirectly contribute to the diffusion of green practices by raising industry standards and creating spillover effects. These findings call for a fundamental rethinking of competition policy frameworks to better distinguish between different types of innovation outcomes. Rather than applying uniform standards to concentrated markets, regulators could develop more nuanced approaches that recognize and reward superstar firms' positive

contributions to green technology diffusion while maintaining vigilance against practices that suppress general innovation. Such differentiated policy could include innovation-weighted antitrust assessments and sustainability-oriented regulatory sandboxes.For smaller firms, the study highlights the importance of strategic positioning: those with stronger ESG engagement and greater technological alignment with superstar firms are more resilient to competitive pressure and more likely to leverage green innovation as a viable differentiation strategy. Managerially, this implies that corporate leaders in dominant firms should consciously align their innovation portfolios with societal sustainability goals, while smaller players need to develop specialized capabilities in green technology niches where they can thrive alongside rather than directly against industry giants. This context-specific understanding underscores the importance of tailoring innovation and competition policies to the local institutional environment The observed patterns highlight a potential coordination role for industrial policy in the innovation landscape. By creating incentives for green R&D and building bridges for knowledge transfer, policy could effectively channel the resources and influence of concentrated markets toward accelerating sustainability transitions.

. Future research could productively test the boundaries of these findings through comparative studies across countries with varying levels of state involvement and market concentration.Future research could further explore the causal mechanisms driving this divergence by incorporating qualitative data on managerial decision-making. Recent work suggests that a close probe of executives' mind-sets, motives, and exchanges is essential for unpacking how competitive strain lead to specific innovation paths, whereas leaning solely on numeric gauges—like R & D intensity or patent tallies—rarely surfaces this

opaque machinery (Quan, Ke, Qian, & Zhang, 2023). Cross-country comparative studies may also help to clarify whether the observed patterns hold in different regulatory environments or industry structures. For example, prior research shows that institutional factors—such as environmental policy stringency, state ownership prevalence, or capital market maturity—can significantly shape firms' innovation incentives and strategic responses (Peng, Wang, & Jiang, 2008; Aguilera et al., 2019). By comparing economies with varying degrees of market liberalization or sustainability regulation, future studies can better isolate context-specific effects from more generalizable mechanisms.

In sum, this study demonstrates that the influence of superstar firms on peer innovation is neither uniformly negative nor positive, but contingent on the type of innovation, firm-level characteristics, and broader institutional context. These insights contribute to a more balanced understanding of market concentration and innovation in the age of dominant enterprises and growing environmental urgency.

Table 4- 1 Annual Distribution of Superstar Firms Identified in the Sample

Year	Freq	Percent
2007	36	6.55
2008	58	16.55
2009	44	8.00
2010	42	7.64
2011	37	6.73
2012	32	5.82
2013	32	5.82
2014	28	5.09
2015	38	6.91
2016	32	5.82
2017	32	5.82
2018	36	6.55
2019	29	5.27
2020	25	4.55
2021	23	4.18
2022	26	4.73
Total	550	100

This table reports the number and percentage of firms classified as superstar firms each year from 2007 to 2022, based on industry-level Herfindahl-Hirschman Index (HHI) thresholds and firm-level market share criteria. The data reveal that while the number peaked in 2008 (58 firms), there is an overall declining trend in the prevalence of superstar firms, particularly after 2015. This fluctuation reflects the dynamic and selective nature of the superstar classification, as many firms only qualify intermittently, further supporting the exogeneity assumption used in the empirical identification strategy.

Table 4- 2 Summary Statistics of Key Variables in the Full Sample

Variable	Obs	Mean	Std. dev.	Min	Max
Log R&D Spending	33,458	17.83541	1.581341	5.09375	25.02515
Patent Application	33,701	3.289319	1.713684	0	7.603399
Patent Award	33,701	3.289319	1.713684	0	7.603399
Green Patent Application	33,701	2.17955	14.62293	0	941
Patent Application	33,701	1.303077	8.862491	0	574
Superstar	33,701	0.01632	0.1267049	0	1
Size	33,701	22.09938	1.307857	17.80613	28.63649
ROA	33,700	0.0451524	0.0776697	-1.859121	1.28476
Leverage	33,701	0.3977095	0.2028894	0.0075213	1.956558
Marketshare	33,699	9.784629	21.84859	0.0000174	100
ListAge	33,701	1.882118	0.9680509	0	3.496508
Intangible	33,701	0.0452641	0.051933	0	0.936415
CashRatio	33,701	1.126293	2.823042	-4.358657	167.544
Female	33,668	0.1939843	0.1146628	0	0.7333
Growth	33,691	0.343651	12.17779	-0.971304	1878.372
TobinQ	33,251	2.064082	1.573833	0.624542	92.24998
Liquid	33,701	2.944691	4.191205	0.0747	190.8692

This table presents descriptive statistics for the main variables used in the empirical analysis, based on 33,701 firm-year observations from Chinese listed companies between 2007 and 2022. The data show substantial heterogeneity in innovation input (Log R&D Spending), innovation output (Patent Application, Patent Award), and green innovation (Green Patent Application). The average firm operates in a market with low superstar firm prevalence (mean = 0.01632), supporting the rarity assumption. Control variables such as firm size, leverage, Tobin's Q, and cash ratio also exhibit wide dispersion, underscoring the importance of accounting for firm-level differences in the regression models.

Table 4- 3 Impact of Superstar Firms on General Innovation

	(1)	(2)	(3)	(4)	(5)	(6)
	Log R&D Spending		Patent Application		Patent Award	
L.Superstar	-0.630***	-0.157**	-0.180*	-0.260***	-0.106	-0.157*
	(-6.24)	(-2.17)	(-1.85)	(-2.75)	(-1.22)	(-1.86)
Size		0.922***		0.672***		0.599***
		(41.08)		(21.22)		(20.23)
ROA		0.075		-0.037		-0.551***
		(0.84)		(-0.29)		(-4.76)
Lev		-0.623***		-0.404***		-0.220**
		(-7.76)		(-3.84)		(-2.24)
Marketshare		-0.001**		-0.000		-0.000
		(-2.19)		(-0.21)		(-0.91)
ListAge		0.266***		-0.059		-0.066
		(11.88)		(-1.23)		(-1.47)
Intangible		-0.133		0.729**		0.782**
		(-0.46)		(2.13)		(2.09)
CashRatio		0.005		0.007		-0.000
		(1.26)		(0.88)		(-0.02)
Female		0.080		-0.483***		-0.282**
		(0.76)		(-3.28)		(-1.98)
Growth		0.000		0.001		0.000
		(0.81)		(0.89)		(0.28)
TobinQ		0.011*		0.005		-0.002
		(1.87)		(0.69)		(-0.26)
Liquid		-0.008**		-0.006		-0.006
		(-2.33)		(-0.86)		(-1.17)
cons	18.009***	-2.753***	1.517***	-12.866***	1.303***	-11.879***
	(23598.76)	(-5.93)	(3.75)	(-12.18)	(3.65)	(-15.75)
FE Year	Yes	Yes	Yes	Yes	Yes	Yes
FE Industry	Yes	Yes	Yes	Yes	Yes	Yes
FE Firm	Yes	Yes	Yes	Yes	Yes	Yes
N	27739	27347	27874	27478	27874	27478
adj. R^2	0.004	0.502	0.197	0.246	0.248	0.292

This table presents the regression results examining how the presence of superstar firms affects the general innovation activities of peer firms. Columns (1) and (2) use the logarithm of R&D spending as the dependent variable, columns (3) and (4) use the number of patent applications (weighted by type), and columns (5) and (6) use the number of approved patents. The key explanatory variable is L.Superstar, a lagged dummy indicating whether the firm operates in an industry with a superstar firm. All regressions include firm, year, and industry fixed effects. Coefficient t-statistics are reported in parentheses. Robust standard errors clustered at the industry level are used to account for heteroscedasticity and within-industry correlation. The results suggest that superstar firms significantly suppress general innovation, particularly in terms of R&D investment and patenting activity. Significance levels: *p < 0.1, **p < 0.05, **p < 0.01.

Table 4- 4 Impact of Superstar Firms on Green Innovation

	(1)	(2)	(3)	(4)
	Green Patent Application		Green Patent Award	
L.Superstar	1.526**	1.428**	0.826***	0.764***
	(2.16)	(2.00)	(3.93)	(3.66)
Size		0.977***		0.736***
		(3.46)		(3.64)
ROA		-0.570		-0.943***
		(-0.96)		(-2.65)
Lev		-0.761		-0.356
		(-1.17)		(-0.94)
marketshare		0.001		-0.001
		(0.16)		(-0.22)
ListAge		-0.528		-0.197
		(-1.08)		(-0.80)
Intangible		-1.605		-0.460
		(-0.76)		(-0.29)
CashRatio		0.001		0.018
		(0.04)		(1.10)
Female		-0.086		0.059
		(-0.06)		(0.08)
Growth		-0.003		-0.001
		(-1.38)		(-0.70)
TobinQ		0.142**		0.054
		(2.47)		(1.46)
Liquid		0.014		-0.001
		(0.59)		(-0.05)
cons	-2.037	-22.373***	-0.883	-16.485***
	(-1.57)	(-3.58)	(-1.22)	(-3.68)
FE Year	Yes	Yes	Yes	Yes
FE Industry	Yes	Yes	Yes	Yes
FE Firm	Yes	Yes	Yes	Yes
N	27874	27478	27874	27478
adj. R^2	0.008	0.010	0.010	0.012

This table reports the regression results assessing how the presence of superstar firms influences peer firms' green innovation activities. Columns (1) and (2) use the number of green patent applications as the dependent variable, while columns (3) and (4) use the number of approved green patents. The key explanatory variable, L.Superstar, is a lagged indicator equal to 1 if the firm operates in an industry with a superstar firm in the prior year. All regressions control for firm, year, and industry fixed effects. Standard errors are clustered at the industry level to account for within-industry correlation. The findings indicate that the presence of superstar firms significantly promotes green innovation, particularly in terms of approved green patents. Coefficient t-statistics are reported in parentheses. Significance levels: *p < 0.1, **p < 0.05, **p < 0

Table 4- 5 ESG Heterogeneity in General Innovation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Patent Application				Patent Award				Log R&D Spending			
	<25th	25th-50th	50th-75th	>75th	<25th	25th-50th	50th-75th	>75th	<25th	25th-50th	50th-75th	>75th
L.Superstar	-0.623**	-0.157	-0.148	-0.136	-0.366*	-0.254	0.128	-0.011	-0.019	-0.243	0.014	-0.143
	(-2.09)	(-0.31)	(-0.71)	(-1.23)	(-1.90)	(-0.88)	(0.46)	(-0.11)	(-0.09)	(-0.84)	(0.07)	(-1.58)
Size	0.540**	0.546***	0.488***	0.701***	0.669***	0.548***	0.418**	0.619***	0.740***	0.765***	0.870***	0.896***
	(2.27)	(4.23)	(3.08)	(19.24)	(4.12)	(4.54)	(2.55)	(18.37)	(4.23)	(7.04)	(12.19)	(37.00)
ROA	-0.147	-0.081	-0.628	-0.063	-2.471***	-0.553	-0.591	-0.529***	-0.095	-0.453**	-0.065	0.007
	(-0.17)	(-0.17)	(-0.96)	(-0.46)	(-3.27)	(-1.19)	(-1.20)	(-4.24)	(-0.11)	(-2.06)	(-0.18)	(0.08)
Lev	-0.302	-0.221	-0.054	-0.406***	-0.507	0.197	-0.139	-0.276**	-0.543*	-0.460*	-0.746**	-0.530***
	(-0.63)	(-0.53)	(-0.11)	(-3.47)	(-1.20)	(0.50)	(-0.34)	(-2.53)	(-1.72)	(-1.75)	(-2.47)	(-6.09)
marketshare	0.002**	0.000	0.000	0.000	0.001	0.003**	0.001	-0.001	-0.002*	-0.001	-0.001	-0.001**
	(2.21)	(0.10)	(0.06)	(0.06)	(0.78)	(2.43)	(0.66)	(-1.56)	(-1.67)	(-0.99)	(-0.64)	(-2.14)
ListAge	0.159	0.344	-0.443	-0.002	0.383*	-0.115	-0.233	0.029	0.451***	0.469***	0.460***	0.254***
	(0.60)	(0.90)	(-1.56)	(-0.03)	(1.81)	(-0.40)	(-0.90)	(0.57)	(2.70)	(3.90)	(3.70)	(11.26)
Intangible	0.994	0.704	0.862	0.583	-0.673	0.197	2.957**	0.702	-1.801**	-1.285	-0.648	-0.092
	(0.91)	(0.56)	(0.67)	(1.55)	(-0.53)	(0.16)	(2.06)	(1.61)	(-2.40)	(-1.39)	(-0.87)	(-0.31)
CashRatio	-0.009	-0.050	0.090	0.011	-0.006	-0.058*	0.134**	0.007	0.017	-0.003	-0.011	-0.006
	(-0.34)	(-1.20)	(1.07)	(0.98)	(-0.38)	(-1.80)	(2.12)	(0.70)	(1.40)	(-0.09)	(-0.33)	(-1.01)
Female	-1.139	-1.196*	0.253	-0.557***	0.219	-0.511	0.818*	-0.410**	0.436	-0.063	0.282	0.019
	(-1.46)	(-1.67)	(0.45)	(-3.45)	(0.36)	(-0.82)	(1.65)	(-2.56)	(0.86)	(-0.14)	(0.89)	(0.17)
Growth	-0.022	0.004	0.000	0.001**	0.023	-0.001	-0.001	0.001*	0.071	0.011*	0.001	-0.000
	(-0.46)	(0.43)	(0.41)	(1.97)	(0.61)	(-0.12)	(-0.32)	(1.72)	(1.43)	(1.78)	(1.10)	(-0.33)
TobinQ	-0.030	0.044	0.036**	-0.001	-0.006	0.018	-0.002	-0.004	0.035*	-0.004	-0.026	0.010
	(-0.95)	(1.53)	(2.01)	(-0.11)	(-0.20)	(0.63)	(-0.13)	(-0.41)	(1.70)	(-0.36)	(-0.93)	(1.64)
Liquid	-0.011	0.018	-0.017	-0.007	-0.009	0.010	-0.059*	-0.011	-0.007	-0.018*	-0.019	0.000
	(-0.95)	(1.36)	(-0.48)	(-0.85)	(-1.26)	(1.12)	(-1.80)	(-1.55)	(-1.52)	(-1.85)	(-0.91)	(0.09)
Cons	-8.858*	-11.762***	-7.475**	-13.365***	-12.869***	-10.402***	-8.384**	-11.960***	0.531	0.063	-2.243	-2.091***
	(-1.75)	(-4.35)	(-2.22)	(-12.95)	(-3.72)	(-4.28)	(-2.36)	(-14.44)	(0.15)	(0.03)	(-1.56)	(-4.17)
FE Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1898	2238	2345	2098	1898	2238	2345	2098	1865	2233	2337	2090
adj. R^2	0.165	0.147	0.173	0.221	0.210	0.151	0.227	0.266	0.229	0.274	0.238	0.528

This table reports the regression results examining how ESG performance moderates the effect of superstar firms on peer firm innovation. The sample is divided into four ESG quartiles: <25th percentile, 25th–50th percentile, 50th–75th percentile, and >75th percentile. Columns (1)–(4) use patent applications, (5)–(8) use patent awards, and (9)–(12) use log R&D spending as dependent variables. The key variable of interest is L.Superstar, indicating whether a firm operates in an industry with a superstar firm in the previous year.All regressions include firm, year, and industry fixed effects. Robust standard errors are clustered at the industry level. The results show that the negative impact of superstar firms on innovation is most pronounced in firms with lower ESG scores and gradually weakens or turns positive as ESG performance improves. This suggests that strong ESG engagement enhances firms' resilience to competitive pressure from superstar firms.Standard errors in parentheses. Significance levels: *p < 0.1, **p < 0.05, **p < 0.01.

Table 4- 6 ESG Heterogeneity in Green Innovation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Green Patent Application				Green Patent Award			
	<25th	25th-50th	50th-75th	>75th	<25th	25th-50th	50th-75th	>75th
L.Superstar	1.005*	0.624	0.530	1.618	0.126	0.680	0.764	0.856**
	(1.93)	(0.75)	(0.48)	(1.38)	(0.29)	(1.09)	(1.28)	(2.05)
Size	1.741*	0.720	0.344	1.101***	0.621*	0.054	-0.067	0.942***
	(1.89)	(1.23)	(0.43)	(3.00)	(1.75)	(0.10)	(-0.15)	(3.30)
ROA	0.647	-0.501	-3.510	-0.099	-1.057	0.375	-5.458**	-0.614*
	(0.23)	(-0.32)	(-0.80)	(-0.18)	(-0.74)	(0.26)	(-2.52)	(-1.76)
Lev	-3.721	-0.961	-2.115	-0.441	-1.210	-0.137	1.156	-0.498
	(-1.09)	(-0.41)	(-0.65)	(-0.67)	(-0.77)	(-0.11)	(0.99)	(-1.11)
marketshare	-0.006	-0.004	0.028	0.001	-0.005	-0.013**	0.005	0.003
	(-0.84)	(-0.56)	(0.92)	(0.15)	(-1.27)	(-1.97)	(0.38)	(0.66)
ListAge	-2.846*	1.154	-0.365	-0.235	-0.806	1.890	-0.072	-0.103
	(-1.83)	(0.48)	(-0.21)	(-0.49)	(-1.13)	(0.69)	(-0.08)	(-0.47)
Intangible	6.330	1.142	-9.459	-4.406*	2.779	-3.041	6.179	-2.553
	(1.12)	(0.24)	(-1.14)	(-1.95)	(1.21)	(-0.74)	(1.39)	(-1.23)
CashRatio	0.086	-0.037	0.076	-0.003	0.017	-0.040	0.124	0.019
	(1.10)	(-0.30)	(0.33)	(-0.08)	(0.53)	(-0.40)	(1.15)	(0.71)
Female	-3.400	-4.367	6.102	-0.171	0.793	5.172	2.426	-0.503
	(-0.96)	(-1.22)	(0.71)	(-0.13)	(0.45)	(0.83)	(0.75)	(-0.54)
Growth	-0.234	-0.008	-0.014	-0.002	-0.081	0.025	-0.005	0.000
	(-1.49)	(-0.37)	(-1.39)	(-1.02)	(-1.19)	(0.67)	(-1.50)	(0.58)
TobinQ	-0.036	0.209*	-0.018	0.209**	-0.011	-0.021	-0.059	0.129*
	(-0.35)	(1.74)	(-0.22)	(2.34)	(-0.25)	(-0.19)	(-0.87)	(1.91)
Liquid	-0.052	0.032	-0.065	0.005	-0.018	0.007	-0.041	-0.010
	(-1.36)	(1.45)	(-0.63)	(0.14)	(-1.22)	(0.35)	(-0.73)	(-0.39)
Cons	-32.630*	-27.107*	-15.229	-23.343***	-12.292*	-6.408	-5.534	-19.867***
	(-1.74)	(-1.87)	(-0.83)	(-3.06)	(-1.70)	(-0.60)	(-0.49)	(-3.26)
FE Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1898	2238	2345	2098	1898	2238	2345	2098
adj. R^2	0.088	0.021	-0.009	0.005	0.049	0.026	0.002	0.009

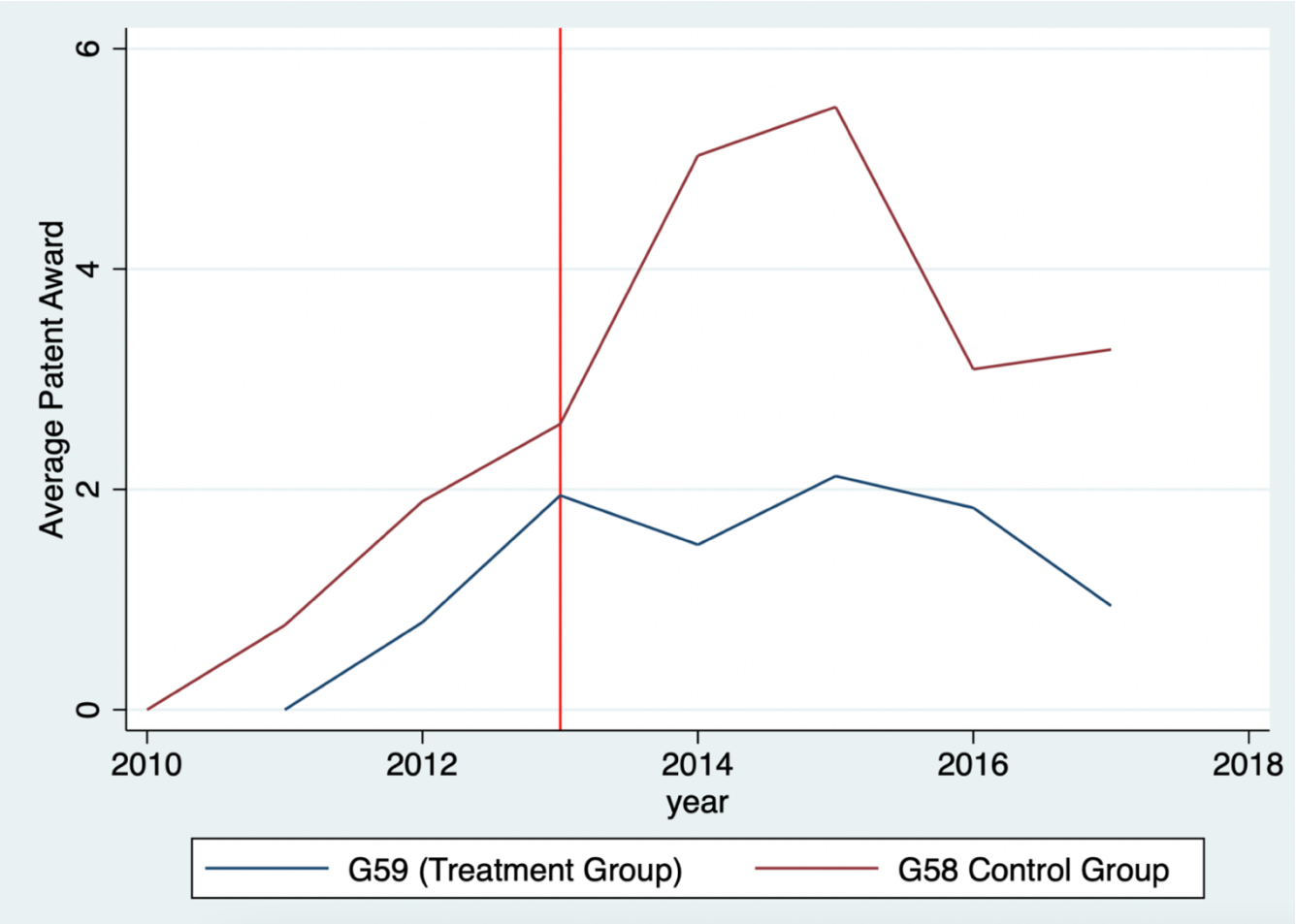
This table presents regression results examining how ESG performance moderates the effect of superstar firms on green innovation. The sample is divided into ESG score quartiles: <25th percentile, 25th–50th percentile, 50th–75th percentile, and >75th percentile. Columns (1)– (4) use green patent applications as the dependent variable, while columns (5)–(8) use green patent awards. The key variable of interest is L.Superstar, a lagged indicator of whether the firm operates in an industry with a superstar firm. The results show that firms with the highest ESG scores (>75th percentile) benefit the most from the presence of superstar firms, with significantly higher green innovation outputs. This suggests that strong ESG commitment enhances firms' ability to absorb knowledge spillovers and compete in environmentally driven innovation fields. All regressions include firm, year, and industry fixed effects. Standard errors are clustered at the industry level. Standard errors in parentheses. Significance levels: *p < 0.1, **p < 0.05, **p < 0.01.

Table 4- 7 Technological Distance Heterogeneity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Log R&D Spending				Patent Application				Patent Award			
	<25th	25th-50th	50th-75th	>75th	<25th	25th-50th	50th-75th	>75th	<25th	25th-50th	50th-75th	>75th
L.Superstar	-0.458	-1.312***	-0.062	-1.316***	0.162	-1.280***	0.209	-2.213***	0.386*	-0.558**	0.247	-2.254***
	(-1.46)	(-4.02)	(-0.22)	(-8.27)	(0.51)	(-3.32)	(0.67)	(-15.02)	(1.95)	(-2.10)	(0.70)	(-17.90)
Size	0.865***	0.864***	0.865***	0.860***	0.647***	0.647***	0.648***	0.645***	0.606***	0.606***	0.606***	0.604***
	(89.60)	(89.60)	(89.75)	(88.19)	(60.16)	(60.14)	(60.21)	(59.46)	(58.94)	(58.92)	(58.98)	(58.25)
ROA	0.363***	0.370***	0.369***	0.416***	0.664***	0.658***	0.662***	0.715***	0.121	0.114	0.118	0.160
	(3.41)	(3.48)	(3.46)	(3.89)	(4.66)	(4.62)	(4.65)	(5.03)	(0.91)	(0.86)	(0.89)	(1.20)
Lev	-0.873***	-0.874***	-0.874***	-0.854***	-0.266***	-0.268***	-0.265***	-0.254***	-0.188***	-0.195***	-0.191***	-0.183***
	(-15.02)	(-15.05)	(-15.04)	(-14.61)	(-3.55)	(-3.59)	(-3.55)	(-3.40)	(-2.65)	(-2.75)	(-2.69)	(-2.58)
marketshare	-0.007***	-0.007***	-0.007***	-0.007***	-0.008***	-0.008***	-0.008***	-0.008***	-0.007***	-0.008***	-0.008***	-0.008***
	(-14.04)	(-14.05)	(-14.09)	(-13.85)	(-13.08)	(-13.11)	(-13.12)	(-13.33)	(-13.54)	(-13.54)	(-13.58)	(-13.85)
ListAge	-0.211***	-0.210***	-0.210***	-0.209***	-0.174***	-0.172***	-0.173***	-0.171***	-0.147***	-0.145***	-0.146***	-0.143***
	(-18.18)	(-18.08)	(-18.08)	(-17.87)	(-11.99)	(-11.83)	(-11.93)	(-11.73)	(-10.69)	(-10.59)	(-10.65)	(-10.37)
Intangible	-2.766***	-2.747***	-2.768***	-2.797***	-1.274***	-1.268***	-1.281***	-1.314***	-1.006***	-1.001***	-1.012***	-1.059***
	(-15.85)	(-15.75)	(-15.88)	(-16.06)	(-6.59)	(-6.57)	(-6.63)	(-6.81)	(-5.36)	(-5.33)	(-5.39)	(-5.64)
CashRatio	-0.000	0.000	0.000	-0.001	-0.025**	-0.025**	-0.025**	-0.025**	-0.043***	-0.043***	-0.044***	-0.044***
	(-0.01)	(0.04)	(0.01)	(-0.13)	(-2.10)	(-2.09)	(-2.10)	(-2.11)	(-4.01)	(-4.00)	(-4.01)	(-4.04)
Female	-0.173***	-0.171***	-0.172***	-0.185***	-0.862***	-0.863***	-0.861***	-0.867***	-0.644***	-0.647***	-0.643***	-0.643***
	(-2.71)	(-2.69)	(-2.71)	(-2.91)	(-9.89)	(-9.91)	(-9.89)	(-9.96)	(-7.76)	(-7.80)	(-7.74)	(-7.76)
Growth	0.002	0.002	0.002	0.002	-0.002	-0.002	-0.002	-0.002	-0.003**	-0.003**	-0.003**	-0.003**
	(1.61)	(1.61)	(1.61)	(1.61)	(-1.57)	(-1.56)	(-1.57)	(-1.55)	(-2.43)	(-2.43)	(-2.44)	(-2.44)
TobinQ	0.090***	0.090***	0.090***	0.088***	0.021***	0.021***	0.021***	0.019***	0.006	0.005	0.006	0.005
	(15.02)	(15.00)	(15.02)	(14.87)	(3.09)	(3.08)	(3.10)	(2.93)	(0.89)	(0.88)	(0.90)	(0.77)
Liquid	-0.020***	-0.020***	-0.020***	-0.019***	-0.011*	-0.011*	-0.011*	-0.011*	-0.003	-0.004	-0.003	-0.003
	(-4.93)	(-4.99)	(-4.96)	(-4.76)	(-1.77)	(-1.77)	(-1.75)	(-1.71)	(-0.64)	(-0.66)	(-0.63)	(-0.58)
Cons	-0.330*	-0.312	-0.328*	-0.233	-9.780***	-9.780***	-9.784***	-9.743***	-9.331***	-9.332***	-9.340***	-9.297***
	(-1.67)	(-1.58)	(-1.66)	(-1.17)	(-44.13)	(-44.12)	(-44.17)	(-43.67)	(-44.02)	(-44.00)	(-44.06)	(-43.57)
FE Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	27170	27170	27162	27263	27295	27295	27286	27396	27295	27295	27286	27396
adj. R^2	0.387	0.387	0.387	0.388	0.192	0.192	0.192	0.198	0.189	0.189	0.189	0.196

This table reports regression results on the role of technological proximity in shaping the influence of superstar firms on corporate innovation. The sample is divided into four groups based on the level of technological similarity between firms and industry superstars, from highest (Quartile 1) to lowest (Quartile 4).Columns (1)–(4) use the logarithm of R&D expenditure as the dependent variable, (5)–(8) report results for patent applications, and (9)–(12) for granted patents. The key explanatory variable is L.Superstar, a one-period lagged dummy equal to one if the firm operates in an industry with a superstar firm.The findings reveal that the negative impact of superstar firms becomes more pronounced as technological similarity decreases. Among firms with high similarity, the effect is weaker or even mildly positive in patent outcomes. In contrast, those with low similarity exhibit larger declines, particularly in R&D intensity and innovation output, reflecting a potential lack of absorptive capacity or strategic relevance.All models control for firm, year, and industry fixed effects. Standard errors are clustered at the industry level. Standard errors in parentheses. Significance levels: *p < 0.1, **p < 0.05, **p < 0.01.

Figure 4- 1 Parallel Trend of Patent Awards Testing



This figure presents the average changes in patent award quantity from 2010 to 2018 for two related industries: G58 (Multimodal Transport and Freight Forwarding) as the control group and G59 (Handling, Loading, and Warehousing) as the treatment group. Prior to 2013, the number of superstar firms in both industries was comparable and relatively stable. Beginning in 2013, G59 experienced a sudden and sustained increase in the number of superstar firms, while G58 remained stable. This sharp divergence in G59 provides a quasi-experimental setting to identify the impact of superstar firms on innovation outcomes

Table 4- 8 DID Estimation: Impact of Superstar Firm Surge on Peer Innovation

	(1) logRDspending	(2) Patent2	(3) Patent_Award2
after2013	1.444***	0.437	0.296
	(4.56)	(0.32)	(0.32)
ifg59	1.650**	3.290***	0.483
	(2.72)	(3.55)	(0.58)
did	-1.388***	-2.087*	-0.877
	(-3.09)	(-1.81)	(-0.85)
Size	0.923***	0.017	0.680
	(5.35)	(0.02)	(0.97)
ROA	-5.037***	-8.750	-8.029***
	(-3.98)	(-1.71)	(-3.89)
Lev	-0.389	-2.608	-1.058
	(-0.40)	(-1.05)	(-0.46)
marketshare	0.001	0.006	0.004
	(0.32)	(1.15)	(0.59)
ListAge	0.128	0.142	0.290
	(0.72)	(0.26)	(0.79)
Intangible	-4.092**	-3.575	-12.746
	(-2.76)	(-0.47)	(-1.12)
CashRatio	-0.242	-1.078	-1.029*
	(-1.56)	(-1.22)	(-1.75)
Female	-1.137	-6.290	-1.414
	(-1.33)	(-1.43)	(-0.41)
Growth	0.159	-0.134	-2.077
	(0.70)	(-0.17)	(-1.67)
TobinQ	-0.156	0.374	-0.253
	(-1.15)	(0.79)	(-0.62)
Liquid	0.090	-0.336	0.474
	(0.93)	(-0.64)	(1.32)
cons	-4.264	6.117	-10.419
	(-1.07)	(0.34)	(-0.69)
Industry FE	No	No	No
Year FE	No	No	No
Firm FE	Yes	Yes	Yes
N	118	118	118
adj. R2	0.638	0.168	0.273

This table presents the results of a Difference-in-Differences (DID) analysis assessing the impact of a sharp increase in superstar firms on innovation outcomes among peer firms. The treatment group is G59 (Handling, Loading, and Warehousing), and the control group is G58 (Multimodal Transport and Freight Forwarding). The year 2013 is identified as the intervention point, marked by a surge in superstar firms in G59.The interaction term did captures the treatment effect. Column (1) uses log R&D spending as the dependent variable, column (2) uses the number of patent applications, and column (3) uses patent awards. The coefficient on did is significantly negative in columns (1) and (2), indicating that the rise of superstar firms in G59 since 2013 has significantly reduced innovation inputs and outputs among affected peer firms. This result supports the hypothesis that superstar firm expansion may crowd out innovation in other firms

within the same industry. Firm fixed effects are included in all models. Industry and year fixed effects are not included. Standard errors are reported in parentheses. Significance levels: *p < 0.1, **p < 0.05, **p < 0.01.

Table 4- 9 Relationship Between Innovation and Having Superstar Firm as Competitor

	(1) Superstar	(2) Superstar	(3) Superstar	(4) Superstar	(5) Superstar
	R&D Spending (Log)	Patent Application	Patent Award	Green Patent Application	Green Patent Award
L.Innovation	-0.126**	-0.074*	-0.065	-0.000	0.001
	(-2.41)	(-1.94)	(-1.52)	(-0.07)	(0.25)
Size	0.071	0.016	0.010	-0.026	-0.038
	(0.91)	(0.25)	(0.16)	(-0.40)	(-0.56)
ROA	1.666*	2.076**	2.035**	2.100**	2.143**
	(1.78)	(2.31)	(2.26)	(2.33)	(2.38)
Lev	-0.200	-0.186	-0.190	-0.194	-0.153
	(-0.41)	(-0.38)	(-0.40)	(-0.40)	(-0.32)
marketshare	0.029***	0.029***	0.029***	0.028***	0.028***
	(14.16)	(14.19)	(14.25)	(14.19)	(14.27)
ListAge	0.232**	0.242**	0.255**	0.256***	0.259***
	(2.24)	(2.44)	(2.57)	(2.58)	(2.60)
Intangible	-0.946	-0.527	-0.520	-0.493	-0.449
	(-0.84)	(-0.48)	(-0.48)	(-0.46)	(-0.42)
CashRatio	-0.048	-0.045	-0.045	-0.037	-0.037
	(-0.73)	(-0.68)	(-0.68)	(-0.55)	(-0.56)
Female	0.049	0.029	0.028	0.090	0.103
	(0.08)	(0.05)	(0.05)	(0.16)	(0.18)
Growth	-0.012	-0.009	-0.010	-0.004	-0.004
	(-0.25)	(-0.19)	(-0.22)	(-0.09)	(-0.09)
TobinQ	-0.068	-0.076	-0.072	-0.074	-0.076
	(-1.21)	(-1.32)	(-1.27)	(-1.31)	(-1.34)
Liquid	-0.005	-0.007	-0.007	-0.012	-0.011
	(-0.10)	(-0.14)	(-0.13)	(-0.23)	(-0.21)
_cons	0.738	-0.141	-0.080	0.684	0.919
	(0.50)	(-0.09)	(-0.05)	(0.47)	(0.60)
FE Industry	Yes	Yes	Yes	Yes	Yes
FE Year	Yes	Yes	Yes	Yes	Yes
N	8105	8184	8184	8184	8184
Pseudo-R^2	0.7876	0.7851	0.7846	0.7839	0.7839

This table presents marginal effects from Probit regressions assessing the relationship between firm-level innovation and the likelihood of becoming a superstar firm. Column (1) includes log R&D spending, columns (2) and (3) include patent applications and awards, and columns (4) and (5) focus on green patent indicators. Higher R&D spending is associated with a lower probability of becoming a superstar firm. Patent indicators show weaker negative effects, while green innovation is not significantly related. All models control for industry and year fixed effects. Z-statistics in parentheses. *p < 0.1, **p < 0.05, **p < 0.01.

5. Conclusion

This thesis brings together three independent but connected studies, each examining how firms with strong market positions—either due to their financial backing or industry size—affect the behaviour and outcomes of other firms in the same economic environment. By studying cases from both Western and Chinese contexts, and across public and private markets, the research highlights that influence is rarely unidirectional, and that market power does not always produce the same result across different settings.

In the first study, I investigate what happens to public firms when they receive venture capital after going public. While such investment is often seen as a positive endorsement, the findings tell a more complicated story. Firms receiving post-IPO VC tend to experience shorter survival periods, weaker financial health, and a higher chance of being delisted from the stock market. This suggests that late-stage VC involvement may not serve as a tool for long-term growth, but instead may reflect efforts by investors to extract value quickly before firm performance declines. These results challenge the typical assumption that VC participation is always beneficial, and instead point to selective behaviours among investors that are not always aligned with company stability.

The second study explores how the rise of unicorn firms affects the funding chances of other early-stage startups in the same sector. Unicorns—startups with valuations over $1 billion—can reshape how capital is distributed within an industry. The findings suggest a dual effect. On one side, unicorns may attract most of the investor attention, leaving fewer resources for smaller competitors. On the other, their success may signal that an industry has growth potential, encouraging more capital to enter. Whether a startup benefits or suffers from unicorn competition depends on factors like

geographic location, investor preferences, and how many unicorns already exist in the sector. This shows that the effect of dominant startups is not straightforward and may vary even within the same market.

The third study focuses on the Chinese market and looks at how large, highly productive companies—so-called "superstar firms"—affect the green innovation efforts of other companies in the same industry. Green innovation, which includes technologies that reduce environmental damage, often requires more time and higher upfront costs than general innovation. The findings suggest that superstar firms tend to reduce innovation activity among smaller firms overall. However, under certain conditions—such as when other firms share similar technologies or have strong ESG (environmental, social, and governance) practices—superstar firms may actually encourage green innovation. This dual outcome highlights the importance of both firm-level capacity and the surrounding institutional environment in shaping innovation behaviour.

Taken together, the three studies offer a more layered understanding of how powerful firms shape market outcomes. While dominant firms are often assumed to either help or harm others, the truth appears to be more conditional. Their influence depends on context: who their peers are, what kind of innovation is at stake, what the policy environment allows, and how investors interpret signals of success or risk. The research suggests that market power is neither entirely constructive nor entirely destructive—it carries potential for both, depending on how it is managed and by whom.

From a theoretical perspective, these findings suggest that researchers should pay closer attention to the settings in which firm behaviour occurs. Many of the effects identified in this thesis only appear when one looks beyond firm size or valuation, and

instead considers how firms relate to each other in practice—through competition, imitation, or network effects. This requires moving beyond general models and towards more specific, context-aware explanations of market outcomes.

Methodologically, the studies apply matching techniques, quasi-experimental designs, and heterogeneity analyses to test for cause-and-effect relationships in environments where random assignment is not possible. This approach helps reduce bias and provides a more accurate picture of how dominant firms shape outcomes. Nonetheless, the use of secondary data means that some internal firm-level decisions—such as strategic motives or informal negotiations—remain outside the scope of this research.

In terms of real-world implications, the findings speak to entrepreneurs, investors, and policymakers. For entrepreneurs, the studies suggest that securing high-profile backing or entering a unicorn-dominated industry requires careful consideration of competitive signals. For investors, the evidence raises questions about the long-term value added by certain types of capital deployment. For policymakers, the research supports the idea that innovation policy must take into account market structure and firm interaction, particularly when environmental goals are concerned.

However, the studies also have their limits. The conclusions are based on available data from specific countries and periods, which may not fully capture longer-term or less visible changes. The effects observed here might differ in industries with other regulatory frameworks or in economies with less developed capital markets. Further research could explore similar questions in other national settings, test for longer-term impacts, or incorporate qualitative insights from industry insiders.

In conclusion, this thesis offers evidence that the growing presence of powerful firms—whether measured by capital, market share, or technological leadership—creates ripple effects that are far from uniform. Understanding these effects requires attention not just to firm attributes, but to the structure of interaction within markets. Influence, in this context, is not a fixed property but a function of relationship, timing, and institutional design. As such, future studies must continue to explore when dominance leads to stagnation and when it can, under the right conditions, spark new waves of innovation.

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