Sustainability and Entrepreneurial Finance: How Does Climate Risk Affect Startup Financing and Valuations?

Purpose:
This study examines the impact of climate risk exposure and sustainability disclosures on financing conditions of European startups. It seeks to understand how environmental considerations shape entrepreneurial finance in an increasingly sustainability-driven economy.

Design/methodology/approach:
The research employs fixed effects panel regressions on a European startup dataset from 2016 to 2023. Key variables analyzed include loan spreads, pre-money valuations scaled by total assets, carbon emissions per capita, climate event exposure, firm-level sustainability disclosures, and relevant firm-specific and macroeconomic controls.

Findings:
Startups in high-emission economies and climate-vulnerable regions experience significantly higher loan spreads and lower pre-money valuations. Conversely, firms engaging in transparent sustainability disclosures benefit from reduced borrowing costs and enhanced valuations, indicating lender and investor preference for proactive ESG engagement. Results highlight firm size, R&D intensity, and founder experience as additional influential factors positively associated with favorable financing outcomes.

Research limitations/implications:
The study highlights the importance of integrating climate risks and sustainability disclosures into entrepreneurial financial modeling. Future research could explore industry-specific impacts of climate risk and further investigate the effectiveness of policy interventions in mitigating observed financing disparities.

Practical implications:
Policymakers are encouraged to develop targeted incentives, standardized ESG reporting frameworks, and resilience-enhancing financial instruments to improve access to funding for startups, especially those vulnerable to climate risks. Adopting transparent ESG practices can enhance entrepreneurs' financial attractiveness and competitive advantage.

Originality/value
This research provides novel empirical evidence linking climate risk and ESG disclosures explicitly to European startup financing conditions, thereby filling a critical gap in the entrepreneurial finance literature regarding sustainability-driven capital allocation.

Keywords: Entrepreneurial Finance, Climate Risk, Startup Valuations, Sustainability Disclosures

1. Introduction

In recent decades, ecological degradation has emerged as a key focus of global financial discourse. Climate-related considerations play a central role in how financial markets operate, how capital is allocated, and how risk is assessed (López Vázquez *et al.*, 2024). Financial institutions, regulators, and policymakers are increasingly embedding environmental sensitivities into investment frameworks, credit assessments, and economic planning (Angeletopoulou *et al.*, 2025; Pop *et al.*, 2025). This shift has triggered a wave of climate-aligned regulations and disclosure requirements, most of which have targeted large corporations and listed firms. These entities have become the primary focus of sustainability mandates (Dumrose *et al.*, 2022). Yet, a critical segment of the economic landscape remains comparatively overlooked. These include startups and early-stage ventures. Despite their central role in innovation and in shaping low-carbon futures, these firms occupy a marginal position in current policy discussions and empirical literature.

The European Union has taken a leading role in promoting sustainable finance and embedding climate considerations into economic governance. From the Green Deal and the Emissions Trading System to the EU Taxonomy and the more recent Corporate Sustainability Reporting Directive, the regulatory landscape has undergone considerable evolution (Li *et al.*, 2025; Montesinos-Sansaloni *et al.*, 2025). While early initiatives focused primarily on heavy emitters and large firms with greater disclosure capacity, the latest reforms are beginning to reach smaller firms through supply chain accountability and value chain transparency. Startups are increasingly expected to define and communicate their environmental commitments. This is not merely for reputational purposes, but as a prerequisite for accessing funding and maintaining long-term viability.

Parallel to these developments, the entrepreneurial finance landscape in Europe has grown more sophisticated. Impact funds, state-backed venture programs, and ESG conscious

investors are gradually reshaping how capital is channeled toward new ventures. Nevertheless, access to finance remains uneven. Startups face well-documented constraints due to limited operating histories, scarce collateral, and uncertain cash flows (Chandra *et al.*, 2020; Tajeddin *et al.*, 2024). Their valuations are often shaped as much by market sentiment as by fundamentals. When environmental risks and evolving regulatory frameworks are factored into this mix, the hurdles can become even more pronounced. Ventures exposed to climate volatility or located in carbon-intensive jurisdictions may face implicit penalties, even if their underlying models promote sustainability.

The existing literature on climate risk and ESG disclosure has primarily focused on mature firms, with a strong emphasis on public markets (Lopez-de-Silanes *et al.*, 2024). A growing number of studies examine the impact of environmental performance on bond spreads, credit ratings, and equity pricing (Mirza *et al.*, 2024; Owolabi *et al.*, 2024). However, these insights do not fully extend to the startup context, where firm-specific volatility, sectoral differentiation, and information asymmetries play a more prominent role. Moreover, most prior research treats climate factors as macro-level shocks, without accounting for how firm-level responses, including voluntary disclosure, might moderate investor and lender behavior. As a result, the relationship between environmental risk, financial perception, and startup-specific characteristics remains underexplored (Sabbaghi, 2025; Yu *et al.*, 2024).

This study addresses that gap by analyzing how climate-related risks and sustainability disclosures shape funding conditions for startups across European countries. Using fixed-effects panel regressions over the period 2016-2023, we examine how carbon emissions per capita, exposure to climate events, and firm-level sustainability disclosures affect two key financial outcomes: loan spreads and pre-money valuations. The dual focus on debt and equity financing provides a more comprehensive understanding of how environmental factors influence various aspects of the startup financing lifecycle. Our findings show that climate risk

is already priced into the funding decisions made by investors and lenders, while sustainability disclosure serves as a mitigating factor that can enhance creditworthiness and valuation.

By evaluating early-stage firms within the broader context of climate finance, this research contributes to a more comprehensive understanding of the green transition. The evidence highlights both the vulnerabilities and the strategic advantages that climate-conscious startups face in navigating contemporary financial markets. For policymakers aiming to scale green innovation, it becomes essential to ensure that climate-related reforms do not unintentionally restrict access to capital for precisely those firms best positioned to lead technological and sustainable transformation.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature. Section 3 describes the data sources and methodological approach. Section 4 presents the empirical findings and discusses their implications. Finally, Section 5 offers some concluding remarks.

2. Literature Review

The financial consequences of climate change have drawn increasing attention, particularly within corporate finance, environmental economics, and institutional investment studies . Early work on climate finance focused on the role of regulatory risk and carbon exposure in shaping the cost of capital for large corporations, especially those in emissions-intensive sectors. Empirical studies have demonstrated that firms with higher greenhouse gas emissions tend to face higher bond spreads and credit default swap premiums, reflecting investor sensitivity to climate transition risks. Similarly, sustainability reporting has been linked to reduced capital costs and enhanced firm value, as it signals transparency and alignment with long-term regulatory trends (Fu *et al.*, 2023). However, the scope of these studies has predominantly centered on listed firms and mature enterprises, where disclosure practices are well-established and investor monitoring is relatively robust.

In contrast, the financial dynamics of early-stage ventures have received less thorough examination in the context of environmental risk and ESG practices. The startup ecosystem presents unique characteristics that complicate the direct application of insights drawn from public markets. Information asymmetry, volatile revenue patterns, and limited disclosure norms often make it challenging for investors and creditors to assess risk using conventional tools (Hoffmann, 2023; Martielli *et al.*, 2025). The entrepreneurial finance literature has highlighted the critical roles of founder credibility, innovation potential, and signaling mechanisms in determining valuation and access to credit. Yet, how environmental positioning and climate vulnerability factor into these assessments remains an open question. Few studies have explored how sustainability disclosure by startups might serve as a credible signal in the face of regulatory uncertainty or climate risk.

Recent contributions in sustainable finance have begun to address the role of ESG considerations in decision-making for venture capital and private equity. Some research suggests that investors are increasingly integrating environmental metrics into due diligence processes, particularly in sectors aligned with the green transition (Rossi *et al.*, 2025). Others argue that ESG considerations in startup funding remain largely aspirational, with limited empirical evidence of consistent pricing mechanisms in place (Garrido-Ruso *et al.*, 2024). Moreover, the literature has not yet reached consensus on whether climate risk is treated as a differentiator or a deterrent in venture financing. While cleantech and green startups may benefit from thematic investment funds, startups operating in high-emission jurisdictions or exposed to physical climate events may face higher perceived risk, regardless of their strategic orientation (Mirza *et al.*, 2023).

The treatment of climate risk itself has also evolved within the academic discourse. Earlier frameworks viewed climate risk primarily as a macroeconomic or systemic concern, emphasizing sovereign exposure, industry shocks, or policy uncertainty (Chenet *et al.*, 2021;

Qin *et al.*, 2023). More recent work, however, has begun to investigate climate risk at the firm level, incorporating location-based vulnerability, transition readiness, and resilience planning (Battiston *et al.*, 2017; Le *et al.*, 2025; Xu *et al.*, 2024; Ye, 2022). This shift has broadened the scope of analysis, but its application to startup finance remains limited. Studies that incorporate spatial data, such as exposure to natural disasters or regional carbon intensity, have typically overlooked smaller firms or treated them as part of aggregated SME datasets, obscuring the distinct challenges startups face.

Within the broader entrepreneurial finance literature, the valuation of early-stage firms is often framed in terms of asymmetric information, growth expectations, and milestone-based funding. However, limited research has been conducted to assess how environmental performance or disclosure may impact investor confidence under such conditions. Similarly, while the determinants of startup borrowing costs have been analyzed in terms of firm size, profitability, and credit history, little attention has been paid to how environmental context and disclosure might influence loan spreads (Zhu *et al.*, 2023). The absence of such analyses is particularly striking given the growing number of policy frameworks aimed at directing green finance toward innovation-led firms.

In parallel, regulatory developments in the EU have transformed the institutional environment in which startups operate. The extension of climate-related reporting through instruments like the CSRD has implications not only for large firms but also for startups embedded in global value chains. As suppliers and partners of regulated entities, many startups are now indirectly subject to ESG compliance requirements (Cardoni and Kiseleva, 2025). This cascading regulatory architecture remains undertheorized in existing finance literature, especially in relation to its impact on startup access to capital. Most policy-oriented studies have focused on disclosure standards and green finance taxonomies without adequately

accounting for their differential impact on firms with limited reporting infrastructure or institutional capacity.

There is also a geographic gap in the current literature. While much of the research on sustainable finance and ESG integration is concentrated in Anglo-American markets, the European context, with its more coordinated regulatory approach and stronger institutional support for climate goals, offers unique insights. Regional heterogeneity within Europe further complicates the landscape. Startups in Northern and Western Europe often benefit from more mature venture capital ecosystems and supportive policy environments, while those in Southern and Eastern Europe may face structural disadvantages. These disparities have yet to be fully captured in comparative empirical research, especially in relation to climate risk and startup funding conditions.

3. Data and Methodology

This research examines how climate risk exposure and sustainability disclosures influence startup funding in the EU. To assess the impact of these factors on how lenders and investors price climate-related risks in the entrepreneurial finance ecosystem, we examine two key dependent variables. These include loan spread and pre-money valuation scaled by total assets. The loan spread (π_{it}) measures the cost of debt financing and reflects the risk premium lenders assign to startups based on perceived creditworthiness and external risk factors, including climate exposure. For firm *i*, with a weighted interest rate of ϑ, a domestic risk-free rate of (Rf) of similar weighted maturity, at time *t* we estimate π_{it} as follows.

$$\pi_{it} = \vartheta_{it} - Rf_t \qquad \ldots\ldots (1)$$

Loan spread is a critical measure of startup borrowing costs, reflecting the risk premium lenders assign to firms. Unlike established corporations with extensive credit histories and tangible collateral, startups often struggle to secure financing at competitive rates due to their high-risk profile and uncertain cash flows. The loan spread provides a market-based assessment

of the cost of debt financing. A higher loan spread signals increased financial constraints for startups, making debt more expensive and reducing available capital for innovation and growth. Conversely, a lower loan spread enhances financial flexibility, allowing startups to allocate funds more efficiently while reducing the risk of financial distress. The loan spread dynamics are essential to assess, as debt costs directly affect a startup's ability to scale, sustain operations, and compete in the market.

Using loan spread instead of nominal interest rates offers a more precise measure of lender risk perception by controlling for broader macroeconomic fluctuations. It is also a superior alternative to leverage ratios, which only capture capital structure choices without reflecting the actual borrowing costs startups face. While a high debt ratio may indicate increased reliance on external financing, it does not differentiate between firms that obtain favorable credit terms and those burdened by excessive borrowing costs.

In the context of climate risk and sustainability disclosures, loan spreads offer significant insights into how lenders incorporate environmental risks into their credit pricing. Startups operating in climate-exposed regions may face higher loan spreads as lenders price in potential disruptions, insurance costs, and long-term business viability concerns. However, sustainability disclosures could serve as a mitigating factor, signaling transparency and proactive risk management, thereby improving lender confidence and potentially lowering borrowing costs.

The second variable of interest is pre-money valuation (PMV_{it}), scaled by total assets (TA_{it}). Pre-money valuation refers to a startup's estimated market value prior to receiving additional external investment. It determines how much a company is worth based on its assets, revenue potential, and market position. Investors use PMV to decide equity ownership stakes, making it a key element in funding negotiations. A higher PMV allows founders to retain a greater ownership stake, while a lower PMV results in more significant dilution. PMV is

typically determined through market comparisons, discounted cash flow (DCF) analysis, revenue multiples, or direct negotiations.

PMV plays a crucial role in startup funding. It determines ownership dilution, as founders must balance their company's financing needs with maintaining control. A lower PMV means investors take a more significant equity stake in exchange for funding. It also influences investor confidence. A high PMV signals growth potential, while a low PMV suggests uncertainty. Furthermore, PMV affects future fundraising. A drop in valuation in later rounds can damage credibility and limit access to capital. Startups with higher sensitivity to climate change face business uncertainty, higher insurance costs, and regulatory challenges. Consequently, Investors may assign lower PMVs due to concerns about long-term viability. Industries like agriculture, real estate, and energy are particularly vulnerable. However, sustainability disclosures can counterbalance these risks. Transparent reporting of climate strategies and sustainability practices can enhance investor trust and improve valuation prospects.

We scale PMV by total assets to make valuation comparisons more meaningful. Startups differ in capital intensity, with some relying on tangible assets (e.g., manufacturing) and others on intellectual property (e.g., fintech). Absolute valuation figures do not account for these differences. Scaling by total assets standardizes comparisons, showing how much investors are willing to pay for each unit of assets. A higher PMV-to-assets ratio suggests strong investor confidence and intangible value creation, while a lower ratio indicates valuation is more asset-dependent.

We estimate the following fixed-effects panel regressions using loan spreads and pre-money valuations.

$$\pi_{it} = \alpha + \beta_1 CE_{it} + \beta_2 SD_{it} + \beta_3 CL_3 + \beta_X X_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad \ldots\ldots (2)$$

$$\frac{PMV_{it}}{TA_{it}} = \alpha + \beta_1 CE_{it} + \beta_2 SD_{it} + \beta_3 CL_3 + \beta_X X_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad \ldots\ldots (3)$$

Equations 2 and 3 employ three distinct climate-related variables to observe their impact on startup funding. Of these, carbon emissions per capita (CE_{it}) and climate event (CL_{it}) are country level, and sustainability disclosure (SD_{it}) is firm level. Carbon emissions shape investor and lender perceptions of climate risk. Startups in high-emission countries may face higher loan spreads and lower valuations due to regulatory risks, investor preferences, and market constraints. Stricter climate policies, such as carbon taxes and emissions penalties, increase business costs and uncertainty. Furthermore, economies reliant on fossil fuels may offer fewer market opportunities for sustainable startups, limiting valuation growth.

SD_{it} is a dummy variable that takes a value of 1 for businesses that have reported on sustainability initiatives and 0 otherwise. Sustainability disclosure acts as a risk-mitigating factor, improving funding conditions for startups. Transparent reporting on climate strategies and risk management provides reassurance to investors and lenders. Startups with sustainability disclosures may benefit from lower loan spreads due to improved creditworthiness and investor confidence. These firms are also more attractive to impact investors and ESG-focused funds, which prioritize businesses committed to sustainability and responsible governance.

CL_{it} is also a dummy variable that takes a value of 1 for startups with a macro-level climate event and 0 otherwise. Frequent and severe climate events can impact startup financing. Countries facing floods, wildfires, or storms present higher operational risks. Startups in these regions are more vulnerable to supply chain disruptions, infrastructure damage, and rising insurance costs. Lenders factor in this uncertainty by raising loan spreads to compensate for increased default risk. The investors may discount startup valuations in high-risk regions, preferring safer markets where capital deployment is more stable. The greater the exposure to climate disasters, the higher the borrowing costs and the lower the valuation prospects.

It is essential to recognize that the institutional environments for ESG enforcement and climate policy differ across European countries. For example, firms in countries such as

Sweden, France, and the Netherlands operate in more mature ESG ecosystems with established sustainability reporting norms. In contrast, those in Romania, Poland, or Hungary may face less regulatory pressure and lower ESG investor expectations. To address this heterogeneity, we control for country-level fixed effects and use clustered standard errors at the country level.

We also include multiple firm-level and macroeconomic control variables (X_{it}). These include size (log of total assets), profitability (ROA), R&D Intensity, financial leverage, founder experience, VC backing, inflation rate, and GDP growth. The fixed-effects panel regression model is employed to account for unobserved heterogeneity that may bias the relationship between climate variables and startup financing. This approach enables us to control for time-invariant firm-specific factors, such as founder quality, sectoral dynamics, or initial funding conditions, that are not directly observable but may influence both the dependent and independent variables. Country and year fixed effects further address macroeconomic shocks, national policy differences, and temporal variation in regulatory intensity. The model's structure is particularly suited for this context, given the panel nature of the dataset and the likely presence of omitted variables correlated with the regressors.

The sample selection criteria ensure a rigorous and representative analysis of European startups, focusing on firms with comprehensive financial and sustainability data. The sample comprises startups from diverse European economies, enabling an assessment of regional disparities in funding conditions, investor sentiment, and the role of sustainability in financing decisions. The study spans the period from 2016 to 2023, capturing key regulatory shifts, the expansion of ESG-driven investing, and the growing role of climate risk in credit markets and valuation models. This timeframe also reflects post-crisis financial recovery, the rise of green finance initiatives, and the regulatory tightening surrounding ESG disclosures. Startups are included in the sample only if they provide relevant financial data and sustainability disclosures for at least two years before their inclusion, ensuring that the dataset accurately captures

longitudinal effects rather than short-term fluctuations. Firms with sporadic reporting or incomplete disclosures are excluded to maintain data consistency and reliability.

The selection criteria also focus on stable and growth-oriented startups rather than micro-enterprises, as their financing needs, risk profiles, and investor expectations differ significantly. Firm-level financial and operational data are obtained from Orbis, Refinitiv Eikon, and S&P Capital IQ, ensuring comprehensive coverage of financial metrics, valuation figures, and capital structure variables. Macroeconomic variables, including GDP growth, inflation, and carbon emissions per capita, are obtained from Eurostat, the World Bank, and the OECD. To enhance internal validity and reduce selection bias, the sample is restricted to startups that provide both financial information and climate-related disclosures for at least two consecutive years prior to their inclusion. Firms with sporadic reporting patterns, incomplete financial statements, or missing ESG-related data were excluded. We also removed micro-enterprises and non-innovative small firms that are structurally different from the venture-backed or growth-oriented firms under study. This helps ensure that our analysis focuses on startups with a minimum threshold of institutional and financial maturity necessary for external financing. The resulting sample distribution is presented in Table 1.

[Table 1 here]

There are a few methodological caveats to acknowledge. To begin with, the analysis draws on self-reported sustainability disclosures, which introduces potential self-selection bias. Firms that voluntarily disclose such information may already possess characteristics, such as stronger governance or greater stakeholder engagement, that influence funding outcomes independently of the disclosure itself. This could result in an overestimation of the benefits associated with transparency. Additionally, the observational nature of the data restricts the ability to draw firm conclusions about causality. Although the use of fixed effects helps account for time-invariant unobserved heterogeneity, concerns remain around possible reverse causality

or omitted variables that vary over time. Finally, the climate risk indicators employed may not adequately reflect the actual climate exposure of individual firms. Future research might address these limitations by adopting instrumental variable strategies, incorporating more granular geographic and sectoral data, or exploiting quasi-experimental settings to strengthen causal inference.

4. Results and Discussion

The weighted mean of key financial and environmental indicators across European startups, as presented in Table 2, reveals notable disparities in funding conditions, valuation dynamics, and risk factors. Loan spreads significantly vary across countries, signaling differences in lender risk perception and financial market efficiency. The overall loan spread for the sample is 4.63%. In contrast, countries such as Greece (6.08%), Romania (5.81%), and Cyprus (5.53%) experience markedly higher spreads, indicating heightened credit risk, weaker lender confidence, and less developed startup financing ecosystems. Conversely, Denmark (3.20%), Belgium (3.23%), and the Netherlands (3.26%) benefit from lower borrowing costs, likely due to more robust financial markets, favorable regulatory environments, and stronger institutional frameworks that mitigate lending risk. The variation in loan spreads suggests that Southern and Eastern European startups operate under tighter financial constraints, which could limit their ability to scale and innovate. In contrast, those in Western and Nordic economies enjoy more competitive borrowing terms, facilitating greater financial flexibility and investment potential.

The differences in pre-money valuation to total assets (PMV/TA) indicate the disparities in investor confidence and market potential across Europe. The sample average of 1.61 times suggests that European startups are generally valued above their tangible asset base, reflecting growth expectations and the premium investors assign to future earnings potential. However, there is substantial variation between countries. Ireland (2.39), Sweden (2.25),

Finland (2.06), and Denmark (2.14) exhibit the highest valuation multiples, suggesting that startups in these countries benefit from stronger investor sentiment, well-developed venture capital ecosystems, and higher expectations for long-term scalability. These economies are known for their thriving technology, fintech, and deep-tech sectors, where intangible assets, such as intellectual property, brand equity, and innovation capacity, play a crucial role in valuation. In contrast, Greece (1.12), Romania (1.12), and Poland (1.21) exhibit significantly lower valuation multiples, indicating that startups in these markets may struggle to attract the same level of investor confidence and may be more reliant on traditional asset-based valuation metrics. The weaker valuations in these regions may also reflect less mature markets, fewer institutional investors, and greater macroeconomic volatility, all of which contribute to a discounted perception of startup potential. These regional valuation disparities reveal how financial ecosystems, institutional capacity, and regulatory readiness shape investor sentiment toward startups. In markets with stronger governance, greener energy profiles, and robust impact-investing infrastructure, valuation signals reflect not only firm-specific fundamentals but also a broader trust in the market's sustainability orientation. In contrast, where environmental governance or investor networks are weaker, even promising startups may be undervalued due to structural inefficiencies. This divergence necessitates a greater integration of country-level contextual factors into investment screening and risk modeling.

Carbon emissions per capita offer insight into the environmental footprint and climate risk exposure of different economies, with implications for sustainability-linked financing and investment attractiveness. Our observations reveal that Germany (8.07), Poland (8.33), and Italy (7.56) have the highest CO_2 emissions, reinforcing their reliance on industrial and energy-intensive sectors. Higher emissions could translate into increased climate-related financial risk as lenders and investors incorporate environmental factors into credit pricing and valuation models. In contrast, Sweden (3.57), Finland (3.84), and Denmark (4.02) exhibit the lowest

emissions, possibly due to their strong adoption of renewable energy, strict environmental regulations, and sustainability-driven economic policies. The divergence in emissions levels suggests that climate policy and energy efficiency are increasingly becoming determinants of financial conditions, influencing how investors and creditors assess risk and growth potential in startup ecosystems.

ROA reveals additional disparities in startup performance. The overall ROA of 3.45% indicates moderate profitability across European startups; however, country-level differences highlight the varying financial viability of early-stage firms. Ireland (6.10%), Finland (5.56%), and Sweden (5.84%) report the highest ROA, indicating that startups in these economies are not only well-funded but also generate strong returns on investment. The presence of high-growth sectors, access to global markets, and favorable business environments may contribute to these superior financial outcomes. Conversely, Greece (1.58%), Romania (1.73%), and Poland (1.98%) experience substantially lower profitability. These differences indicate that startups in these regions face more significant pressures, potentially due to higher operating costs, weaker demand, or limited access to high-value funding opportunities. The profitability gap raises important implications for funding sustainability, as less profitable startups may face more constraints in securing follow-on investments, reinforcing the disparities observed in both loan spreads and valuation multiples.

The level of R&D intensity further differentiates startup ecosystems, reflecting investment in innovation and long-term competitiveness. The overall R&D intensity of 8.93% suggests that European startups allocate a significant portion of their assets to technology development and market expansion, yet the variation across countries is striking. Sweden (13.83%), Finland (13.47%), and Denmark (12.14%) lead in R&D intensity, consistent with their global positioning as innovation hubs with strong government support for research-driven enterprises. These economies are renowned for their high levels of venture capital investment

in technology startups, extensive collaboration between academia and industry, and policies that incentivize research and development (R&D) spending. In comparison, Cyprus (4.16%), Poland (5.94%), and Romania (6.86%) exhibit lower R&D intensities, indicating a weaker focus on technology-driven growth. This divergence in R&D investment aligns closely with the disparities observed in valuation multiples and investor sentiment, reinforcing the link between innovation capacity and financial market confidence.

Leverage highlights how startups finance their operations and the extent to which they rely on external debt. The overall leverage ratio of 45.17% suggests that European startups fund nearly half of their assets through financial debt, but regional differences indicate variations in risk exposure and capital structure preferences. Greece (55.92%), Romania (54.89%), and Poland (52.38%) have the highest leverage ratios, implying a greater dependence on debt financing. This could reflect limited access to equity funding, high-risk premiums on venture capital, or structural weaknesses in local financial markets that necessitate higher borrowing. Sweden (34.57%), Denmark (35.82%), and Luxembourg (36.85%) report significantly lower leverage, suggesting that startups in these economies have greater access to non-debt financing sources, stronger cash flow management, and reduced financial vulnerability. High leverage in certain regions may pose long-term sustainability risks, as excessive debt burdens can increase financial fragility, limit growth opportunities, and expose firms to more significant distress during economic downturns.

[Table 2 here]

The fixed effect results for loan spreads are presented in Table 3. Our findings highlight the financial consequences of climate risk, sustainability practices, firm size, and economic conditions. The positive and significant coefficient for carbon emissions per capita (CE) suggests that startups in countries with high carbon emissions pay higher loan spreads. This is plausible as lenders perceive these economies as riskier due to stricter environmental

regulations, potential carbon taxes, and policy uncertainty. Startups in carbon-intensive regions may also struggle with higher operating costs and lower investor confidence, which can make credit more expensive. Financial institutions are increasingly aligning lending decisions with ESG principles and net-zero commitments. As a result, startups in high-emission economies may find themselves excluded from green financing options or subject to higher risk premiums, limiting their access to affordable credit. However, this aggregate effect masks considerable heterogeneity across the region. For instance, in some high-emission economies, startups with strong ESG disclosure and innovation credentials can secure loan spreads below the median, indicating that firm-level efforts can partially offset structural environmental risks. This suggests that lenders do not apply uniform penalties but instead differentiate based on transition-readiness and firm quality, even within carbon-intensive contexts.

The results also show that climate event exposure (CL) has a significant impact on loan spreads. Startups operating in climate-vulnerable regions face higher borrowing costs due to greater business disruption risks. Climate disasters, such as floods, storms, and wildfires, can damage infrastructure, disrupt supply chains, and increase insurance costs, all of which impact a startup's stability. These risks translate into higher financial uncertainty, prompting lenders to demand larger risk premiums. Furthermore, climate-exposed startups may find it more challenging to secure collateral-backed loans, as frequent disasters reduce asset values and limit insurance availability. This financial strain makes it difficult for startups in these regions to invest in resilience and long-term growth, widening the funding gap between firms in climate-stable and climate-risky economies.

In contrast, sustainability disclosure (SD) significantly lowers loan spreads. Startups publicly disclosing their sustainability commitments benefit from lower borrowing costs, as transparency reassures lenders. Firms that report ESG performance are seen as better-managed, more resilient, and aligned with long-term regulatory trends. They also gain access to green

credit lines, sustainability-linked loans, and preferential lending rates. This finding supports the growing importance of ESG factors in credit risk assessment, where sustainability-oriented firms tend to enjoy more favorable financing terms. As financial institutions integrate climate risk screening into their lending policies, the gap between transparent and non-transparent startups is likely to widen, reinforcing the economic benefits of sustainability reporting.

Beyond climate-related factors, firm-specific characteristics also influence loan spreads. Larger startups secure lower borrowing costs, as lenders associate size with stability, more substantial cash flows, and better risk management. Bigger firms also have greater access to alternative financing sources, making them less dependent on high-cost loans. Similarly, startups with higher R&D intensity tend to have lower spreads, reflecting the long-term value of innovation investments. R&D-driven firms, particularly in the technology and cleantech sectors, attract more investor interest and institutional support, resulting in better credit conditions.

Founder experience also plays a crucial role. More experienced founders secure better loan terms, as they bring industry expertise, financial discipline, and a track record of managing risk. Lenders favor startups led by seasoned entrepreneurs, who are more likely to scale operations effectively and sustain business growth. This finding reinforces the importance of human capital in determining financing conditions for early-stage firms.

At the macroeconomic level, GDP growth is associated with lower loan spreads. Startups in high-growth economies benefit from better credit conditions, as economic expansion improves market confidence, enhances financial stability, and increases competition in lending markets. This is particularly important for startups, which rely on external financing to scale operations and drive innovation. However, inflation does not significantly impact loan spreads, suggesting that short-term price fluctuations do not strongly influence startup financing conditions.

[Table 3 here]

The results for pre-money valuation are presented in Table 4. The findings indicate that environmental factors and financial transparency have a significant influence on investor decisions, underscoring the growing importance of ESG considerations in startup financing. The results suggest that startups operating in carbon-intensive and climate-exposed economies face valuation discounts, while those prioritizing sustainability and innovation attract stronger investor interest.

The negative and highly significant relationship between carbon emissions and pre-money valuation suggests that startups in high-emission economies receive lower valuations. This reflects the growing preference of investors for environmentally responsible firms. High emissions signal greater exposure to climate-related regulatory risks, potential carbon taxation, and operational inefficiencies, which reduce investor confidence. Startups in carbon-intensive regions may also struggle to attract capital from ESG-focused investors and venture funds that prioritize sustainable business models. The financial market is increasingly penalizing firms that fail to align with global climate commitments, reinforcing the long-term costs of operating in high-carbon economies.

On the contrary, sustainability disclosure is positively and significantly associated with pre-money valuation. Startups publicly disclosing their ESG practices and environmental commitments receive higher valuations, as transparency reduces information asymmetry and signals strong governance. Investors view sustainability disclosures as indicators of risk awareness, regulatory compliance, and long-term financial stability, making these firms more attractive. Firms that integrate sustainability into their business strategies also gain better access to green financing, impact investments, and ESG-aligned venture funds, further enhancing their valuation potential. The results confirm that investors assign tangible financial value to sustainability transparency, making ESG integration a strategic advantage in securing funding.

Notably, this effect persists even after controlling for profitability, size, and R&D intensity, suggesting that ESG disclosure operates as a distinct reputational asset. Rather than merely reflecting compliance, sustainability reporting is interpreted by investors as a forward-looking commitment to resilience and strategic foresight. In early-stage investing, where financial data are often limited, such intangible signals gain outsized importance in shaping valuation benchmarks and funding decisions.

Similarly, the negative and significant relationship between climate event exposure and startup valuation highlights the financial impact of operating in disaster-prone regions. Startups in climate-vulnerable areas face lower valuations, as investors perceive them as riskier due to business disruptions, increased insurance costs, and operational uncertainty. Climate disasters, such as floods, wildfires, and storms, can destabilize cash flows, damage infrastructure, and limit long-term scalability, leading investors to apply higher risk premiums. The results align with the broader trend of integrating physical climate risk into valuation models, reinforcing the role of environmental resilience in financial decision-making.

From the control variables, several firm-specific and macroeconomic factors also shape pre-money valuation. Startups with higher returns on assets receive higher valuations, as profitability signals financial strength and sustainable growth potential. Investors favor firms that demonstrate consistent earnings and operational efficiency, which reduces financial risk. Likewise, startups with higher R&D intensity are valued more favorably, as innovation-driven firms are perceived as high-growth opportunities with substantial competitive advantages. Firms that invest in technology, product development, and intellectual property tend to command higher investor confidence, as they are better positioned for scalability.

The results also indicate that startups led by experienced founders receive higher valuations, reflecting the importance of leadership and business acumen in investor decision-making. Investors place greater trust in entrepreneurs with industry experience, strategic vision,

and proven financial management skills, as they are more likely to execute successful growth strategies and mitigate risks effectively. At the macroeconomic level, GDP growth is positively associated with startup valuation, suggesting that firms in high-growth economies benefit from better investor sentiment, greater risk appetite, and stronger access to capital markets.

[Table 4 here]

Our findings present imperative policy implications for enhancing startup financing conditions, fostering innovation, and integrating sustainability into financial markets. Policymakers must design targeted financial and regulatory interventions to ensure that startups, particularly those in carbon-intensive or climate-vulnerable economies, are not disproportionately constrained by financing barriers.

Given the higher loan spreads faced by startups in high-emission economies, there is a need for policy-driven incentives to accelerate the transition toward low-carbon business models. Governments can implement subsidized green credit lines, tax incentives for sustainability investments, and carbon reduction grants to help startups align with evolving investor preferences. Financial regulators should encourage banks to expand sustainability-linked lending programs, ensuring startups pursuing carbon-neutral strategies can access credit at competitive rates. Climate risk-adjusted credit assessments should also be standardized to ensure that startups are not penalized solely based on national-level emissions, but instead assessed on their transition efforts and environmental performance.

The evidence that sustainability disclosure lowers borrowing costs and increases valuations highlights the need for stronger ESG reporting frameworks tailored to startups. Policymakers should streamline sustainability reporting requirements to make them accessible for early-stage firms, reducing compliance costs while ensuring transparency. Standardized ESG disclosure guidelines at the European level would create a more comparable and investor-friendly environment, allowing startups to differentiate themselves based on sustainability

performance. Financial market regulators should also strengthen the integration of ESG metrics in investment screening, encouraging institutional investors to reward startups with verifiable sustainability commitments.

Startups in climate-vulnerable regions face significant financing constraints as lenders and investors factor in the risks of physical climate events. To mitigate this, governments should develop climate risk insurance schemes, disaster resilience funds, and infrastructure adaptation programs to reduce the financial burden on businesses operating in high-risk regions. This would enhance business continuity and improve investor confidence in climate-exposed economies. Moreover, blended finance mechanisms, such as public-private partnerships for climate adaptation, can help de-risk investments in startups operating in regions prone to environmental disruptions.

Beyond climate-related risks, disparities in loan spreads and valuations across regions suggest structural inefficiencies in financial markets. The findings indicate that startups in Southern and Eastern Europe face higher borrowing costs and lower valuations, reflecting weaker financial ecosystems and lower investor confidence. Policymakers should focus on strengthening local venture capital networks, expanding startup-friendly financial instruments, and fostering cross-border investment. Developing regional investment funds targeted at high-growth startups could help bridge the funding gap, ensuring that geographic biases do not hinder promising firms in financial markets. The role of R&D intensity and founder experience in enhancing startup financing conditions highlights the importance of policies that foster innovation and entrepreneurial capacity-building.

The policy implications derived from our findings necessitate both immediate and long term interventions. In the short term, regulators, development banks, and financial intermediaries can take steps within the existing frameworks. These include creating standardized credit evaluation tools that are related to ESG, offering lower lending rates to low

carbon business models, and making disclosure templates easier to use. These initiatives will make things more clear right away, make lenders more confident, and lower the cost of borrowing for new businesses.

Structural adjustments are necessary in the long term. Policymakers should incorporate climate risk assessment into prudential regulations. The EU green funding initiatives should be made available to startups. Over time, adding startup focused ESG measures to the changing CSRD framework will make responsible finance practices the norm. This will also bring startup ecosystems in line with the EU's larger transition strategy.

5. Conclusion

This study comprehensively examines the impact of climate risk exposure and sustainability disclosures on startup financing conditions in Europe. The findings highlight the growing intersection between financial decision-making and environmental considerations, showing that lenders and investors are increasingly factoring climate risk into their credit pricing and valuation models. These results contribute to the broader discourse on how climate-related financial constraints, sustainability strategies, and market dynamics shape entrepreneurial finance. As financial markets transition towards sustainability-driven decision-making, startups must adapt to these evolving expectations to secure competitive funding terms.

The growing financial burden on startups in carbon-intensive economies and climate-vulnerable regions indicates that climate risk is no longer a secondary consideration for financiers. Banks, venture capitalists, and institutional investors are incorporating climate exposure into their risk models, resulting in higher borrowing costs and discounted valuations for firms operating in environmentally risky markets. This shift reflects broader regulatory and market-driven trends that seek to align investment practices with climate objectives, particularly within the EU. The financial penalties associated with high-emission economies

and climate disasters suggest that investors are no longer focusing solely on short-term economic returns, but are also considering long-term sustainability risks and the readiness for transition.

For startups, this trend presents both challenges and opportunities. Those operating in industries directly exposed to climate risks, such as agriculture, real estate, and energy, may struggle to attract investment unless they develop clear sustainability strategies. At the same time, startups aligning their operations with low-carbon business models and resilience planning benefit from preferential financing conditions. This creates a dual pressure on firms: they must demonstrate profitability and growth potential and ensure that their business models are aligned with sustainability imperatives.

One of the key takeaways from this study is the financial benefit of transparency in sustainability reporting. Startups that voluntarily disclose their ESG commitments, environmental impact, and climate risk mitigation strategies receive better financing terms, as lenders and investors view them as less risky and better positioned for long-term success. This suggests that sustainability disclosure is no longer just a compliance requirement, but a strategic asset that can influence both the cost of capital and investor confidence. Early adoption of ESG reporting practices can give startups a competitive edge. Firms that proactively disclose their climate strategies, carbon footprint, and sustainability initiatives are better positioned to access green financing, sustainability-linked loans, and impact investment funds. As financial institutions refine their ESG screening processes, startups with robust sustainability disclosures may continue to see improvements in their ability to raise capital. Given the rapid expansion of sustainable finance markets, failure to integrate ESG considerations into business strategies could limit access to critical funding sources and place firms at a competitive disadvantage. It is important to note that ESG disclosures remain largely voluntary for many startups across the EU, particularly those below the CSRD threshold. While

the observed financial benefits of disclosure are compelling, they may reflect selective transparency by more capable or investor-facing firms. This distinction raises questions about the scalability of ESG-driven financing advantages and calls for targeted policy approaches that strike a balance between standardization and feasibility for early-stage firms.

From a policy perspective, these findings stress the need for standardized ESG disclosure frameworks specifically designed for startups. Unlike large corporations, startups often lack the resources and expertise to produce comprehensive sustainability reports. Simplified and cost-effective reporting mechanisms could incentivize broader participation in ESG disclosures, ensuring that sustainability-driven financing opportunities are accessible to firms at different growth stages. The study also highlights the increasingly complex risk assessment landscape for investors and financial institutions. As climate risk becomes a more prominent factor in credit scoring, equity valuation, and portfolio allocation, investment decisions must balance between financial returns and sustainability considerations. This shift highlights the need for more sophisticated risk-adjusted pricing mechanisms that account for both physical and transition climate risks, while ensuring that high-potential startups are not unfairly excluded from financing opportunities.

Financial institutions should refine their ESG risk assessment models to ensure that startups are evaluated on their current environmental footprint and transition strategies. A firm operating in a high-emission economy but actively working to reduce carbon exposure should not face the same financing penalties as one with no sustainability initiatives. Creating climate risk-adjusted lending frameworks that incentivize transition efforts rather than penalizing entire economies could enhance financial inclusion while promoting sustainability. For venture capitalists and private equity investors, the findings reinforce the value of incorporating sustainability metrics into investment strategies. Investors prioritizing firms with strong ESG commitments and climate resilience plans may see better long-term returns, as these businesses

are more likely to attract institutional capital and regulatory support. This also presents opportunities for thematic investing in sectors such as cleantech, renewable energy, and circular economy startups, which are well-positioned to benefit from the broader sustainability transition.

Beyond empirical validation, the findings offer important theoretical insights. This study contributes to the entrepreneurial finance literature by integrating climate risk and sustainability disclosure into startup-level financial modeling, which has traditionally been dominated by market traction and founder characteristics. It bridges institutional theory and signal theory by showing how voluntary ESG disclosures function as credible signals under uncertain regulatory regimes. Moreover, it extends prior climate finance frameworks by applying them to early-stage firms, thereby offering a foundation for future research at the intersection of sustainability, financing constraints, and firm lifecycle.

Future research can explore heterogeneity across sectors and geographies in greater detail, particularly in understanding how ESG relevance varies between capital-intensive startups and service-oriented firms. Cross-country comparative studies examining differences in regulatory uptake, disclosure norms, and financial ecosystem maturity would deepen the contextual understanding. Moreover, quasi-experimental designs could help establish causal links between climate risk exposure and financing outcomes, addressing current limitations in observational methods. As the ESG landscape continues to evolve, longitudinal studies tracking disclosure practices, investor responses, and funding dynamics over time would be especially valuable.

References

Angeletopoulou, P. (Vivian), Sardianou, E., Hondroyiannis, G. and Kostakis, I. (2025), "Advancing sustainable construction in the EU: the role of environmental taxation, financial development and green energy financing", *Sustainable Finance Review*, pp. 1–19, doi: 10.1108/SFR-05-2025-0009.

Battiston, S., Mandel, A., Monasterolo, I., Schütze, F. and Visentin, G. (2017), "A climate stress-test of the financial system", *Nature Climate Change*, Vol. 7 No. 4, pp. 283–288, doi: 10.1038/nclimate3255.

Cardoni, A. and Kiseleva, E. (2025), "Do SMEs have an ESG communication strategy? Exploring the quality and influencing factors of voluntary ESG disclosures using web-based and annual report channels", *Business Strategy and the Environment*, John Wiley & Sons, Ltd, Vol. 34 No. 1, pp. 1267–1286, doi: 10.1002/BSE.4038.

Chandra, A., Paul, J. and Chavan, M. (2020), "Internationalization barriers of SMEs from developing countries: a review and research agenda", *International Journal of Entrepreneurial Behaviour and Research*, Emerald Group Holdings Ltd., Vol. 26 No. 6, pp. 1281–1310, doi: 10.1108/IJEBR-03-2020-0167/FULL/XML.

Chenet, H., Ryan-Collins, J. and van Lerven, F. (2021), "Finance, climate-change and radical uncertainty: Towards a precautionary approach to financial policy", *Ecological Economics*, Elsevier, Vol. 183, p. 106957, doi: 10.1016/j.ecolecon.2021.106957.

Dumrose, M., Rink, S. and Eckert, J. (2022), "Disaggregating confusion? The EU Taxonomy and its relation to ESG rating", *Finance Research Letters*, Elsevier, Vol. 48, p. 102928, doi: 10.1016/J.FRL.2022.102928.

Fu, M., Yu, D. and Zhou, D. (2023), "Secret Recipe of IPO survival: ESG disclosure and performance", *Financial Markets, Institutions and Instruments*, John Wiley and Sons Inc, Vol. 32 No. 1, pp. 3–19, doi: 10.1111/FMII.12169;WEBSITE:WEBSITE:PERICLES;SUBPAGE:STRING:ACCESS.

Garrido-Ruso, M., Otero-González, L., López-Penabad, M.C. and Santomil, P.D. (2024), "Does ESG implementation influence performance and risk in SMEs?", *Corporate Social Responsibility and Environmental Management*, John Wiley & Sons, Ltd, Vol. 31 No. 5, pp. 4227–4247, doi: 10.1002/CSR.2783.

Hoffmann, C.H. (2023), "Startup valuation reassessed: against celebrity, sustainability and state intervention", *Journal of Ethics in Entrepreneurship and Technology*, Emerald Publishing Limited, Vol. 3 No. 1, pp. 7–19, doi: 10.1108/JEET-08-2022-0012.

Le, B., Moore, P.H. and Paul, D.L. (2025), "Climate change regulation compliance and earnings management", *Review of Accounting and Finance*, Emerald Publishing, Vol. ahead-of-print No. ahead-of-print, doi: 10.1108/RAF-06-2024-0230/FULL/XML.

Li, J., Zhao, T. and Taghizadeh-Hesary, F. (2025), "Impact of EU corporate sustainability reporting directive on financial performance: evidence from companies", *Journal of Risk*

Finance, Emerald Publishing, doi: 10.1108/JRF-01-2025-0008/1254097/IMPACT-OF-EU-CORPORATE-SUSTAINABILITY-REPORTING.

López Vázquez, B., Martínez González, J.M., Gómez Olmedo, A.M. and Guevara Riera, M.F. (2024), "Understanding sustainable investments: an empirical study of best-in-class mutual funds", *Journal of Risk Finance*, Emerald Publishing, Vol. 26 No. 1, pp. 78–97, doi: 10.1108/JRF-05-2024-0131/FULL/XML.

Lopez-de-Silanes, F., McCahery, J.A. and Pudschedl, P.C. (2024), "Institutional Investors and ESG Preferences", *Corporate Governance: An International Review*, John Wiley & Sons, Ltd, Vol. 32 No. 6, pp. 1060–1086, doi: 10.1111/CORG.12583.

Martielli, F., Laus, V., Salvi, A. and Kotaskova, A. (2025), "Unlocking funding success: intercultural entrepreneurship dynamics in European startups", *International Entrepreneurship and Management Journal*, Springer, Vol. 21 No. 1, pp. 1–31, doi: 10.1007/S11365-024-01038-5/METRICS.

Mirza, N., Afzal, A., Umar, M. and Skare, M. (2023), "The impact of green lending on banking performance: Evidence from SME credit portfolios in the BRIC", *Economic Analysis and Policy*, Elsevier, Vol. 77, pp. 843–850, doi: 10.1016/J.EAP.2022.12.024.

Mirza, N., Umar, M., Horobet, A. and Boubaker, S. (2024), "Effects of climate change and technological capex on credit risk cycles in the European Union", *Technological Forecasting and Social Change*, North-Holland, Vol. 204, p. 123448, doi: 10.1016/J.TECHFORE.2024.123448.

Montesinos-Sansaloni, E.X., Ribeiro, D. and Botella-Carrubi, D. (2025), "The role of the corporate sustainability reporting directive in public–private partnerships for research and development: spotlight on the social economy", *Journal of Risk Finance*, Emerald Publishing, doi: 10.1108/JRF-02-2025-0071/1265628/THE-ROLE-OF-THE-CORPORATE-SUSTAINABILITY-REPORTING.

Owolabi, A., Mousavi, M.M., Gozgor, G. and Li, J. (2024), "The impact of carbon risk on the cost of debt in the listed firms in G7 economies: The role of the Paris agreement", *Energy Economics*, North-Holland, Vol. 139, p. 107925, doi: 10.1016/J.ENECO.2024.107925.

Pop, R., Achim, M.V. and Bota-Avram, C. (2025), "The shifting landscape of greenwashing – insights from a bibliometric analysis", *Sustainable Finance Review*, pp. 1–19, doi: 10.1108/SFR-05-2025-0005.

Qin, M., Su, Y.H., Zhao, Z. and Mirza, N. (2023), "The politics of climate: Does factionalism impede US carbon neutrality?", *Economic Analysis and Policy*, Elsevier, Vol. 78, pp. 954–966.

Rossi, M., Capasso, A., Solak, I., Jarrar, H. and Salloum, C. (2025), "Green scores, golden returns: ESG's role in shaping SME financial outcomes", *Review of Accounting and Finance*, Emerald Publishing, doi: 10.1108/RAF-10-2024-0468/1269207/GREEN-SCORES-GOLDEN-RETURNS-ESG-S-ROLE-IN-SHAPING.

Sabbaghi, O. (2025), “ESG risk and idiosyncratic risk: recent evidence”, *Sustainable Finance Review*, pp. 1–16, doi: 10.1108/SFR-04-2025-0002.

Tajeddin, M., Simba, A., Liguori, E.W., Edeh, J. and Nuhu, N. (2024), “Exploiting a non-mainstream financial scheme to innovate: SMEs in the developing world”, *International Journal of Entrepreneurial Behaviour and Research*, Emerald Publishing, Vol. ahead-of-print No. ahead-of-print, doi: 10.1108/IJEBR-07-2024-0745/FULL/XML.

Xu, X., An, H., Huang, S., Jia, N. and Qi, Y. (2024), “Measurement of daily climate physical risks and climate transition risks faced by China’s energy sector stocks”, *International Review of Economics & Finance*, JAI, Vol. 93, pp. 625–640, doi: 10.1016/J.IREF.2024.05.006.

Ye, L. (2022), “The effect of climate news risk on uncertainties”, *Technological Forecasting and Social Change*, North-Holland, Vol. 178, p. 121586, doi: 10.1016/J.TECHFORE.2022.121586.

Yu, P., Dai, H., Zhu, J., Hamori, S., Dong, R.K. and Yue, X. (2024), “How does venture capital play a role in corporate green innovation? Evidence from China”, *International Review of Economics & Finance*, JAI, Vol. 96, p. 103654, doi: 10.1016/J.IREF.2024.103654.

Zhu, B., Liang, C., Mirza, N. and Umar, M. (2023), “What drives gearing in early-stage firms? Evidence from blue economy startups”, *Journal of Business Research*, Elsevier, Vol. 161, p. 113840, doi: 10.1016/J.JBUSRES.2023.113840.

Tables

Table 1: Year Wise Sample Distribution

Country	2016	2017	2018	2019	2020	2021	2022	2023
Austria	37	37	37	38	38	38	38	38
Belgium	42	43	43	43	44	44	46	46
Croatia	16	16	17	17	17	17	17	19
Cyprus	11	11	11	11	11	12	12	12
Denmark	60	60	60	60	60	60	63	63
Estonia	16	16	16	16	16	17	17	18
Finland	32	32	33	33	35	35	35	36
France	66	67	69	72	72	72	72	72
Germany	108	110	110	110	111	114	115	115
Greece	31	31	31	31	31	31	31	31
Hungary	11	11	11	11	11	11	11	11
Ireland	27	28	28	28	29	29	29	30
Italy	31	33	34	36	37	37	37	37
Latvia	11	11	12	12	12	12	12	12
Lithuania	16	16	16	16	16	16	16	16
Luxembourg	8	11	12	13	13	15	15	17
Netherlands	45	45	45	51	51	52	52	54
Poland	11	11	12	12	12	12	12	12
Portugal	30	30	30	30	30	30	30	30
Romania	19	19	19	20	20	20	21	21
Slovakia	13	13	13	13	13	13	13	13
Slovenia	10	11	11	11	12	13	13	13
Spain	41	43	43	43	44	44	44	46
Sweden	52	52	52	53	53	53	54	54
Total	**743**	**757**	**765**	**780**	**788**	**797**	**805**	**816**

Source: Authors own work

Table 2: Weighted Mean of Selected Variables for Sample Start-ups

	Loan Spread	PMV/TA (Times)	CO2 Emissions	ROA	R&D Intensity	Leverage
Overall	0.04632	1.61106	6.02041	0.03454	0.08936	0.45167
Austria	0.04685	1.72985	7.21349	0.04173	0.09173	0.42618
Belgium	0.03232	1.64287	6.87235	0.03541	0.07358	0.44751
Croatia	0.04812	1.34562	5.94329	0.02185	0.05628	0.50829
Cyprus	0.05539	1.23847	5.57281	0.01872	0.04157	0.53982
Denmark	0.03203	2.14586	4.02563	0.05067	0.12143	0.35824
Estonia	0.05483	1.42968	4.52748	0.03064	0.08675	0.40729
Finland	0.03922	2.05892	3.84273	0.05563	0.13467	0.38719
France	0.03457	1.63589	6.53782	0.03463	0.09253	0.46832
Germany	0.03796	1.84732	8.07421	0.04256	0.10731	0.41984
Greece	0.06083	1.12957	6.27834	0.01584	0.06732	0.55921
Hungary	0.04759	1.37592	6.94587	0.02382	0.07819	0.49752
Ireland	0.04915	2.38926	5.04823	0.06095	0.11258	0.37314
Italy	0.04827	1.45298	7.56832	0.02837	0.08642	0.48756
Latvia	0.05533	1.56284	4.78412	0.03198	0.09472	0.45379
Lithuania	0.05433	1.52183	5.24519	0.03076	0.08931	0.43726
Luxembourg	0.04254	2.03458	5.14923	0.05274	0.10623	0.36852
Netherlands	0.03264	1.95826	5.43782	0.04832	0.11392	0.39581
Poland	0.05064	1.21934	8.32874	0.01984	0.05942	0.52376
Portugal	0.04238	1.35742	6.73952	0.02574	0.07942	0.47215
Romania	0.05813	1.12952	7.04892	0.01730	0.06857	0.54891
Slovakia	0.04978	1.26347	7.31245	0.02098	0.07315	0.50784
Slovenia	0.05652	1.42937	5.93724	0.03265	0.08791	0.44827
Spain	0.04394	1.51792	6.48259	0.02943	0.08329	0.45791
Sweden	0.03844	2.24876	3.57349	0.05844	0.13827	0.34572

CO2 Emissions are per capita and at the country level

This table presents the weighted means of key financial and environmental variables across countries. Loan spread measures borrowing costs, while PMV/TA represents pre-money valuation scaled by total assets as a proxy for investor sentiment. CO_2 emissions capture country-level carbon intensity, while ROA, R&D intensity, and leverage represent firm-level characteristics.

Source: Authors own work

Table 3: Panel Regression Fixed Effects (Loan Spread)

Variable	Coefficient	Std Error	t Stats	
CE	0.10834	0.05422	1.99812	**
SD	-0.09457	0.02614	-3.61748	***
CL	0.12583	0.05782	2.17632	**
Size	-0.06892	0.03303	-2.08634	**
ROA	-0.04218	0.03656	-1.15376	
R&D	-0.04532	0.01264	-3.58534	***
Leverage	0.07849	0.08183	0.95921	
Founder Exp	-0.05982	0.03004	-1.99142	**
VC Backing	-0.07241	0.01598	-1.03124	
Inflation	0.05721	0.01847	0.09831	
gGDP	-0.03746	0.01847	-3.42418	***
constant	0.17528	0.01847	1.06622	
Country FE		YES		
Year FE		YES		
Adj R2	0.681597			

**** represents significance at 1%, ** at 5%*

This table presents the fixed-effects panel regression results, with loan spreads as the dependent variable. Positive coefficients indicate factors associated with higher borrowing costs, while negative coefficients indicate factors related to reduced loan spreads.

Source: Authors own work

Table 4: Panel Regression Fixed Effects (Pre-Money Valuation)

Variable	Coefficient	Std Error	t Stats	
CE	-0.10876	0.0221443	-4.91142	***
SD	0.12489	0.0399881	3.12318	***
CL	-0.09724	0.032503	-2.99172	***
Size	0.08231	0.071822	1.146028	
ROA	0.07318	0.0372317	1.965532	**
R&D	0.05824	0.0292275	1.992647	**
Leverage	-0.07241	0.0679708	-1.06531	
Founder Exp	0.10345	0.0329743	3.13729	***
VC Backing	0.09827	0.8374808	0.11734	
Inflation	-0.04853	0.0904938	-0.53628	
gGDP	0.06214	0.0312982	1.98542	**
constant	0.10489	0.1731344	0.60583	
Country FE		YES		
Year FE		YES		
Adj R2	0.6435938			

**** represents significance at 1%, ** at 5%*

This table presents the fixed-effects panel regression results, with pre-money valuation scaled by total assets as the dependent variable. Positive coefficients indicate factors associated with higher valuations, while negative coefficients indicate factors related to valuation discounts.

Source: Authors own work