From Failure to Innovation: Strategic Knowledge Transfer in Corporate Venture Capital

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Abstract

This paper investigates how corporate venture capital (CVC) investors strategically extract value from failed start-up investments and facilitate the reallocation of innovation resources and talent. I find that failed CVC-backed start-ups hold a higher proportion of patents in technological areas where their parent firms do not have prior patenting activity, introducing parent firms to novel technological domains despite financial losses. CVC parent firms are more likely to cite patents from failed start-ups when those patents introduce previously unexplored technological knowledge. Post-exit, parent firms integrate this knowledge by exploring adjacent or broader technological domains. They also frequently acquire patents from these start-ups and hire inventors with specialized expertise in these unfamiliar areas, effectively incorporating both codified and tacit knowledge into their innovation pipelines. Finally, failed start-ups tend to have higher technological overlap with the competitors of the CVC parent than those successful ventures, suggesting that parent firms may use these investments to gain insights into emerging competitive technologies and strengthen their strategic positioning.

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1 Introduction

Entrepreneurship is a key driver of innovation, economic growth, and long-term prosperity (Lerner and Stern, 2022). However, investing in start-ups involves inherent uncertainty and a high risk of failure. This reality is especially pronounced in the venture capital (VC) sector, where approximately 40% of VC-backed start-ups ultimately fail (Brown, Harris, Hu, Jenkinson, Kaplan, and Robinson, 2020). Yet, each start-up represents a meaningful experiment, exploring new business areas and pushing the boundaries of innovation. Even when these ventures do not succeed, their innovative outputs may continue to offer valuable insights that shape future innovation trajectories. As Elon Musk famously stated, "If things are not failing, you are not innovating enough".

The process of exiting failed start-ups and reallocating their innovative assets is as crucial to promoting a healthy innovation ecosystem as fostering entrepreneurial entry (Kerr, Nanda, and Rhodes-Kropf, 2014). If an ecosystem can efficiently reallocate patents and technological assets from failed start-ups, it may incentivize a greater amount of, and earlier-stage investment in the entrepreneurial life cycle (De Rassenfosse and Fischer, 2016; Hochberg, Serrano, and Ziedonis, 2018). In public equity markets, bankruptcy institutions play an important role in managing the distribution of innovative assets from distressed firms (Bernstein, Colonnelli, and Iverson, 2019). However, since most start-ups are relatively small, the high costs associated with formal bankruptcy procedures often make court resolutions impractical. The fundamental question, therefore, is what mechanisms or institutional environments can effectively facilitate the exit of failed start-ups while ensuring the optimal reallocation of their innovative outputs.

With this question in mind, this paper explores the role that corporate venture capital (CVC) plays in the exit process of ventures that ultimately fail. Unlike independent venture capital (IVC) investors which focus primarily on financial returns, CVCs pursue both financial and strategic objectives. As Ma (2020) point out, CVCs allow their parent companies to acquire knowledge from start-ups and regain their innovation edge. Moreover, interactions with start-up managers provide CVC parent firms with valuable first-hand information, enabling them to identify promising new business opportunities (Zhang, 2021). Therefore, compared with IVCs, CVCs should have stronger incentives to observe and retain the innovative outputs from failed start-ups, using them as a foundation for future business exploration and development.

However, examining how CVCs navigate the exit process of failed ventures and the reallocation of their innovative outputs requires addressing two key issues. First, it remains unclear which types of innovations CVC parents are more likely to absorb from failed ventures compared to their successful investments. In other words, what strategic benefits do these failed ventures offer to the CVC parent firms? Second, it is essential to examine how CVCs subsequently utilize these innovations, particularly whether they integrate the acquired knowledge into their own innovation practices.

To explore these questions, I construct a comprehensive dataset by merging information from PitchBook on VC-backed start-ups with patent data from the U.S. Patent and Trademark Office (USPTO). The matching process follows the methodology developed by the University of Virginia Darden School of Business (2019)[1]. The final sample includes 5,148 U.S.-based VC investors and 40,599 start-ups they have backed, all of which have reached an exit. Among these, 329 are CVC investors backing 7,808 start-ups. Notably, 3,891 of these start-ups have filed patents, either before or after receiving CVC investments.

To identify the technological areas in which start-ups and incumbent firms specialize, I utilize the Cooperative Patent Classification (CPC) system, which systematically categorizes patents based on their technological content. This classification enables me to map each start-up's innovation focus and compare it to the existing patent portfolio of the CVC parent firm. By calculating the proportion of a start-up's CPC codes that do not appear in the CVC parent's patent portfolio prior to investment, I can assess the extent to which the parent firm is exposed to new technological areas through its portfolio companies, particularly those that ultimately fail. This approach provides insight into what CVC parents learn from their start-ups and which types of innovations are more likely to be absorbed. Furthermore, the hierarchical structure of the CPC system allows for robust analyses across different levels of technological granularity, enhancing the accuracy of the findings.

My analysis reveals that start-ups that ultimately undergo liquidation tend to have a higher proportion of patents in CPC areas previously unexplored by their CVC investors, even at the initial investment stage, compared to start-ups that eventually achieve successful exits. This pattern suggests that CVC parent companies strategically invest in start-ups that offer exposure to novel and differentiated technological domains, reflecting a deliberate approach to exploring new areas of innovation. Even though these startups may fail, my analysis uncovers an important source of strategic benefit obtained by the CVC parent.

Furthermore, when focusing on patents from liquidated start-ups that belong to technological areas previously unfamiliar to the CVC parent firm, I find that these patents are more likely to be cited by the CVC parents than both other patents filed by the same liquidated companies and patents filed by start-ups that successfully exited. This tendency becomes even more pronounced following the venture's exit. These results indicate that

[1] Details of the matching process are available in the guidelines of the UVA Darden Global Corporate Patent Dataset: https://patents.darden.virginia.edu/.

CVCs not only seek exposure to new technological domains through their investments but also continue to leverage the knowledge generated by failed start-ups, especially when it introduces them to areas outside their existing expertise. These findings suggest that the exploratory efforts of failed start-ups can yield valuable technological insights, functioning as strategic experiments that contribute to future innovation. This aligns with the notion that creative destruction, often driven by widespread failure, fosters meaningful experiential learning (Kerr, Nanda, and Rhodes-Kropf, 2014).

Additional evidence supports the view that CVC parents integrate knowledge gained from failed ventures into their own innovation activities. Following the exit of a failed start-up, CVCs are less likely to pursue the exact technological trajectories previously explored by the venture. Instead, they tend to leverage this knowledge to innovate in adjacent or broader domains. In this sense, the failure of CVC-backed start-ups can facilitate strategic refinement of the parent firm's activities. CVC parent firms appear to reallocate resources and shift their innovation focus toward related opportunities, positioning themselves to lead in emerging technological areas. These patterns suggest that, unlike IVCs, CVCs may have stronger incentives to preserve and repurpose insights from failed investments, viewing them not as financial losses but as opportunities for organizational learning and long-term innovation capability building.

Beyond leveraging knowledge, CVCs also play a critical role in retaining the innovative outputs of failed ventures. As Gompers and Lerner (2000) note, when ventures fail, key personnel and knowledge are often scattered. CVCs, which operate as innovation arms of established public firms, tend to have stronger incentives and organizational capacity to retain these assets. Using the USPTO Patent Assignment Dataset (PAD), I examine post-exit patent transfers and find that CVC parent companies are more likely to acquire patents from liquidated start-ups when those patents represent novel technological areas not previously covered in the parent firm's existing portfolio.

In addition, by tracing inventors' career trajectories using patent data, I show that CVCs also preserve the human capital of failed ventures. Patent records disclose not only the identity of inventors but also the assignee institutions to which their patents are attributed. By tracking the sequence of assignee institutions associated with patents filed by the same inventor over time, I am able to trace the career movement of each inventor. Through this method, I find that CVC parent firms are more likely to hire inventors from liquidated portfolio companies, particularly those with experience in technological domains previously unfamiliar to the parent. This practice enables CVCs to retain not only codified knowledge in the form of patents but also tacit knowledge embedded within individual inventors. In doing so, CVCs also help maintain a pool of experienced talent within the broader innovation ecosystem and facilitate the continuity of experimentation beyond the failure of individual start-ups.

This behavior outlined above reflects the principle of efficient experimentation, in which both successes and failures play a crucial role in fostering learning and progress. Although much of the existing literature emphasizes the importance of encouraging entrepreneurial entry, Kerr, Nanda, and Rhodes-Kropf (2014) highlight that supporting efficient exits is equally critical for sustaining a healthy innovation ecosystem. Such an ecosystem requires not only the creation of new ventures but also mechanisms that allow resources, such as knowledge and talent, to be reallocated after failure. As entrepreneurial activity is a key driver of innovation, productivity, and employment (Audretsch, 2007; Acs and Audretsch, 2005), understanding the post-failure trajectories of inventors and innovation outputs carries important policy and economic implications.

A potential concern, however, is that CVC parents may actively influence start-ups to pursue high-risk, exploratory projects aligned with the parent firm's strategic interests, diverting them from building their own technological capabilities. Such influence, if it contributes to venture failure, may raise concerns about anti-competitive behavior (Cunningham, Ederer, and Ma, 2021). Yet evidence from this study suggests otherwise. Rather than coercing start-ups into risky exploration, CVCs appear to selectively invest in ventures that are already engaged in exploratory activities. Portfolio companies that ultimately failed had significantly lower technological overlap with the CVC parent at entry across all levels of CPC classification, and did not experience greater changes in technological alignment over the investment period. This initial gap persists through to exit. These findings suggest that CVC investors choose to invest in inherently exploratory ventures despite the elevated risk, because such investments generate potential strategic value regardless of the outcomes.

Finally, I investigate whether failed CVC investments help CVC parent firms catch-up to, or surpass their existing competitors. I find that failed start-ups tend to have higher technological overlap with the competitors of the CVC parent. This suggests that CVCs may invest in such ventures to gain insights into competing technologies and to strengthen their competitive position. In addition, failed start-ups also exhibit higher technological overlap with the suppliers and customers of the CVC parent, consistent with a vertical integration strategy aimed at tightening control over the value chain. These patterns offer new insights into what incumbent firms stand to gain, even from failed CVC investments, and highlight the strategic intent underlying their venture selection decisions.

This paper contributes to the CVC literature by deepening my understanding of the strategic value that incumbent firms derive from investing in start-ups, particularly those that fail. While prior studies have emphasized the benefits of successful CVC investments, such as learning from new business models or technologies (Ma, 2020) or identifying new business opportunities that expand firm scope (Zhang, 2021), this paper shifts the focus to failed ventures. Unlike start-ups that signal strong performance and overlap with the CVC parent's core business, failed ventures often operate in more novel technological domains. The findings suggest that CVC parents deliberately invest in these riskier and more exploratory ventures not only to capture upside potential but also to acquire strategic knowledge, such as insight into emerging technologies, competitors, or supply chains, that can inform long-term innovation trajectories.

This study also contributes to the literature on failure tolerance in innovation. Prior work shows that more failure-tolerant investors are associated with higher innovation output, conditional on success (Tian and Wang, 2014), and that CVCs are more failure-tolerant than independent VC firms (Chemmanur, Loutskina, and Tian, 2014). This paper extends these insights by demonstrating that failure tolerance is not merely a behavioral trait but a structural feature of CVC strategy. Because CVCs are able to extract value from failed investments, through knowledge absorption and subsequent application, they are incentivized to view failure as part of an experimental learning process rather than a pure financial loss.

Finally, the findings underscore the role of CVCs in facilitating efficient exit. By absorbing innovation outputs with exploitative value and their inventors from failed ventures, CVC parents help preserve knowledge that might otherwise be lost. This practice also has broader implications for entrepreneurial activity. Recent research highlights the role of employment protection regulations in shaping the dynamics of experimentation (Kerr, Nanda, and Rhodes-Kropf, 2014). While these policies aim to protect workers, overly rigid employment protections may reduce flexibility, making it harder for incumbent firms to experiment, pivot, or exit under uncertainty. Therefore, start-ups become a more viable and efficient approach for exploring untested technological opportunities. This not only supports the innovation capabilities of the parent firm but also provides a safety net for talented inventors, as it reduces the job-risk inherent in startups. This can encourage continued experimentation and high-risk innovation. Understanding these dynamics has important policy implications for fostering a resilient entrepreneurial ecosystem, which views failure as a natural and even necessary component of the innovation process, rather than a definitive setback. An institutional environment that facilitates experimentation and allows recovery from failure is essential for sustaining entrepreneurial vitality and long-term economic dynamism (Dosi and Nelson, 2010; Ganco, 2013).

The rest of the paper proceeds as follows: section 2 introduces the findings in the literature and develops the hypotheses; section 3 describes the data and summary statistics; section 4 provides the evidence for the strategic benefits generated from those failed ventures; section 5 concludes the study.

2 Literature & Hypotheses development

2.1 Financial return and strategic return

The unique nature of corporate venture capital distinguishes it from the traditional intermediary VC (IVC) model, which is primarily driven by financial returns. Unlike IVCs, CVCs pursue both financial and strategic objectives, leveraging venture investments to create synergies and enhance their parent firms' competitive positions (Hellmann, 2002; Ma, 2020; Chemmanur, Loutskina, and Tian, 2014). The potential for indirect strategic benefits often leads corporate investors to pay a premium for their investments relative to IVCs.

Another key distinction lies in the incentive structures of fund managers. IVC managers are typically compensated through performance-based mechanisms, such as carried interest, which directly reward high financial returns. In contrast, CVC managers are usually salaried employees of the parent firm, with bonuses tied to the firm's overall strategic and financial performance. This fundamental difference in incentives shapes investment behavior: IVC managers, driven by personal financial upside, tend to prioritize deals with the highest expected financial returns. CVC managers, however, are more likely to pursue investments that align with the parent firm's strategic goals, even if such investments generate lower direct financial returns. These strategic motivations, such as access to new technologies, markets, or talent, can lead CVCs to accept higher entry valuations or invest in riskier ventures with uncertain payoffs. Although this trade-off has been widely theorized in the literature, direct empirical evidence remains limited. One exception is Gompers and Lerner (2000), which finds that CVC-backed start-ups tend to have higher pre-money valuations than those backed by IVCs. However, this premium could reflect superior start-up quality rather than overpayment driven by strategic motives.

To provide more direct evidence, I analyze the actual returns generated by individual investors at the venture investment level. This approach allows me to assess whether CVC investors systematically achieve lower financial returns than their IVC counterparts. Based on these considerations, I propose the following hypothesis:

$\mathbf{H}_1$: CVC investors pay higher prices for their venture investments and thus, generate lower returns compared to IVC investors.

2.2 CVC parent company and start-ups

Ma (2020) refines the strategic perspective of CVC by providing the first empirical evidence on the specific strategic benefits that incumbent firms gain through their CVC arms. The study finds that CVC investments primarily help struggling firms address weaknesses and regain innovative capacity. These strategic considerations also shape CVC portfolio decisions, as CVCs tend to invest in start-ups that share a similar technological focus but possess non-overlapping knowledge bases, allowing them to integrate novel technologies that create strategic value.

However, the degree of technological alignment between the corporate parent and the start-up also influences the extent to which CVC parents can nurture innovation. Chemmanur, Loutskina, and Tian (2014) argue that CVCs are most effective when investing in start-ups with a strong technological fit, as this facilitates knowledge transfer and enhances strategic synergies. In contrast, start-ups with a more distinct knowledge base receive less strategic guidance due to weaker alignment with the CVC parent's expertise. Instead, these investments often serve as exploratory ventures, allowing CVC parent firms to probe unfamiliar technological domains or assess emerging business opportunities (Keil, Autio, and George, 2008; Zhang, 2021). In such cases, start-ups may operate in areas that are significantly distant from the parent firm's core competencies. This distance can limit the technical and strategic support that CVC parents are able to provide. Moreover, when used primarily as vehicles for exploration, these start-ups may not have the opportunity to fully develop their own innovation trajectories. While the reasons behind failure are likely multifaceted and beyond the scope of this study, these dynamics suggest that failed start-ups may be more likely to possess technological portfolios that are distinct from those of their CVC parents. Based on this reasoning, I propose the following hypothesis:

$\mathbf{H}_2$: CVC-backed start-ups that ultimately fail are more likely to possess patent portfolios that are technologically distinct from those of their CVC parent firms, relative to start-ups that successfully exit.

2.3 Strategic benefits from failed investments

While the previous section highlights how technological distance may characterize failed CVC-backed ventures, this distinction does not preclude their strategic value. On the contrary, even when such ventures do not succeed, they can yield important insights that shape future corporate strategy. From this perspective, each CVC investment, particularly those in unfamiliar domains, can be viewed as an experiment, offering a real option for future expansion, which is consistent with the experimentation view (Keil, Autio, and George, 2008).

Through direct engagement with start-ups, such as interacting with management teams and participating in operations, CVC parents acquire valuable insights, referred to as signals regarding the commercial viability of emerging technologies or business models. These signals encompass both soft and hard information, much of which would be inaccessible without direct investment and operational involvement.

Existing research primarily focuses on how CVC parents capitalize on positive signals. Zhang (2021) finds that CVC parents are more likely to establish new business divisions after observing the success of their portfolio companies, illustrating how corporate investors refine strategic direction based on successful investments. However, the potential for learning from failures remains underexplored. Failed investments, while often perceived as setbacks, can serve as valuable experiments that generate knowledge essential for disruptive innovation and long-term competitive advantage. Ma (2020) provides initial evidence that CVC parents absorb information from failed ventures, but the mechanisms through which this learning occurs remain unclear.

While some start-ups may fail, their exploratory efforts generate valuable technological insights and market understanding that CVC parents can leverage. These trials and experiments act as stepping stones, equipping the CVC parent with a foundation of experience that informs future innovation efforts. From this perspective, failed start-ups may contribute to corporate knowledge creation by generating patents that, despite the firm's liquidation, hold technological relevance. If CVC parents systematically learn from these failures, their subsequent innovations should reflect this acquired knowledge. Based on this argument, I propose the following hypothesis:

$\mathbf{H}_3$: Unique patents filed by liquidated start-ups are more likely to be cited by their former CVC parent firms than other patents filed by the same start-up or by start-ups that achieved successful exits.

A critical question following the learning process is how CVC parents integrate the knowledge gained from start-ups into their own innovation strategies. Engaging with start-ups provides CVC parents with insights into emerging technologies and markets, positioning them as potential "first movers" in promising sectors and allowing them to capture a larger market share (Zhang, 2021).

Rather than perceiving failures as complete losses, CVC parents can treat them as experimental ventures that clarify which technological directions hold the most promise. Failed start-ups, through their R&D activities, still contribute to knowledge accumulation by testing novel ideas, identifying technological bottlenecks, and revealing unanticipated market challenges. This accumulated experience allows CVC firms to refine their strategic focus, avoiding previously encountered pitfalls while accelerating innovation in adjacent or broader technological domains.

In other words, investing in an emerging field signals corporate interest, and observing a venture's failure does not necessarily lead to disengagement. Instead, it provides the CVC parent with insights into how to navigate the technological landscape more effectively. By internalizing lessons from unsuccessful ventures, they can strategically reallocate resources, explore adjacent opportunities, and position themselves as pioneers in these evolving domains. Based on these arguments, I propose the following hypothesis:

$\mathbf{H}_4$: Following the exit of a failed venture, CVC parent companies are more likely to file patents in broader technological domains related to the failed venture but are less likely to file patents in the exact same specific subfield, compared with their successful ventures.

2.4 Implications of Entrepreneurship as Experimentation

The preceding analyses focus on how CVC parents learn from failed ventures by absorbing novel technological knowledge and integrating it into their innovation activities. A natural extension of this inquiry is to consider how CVCs retain not only the codified knowledge but also the human capital generated through their portfolio ventures, especially those that fail. In the context of entrepreneurship as experimentation, preserving these assets is as critical as learning from outcomes, ensuring that the insights and talent accumulated do not dissipate with failure.

This perspective aligns with the logic of efficient experimentation, which emphasizes the need for institutional environments that facilitate both entry and exit (Kerr, Nanda, and Rhodes-Kropf, 2014). In innovation-intensive sectors, where outcomes are highly uncertain and technological change is rapid, the ability to fail and efficiently reallocate resources, such as patents and inventors, is essential for sustaining long-run progress.

CVCs are uniquely positioned to support the reallocation of innovation outputs from failed ventures due to their strategic orientation and organizational structure. Unlike IVC funds, which focus primarily on financial returns and operate under fixed investment horizons, CVCs are embedded within established corporations that actively engage in their own R&D and innovation efforts. This structure provides CVC parents with both the incentive and the internal capacity to absorb and further develop technologies from their portfolio start-ups. As previously shown, failed CVC-backed ventures tend to generate innovations that are more technologically distinct from the parent firm's existing capabilities. These start-ups are selected probably because they offer exposure to unfamiliar domains, enabling the parent firm to explore new business opportunities and expand its technological frontier (Zhang, 2021). Accordingly, patents from these failed ventures—especially those in areas outside the parent firm's current specialization—may be particularly attractive for acquisition and strategic integration. Based on this reasoning, I propose the following hypothesis:

$\mathbf{H}_{5a}$: CVC parent firms are more likely to acquire patents from liquidated start-ups when those patents fall outside the parent firm's existing technological specialization than from those successfully exited start-ups.

In addition to acquiring technological assets, CVC parents may seek to retain the human capital associated with failed ventures. Hiring inventors from liquidated start-ups enables CVC firms to capture not only codified technical expertise, but also the tacit knowledge accumulated through hands-on experimentation in emerging domains. This retention helps preserve innovation-relevant insights that are often lost in the aftermath of failure, while also strengthening the parent firm's internal capacity to pursue novel technological opportunities. This practice also contributes to maintaining critical talent within the innovation ecosystem. This effect is likely to be particularly strong when inventors are linked to highly novel or unique patents, as their specialized expertise offers distinctive strategic value to the acquiring firm. Based on this reasoning, I propose the following hypothesis:

$\mathbf{H}_{5b}$: Inventors from failed start-ups are more likely to join their CVC parent companies post-exit when they are associated with patents in technological areas unfamiliar to the parent firm than inventors from successfully exited start-ups.

2.5 Non-Overlapping Innovation and Strategic Fit

While CVCs often seek start-ups that operate in technological areas distinct from their parent firms' current capabilities, they rarely invest in ventures that are entirely unrelated to their core business. Instead, these investments typically occupy adjacent or strategically relevant domains that align with the parent's broader competitive landscape. This raises a key question: when start-ups generate innovations outside the parent firm's existing specialization, how do these ventures support the firm's strategic objectives, and what types of market positions or business expansions are being pursued?

Masulis and Nahata (2009) suggest that CVC-backed start-ups frequently compete with the CVC parent or produce complementary technologies. From this perspective, investing in such ventures allows incumbent firms to monitor technological and competitive developments, gain early insights into potential threats, and inform their strategic responses. These knowledge flows enhance the parent's ability to adapt and maintain market leadership.

In addition, CVCs often target start-ups operating within the parent company's broader value chain—such as suppliers or customers, as part of a strategy to deepen vertical integration. Investing in these markets enables firms to strengthen operational control, increase efficiency, and generate strategic synergies. As Rothaermel, Hitt, and Jobe (2006) argue, firms that balance vertical relationships through strategic outsourcing and integration can better develop related product lines and maintain competitive advantage in dynamic industries.

Accordingly, while CVCs may deliberately pursue ventures outside their immediate technological domain to broaden innovation horizons, they do so with strategic intent, focusing on start-ups that intersect meaningfully with their competitive or operational environment. Based on this reasoning, I propose the following hypothesis:

$\mathbf{H}_6$: CVC parents are more likely to select and invest in start-ups that overlap with their competitors, suppliers, or customers.

3 Data and Variable Construction

3.1 The CVC Sample

The data are sourced from PitchBook, which hosts one of the most comprehensive databases of private market investments. It offers unique and detailed information on financing rounds for privately funded companies, including timing, deal type, amount raised, investors, and their respective funds involved in a given deal. To construct the sample, I begin with the broad set of VC-funded rounds raised by private firms. Specifically, each round must (1) involve the raising of new equity (excluding debt-only and secondary-sale rounds) and (2) be identified in the PitchBook database as a "Venture Capital" round to be included in the sample.

I also collect information linking each financing round to the corresponding U.S. venture capital investors that participated in the round. While this information can be obtained from PitchBook, there are some gaps in coverage. To fill these gaps as much as possible, I rely on Preqin as a supplementary data source. Specifically, additional VC-level holdings are obtained by matching round-investor pairs in my sample to those in Preqin, using firm name, round date, and investor name as matching criteria. I rely on the PitchBook classification to distinguish CVC units from IVC. This gives me 149,947 U.S. based-VC-funded financing rounds of 84,626 start-ups that have corresponding investor information. Among these, 21,356 financing rounds of 14,182 start-ups are CVC-backed.

3.2 Start-up Exit Outcomes

To define exit outcomes, I rely on PitchBook, which provides detailed information on transaction types and business status for each start-up. A start-up is classified as having exited via merger or acquisition if, following a series of VC financing rounds, it records a transaction labeled as *'Merger & Acquisition', 'Merger of Equals', 'Buyout/LBO', 'Investor Buyout by Management',* or *'Reverse Merger'*. An IPO exit is recorded when the firm undergoes an initial public offering.

A start-up is identified as liquidated if it either (1) records a subsequent transaction classified as *'Bankruptcy: Liquidation', 'Bankruptcy: Admin/Reorg',* or *'Out of Business'*, or (2) has a business status explicitly marked as *'Bankruptcy'* or *'Out of Business'*. These criteria capture companies that have formally ceased operations, either through court-administered bankruptcy or informal shutdown.

In addition, a start-up is classified as a zombie company if it does not record any form of exit, such as M&A, IPO, or liquidation and has not raised additional financing within five years following its last observed VC funding round (i.e., the last round occurred before 2017). These zombie firms are also categorized as failed ventures, given their prolonged inactivity and lack of formal resolution. Conversely, firms whose final VC round occurred after 2017 and for which no exit has yet been observed are considered active and are excluded from the analysis, as the focus of this study is on realized outcomes. Based on these criteria, all start-ups in the final sample fall into one of three mutually exclusive exit categories: *IPO*, *mergers*, or *failed ventures*.

3.3 Start-ups' Innovation Activities

I analyze the innovation activities of start-ups and incumbent firms by looking into micro-records of patents filed and granted with the United States Patent and Trademark Office (USPTO) using the PatentsView database. This dataset provides comprehensive patent details along with information on associated assignee(s) and inventor(s). An assignee is the entity that holds the legal rights to the patent, while an inventor is the individual who contributed to the invention, though they may not hold ownership rights. PatentsView applies a disambiguation algorithm to assign unique identifiers to assignees and inventors, denoted as *assignee id* and *inventor id*, respectively. When a patent has multiple inventors, both the patent and its citations are attributed to all listed inventors.

To measure the innovation output of start-ups, I link patent assignees to the corresponding private companies recorded in the PitchBook database. This matching process is inherently complex due to two primary challenges. First, unlike public firms, private companies are not subject to disclosure requirements, limiting the availability of public information. Additionally, there is no universally adopted identifier for private firms, complicating cross-database linkages. Second, the company name strings extracted from patent applications and grant documents often do not align with a firm's exact legal name, as they are not standardized. Consequently, patent databases do not provide a unique identifier for assignees. For firms with long histories of innovation, this results in numerous variations of the same company's name appearing as distinct assignee strings.

Previous research has primarily relied on fuzzy-string matching techniques to link patent assignee names extracted from patent documents to company names in external databases. To improve upon this, I adopt the methodology developed by of Virginia Darden School of Business (2019), which complements the fuzzy-string matching approach of Bena, Ferreira, Matos, and Pires (2017) with a domain-based disambiguation technique that utilizes internet search engines. Specifically, I use search engines to query each patent assignee string and identify the associated corporate domain name. For example, a search for assignee names such as "International Business Machines Corp," "I.B.M. Corporation," or "Comp.; Ibm" consistently returns the domain `www.ibm.com`. I then match patent assignee strings to firm names in external databases through the identified domain names. This approach significantly improves matching precision, especially for non-standardized or abbreviated names.

This domain-based method also helps distinguish companies with similar names that would otherwise be conflated under string-distance metrics. For instance, while "ABBOTT LABORATORIES" and "ATT LABORATORIES" appear similar under common string-distance metrics, search results correctly map them to *abbott.com* and *att.com*, respectively. However, search engines often prioritize widely visited but unrelated websites, such as social media platforms, business directories, and investor portals, over relevant corporate domains.[2] To mitigate this issue, I manually compile a domain blacklist and exclude these domains from the collected results. I further improve accuracy by supplementing automated matches with manual verification. Specifically, I hand-collect data on the most frequently unmatched assignees from USPTO records and resolve cases where a single domain is linked to multiple firms, thereby ensuring accurate firm-level patent assignments.

[2] Examples include Facebook, LinkedIn, Yahoo, Bloomberg, Wikipedia, business registers (e.g., DelawareLookup), and patent-related sites (e.g., PatentBuddy).

3.4 Technological Overlap and Knowledge Transfer between Start-ups and CVC Parents

To assess the technological relationship between start-ups and their CVC parent firms, I construct three key measures. The first, *patent uniqueness*, captures the extent to which a start-up's innovation portfolio overlaps with that of its CVC parent, as well as with related incumbents such as the parent's competitors, suppliers, and customers. Specifically, I identify all Cooperative Patent Classification (CPC) categories in which the CVC parent has previously filed patents and compare these with the CPC categories in the start-up's patent portfolio. *Patent uniqueness* is defined as the proportion of CPC categories in the start-up's portfolio that also appear in the CVC parent's portfolio, providing an indicator of technological alignment. This measure enables an evaluation of whether the start-up is innovating within the parent firm's existing technological domains or exploring more distinct areas. To capture how this alignment evolves over time, I compute the measure at three key points: at the time of initial investment (entry), at exit, and ten years post-exit. All calculations are based on patent application dates, rather than grant dates, to more accurately reflect the timing of innovation.

To classify patents by technological domain, I rely on the Cooperative Patent Classification (CPC) system, jointly developed by the European Patent Office (EPO) and the USPTO. As an extension of the International Patent Classification (IPC) system, CPC offers a more detailed framework, organizing patents hierarchically into categories and subcategories. Each CPC code consists of a sequence of letters and numbers that specify increasingly granular levels of technology classification. In this study, I examine different levels of CPC classification, including subclass, main group, and group, to ensure robustness in identifying technological overlap.[3]

Beyond technological overlap, I measure *knowledge transfer* by tracking instances where a CVC parent cites patents from its portfolio start-ups. At the patent level, I define $I_{Cited\ by\ CVC}$ as an indicator variable that equals 1 if a start-up's patent is cited in a subsequent patent filed by the CVC parent, either during the investment period or within 10 years after the start-up's exit.[4]

At the firm level, I examine whether the CVC parent leverages novel technologies devel-

[3] For example, a CPC code of "A61B5/021" can be broken down in the following way, **A** represents *Section* (Human Necessities); **61** represents *Class* (Medical or Veterinary Science); **B** represents *Subclass* (Diagnostic Instruments); **5** represents *Main Group* (Instruments for performing diagnoses); **/021** represents *Subgroup* (Specific aspects of diagnostic instruments). In this paper, when I refer to "CPC Subclass", "Main Group", or "Group", I mean that the CPC code is kept from the first letter up to the corresponding digit.

[4] I also construct a variable, $Cited\ by\ CVC_{post\ exit}$, to capture the citation behaviors between a start-up and its corresponding CVC parent after its exit. Results relying on this measure are shown in Table B.2

oped by the start-up through subsequent expansion of its own patenting activity into those areas following the venture's exit. To construct this measure, I first identify the CPC classes that are unique to the start-up at the time of exit—that is, technological areas in which the CVC parent had not previously filed patents. I then calculate the share of the start-up's patent portfolio that falls into these unique CPC classes at the time of exit and again ten years post-exit. The change in this share over time captures the extent to which the CVC parent begins to file patents in domains that were initially exclusive to the start-up, thereby indicating post-exit technological integration and firm-level knowledge transfer.

Finally, to study *human capital flows*, I trace inventors' career trajectories through patent records, which include both inventor identities and the assignee institutions of their patents. This enables me to track the post-exit mobility of inventors and classify whether they join their former start-up's CVC parent firm (in the case of CVC-backed start-ups). This analysis provides insight into how CVC involvement affects the reallocation of technical talent and whether it facilitates direct absorption of key personnel into the parent organization.

3.5 Financial Returns to VC Investors

To examine whether CVC parents trade off financial returns for strategic objectives, I compare the financial returns of CVC and IVC investors using multiple measures. First, I calculate the *Round Return*, defined as the percentage change in the price paid for a firm's securities from the immediately preceding financing round. One advantage of using the PitchBook database is the availability of detailed round price data, which provides a more precise measure of valuation changes compared to simply comparing round-to-round firm valuations. The latter approach can be influenced by various unobservable factors unrelated to returns, such as additional shares or options issued to employees and founders. Moreover, relying on round prices mitigates potential biases from missing intervening rounds, ensuring that valuation increases over time can still be estimated accurately.

To further refine the return calculations, I adjust security price returns for stock splits. This involves first adjusting raw returns using the relevant split factors provided by PitchBook. I then cross-check these adjusted price returns with an alternative return measure based on changes in the firm's equity valuation, computed as the ratio of the pre-money valuation of the current round to the post-money valuation of the previous round. If the adjusted round return exceeds this alternative return by more than five times on the positive side (or falls below it by more than 0.8 on the negative side), I apply a new split factor. This factor is computed as the ratio of the number of securities in the current round (excluding newly issued securities) to the number of securities in the previous round, ensuring consistency in price return adjustments.

Next, I construct a broader return measure labeled *Return to Exit*, which captures the compounded annualized change in the (split-adjusted) price per security from the round in which VC firms first invest to the final exit, following Pham, Turner, and Zein (2021). Since round price data at exit is unavailable, I infer it using the last recorded round price before exit, scaling it based on the percentage change in post-money valuation from the final round to the exit valuation. The computation of exit valuation returns varies by exit type. For mergers and acquisitions (M&A), I use the sale price as a proxy for the firm's exit value. For initial public offerings (IPOs), where firms raise additional capital, I approximate the exit valuation by subtracting IPO proceeds from the firm's IPO market capitalization.

Furthermore, I compute the Total Value to Paid-In capital (TVPI) ratio at the investor–portfolio company level to provide a more direct assessment of financial performance. TVPI measures the multiple of value realized relative to invested capital and is widely used in the venture capital literature as a standard indicator of investment performance. In this study, TVPI is calculated using the total funding received by each start-up and its realized exit valuation, thereby focusing exclusively on completed deals. However, due to data limitations, detailed cash flow records for individual VC investors within each round are not available. To approximate investor-specific contributions, I adopt a common assumption: in syndicated rounds, the lead investor is assumed to contribute twice as much capital as the total contributed by all non-lead investors. This heuristic enables the construction of investor-level TVPI estimates based on available deal size and syndicate structure information.

It is important to note that a substantial portion of failed companies in my final dataset are "zombie" firms, whose exit outcomes remain unidentified. As a result, their focal-to-exit returns, IRR, and TVPI cannot be computed. Nevertheless, even though these measures apply only to successful investments, they still provide valuable insights into the premium that CVC parents may pay when investing in start-ups.

3.6 Summary Statistics

Table 1 presents summary statistics and univariate comparisons between CVC- and IVC-backed start-ups. On average, CVC-backed firms hold more patents and receive a higher number of citations than their IVC-backed counterparts, even at the initial investment stage. This pattern likely reflects the tendency of CVCs to invest at later stages, as entrepreneurs often delay engagement with corporate investors until their intellectual property (IP) is more securely protected (Colombo and Shafi, 2016; Dushnitsky and Shaver, 2009). In addition to patent quantity and quality, CVC-backed start-ups also demonstrate greater technological breadth, as evidenced by a wider dispersion of patent filings across CPC subclasses, main groups, and groups.

To formally assess this diversification, I compute the Herfindahl-Hirschman Index (HHI) based on the distribution of patents across multiple levels of CPC classifications. The results indicate that, at the time of initial investment, CVC-backed start-ups exhibit significantly lower HHI scores, suggesting that their patent portfolios are more diversified than those of start-ups backed by IVC firms. This pattern persists through to the point of exit. Regression analyses reported in Table B.1 confirm these findings, which are especially pronounced when CVCs act as lead investors. Taken together, the evidence supports the view that CVCs use start-up investments as exploratory vehicles to access and experiment across a wide range of emerging technological domains (Zhang, 2021; Keil, Autio, and George, 2008).

However, this strategic orientation appears to come at a financial cost. As shown in Panel B of Table 1, CVC-backed start-ups receive pre-money valuations that are, on average, $54 million higher than their IVC-backed counterparts. While this premium is consistent with the superior innovation quality discussed above, it is accompanied by diminished financial performance. Specifically, CVC investors realize a focal-to-exit multiple that is 2.48 points lower and a round-to-round return that is 21% lower than those achieved by IVC investors, both differences statistically significant at the 1% level. To more directly examine this trade-off, I calculate the TVPI multiple at the investor–start-up level. Although simple t-tests indicate a lower average TVPI for CVC-backed deals, the difference is not statistically significant. However, after accounting for industry, geography, financing round, exit year fixed effects, and start-up characteristics, Column (1) of Table 3 reveals that CVC investors earn a TVPI that is 0.72 lower than that of IVCs, with a t-stat of -3.53. Given that the average TVPI in the sample is around 4, this gap is both economically and statistically meaningful. Collectively, these results reinforce the strategic view of CVC: corporate investors are willing to pay a premium and accept lower financial returns in exchange for long-term strategic benefits (Gompers and Lerner, 2000).

Table 2 presents a comparative analysis of failed and successful CVC-backed ventures. Although failed start-ups produce fewer patents on average, they file across a similarly broad range of CPC main groups and subclasses, with only a modest reduction in the number of distinct CPC groups. The HHI index indicates comparable levels of technological concentration across both groups, suggesting similar levels of diversification in their innovation portfolios. The most notable difference lies in the degree of technological alignment with the CVC parent: failed ventures exhibit greater non-overlap with the parent firm's existing patent portfolio, implying that they operated in technological domains further removed from the parent's core capabilities. Additionally, by the time of exit, patents from failed ventures demonstrate higher overlap with the technological areas associated with the parent's competitors, suppliers, and customers. These patterns are consistent with the interpretation of CVC investment as a form of strategic experimentation, allowing corporate parents to explore adjacent markets, monitor competitive technologies, and test the boundaries of their innovation ecosystems. Despite their eventual failure, such ventures generate meaningful knowledge spillovers that can inform the parent firm's future strategic direction and technological development.

4 Baseline Results

4.1 Learning from failure

In this section, I examine the extent to which CVC parent companies acquire technological information from their failed investments. While summary statistics reveal differences in firm-level characteristics and innovation activities between failed ventures and successful exits, it remains unclear whether and how CVC parents extract valuable technological insights from these failed start-ups. To address this question, I develop the following ordinary least squares (OLS) model at patent level:

$$Y_{i,j,z} = \beta_0 + \beta_1 Liquidation_j \times I_{uniq.\ CPC} + \beta_2 I_{uniq.\ CPC} + \beta_3 Liquidation_j + \gamma X_{j,z} + \lambda + \epsilon_i \quad (1)$$

where $Y_{i,j,z}$ is a binary variable equal to one if patent i filed by portfolio company j is cited by a subsequent patent filed by the corresponding CVC parent z, and zero if not; $I_{uniq. CPC}$ is an indicator equal to one if the patent falls into a unique CPC subclass, main group, or group in which the CVC parent had no prior filings before investing in start-up j, and zero otherwise; $Liquidation_j$ represents a dummy variable equal to one if start-up j was eventually liquidated, and zero if it was successfully exited (i.e. M&A, or IPO); and $I_{uniq. CPC} \times Liquidation_j$ captures the interaction between technological novelty and venture outcomes. $X_{j,z}$ is a vector of start-up and investor characteristics, and λ includes fixed effects for citation year, start-up industry, and the round number of the initial CVC investment in the start-up. Standard errors are clustered at the portfolio company level.

Table 4 reports the estimation results of the linear probability model specified in Equation (1). Columns (1) to (3) present the citation probability during the holding period. Across all CPC classification levels, i.e. CPC subclass, main group and group, the coefficients on the indicator for unique patent categories, $I_{uniq.\ CPC}$, are negative and statistically significant. This finding suggests that patents falling outside the CVC parent's core technological streams are generally less likely to be cited by the parent's patents. The coefficients on *liquidation* are small and statistically insignificant, indicating that knowledge generated from failed investments is, at a minimum, equally valuable as that from successful investments in supporting the CVC parent's innovation, consistent with the findings of Ma (2020).

To further examine whether the technological value that CVC parents derive from start-ups differs by venture outcome, I turn to the interaction terms. In Column (1), the interaction between liquidation status and subclass-level uniqueness is positive and statistically significant, suggesting that during the holding period, CVC parents are more likely to cite patents from failed ventures than those from successful ventures, when the patents represent broader departures from the parent's prior technological expertise. However, this learning effect appears to diminish when narrowing the analysis to finer levels of CPC classification. As shown in Columns (2) and (3), the interaction terms $I_{uniq.\ main\ group} \times I_{liquidation}$ and $I_{uniq.\ group} \times I_{liquidation}$ are not statistically significant. These findings imply that failed start-ups that engaged in high-level, exploratory innovation provided more meaningful learning opportunities than those producing incremental innovations within closely related technological domains. The lack of significance at the main group and group levels implies that CVC parents may place less short-term value on narrowly scoped innovations from failed ventures, instead prioritizing broader strategic experimentation during the investment period.

By contrast, the long-term citation patterns reveal a different dynamic. As shown in Columns (4) to (6), the interaction terms between liquidation status and unique patent categories are consistently positive and statistically significant across all CPC classification levels. This indicates that, after a start-up's exit, CVC parents are more likely to cite patents that were initially unique to the failed venture, regardless of whether the technological novelty was broad or narrow. Over time, even patents representing more incremental innovations appear to be absorbed into the parent firm's innovation pipeline. These results suggest that, while CVC parents may initially focus on broad exploratory learning, the full value of both radical and incremental knowledge from failed ventures unfolds gradually, contributing to the parent's longer-term technological development. This pattern reinforces the view that failed ventures serve as strategic experiments, with their accumulated knowledge shaping future innovation trajectories, which is consistent with the findings of Ma (2020) and Zhang (2021).

To assess the robustness of these results, I re-estimate the analysis by redefining patent uniqueness at the time of exit, rather than at initial investment. The findings remain consistent. As reported in Table Table B.2, patents that are still novel to the CVC parent at the time of exit are significantly more likely to be cited in the years following liquidation.

This further supports the interpretation that CVCs continue to value and absorb distinctive technological knowledge from failed ventures, shedding more light on the view that even in the absence of commercial success, these investments yield exploitable innovation assets with enduring strategic relevance.

4.2 Incorporating accumulated knowledge post-exit

To examine how CVC parents integrate knowledge gained from start-ups into their own innovation strategies, this section analyzes post-exit patenting activities of these incumbent firms using the following OLS model estimated at the portfolio company level:

$$Y_{j,z} = \beta_0 + \beta_1 Liquidation_j + \gamma X_{j,z} + \lambda + \epsilon_j \tag{2}$$

where the dependent variable $Y_{j,z}$ captures the extent to which CVC parent z expands its patenting activity into technological areas that were previously unique to start-up j following the venture's exit. It is constructed by measuring the change, over a ten-year period post-exit, in the share of CPC categories within the start-up's patent portfolio in which the CVC parent had no prior patenting activity. This measure is computed at three levels of technological granularity based on CPC classification system: group, main group, and subclass. The key independent variable, $Liquidation_j$, is a binary indicator equal to one if start-up j was liquidated. $X_{j,z}$ is a vector of firm- and investor-level controls, λ includes fixed effects for industry, investment timing, and geography, and ϵ_j denotes the error term.

Column (1) of Table 5 shows that CVC parents are 1.7% less likely to file patents in the exact CPC groups uniquely associated with failed start-ups, relative to successful ones. However, this pattern reverses at broader levels of technological classification. When focusing on CPC main groups, the coefficient on $I_{liquidation}$ turns positive, and becomes significantly positive at the CPC subclass level. As shown in Column (3), CVC parents are 1.1% more likely to file patents in CPC subclasses that were unique to failed start-ups compared to those in which successfully exited start-ups had patents. This suggests that, following failure, CVC parents are more inclined to pursue broader technological domains explored by the failed ventures but less willing to replicate their specific innovations. Notably, this pattern is not observed among successful exits, as shown in Columns (4) to (6).

These results suggest that, after the exit of a failed venture, CVC parents are less inclined to replicate the specific technological paths explored by the failed start-up but more likely to leverage that experience to innovate in adjacent or broader domains. Observing failure provides CVC parents with critical insights into unfamiliar technological landscapes, helping them refine strategic direction, avoid previously encountered pitfalls, and accelerate innovation in related areas. Combined with the earlier citation results, these findings reinforce the view that even unsuccessful ventures contribute valuable knowledge. Their exploratory efforts serve as stepping stones, building a foundation of experience that shapes future innovation and supports the CVC parent's long-term competitive advantage.

4.3 Patent Assignment

To provide additional evidence on how CVC parent firms integrate knowledge from failed ventures into their own innovation portfolios, I examine whether they formally acquire patents from their liquidated portfolio companies. This analysis allows me to assess the extent to which CVCs retain codified innovation outputs after a venture's failure, particularly as a means of incorporating these technologies into their future R&D efforts. I adopt the same regression specification as in Equation (1), with the dependent variable $Y_{i,j,z}$ now indicating whether patent i originally filed by start-up j was subsequently reassigned to its corresponding CVC parent z. All control variables and fixed effects remain consistent with prior analyses.

Table 6 presents regression results examining the likelihood that patents from start-ups are assigned to their CVC parent firms following liquidation. Across all specifications, I find that the main effects of technological uniqueness and liquidation status are both negative and statistically significant, indicating that, on average, patents from novel technological areas are less likely to be acquired, and failed start-ups are less likely to transfer patents to their CVC parents. However, the interaction between technological uniqueness and liquidation is consistently positive and significant, suggesting that CVC parents are particularly likely to acquire patents from failed ventures when those patents originate in technological domains not previously represented in their portfolios. This pattern is robust across different levels of CPC classification granularity, including subclass, main group, and group. It supports the interpretation of a targeted acquisition strategy aimed at retaining strategically valuable innovation outputs from failed investments.

This acquisition behavior also offers a plausible mechanism for my earlier finding that CVCs are more likely to cite patents from failed start-ups operating in novel technological areas. Acquiring a patent may directly facilitate its subsequent use and citation, or conversely, frequent citation may reflect knowledge integration following acquisition. In either case, these patterns underscore that the innovation outputs of failed start-ups are valuable to the CVC parent company and can serve as productive inputs into their future innovation.

4.4 Inventor Movement

Another important channel through which CVC parents internalize knowledge from their portfolio ventures is human capital acquisition. Hiring inventors from start-ups enables CVC parents to capture not only technical expertise but also tacit knowledge and insights generated through trial and error, which are critical for future innovation efforts. To analyze this mechanism, I estimate the following model at the inventor level:

$$Y_{k,j,z} = \beta_0+\beta_1 Liquidation_j \times NewCPC_k+\beta_2 NewCPC_k+\beta_3 Liquidation_j+\gamma X_{j,z}+\lambda+\epsilon_k \quad (3)$$

where $Y_{k,j,z}$ is a binary indicator equal to one if inventor k from start-up j joins the CVC parent company z after the start-up's exit. The key explanatory variable is $Liquidation_j$, which equals one if start-up j was liquidated and zero if it exited successfully via M&A or IPO. To assess the strategic value of individual inventors, I construct two measures that capture the novelty of an inventor's patenting activity relative to the CVC parent's existing technological domain. First, I_{NewCPC} is a dummy variable equal to one if inventor k has ever filed patents in CPC classes not previously covered by the CVC parent. Second, %NewGrp measures the proportion of inventor k's patents that fall into these novel technological areas. Control variables Xj, z and fixed effects λ are defined as in Equation 2.

Columns (1) to (3) of Table 7 report results using the I_{NewCPC} measure at different levels of CPC classification. Across all specifications, the coefficient on $Liquidation_j$ is negative and significant, indicating that, overall, CVC parents are less likely to hire inventors from start-ups that were liquidated. This suggests that liquidation serves as a negative signal, and CVC parents may perceive inventors from failed ventures as less skilled or misaligned with the firm's strategic technological direction.

While the main effect of I_{NewCPC} is statistically insignificant, the interaction term $Liquidation_j \times I_{\text{NewCPC}}$ is positive and significant at the 5% level, particularly when uniqueness is measured at broader CPC levels. This suggests that, although possessing unique patents alone does not increase an inventor's general likelihood of joining the CVC parent, such experience becomes valuable in the context of start-up failure. As shown in Column (2), inventors from liquidated ventures who hold patents in CPC main groups unexplored by the CVC parent are 0.6% more likely to be rehired by the parent. Similarly, Column (3) shows a 0.5% increase in the likelihood of rehiring when uniqueness is measured at the CPC subclass level. Given that the baseline probability of inventor movement is only 0.48%, this effect represents a substantial increase, nearly doubling the likelihood of absorption.

By contrast, the interaction effect based on narrower definitions of uniqueness, specifically at the CPC group level, is statistically insignificant, as shown in Column (1). When considered alongside the citation patterns in Table 4, this suggests that while more incremental or domain-specific innovations may still generate long-term value for the CVC parent, they do not necessarily warrant the rehiring of the original inventors. These technologies may be easier to internalize through documentation, internal R&D, or later-stage external hiring. In contrast, broader, exploratory innovations often involve complex, uncodified knowledge that is more difficult to transfer without direct involvement. In such cases, rehiring inventors becomes a more effective mechanism for retaining critical insights and supporting the parent firm's strategic exploration. These rehiring patterns also complement earlier findings in Table 5, where CVC parents are more inclined to expand into broad technological domains pioneered by failed ventures, while avoiding replicating specific narrow innovations.

Similar results are observed when using the continuous measure %NewTech. As shown in Columns (5) and (6), the coefficients are 0.008 and 0.006, respectively, both statistically and economically significant at the 5% level. These effects are observed when measuring technological uniqueness at broader CPC classification tiers, main group and subclass, mirroring the earlier results using the binary indicator. The findings remain robust when employing Poisson regression models, as reported in Table B.3, following the approach of Cohn, Liu, and Wardlaw (2022). Together, these patterns reinforce the strategic relevance of inventor expertise in novel technological domains, particularly in the aftermath of start-up failure.

Hiring inventors with relevant creative experience allows CVC parents to internalize valuable tacit knowledge accumulated through these high-risk experiments and continue exploring promising areas without starting from scratch. Reintegrating inventors directly from the failed start-up also reduces recruitment and training costs while ensuring knowledge continuity. Importantly, this mechanism prevents valuable knowledge from being lost or dispersed upon liquidation. As Gompers and Lerner (2000) notes, venture failure often leads to the scattering of key personnel and knowledge, limiting potential corporate benefits. By rehiring inventors, CVC parents preserve critical knowledge assets, strengthen their innovation capacity, and contribute to broader societal efficiency in knowledge retention and resource allocation. At the same time, this process provides a soft landing for inventors, helping them mitigate career risks, and highlighting one of the strategic benefits start-ups can derive from having a CVC investor.

4.5 Venture selection

While the previous sections discuss the knowledge and strategic benefits CVC parents may gain from the exploratory activities of failed ventures, it remains unclear whether CVC parents actively influence these start-ups to undertake such exploration or simply select start-ups that are inherently more exploratory. This distinction is crucial. If CVC parents pressure start-ups to engage in risky, exploratory projects aligned with the corporate's strategic interests, rather than allowing them to focus on strengthening their own technologies and competitive advantages, it could contribute to venture failure and raise concerns related to anti-competitive behavior (Cunningham, Ederer, and Ma, 2021). In this section, I seek to shed light on this mechanism.

Panel A of Table 8 compares the technological positioning of liquidated and successfully exited start-ups at the time of initial CVC investment. Consistent with the summary statistics presented in Table 2, the results indicate that liquidated ventures were more technologically distinct from their CVC parents at entry. Specifically, they exhibited 4.1% more unique CPC groups, 4.6% more unique CPC main groups, and 3.7% more unique CPC subclasses, all relative to their CVC parent's existing patent portfolio. These differences are statistically significant and suggest that liquidated start-ups were already engaged in more exploratory or peripheral technological domains at the time of investment.

If CVC parents had deliberately guided these ventures into novel technological areas during the holding period, one would expect to see a larger increase in the share of unique CPC classifications among liquidated firms compared to successful exits. However, as shown in Panel B, no significant differences emerge in the change in technological distinctiveness between the two groups across all levels of CPC classification. This indicates that the degree of technological distance from the parent remained relatively stable for both groups throughout the investment period. Moreover, Panel C shows that the initial gap in uniqueness observed at entry remains persistent through to exit. The coefficients on $I_{Liquidation}$ remain statistically significant, and while slightly larger, are comparable in magnitude to those observed in Panel A. Collectively, these findings indicate that the greater technological distinctiveness of failed ventures was largely present at the time of investment, rather than being a consequence of active strategic redirection by CVC parents during the investment period.

4.6 Non-overlapping innovation and strategic fit

While CVCs seldom invest in ventures that are entirely disconnected from their core business, the presence of substantial technological non-overlap raises an important question: when start-ups develop patents in areas beyond the parent's prior expertise, how do these innovations align with the parent firm's broader strategic objectives? Understanding this alignment is crucial for interpreting the value of such exploratory investments. One plausible explanation is that CVC parents use these engagements to explore adjacent domains, either in response to emerging competitive threats or to pursue vertical integration by extending into supplier or customer markets to enhance their strategic positioning.

The results reported in Table 9 support this interpretation. Panel A documents the extent of technological overlap between start-ups' patent portfolios and those of the CVC parent's competitors, suppliers, and customers at the time of initial investment. Columns (1) and (2) show that, on average, liquidated companies exhibited 6.5% and 7.8% greater overlap with the patent portfolios of the CVC parent's competitors at the CPC group and subclass levels, respectively, relative to successful exits. Likewise, Columns (3) and (4) indicate that these liquidated ventures also showed 6.3% and 7.0% more overlap with the technological domains of the parent's suppliers and customers. These patterns suggest that, during the selection stage, CVC parents are more likely to back start-ups positioned in technological areas that intersect with key elements of their competitive landscape or value chain.

Panel B analyzes how this alignment evolved over the investment period. The results indicate that liquidated start-ups exhibited significantly greater increases in technological overlap with the CVC parent's ecosystem compared to successful exits. As shown in Columns (1) and (2), liquidated start-ups experienced a 4.7% and 5.1% greater increase in CPC group- and subclass-level overlap with the CVC parent's competitors respectively, relative to successfully exited firms. Similarly, Columns (3) and (4) reveal a 4.8% higher increase in overlap with the parent's suppliers and customers at both CPC levels for liquidated ventures. These estimates are statistically significant and indicate that failed ventures increasingly directed their innovation efforts toward domains of strategic importance to the CVC parent.

Panel C confirms that this shift persisted through to exit. By the end of the investment period, liquidated start-ups had 8.6% and 9.8% more overlap with the parent's competitors and 8.5% and 8.4% more with their suppliers and customers (at the CPC group and subclass levels, respectively), relative to successful exits. The widening gap suggests that these firms did not diverge from their initial positioning but rather deepened their engagement in areas strategically relevant to the parent firm's broader operational landscape.

Taken together, these findings suggest that CVC parents may intentionally invest in riskier start-ups operating in adjacent competitive or supply chain domains, allowing them to evolve along strategically aligned trajectories. Even when such ventures ultimately fail, they function as valuable strategic experiments—enabling the parent firm to gain insight into competitors, assess integration opportunities, and reinforce control over key segments of the value chain. These dynamics highlight the broader strategic rationale behind investments that may not yield immediate financial returns but instead contribute to long-term corporate positioning and innovation capacity.

5 Conclusion

Despite the central role of start-ups in driving innovation and economic dynamism, a substantial share of start-ups, particularly those backed by venture capital, ultimately do not survive. When start-ups collapse, they often leave behind innovations, technological assets, and skilled inventors that hold significant exploitative potential. This paper examines a critical yet underexplored question in the entrepreneurial finance literature, which is how the technological knowledge and talent developed by failed start-ups are reallocated or absorbed after failure. Specifically, the study investigates whether and how CVC investors retain the outputs of failed ventures, thereby transforming entrepreneurial failure into a source of strategic value.

Drawing on a rich dataset that merges information on VC-backed start-ups from PitchBook with patent records from the U.S. Patent and Trademark Office, this paper offers novel empirical insights into how CVC investors respond to start-up failure. The analysis reveals that even when start-ups are liquidated, their patents, particularly those in technological domains previously unexplored by the CVC parent, are more likely to be cited by the parent firm than those originating from successfully exited ventures. This citation effect is especially pronounced in the post-liquidation period, suggesting that failure does not erode the underlying value of the innovation. Instead, these failed ventures function as strategic exploratory experiments, contributing meaningfully to the parent firm's long-term innovation trajectory even in the absence of commercial success.

Further analyses show that CVC parents actively absorb the innovation outputs of failed ventures through two primary channels, patent acquisition and inventor hiring. Patents developed in novel technological areas are more likely to be reassigned to the CVC parent after liquidation, and inventors associated with these domains are more likely to be recruited into the parent firm. These mechanisms allow CVCs to capture both codified knowledge (through patent transfers) and tacit knowledge (through inventor mobility), mitigating the risk of knowledge dissipation and preserving the innovative potential of failed start-ups.

Crucially, the evidence indicates that CVC parents redeploy this knowledge strategically. Rather than simply replicating the failed start-up's technological path, they tend to leverage the acquired insights to explore adjacent or broader innovation domains. This behavior suggests a deliberate process of organizational learning and strategic refinement, whereby failed ventures serve as valuable inputs for shaping future innovation agendas and strengthening long-term competitive positioning.

The findings also show that start-ups that ultimately fail tend to be more technologically exploratory at the time of initial investment than those that succeed, implying that CVCs intentionally target high-risk, high-novelty ventures to gain exposure to emerging technologies. Moreover, failed ventures exhibit greater technological overlap with the CVC parent's competitors, suppliers, and customers, both at entry and throughout the investment period, pointing to a broader strategic rationale. These patterns suggest that CVCs may use such investments not only to access new technologies but also to gather competitive intelligence and explore opportunities for vertical integration. Even in the absence of financial returns, these investments generate valuable strategic insights, highlighting how failure can serve as a vehicle for organizational adaptation and capability development.

This study contributes to the CVC literature by highlighting the strategic value that incumbent firms can extract from failed investments, an aspect largely overlooked in prior research, which has traditionally emphasized successful outcomes. The findings reveal that CVCs do not passively absorb the costs of failure; rather, they actively manage and redeploy the innovation outputs of failed ventures to advance broader corporate objectives. In doing so, they transform failure into a source of strategic learning and innovation. Moreover, the study underscores the role of CVCs in facilitating efficient exit and knowledge reallocation within the innovation ecosystem. By acquiring patents and rehiring inventors from liquidated start-ups, CVCs not only strengthens the innovation capabilities of the parent firm but also contributes to broader societal efficiency by ensuring that valuable technological assets and human capital remain active in the innovation cycle. In providing a post-failure landing path for inventors, CVCs may also reduce the career risks associated with entrepreneurship, thereby encouraging greater experimentation and high-risk innovation.

Taken together, these findings reframe entrepreneurial failure not as a dead-end but as a critical phase in a dynamic process of experimentation, learning, and renewal. They underscore the importance of institutional mechanisms, like CVCs, that enable the absorption and strategic reallocation of knowledge from failed ventures. As innovation continues to drive long-term economic growth and competitive advantage, understanding how failure can be systematically leveraged for strategic gain is essential for scholars, practitioners, and policymakers alike.

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6 Tables and Figures

Table 1
Comparative Summary Statistics between CVC- and IVC-backed Start-ups

This table presents summary statistics for variables analyzed in the study, comparing start-ups backed by Corporate Venture Capital (CVC) investors and those backed by Independent Venture Capital (IVC) investors. T-tests are performed to identify statistically significant differences in means between the two groups. Panel A reports summary statistics related to patenting activities, Panel B presents data on financial performance indicators, and Panel C provides descriptive statistics for firm and VC characteristics used in subsequent analyses. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively. Comprehensive definitions of all variables are provided in Table A.1.

	CVC-backed Start-ups				***IVC-backed Start-ups***					
	N	Mean	Median	std. dev	N	Mean	Median	std. dev	Diff.	t-stat
Panel A: Patenting Characteristics										
Rnd. Num_{entry}	7,808	2.34	2.00	1.63	32,791	1.56	1.00	1.11	0.78***	50.26
Comp. with Patents	7,808	0.50	0.00	0.50	32,791	0.29	0.00	0.46	0.20***	35.02
Num. Patents_{entry}	7,808	3.85	0.00	27.48	32,791	1.71	0.00	67.64	2.14***	2.74
Num. Patents_{exit}	7,808	8.71	0.00	42.60	32,791	3.70	0.00	101.52	5.01***	4.27
Forward Citation_{entry}	2,647	19.78	0.00	54.62	3,852	15.06	0.00	43.72	4.72***	3.86
Forward Citation_{exit}	2,773	43.78	10.00	88.49	4,580	32.49	8.00	69.84	11.30***	6.07
Num. CPC Sub_{entry}	7,808	1.86	0.00	4.91	32,791	0.77	0.00	4.06	1.09***	20.43
Num. CPC Sub_{exit}	7,808	3.08	0.00	6.57	32,791	1.40	0.00	5.12	1.67***	24.48
Num. CPC Main_{entry}	7,808	3.27	0.00	11.09	32,791	1.30	0.00	11.11	1.97***	14.09
Num. CPC Main_{exit}	7,808	5.74	0.00	14.98	32,791	2.42	0.00	14.19	3.32***	18.37
Num. CPC Grp_{entry}	7,808	13.88	0.00	70.52	32,791	5.19	0.00	93.28	8.69***	7.72
Num. CPC Grp_{exit}	7,808	26.65	0.00	100.27	32,791	10.37	0.00	130.61	16.28***	10.31
$HHI_{Grp,entry}$	2,739	0.12	0.06	0.17	6,093	0.16	0.09	0.20	-0.04***	-9.69
$HHI_{Grp,exit}$	3,625	0.10	0.05	0.16	8,660	0.14	0.07	0.19	-0.04***	-11.43
$HHI_{Main,entry}$	2,739	0.23	0.15	0.23	6,093	0.29	0.20	0.26	-0.06***	-10.07
$HHI_{Main,exit}$	3,625	0.21	0.14	0.22	8,660	0.27	0.18	0.25	-0.05***	-11.64
$HHI_{sub,entry}$	2,739	0.42	0.33	0.27	6,093	0.47	0.38	0.29	-0.06***	-8.70
$HHI_{sub,exit}$	3,625	0.39	0.32	0.26	8,660	0.44	0.35	0.28	-0.05***	-9.87
Panel B: Financial Return										
Focal-to-Exit Multiple	929	4.58	1.71	11.27	5,227	7.07	2.20	15.76	-2.48***	-4.60
Round Ret.	6,429	2.00	1.53	1.73	29,774	2.21	1.63	1.94	-0.21***	-7.89
Pre-money Valuation	4,637	126.25	31.66	321.17	33,537	72.25	12.63	254.35	54.00***	13.09
TVPI	291	3.57	1.69	7.80	2,570	4.34	1.84	8.93	-0.77	-1.41
Panel C: Firm Characteristics										
Firm Age at Round One	14,306	2.39	1.00	3.84	59,765	2.78	2.00	4.86	-0.39***	-8.94
VC Exp.	15,059	109.93	69.55	148.06	69,567	110.68	46.00	203.36	-0.75	-0.43
Num. of Investors	15,059	12.41	9.00	12.07	69,567	6.01	4.00	6.67	6.40***	90.13
Total Funding at Round One	13,613	9.99	3.74	37.22	51,325	5.86	2.00	26.97	4.13***	14.57

Table 2
Summary Statistics for CVC-backed Start-ups by Exit Outcome (Liquidation vs. Successful Exit)

This table presents summary statistics for key variables, comparing CVC-backed start-ups that were liquidated to those that achieved successful exits. T-tests are conducted to assess statistically significant differences in means between the two groups. Panel A summarizes patenting activity, Panel B reports financial performance measures, and Panel C presents firm- and VC-level characteristics employed in the empirical analysis. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively. Detailed definitions of all variables are provided in Table A.1.

	Liquidated Start-ups				***Successful Exits***					
	N	Mean	Median	std. dev	N	Mean	Median	std. dev	Diff.	t-stat
Rnd. Num$_{entry}$	1,164	2.42	2.00	1.66	2,727	2.84	2.00	1.86	-0.42***	-6.67
Num. Patents$_{entry}$	1,164	6.41	2.00	14.16	2,727	8.04	2.00	44.16	-1.63	-1.24
Num. Patents$_{exit}$	1,164	14.65	5.00	27.82	2,727	18.69	6.00	68.15	-4.04*	-1.95
Num. CPC Sub$_{entry}$	1,164	3.70	2.00	5.01	2,727	3.73	2.00	6.93	-0.03	-0.14
Num. CPC Sub$_{exit}$	1,164	6.18	4.00	6.73	2,727	6.17	4.00	8.78	0.01	0.02
Num. CPC Main$_{entry}$	1,164	6.06	4.00	8.18	2,727	6.76	3.50	17.08	-0.70	-1.33
Num. CPC Main$_{exit}$	1,164	10.68	7.00	11.40	2,727	11.88	7.13	22.18	-1.20*	-1.75
Num. CPC Grp$_{entry}$	1,164	23.62	10.00	41.96	2,727	29.18	9.00	112.97	-5.56	-1.63
Num. CPC Grp$_{exit}$	1,164	46.33	24.00	67.46	2,727	56.52	24.00	157.39	-10.19**	-2.13
$HHI_{Grp,entry}$	824	0.11	0.06	0.16	1,915	0.12	0.06	0.17	-0.01	-0.81
$HHI_{Grp,exit}$	1,119	0.10	0.05	0.16	2,506	0.10	0.05	0.16	0.00	0.63
$HHI_{Main,entry}$	824	0.23	0.16	0.21	1,915	0.23	0.15	0.23	-0.01	-0.94
$HHI_{Main,exit}$	1,119	0.21	0.14	0.21	2,506	0.21	0.14	0.22	0.00	0.44
$HHI_{Sub,entry}$	824	0.41	0.33	0.26	1,915	0.42	0.33	0.27	-0.01	-1.08
$HHI_{Sub,exit}$	1,119	0.39	0.32	0.26	2,506	0.39	0.33	0.26	-0.00	-0.48
% Uniq Pat Grp$_{entry}$	732	0.54	0.66	0.44	1,719	0.52	0.52	0.45	0.02	1.13
% Uniq Pat Grp$_{exit}$	732	0.71	0.96	0.36	1,719	0.68	0.95	0.38	0.03*	1.90
% Uniq Pat Main$_{entry}$	732	0.43	0.16	0.46	1,719	0.41	0.07	0.46	0.02	1.05
% Uniq Pat Main$_{exit}$	732	0.56	0.67	0.44	1,719	0.54	0.61	0.45	0.02	1.13
% Uniq Pat Sub$_{entry}$	732	0.37	0.00	0.46	1,719	0.35	0.00	0.46	0.02	0.94
% Uniq Pat Sub$_{exit}$	732	0.49	0.33	0.46	1,719	0.47	0.33	0.47	0.01	0.73
%Comm. wth Compet.$_{entry;\ Grp}$	563	0.26	0.00	0.39	1,146	0.25	0.00	0.39	0.01	0.28
%Comm. wth Compet.$_{exit;\ Grp}$	563	0.70	0.85	0.34	1,146	0.61	0.77	0.39	0.09***	4.46
%Comm. wth Compet.$_{entry;\ Sub}$	563	0.36	0.00	0.47	1,146	0.34	0.00	0.47	0.02	0.81
%Comm. wth Compet.$_{exit;\ Sub}$	563	0.91	1.00	0.27	1,146	0.80	1.00	0.39	0.11***	6.05
%Comm. wth S&C$_{entry;\ Grp}$	635	0.25	0.00	0.39	1,288	0.24	0.00	0.38	0.01	0.47
%Comm. wth S&C$_{exit;\ Grp}$	635	0.68	0.83	0.36	1,288	0.59	0.75	0.40	0.09***	4.83
%Comm. wth S&C$_{entry;\ Sub}$	635	0.35	0.00	0.47	1,288	0.34	0.00	0.47	0.01	0.33
%Comm. wth S&C$_{exit;\ Sub}$	635	0.87	1.00	0.31	1,288	0.78	1.00	0.40	0.09***	5.19

Table 3
IVC vs CVC Investment Returns

This table presents regression results examining the relationship between CVC and IVC investments and start-up performance, as measured by investment returns and valuations. The dependent variables include: Focal-to-Exit Mul., which captures the change in (split-adjusted) price per security from the round in which the CVC (or IVC) participated to the final exit; and IRR, which reflects the total annualized return generated by the CVC (or IVC) from its investment in the start-up.The key independent variable, I_{CVC}, is a binary indicator equal to one if the focal start-up was backed by CVC or purely backed by IVC investors. Control variables include *log(Firm Age at Round One)*, which denotes the logarithm of the start-up's age at the time of the first VC investment; *log(VC Age)*, the logarithm of the average age of the VC investors at the time of investment; *Num. of Investors*, the logarithm of the total number of investors participating in the start-up; and *ln(Total Funding at Round One)*, the logarithm of the first-round deal size. Fixed effects included in the regressions are specified in each column. t-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Detailed definitions of all variables are provided in Table A.1.

	TVPI	Focal-to-Exit Ret.	Round Ret.	Premoney Valuation
	(1)	(2)	(3)	(4)
I_{CVC}	-0.717***	-1.475***	-0.124***	11.390***
	(-3.53)	(-5.25)	(-4.88)	(3.40)
log(Firm Age at Round One)	0.342***	-0.247	-0.128***	-10.371***
	(2.88)	(-1.20)	(-7.81)	(-6.21)
log(VC Age)	0.003	0.127	0.031***	7.114***
	(0.04)	(0.88)	(3.09)	(5.99)
log(Num. of Investors)	1.807***	4.094***	0.370***	51.515***
	(10.19)	(11.72)	(20.54)	(29.65)
ln(Total Funding at Round One)	-1.063***	-1.891***	-0.198***	63.668***
	(-15.17)	(-13.01)	(-14.59)	(28.00)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Firm State FE	Yes	Yes	Yes	Yes
VC Stage FE	Yes	Yes	Yes	Yes
Obs.	16,263	9,713	31,026	55,707
Adj. R^2	0.10	0.12	0.13	0.29

Table 4
Regression Analysis of Patent Citations by CVC Parent Firms

This table presents regression results examining the citation behaviors between CVC parent companies and their portfolio companies at patent level. The dependent variable, *Cited by* $CVC_{holding\ time}$ are binary indicators equal to one if a given patent was cited by the CVC parent's patents, either during the holding period or after the start-up's exit, and zero otherwise. *Cited by* $CVC_{post\ exit}$ represents a binary indicator equal to one if a patent application, filed by the start-up before its exit, was cited by the CVC parent in patents filed after the exit, and zero otherwise. Key independent variables include $I_{\text{Liquidation}}$, a dummy equal to one if the focal start-up was ultimately liquidated, and zero if it exited successfully via M&A or IPO; $I_{\text{uniq. Sub/Main/Grp}}$, a dummy equal to one if the patent was filed in a CPC subclass, main group, or group where the CVC parent had no prior patenting activity at the time of initial investment; and their interaction term. Control variables include *log(Firm Age at Round One)*, which denotes the logarithm of the start-up's age at the time of the first VC investment; *log(VC Age)*, the logarithm of the average age of the VC investors at the time of investment; *Num. of Investors*, the logarithm of the total number of investors participating in the start-up; and *ln(Total Funding at Round One)*, the logarithm of the first-round deal size. Fixed effects used in regressions are indicated in each column, Standard errors are clustered at the firm level, and t-statistics are reported in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. Detailed variable definitions are provided in Table A.1.

	Cited by $CVC_{holding\ time}$			Cited by $CVC_{post\ exit}$		
	(1)	(2)	(3)	(4)	(5)	(6)
$I_{uniq.\ Sub}$	-0.044***			-0.041***		
	(-3.73)			(-4.16)		
$I_{uniq.\ Sub} \times I_{Liquidation}$	0.021*			0.038***		
	(1.82)			(3.43)		
$I_{uniq.\ Main}$		-0.044***			-0.046***	
		(-4.50)			(-4.07)	
$I_{uniq.\ Main} \times I_{Liquidation}$		0.013			0.043***	
		(1.10)			(3.23)	
$I_{uniq.\ Grp}$			-0.037***			-0.084***
			(-4.24)			(-4.60)
$I_{uniq.\ Grp} \times I_{Liquidation}$			-0.002			0.070***
			(-0.11)			(3.63)
$I_{Liquidation}$	-0.008	-0.003	0.006	-0.057***	-0.063***	-0.096***
	(-0.86)	(-0.32)	(0.42)	(-5.29)	(-5.10)	(-4.79)
log(Firm Age at Round One)	-0.007	-0.006	-0.007	-0.000	-0.000	-0.001
	(-1.29)	(-1.20)	(-1.26)	(-0.04)	(-0.01)	(-0.09)
log(VC Age)	0.002	0.001	0.001	-0.004	-0.005	-0.006
	(0.90)	(0.53)	(0.48)	(-1.16)	(-1.39)	(-1.60)
log(Num. of Investors)	-0.004	-0.004	-0.006	-0.018**	-0.018**	-0.020***
	(-0.58)	(-0.60)	(-0.87)	(-2.46)	(-2.45)	(-2.67)
ln(Total Funding at Round One)	0.002	0.002	0.003	-0.003	-0.003	-0.002
	(0.80)	(0.75)	(1.11)	(-0.76)	(-0.79)	(-0.47)
Citation Year	Yes	Yes	Yes	Yes	Yes	Yes
Firm State	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
VC Stage FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	29,044	29,044	29,044	29,134	29,134	29,134
Adj. R^2	0.05	0.05	0.05	0.13	0.13	0.14

Table 5
Integrating Innovations from CVC Failed Investments

This table presents regression results examining the post-exit patenting behavior of CVC parent firms. The dependent variables measure the percentage change, over the ten years following the start-up's exit, in the share of CPC subclasses, main groups, or groups that were unique to the start-up at exit, i.e. technological domains in which the CVC parent had no prior patenting activity. Key independent variables include $I_{\text{Liquidation}}$, a dummy equal to one if the focal start-up was ultimately liquidated, and zero if it exited successfully via M&A or IPO. Control variables include *log(Firm Age at Round One)*, which denotes the logarithm of the start-up's age at the time of the first VC investment; *log(VC Age)*, the logarithm of the average age of the VC investors at the time of investment; *Num. of Investors*, the logarithm of the total number of investors participating in the start-up; and *ln(Total Funding at Round One)*, the logarithm of the first-round deal size. Fixed effects used in regressions are indicated in each column, Standard errors are clustered at the firm level, and t-statistics are reported in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. Detailed variable definitions are provided in Table A.1.

	%Group Learned	%Main Group Learned	%Subclass Learned	%Group Learned	%Main Group Learned	%Subclass Learned
	(1)	(2)	(3)	(4)	(5)	(6)
$I_{Liquidation}$	-0.017***	0.004	0.011*			
	(-2.60)	(0.66)	(1.71)			
log(Firm Age at Round One)	-0.009**	0.001	0.000	-0.010**	0.001	0.001
	(-2.43)	(0.23)	(0.12)	(-2.55)	(0.24)	(0.20)
log(VC Age)	0.010***	-0.004*	-0.005**	0.010***	-0.004*	-0.005**
	(3.96)	(-1.67)	(-2.53)	(4.02)	(-1.68)	(-2.57)
log(Num. of Investors)	-0.015***	-0.001	0.002	-0.013***	-0.002	0.001
	(-3.17)	(-0.28)	(0.61)	(-2.84)	(-0.44)	(0.20)
EarlyStage_ind	-0.001	-0.002	-0.000	-0.002	-0.001	0.000
	(-0.22)	(-0.30)	(-0.02)	(-0.26)	(-0.26)	(0.04)
ln(Total Funding at Round One)	0.002	0.004	0.005**	0.003	0.003	0.005**
	(0.87)	(1.44)	(2.31)	(1.07)	(1.38)	(2.17)
I_{MA}				0.007	-0.005	-0.007
				(1.29)	(-0.89)	(-1.38)
Exit Year	Yes	Yes	Yes	Yes	Yes	Yes
Firm State	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
VC Stage FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	4,029	4,029	4,029	4,029	4,029	4,029
Adj. R^2	0.13	0.06	0.03	0.12	0.06	0.03

Table 6
Patent Assignment from Start-ups to CVC

This table reports regression results analyzing the likelihood that a start-up's patent is assigned to its former CVC parent. The dependent variable, $I_{Assign\ to\ CVC}$, is a binary variable equal to one if a given patent was assigned to the start-up's CVC investor, and zero otherwise. Key independent variables include $I_{\text{Liquidation}}$, a dummy equal to one if the focal start-up was ultimately liquidated, and zero if it exited successfully via M&A or IPO; $I_{\text{uniq. Sub/Main/Grp}}$, a dummy equal to one if the patent was filed in a CPC subclass, main group, or group where the CVC parent had no prior patenting activity at the time of initial investment; and their interaction term. Control variables include *log(Firm Age at Round One)*, which denotes the logarithm of the start-up's age at the time of the first VC investment; *log(VC Age)*, the logarithm of the average age of the VC investors at the time of investment; *Num. of Investors*, the logarithm of the total number of investors participating in the start-up; and *ln(Total Funding at Round One)*, the logarithm of the first-round deal size. Fixed effects used in regressions are indicated in each column, Standard errors are clustered at the firm level, and t-statistics are reported in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. Detailed variable definitions are provided in Table A.1.

	$I_{Assign\ to\ CVC}$		
	(1)	(2)	(3)
$I_{uniq.\ Sub}$	-0.034***		
	(-3.04)		
$I_{uniq.\ Sub} \times I_{Liquidation}$	0.031**		
	(2.57)		
$I_{uniq.\ Main}$		-0.034***	
		(-3.24)	
$I_{uniq.\ Main} \times I_{Liquidation}$		0.034***	
		(2.94)	
$I_{uniq.\ Grp}$			-0.019*
			(-1.91)
$I_{uniq.\ Grp} \times I_{Liquidation}$			0.020*
			(1.66)
$I_{Liquidation}$	-0.039***	-0.043***	-0.038***
	(-3.32)	(-3.55)	(-2.79)
log(Firm Age at Round One)	-0.010*	-0.010*	-0.010*
	(-1.72)	(-1.73)	(-1.77)
log(VC Age)	0.003	0.003	0.003
	(0.79)	(0.65)	(0.67)
log(Num. of Investors)	-0.020**	-0.020**	-0.022**
	(-2.26)	(-2.25)	(-2.28)
ln(Total Funding at Round One)	0.001	0.001	0.002
	(0.34)	(0.42)	(0.65)
Exit Year	Yes	Yes	Yes
Firm State	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
VC Stage FE	Yes	Yes	Yes
Obs.	51,581	51,581	51,581
Adj. R^2	0.13	0.12	0.12

Table 7
Inventors Post-Exit Movement

This table presents regression results examining the post-exit inventor movements between start-ups and their CVC parent companies at inventor level. The dependent variable, $I_{\text{Move to CVC}}$, is a binary indicator equal to one if an inventor joins the CVC parent firm and subsequently files patents on its behalf following the start-up's exit, and zero otherwise. Key independent variables include $I_{\text{Liquidation}}$, a dummy equal to one if the focal start-up was ultimately liquidated and zero if it exited successfully via M&A or IPO. I_{NewGrp} (I_{NewMain}; I_{NewSub}) is a binary indicator equal to one if the inventor had filed any patents in a CPC group (main group; subclass) where the CVC parent had no prior patenting activity at the time of investment. %NewGrp (%NewMain; %NewSub) is a continuous variable capturing the percentage of the inventor's patents that fall into such novel CPC classifications. Interaction terms between these variables are also included. The set of control variables is the same as in Table 4. Fixed effects applied in each regression are noted in the corresponding column. Standard errors are clustered at the firm level, and t-statistics are reported in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. Detailed variable definitions are provided in Table A.1.

	$I_{move\ to\ CVC.}$					
	(1)	(2)	(3)	(4)	(5)	(6)
I_{NewGrp}	-0.003					
	(-1.42)					
$I_{Liquidation} \times I_{\text{NewGrp}}$	0.005					
	(1.32)					
I_{NewMain}		-0.001				
		(-0.29)				
$I_{Liquidation} \times I_{\text{NewMain}}$		0.006**				
		(2.33)				
I_{NewSub}			-0.001			
			(-0.41)			
$I_{Liquidation} \times I_{\text{NewSub}}$			0.005**			
			(2.16)			
%NewGrp				-0.003		
				(-1.30)		
$I_{Liquidation}$ × %NewGrp				0.005		
				(1.12)		
%NewMain					-0.001	
					(-0.41)	
$I_{Liquidation}$ × %NewMain					0.008**	
					(2.57)	
%NewSub						-0.001
						(-0.41)
$I_{Liquidation}$ × %NewSub						0.006**
						(2.29)
$I_{Liquidation}$	-0.009**	-0.010***	-0.006***	-0.007*	-0.009***	-0.007***
	(-2.44)	(-3.65)	(-2.78)	(-1.76)	(-3.12)	(-2.84)
log(Firm Age at Round One)	-0.003**	-0.003**	-0.002*	-0.002*	-0.002*	-0.002*
	(-2.39)	(-2.36)	(-1.66)	(-1.70)	(-1.68)	(-1.66)
log(VC Age)	-0.003*	-0.003*	0.000	-0.000	0.000	0.000
	(-1.89)	(-1.87)	(0.08)	(-0.03)	(0.11)	(0.08)
log(Num. of Investors)	-0.006***	-0.006***	-0.005***	-0.005***	-0.005***	-0.005***
	(-3.49)	(-3.51)	(-3.53)	(-3.54)	(-3.54)	(-3.53)
ln(Total Funding at Round One)	-0.001*	-0.001*	-0.002*	-0.002*	-0.002*	-0.002*
	(-1.93)	(-1.85)	(-1.82)	(-1.85)	(-1.82)	(-1.82)
Exit Year	Yes	Yes	Yes	Yes	Yes	Yes
Firm State	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
VC Stage FE	Yes	Yes	Yes	Yes	Yes	Yes
CVC Parent FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	52,190	52,190	52,190	52,190	52,190	52,190
Adj. R^2	0.03	0.03	0.03	0.03	0.03	0.03

Table 8
CVC-backed Start-ups' Innovation Activities During Holding Period

This table presents regression results examining the correlation between the patent portfolios of start-up companies and those of their CVC parent firms. The dependent variable, % Uniq. Subclass/Main Group/Group, measures the percentage of CPC subclasses, maingroups, or groups in which the start-up had filed patents, but the CVC parent firm had no prior patenting activity. Panel A reports the innovation characteristics of these start-ups at the time of investment. Panel B captures changes in their innovation features over the holding period. Panel C reassesses these percentages at the time of exit. The key independent variable, $I_{\text{Liquidation}}$, is a binary indicator equal to one if the focal start-up was ultimately liquidated, and zero if it exited successfully via M&A or IPO. The same control variables as in Table 4 are included. Fixed effects used in the regressions are specified in each column. t-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Detailed definitions of all variables are provided in Table A.1.

Panel A:

	% Uniq Pat Group$_{Beg}$	% Uniq Pat Main Group$_{Beg}$	% Uniq Pat Subclass$_{Beg}$
	(1)	(2)	(3)
$I_{Liquidation}$	0.041**	0.046**	0.037*
	(1.98)	(2.16)	(1.72)
log(Firm Age at Round One)	0.097***	0.083***	0.083***
	(7.03)	(5.78)	(5.77)
ln_VCAge	-0.045***	-0.043***	-0.033***
	(-4.65)	(-4.37)	(-3.29)
log(Num. of Investors)	-0.005	0.006	0.006
	(-0.29)	(0.33)	(0.32)
EarlyStage_ind	-0.019	-0.017	-0.005
	(-0.96)	(-0.83)	(-0.27)
ln(Total Funding at Round One)	-0.010	-0.015	-0.020**
	(-0.98)	(-1.55)	(-2.00)
Exit Year	Yes	Yes	Yes
Firm State	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
VC Stage FE	Yes	Yes	Yes
Obs.	2,375	2,375	2,375
Adj. R^2	0.10	0.09	0.08

Panel B:

	Δ% Uniq. Group	Δ% Uniq. Main Group	Δ% Uniq. Subclass
	(1)	(2)	(3)
$I_{Liquidation}$	-0.000	-0.003	0.006
	(-0.00)	(-0.17)	(0.37)
log(Firm Age at Round One)	-0.078***	-0.064***	-0.043***
	(-7.03)	(-6.32)	(-4.38)
ln_VCAge	-0.022**	-0.018**	-0.013*
	(-2.50)	(-2.19)	(-1.67)
log(VC Exp.)	-0.006	-0.010	-0.007
	(-0.63)	(-1.03)	(-0.89)
log(Num. of Investors)	0.057***	0.056***	0.064***
	(4.10)	(4.18)	(5.21)
EarlyStage_ind	-0.015	-0.001	-0.004
	(-0.93)	(-0.04)	(-0.23)
ln(Total Funding at Round One)	-0.009	-0.001	-0.002
	(-1.03)	(-0.09)	(-0.23)
Exit Year	Yes	Yes	Yes
Firm State	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
VC Stage FE	Yes	Yes	Yes
Obs.	2,375	2,375	2,376
Adj. R^2	0.11	0.10	0.09

Table 8
CVC-backed Start-ups' Innovation Activities During Holding Period

Panel C

	% Uniq Pat Group$_{Exit}$	% Uniq Pat Main Group$_{Exit}$	% Uniq Pat Subclass$_{Exit}$
	(1)	(2)	(3)
$I_{Liquidation}$	0.057***	0.051**	0.035
	(3.20)	(2.37)	(1.54)
log(Firm Age at Round One)	0.024**	0.024*	0.034**
	(2.12)	(1.71)	(2.31)
ln_VCAge	-0.067***	-0.062***	-0.049***
	(-8.14)	(-6.29)	(-4.75)
log(Num. of Investors)	0.060***	0.068***	0.070***
	(4.08)	(3.89)	(3.81)
EarlyStage_ind	-0.028*	-0.010	0.010
	(-1.65)	(-0.50)	(0.50)
ln(Total Funding at Round One)	-0.017**	-0.014	-0.020*
	(-2.10)	(-1.43)	(-1.94)
Exit Year	Yes	Yes	Yes
Firm State	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
VC Stage FE	Yes	Yes	Yes
Obs.	2,375	2,375	2,375
Adj. R^2	0.11	0.11	0.10

Table 9
Start-up Innovations and CVC Parents' Suppy Chain

This table presents regression results examining the correlation between the patent portfolios of start-up companies and those of firms along the value chains of their CVC parent companies. The dependent variable, % Comm. wth Compet., measures the percentage of CPC subclasses or groups in which the start-up had filed patents that also overlapped with those of the CVC parent's competitors. Similarly, % Comm. wth Suppl&Cust. measures the percentage of CPC subclasses or groups in which the start-up had filed patents that also overlapped with those of the CVC parent's suppliers or customers. Panel A reports the innovation characteristics of these start-ups at the time of investment. Panel B captures changes in their innovation features over the holding period. Panel C reassesses these percentages at the time of exit. The key independent variable, $I_{\text{Liquidation}}$, is a binary indicator equal to one if the focal start-up was ultimately liquidated, and zero if it exited successfully via M&A or IPO. The same control variables as in Table 4 are included. Fixed effects used in the regressions are specified in each column. t-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Detailed definitions of all variables are provided in Table A.1.

Panel A:

	Overlap with Competitors		Overlap with Supp & Custom	
	% Comm Grp.$_{Beg}$	% Comm Sub.$_{Beg}$	% Comm Grp.$_{Beg}$	% Comm Sub.$_{Beg}$
	(1)	(2)	(3)	(4)
$I_{Liquidation}$	0.065***	0.078***	0.063***	0.070***
	(3.10)	(3.11)	(3.16)	(2.92)
log(Firm Age at Round One)	0.080***	0.126***	0.070***	0.112***
	(5.62)	(7.34)	(5.23)	(6.90)
ln_VCAge	0.010	-0.004	-0.017*	-0.011
	(0.96)	(-0.31)	(-1.82)	(-0.96)
log(Num. of Investors)	-0.015	-0.023	-0.007	-0.022
	(-0.81)	(-0.99)	(-0.43)	(-1.06)
EarlyStage_ind	0.007	0.007	0.019	0.009
	(0.35)	(0.30)	(0.99)	(0.40)
ln(Total Funding at Round One)	0.034***	0.024**	0.036***	0.033***
	(3.33)	(2.01)	(3.79)	(2.97)
Invest Year	Yes	Yes	Yes	Yes
Firm State	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
VC Stage FE	Yes	Yes	Yes	Yes
Obs.	1,659	1,659	1,824	1,824
Adj. R^2	0.18	0.20	0.19	0.19

Panel B:

	Overlap with Competitors		Overlap with Supp & Custom	
	Δ% Comm Grp.	Δ% Comm Sub.	Δ% Comm Grp.	Δ% Comm Sub.
	(1)	(2)	(3)	(4)
$I_{Liquidation}$	0.047*	0.051*	0.048**	0.048*
	(1.95)	(1.84)	(2.07)	(1.85)
log(Firm Age at Round One)	-0.123***	-0.129***	-0.110***	-0.131***
	(-7.94)	(-7.37)	(-7.58)	(-8.03)
ln_VCAge	0.010	-0.006	-0.001	0.002
	(0.84)	(-0.47)	(-0.09)	(0.14)
log(Num. of Investors)	0.060***	0.055**	0.045**	0.046**
	(2.87)	(2.29)	(2.29)	(2.04)
EarlyStage_ind	-0.061***	-0.070***	-0.073***	-0.078***
	(-2.67)	(-2.74)	(-3.38)	(-3.18)
ln(Total Funding at Round One)	-0.006	-0.013	-0.001	-0.003
	(-0.50)	(-0.99)	(-0.07)	(-0.27)
Exit Year	Yes	Yes	Yes	Yes
Firm State	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
VC Stage FE	Yes	Yes	Yes	Yes
Obs.	1,694	1,694	1,861	1,861
Adj. R^2	0.13	0.13	0.14	0.13

Table 9
Start-up Innovations and CVC Parents' Suppy Chain

Panel C

	Overlap with Competitors		Overlap with Supp & Custom	
	% Comm Grp.$_{Exit}$	% Comm Sub.$_{Exit}$	% Comm Grp.$_{Exit}$	% Comm Sub.$_{Exit}$
	(1)	(2)	(3)	(4)
$I_{Liquidation}$	0.086***	0.098***	0.085***	0.084***
	(4.27)	(5.23)	(4.31)	(4.40)
log(Firm Age at Round One)	-0.042***	-0.004	-0.033**	-0.018
	(-3.03)	(-0.28)	(-2.40)	(-1.29)
ln_VCAge	0.020*	-0.005	-0.019*	-0.004
	(1.86)	(-0.46)	(-1.90)	(-0.40)
log(VC Exp.)	0.001	-0.012	0.021*	-0.005
	(0.11)	(-0.92)	(1.70)	(-0.39)
log(Num. of Investors)	0.034*	0.024	0.023	0.015
	(1.93)	(1.36)	(1.33)	(0.91)
EarlyStage_ind	-0.040**	-0.045**	-0.040**	-0.054***
	(-2.08)	(-2.43)	(-2.15)	(-2.89)
ln(Total Funding at Round One)	0.023**	0.008	0.028***	0.025***
	(2.30)	(0.77)	(2.87)	(2.60)
Exit Year	Yes	Yes	Yes	Yes
Firm State	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
VC Stage FE	Yes	Yes	Yes	Yes
Obs.	1,694	1,694	1,861	1,861
Adj. R^2	0.08	0.07	0.16	0.08

Appendix

Appendix A. Variable Definitions

Table A.1: Variable Definitions

Variable	**Definition**
$Rnd.\ Num_{entry}$	The financing round number when CVC started investing in the start-up.
$Num.\ Patents_{entry}$	The number of patents a firm had at the beginning of the CVC investment.
$Num.\ Patents_{exit}$	The number of patents a firm had when it was exited.
CPC Sub	The first four characters of the Cooperative Patent Classification (CPC) code. For example, for a patent with the CPC code *A61B5/00*, the CPC subclass is *A61B*.
CPC Main Group	The portion of the Cooperative Patent Classification (CPC) code preceding the slash. For example, for the CPC code *A61B5/00*, the CPC main group is *A61B5*.
CPC Group	The complete Cooperative Patent Classification (CPC) code, including the subclass, main group, and subgroup elements.
$Num.\ CPC\ Sub_{entry}$	The number of CPC subclasses in which a firm ever filed patents at the start of CVC investment.
$Num.\ CPC\ Sub_{exit}$	The number of CPC subclasses in which a firm ever filed patents when it was exited.
$Num.\ CPC\ Main_{entry}$	The number of CPC main groups in which a firm ever filed patents at the start of CVC investment.
$Num.\ CPC\ Main_{exit}$	The number of CPC main groups in which a firm ever filed patents when it was exited.
$Num.\ CPC\ Grp_{entry}$	The number of CPC groups in which a firm ever filed patents at the start of CVC investment.
$Num.\ CPC\ Grp_{exit}$	The number of CPC groups in which a firm ever filed patents when it was exited.
$\%Uniq\ Pat\ Sub_{entry}$	The percentage of CPC subclasses in which the start-up had filed patents, but the CVC parent firm had no prior patenting activity, measured at the time of investment.
$\%Uniq\ Pat\ Sub_{exit}$	The percentage of CPC subclasses in which the start-up had filed patents, but the CVC parent firm had no prior patenting activity, measured at the time of exit.
$\%Uniq\ Pat\ Main_{entry}$	The percentage of CPC main groups in which the start-up had filed patents, but the CVC parent firm had no prior patenting activity, measured at the time of investment.
$\%Uniq\ Pat\ Main_{exit}$	The percentage of CPC main groups in which the start-up had filed patents, but the CVC parent firm had no prior patenting activity, measured at the time of exit.

Variable	Definition
$\%Uniq\ Pat\ Grp_{entry}$	The percentage of CPC groups in which the start-up had filed patents, but the CVC parent firm had no prior patenting activity, measured at the time of investment.
$\%Uniq\ Pat\ Grp_{exit}$	The percentage of CPC groups in which the start-up had filed patents, but the CVC parent firm had no prior patenting activity, measured at the time of exit.
$\%Comm\ wth\ Compet._{entry;\ Grp}$	The percentage of CPC groups in which the start-up had filed patents that also overlapped with those of the CVC parent's competitors, as identified using the FactSet database, measured at the time of investment.
$\%Comm\ wth\ Compet._{exit;\ Grp}$	The percentage of CPC groups in which the start-up had filed patents that also overlapped with those of the CVC parent's competitors, as identified using the FactSet database, measured at the time of exit.
$\%Comm\ wth\ Compet._{entry;\ Sub}$	The percentage of CPC subclasses in which the start-up had filed patents that also overlapped with those of the CVC parent's competitors, as identified using the FactSet database, measured at the time of investment.
$\%Comm\ wth\ Compet._{exit;\ Sub}$	The percentage of CPC subclasses in which the start-up had filed patents that also overlapped with those of the CVC parent's competitors, as identified using the FactSet database, measured at the time of exit.
$\%Comm\ wth\ S\&C_{entry;\ Grp}$	The percentage of CPC groups in which the start-up had filed patents that also overlapped with those of the CVC parent's suppliers or customers, as identified using the FactSet database, measured at the time of investment.
$\%Comm\ wth\ S\&C_{exit;\ Grp}$	The percentage of CPC groups in which the start-up had filed patents that also overlapped with those of the CVC parent's suppliers or customers, as identified using the FactSet database, measured at the time of exit.
$\%Comm\ wth\ S\&C_{entry;\ Sub}$	The percentage of CPC subclasses in which the start-up had filed patents that also overlapped with those of the CVC parent's suppliers or customers, as identified using the FactSet database, measured at the time of investment.
$\%Comm\ wth\ S\&C_{exit;\ Sub}$	The percentage of CPC subclasses in which the start-up had filed patents that also overlapped with those of the CVC parent's suppliers or customers, as identified using the FactSet database, measured at the time of exit.
HHI_{entry}	The Herfindahl–Hirschman index calculated based on the CPC subclass/main group/group to capture the extent to which a start-up's patent pool is concentrated in one area, at the beginning of CVC investment.
HHI_{exit}	The Herfindahl–Hirschman index calculated based on the CPC subclass/main group/group to capture the extent to which a start-up's patent pool is concentrated in one area, at the exit.
$I_{Liquidation}$	A dummy variable which is equal to one if the focal start-up was ultimately liquidated, and zero if it exited successfully via M&A or IPO.
$I_{uniq.\ Sub}$	A dummy variable which is equal to one if the patent was filed in a CPC subclass where the CVC parent had no prior patenting activity at the time of investment, and zero otherwise.

Variable	Definition
$I_{uniq.\ Main}$	A dummy variable which is equal to one if the patent was filed in a CPC main group where the CVC parent had no prior patenting activity at the time of investment, and zero otherwise.
$I_{uniq.\ Grp}$	A dummy variable which is equal to one if the patent was filed in a CPC group where the CVC parent had no prior patenting activity at the time of investment, and zero otherwise.
I_{NewSub}	A binary indicator which is equal to one if the inventor had filed any patents in a CPC subclass where the CVC parent had no prior patenting activity at the time of investment, and zero otherwise.
$I_{NewMain}$	A binary indicator which is equal to one if the inventor had filed any patents in a CPC main group where the CVC parent had no prior patenting activity at the time of investment, and zero otherwise.
I_{NewGrp}	A binary indicator which is equal to one if the inventor had filed any patents in a CPC group where the CVC parent had no prior patenting activity at the time of investment, and zero otherwise.
$I_{\text{Move to CVC}}$	A binary indicator equal to one if an inventor joins the CVC parent firm and subsequently files patents on its behalf following the start-up's exit, and zero otherwise.
Cited by CVC$_{holding\ time}$	A binary indicator which is equal to one if a given patent was cited by the CVC parent's patents during the holding period, and zero otherwise.
Cited by CVC$_{post\ exit}$	A binary indicator equal to one if a patent application, filed by the start-up before its exit, was cited by the CVC parent in patents filed after the exit, and zero otherwise.
$I_{Assign\ to\ CVC}$	A binary variable which is equal to one if a given patent was assigned to the start-up's CVC investor, and zero otherwise.
%Subclass Learned	The percentage change, over the ten years following the start-up's exit, in the share of CPC subclasses that were unique to the start-up at exit.
%Main Group Learned	The percentage change, over the ten years following the start-up's exit, in the share of CPC main groups that were unique to the start-up at exit.
%Group Learned	The percentage change, over the ten years following the start-up's exit, in the share of CPC groups that were unique to the start-up at exit.
log(Firm Age at Round One)	Natural logarithm of the start-up's age at the time of the first VC investment.
log(VC Age)	Natural logarithm of the average age of the VC investors at the time of investment.
log(Num. of Investors)	Natural logarithm of the total number of investors participating in the start-up.
ln(Total Funding at Round One)	Natural logarithm of the first-round deal size to capture the start-up's firm size at the entry.

Appendix B. Additional Tables and Figures

Table B.1
IVC- vs CVC-backed Startups' Innovation Diversification

This table presents regression results analyzing the relationship between the backing status of start-ups and their level of innovation diversification at exit. The dependent variables, HHI_{Sub}, HHI_{Main}, and HHI_{Grp}, represent the Herfindahl–Hirschman Index calculated at different levels of the Cooperative Patent Classification (CPC) system (subclass, main group, and group, respectively), capturing the concentration of a start-up's patent portfolio at the time of exit. Key independent variables include I_{CVC}, a binary indicator equal to one if the focal start-up was backed by CVC investors and zero if backed exclusively by IVC investors; and $I_{LeadCVC}$, a binary indicator equal to one if a CVC investor served as the lead investor in the financing syndicate, and zero otherwise. Control variables comprise *log(Firm Age at Round One)*, the logarithm of the start-up's age at the time of its initial VC investment; *log(VC Age)*, the logarithm of the average age of the participating VC investors at the time of investment; *Num. of Investors*, the logarithm of the total number of investors participating in the start-up; and *ln(Total Funding at Round One)*, the logarithm of the deal size in the initial funding round. Each regression specification includes fixed effects as indicated in the respective columns. Reported t-statistics are provided in parentheses beneath the coefficient estimates. Significance levels at the 10%, 5%, and 1% thresholds are denoted by *, **, and ***, respectively. Comprehensive definitions for all variables are detailed in Table A.1.

	$HHI_{subclass}$	$HHI_{maingroup}$	HHI_{group}	$HHI_{subclass}$	$HHI_{maingroup}$	HHI_{group}
	(1)	(2)	(3)	(4)	(5)	(6)
I_{CVC}	-0.040***	-0.031***	-0.020***			
	(-8.31)	(-7.77)	(-6.83)			
$I_{LeadCVC}$				-0.031***	-0.027***	-0.020***
				(-3.95)	(-4.02)	(-4.45)
log(Firm Age at Round One)	-0.015***	-0.002	0.001	-0.016***	-0.002	0.002
	(-5.27)	(-0.62)	(0.71)	(-5.08)	(-0.65)	(0.84)
log(VC Exp.)	0.011***	0.004**	0.001	0.011***	0.004**	0.002
	(5.79)	(2.26)	(1.14)	(5.34)	(2.29)	(1.47)
log(Num. of Investors)	-0.044***	-0.035***	-0.024***	-0.043***	-0.035***	-0.024***
	(-14.65)	(-13.95)	(-12.83)	(-13.47)	(-13.06)	(-11.77)
ln(Total Funding at Round One)	-0.023***	-0.027***	-0.020***	-0.023***	-0.027***	-0.020***
	(-10.99)	(-15.17)	(-14.70)	(-10.37)	(-13.79)	(-13.16)
Exit Year	Yes	Yes	Yes	Yes	Yes	Yes
Firm State	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
VC Stage FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	21,310	21,310	21,310	18,892	18,892	18,892
Adj. R^2	0.09	0.10	0.09	0.09	0.10	0.09

Table B.2
CVC Parent and Start-ups' Patent Citations

This table presents regression results examining the citation behaviors between CVC parent companies and their portfolio companies at patent level. The dependent variable *Cited by* $CVC_{post\ exit}$ is a binary variable which is equal to one if a given patent was cited by the CVC parent's patents, after the start-up's exit and zero otherwise. Key independent variables include $I_{\text{Liquidation}}$, a dummy equal to one if the focal start-up was ultimately liquidated, and zero if it exited successfully via M&A or IPO; $I_{\text{uniq. Sub/Main/Grp}}$, a dummy equal to one if the patent was filed in a CPC subclass, main group, or group where the CVC parent had no prior patenting activity at the time of exit; and their interaction term. Control variables include *log(Firm Age at Round One)*, which denotes the logarithm of the start-up's age at the time of the first VC investment; *log(VC Age)*, the logarithm of the average age of the VC investors at the time of investment; *Num. of Investors*, the logarithm of the total number of investors participating in the start-up; and *ln(Total Funding at Round One)*, the logarithm of the first-round deal size. Fixed effects used in regressions are indicated in each column, Standard errors are clustered at the firm level, and t-statistics are reported in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. Detailed variable definitions are provided in Table A.1.

	Cited by $CVC_{post\ exit}$		
	(1)	(2)	(3)
$I_{uniq.\ Sub}$	-0.039***		
	(-4.14)		
$I_{uniq.\ Sub} \times I_{Liquidation}$	0.036***		
	(3.45)		
$I_{uniq.\ Main}$		-0.047***	
		(-4.58)	
$I_{uniq.\ Main} \times I_{Liquidation}$		0.044***	
		(3.83)	
$I_{uniq.\ Grp}$			-0.071***
			(-4.91)
$I_{uniq.\ Grp} \times I_{Liquidation}$			0.067***
			(4.09)
$I_{Liquidation}$	-0.055***	-0.062***	-0.089***
	(-5.38)	(-5.43)	(-5.09)
log(Firm Age at Round One)	-0.000	-0.000	-0.000
	(-0.06)	(-0.00)	(-0.01)
log(VC Age)	-0.004	-0.005	-0.006
	(-0.98)	(-1.28)	(-1.54)
log(Num. of Investors)	-0.018**	-0.018**	-0.019***
	(-2.52)	(-2.49)	(-2.61)
ln(Total Funding at Round One)	-0.003	-0.003	-0.002
	(-0.70)	(-0.76)	(-0.59)
Citation Year	Yes	Yes	Yes
Firm State	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
VC Stage FE	Yes	Yes	Yes
Obs.	29,134	29,134	29,134
Adj. R^2	0.13	0.13	0.14

Table B.3
Inventors Post-Exit Movement

This table presents poisson test results examining the post-exit inventor movements between start-ups and their CVC parent companies at inventor level. The dependent variable is a binary indicator equal to one if an inventor filed patents on behalf of the start-up and later filed patents on behalf of the CVC parent firm after the portfolio company's exit, and zero otherwise. Key independent variables include $I_{\text{Liquidation}}$, a dummy equal to one if the focal start-up was ultimately liquidated, and zero if it exited successfully via M&A or IPO; I_{NewGrp} (I_{NewMain}; I_{NewSub}) is a binary indicator equal to one if the inventor had filed any patents in a CPC group (main group; subclass) where the CVC parent had no prior patenting activity at the time of investment. %NewGrp (%NewMain; %NewSub) is a continuous variable capturing the percentage of the inventor's patents that fall into such novel CPC classifications. Interaction terms between these variables are also included. Same control variable as Table 4 are included. Fixed effects used in regressions are indicated in each column, Standard errors are clustered at the firm level, and t-statistics are reported in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. Detailed variable definitions are provided in Table A.1.

	$I_{move\ to\ CVC.}$					
	(1)	(2)	(3)	(4)	(5)	(6)
I_{NewGrp}	-0.243*					
	(-1.96)					
$I_{Liquidation} \times I_{\text{NewGrp}}$	0.596*					
	(1.69)					
I_{NewMain}		-0.024				
		(-0.18)				
$I_{Liquidation} \times I_{\text{NewMain}}$		0.724**				
		(2.23)				
I_{NewSub}			-0.163			
			(-0.98)			
$I_{Liquidation} \times I_{\text{NewSub}}$			0.603*			
			(1.72)			
%NewGrp				-0.402***		
				(-3.15)		
$I_{Liquidation} \times$%NewGrp				0.508		
				(1.43)		
%NewMain					-0.225	
					(-1.58)	
$I_{Liquidation} \times$%NewMain					1.153***	
					(3.32)	
%NewSub						-0.180
						(-0.95)
$I_{Liquidation} \times$%NewSub						0.763**
						(1.97)
$I_{Liquidation}$	-0.673**	-0.607**	-0.421**	-0.546*	-0.759***	-0.457**
	(-2.19)	(-2.47)	(-2.01)	(-1.84)	(-2.97)	(-2.11)
log(Firm Age at Round One)	-0.358***	-0.361***	-0.353***	-0.357***	-0.361***	-0.352***
	(-3.78)	(-3.75)	(-3.71)	(-3.80)	(-3.74)	(-3.69)
log(VC Age)	0.309*	0.339**	0.324**	0.288*	0.340**	0.324*
	(1.93)	(2.07)	(1.96)	(1.82)	(2.08)	(1.95)
log(Num. of Investors)	-0.659***	-0.661***	-0.652***	-0.656***	-0.666***	-0.655***
	(-6.39)	(-6.33)	(-6.28)	(-6.36)	(-6.38)	(-6.31)
ln(Total Funding at Round One)	-0.158**	-0.161**	-0.156**	-0.160**	-0.160**	-0.155**
	(-2.14)	(-2.17)	(-2.11)	(-2.17)	(-2.16)	(-2.09)
Exit Year	Yes	Yes	Yes	Yes	Yes	Yes
Firm State	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
VC Stage FE	Yes	Yes	Yes	Yes	Yes	Yes
CVC Parent FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	20,558	20,558	20,558	20,558	20,558	20,558