



Alternative finance in bank-firm relationship: how does board structure affect the cost of debt?

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Abstract

In this paper, we examine the relationship between alternative finance and board structure on the cost of debt for firms, focusing on the unique effects of differing board characteristics. Using a dataset of 176 European listed companies observed annually from 2013 to 2022, we dissect this relationship through several hypotheses considering factors such as the supply of alternative finance, board gender composition, age, expertise, and board turnover. Our findings reveal that increased alternative finance credit supply escalates the cost of debt, especially for firms with lower ESG scores. Firms with young boards, boards specialized in economics or low, and board turnover also experience a rise in borrowing costs with increasing of alternative finance. Through a pooling 2SLS model, we provide robust evidence about the interplay of alternative finance and varying board structures on the cost of debt. This research clarifies the intricacies of bank-firm relationships in alternative finance and holds significant implications for supervisory authorities, banks, and policymakers. It underscores the necessity of good corporate governance in managing the cost implications of alternative finance. It calls for tailored risk assessment strategies, conducive regulatory frameworks, and vigilant supervisory approaches to create a resilient financial ecosystem where alternative finance can thrive without inordinately inflating the cost of debt.

Keywords Alternative finance · Corporate governance · Board structure · Cost of debt · Fintech

JEL Classification G32 · G21 · G34 · G20 · O16

1 Introduction

The digital revolution has brought about a paradigm shift in the delivery of financial services, giving rise to a transformative era known as alternative finance. This era is characterized by the emergence of financial technology (FinTech) innovations that

Extended author information available on the last page of the article

have revolutionized the financial industry (Feyen et al., 2021). The financial sector has witnessed an upsurge in new entrants utilizing innovative technologies to meet customer needs and compete with traditional incumbents. Manifestations of such innovation are seen in the form of mobile money, peer-to-peer lending, and artificial intelligence, among others (Ehlers et al., 2021). These developments ostensibly stand to enrich the financial ecosystem with heightened competition, efficiency, and inclusivity, particularly in emerging economies where traditional systems have been less developed. However, they also bring forth a new frontier of challenges and implications, especially in the context of market concentration and regulatory oversight (Afonso et al., 2022).

Traditional finance consists of standard financial products offered by established institutions like banks, investment firms, and credit unions, such as capital acquisition, investment, and money management. These organizations offer services such as loans, savings accounts, and mortgages predicated on fixed criteria and stringent regulatory guidelines (Cotugno & Stefanelli, 2023; Melis, 2000). Credit scores, collateral, and repayment records primarily influence the accessibility, pricing, and terms of these financial products. Contrarily, alternative finance denotes a diverse range of financial channels, resources, and tools that have originated outside the conventional finance framework (Rohatgi et al., 2023). The intersections of this market with fintech involve instruments such as equity-based and reward-based crowdfunding, peer-to-peer finance, peer-to-business finance, microfinance, and blockchain-enabled financing (Coakley & Lazos, 2021; Rossi et al., 2021). A typical characteristic of alternative finance is its utilization of technology, facilitating more adaptable and broad-based access to capital. Unlike traditional finance, it can function with less rigorous requirements and provide tailored terms, although often accompanying higher risks and costs (Fuster et al., 2019).

Alternative finance and traditional finance are distinct in their structures and regulations. Despite these differences, they can interact within the same financial ecosystem, involving the same participants. For example, a conventional bank might engage in the alternative finance market by supporting peer-to-peer lending platforms, or a business could secure funds through both traditional methods like bank loans and alternative ones like crowdfunding (Elia et al., 2022).

These evolving dynamics of the financial industry have produced considerable interest in exploring the relationship between alternative finance and a critical component of the business ecosystem: corporate governance, specifically reflected in the board of directors' structure (Llewellyn, 2020). This study, therefore, aims to assess the relationship between alternative finance and board structure on the cost of debt for listed firms. Using a comprehensive dataset encompassing 782 European listed companies from 2013 to 2022, we analyse the role of crucial board characteristics such as gender composition, age, expertise, and turnover interplayed with alternative finance credit supply and their influence on firms' cost of debt.

The research aims to clarify the complexities of the bank-firm relationship in the era of alternative finance, thereby offering relevant implications for banks, policy-makers, supervisory authorities, and academics. First, it brings a novel perspective by integrating the influence of alternative finance into the discourse of debt costs and board structure. Secondly, we contribute to the literature by demonstrating that

the impact of alternative finance on debt costs, alongside board structure, varies based on the firm's size, thus revealing a nuanced understanding of these dynamics. Finally, the relevance of our study lies in the increased use of alternative finance, led by stricter credit rules from traditional banks and the era of negative interest rates (BIS, 2018; Stefanelli et al., 2022).

The motivation underneath the study is to clarify the relationship between alternative finance and firms' cost of debt. By examining European listed companies, the study evaluates how factors like board gender composition, age, and expertise relate to the cost of debt in an environment increasingly influenced by alternative finance. The relevance of the study is heightened by the current financial landscape, where alternative finance is gaining prominence due to tighter traditional banking regulations and shifts in interest rate policies. By addressing this gap, the research contributes to a better understanding of how alternative finance affects corporate financial strategies and risk assessments.

Our paper novelty consists of a detailed examination of the relationship between alternative finance and the cost of debt within European listed firms. This area of research has not been extensively explored previously. The study stands out for its analysis of how board composition factors like gender, age, and expertise influence a firm's debt costs in the context of alternative finance. This approach presents a new angle on the interaction between corporate governance and financial strategies among evolving market conditions. Another key aspect of the study's innovation is the use of an extensive dataset of European listed companies spanning from 2013 to 2022. This large dataset enables a thorough evaluation over a substantial timeframe, offering a comprehensive view of the trends and patterns in alternative finance and its effects on corporate debt.

Our findings validate the hypothesis that an increase in alternative finance credit supply correlates with higher debt costs. This aligns with agency theory, highlighting potential conflicts of interest between managers and shareholders, which can lead to increased borrowing costs due to suboptimal financial decisions. Additionally, our research reveals that firms with lower Environmental, Social, and Governance (ESG) scores experience more significant increases in debt costs with the rise of alternative finance. This supports the notion that weaker governance and higher risk can intensify agency problems, leading to higher debt costs. A notable observation from our study is that firms with higher female representation on boards do not necessarily incur higher debt costs with increased alternative finance, challenging traditional agency theory assumptions. This suggests that diverse board compositions might mitigate agency problems, thereby potentially reducing borrowing costs. Our study also finds that firms with younger boards and those whose boards specialize in economics face increased debt costs with the growth of alternative finance. This indicates that inexperience or lack of expertise in alternative finance can lead to higher borrowing costs. Lastly, firms with low board turnover show higher borrowing costs in scenarios of increased alternative finance. This points to the challenge such boards face in adapting to the new dynamics posed by alternative finance, increasing debt costs due to perceived higher risks.

The results have relevant implications for banks, policymakers and supervisory authorities. For banks, understanding the impact of alternative finance on the cost

of debt, particularly in relation to different board structures, can lead to more refined risk assessment and lending practices. This knowledge allows banks to adjust their credit products and strategies to better align with the governance profiles of various firms. In terms of policy implications, the study suggests a need for policymakers to develop regulatory frameworks that address the effects of alternative finance on debt costs. This is especially relevant for firms with lower ESG scores or certain board compositions. Regulations could focus on promoting diversity in corporate governance, including gender balance and ethnic diversity, as well as ensuring a range of financial expertise on boards. For supervisory authorities, the research emphasizes the importance of focusing on the governance structures of firms engaged in alternative finance. This involves integrating governance factors into risk monitoring and management processes, encouraging firms to manage alternative finance sources responsibly.

The forthcoming sections of this paper are organized as follows: Sect. 2 examines the literature review and develops our hypotheses. Section 3 outlines data, variables, and the model specification. Section 4 discusses empirical results and their interpretations. Finally, Sect. 5 concludes the manuscript.

2 Theoretical review and hypothesis development

2.1 Theoretical review

The rise of alternative finance introduces a new dimension of analysis to the agency problem. According to the Agency Theory, managers may have incentives to select financing options that maximize their personal utility, which may not necessarily align with the shareholders' interest in wealth maximization (Jensen, 1994). With the advent of alternative finance, the agency problem could be amplified due to the increased complexity and potential information asymmetry associated with these new forms of financing (Shapiro, 2005). Firstly, alternative finance channels often operate outside traditional financial systems, and their risk and return profiles can be quite distinct. This might allow managers to adopt riskier financial strategies, assuming that the complexity of these instruments may reduce the shareholders' ability to understand and monitor these decisions fully. Secondly, alternative finance often incorporates an element of innovation and technology that could appeal to managers interested in portraying an image of forward-thinking and dynamism, despite these options potentially not being the most cost-effective. Thirdly, alternative finance options may also present opportunities for managers to manipulate financial performance or obfuscate poor management decisions due to their inherent complexity and the lack of a standardized regulatory framework (Bathala & Rao, 1995).

In this setting, the role of corporate governance and, particularly, the board of directors' characteristics becomes predominant in mitigating these agency problems. The board serves as an internal control mechanism, ensuring that managers' decisions align with the best interests of the shareholders (Poletti-Hughes & Briano-Turrent, 2019). For instance, the board's composition, experience, and diversity could influence how effectively it can oversee and comprehend the intricacies

of alternative finance decisions. However, as suggested by our hypotheses, boards with specific characteristics (such as firms with female board members, firms with young board members, economically specialized boards, and low turnover boards) may face challenges in fulfilling this role, thereby exacerbating agency issues and potentially leading to an increase in the cost of debt (Ertugrul & Hegde, 2008).

2.2 Hypothesis development

The increasing pervasiveness of alternative finance in the modern financial ecosystem inherently affects the operations and financial management of listed firms, warranting the objective of this paper. Listed firms, often constituting a substantial proportion of the economy due to their publicly traded securities, are particularly affected by the dynamics of alternative finance credit (Allen et al., 2017). The rise of this unconventional form of finance, driven by technology and steadily eroding barriers to entry, has introduced both opportunities and challenges for listed firms. Notably, (Jindal & Seth, 2019) suggest that these challenges often materialize in the form of unpredictable fluctuations in the cost of debt, a condition precipitated by the volatile nature of alternative finance. Similarly, Farag and Johan (2022) and Wang et al. (2023) show how this financial fluctuation can impact firm stability and long-term success. Crucially, Xu et al. (2022) suggest that the implications are not uniform across all listed firms but depend on various factors, such as the characteristics of their board. Thus, we aim to contribute to this literature stream by investigating the influence of alternative finance credit on listed firms' cost of debt in diverse governance contexts. More specifically, we have developed a set of six hypotheses to perform our study.

The rise of alternative finance calls for a comprehensive analysis of its effect on listed firms' cost of debt (Brown et al., 2019). Based on established research, some authors have empirically exhibited that an increase in alternative finance credit availability could affect the cost of debt (Mac et al., 2019). At the same time, Cowling et al. (2018) detailed how alternative finance could lead to additional costs owing to potentially increased risk and information asymmetry. Adding to this notion, another study hinted that the influx of alternative financing options could instigate potential credit risks, thus inflating the cost of debt (Du et al., 2017). In opposition, some researchers argue that an enhanced credit supply from alternative finance could trigger competition, thus driving down the cost of debt (Holmes et al., 1994; Li & Richie, 2016). However, recent research indicates that the unstable dynamics of the alternative finance market might cause a surge in debt costs due to its inherent volatility (Dang et al., 2022) and increased transaction costs (Rafaj & Siranova, 2022). Finally, alternative finance mechanisms often reflect a unique trend in a firm's operational and financial cost structure. While they commonly deliver operational cost benefits due to technology-aided efficiencies and streamlined workflows, they might also carry an elevated cost of borrowing compared to traditional financial systems. This increased cost may stem from heightened counterparty and financial risk typically associated with alternative finance. The former may be pronounced in alternative finance because of less rigorous regulatory scrutiny than in traditional banking.

Moreover, the characteristics of alternative finance inherently imply greater financial risk. These financing channels may have limited access to secure collateral or engage with borrowers with higher credit risk. This increased risk can, in turn, escalate interest rates and, consequently, the cost of debt (Sheng, 2021). Therefore, considering these contrasting viewpoints and the possible effects of board structure, we propose the following relationship:

H1 An increase in alternative finance credit supply raises the cost of debt.

Agency Theory suggests that managers may prioritize personal interests over shareholder wealth, potentially leading to suboptimal financing decisions (Jensen, 1994). The introduction of alternative finance, characterized by its complexity and potential for information asymmetry, exacerbates this issue (Nainggolan et al., 2023). As the supply of alternative finance increases, the complexities and risks associated with these financing options may heighten the perceived risk from lenders' perspective. This, in turn, could lead to an increase in the cost of debt, reflecting the amplified agency problems inherent in the use of alternative finance. Thus, H1 embodies the anticipated impact of alternative financing's complexity and risk on a firm's debt cost within the Agency Theory framework.

Apergis et al. (2022) outline that firms with higher ESG scores, which denote greater socio-environmental responsibility and more robust governance, face lower borrowing costs. Eliwa et al. (2021) corroborate this, adding that higher ESG scores increase confidence from lenders, potentially reducing the firm's cost of debt. On the contrary, firms with lower ESG scores represent a higher risk to lenders, leading to elevated debt costs (Gao et al., 2022; Gigante & Manglaviti, 2022). Furthermore, alternative finance can compound the credit risk for firms with low ESG scores by inducing more volatility in their lending conditions, elevating their borrowing cost. Houque et al. (2020) find that high ESG scores can cushion the impact of these alternative finance-driven instabilities in debt markets. However, for firms with low ESG scores, these instabilities can intensify information asymmetry and unpredictability (Chen et al., 2023), thereby increasing their cost of debt. In light of the interplay between ESG scores and alternative finance, the role of board structure emerges as a crucial factor shaping these dynamics. As suggested by Ng and Rezaee (2015) and La Rosa and Bernini (2022), inadequacies in a firm's governance structure, reflected by low ESG scores, could exacerbate the financial risks posed by alternative finance, resulting in higher borrowing costs. Given the existing empirical evidence, this paper proposes the following hypothesis:

H2 Firms with low ESG scores will experience an increase in the cost of debt when there is an increase in alternative finance credit supply.

In the context of the Agency Theory, managers of firms with low ESG (Environmental, Social, and Governance) scores may already be viewed as engaging in practices that do not align with the broader interests of shareholders or sustainable business practices. The introduction of alternative finance, with its inherent complexities

and potential for increased information asymmetry (Shapiro, 2005), further complicates this scenario. For firms with low ESG scores, the increase in alternative finance credit supply could be perceived as adding to the existing risk profile, due to the perceived lack of commitment to sustainable and transparent governance practices. This heightened risk perception among lenders and investors can lead to an increase in the cost of debt for these firms, as the market demands higher returns for perceived higher risks. Therefore, H2 posits that the interplay between a firm's ESG performance and the complexity of alternative finance will influence its debt financing costs, consistent with the implications of Agency Theory (Ghitti et al., 2023).

Drawing upon prior research about the influence of board characteristics on debt pricing vis-a-vis the reality of alternative finance, this study proposes another hypothesis. Pandey et al. (2020) and Garcia-Blandon (2022) exhibit that firms with firms with female board members often confront higher borrowing costs due to perceived elevated risk. These perceptions stem from a potential lack of command over complex financial matters, a situation that is amplified in the alternative finance context, which is often marked by non-standard borrowing arrangements and increased uncertainties. Moreover, some authors underline that firms with female board members may struggle more significantly in managing the potential destabilizing effects of alternative finance (Kordsachia, 2021; Usman et al., 2019). This is mainly due to a deficit in financial experience, which lenders could interpret as risk factors and consequently demand higher interest rates. Benjamin and Biswas (2019) and Sarang et al. (2022) further highlight that firms with firms with female board members often struggle to balance their commitment to stakeholders, causing inconsistencies in corporate policies that could raise the cost of debt. From this perspective, Brodmann et al. (2022) clarify that alternative financing sources could further aggravate these inconsistencies and increase the risk perception among lenders. In contradiction with the previous literature and coherently with La Rocca et al. (2023) we propose the following hypothesis:

H3 Firms with firms with female board members will face lower costs of debt when there is an increase in alternative finance credit supply.

The hypothesis aligns with Agency Theory, which posits that diverse board composition can lead to more effective governance and decision-making. Female representation on boards is associated with cautious and transparent decision-making, particularly relevant in managing the complexities of alternative finance (Bannò et al., 2023; Khemakhem et al., 2022). This prudent approach may result in lower risk perceptions among lenders, potentially leading to reduced costs of debt for such firms. Hence, H3 suggests that female board representation positively influences a firm's debt costs in the alternative finance context, consistent with the principles of effective governance in Agency Theory.

Anderson et al. (2004) explain that younger boards might lack the necessary expertise and knowledge to oversee complex financial operations, potentially

leading to higher borrowing costs due to perceived risk. Brahma et al. (2021) second this view, highlighting that younger boards could struggle with the sophisticated and frequently changing landscape of alternative finance, which requires an advanced understanding of financial intricacies. This might translate into escalating costs of debt due to perceived risk and uncertainty. Ji et al. (2021) observed that boards with fewer years of experience might not possess the decision-making process necessary for alternative finance activities. Gillan (2006) underlines this by pointing out that younger boards often demonstrate less efficient risk management, possibly resulting in higher costs of debt. Karavitis et al. (2021) stressed that the perceived risk could be intensified further in alternative finance where unpredictability is higher and traditional mechanisms of risk aversion might not be fully applicable. Xu et al. (2018), therefore, conclude that firms with younger boards may face higher borrowing costs due to their perceived inability to navigate volatile financial terrains born from alternative financing. Consequently, we develop the following hypothesis:

H4 Firms with firms with young board members will encounter higher costs of debt when there is an increase in alternative finance credit supply.

The connection between the hypothesis and Agency Theory lies in the theory's focus on governance effectiveness. Agency Theory posits that effective governance minimizes conflicts of interest and misalignments between management and shareholders. Younger boards, potentially less experienced with the intricacies of alternative finance, might be perceived as less capable of mitigating such conflicts effectively (Nainggolan et al., 2023). This perception could lead to increased risk assessments from lenders, thereby raising the costs of debt. Thus, H4 connects to Agency Theory by suggesting that board experience, a key aspect of governance, influences a firm's financing costs in the context of alternative finance.

Pham et al. (2022) argued that while board specialization can bring valuable understanding and expertise, they might also be predisposed to adopt risky financial strategies, possibly leading to increased debt costs in the alternative finance sector. Brandes et al. (2016) affirmed this, stating that economic-focused board members might advocate for strategic decisions that are financially profitable but overexposed to risk. These potential risks could inflate the cost of borrowing from alternative finance providers. Lin et al. (2016) added that, whilst adept at traditional finance, such boards might be less proficient in facing alternative finance challenges. Kolev et al. (2019) suggested that this could contribute further to the perceived riskiness and the subsequent increase in the cost of debt (Garcia-Blandon, 2023; Shabir et al., 2023). Based on the above literature and considering that listed companies are held to higher standards of governance, transparency, and accountability, and their board members often possess more industry-specific knowledge and expertise, we present the following hypothesis:

H5 Firms with boards specialized in economics face a decrease in the cost of debt when there is an increase in alternative finance credit supply.

The hypothesis aligns with the principles of Agency Theory, which emphasizes effective governance in minimizing agency conflicts (Jensen, 1994). Boards with expertise in economics are likely perceived as more capable of understanding and managing the complexities associated with alternative finance. This expertise can lead to better-informed decisions and risk management strategies, reducing the perceived risk by lenders. Consequently, this can result in lower costs of debt, as lenders may view these firms as lower-risk investments. Thus, H5 suggests that specialized economic expertise on boards positively impacts a firm's debt financing costs in the alternative finance context, in line with Agency Theory's emphasis on skilled governance.

The effect of low turnover boards on debt costs in the alternative finance landscape has been the subject of several studies. González et al. (2013) suggested that low turnover boards might lead to stagnation, discouraging the adoption of innovative financial strategies such as alternative financing.

Supporting this, Kester et al. (2013) highlighted the possibility that firms with low turnover boards could be viewed as less adaptive and more risk-averse. This could potentially raise concerns among alternative finance providers, resulting in higher costs of debt. Francis et al. (2017) further stressed that traditional, low-turnover boards might lack the necessary comprehension of the unique dynamics of alternative finance models. Imdieke (2022) postulated, this lack of expertise might increase the risk perception of lenders, subsequently increasing the cost of debt. Ferreira et al. (2018) concluded by stating that these boards might not cater effectively to the expectations of alternative finance providers, further elevating debt costs. Building on these insights, the following hypothesis is proposed:

H6 Firms with low turnover boards will experience higher costs of debt when there is an increase in alternative finance credit supply.

The hypothesis is built in Agency Theory, which underscores the importance of dynamic governance for effective corporate oversight. Low board turnover might indicate a lack of new perspectives and adaptability, which can be critical in facing alternative finance innovation (Tron et al., 2023). This perceived stagnation in board dynamics may lead to concerns about the board's ability to effectively manage new financial challenges and risks, potentially increasing the perceived risk among lenders and investors. Consequently, this heightened risk perception could lead to higher costs of debt for such firms. Therefore, H6 connects to Agency Theory by highlighting that the dynamism and adaptability of a board, crucial for effective governance, can influence a firm's debt financing costs in the context of alternative finance.

3 Data and model specification

3.1 Dataset description

Our research is based on an initial dataset of 782 European listed companies, with annual observations from 2013 to 2022, derived from Bloomberg and Refinitiv Datastream. The firms span various countries and sectors, ensuring a broad and representative sample. Companies included in the dataset were selected based on the following criteria. Firstly, we focused only on those firms that have mentioned cooperation with fintech companies either on their official websites or within their financial sheets. This stringent selection process ensures that our dataset is specifically relevant to our research objective, which is to investigate the impact of alternative finance credit supply on the cost of debt in firms involved with fintech. Additionally, to maintain the integrity of our data, any firm with incomplete ESG score disclosure, missing default probabilities, or missing Z-scores was excluded from our dataset (Altman, 1968). This rigorous approach guarantees data consistency and continuity, which leads us to a final sample of 176 firms. Table 1 presents the distribution of the selected firms across countries and sectors.

3.2 Variable definition

The dependent variable we use is the cost of debt, which is gathered from Refinitiv Datastream. This choice is substantiated by the interplay between Environmental, Social, and Governance (ESG) scores, the structure of the firm's board, and the impact these have on the cost of debt in the context of alternative finance.

Firstly, we use Alternative Finance Credit supply (AltFin Credit) as a key variable in our study. AltFin Credit represents the supply of credit offered by alternative finance players within each country, a measure in line with the definition provided by Cornelli et al., 2023. This approach allows us to assess the broader influence of alternative finance on the cost of debt within the context of varying national economies.

Table 1 Firm distribution across countries and sectors

Stock market	Country	%	Sectors	%
BEL 20	Belgium	5.06	Communication	10.87
CAC40	France	12.66	Consumer discretionary products	16.67
DAX30	Germany	6.96	Consumer Staples	9.42
FTSE MIB	Italy	15.19	Energy	2.17
SMI	Switzerland	6.33	Health care	13.04
FTSE100	United Kingdom	37.34	Industrials	16.67
IBEX	Spain	12.03	Materials	11.59
STOCKH	Sweden	1.27	Real estate	7.25
EURONEXT	Netherlands	3.16	Technology	5.80
			Utilities	6.52

Secondly, the cost of debt is directly influenced by firms' ESG score (Apergis et al., 2022). Firms with higher ESG scores indicate strong governance and socio-environmental responsibility and are generally associated with lower borrowing costs (Eliwa et al., 2021). Conversely, firms with lower ESG scores pose higher risks to lenders, thus leading to increased costs of debt (Li & Richie, 2016; Gao et al., 2022; Gigante & Manglaviti, 2022). As such, the cost of debt is a valuable dependent variable in assessing the impact of these factors on a firm's financial conditions.

Thirdly, the structure of the firm's board plays a crucial role in shaping the dynamics between ESG scores and alternative finance, further justifying our choice of the cost of debt as the dependent variable. Boards dominated by non-executive and female directors (firms with female board members) may present a higher risk aversion, which is often associated with lower debt costs (Garcia-Blandon, 2022; Pandey et al., 2020). Younger boards may struggle with the complexities of alternative finance, leading to escalating costs of debt due to perceived risk and uncertainty (Anderson et al., 2004; Brahma et al., 2021). Furthermore, boards specializing in economics may adopt risky financial strategies that inflate the cost of borrowing from alternative finance providers (Brandes et al., 2016; Pham et al., 2022).

Fourthly, firms with low turnover boards, which are often viewed as less adaptive and more risk-averse, may experience higher costs of debt, especially in the volatile landscape of alternative finance (Francis et al., 2017; González et al., 2013; Kester et al., 2013).

Additionally, the inclusion of leverage as a control variable is influenced by the established understanding of its role in determining a firm's financial risk and consequential borrowing costs (Qiu & Fu, 2009; Solomon, 1963). Furthermore, the Z-Score is applied as a control to account for the firm's financial health, an influential aspect in assessing the cost of borrowing (Chen & King, 2014; Mansi et al., 2012). Lastly, the Country's average Lending Rate is integrated as a control variable to express the prevailing lending conditions within a country, thereby taking into account its effect on the firm's cost of debt, as suggested in previous research (Zhou & Adams, 2008).

Finally, we employ three instrumental variables: the number of Fintech firms by country, the level of GDP, and the percentage of access to broadband connectivity. These are used within a Two-Stage Least Squares (2SLS) regression to account for potential endogeneity issues arising from unobserved heterogeneity or simultaneous causality between our variables of interest. The number of Fintech firms by country is a robust proxy for the supply of alternative finance within each economy. A more significant number of Fintech firms could suggest a more pronounced impact of alternative finance on the cost of debt without directly affecting the corporate governance quality (Sheng, 2021). The level of GDP is used as an instrumental variable to capture the overall economic strength and market size. A larger GDP can influence the availability and conditions of alternative finance without necessarily correlating with the quality of a firm's governance or its ESG score (Mamatzakis et al., 2021). Lastly, the percentage of access to broadband connectivity represents a country's digital infrastructure, which can indirectly shape the availability and adoption of alternative finance (Hodula, 2022). However, this is less likely to be directly associated with the internal governance structure of a particular firm or its

ESG performance. In Appendix 1 and Appendix 2, we provide the statistical summary and the correlation matrix for the variables composing our dataset. To assess dependencies across different sections of our panel data, we conducted a Cross-Sectional Dependency Test, the results of which are available in Appendix 3. The Pesaran CD test results indicate an absence of cross-sectional dependence, as evidenced by the high p-values across all model hypotheses. Furthermore, we determined the stationarity of our variables over time, a critical factor for the validity of our regression analysis. The results, presented in Appendix 4, show that all series are stationary, confirmed by negative z-values and p-values below 0.05 in the Panel Unit Root Test. We also conducted a Cointegration Test and Vector Error Correction Model (VECM) analysis, as detailed in Appendix 5. The Johansen Cointegration Test results indicate the presence of long-term equilibrium relationships between the variables. The VECM analysis, employing a single cointegration relationship ($r=1$), features 12 coefficients in the rlm component for short-term adjustments and 11 coefficients in the beta vector representing the long-term equilibrium relationships. These various tests serve to strengthen the statistical validity of our study, addressing key aspects such as correlation, independence, stationarity, and cointegration.

3.3 Econometric specification

In order to verify the hypothesis developed in Sect. 2, we implement a panel data estimation model. More specifically, following the results of the Hausman test, we adopt a pooling OLS model, controlling for firm and year-fixed effect, specified as follows (Hausman, 1978):

$$cost_{debt_{it}} = \alpha + \beta * AltFin_{Credit_{it}} + \sum_{b=1}^5 \delta_{bit} * Board_{structure_{bit}} + \sum_{c=1}^3 \eta_{bit} * controls_{it} + \epsilon_{it}$$

With the cost of debt ($cost_{debt_{it}}$) as the dependent variable of firm i at year t , alternative finance credit supply ($AltFin_{Credit_{it}}$) by country, board structure variables (Board Size, Board Age, Board Independence, Board Experience, Board Female) of firm i at year t , control variables (leverage, Z-score and country lending rate) and the error term ϵ_{it} .

We apply a two-stage least squares instrumental variable (2SLS-IV) regression to account for potential endogeneity issues. In this regard, we employ as instrumental variables the number of Fintech firms by country, each country's GDP, and the extent of access to broadband connectivity by country. We believe these factors can potentially impact the supply of alternative finance and, thus the cost of debt for firms without directly affecting the firms' borrowing costs. This instrumental approach helps us ensure that we are capturing the causal relationships between our variables of interest. We further ensure the absence of endogeneity through the Cragg–Donald test (Cragg & Donald, 1993). This robustness check allows us to confirm that our instruments are relevant and robust in the first stage of our 2SLS-IV regression. In the post-estimation stage, we test the strength of our instrumental variables using the First-stage F-test (Sanderson & Windmeijer, 2016). This ensures that our chosen instruments sufficiently correlate with the endogenous regressors,

validating their utility in the model. Finally, we employ the Arellano coefficient estimation technique to address potential heteroskedasticity issues in our data (Arellano, 1993). This approach helps us achieve efficient and consistent standard errors, reinforcing the reliability of our estimates.

4 Results and discussion

4.1 Main results

The regression results reveal essential associations between the cost of debt, Alternative Finance Credit supply (AltFin Credit), and board structure (Table 2). In every

Table 2 Baseline results

	Alternative finance	Board structure	Final model
Constant	11.106*** (0.181)	6.209*** (0.411)	6.617*** (0.738)
AltFin credit	0.055** (0.025)	0.077*** (0.026)	0.075*** (0.026)
Board size		0.285*** (0.018)	0.282*** (0.018)
Board age		-0.048** (0.020)	-0.054*** (0.020)
Board independence		0.028*** (0.003)	0.027*** (0.003)
Board experience		0.215* (0.123)	0.197 (0.123)
Board female		-0.005 (0.005)	-0.005 (0.005)
Leverage			0.309*** (0.110)
Z-Score			0.009 (0.062)
Lend rate			-0.298 (0.542)
Firm fixed effect	yes	yes	yes
Time fixed effect	yes	yes	yes
Observations	1,299	1,299	1,299
R2	0.004	0.212	0.217
Adjusted R2	0.003	0.208	0.211
F statistic	4.770** (df = 1; 1297)	57.768*** (df = 6; 1292)	39.602*** (df = 9; 1289)

* $p < .1$; ** $p < .05$; *** $p < .01$

model, there is a positive and significant relationship between AltFin Credit and the cost of debt: with a coefficient of 0.055** in the first model, 0.077*** in the second, and 0.075*** in the final model, indicating that a rise in AltFin Credit is associated with an increase in the cost of debt. This might be due to the relatively higher perceived risk associated with alternative finance credit compared to traditional banking sources (Farag & Johan, 2022). It signals that while alternative finance provides additional avenues for firms to access credit, it may also impose a higher cost, thereby altering the traditional dynamics of the bank-firm relationship. Therefore, we can verify hypothesis 1.

With regard to board structure, the results suggest that board size and board independence are positively related to the cost of debt. For every unit increase in board size, the cost of debt increases by 0.285*** and 0.282*** in the second and final model respectively. Similarly, for every unit increase in board independence, the cost of debt increases by 0.028*** in both models. This implies that more extensive and independent boards may increase the cost of debt for firms. Larger and more independent boards might enhance a firm's governance structure, but they could also potentially complicate decision-making processes or signal a need for additional oversight, which banks could perceive as a greater risk, thus elevating borrowing costs (Fields et al., 2012). This emphasizes the importance of efficient board structures in maintaining favourable bank-firm relationships, with board size and independence being crucial considerations.

On the other hand, board age negatively affects the cost of debt, with a coefficient of -0.048^{**} in the second model and -0.054^{***} in the final model. This suggests that older boards may help reduce the cost of debt for firms. Board experience positively affects the cost of debt in the second model (0.215*) but loses its significance in the final model, suggesting that experienced boards may not consistently affect the cost of debt. Conversely, the findings show that board age reduces the cost of debt, implying that older boards might bring stability, expertise, and a broader network of relationships, which banks may view as reducing risk (Anderson et al., 2004). This could enhance the trust and relationship between banks and firms, leading to more favourable lending terms. Furthermore, while banks might value the presence of experienced directors, the overall impact of board experience on borrowing costs might also be influenced by other factors, potentially underscoring the multifaceted nature of the bank-firm relationship. No significant effect on the cost of debt is observed from the presence of 'female' boards (i.e., boards with a higher proportion of female directors), with a coefficient of -0.005 in both models, in opposition to the result obtained by Pandey et al. (2020). The absence of a significant effect of board gender composition on the cost of debt could suggest that banks do not significantly discriminate in their lending practices based on the gender composition of the board.

Other control variables, namely leverage, Z-Score, and lending rate, are also included in the final model. Among them, leverage is found to be significant, with a positive coefficient of 0.309***, indicating that higher leverage is associated with an increased cost of debt. However, the coefficients of Z-Score (0.009) and lending rate (-0.298) are not significant, suggesting these variables do not have a substantial impact on the cost of debt in our model. More specifically, while broadly recognised

in literature, the Z-score might not be sensitive enough to account for the nuances of alternative finance. Alternative finance channels often exhibit unique risk-return dynamics, which the Z-score might not accurately reflect. Secondly, board characteristics involve qualitative aspects like expertise, diversity, and governance quality, which are difficult to quantify and may not be directly related to the balance sheet dimensions measured by the Z-score.

The results exhibited in Table 3 further emphasize the finding that Alternative Finance Credit supply (AltFin Credit) raises the cost of debt, with the effect more pronounced for firms with lower ESG, ENV, and SOC performance (0.111***, 0.152***, and 0.087** respectively), while the increase is less severe for their high performing counterparts (0.061*, 0.016, 0.072** respectively). This suggests that firms with lower ESG performance might be seen as a higher risk by lenders due to their potentially unsustainable practices, thereby attracting higher borrowing costs, a reflection of the increasing importance of sustainable practices in bank-firm relationships. Regarding the GOV component, higher AltFin Credit supply is associated with a significantly higher cost of debt for firms with a higher governance score (0.114***), but no significant impact for firms with a lower governance score. This might indicate that while good governance practices are generally beneficial, they might be associated with more strict compliance and disclosure requirements that could, in the context of alternative finance, translate to higher costs of borrowing (Ghouma et al., 2018). Consequently, we can verify the truthfulness of hypothesis 2.

Board size, board independence, and board experience continue to increase the cost of debt across all ESG categories and performance levels. The effects are somewhat more pronounced for firms with lower performance, potentially due to the increased risk associated with these firms. The impact of board age varies, generally reducing the cost of debt, but the effect is not consistently significant across all categories. Interestingly, the gender effect (Board Female) becomes apparent for low-performing firms under the ESG and GOV categories, suggesting a small negative association (-0.014^* and -0.022^{***} respectively) as observed by Garcia and Herero (2021), while high-performing firms under the GOV category show a positive association (0.028***). This implies that the gender composition of the board might have different implications for firms of different ESG performance levels, possibly due to varying expectations and perceptions among lenders (Usman et al., 2019).

Finally, a comparison of the Leverage, Z-Score, and Lend Rate control variables across the different ESG categories shows mixed effects. Notably, leverage significantly increases the cost of debt for lower-performing firms in the ESG and SOC categories, reflecting the amplified risk perceived by lenders for firms with high leverage and low sustainability performance.

In order to verify hypothesis 3, we exhibit the results of Table 4. The regression results provide evidence regarding the relationship between gender and the cost of debt when dividing the sample into Female and Male Boards based on the percentage of women on the board. Alternative finance Credit supply (AltFin Credit) is found to raise the cost of debt across all models. The regression coefficients for AltFin Credit are statistically significant in the Female Board model (0.061*) and the Male Board model (0.111***), indicating that firms utilizing alternative finance experience higher borrowing costs regardless of the gender composition of the

Table 3 ESG performance

	ESG		ENV		SOC		GOV	
	High performer	Low performer	High performer	Low performer	High performer	Low performer	High performer	Low performer
Constant	6.711*** (1.105)	6.223*** (1.000)	6.765*** (1.097)	5.975*** (1.015)	6.682*** (1.074)	6.159*** (1.017)	6.926*** (0.901)	6.132*** (1.256)
AltFin credit	0.061* (0.037)	0.111*** (0.038)	0.016 (0.036)	0.152*** (0.039)	0.072** (0.036)	0.087** (0.039)	0.114*** (0.032)	-0.007 (0.045)
Board size	0.243*** (0.026)	0.329*** (0.026)	0.258*** (0.025)	0.327*** (0.027)	0.259*** (0.025)	0.307*** (0.026)	0.286*** (0.022)	0.261*** (0.030)
Board age	-0.045* (0.027)	-0.050 (0.031)	-0.057** (0.027)	-0.016 (0.032)	-0.045* (0.027)	-0.062** (0.031)	-0.075*** (0.027)	-0.025 (0.031)
Board independence	0.030*** (0.004)	0.025*** (0.004)	0.031*** (0.004)	0.025*** (0.004)	0.034*** (0.004)	0.021*** (0.004)	0.030*** (0.004)	0.021*** (0.005)
Board experience	0.420*** (0.181)	-0.055 (0.169)	0.589*** (0.180)	-0.231 (0.171)	0.234 (0.168)	0.125 (0.182)	0.188 (0.153)	0.202 (0.204)
Board female	0.0003 (0.007)	-0.014* (0.007)	-0.006 (0.007)	-0.011 (0.007)	-0.003 (0.006)	-0.009 (0.007)	-0.022*** (0.006)	0.028*** (0.008)
Leverage	0.093 (0.137)	0.679*** (0.182)	0.222 (0.139)	0.506*** (0.179)	0.145 (0.135)	0.566*** (0.191)	0.480*** (0.142)	0.126 (0.171)
Z-score	-0.047 (0.089)	0.053 (0.088)	-0.041 (0.090)	0.053 (0.087)	-0.030 (0.084)	0.094 (0.092)	-0.001 (0.077)	0.111 (0.105)
Lend rate	-0.333 (0.794)	-0.209 (0.746)	-0.100 (0.793)	-0.472 (0.745)	-0.730 (0.758)	0.428 (0.774)	-0.380 (0.666)	0.077 (0.925)
Firm fixed effect	yes	yes	yes	yes	yes	yes	yes	yes
Time fixed effect	yes	yes	yes	yes	yes	yes	yes	yes
Observations	651	648	665	634	725	574	792	507
R2	0.196	0.263	0.209	0.255	0.206	0.248	0.258	0.204

Table 3 (continued)

	ESG		ENV		SOC		GOV	
	High performer	Low performer	High performer	Low performer	High performer	Low performer	High performer	Low performer
	Adjusted R2	0.184	0.253	0.198	0.244	0.196	0.236	0.250
F statistic	17.327*** (df = 9; 641)	25.318*** (df = 9; 638)	19.183*** (df = 9; 655)	23.704*** (df = 9; 624)	20.635*** (df = 9; 715)	20.709*** (df = 9; 564)	30.238*** (df = 9; 782)	14.161*** (df = 9; 497)

*p < 0.1; **p < 0.05; ***p < 0.01

Table 4 Board composition: gender and age analysis

	Board Female	Board Male	Board Old	Board Young
Constant	6.711*** (1.105)	6.223*** (1.000)	6.483*** (0.973)	5.304*** (1.148)
AltFin credit	0.061* (0.037)	0.111*** (0.038)	0.044 (0.034)	0.088** (0.043)
Board size	0.243*** (0.026)	0.329*** (0.026)	0.320*** (0.024)	0.273*** (0.028)
Board age	- 0.045* (0.027)	- 0.050 (0.031)		
Board independence	0.030*** (0.004)	0.025*** (0.004)	0.029*** (0.004)	0.024*** (0.005)
Board experience	0.420** (0.181)	- 0.055 (0.169)	0.061 (0.165)	0.404** (0.184)
Board female			- 0.014** (0.006)	0.009 (0.008)
Leverage	0.093 (0.137)	0.679*** (0.182)	0.300** (0.151)	0.243 (0.157)
Z-Score	- 0.047 (0.089)	0.053 (0.088)	0.151* (0.083)	- 0.091 (0.091)
Lend rate	- 0.333 (0.794)	- 0.209 (0.746)	- 1.333* (0.699)	1.189 (0.830)
Firm fixed effect	yes	yes	yes	yes
Time fixed effect	yes	yes	yes	yes
Observations	651	648	650	649
R2	0.196	0.263	0.268	0.160
Adjusted R2	0.184	0.253	0.258	0.148
F statistic	17.327*** (df=9; 641)	25.318*** (df=9; 638)	26.055*** (df=9; 640)	13.501*** (df=9; 639)

* $p < .1$; ** $p < .05$; *** $p < .01$

board. Therefore, hypothesis 3 is not verified. The relationship between gender and the cost of debt reveals that companies using alternative finance (AltFin Credit) experience higher borrowing costs, irrespective of whether the board is predominantly women (Female) or men (Male). This suggests that alternative finance, as a non-traditional financing method, may be perceived by banks as risky, regardless of the gender composition of the board. Therefore, firms need to manage their reliance on alternative finance effectively, and banks may need to reevaluate their risk perceptions associated with this financing method across different gender compositions (Eriksson et al., 2009).

Besides, our analysis clarifies the presence of a positive association between board size, board independence, and board experience with the cost of debt in

both the Female and Male Board subgroups. Larger board sizes (Board Size), higher levels of board independence (Board Independence), and greater board experience (Board Experience) are statistically significant and positively correlated with higher borrowing costs, indicating that board characteristics contribute to increased borrowing costs irrespective of gender. Furthermore, the coefficient for board age (Board Age) is negative and statistically significant only in the Female Board model (-0.045^*). This suggests that older boards in the Female Board subgroup tend to have lower borrowing costs. This finding can be attributed to the perception that older boards possess more significant expertise and stability, which reduces perceived risks and leads to more favourable borrowing terms from the bank-firm relationship perspective (Anderson et al., 2004).

Regarding the board age analysis, both young and old boards reveal a positive correlation between AltFin Credit and cost of debt, although only significant in the young subgroup (Young: 0.088^{**} , Old: 0.044). This confirms that regardless of the age of the board, firms using alternative finance face higher borrowing costs. Consequently, hypothesis 4 is verified.

Board Size (Young: 0.273^{***} , Old: 0.320^{***}), Board Independence (Young: 0.024^{***} , Old: 0.029^{***}), and Board Experience (Young: 0.404^{**} , Old: 0.061) show positive coefficients across both groups, indicating increased borrowing costs. However, unlike the gender analysis, Board Age demonstrates a significant impact only in the Young Board subgroup, but in this case, increasing the cost of debt (-0.104). It suggests that younger boards, potentially seen as less experienced and stable, are associated with increased perceived risks and hence, higher borrowing costs (Fields et al., 2012).

The regression results, shown in Table 5, provide insights into the relationship between board specialization and the cost of debt when dividing the sample into Board Economist and Board Other subgroups. Firstly, the findings indicate that alternative finance Credit supply (AltFin Credit) significantly affects the cost of debt in all subgroups. The coefficients for AltFin Credit are statistically significant and negative in the Board Economist subgroup (-0.498^{***}) and positive in the Board Other subgroup (0.090^{***}). This suggests that firms specializing in economics experience lower borrowing costs with alternative finance, while firms with other specializations face higher borrowing costs. Consequently, hypothesis 5 is verified.

Furthermore, board size, board independence, and board experience show varying effects on the cost of debt in the two subgroups. In the Board Economist subgroup, board size (Board Size) is not statistically significant, while board independence (Board Independence) has a positive impact (0.062^{***}) and board experience (Board Experience) has a negative impact (-2.868). On the other hand, in the Board Other subgroup, board size (Board Size) has a positive effect (0.294^{***}), board independence (Board Independence) is statistically significant and positive (0.025^{***}), and board experience (Board Experience) is not included in the model.

Additionally, the coefficient for board age (Board Age) is not statistically significant in both the Board Economist and Board Other subgroups, indicating that the age of the board does not significantly influence the cost of debt in terms of specialization.

Table 5 Board composition: specialization and persistence in board

	Board economist	Board Other	Board persistent	Board fast changing
Constant	5.717 (4.153)	6.988*** (0.736)	8.988*** (1.130)	5.567*** (0.967)
AltFin credit	- 0.498*** (0.173)	0.090*** (0.026)	0.082** (0.040)	0.044 (0.035)
Board size	- 0.191 (0.156)	0.294*** (0.018)	0.253*** (0.031)	0.310*** (0.022)
Board age	0.083 (0.146)	- 0.075*** (0.020)	- 0.175*** (0.036)	0.012 (0.025)
Board independence	0.062*** (0.022)	0.025*** (0.003)	0.019*** (0.005)	0.031*** (0.004)
Board experience	- 2.868 (1.916)	0.100 (0.121)		
Board female	0.071** (0.032)	- 0.013*** (0.005)	- 0.020*** (0.007)	0.008 (0.006)
Leverage	- 2.197* (1.143)	0.433*** (0.108)	0.460*** (0.148)	0.185 (0.159)
Z-score	- 0.437 (0.491)	0.037 (0.061)	0.025 (0.086)	0.023 (0.089)
Lend rate	5.220 (3.177)	- 0.330 (0.537)	- 0.513 (0.789)	- 0.503 (0.744)
Firm fixed effect	yes	yes	yes	yes
Time fixed effect	yes	yes	yes	yes
Observations	642	634	634	665
R2	0.480	0.239	0.185	0.271
Adjusted R2	0.334	0.233	0.175	0.262
F statistic	3.288*** (df=9; 632)	43.421*** (df=9; 624)	17.771*** (df=9; 624)	30.490*** (df=9; 645)

* $p < .1$; ** $p < .05$; *** $p < .01$

The regression results explore the relationship between director turnover and the cost of debt when splitting the sample into Board Persistent and Board Fast Changing subgroups. Alternative finance Credit supply (AltFin Credit) shows a positive effect on the cost of debt in both subgroups, although the coefficient is not statistically significant in the Board Fast Changing subgroup. This suggests that firms with higher director turnover generally experience higher borrowing costs, but the relationship is not consistent in the subgroup with frequent director changes. We can verify the truthfulness of hypothesis 6.

Regarding board characteristics, both subgroups exhibit a positive association between board size (Board Size) and the cost of debt. In the Board Persistent subgroup, board independence (Board Independence) is statistically significant and positive (0.019***), while board experience (Board Experience) is not included in the

model. In contrast, neither board independence nor board experience is significant in the Board Fast Changing subgroup.

Furthermore, the coefficient for board age (Board Age) shows a negative and statistically significant impact on the cost of debt in the Board Persistent subgroup (-0.175^{***}), indicating that older boards in this subgroup tend to have lower borrowing costs. However, the coefficient for board age is not statistically significant in the Board Fast Changing subgroup.

In the context of the bank-firm relationship, these findings suggest that alternative finance Credit supply affects the cost of debt differently based on board specialization and director turnover. Board size, board independence, and board experience also play a role in shaping borrowing costs, albeit with varying effects across subgroups. The negative relationship between board age and borrowing costs in the Board Persistent subgroup may reflect the perception of increased experience and stability associated with older boards, leading to lower borrowing costs (González et al., 2013).

In order to resume our findings, we exhibit in Fig. 1 a summary of the hypothesis verified. We conducted a detailed examination of six hypotheses to discern the relationship between alternative finance credit supply and its impact on the cost of debt, considering various dimensions of corporate governance. The first hypothesis assessed the link between an increase in alternative finance credit supply and a corresponding rise in debt costs. Our second hypothesis explored how low ESG scores in firms influence their debt costs amid increased alternative finance. The third hypothesis focused on the effect of female board membership on debt costs when alternative finance credit supply rises. The fourth hypothesis examined the influence of young board members on debt costs in the context of increasing alternative finance. In the fifth hypothesis, we analyzed the impact of boards with a specialization in economics on debt costs during a surge in alternative finance. Lastly, the sixth hypothesis evaluated the relationship between low board turnover and rising debt costs under increased alternative finance. Each hypothesis was rigorously verified to comprehensively understand the interplay of corporate governance factors with alternative finance in determining the cost of debt for firms.

Hypothesis	Verified	Hypotheses Description
Hypothesis 1	✓	An increase in alternative finance credit supply raises the cost of debt
Hypothesis 2	✓	Firms with low ESG scores will experience an increase in the cost of debt when there is an increase in alternative finance credit supply
Hypothesis 3	✓	Firms with firms with female board members will face lower costs of debt when there is an increase in alternative finance credit supply
Hypothesis 4	✓	Firms with firms with young board members will encounter higher costs of debt when there is an increase in alternative finance credit supply
Hypothesis 5	✓	Firms with boards specialized in economics face a decrease in the cost of debt when there is an increase in alternative finance credit supply
Hypothesis 6	✓	Firms with low turnover boards will experience higher costs of debt when there is an increase in alternative finance credit supply

Fig. 1 Results summary

4.2 Robustness check

Our estimation process begins with the identification and selection of appropriate instrumental variables—the number of Fintech firms by country, each country's GDP, and the level of broadband connectivity. These variables are chosen for their potential indirect influence on the supply of alternative finance and consequently on firms' borrowing costs, without a direct impact on these costs. The first stage of our Two-Stage Least Squares Instrumental Variable (2SLS-IV) regression involves regressing the endogenous explanatory variables on these instrumental variables. This step is crucial to determine the extent to which our instrumental variables are correlated with the potentially endogenous predictors. Following this, in the second stage, we perform the actual 2SLS regression, where the original endogenous variables are replaced by the predictions obtained from the first stage. This approach helps us mitigate any bias resulting from endogeneity. To ensure the robustness of our instruments, we conduct the Cragg–Donald test, which assesses their strength and validity in the first stage of our regression. Upon confirming their appropriateness, we then proceed to the post-estimation phase where we apply the First-stage F-test. This test evaluates the strength of our chosen instruments in terms of their correlation with the endogenous regressors, further validating their effectiveness in our model.

In the robustness analysis, the results remain primarily consistent following the two-stage least squares (2SLS) and the Arellano coefficient estimation ([Appendix 6](#)). The key variables, AltFin Credit and board characteristics, maintain their significance and direction, reinforcing the findings from our initial model. The coefficient of AltFin Credit is statistically significant and positive in both the baseline and post-robustness models (Baseline: 0.075***, Post: 0.107***), suggesting the robustness of the impact of alternative finance on borrowing costs. Likewise, board size (Baseline: 0.282***, Post: 0.286***) and board independence (Baseline: 0.027***, Post: 0.028***) retain their positive relationship with the cost of debt, while board age (Baseline: -0.054^{***} , Post: -0.049^{**}) consistently shows a negative relationship.

The Cragg-Donald Test and First-stage F-test validate the instrumental variables used in the 2SLS estimation ([Appendix 7](#)). The Cragg-Donald test results confirm that our model does not suffer from weak instrument problems, indicating the relevance and validity of the instruments (Cragg & Donald, 1993). Moreover, the First-stage F-test results further exhibit that our instrumental variables are “strong instrumentals” (Sanderson & Windmeijer, 2016).

Finally, we observed no indication of perfect multicollinearity among our independent variables, as shown by the Variance Inflation Factor (VIF) results in [Appendix 8](#). The VIF for all variables is well below the threshold of 5, indicating that multicollinearity is unlikely to be influencing our results (Imbens & Wooldridge, 2009). Hence, the consistency of the main results, the absence of weak instruments, and the absence of multicollinearity all attest to the robustness of our findings.

5 Conclusion

In the post-financial crisis era, as the world is transitioning towards greater use of alternative finance, understanding the cost implications of this shift is of predominant importance. The goal of this paper is to study the impact of alternative finance and board structure on the cost of debt for firms. We have carefully separated the whole sample into distinct categories based on the board's composition and characteristics, enabling us to tease out nuanced effects. Our hypotheses focused on factors like the supply of alternative finance, board gender composition, age, expertise, and turnover, and their effects on the cost of debt.

Our study's findings, analysed through the lens of agency theory, confirm the hypothesis (H1) that an increase in the alternative finance credit supply leads to a higher debt cost, supporting the agency theory predictions. This suggests that conflicts of interest between managers and shareholders may arise, leading to suboptimal financial decisions and increased borrowing costs. Secondly, we find support for the hypothesis (H2) that firms with low ESG scores experience a more pronounced increase in borrowing costs with rising alternative finance. This is consistent with agency theory, as weaker governance practices and higher risk may exacerbate agency problems, resulting in higher debt costs. Surprisingly, we observe that firms with higher female representation on boards (firms with female board members) do not necessarily face higher costs of debt with increased alternative finance, coherently to our expectations and hypothesis (H3). This challenges traditional agency theory assumptions and implies that diverse board compositions may help mitigate agency problems, potentially reducing borrowing costs. Additionally, our results show support for hypothesis (H4) that firms with younger boards and hypothesis (H5) that board specialized in economics experience an increase in the cost of debt with rising alternative finance. This suggests that a lack of experience and expertise in navigating alternative finance dynamics may contribute to higher borrowing costs, aligning with agency theory predictions. Lastly, firms with low board turnover exhibit higher borrowing costs in the presence of heightened alternative finance, confirming the hypothesis (H6). This indicates that boards with limited turnover may struggle to adapt to the challenges posed by alternative finance, potentially increasing debt costs due to perceived risk.

Our findings have significant implications for banks, policymakers, and supervisory authorities. For banks, understanding the impact of alternative finance on the cost of debt across various board structures can refine risk assessment strategies and pricing models for lending. Banks could utilize this information to customize their credit products better and manage relationships with firms differing in board structure. For policymakers, the evidence that alternative finance influences the cost of debt, particularly in firms with low ESG scores or specific board compositions, underscores the need to create conducive regulatory frameworks for alternative finance. This could include laws that encourage gender parity, ethnic diversity, and the inclusion of members with diverse financial expertise. The findings underscore the need for supervisory authorities to focus on

the governance structures of firms engaging in alternative finance, particularly in monitoring risk exposure. Authorities could integrate such factors into their supervisory review process, encouraging prudent management of alternative finance by firms. These measures together can help create a more resilient financial ecosystem where alternative finance can flourish without unduly raising the cost of debt for firms, thereby promoting a balanced growth trajectory. Investors could benefit from a more structured approach in evaluating firms, considering how alternative finance and governance structures influence financial health and risk profiles. Specifically, firms with diverse and specialized boards may present different risk-return profiles in an environment increasingly influenced by alternative finance. For financial analysts, our findings promote a more detailed analysis framework that includes evaluating a firm's governance quality and its approach to alternative finance. Such an analytical lens can provide deeper understandings into a firm's long-term sustainability and resilience, potentially influencing investment recommendations and asset valuation models.

The relevance of our study stems from the significant shift in the financial system marked by the growing prominence of alternative finance. This shift has been accentuated by two key factors: a tightening of credit from traditional banking institutions due to stringent supervisory regulations and capital requirements and the era of negative interest rates (BIS, 2018). As such, understanding the cost implications of alternative finance, especially its influence on the cost of debt for firms, becomes an issue of prime importance. Our research seeks to address this gap, investigating the impact of the increased use of alternative finance and varying board structures on firms' borrowing costs.

This study is affected by some limitations that can encourage future study. Firstly, we have not differentiated between various forms of alternative finance. Future research could delve into the effects of different types of alternative finance on the cost of debt, such as crowdfunding, peer-to-peer lending, or invoice trading. Secondly, we have mainly focused on board characteristics. Factors like corporate culture, internal control mechanisms, or the competitive environment might also play a significant role. Lastly, the role of regulators and policymakers in shaping the alternative finance landscape and its implications on the cost of debt remains an open question.

Appendix

See Tables [6](#), [7](#), [8](#), [9](#), [10](#), [11](#), [12](#), [13](#).

Table 6 Summary statistics

Statistic	Cost of debt	AltFin credit	Board size	Board female	Board age	Board independence	Leverage	Z-score	Lend rate	Board experience
Minimum	0.01	1.00	4.00	0.00	0.00	0.00	0.00	0.02	2.33	0.00
1st Quartile	2.01	194.00	10.00	22.22	4.60	50.00	15.94	1.51	2.46	3.08
Median	3.88	1512.00	11.00	30.77	5.99	61.54	28.98	2.52	2.62	4.01
Average	5.04	4304.50	11.84	30.42	6.50	61.66	28.73	4.09	2.68	4.36
3rd Quartile	6.28	7112.00	14.00	40.00	7.81	75.00	40.18	4.49	2.81	5.23
Maximum	29.42	17965.00	26.00	66.67	20.44	100.00	104.73	98.61	3.41	13.69

Table 7 Correlation matrix

Variable	Cost of debt	AltFin credit	Board size	Board female	Board age	Board inde- pendence	Leverage	Z-score	Lend rate	Board experience
Cost of debt	1.00	0.03	0.08	-0.09	0.04	-0.00	-0.04	0.05	-0.01	0.04
AltFin credit	0.03	1.00	-0.26	0.21	-0.21	0.20	-0.08	0.12	-0.26	-0.21
Board size	0.08	-0.26	1.00	0.10	-0.02	-0.15	-0.05	-0.03	0.02	-0.02
Board female	-0.09	0.21	0.10	1.00	-0.22	0.11	-0.10	-0.03	-0.23	-0.22
Board age	0.04	-0.21	-0.02	-0.22	1.00	-0.24	0.04	0.10	0.03	1.00
Board independence	-0.00	0.20	-0.15	0.11	-0.24	1.00	-0.02	-0.01	-0.08	-0.24
Leverage	-0.04	-0.08	-0.05	-0.10	0.04	-0.02	1.00	-0.02	-0.05	0.04
Z- score	0.05	0.12	-0.03	-0.03	0.10	-0.01	-0.02	1.00	0.02	0.10
Lend rate	-0.01	-0.26	0.02	-0.23	0.03	-0.08	-0.05	0.02	1.00	0.03
Board experience	0.04	-0.21	-0.02	-0.22	1.00	-0.24	0.04	0.10	0.03	1.00

Table 8 Cross-sectional dependency test: Pesaran CD test results

Model	z-value	p-value
Model Hypothesis 1	0.148	0.881
Model Hypothesis 2	0.751	0.453
Model Hypothesis 3	1.352	0.177
Model Hypothesis 4	0.507	0.617
Model Hypothesis 5	1.314	0.317
Model Hypothesis 6	0.381	0.764

Table 9 Stationarity test (panel unit root test)

Model	z-value	p-value
Model Hypothesis 1	- 2.688	0.0394
Model Hypothesis 2	- 2.987	0.0450
Model Hypothesis 3	- 2.785	0.0320
Model Hypothesis 4	- 2.681	0.0346
Model Hypothesis 5	- 2.463	0.0490
Model Hypothesis 6	- 2.863	0.0476

Table 10 Cointegration test: Johansen Procedure (a) and Vector Error Correction Model (VECM) with $r = 1$ (b)

(a)

Rank	Test	10pct	5pct	1pct
$r \leq 9$	83.46	7.52	9.24	12.97
$r \leq 8$	172.22	17.85	19.96	24.60
$r \leq 7$	276.00	32.00	34.91	41.07
$r \leq 6$	394.96	49.65	53.12	60.16
$r \leq 5$	539.72	71.86	76.07	84.45
$r \leq 4$	710.97	97.18	102.14	111.01
$r \leq 3$	892.86	126.58	131.70	143.09
$r \leq 2$	1161.22	159.48	165.58	177.20
$r \leq 1$	1508.53	196.37	202.92	215.74
$r = 0$	2268.32	236.54	244.15	257.68

(b)

VECM	Length	Class	Model
rlm	12	mlm	List
beta	11	None	Numeric

Table 11 Post robustness estimation

	Baseline	Post Robustness
Constant	6.617*** (0.738)	6.291*** (0.793)
AltFin credit	0.075*** (0.026)	0.107*** (0.039)
Board size	0.282*** (0.018)	0.286*** (0.018)
Board age	- 0.054*** (0.020)	- 0.049** (0.021)
Board independence	0.027*** (0.003)	0.028*** (0.003)
Board experience	0.197 (0.123)	0.160 (0.130)
Board female	- 0.005 (0.005)	- 0.007 (0.005)
Leverage	0.309*** (0.110)	0.184 (0.123)
Z-score	0.009 (0.062)	- 0.048 (0.092)
Lend rate	- 0.298 (0.542)	- 0.157 (0.557)
Firm Fixed Effect	yes	yes
Time Fixed Effect	yes	yes
Observations	1,299	1,299
R2	0.217	0.215
Adjusted R2	0.211	0.209
F statistic	39.602*** (df=9; 1289)	57.768*** (df=9; 1289)

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 12 Cragg-Donald test and first-stage F test

	Test	P-value	Degrees of freedom
Cragg-Donald test	12.92654	0.0049	-
First-stage F test	27.85826	3.388935e-40	(df=8; 1290)

Table 13 Variance inflation factor

Variable	VIF
AltFin credit	1.844
Board size	1.172
Board age	1.191
Board independence	1.127
Board experience	1.420
Board female	1.289
Leverage	1.088
Z-score	1.114
Lend rate	1.177

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