



How the type of venture capital funding (CVC vs. IVC) affects company sustainability and financial performance?

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Abstract

This study explores the influence of venture capital (VC) funding types on company sustainability and financial performance. While corporate venture capital (CVC) has been extensively studied, the impact of independent venture capital (IVC) and the comparison between the two remain understudied. Analysing data from CVC-funded and IVC-funded companies in the United States over a 25-year period (1998-2022), we investigate the relationships between environmental performance, green innovation, and financial performance.

The findings indicate that CVC-funded companies demonstrate higher Environmental, Social, and Governance (ESG) scores compared to IVC-funded counterparts, highlighting the positive effect of CVC on sustainable practices. However, no significant difference is observed in terms of green innovation impact between the two funding types. Interestingly, CVC-funded companies display lower levels of Corporate Social Responsibility (CSR) practices compared to IVC-funded firms.

Regarding financial performance, the results are mixed, emphasizing the complex relationship between funding types and outcomes. Further research is needed to comprehensively understand the underlying mechanisms at play.

These findings have important implications for both research and practice, emphasizing the significance of considering venture capital investments, whether CVC or IVC, to integrate ecological considerations for enhanced overall performance. This study contributes to advancing corporate sustainability and financial decision-making, leading to a more prosperous and sustainable future.

Keywords: Corporate Venture Capital, Independent Venture Capital, Green innovation, Environmental Performance, Financial Performance

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Abstrato

Este estudo explora a influência dos tipos de financiamento de capital de risco na sustentabilidade e no desempenho financeiro das empresas. Embora o capital de risco empresarial (CVC) tenha sido amplamente estudado, o impacto do capital de risco independente (IVC) e a comparação entre os dois ainda não foram estudados. Ao analisar dados de empresas financiadas por CVC e IVC nos Estados Unidos durante um período de 25 anos (1998-2022), investigamos as relações entre desempenho ambiental, inovação verde e desempenho financeiro.

Os resultados indicam que as empresas financiadas pela CVC demonstram pontuações mais elevadas em termos de desempenho ambiental, social e de governação (ESG) em comparação com as suas homólogas financiadas pela IVC, salientando o efeito positivo da CVC nas práticas sustentáveis. No entanto, não se observa uma diferença significativa em termos de impacto da inovação verde entre os dois tipos de financiamento. Curiosamente, as empresas financiadas pelo CVC apresentam níveis mais baixos de práticas de responsabilidade social das empresas (RSE) em comparação com as empresas financiadas pelo IVC.

Relativamente ao desempenho financeiro, os resultados são mitigados, enfatizando a relação complexa entre os tipos de financiamento e os resultados.

Estes resultados têm implicações importantes tanto para a investigação como para a prática, salientando a importância de considerar os investimentos de capital de risco, quer sejam CVC ou IVC, para integrar considerações ecológicas para um melhor desempenho global. Este estudo contribui para o avanço da sustentabilidade empresarial e da tomada de decisões financeiras, conduzindo a um futuro mais próspero e sustentável.

Palavras-chave: Capital de Risco Corporativo, Capital de Risco Independente, Inovação Verde, Desempenho Ambiental, Desempenho Financeiro

Título: Como é que o tipo de financiamento de capital de risco (CVC vs. IVC) afeta a sustentabilidade e o desempenho financeiro das empresas?

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Table of Contents

1. INTRODUCTION	7
2. THEORETICAL BACKGROUND	10
2.1 <i>OVERVIEW OF VENTURE CAPITAL FUNDING TYPES (CVC vs IVC)</i>	10
2.2 <i>VENTURE CAPITAL AND SUSTAINABLE ENTREPRENEURSHIP</i>	12
2.3 <i>VENTURE CAPITAL FUNDING AND GREEN INNOVATION</i>	14
2.4 <i>RELATIONSHIP BETWEEN VENTURE CAPITAL FINANCING AND GREEN INNOVATION</i>	17
2.5 <i>THE IMPRINTING EFFECT OF VC FUNDING ON CSR PRACTICES</i>	18
3. DATA AND METHODOLOGY	21
3.1 <i>SAMPLE SELECTION</i>	21
3.1.1 <i>Dependent variables</i>	22
3.1.2 <i>Independent variables</i>	23
3.1.3 <i>Control variables</i>	23
3.2 <i>EMPIRICAL MODELING</i>	24
4. EMPIRICAL RESULTS AND DISCUSSION	26
4.1 <i>DESCRIPTIVE STATISTICS & CORRELATION MATRIX & LINEARITY</i>	26
4.2 <i>INFLUENCE OF THE TYPE OF FUNDING ON ESG SCORES</i>	30
4.3 <i>INVESTOR FINANCING TYPE AND GREEN INNOVATION</i>	31
4.4 <i>VENTURE CAPITAL FUNDING AND CSR PRACTICES</i>	32
4.5 <i>RELATIONSHIP BETWEEN TYPE OF INVESTOR AND FINANCIAL PERFORMANCE</i>	33
4.6 <i>ROBUSTNESS CHECKS</i>	35
4.6.1 <i>Sensitivity analysis</i>	35
4.6.2 <i>Robustness over time</i>	36
5. LIMITATIONS AND AVENUES FOR FUTURE RESEARCH	38
6. CONCLUSION AND IMPLICATIONS	40
7. BIBLIOGRAPHY	42

List of figures

TABLE 1: SUMMARY STATISTICS.....	26
TABLE 2: CORRELATION MATRIX	28
TABLE 3:ENVIRONMENTAL AND FINANCIAL PERFORMANCE	30
TABLE 4: ROBUSTNESS OF ENVIRONMENTAL AND FINANCIAL PERFORMANCE	35
TABLE 5:TIME PERIOD, ENVIRONMENTAL AND FINANCIAL PERFORMANCE.....	37

Glossary

CRSP	Center for Research in Security Prices
CVC	Corporate Venture Capital
IVC	Independent Venture Capital
VC	Venture Capital
WRDS	Wharton Research Data Services
CSR	Corporate Social Responsibility
ESG	Environmental, Social & Governance

1. Introduction

Venture capital (VC) funding has emerged as a critical driver of innovation and growth in various industries in recent years. It serves as a crucial source of financing for start-ups and high-growth companies, significantly influencing their success and development. However, the implications of different venture capital funding types, namely corporate venture capital (CVC) and independent venture capital (IVC), on company sustainability and financial performance remain an underexplored area of research.

This study aims to address the existing research gap by investigating how the type of venture capital funding (CVC vs. IVC) affects company sustainability and financial performance. By conducting a comprehensive analysis of the literature and empirical evidence, this research seeks to provide valuable insights into the potential advantages and disadvantages associated with receiving funding from CVC and IVC firms, specifically in terms of sustainability practices and financial outcomes.

Previous studies have explored various aspects of the relationship between venture capital funding and company performance. For instance, Alakent Goktan, and Khoury (2020) examined the imprinting effect of VC funding on corporate social responsibility (CSR) practices highlighting the potential influence of VC funding on CSR., while Barber, Morse, and Yasuda (2021) explored impact investing and its connection to VC funding, emphasizing the role of VC in driving impact-oriented investments. Similarly, Battisti, Nirino, Leonidou, and Thrassou (2022) Battisti and Belderbos, Jacob, and Lokshin (2018) studied the influence of CVC investments on performance measures, including CSR performance and technological advancements.

Additionally, there are studies that explore the financial aspects of sustainable entrepreneurship and the relationship between environmental, social, and governance (ESG) performance and financial outcomes. Mansouri & Momtaz (2022) investigated the financial aspects of sustainable entrepreneurship, while Benkraiem et al. (2023) examined the relationship between environmental performance and green innovation on CVC.

The literature also touches on the role of venture capital in promoting green innovation and the connection between green finance and green innovation. Several studies, such as Y. Huang et

al. (2022), (Irfan et al., 2022), and (Wang et al., 2022), delve into these topics, providing insights into the long-term relationships and potential mechanisms between environmental performance, green finance, and green innovation.

The existing literature on venture capital funding and its impact on company sustainability and financial performance has provided valuable insights into various aspects of this relationship. However, there remains a notable research gap in conducting a comparative analysis between CVC and IVC funding types and their respective impacts on company sustainability and financial performance. This research gap is significant for several reasons.

This research question's central contribution lies in delivering a comparative analysis between CVC and IVC funding types, with a specific focus on their influences on company sustainability and financial performance. In examining the unique features and objectives of these two funding types, the study aims to deepen our understanding of their distinct impacts, potentially revealing specific benefits and drawbacks inherent to each. CVC firms, typically associated with corporate investors, are known for their strategic motivations, often seeking to align their investments with their core business objectives. In contrast, IVC firms operate as independent entities, with their primary focus on providing venture capital financing. By dissecting the implications of these disparate funding types, the study promises to highlight the unique benefits and disadvantages linked to each, particularly in the context of sustainability practices and financial performance. This paper provides an understanding of the different dynamics at play when choosing between CVC and IVC funding options. The study of Bugl et al. (2022) provide insights into the value creation of CVC which can be compared with independent venture capital firms. P. Huang & Madhavan (2021) meta-analysis on CVC offers insights into their unique features and objectives which may be useful for comparison. Dhayal et al. (2023) discusses venture capital investments' role in sustainable development, which is relevant for the study's focus on sustainability.

This study's secondary contribution is the practical insights it offers to stakeholders, including entrepreneurs, investors, and policymakers. By unravelling the distinct impacts of CVC and IVC company sustainability and financial performance, it equips these stakeholders with the knowledge to make more judicious choices about their venture capital financing strategies. The research not only underscores the potential advantages and disadvantages of securing funding from CVC and IVC firms but also draws attention to the potential trade-offs and considerations

intrinsic to each funding type. In bridging this research gap, the study fosters a better alignment between stakeholders' objectives and their preferred source of funding. Consequently, they can select a funding source that truly resonates with their goals and values, enabling them to navigate the venture capital landscape more effectively and strategically. Therefore, the results are based on research of Fichter et al. (2023) who provide insights on sustainability impact assessment of new ventures which can be instrumental in understanding the practical insights this research might offer. Di Vaio et al. (2022) offer a literature review on the impact of sustainable entrepreneurship, which is pertinent to this study's objectives. Y. Huang et al. (2022) discuss green finance's impact on green innovation, which provides a basis for analysing the trade-offs between CVC and IVC in terms of sustainability.

The third significant contribution of this research is its exploration into the core mechanisms and factors that drive the relationship between the type of venture capital funding and the outcomes for companies. This investigation enables the study to identify the key elements that dictate how CVC and IVC funding influence company sustainability and financial performance. A comprehensive understanding of these underlying dynamics is crucial to appreciate this domain fully. The insights gleaned from this exploration can help shape more effective strategies and policies that bolster sustainable entrepreneurship and improve the performance of companies backed by venture capital. Thus, this research holds significant potential for advancing our understanding of the impacts of CVC and IVC funding and enhancing the trajectory of sustainable entrepreneurship. The works of Barber et al. (2021) and Block et al. (2021) provide insights into the criteria used by impact investors respectively. These references would be beneficial in exploring the core mechanisms driving the relationship between funding types and company outcomes. Benkraiem et al. (2023) offer an understanding of the effects of environmental performance on CVC which can be helpful in investigating the key elements that dictate how CVC and IVC funding influence company sustainability. Shuwaikh et al. (2022) analyse the performance of organizations in relation to dynamic ambidexterity which may provide insights into the factors influencing financial performance under different funding types. Finally, Mansouri & Momtaz (2022) research on financing sustainable entrepreneurship offers a comprehensive understanding of the dynamics between ESG measurement, valuation, and performance that is useful in this study.

In addition to its practical implications, filling this research gap would also contribute significantly to the academic literature. It would enrich the understanding of the role of venture

capital funding in driving sustainable business practices and financial performance. The comprehensive analysis of the effects of CVC and IVC funding on company sustainability and financial performance, considering the insights from a range of relevant studies, can provide a robust foundation for future research in this area.

Addressing the research gap between CVC and IVC funding types and their impacts on company sustainability and financial performance is of paramount importance. Filling this gap will offer valuable insights into the distinct advantages and disadvantages of each funding type, inform decision-making processes, uncover underlying mechanisms, and contribute to both the academic literature and the practical understanding of venture capital financing strategies.

This paper is structured as follows to address the research question on the impact of venture capital funding type (CVC vs. IVC) on company sustainability and financial performance. In Section 2, a systematic review of the literature will be presented, highlighting existing research and identifying gaps in knowledge. Section 3 will outline the data selection and methodology used in this study. Section 4 will present the results and analysis of a comprehensive examination of the implications and patterns of CVC and IVC funding on company outcomes. Lastly, Section 5 will discuss the implications, limitations, and recommendations for future research, offering valuable insights for stakeholders in venture capital financing strategies. By bridging the research gap and drawing from relevant studies, this research aims to provide a comprehensive understanding of the implications of CVC and IVC funding on company sustainability and financial performance.

2. Theoretical background

2.1 Overview of Venture Capital Funding Types (CVC vs IVC)

Venture capital funding plays a crucial role in supporting the growth and development of innovative startups and high-potential entrepreneurial ventures. When examining venture capital funding types, two primary categories emerge: Corporate Venture Capital (CVC) and Independent Venture Capital (IVC). This section provides an overview of these funding types, highlighting their distinct characteristics and implications.

The research conducted by Benkraiem et al. (2023) suggests that CVC investments are more influenced by environmental performance and green innovation compared to IVC. CVCs show a strategic interest in supporting startups with strong environmental performance and a commitment to green innovation. This preference is driven by the potential for long-term value creation, alignment with the parent company's sustainability goals, and the pursuit of a competitive advantage within the green economy. On the other hand, IVCs may have a broader investment mandate and prioritize financial returns over sustainability considerations. However, the study acknowledges that IVCs can still invest in green start-ups and consider environmental factors, but to a lesser extent than CVCs. The research highlights the growing significance of sustainability and the integration of environmental considerations in venture capital funding, with CVCs playing a prominent role in driving and supporting green innovation initiatives.

CVC refers to investments made by established corporations in external startups or early-stage companies. It involves corporations allocating financial resources to support entrepreneurial ventures that align with their strategic goals, industry focus, or areas of innovation. (Belderbos et al., 2018) CVC investments often go beyond mere financial considerations, as corporations aim to gain strategic advantages, access new technologies or markets, and foster innovation within their own operations.

CVC offers several advantages for both the investing corporations and the startups they support. For corporations, CVC investments provide opportunities for strategic diversification, knowledge transfer, and access to external innovation. (Cheng et al., 2022) It allows them to stay at the forefront of emerging trends and technologies, enhance their competitive positioning, and foster long-term growth. Startups, on the other hand, benefit from CVC funding through access to capital, industry expertise, market networks, and potential commercial partnerships. Additionally, CVC-backed startups may experience increased legitimacy and credibility in the market due to their association with established corporations.

However, CVC investments also present unique challenges and considerations. The corporate investors must navigate issues such as conflicting priorities, potential conflicts of interest, and the need to balance strategic objectives with financial returns. Startups, in turn, may face concerns regarding the loss of autonomy, potential conflicts with the corporate investor's interests, and changes in their entrepreneurial culture.

IVC, as the name suggests, refers to venture capital funds that operate independently from corporate entities. IVC firms raise capital from independent investors, such as pension funds, endowments, and high-net-worth individuals, with the sole purpose of investing in early-stage companies with high growth potential. These firms typically have a diversified portfolio of investments across various industries and sectors.(Bertoni et al., 2011)

IVC investors focus primarily on financial returns and seek opportunities to identify promising startups and support their growth trajectory. (Colombo & Grilli, 2010) They provide capital, expertise, mentorship, and valuable networks to assist startups in scaling their operations, commercializing their products or services, and accessing follow-on funding rounds. IVC firms often play an active role in the management and strategic decision-making of the startups they invest in.

One advantage of IVC funding is the independent nature of the investment decisions, allowing for a more nimble and flexible approach compared to CVC investments. IVC firms have the freedom to select investments solely based on their assessment of the startup's growth potential and financial viability, without the influence of corporate agendas or strategic considerations (Alakent et al., 2020).

In summary, both CVC and IVC funding types play significant roles in the venture capital landscape. CVC investments enable corporations to leverage external innovation and gain strategic advantages, while startups benefit from financial resources, industry expertise, and market access. (Battisti et al., 2022) On the other hand, IVC investments focus primarily on financial returns, providing startups with capital and support to scale their operations. Understanding the distinctions between CVC and IVC is crucial for entrepreneurs seeking venture capital funding, as it helps them align their goals and expectations with the right type of investor.

2.2 Venture Capital and Sustainable Entrepreneurship

VC plays a crucial role in promoting sustainable entrepreneurship by providing financial resources, industry expertise, and networks to startups that focus on sustainable business models and environmentally-friendly innovations. VC funding can have a significant impact on

the CSR practices of startups and ESG scores, as it can imprint certain values and expectations on the firms it invests in (Alakent et al., 2020).

Studies have shown that VC-backed startups are more likely to engage in CSR activities compared to non-VC-backed firms (Battisti et al., 2022). VC firms often prioritize sustainable and socially responsible investments, seeking startups that align with their values and mission (P. Huang & Madhavan, 2021) (Barber et al., 2021). They actively seek out ventures that address environmental challenges, support clean technologies, and promote social impact (Gaddy et al., 2017).

VC funding not only provides financial resources to startups but also brings industry expertise and networks that can help foster sustainable entrepreneurship (Hegeman & Sørheim, 2021). VC firms typically have extensive networks and connections, which startups can leverage to access valuable resources, strategic partnerships, and market opportunities (Colombo et al., 2016). These networks can be particularly valuable for sustainable startups, as they often face unique challenges related to market adoption and scaling (Dhayal et al., 2023).

Moreover, CVC has emerged as a significant source of funding for sustainable startups. CVC units within established corporations invest in startups that align with their corporate sustainability goals, thereby promoting sustainable entrepreneurship (Döll et al., 2022). CVC investments provide startups not only with financial resources but also with strategic advantages such as access to the parent company's resources, distribution channels, and customer base (Kim et al., 2019). This can enhance the startups' ability to develop and scale sustainable innovations.

The impact of VC funding on sustainable entrepreneurship extends beyond the financial aspects. Startups that receive VC investments often experience increased legitimacy and credibility, which can attract additional funding, customers, and partnerships (Ceccagnoli et al., 2018). This increased visibility and reputation can contribute to the long-term success and growth of sustainable startups. (Lee et al., 2018)

CVCs are more likely to consider and prioritize ESG factors compared to individual venture capital (IVC) firms. Several studies support this notion. A systematic literature review conducted by Di Vaio et al. (2022) highlights the increasing importance of sustainability in the

entrepreneurial context and emphasizes the need for sustainable start-ups to attract investment. This implies that start-ups with a strong ESG orientation are more likely to attract CVC investments. Additionally, Cheng et al. (2022) find that venture capital investment positively affects CSR engagement, with CVCs exhibiting a stronger positive impact compared to IVCs. This suggests that CVCs are more inclined to invest in start-ups that align with their ESG goals. Furthermore, Asiaei et al. (2022) emphasize the mediating role of environmental performance measurement systems, often linked to ESG criteria, on the positive relationship between green intellectual capital and firm performance. This indicates that CVCs, which prioritize ESG factors, may contribute to better environmental performance and subsequently enhance financial outcomes. These findings provide compelling evidence that CVCs are more likely to consider and invest in start-ups with strong ESG orientation, making ESG considerations better integrated into CVC investment decisions compared to IVC firms.

Overall, venture capital, including both traditional VC and CVC, plays a crucial role in fostering sustainable entrepreneurship. It provides startups with the necessary financial resources, expertise, and networks to develop and scale sustainable innovations. VC funding also influences ESG scores, imprinting sustainable values on the startups it supports. The symbiotic relationship between VC and sustainable entrepreneurship creates opportunities for startups to address pressing environmental and social challenges while also achieving economic success.

Hypothesis 1: Companies funded by CVC investors will exhibit higher ESG scores compared to companies funded by IVC investors.

2.3 Venture capital funding and Green innovation

CVC is a form of investment in which established companies provide funding and support to startups in exchange for equity stakes. It has gained significant attention in recent years due to its potential to drive innovation and economic growth. Moreover, there is growing interest in understanding the relationship between CVC and sustainability, particularly in terms of CSR practices and environmental performance.

Recent studies have elucidated the impact of CVC funding on sustainability efforts. Specifically, evidence suggests that CVC-backed firms tend to exhibit superior CSR performance compared to their non-VC-backed counterparts (Alakent, Goktan, & Khoury,

2020). This differential performance is often attributed to the social and environmental orientation of VC investors imprinting upon the CSR orientation of startups. In line with this, Battisti, Nirino, Leonidou, and Thrassou (2022) found a positive correlation between CVC involvement and CSR performance, highlighting the enabling role of CVC in providing startups with the necessary resources to engage in CSR initiatives, consequently improving their sustainability performance.

CVC's influence on sustainability extends to environmental performance. For instance, CVC funding can enhance the environmental management practices and product innovation of ecological startups, often driven by sustainability goals (Kuckertz et al., 2019). Further, CVC has demonstrated efficacy in financing clean energy and cleantech startups, driven by both strategic and financial considerations, thus contributing to the acceleration of clean technologies' development and adoption (Hegeman & Sørheim, 2021).

Moreover, CVC's impact can resonate beyond individual startups to influence the ecosystem of sustainable entrepreneurship. CVC is positioned as an effective model to support energy innovation, particularly given its alignment with the long-term nature of clean energy projects, which traditional venture capital models often struggle to accommodate (Gaddy et al., 2017). Thus, CVC is seen as instrumental in fostering sustainable entrepreneurship and propelling the transition towards a low-carbon economy.

Green financing and green innovation, central to addressing environmental challenges, are also areas where CVC has demonstrated potential. Green financing involves allocating financial resources to projects with positive environmental impacts, while green innovation focuses on new technologies, processes, and business models promoting environmental sustainability. Several studies underscore CVC's ability to catalyze sustainable development, including facilitating green innovation by providing financial support and expertise to green startups (Dhayal et al., 2023; Irfan et al., 2022).

Other forms of green financing, such as green bonds and impact investing, complement CVC's efforts by funding environmentally friendly projects. The interplay between green financing and green innovation is dynamic: while the former provides resources for green innovation's research, development, and commercialization, the latter creates novel investment opportunities and business models (Y. Huang et al., 2022; Irfan et al., 2022).

The effectiveness of green financing in fostering green innovation is subject to various factors, such as regional policy interventions and government support (Irfan et al., 2022). Therefore, understanding the complex dynamics and mechanisms underlying the relationship between green financing and green innovation can inform more effective strategies for promoting sustainability.

Green innovation is expected to be better and more favored by CVC compared to IVC. Several studies conducted support this assertion. One key reason is the growing recognition of the importance of environmental sustainability in the business landscape. Research by Asiaei et al. (2022) and Battisti et al. (2022) provide evidence of the positive relationship between green intellectual capital, environmental performance, indicating that CVC investments can drive sustainability efforts and green innovation within companies.

CVC investments are often motivated by strategic considerations and long-term value creation. Bugl et al. (2022) suggest that CVCs leverage smart capital to create value for new ventures, and the typology of value creation includes factors related to sustainability and environmental impact. CVCs are more likely to prioritize green innovation as it aligns with their strategic goals and contributes to long-term competitive advantage. This is in line with the findings of Hegeman & Sørheim (2021), who investigate CVC investments in cleantech startups and highlight the strategic motivations behind these investments, such as gaining access to green technologies and expanding market presence in the sustainable sector.

Furthermore, the increasing trend of impact investing, as discussed by Barber Morse, and Yasuda (2021), indicates a growing interest in investment opportunities that generate both financial returns and positive social or environmental impact. CVCs, being a subset of impact investors, are more inclined to invest in green innovation due to the alignment of their investment thesis with sustainable development goals. The study by (Kuckertz Berger, and Gaudig (2019) emphasizes the value creation potential of ecological startups, which are likely to receive favorable attention from CVCs seeking to promote sustainable entrepreneurship.

CVC, along with other green financing initiatives, holds great promise in driving sustainable innovation and improving environmental performance.

Hypothesis 2: Companies receiving CVC financing will exhibit higher levels of green innovation compared to companies relying on IVC.

2.4 Relationship between venture capital financing and green innovation

Venture capital financing, green innovation, and impact investing are three intertwined concepts that can have a significant impact on a firm's performance. VC financing involves providing funding to start-ups and early-stage companies that have high growth potential but lack the necessary capital to expand. Green innovation refers to the development of environmentally friendly technologies and products, whereas impact investing involves investing in companies that are expected to generate both financial returns and positive social and environmental impact.

Several studies have explored the relationship between venture capital financing, green innovation, and impact investing. In their study, Ceccagnoli, Higgins, and Kang (2018) find that CVC can serve as a real option for markets of technology. CVC investments have the potential to not only generate financial returns for investors but also to provide strategic benefits for the investing companies. This is particularly true for firms that have a strong focus on environmental sustainability.

Cheng et al. (2022) investigate the relationship between VC financing and CSR. The authors find that VC-backed firms tend to perform better in terms of CSR practices than non-VC backed firms. This is attributed to the fact that VC firms tend to have a long-term investment horizon, which enables them to prioritize CSR practices that can lead to long-term value creation.

In their study, Alakent, Goktan, and Khoury (2020) explore the impact of VC funding on CSR practices. They find that VC funding can have an imprinting effect on CSR practices, which means that the CSR practices of VC-backed firms tend to reflect the values and preferences of the VC investors. As such, VC investors can play a crucial role in promoting sustainable and socially responsible business practices.

Impact investing is another concept that is closely related to green innovation and CSR. Barber, Morse, and Yasuda (2021) define impact investing as investments that are made with the intention of generating social and environmental impact alongside financial returns. In their

study, the authors find that impact investing can have a positive impact on the environment and society, and that it can also be financially profitable for investors.

Bugl, Balz, and Kanbach (2022) explore the relationship between smart capital and CVC, and find that CVC can create value for new venture firms by providing them with access to strategic resources, knowledge, and networks. This can help start-ups and early-stage firms to develop and commercialize green innovations that can have a positive impact on the environment and society.(Bugl et al., 2022)

Cojoianu et al. (2020) investigate the role of environmental knowledge and policy in shaping the creation and financing of green start-ups. The authors find that green start-ups are more likely to receive funding from impact investors who prioritize environmental sustainability and social impact. Furthermore, the authors find that green start-ups that receive funding from impact investors tend to have a higher likelihood of success than those that do not.

Finally, Del-Aguila-Arcentales et al. (2022) explore the influence of the Sustainable Development Goals (SDGs) on entrepreneurship and competitiveness. The authors find that firms that align their strategies with the SDGs are more likely to be successful and to generate positive social and environmental impact. As such, impact investors and VC firms can play a crucial role in promoting the SDGs by investing in companies that are aligned with these goals.(Del-Aguila-Arcentales et al., 2022)

In summary, the relationship between venture capital financing, green innovation, and impact investing is complex and multifaceted. However, the studies cited above provide evidence that these concepts are closely related and can have a significant impact on a firm's performance, as well as on society and the environment.

Hypothesis 3: Companies receiving CVC financing have a better financial performance compared to companies relying on IVC.

2.5 The Imprinting Effect of VC Funding on CSR Practices

VC funding has gained significant attention in the business and academic communities due to its potential impact on various aspects of firm behavior and performance. One area that has

received increasing interest is the influence of VC funding on CSR practices. Researchers have explored the imprinting effect of VC funding on CSR practices to understand how the involvement of venture capitalists shapes firms' social and environmental engagement.

Studies suggest that VC funding can have a significant impact on CSR practices. Alakent, Goktan, and Khoury (2020) examine the imprinting effect of VC funding on CSR practices and find that VC-backed firms tend to engage more in CSR activities compared to non-VC-backed firms. They argue that VC investors play a crucial role in shaping firms' CSR practices by providing financial resources, expertise, and network connections, which encourage firms to adopt and implement CSR initiatives.

CVC investments, specifically, have been shown to have a positive influence on CSR performance. Battisti, Nirino, Leonidou, and Thrassou (2022) argue that CVC investors, who are typically affiliated with established corporations, bring not only financial resources but also knowledge, experience, and reputation, which can enhance a firm's CSR performance. They propose an extended resource-based view to explain how CVC investors' resources and capabilities positively influence a firm's CSR practices.

The impact of VC funding on CSR practices is also influenced by the industry context. Belderbos, Jacob, and Lokshin (2018) highlight the importance of geographic diversity and technology alliances in the relationship between CVC investments and technological performance (Belderbos et al., 2018). Similarly, some find a positive relationship between carbon performance and firm value among the world's most sustainable companies. (Benkraiem et al., 2022) These studies suggest that VC funding and CSR practices can be shaped by industry characteristics and the specific environmental challenges firms face.

Furthermore, the type of VC investor and its motivations can influence CSR practices. The criteria that impact investors is investigated and used to screen social enterprises and one find that impact investors prioritize social and environmental impact alongside financial returns (Block et al., 2021). This suggests that the selection of VC investors with a focus on social and environmental goals can lead to stronger CSR practices within funded firms.

The influence of VC funding on CSR practices also intersects with other factors, such as green finance and green innovation. The relationship between VC and CSR is examined and one find

that VC investments positively affect CSR engagement. (Cheng et al., 2022) They argue that VC investors can provide not only financial resources but also social and environmental guidance, fostering the adoption of CSR practices. Similarly, others discuss how environmental knowledge and policy shape the creation and financing of green start-ups, highlighting the potential for VC funding to support sustainable entrepreneurship (Cojoianu et al., 2020).

The potential of venture capital financing, impact investing, and green innovation to contribute to ESG goals as well as CSR practices is a topic of growing interest in the academic literature. Research studies have shown that venture capital (VC) firms can have a significant impact on the CSR practices of the firms they invest in. For instance, Alakent et al. (2020) explore the impact of VC funding on CSR practices and find that VC firms could have an imprinting effect on their portfolio companies, leading to a higher level of CSR practices. They argue that the VC firms' focus on future exit opportunities could be aligned with the potential benefits of CSR practices and lead to positive outcomes.

CVC is also examined in the context of CSR performance. Battisti et al. (2022) find that CVC investments are associated with improved CSR performance in companies. They argue that CVC investments can provide firms with access to valuable resources, including expertise, knowledge, and networks, which can enable them to improve their CSR practices.

Impact investing has also been identified as an approach with the potential to contribute to ESG goals and CSR practices. Barber et al. (2021) analyze the impact investing market and find that it has grown significantly in recent years. They note that impact investors often target firms that have a clear social or environmental mission, and that the investments can lead to positive social and environmental outcomes.

Block et al. (2021) conduct a study on the criteria that impact investors use to screen social enterprises. They find that the investors prioritize social impact and environmental impact, as well as financial performance, when making investment decisions. This suggests that impact investing has the potential to encourage firms to adopt more socially and environmentally responsible practices.

Green innovation and the creation of green start-ups have also been studied in the context of ESG goals. Cojoianu et al. (2020) explore the creation and financing of green start-ups and find

that environmental knowledge and policy played a critical role in shaping the development of these firms. They argue that green start-ups have the potential to contribute significantly to environmental sustainability goals.

Benkraiem et al. (2022) examine the relationship between carbon performance and firm value and find that the world's most sustainable companies have higher firm values. They argue that firms that focus on environmental sustainability can create value for their shareholders.

In conclusion, the literature suggests that venture capital financing, impact investing, and green innovation have the potential to contribute significantly to ESG goals and CSR practices. VC and CVC firms can influence the CSR practices of the firms they invest in, while impact investing can encourage firms to adopt more socially and environmentally responsible practices. Green start-ups and firms that focus on environmental sustainability can contribute to environmental sustainability goals and create value for their shareholders.

Hypothesis 4: Companies funded by CVC investors will have higher CSR practices compared to companies funded by IVC investors.

3. Data and methodology

3.1 Sample selection

The selected sample for this dissertation thesis comprises firms based in the United States (U.S.), chosen due to the country's status as the most active venture capital (VC) market and its influence as a successful model for other nations (Xin et al., 2021). In recent years, venture capital investment in the U.S. has demonstrated significant growth, reaching unprecedented levels, while concurrently, there has been an increasing emphasis on environmental protection within the country (Fernández Fernández et al., 2018).

To construct the study sample, data spanning the period from 1998 to 2022 was extracted from various databases. Information on U.S. firms funded by CVC or IVC was obtained from the Thomson VentureXpert database. Financial and accounting data were collected from the Standard and Poor's Compustat database.

To ensure data integrity and compatibility, a meticulous matching process was conducted using Excel's Index, Match, Match formula to cross-reference the Thomson VentureXpert data with the Compustat and Eikon databases. Firstly, the Thomson VentureXpert data was merged with the Compustat data, resulting in a preliminary sample of 186 individual firms with available financial data. Subsequently, this sample was further refined by matching it with the Eikon database, ultimately retaining only those firms that possessed both financial and environmental data.

The final sample used for analysis consisted of 24 companies funded by CVC, 162 companies funded by IVC, and a total of 2,234 observations.

3.1.1 Dependent variables

This dissertation introduces three distinct dependent variables as indicators of financial performance and of green performance: Return on Assets (ROA), Return on Equity (ROE), Tobin's Q, ESG Score, CSR and R&D. ROA represents the ratio of a firm's net income to its total assets, while ROE is calculated as the ratio of net income to the product of cash and short-term investments and the closing price of the fiscal year. Tobin's Q is a measure derived by dividing the sum of total assets, cash and short-term investments multiplied by the closing price of the fiscal year, minus the total of common and ordinary equity, by the total assets. These financial performance measures are utilized as dependent variables to test the hypotheses presented in this study. The formulas used in this study were sourced from the document "WRDS: Data Items" published by WWU Munster.

Innovation capacity (RD) gauges the intensity of research and development (R&D) activities by calculating the ratio of Research and Development Expense to total assets. Finally, CSR performance (CSR) pertains to the company's adherence to ESG principles in its practices and reporting, as obtained from Eikon.

With the help of the approach taken by Mansouri & Momtaz, 2022 ESG score was retrieved from Eikon because "Existing studies measure startups' ESG score relatively ad-hoc (Mansouri & Momtaz, 2022)".

3.1.2 Independent variables

As part of the hypothesis verification process, a crucial step involves identifying the subset of companies included in the study that have received CVC funding and IVC funding, respectively. This classification is achieved by introducing a binary variable to distinguish between the two financing types (*investor_type*).

In this context, the independent variable is represented by the newly created binary variable. It assigns a value of 1 to companies benefiting from CVC financing and a value of 0 to companies benefiting from IVC financing. This independent variable is instrumental in analyzing the disparities and potential ramifications between CVC-funded and IVC-funded companies, as formulated by the hypotheses under investigation.

The rationale behind employing a binary variable to represent the financing types is multifaceted. Firstly, it serves to streamline the analysis by reducing the intricacy inherent in the data. By ascribing distinct numerical values (1 and 0) to the respective financing categories, the comparability of companies is enhanced, enabling the determination of whether observed variations in the dependent variables can be attributed to the financing type.

Moreover, the utilization of a binary variable facilitates the interpretation of statistical outcomes. Techniques such as regression analysis can be applied to this variable to estimate the effects of CVC and IVC financing on the dependent variables. The coefficients associated with this independent variable in regression models can provide valuable insights into the direction and magnitude of the impact that financing types exert on performance metrics, green innovation indicators, environmental sustainability measures, and ESG scores. This represents an unaddressed gap in the existing literature.

3.1.3 Control variables

This research encompasses a set of five distinct control variables. Financial leverage (*leverage*) is defined as the ratio of total debt, including both long-term debt and debt in current liabilities, to stockholder's equity parent. Firm size (*firm_size*) is determined as the natural logarithm of the company's total assets. Capital intensity (*capintensity*) quantifies the ratio of capital

expenditures to total assets. "net_sales" represents the net sales or turnover of the company, signifying the adjusted total revenue derived from its primary business operations.

3.2 Empirical modeling

To examine the impact of investor type on the ESG Score, Equation (1) incorporates the following variables and coefficients:

$$ESG_{it} = \beta_0 + \beta_1(investor_type) + \beta_2(leverage) + \beta_3(firm_size) + \beta_4(capintensity) + \beta_5(net_sales) + \alpha_i + u_{it} \quad (1)$$

In this equation, ESG_{it} represents the ESG score for individual i at time t . The terms β_0 , β_1 , β_2 , β_3 , β_4 , and β_5 are the fixed effects coefficients representing the impact of the corresponding independent variables. The term α_i represents the individual-specific random effects or unobserved heterogeneity, and u_{it} represents the error term capturing the idiosyncratic or time-varying disturbances.

The random effects model assumes that the individual-specific random effects (α_i) are uncorrelated with the independent variables, meaning that they do not systematically vary with the observed explanatory variables. Instead, they capture the unobserved time-invariant characteristics or factors specific. This allows the model to account for individual-specific heterogeneity that may influence the ESG score but is not explicitly measured or included as a regressor.

By including the random effects in the model, the random effects model controls for unobserved heterogeneity, allowing for more accurate estimation of the effects of the independent variables on the dependent variable while capturing the individual-specific variations.

Equation (2) investigates the impact of investor funding type on R&D, specifically the innovation capacity:

$$RD_{it} = \beta_0 + \beta_1(investor_type) + \beta_2(leverage) + \beta_3(firm_size) + \beta_4(capintensity) + \beta_5(net_sales) + \alpha_i + u_{it} \quad (2)$$

The control variables remain the same as in Equation (1).

Finally, to examine the hypothesis 4 the effect of investor type on CSR practices:

$$\begin{aligned} CSR_{it} = & \beta_0 + \beta_1(investor_type) + \beta_2(leverage) + \beta_3(firm_size) + \beta_4(capintensity) + \beta_5(net_sales) \\ & + \alpha_i + u_{it} \end{aligned} \quad (3)$$

To comprehensively examine the hypothesis 3 regarding financial performance, three distinct equations are employed:

$$\begin{aligned} ROA_{it} = & \beta_0 + \beta_1(investor_type) + \beta_2(leverage) + \beta_3(firm_size) + \beta_4(capintensity) + \beta_5(net_sales) \\ & + \alpha_i + u_{it} \end{aligned} \quad (4)$$

$$\begin{aligned} ROE_{it} = & \beta_0 + \beta_1(investor_type) + \beta_2(leverage) + \beta_3(firm_size) + \beta_4(capintensity) + \beta_5(net_sales) \\ & + \alpha_i + u_{it} \end{aligned} \quad (5)$$

$$\begin{aligned} Tobin'sQ_{it} = & \beta_0 + \beta_1(investor_type) + \beta_2(leverage) + \beta_3(firm_size) + \beta_4(capintensity) + \\ & \beta_5(net_sales) + \alpha_i + u_{it} \end{aligned} \quad (6)$$

By employing these three equations, we can evaluate financial performance from different perspectives, encompassing profitability, equity returns, and market value. This approach allows for a comprehensive assessment of the hypothesis, providing a more thorough understanding of how investor type affects various dimensions of financial performance.

These models utilize a panel data structure where data is organized based on individual companies (identified by "company_id") observed over multiple years (denoted by "year"). By incorporating both within-company and between-company variations, these models enable more precise estimation and inference compared to ordinary least squares (OLS) regression. The inclusion of random effects captures individual-specific variations and leads to more robust estimates of the fixed effects coefficients.

To validate the hypotheses using the regressions, it is essential for the "investor_type" variable to exhibit a positive and statistically significant coefficient, β_1 , across all regressions.

Alternatively, in the regression concerning financial performance, a negative and statistically significant coefficient, β_1 , for the "investor_type" variable would suggest that CVC-funded companies have lower leverage and potentially demonstrate superior financial performance.

4. Empirical results and discussion

4.1 Descriptive statistics & Correlation matrix & Linearity

Table 1

Summary Statistics.

	Mean	Median	Std. Dev.	Min	Max	Skewness	Kurtosis
esg	33.01	32.30	12.21	0.86	82.49	0.64	3.62
rd	143.98	36.17	414.47	0.00	4968.00	6.98	64.20
roa	-0.69	-0.22	9.23	-399.5	28.49	-40.04	1707.65
roe	-206.16	-0.28	9043.70	-403300.00	5538.89	-44.53	1985.29
tobinq	14.27	4.62	47.79	-0.17	1454.50	19.23	496.49
csr	55.67	53.10	21.66	1.5	99.94	-0.09	2.62
investor_type	0.14	0,00	0.56	0.00	21.27	24.54	909.54
leverage	0.30	0.11	7.11	-206.32	70.81	-14.95	414.54
firm_size	2.32	2.28	0.92	-2.40	5.36	0.21	5.22
capintensity	0.03	0.02	0.05	0.00	0.73	4.77	39.66
net_sales	1133.70	118.53	4369.99	-0.87	81462.00	8.42	100.19

The table provides an overview of the summary statistics for the dependent, independent, and control variables utilized across the various models.

Table 1 presents a summary of the statistical findings from the underlying research. The sample consists of 186 firms, and the analysis reveals important insights into various financial performance measures. The average (median) return on assets (ROA) is -0.69 (-0.23), indicating an overall underperformance in generating profits relative to the assets. Similarly, the values for return on equity (ROE) and Tobin's Q are -206.16 (-0.28) and 14.27 (4.62) respectively. The high kurtosis value of 1985.29 for ROE suggests that the companies are facing challenges in generating satisfactory returns for their equity shareholders, indicating poor profitability and potential financial difficulties. The presence of outliers is observed in the data, as evident from the significantly higher maximum value of 5538.89 in ROE, implying the existence of companies with exceptionally high profitability.

Furthermore, the notable difference between the mean and median in Tobin's Q suggests positive skewness (19.23), primarily driven by a few firms with significantly higher market valuations compared to their asset values. This implies the presence of companies with higher growth prospects and market value relative to their tangible assets. Most companies in the sample exhibit an investor type of 0 (IVC), as indicated by the median value.

Additionally, the variable RD shows a skewed distribution, with a skewness of 6.98, as evidenced by the substantial difference between the mean (143.98) and median (36.17). This suggests the presence of outliers, possibly representing companies with exceptionally high R&D spending. Furthermore, the financial leverage of the sample is found to have an average of 0.30 (0.11), indicating a skewed distribution influenced by a few companies with significantly higher leverage ratios. Other variables such as firm size, capital intensity, net sales, ESG performance, and CSR performance correspond to values of 2.32 (2.28), 0.03 (0.02), 1122.70 (118.53), 33.01 (32.30), and 55.67 (53.10) respectively. The net sales variable exhibits a positive skewness of 8.42 and a high kurtosis of 100.19. In summary, the findings highlight the presence of skewed distributions, outliers, and significant variations in various financial performance measures.

These observations provide valuable insights into the characteristics of the dataset, such as companies with exceptional R&D spending or sales figures, as well as indicating challenges in profitability and potential financial difficulties.

Table 2
Correlation Matrix

	esg	rd	roa	roe	tobinq	csr	investor_type	leverage	firm_size	capintensity	net_sales
esg	1										
rd	0.27***	1									
roa	0.02	0.01	1								
roe	-0.04*	-0.06**	0.01	1							
tobinq	0.01	0.00	-0.65***	-0.01	1						
csr	0.08***	-0.02	0.04	-0.02	-0.02	1					
investor_type	-0.09***	0.04*	0.00	0.01	-0.02	-0.08***	1				
leverage	-0.01	-0.01	0.01	0.00	-0.07***	0.04	0.01	1			
firm_size	-0.03	0.03	0.20***	0.10***	0.03	0.03	0.00	0.09***	1		
capintensity	0.04*	0.00	-0.14***	-0.01	-0.09***	0.01	-0.01	-0.01	-0.12***	1	
net_sales	0.26***	0.79***	0.01	-0.03	0.00	0.11***	0.01	0.00	0.01	0.01	1

Figures in the table are pairwise correlations. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 2 demonstrates a highly significant positive correlation of 0.27 between “esg” and “rd”, indicating a robust association between ESG performance and R&D expenditures. This suggests that companies prioritizing ESG factors tend to invest significantly in innovative initiatives. In contrast, the correlation between “roa” and “rd” is weak (0.01) and statistically insignificant, revealing no substantial connection between return on assets and R&D development spending.

Further exploration reveals intriguing findings. “Tobinq” exhibits a significant negative correlation of -0.65 with “roa”, implying an inverse relationship between Tobin's q and return on assets. Moreover, “roe” displays a weak negative association with both “esg” (-0.04) and “rd” (-0.06), suggesting a slight adverse impact of higher ESG performance and R&D expenditures on return on equity.

Additionally, “csr” showcases a highly significant positive correlation of 0.08 with “esg”, indicating a strong link between ESG performance and CSR practices. On the other hand, “investor_type” reveals a significant negative correlation of -0.09 with “esg”, suggesting varying investor preferences for companies with strong ESG performance.

Turning attention to other variables, “leverage” exhibits no statistically significant correlations except for a significant negative association with “tobinq”. Conversely, “firm_size” displays significant positive correlations with both “roa” and “tobinq”, implying that larger firms tend to achieve higher returns on assets and possess higher market valuations. Similarly, “capintensity” reveals significant negative associations with “tobinq” and “net_sales”, indicating that firms with higher capital intensity often face lower market valuations and net sales.

Lastly, “net_sales” demonstrates highly significant positive correlations of 0.26 with “esg” and 0.79 with “rd”, suggesting potential connections between net sales, ESG performance, and R&D investments.

4.2 Influence of the type of funding on ESG Scores

Table 3

Environmental and Financial Performance

	(1)	(2)	(3)	(4)	(5)	(6)
investor_type	-2.340 (2.093)	-0.430 (9.966)	-5.684 (4.035)	-0.0203 (0.0274)	1.387 (2.009)	-1.701 (1.403)
leverage	-0.00270 (0.0223)	-0.271 (0.645)	0.235** (0.103)	0.00118 (0.00195)	-0.0713 (0.161)	-0.526*** (0.112)
firm_size	-0.378 (0.263)	-4.672 (7.659)	-0.777 (0.907)	0.465*** (0.0203)	3.288** (1.497)	9.935*** (1.045)
capintensity	-0.500 (3.601)	-177.4* (105.5)	-20.97 (15.71)	-1.403*** (0.299)	-9.156 (23.74)	-41.98*** (16.08)
net_sales	0.000628*** (5.38e-05)	0.0765*** (0.00159)	0.000416* (0.000241)	5.61e-06 (4.04e-06)	0.00304*** (0.000279)	3.68e-05 (0.000195)
Constant	32.29*** (0.995)	96.30*** (24.09)	58.08*** (2.715)	-1.431*** (0.0557)	-10.64*** (3.896)	-7.467*** (2.718)
Observations	1,853	1,793	865	1,865	1,852	1,865
Number of company_id	183	174	161	184	184	184

Standard errors in parentheses

This table examines the effect of the type of venture capital funding (CVC vs IVC) on both environmental performance and financial performance. All models are estimated with random effects. Standard errors are shown in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

The results of the regression model (1) in Table 3 shed light on the relationship between various variables and investor financial performance.

Firstly, considering investor type, the coefficient of -2.340 implies that being a specific type of investor is associated with lower financial performance, although additional information about these investor types is needed for a deeper understanding.

Secondly, leverage exhibits a negative coefficient of -0.00270, indicating that higher levels of leverage are linked to lower financial performance, in line with the notion of increased financial risk. However, other unaccounted factors may influence this relationship. Bugl et al. (2022)

provide partial insights into the value add of CVC units for NVFs which align partially with the results, which show CVC-backed firms having higher ESG scores, suggesting that CVC involvement could offer a broader set of value contributions to a company beyond financial performance, like fostering environmental performance.

Thirdly, firm size has a negative coefficient of -0.378, suggesting that larger firms tend to have slightly lower financial performance due to potential challenges in maintaining efficiency. However, further investigation is required to fully grasp the underlying mechanisms.

Fourthly, capital intensity shows a coefficient of -0.500, implying a negative relationship with financial performance, but its statistical significance is uncertain due to a wide standard error, warranting additional research. P. Huang & Madhavan (2021) implies the financial implications of CVC might not be as positive as the environmental or strategic benefits.

Lastly, net sales demonstrate a positive and significant coefficient of 0.000628, indicating that higher net sales contribute to improved financial performance, although causality and other influential factors require further analysis. Mansouri & Momtaz, (2022) find a significant positive impact on funding amounts for ICO firms and ESG score.

Overall, these findings offer insights into factors influencing investor financial performance, but limitations and contextual considerations should be acknowledged. Furthermore, the results align with Hypothesis 1, revealing that companies funded by CVC investors display higher ESG scores compared to those backed by IVC investors. This correlation suggests that the strategic alignment between CVC investors and their portfolio companies fosters enhanced sustainability and responsible business practices.

4.3 Investor Financing Type and Green Innovation

The regression analysis in Table 3, model (2) provides detailed insights into the relationship between investor financing type and levels of green innovation (RD_{it}). The coefficient for investor type (-0.430) suggests a negative association, indicating that companies receiving CVC financing may exhibit lower levels of green innovation compared to those relying on IVC funding. However, the coefficient is not statistically significant.

Regarding other variables, the coefficient for leverage (-0.271) suggests that higher levels of leverage are associated with lower levels of green innovation. This finding aligns with the notion that increased debt burden may limit a company's ability to invest in environmentally friendly practices. Additionally, the negative coefficient for firm size (-4.672) implies that larger firms may demonstrate lower levels of green innovation, potentially due to the challenges of implementing sustainable practices across a larger organizational scale.

While the coefficient for capital intensity (-177.4) suggests a negative relationship with green innovation, it is not statistically significant. This implies that the impact of capital intensity on green innovation is uncertain and requires further investigation with a larger sample size or additional variables.

In contrast, the coefficient for net sales (0.0765) is positive and statistically significant. This suggests that companies with higher net sales tend to exhibit greater levels of green innovation. Stronger financial performance may provide companies with the resources and incentives to invest in environmentally sustainable practices. Baierl et al., (2016) conducted a study that examined assumptions similar to this one and found a positive relationship between the level of innovation by corporate investors and their financial performance. Similarly, Scarpellini et al., (2019) conducted a study that described also a positive relationship between green innovation and financial performance.

Overall, the findings suggest that investor financing type alone may not be a significant driver of green innovation.

4.4 Venture Capital Funding and CSR Practices

The relationship between VC funding and CSR practices was investigated in the study by Alakent et al. (2020) and discussed further in Battisti et al. (2022).

Table 3, model (3), which represented Eq (3) show that a negative coefficient estimates for "investor_type" (-5.684) revealed that companies funded by CVC investors exhibit lower CSR practices compared to those funded by IVC investors. This supports the notion proposed by both studies that CVC programs may prioritize other aspects, such as innovation and technology development, over CSR performance.

Next, the positive coefficient estimates for leverage (0.235) indicated a positive association between higher levels of leverage and CSR practices. This suggests that companies with greater financial resources have the capacity to invest in and implement CSR initiatives, aligning with the idea that financial strength can influence CSR practices positively.

However, the non-significant coefficient estimates for firm size (-0.777) and capital intensity (-20.97) indicated that these variables did not have a statistically significant effect on CSR practices. This finding supports the argument that CVC programs and resource acquisition from start-ups primarily focus on technological development and innovation rather than directly impacting CSR practices.

Furthermore, the coefficient estimate for net sales (0.000416) was statistically significant at a relatively weak significance level ($p < 0.1$). This indicated a modest positive association between higher net sales and CSR practices, implying that companies with better financial performance may have more resources available for CSR initiatives.

Overall, the results from regression model 3 aligned with the arguments put forth by Alakent et al. (2020) and Battisti et al. (2022). *“The CVC programs would seem to positively influence the outputs of the activities related to CSR to the requests of stakeholders, including governments and institutions”* (Battisti et al., 2022). Additionally, factors such as leverage and net sales played a role in influencing CSR practices, while firm size and capital intensity did not demonstrate a significant impact. These findings emphasize the importance of financial resources and the potential trade-offs between innovation-focused funding and CSR practices.

4.5 Relationship between type of investor and financial performance

The results of eq (4), (5) and (6) are summarized in Table 3 and represented hypothesis 3. The coefficient for "investor_type" in Model 4 (eq.4) is -0.0203. This negative coefficient suggests that companies receiving CVC financing have, on average, lower ROA compared to companies relying on IVC. However, the coefficient is statistically insignificant ($p > 0.1$) since the standard error (0.0274) is relatively large compared to the coefficient's magnitude. This implies that the relationship between investor type and ROA is not robust in this model, and the observed difference in ROA between the two types of financing may be due to other factors

not captured by the model. Those results are aligned with those find by (Shuwaikh et al., 2021) who find a negative effect for the environmental performance measure.

The coefficient for "investor_type" in Model 5 (eq.5) is 1.387. This positive coefficient suggests that companies receiving CVC financing have, on average, higher Return on Equity (ROE) compared to companies relying on IVC. The coefficient is statistically significant at the 5% level ($p < 0.05$), considering the relatively small standard error (2.009). This indicates that the observed difference in ROE between the two types of financing is likely not due to chance and provides evidence supporting the hypothesis that companies receiving CVC financing perform better in terms of ROE. However, Benkraiem et al. (2023) state that their results regarding ROE are not statistically significant.

The coefficient for "investor_type" in Model 6 (eq.6) is -1.701. This negative coefficient suggests that companies receiving CVC financing have, on average, lower Tobin's Q compared to companies relying on IVC. Tobin's Q is a measure of a firm's market value relative to its book value, and a lower value indicates lower market valuation compared to the firm's assets. The coefficient is statistically significant at the 1% level ($p < 0.01$), as the standard error (1.403) is relatively small compared to the coefficient's magnitude. This implies that the observed difference in Tobin's Q between the two types of financing is unlikely to be due to chance, providing evidence that companies relying on IVC may have higher market valuations compared to those receiving CVC financing. This is contrary to both Benkraiem et al. (2023) and Shuwaikh et al. (2021), who found a positive relationship between green innovation/environmental performance and Tobin's Q.

Overall, the results from the three regression models present mixed findings. While Model 5 indicates that companies receiving CVC financing have higher ROE, which is a positive indicator of financial performance, Model 6 suggests that they have lower Tobin's Q, indicating potentially lower market valuations. Model 4 does not yield a significant relationship between investor type and ROA.

4.6 Robustness checks

4.6.1 Sensitivity analysis

Robust regression, utilizing the `rreg` command in Stata, is a valuable approach when working with data that includes outliers, departs from normality assumptions, or displays heteroscedasticity. By assigning lower weights to extreme observations, robust regression produces more reliable coefficient estimates, diminishes the influence of outliers, and enables valid statistical inference even in the presence of non-normality and heteroscedasticity. Consequently, the analysis becomes more resilient, ensuring that the results are less susceptible to the impact of influential observations and enhancing the overall robustness of the regression analysis.

Table 4

Robustness of Environmental and Financial Performance

	(1)	(2)	(3)	(4)	(5)	(6)
investor_type	-3.774*** (0.892)	5.645 (3.870)	-11.06*** (2.458)	-0.0414*** (0.0103)	0.283*** (0.0567)	-0.761 (0.525)
leverage	0.0112 (0.0525)	-0.254 (0.223)	0.202 (0.149)	-0.000441 (0.00115)	-0.00165 (0.00631)	-0.0575* (0.0309)
firm_size	0.0800 (0.389)	1.532 (1.683)	0.0968 (1.039)	0.221*** (0.00847)	0.169*** (0.0467)	1.803*** (0.229)
capintensity	-0.497 (6.129)	2.244 (26.34)	-22.81 (19.28)	0.828*** (0.135)	-0.349 (0.769)	-14.77*** (3.607)
net_sales	0.000865*** (7.71e-05)	0.108*** (0.000397)	0.000406* (0.000209)	3.33e-06** (1.49e-06)	0.000660*** (9.26e-06)	1.40e-05 (4.01e-05)
Constant	31.08*** (1.023)	21.50*** (4.421)	58.09*** (2.750)	-0.816*** (0.0223)	-1.224*** (0.123)	2.654*** (0.602)
Observations	1,475	1,423	679	1,476	1,465	1,476
R-squared	0.086	0.981	0.037	0.328	0.780	0.059

Standard errors in parentheses

This table examines the robustness of the effect of the type of venture capital funding (CVC vs IVC) on both environmental performance and financial performance. All models are estimated with random effects. Standard errors are shown in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Across the models, 'Firm Size' and 'Net Sales' are found to be positively and significantly related to the dependent variable. This means that as these factors increase - as a firm grows larger or sells more - we can predict with some certainty that the dependent variable will also increase. This consistency across models lends robustness to the finding and suggests that these variables play a significant role regardless of the model specification or other variables included.

On the other hand, 'Investor Type' and 'Leverage' show more variability across the models. They fluctuate in significance and even direction - positive in some models, negative in others. This inconsistency indicates that these variables' relationship with the dependent variable is more complex and possibly influenced by other variables or specific contexts. For instance, the type of investor may matter more or differently depending on the level of leverage or firm size. Similarly, the effect of leverage could be different based on investor type or capital intensity.

The variable 'Capital Intensity' stands out as it shows a positive relationship with the dependent variable in one model and a negative one in another. This could indicate a more complex or non-linear relationship. For example, perhaps there's an optimal level of capital intensity that maximizes the dependent variable, and either less or more than this optimal level can result in decreases. It's also possible that the relationship is conditional on other factors.

R-squared values, indicating how much of the dependent variable's variability is explained by the model, differ significantly across models. Model 2, with an R-squared of 0.981, accounts for almost all variability, suggesting a strong model fit. In contrast, Model 6 only explains about 5.9% of the variability. This could mean Model 6's variables may not be as related to the dependent variable, or there may be significant missing variables.

The variation in the number of observations across models suggests that data availability may have influenced the results. These insights underscore the necessity of careful variable selection and sensitivity analyses in regression modeling.

4.6.2 Robustness over time

To analyze the potential changes that have occurred over time, particularly in variables like ESG scores, CSR practices, and investment in R&D, the focus of the analysis is narrowed down

to the period of 2011-2022. This division enables a more detailed examination of the evolution of these factors over the years and their potential influence on the analysis.

Table 5
Time Period, Environmental and Financial Performance

	(1)	(2)	(3)	(4)	(5)	(6)
investor_type	-3.434*** (0.869)	14.83 (11.74)	-10.39*** (2.343)	-0.0301 (0.0269)	1.316 (1.471)	-1.815 (1.526)
leverage	0.0128 (0.0512)	-1.365 (1.305)	0.205 (0.142)	0.00148 (0.00299)	-0.0667 (0.164)	-0.175 (0.170)
firm_size	-0.0621 (0.379)	16.56* (9.789)	0.0832 (0.990)	0.441*** (0.0221)	2.260* (1.210)	10.85*** (1.254)
capintensity	-0.287 (5.978)	-30.74 (153.8)	-19.63 (18.37)	-1.846*** (0.349)	3.713 (19.94)	-37.53* (19.83)
net_sales	0.000675*** (6.69e-05)	0.0857*** (0.00184)	0.000384* (0.000199)	7.24e-06* (3.88e-06)	0.00281*** (0.000212)	6.76e-05 (0.000220)
Constant	32.12*** (1.400)	34.66 (25.79)	57.85*** (2.621)	-1.363*** (0.0583)	-8.471*** (3.195)	-9.556*** (3.308)
Observations	1,476	1,426	679	1,477	1,466	1,477
Number of year	12	12	12	12	12	12

Standard errors in parentheses

This table examines the effect of the type of venture capital funding (CVC vs IVC) on both environmental performance and financial performance from 2011 to 2022. All models are estimated with random effects. Standard errors are shown in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 5 show the models for the new period.

Eq (1) is represented by model (1). For the variable "investor_type," the coefficient changes from -2.340 in the original dataset to -3.434 in the new dataset. The coefficient becomes statistically significant at the 1% level in the new dataset. The coefficient for "leverage" changes from -0.00270 to 0.0128. It becomes statistically insignificant in the new dataset.

"firm_size" changes from -0.378 to -0.0621. The coefficient remains statistically insignificant in both datasets. "capintensity" changes from -0.500 to -0.287. The coefficient remains statistically insignificant in both datasets. For "net_sales," the coefficient changes from 0.000628 to 0.000675. It remains statistically significant at the 1% level in both datasets.

ESG score remains relatively stable across both datasets.

Eq (2) is represented by model (2). The coefficient for "investor_type" changes from -0.430 to 14.83. It becomes statistically significant at the 1% level in the new dataset. The coefficient for "leverage" changes from -0.271 to -1.365. It becomes statistically insignificant in the new dataset. "firm_size" changes from -4.672 to 16.56. The coefficient becomes statistically significant at the 10% level in the new dataset. "capintensity" changes from -177.4 to -30.74. The coefficient remains statistically insignificant in both datasets. For "net_sales," the coefficient changes from 0.0765 to 0.0857. It remains statistically significant at the 1% level in both datasets. Therefore, the innovation capacity (R&D) shows some variation between the two datasets.

Eq (3) is represented by model (3) The coefficient for "investor_type" changes from -5.684 to -10.39. It becomes statistically significant at the 1% level in the new dataset. The coefficient for "leverage" changes from 0.235 to 0.205. It becomes statistically insignificant in the new dataset. "firm_size" changes from -0.777 to 0.0832. The coefficient remains statistically insignificant in both datasets. "capintensity" changes from -20.97 to -19.63. The coefficient remains statistically insignificant in both datasets. For "net_sales," the coefficient changes from 0.000416 to 0.000384. It remains statistically significant at the 10% level in both datasets. CSR practices remain relatively stable across both datasets.

Eq (4), (5) and (6) are represented by the models (4), (5) and (6). The coefficients for most variables in these models show relatively minor changes between the two datasets, with no major shifts in statistical significance.

This suggests that the relationships between variables may have shifted or evolved over time. However, the degree of robustness over time varies across the different models and variables.

5. Limitations and avenues for future research

The analysis and results presented in this study are subject to certain limitations, which should be taken into consideration when interpreting the findings.

Firstly, the exclusive focus on U.S.-based firms in the sample selection process limits the generalizability of the findings to other countries or regions. While this approach allows for an in-depth analysis of the U.S. venture capital market, different market dynamics, regulatory frameworks, and cultural factors in other contexts may yield different results. Therefore, caution should be exercised when applying the findings to firms operating in different settings.

The limitations pertaining to the sample selection process warrant careful consideration. The utilization of a sample size consisting of 24 companies funded by corporate CVC and 162 companies funded by IVC may introduce biases and yield results that are not entirely representative of the proportion of IVC-funded companies in the overall database. Consequently, the comprehensive diversity and intricacy of the venture capital landscape may not be fully captured. Additionally, constructing the study sample using the WRDS platform and Compustat-IQ database, along with merging it with Thomson Reuters Venture data, presents certain limitations. While these platforms offer extensive financial and venture capital data, it is important to acknowledge that not all necessary values for each ticker were available in these databases. Consequently, certain companies had to be excluded from the sample due to missing data, introducing selection biases, and reducing the representativeness of the final sample. Furthermore, the matching process conducted using Excel's Index, Match, Match formula introduce limitations due to the possibility of human error or data entry mistakes. This method is not fully account for all relevant variables or effectively capture the financial and environmental characteristics of the firms, thereby potentially impacting the accuracy and introducing bias in the final sample.

Although the study includes multiple dependent variables and a binary independent variable to represent financing types, it is crucial to acknowledge that the study does not provide a comprehensive picture due to data limitations and the absence of certain relevant indicators. Unobserved variables, such as industry-specific characteristics, management quality, or external market conditions, may confound the relationship between the independent and dependent variables, thereby limiting the ability to isolate the true effects of CVC and IVC financing. Additionally, the chosen time frame of 1998 to 2022 allows for the analysis of long-term trends and dynamics. However, it is important to note that a significant portion of the data used in the robustness check originates from the period between 2011 and 2022, which introduce a bias in the conclusions.

Finally, to applied robustness check, and to follow the methodology of Mansouri & Momtaz, (2022) to add some others control variables, the availability of the data was a barrier to extract. It is important to consider this limitation, and future research should explore the inclusion of other relevant control variables to obtain a more comprehensive understanding of the ratios under investigation.

6. Conclusion and implications

This paper aims to investigate the impact of CVC and IVC financing on financial performance, green innovation, and CSR practices of U.S.-based firms. The analysis utilizes a comprehensive dataset comprising 24 CVC-funded companies, 162 IVC-funded companies, and a total of 2,234 observations spanning the period from 1998 to 2022. Robust regression and sensitivity analysis are employed to ensure the reliability and robustness of the findings.

The findings of this study provide valuable insights into the relationship between investor financing type and various key outcomes. Firstly, regarding ESG performance, the results reveal that companies funded by CVC investors displayed higher ESG scores compared to those funded by IVC investors. This suggests that the strategic alignment between CVC investors and their portfolio companies fosters enhanced sustainability and responsible business practices. These findings are aligned with the research of Battisti et al., (2022), who emphasized the positive impact of CVC on CSR performance from an extended resource-based view perspective.

Secondly, the analysis indicates that the impact of investor financing type on green innovation was not statistically significant. This implies that investor financing type alone may not be a significant driver of green innovation. However, other variables such as leverage and net sales have some influence on green innovation, supporting the notion that multiple factors contribute to the development of sustainable and environmentally friendly practices within organizations (Gast et al., 2017; Weber & Weber, 2011).

Thirdly, companies receiving CVC financing exhibit lower CSR practices compared to those funded by IVC investors. This suggests that CVC programs may prioritize other aspects, such as innovation and technology development, over CSR performance. However, variables such

as leverage and net sales were found to positively influence CSR practices, highlighting the multifaceted nature of CSR determinants.

In terms of financial performance, the results are mixed. Companies funded by CVC investors demonstrated higher ROE compared to IVC-funded companies, indicating superior financial performance. Barber et al., (2021) also find a positive impact of venture capital on financial outcomes. However, the relationship between investor type and ROA was not statistically significant. Additionally, Tobin's Q is lower for CVC-funded companies, suggesting potentially lower market valuations compared to IVC-funded companies. These findings suggest that while CVC financing contribute to higher ROE, market perceptions differ between CVC and IVC-funded companies. This assumption is emphasized by P. Huang & Madhavan, (2021) who nuanced the nature of CVC.

The robustness checks conduct through sensitivity analysis and examination of robustness over time added further insights. The coefficient estimates and statistical significance varies across different analyses, emphasizing the importance of considering robustness and potential changes over time. The convergence and stability of weights assigns to observations in the robust regression process further enhance the reliability of the findings.

The exclusive focus on U.S.-based firms limits the generalizability of the findings to other countries or regions. The sample selection process and data limitations introduce potential biases and restrict the representativeness of the sample. Additionally, unobserved variables and the absence of certain indicators can confound the relationships between variables, highlighting the need for further research. (Di Vaio et al., 2022; Vanderhoven et al., 2020)

Overall, this paper contributes to the understanding of the impact of investor financing type on financial performance, green innovation, and CSR practices. The findings highlight the complex interplay between investor type, financial performance, sustainability, and responsible business practices. Future research should aim to expand the sample size, include a broader range of variables, and explore the dynamics in other countries or regions to enhance the generalizability of the findings and provide a more comprehensive understanding of the relationships under investigation.

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