

The Role of Environmental and Social Responsibility in Reducing the Cost of Financing of Petrochemical Companies

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ABSTRACT

The present study aimed to investigate the role of environmental and social responsibility in reducing the cost of financing of petrochemical companies. In terms of purpose, this study was applied, and in terms of methodology, it employed a descriptive-correlational design. The statistical population consisted of all financial managers, deputy financial managers, and internal auditors of petrochemical companies listed on the Tehran Stock Exchange; according to official information, this population was estimated at 120 individuals. Using the Krejcie and Morgan table, the required sample size was determined to be 92 individuals. Following questionnaire distribution and collection, 85 completed and valid questionnaires were retained for the final analysis. The data collection instrument was a researcher-developed questionnaire based on a five-point Likert scale, with its items adapted from validated measures used in previous studies. The content validity of the questionnaire was confirmed through consultation with university professors and subject-matter experts, while construct validity, including convergent and discriminant validity, was assessed using the average variance extracted (AVE) and the Fornell–Larcker criterion. Instrument reliability was also confirmed using Cronbach's alpha and composite reliability (CR), both of which exceeded the threshold of .70. SMART PLS 3 software and structural equation modeling (SEM) were employed to test the hypotheses and assess the fit of the conceptual model. The path analysis results indicated that all four research hypotheses were supported at the 95% confidence level, indicating that both environmental and social responsibility had positive and statistically significant effects on reducing the cost of debt financing and increasing shareholders' equity. The findings suggest that petrochemical companies can reduce investors' perceived risk and gain access to less expensive and more attractive sources of financing by improving their environmental and social performance.

Keywords: environmental responsibility, social responsibility, cost of financing, petrochemical companies, Tehran Stock Exchange.

Introduction

The growing integration of environmental and social considerations into corporate strategy has transformed the way firms are evaluated by investors, creditors, regulators, and other stakeholders. Traditionally, financing decisions were primarily based on conventional indicators such as profitability, leverage, liquidity, asset structure, and expected cash flows. In recent years, however, environmental and social performance has increasingly become part of the information set used to assess corporate risk and long-term financial sustainability. This shift is particularly evident in capital-intensive and pollution-intensive industries, where environmental externalities, regulatory exposure, stakeholder pressure, and reputational risks may directly affect firms' financing conditions.



Article history:
Received 11 June 2026
Revised 04 September 2026
Accepted 11 September 2026
Initial Publish 27 November 2026
Published online 01 October 2027

How to cite this article:

Loghavian Zadeh, M., (2027). The Role of Environmental and Social Responsibility in Reducing the Cost of Financing of Petrochemical Companies. *Journal of Management and Business Solutions*, 5(6), 1-17. <https://doi.org/10.61838/jmbs.440>



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From the perspective of legitimacy theory, organizations are expected to align their activities with the values and expectations of the societies in which they operate, and environmental and social disclosures can function as mechanisms through which firms demonstrate such alignment and preserve organizational legitimacy (1). At the same time, the sustainable-finance literature increasingly treats environmental, social, and governance performance as financially material rather than merely ethical or reputational. Large-scale evidence suggests that environmental, social, and governance performance is frequently associated with favorable corporate financial outcomes, although the strength and direction of these relationships may vary across institutional settings, industries, measurement frameworks, and time periods (2). Consequently, environmental and social responsibility has evolved from a peripheral corporate concern into a potential determinant of access to capital, financing risk, and the cost at which financial resources can be obtained.

Theoretically, several mechanisms explain why environmentally and socially responsible firms may face lower financing costs. Corporate responsibility can reduce information asymmetry by improving the quality, scope, and credibility of nonfinancial information available to external capital providers. Better disclosure may enable creditors and investors to evaluate future liabilities, regulatory risks, operational vulnerabilities, and stakeholder-related uncertainties more accurately. Responsible environmental and social conduct can also strengthen stakeholder relationships, enhance corporate reputation, reduce the probability of costly controversies, and decrease the perceived likelihood of unexpected cash-flow shocks. In financing markets, these characteristics can translate into lower required risk premiums and improved access to external funds. Cheng et al. demonstrated that stronger corporate social responsibility can facilitate access to finance by reducing agency problems and informational frictions between firms and capital providers (3). Similarly, the role of social capital in debt contracting indicates that trust, reputation, and the quality of social relationships can affect the terms under which firms obtain both bank loans and public debt (4). These mechanisms are closely related to the broader development of responsible investment, in which investors seek portfolios that jointly reflect risk-return efficiency and environmental, social, and governance characteristics rather than considering financial returns independently from corporate responsibility (5). Accordingly, firms with stronger environmental and social responsibility may benefit not only from stakeholder approval but also from measurable financial advantages in capital markets.

The cost of debt represents one of the most direct channels through which environmental and social performance can influence corporate financing. Creditors price debt according to expected default risk, information quality, asset quality, cash-flow stability, and exposure to events that can impair a borrower's repayment capacity. Environmental violations, litigation, regulatory sanctions, inefficient resource use, pollution liabilities, and social conflicts can increase such risk, particularly in industries where environmental externalities are substantial. Empirical evidence from European countries indicates that environmental, social, and governance practices are associated with debt financing conditions, suggesting that creditors incorporate corporate sustainability characteristics into their risk assessments (6). Likewise, research focused specifically on ESG scores and the cost of debt has reinforced the proposition that sustainability performance can affect borrowing costs because ESG information provides lenders with additional signals about managerial quality, long-term risk, and corporate resilience (7). Magnanelli and Izzo similarly examined the relationship between corporate social performance and the cost of debt, further demonstrating the relevance of socially responsible behavior for debt-market outcomes (8). More recent evidence shows that both ESG performance and ESG disclosure can influence borrowing costs and that corporate reputation

may mediate this relationship, indicating that the financing consequences of responsibility may partly emerge through the reputational capital accumulated by responsible firms (9).

The relationship between responsibility and financing costs is particularly important for firms operating in environmentally sensitive industries. Pollution-intensive companies face greater regulatory scrutiny and are more exposed to environmental taxes, remediation obligations, transition risks, community resistance, and changes in environmental policy. Under such conditions, proactive environmental responsibility may operate as a form of risk management that reduces uncertainty surrounding future liabilities and improves the firm's credibility with capital providers. Evidence from pollution-intensive industries shows that corporate social responsibility, particularly when supported by green financial policies and institutional guidelines, can contribute to reductions in the cost of debt financing (10). In the Chinese context, green social responsibility has also been linked to corporate financing costs, reinforcing the argument that environmental and socially responsible practices can affect the financial terms offered to listed companies (11). Moreover, corporate governance mechanisms are relevant because environmental externalities may differ according to organizational ownership, monitoring, and accountability structures, implying that the financing relevance of environmental responsibility cannot be separated entirely from the governance environment in which firms operate (12). These findings are highly relevant to petrochemical companies because their production processes, emissions profiles, energy consumption, waste generation, occupational risks, and environmental impacts make environmental and social responsibility particularly salient to regulators, communities, creditors, and equity investors.

Environmental and social responsibility can also affect equity financing. Equity investors determine the required rate of return according to their assessment of systematic and firm-specific risk, growth opportunities, governance quality, information transparency, and the probability of adverse events. Stronger responsibility practices may therefore lower the perceived risk premium attached to a firm and improve its attractiveness to investors. Research on ESG disclosure and the cost of capital suggests that the financial consequences of sustainability reporting extend beyond debt markets and can influence the broader cost of external capital (13). More specifically, evidence on corporate social responsibility and the cost of equity indicates that CSR practices can affect shareholders' required returns, although mechanisms such as earnings-management behavior may alter the magnitude or credibility of this relationship (14). Amarna et al. similarly examined ESG disclosure, real earnings management, and financing costs, emphasizing that the financial benefits of sustainability-related information depend not only on disclosure volume but also on the credibility and quality of the reported information (15). Thus, environmental and social responsibility may influence equity financing by improving transparency, reducing uncertainty, signaling managerial commitment to long-term value creation, and strengthening confidence in the sustainability of future cash flows.

The quality of sustainability communication is especially important because not all environmental and social disclosures necessarily provide equally useful information to capital providers. Sustainability reports can reduce information asymmetry when they communicate verifiable, comparable, and decision-relevant information, but they may also be used symbolically for impression management. The use of visual devices and infographics in sustainability reporting illustrates this tension, as communication techniques may improve accessibility while simultaneously creating opportunities for selective presentation or reputational embellishment (16). Consequently, investors and creditors may distinguish between substantive environmental and social responsibility and merely symbolic disclosure. This distinction helps explain why empirical findings regarding ESG and financing outcomes are not always uniform across contexts. In addition, socially responsible behavior may contribute to investment

efficiency by improving transparency and corporate decision-making, thereby reducing the likelihood that capital is allocated to value-destroying projects (17). These considerations suggest that the financing effect of responsibility should be examined not simply as a reporting phenomenon but as a broader organizational capability involving genuine environmental performance, stakeholder management, accountability, and credible disclosure.

Recent developments in financial markets provide further evidence that ESG-related characteristics are increasingly incorporated into credit allocation. Research on corporate access to commercial credit financing indicates that stronger ESG performance can create financing benefits outside conventional bank lending and securities markets, expanding the range of external financing channels potentially available to responsible firms (18). Similarly, recent evidence examining ESG performance from a supply-chain perspective suggests that sustainability characteristics may affect debt financing costs through interorganizational relationships, risk transmission, and the quality of firms' positions within supply networks (19). These findings are especially significant for petrochemical firms because they operate within complex supply chains involving feedstock suppliers, industrial contractors, transportation networks, export markets, downstream manufacturers, and regulatory institutions. Environmental incidents or social controversies in such networks can generate financial consequences beyond the boundaries of the focal firm. Therefore, environmental and social responsibility may improve financing conditions not only through direct investor perceptions but also by strengthening supply-chain resilience, reducing counterparty concerns, and demonstrating the firm's capacity to manage operational and stakeholder risks over the long term.

The importance of these issues became even more evident under conditions of heightened uncertainty. The COVID-19 pandemic illustrated how institutional environments and major external shocks can alter the relationship between corporate social performance and debt structures. Evidence suggests that corporate social performance and firm debt levels may be affected by both crisis conditions and the institutional setting in which firms operate (20). This observation is relevant because the financing advantages associated with environmental and social responsibility are unlikely to be universal or mechanically identical across markets. Legal enforcement, investor protection, environmental regulation, disclosure requirements, banking structures, capital-market development, and stakeholder expectations can shape how sustainability information is interpreted. Firms operating in emerging markets may face different financing constraints and disclosure incentives from firms in more developed markets. Accordingly, studies conducted in European, Chinese, or other international settings cannot automatically be generalized to the Iranian capital market without direct empirical examination. A context-specific analysis is therefore necessary to determine whether environmental and social responsibility is materially associated with financing outcomes among firms operating under the regulatory, economic, and institutional conditions of Iran.

This contextual issue is particularly important in the Tehran Stock Exchange, where petrochemical and chemical companies constitute a strategically important segment of the listed corporate sector. Iranian evidence has already highlighted the relevance of environmental information to corporate financial evaluation. A financial performance model based on environmental information disclosure among companies listed on the Tehran Stock Exchange suggests that environmental reporting is linked to financial performance considerations in the domestic market (21). Research focusing specifically on petrochemical and chemical industry companies has also examined environmental disclosure in relation to mandatory and voluntary environmental costs and corporate tax behavior, demonstrating the increasing importance of environmental accounting and disclosure in this sector (22). Nevertheless, the financing implications of environmental and social responsibility remain insufficiently clarified in this setting. Petrochemical firms are simultaneously capital-intensive, environmentally sensitive, strategically

important, and dependent on substantial internal and external financial resources. Their financing decisions can therefore be affected by both conventional financial indicators and nonfinancial risk perceptions. Understanding whether stronger environmental and social responsibility is associated with lower financing costs and more favorable equity-related outcomes can provide useful evidence for corporate managers, investors, creditors, policymakers, and regulators concerned with sustainable corporate finance.

The distinction between debt-related and equity-related financing outcomes is also analytically important. Creditors and shareholders differ in their contractual claims, downside exposure, risk tolerance, monitoring mechanisms, and expected returns. Environmental and social responsibility may therefore influence these stakeholder groups through partially different channels. Creditors may respond primarily to default risk, cash-flow stability, collateral quality, regulatory liabilities, and the likelihood of financial distress, whereas shareholders may place greater weight on long-term growth, corporate reputation, stakeholder relationships, future profitability, and risk-adjusted returns. Evidence showing that ESG performance affects cost-of-debt outcomes (6, 7, 9) and that CSR and ESG practices are related to equity financing and broader capital access (3, 13, 14) supports the need to consider multiple financing dimensions rather than treating the cost of capital as a single undifferentiated construct. Such a distinction can reveal whether environmental responsibility and social responsibility have similar or different effects across financing channels and can provide managers with more precise guidance regarding which sustainability investments are most relevant to financial stakeholders.

Methodologically, examining these relationships also requires an analytical framework capable of simultaneously assessing latent constructs and multiple structural relationships. Environmental responsibility, social responsibility, and financing-related perceptions are multidimensional concepts that are often measured through sets of observed indicators rather than single directly observable variables. Partial least squares structural equation modeling is particularly suitable for assessing such relationships because it enables simultaneous evaluation of measurement quality and structural paths and is widely applied in studies involving latent variables and prediction-oriented models. The methodological foundations of PLS path modeling emphasize the importance of evaluating the measurement model through reliability and validity criteria and subsequently assessing the explanatory and predictive performance of the structural model (23). This approach is therefore appropriate for determining whether the proposed relationships between environmental responsibility, social responsibility, cost of financing, and shareholders' equity are supported by the observed data while accounting for measurement error across the underlying constructs.

Despite the expansion of the ESG and sustainable-finance literature, several gaps remain. First, much of the international evidence has been derived from developed economies or large emerging markets, while relatively limited evidence is available for Iranian listed companies. Second, previous studies frequently examine aggregated ESG scores or broad CSR indicators, whereas environmental responsibility and social responsibility may exert distinct effects on financing outcomes. Third, many studies focus solely on debt financing or the aggregate cost of capital and therefore provide limited evidence regarding how responsibility relates simultaneously to debt-related financing costs and equity-related outcomes. Fourth, sector-specific analysis remains essential because sustainability risks differ substantially across industries. In petrochemical companies, environmental responsibility is directly associated with pollution control, emissions, resource consumption, environmental compliance, and ecological externalities, while social responsibility encompasses employee welfare, occupational safety, community relations, stakeholder engagement, and broader social legitimacy. The financial consequences of these practices

may therefore be stronger and more visible than in sectors with lower environmental and social exposure. Furthermore, recent developments in ESG-oriented lending, responsible investment, reputation-based financing, green financial regulation, and supply-chain risk assessment indicate that the relationship between sustainability and corporate finance is becoming increasingly multidimensional (5, 10, 18, 19). A focused examination of petrochemical companies listed on the Tehran Stock Exchange can thus contribute context-specific evidence to this expanding literature.

Accordingly, the aim of the present study is to investigate the effects of environmental responsibility and social responsibility on the cost of financing and shareholders' equity in petrochemical companies listed on the Tehran Stock Exchange.

Methods and Materials

The present research is applied in terms of purpose and descriptive-correlational in terms of methodology. The statistical population of this study consisted of all financial managers, deputy financial managers, and internal auditors employed by petrochemical companies listed on the Tehran Stock Exchange, specifically companies operating in the petrochemical and chemical products industries. Based on information obtained from the relevant authorities and a review of the websites of the Tehran Stock Exchange and the Securities and Exchange Organization, the statistical population was estimated at 120 individuals. Based on the Krejcie and Morgan table and considering the size of the statistical population, the sample size was calculated as 92 individuals. Following the distribution and collection of the questionnaires, 85 completed and usable questionnaires were returned. A standardized questionnaire was used for data collection. The questionnaire items were adapted from validated scales employed in previous studies. A five-point Likert scale was used to measure the variables included in the conceptual model. This study employed SMART PLS 3 software and structural equation modeling to examine the relationships among the variables. One advantage of this approach over some other available software packages is that it does not require the data to follow a normal distribution (Kline, 2015). The validity of the questionnaire was evaluated and confirmed in terms of content validity and construct validity. To assess the content validity of the instrument, the opinions of professors and subject-matter experts were obtained, while convergent and discriminant validity were employed to assess construct validity within the structural equation modeling framework. Convergent validity was evaluated using the average variance extracted (AVE), whereas discriminant validity was assessed using the square root of the AVE (Hosseini et al., 2024). Reliability was assessed using Cronbach's alpha and composite reliability. Cronbach's alpha is a reliability coefficient ranging from 0 to 1, and a Cronbach's alpha value greater than .70 indicates acceptable reliability (Cronbach, 1951). Composite reliability (CR) was introduced by Werts et al. (1974), and its advantage over Cronbach's alpha is that construct reliability is calculated by taking into account the relationships among the construct indicators rather than being estimated in an absolute manner. A composite reliability value greater than .70 for each construct indicates satisfactory internal reliability of the measurement models, whereas a value below .60 indicates inadequate reliability. Fornell and Larcker (1981) introduced the average variance extracted (AVE) criterion for assessing convergent validity and proposed .50 as the critical threshold.

Findings and Results

The research model was evaluated in two stages. In the first stage, the outer measurement model was examined, followed by evaluation of the inner structural model in the second stage.

In the first stage, the factor loadings of the indicators measuring each variable were examined. Factor loadings greater than .40 were considered acceptable. The model in terms of the initial path coefficients and factor loadings is presented in Table 1 and Figure 1.

Table 1. Factor Loadings

Variable	Indicator	Factor Loading
Environmental Responsibility	Q1	0.873
	Q2	0.915
	Q3	0.882
Social Responsibility	Q4	0.882
	Q5	0.881
	Q6	0.864
Cost of Financing	Q7	0.655
	Q8	0.838
	Q9	0.869
Shareholders' Equity	Q10	0.780
	Q11	0.697
	Q12	0.814

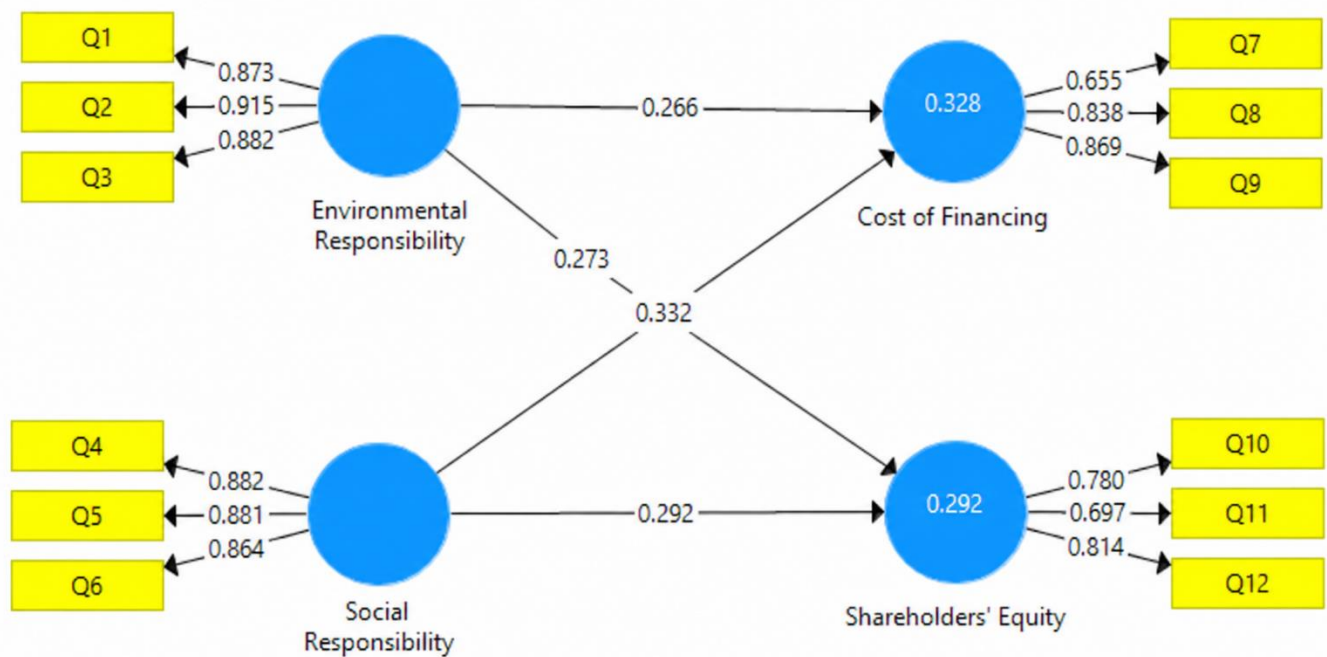


Figure 1. Structural Equation Model in the Standardized Coefficient Estimation Mode (Factor Loadings)

In SmartPLS, measurement model fit in terms of reliability is assessed using factor loadings and composite reliability (CR), convergent validity of the measurement models is assessed using average variance extracted (AVE), and discriminant validity is examined through the Fornell–Larcker criterion.

Table 2 presents Cronbach's alpha, composite reliability, and average variance extracted for each construct.

Table 2. Cronbach's Alpha, Composite Reliability, and Convergent Validity

Variable	Cronbach's Alpha	Composite Reliability	AVE
Shareholders' Equity	0.725	0.809	0.586
Social Responsibility	0.848	0.908	0.767
Environmental Responsibility	0.869	0.920	0.793
Cost of Financing	0.746	0.833	0.628

According to Table 2, Cronbach's alpha coefficients for all constructs were greater than .70, indicating satisfactory model reliability. Similarly, composite reliability values for all constructs exceeded .70, demonstrating satisfactory reliability. Furthermore, all AVE values were greater than .50, indicating adequate measurement model fit.

As shown in Table 3, the square roots of the AVE values for the latent variables, located on the main diagonal of the matrix, were greater than the corresponding interconstruct correlations shown below and to the right of the diagonal. This finding indicates satisfactory fit of the measurement models in terms of discriminant validity.

Table 3. Fornell–Larcker Criterion

Variable	Shareholders' Equity	Social Responsibility	Environmental Responsibility	Cost of Financing
Shareholders' Equity	0.765			
Social Responsibility	0.519	0.876		
Environmental Responsibility	0.516	0.835	0.890	
Cost of Financing	0.697	0.554	0.543	0.793

According to Table 3, all values on the main diagonal were greater than the corresponding values below and to the right of the diagonal; therefore, the model demonstrated satisfactory discriminant validity.

Several criteria were used to evaluate the fit of the structural model. The first and most fundamental criterion was the significance of the Z coefficients. Structural model fit was assessed using *t*-statistics, which must exceed 1.96 for statistical significance to be confirmed at the 95% confidence level. When the *t*-statistic is greater than 1.96, the path coefficient is statistically significant at the 95% confidence level, whereas a *t*-statistic greater than 2.58 indicates significance at the 99% confidence level (Davari & Rezazadeh, 2013).

Table 4. Z Significance Coefficients for the Hypotheses (T-Values)

Path	T-Value
Environmental Responsibility → Cost of Financing	2.337
Environmental Responsibility → Shareholders' Equity	2.162
Social Responsibility → Shareholders' Equity	2.138
Social Responsibility → Cost of Financing	2.830

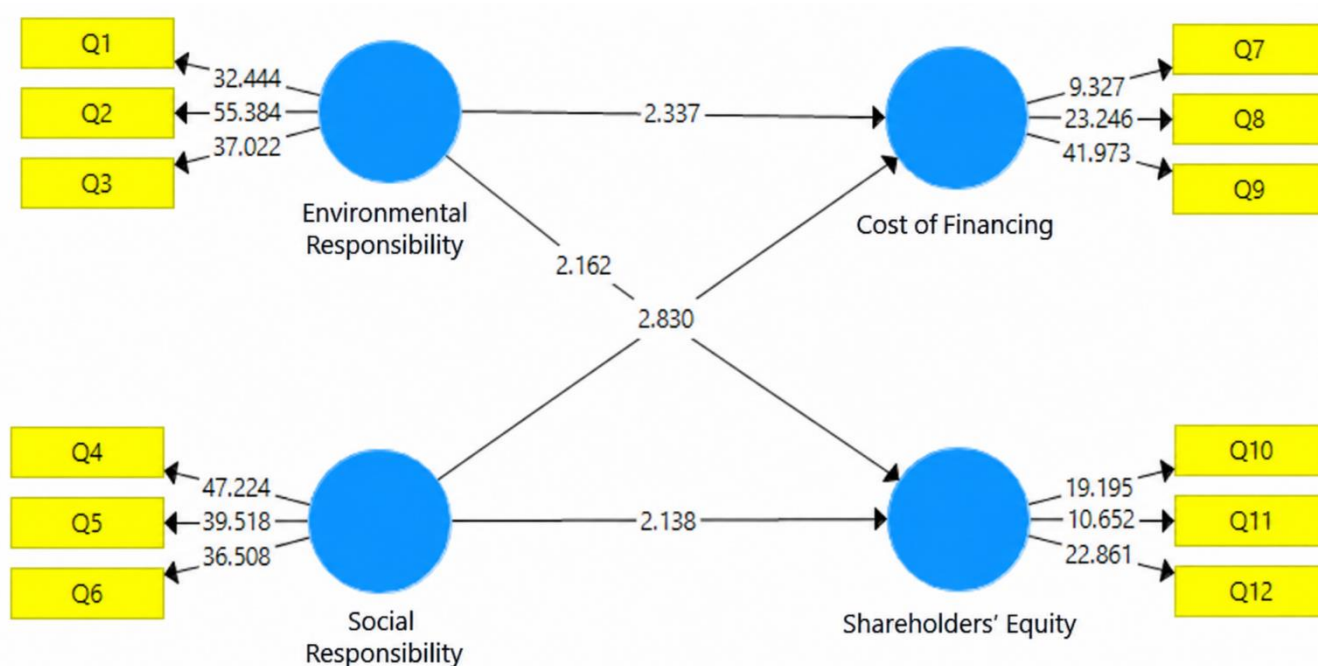


Figure 2. Structural Equation Model in the Z-Significance Coefficient Mode

R^2 is a criterion used to connect the measurement and structural components of structural equation modeling and represents the extent of the effect exerted by an exogenous variable on an endogenous variable. It should be noted that R^2 is calculated only for dependent (endogenous) constructs in the model; for exogenous constructs, this criterion is zero. Higher R^2 values for endogenous constructs indicate better model fit. Chin (1998) proposed the values of .19, .33, and .67 as benchmarks representing weak, moderate, and substantial structural model fit, respectively, based on R^2 .

Table 5. R-Square Values

Variable	R Square
Shareholders' Equity	0.292
Cost of Financing	0.328

The coefficients of determination presented in Table 5 indicate satisfactory model fit.

This criterion indicates the predictive capability of the model. Models demonstrating acceptable structural model fit should also be capable of predicting the indicators associated with the endogenous constructs. Henseler et al. (2009) proposed values of .02, .15, and .35 to represent weak, moderate, and strong predictive relevance, respectively. It should be noted that this value is calculated only for endogenous constructs whose indicators are reflective (Davari & Rezazadeh, 2013).

Table 6. Predictive Relevance (Q^2)

Variable	Q^2
Shareholders' Equity	0.146
Cost of Financing	0.188

The predictive relevance values reported in Table 6 indicate that this criterion is at an acceptable level.

There is no single criterion for assessing the entire model. Nevertheless, Tenenhaus et al. proposed an overall goodness-of-fit criterion known as the GOF index.

The overall model incorporates both the measurement and structural components, and confirmation of its fit completes the assessment of the full model. To evaluate the fit of the overall model, it is sufficient to calculate a single criterion known as GOF:

$$GOF = \sqrt{\text{Communalities} \times \bar{R}^2}$$

The Communalities value is obtained from the mean of the communality values reported in the preceding table.

The mean communality value was: 0.693.

The mean value of $\bar{R}^2$ was: 0.310.

Therefore, the GOF value was: 0.463.

Considering the values of .01, .25, and .36, which have been introduced as benchmarks for weak, moderate, and strong GOF, respectively, the value obtained for this criterion indicates a strong overall fit of the research model.

According to Ringle (2013), when $GOF > .35$, the quality of the model reaches 97% of the covariances.

With regard to testing the research hypotheses, structural fit was assessed using t -statistics, which must exceed 1.96 for their significance to be confirmed at the 95% confidence level. It should be noted that t -values indicate only whether the relationships are statistically significant and cannot be used to determine the strength of the relationships among constructs. Path coefficients, in contrast, indicate the positive or negative effect of one variable on another (Davari & Rezazadeh, 2013).

Table 7. Results of Hypothesis Testing

No.	Research Hypothesis	Path Coefficient	t -Statistic	p -Value	Significance Level	Result
1	Environmental Responsibility → Cost of Financing	0.266	2.337	0.020	$p < .05$	Supported
2	Environmental Responsibility → Shareholders' Equity	0.273	2.162	0.031	$p < .05$	Supported
3	Social Responsibility → Shareholders' Equity	0.292	2.138	0.033	$p < .05$	Supported
4	Social Responsibility → Cost of Financing	0.332	2.830	0.005	$p < .05$	Supported

According to Table 7, all of the research hypotheses were supported.

Discussion and Conclusion

The present study investigated the effects of environmental responsibility and social responsibility on the cost of financing and shareholders' equity among petrochemical companies listed on the Tehran Stock Exchange. The structural model results supported all four proposed relationships. Environmental responsibility had a positive and statistically significant effect on the cost-of-financing construct ($\beta = 0.266$, $t = 2.337$, $p = .020$) and on shareholders' equity ($\beta = 0.273$, $t = 2.162$, $p = .031$). Social responsibility also had a positive and statistically significant effect on shareholders' equity ($\beta = 0.292$, $t = 2.138$, $p = .033$) and on the cost-of-financing construct ($\beta = 0.332$, $t = 2.830$, $p = .005$). Consistent with the conceptualization adopted in this study, a favorable change in the cost-of-financing construct was interpreted as a reduction in financing costs. Therefore, the findings indicate that higher levels of environmental and social responsibility are associated with more favorable financing conditions and stronger equity-related outcomes. The explanatory power of the model was also acceptable, with R^2 values of 0.328 for the cost of financing and 0.292 for shareholders' equity. Moreover, the Q^2 values of 0.188 and 0.146, respectively, indicated meaningful predictive relevance, while the overall GOF value of 0.463 suggested strong overall model fit. These

results collectively demonstrate that environmental and social responsibility are not merely reputational or ethical dimensions of corporate conduct but can constitute financially relevant organizational attributes in the petrochemical industry.

The significant relationship between environmental responsibility and the cost of financing indicates that environmentally responsible practices can influence the way capital providers perceive corporate risk. Petrochemical companies are particularly exposed to environmental risks because their operations involve substantial energy consumption, emissions, hazardous materials, waste generation, and regulatory obligations. A company that systematically manages these risks can signal superior operational control, lower probability of environmental penalties, and greater preparedness for regulatory changes. Consequently, creditors and other financing providers may perceive such a company as less risky and demand a lower risk premium. This interpretation is consistent with evidence showing that higher ESG performance can reduce the cost of debt by improving lenders' assessments of corporate sustainability and long-term repayment capacity (7). Similar evidence from European firms suggests that ESG practices are incorporated into creditors' risk evaluations and can affect borrowing costs (6). The finding also agrees with research in pollution-intensive industries showing that corporate social responsibility and environmentally oriented financial policies are associated with lower debt financing costs (10). Thus, the present findings extend the broader international evidence to Iranian petrochemical companies and suggest that environmental responsibility may function as a risk-reduction mechanism in corporate financing.

This result is also consistent with the argument that green social responsibility can improve firms' financing conditions by reducing uncertainty regarding environmental liabilities and enhancing the confidence of external capital providers (11). Environmental responsibility may lower information asymmetry because firms that systematically monitor and communicate their environmental performance provide lenders and investors with additional information regarding resource efficiency, regulatory compliance, environmental contingencies, and future cash-flow risks. In a sector such as petrochemicals, these issues can directly affect expected profitability and the probability of unexpected financial obligations. The result is therefore also compatible with the findings of Maaloul et al., who showed that ESG performance and disclosure can reduce the cost of debt and that corporate reputation represents an important mechanism through which this effect occurs (9). A responsible environmental profile can enhance reputation, which in turn can improve relationships with banks, institutional investors, government bodies, customers, and other stakeholders. Such reputational capital may reduce perceived default risk and facilitate access to more favorable financing arrangements.

The positive and significant effect of environmental responsibility on shareholders' equity further demonstrates that the financial consequences of environmental performance are not limited to debt markets. The coefficient for this path was $\beta = 0.273$, indicating that improvement in environmental responsibility was associated with a favorable equity-related outcome. Equity investors are residual claimants and are therefore highly sensitive to long-term risks that may influence corporate cash flows, asset values, competitiveness, and firm survival. Environmental irresponsibility may generate penalties, remediation costs, production interruptions, litigation, reputational damage, or reduced market access. Conversely, proactive environmental management can reduce these risks and strengthen expectations regarding sustainable value creation. The result is consistent with the broader evidence summarized by Friede et al., who found that the majority of empirical studies examining ESG and corporate financial performance report nonnegative, and often positive, relationships between sustainability performance and financial outcomes (2). It is also compatible with the ESG-efficient frontier perspective, according to which responsible

investment characteristics can be incorporated into portfolio allocation without necessarily sacrificing financial performance and may improve the risk-return profile of investments (5).

The finding regarding environmental responsibility and shareholders' equity can additionally be interpreted through the informational and legitimacy functions of environmental disclosure. Legitimacy theory suggests that firms operating in environmentally sensitive industries face strong incentives to demonstrate that their activities conform to societal expectations and accepted environmental norms (1). For petrochemical firms, preserving legitimacy is especially important because their activities are visible to regulators, local communities, environmental organizations, and investors. Strong environmental responsibility can reduce legitimacy threats and thereby protect firm value. Iranian evidence also provides support for the relevance of environmental information in capital-market evaluation. Abgineh et al. developed a financial performance model based on environmental information disclosure among companies listed on the Tehran Stock Exchange and demonstrated the financial relevance of environmental reporting in the Iranian market (21). In addition, environmental disclosure and environmental costs have been examined specifically in Iranian petrochemical and chemical companies, further indicating that environmental issues have become increasingly material in this industry (22). Accordingly, the positive relationship observed in the present study is consistent with both international sustainability-finance research and emerging evidence from the Iranian corporate context.

The results also indicated that social responsibility had a statistically significant positive effect on shareholders' equity, with a path coefficient of $\beta = 0.292$. This finding suggests that socially responsible behavior can strengthen the attractiveness and perceived value of a petrochemical company from the perspective of equity holders. Social responsibility encompasses relationships with employees, local communities, customers, suppliers, and other stakeholders and therefore affects organizational reputation, stakeholder cooperation, and social legitimacy. Firms that maintain stronger stakeholder relationships may experience lower conflict, greater employee commitment, more stable operations, and stronger public acceptance. These characteristics can reduce uncertainty and support long-term value creation. The result aligns with Cheng et al., who demonstrated that corporate social responsibility can improve access to finance by reducing agency problems and informational asymmetry (3). When socially responsible behavior increases transparency and trust, investors may be more willing to provide capital and may perceive the firm's future cash flows as more sustainable.

The positive effect of social responsibility on shareholders' equity also corresponds with evidence that CSR-related disclosure can influence the cost of equity and investor assessments. Chouaibi and Zouari showed that CSR practices are related to the cost of equity and that real earnings management can mediate this relationship, emphasizing that the credibility of responsible behavior is important for capital-market consequences (14). Similarly, Amarna et al. found that ESG disclosure and real earnings management interact in shaping the cost of financing, highlighting the importance of transparent and credible sustainability information (15). These findings help explain the present result because investors are unlikely to respond only to the existence of CSR activities; rather, they evaluate whether such activities reflect genuine organizational commitment and whether the associated disclosures are credible. For petrochemical companies, substantive responsibility toward employees and communities may be particularly important because industrial operations can have substantial social and occupational consequences. Effective social responsibility can therefore serve as a signal of competent management and lower stakeholder-related risk.

The strongest structural coefficient in the model was observed for the effect of social responsibility on the cost of financing ($\beta = 0.332$, $t = 2.830$, $p = .005$). This finding implies that, within the studied model, social responsibility had an especially important association with favorable financing conditions. One explanation is that lenders assess not only financial statements but also qualitative indicators of corporate stability. Poor labor relations, occupational accidents, community conflicts, stakeholder disputes, and reputational crises can disrupt operations and create direct or indirect financial losses. Socially responsible companies may therefore be viewed as having more stable stakeholder relationships and lower nonfinancial risk. This interpretation is supported by evidence on social capital and debt contracting. Hasan et al. showed that social capital can affect bank loans and public bond financing by influencing trust and contracting conditions (4). Social responsibility can similarly generate relational capital and trust, thereby lowering perceived risk and improving access to external financing.

The result is also consistent with Magnanelli and Izzo, who identified a relationship between corporate social performance and the cost of debt (8). Furthermore, recent research suggests that ESG performance can improve access to commercial credit financing, indicating that sustainability characteristics may expand financing opportunities beyond traditional bank debt (18). From a supply-chain perspective, ESG performance may also affect debt financing costs because lenders consider the stability, sustainability, and interconnected risks of firms within their supply networks (19). This mechanism is particularly relevant to petrochemical companies because they operate within complex networks of suppliers, industrial contractors, transportation firms, downstream producers, and export markets. Responsible treatment of stakeholders can reduce supply-chain disruption and improve contractual reliability, which can indirectly reduce financing risk.

The findings regarding social responsibility should also be interpreted in relation to the institutional environment. Bai and Ho demonstrated that the association between corporate social performance and debt levels can vary according to institutional conditions and external shocks such as the COVID-19 pandemic (20). Therefore, the financing benefits of social responsibility may depend partly on how stakeholders, lenders, and investors evaluate nonfinancial risk in a particular market. In the Iranian context, where firms may encounter distinctive financial constraints, regulatory conditions, and capital-market structures, social responsibility may provide an additional signal of stability and managerial quality. This could explain why social responsibility displayed a stronger coefficient for the cost-of-financing construct than environmental responsibility in the present model. Stakeholder relationships may be immediately visible to lenders through operational continuity, employee relations, supplier reliability, and reputational standing, whereas some environmental benefits may materialize over a longer horizon.

Nevertheless, the financial benefits of environmental and social responsibility depend on the credibility of corporate sustainability activities and disclosures. Kanbaty et al. emphasized that sustainability-reporting tools can either communicate useful information or be employed for impression management (16). Thus, firms cannot assume that symbolic reporting alone will generate favorable financing effects. Investors and creditors are likely to distinguish between substantive responsibility and superficial communication, particularly as ESG assessment becomes more sophisticated. Furthermore, CSR disclosure has been associated with improved investment efficiency, indicating that responsibility-related information may contribute to more effective corporate resource allocation (17). In this sense, environmental and social responsibility can produce financing benefits when they are embedded in managerial decision-making and supported by reliable reporting, rather than being treated solely as promotional activities.

Taken together, the findings support a stakeholder- and risk-based interpretation of the relationship between corporate responsibility and financing outcomes. Environmental and social responsibility can reduce informational uncertainty, enhance reputation, strengthen stakeholder trust, mitigate operational and regulatory risks, and signal managerial quality. These mechanisms can improve access to financing and strengthen the position of equity holders. The results are therefore consistent with prior studies showing that ESG practices can affect both the cost of debt and broader access to capital (3, 6, 7, 9). The findings are also consistent with research demonstrating that environmental and social performance can contribute to financial performance, responsible investment efficiency, and more favorable debt and equity market outcomes (2, 5, 13). From a methodological standpoint, the acceptable reliability, convergent validity, discriminant validity, explanatory power, predictive relevance, and overall model fit provide support for the structural relationships estimated using PLS-SEM, consistent with the use of partial least squares path modeling for the simultaneous analysis of latent constructs and structural relationships (23). Overall, the results reinforce the proposition that environmental and social responsibility should be understood as part of firms' financing strategy and risk-management architecture rather than as activities separate from financial management.

The present study is subject to several limitations that should be considered when interpreting its findings. First, the statistical population was restricted to financial managers, deputy financial managers, and internal auditors of petrochemical companies listed on the Tehran Stock Exchange, and the final analysis was based on 85 valid questionnaires; therefore, the findings may not be fully generalizable to unlisted petrochemical firms, other industries, or firms operating in different institutional environments. Second, the study relied on questionnaire-based self-reported data, which may be affected by respondents' perceptions, social desirability, common method bias, or differences in their knowledge of corporate environmental and social practices. Third, the cross-sectional design limits the ability to establish temporal precedence or strong causal inference, because responsibility practices and financing outcomes were assessed within a single period. Fourth, environmental responsibility, social responsibility, cost of financing, and shareholders' equity were operationalized as latent constructs based on perceptual indicators rather than exclusively through audited archival measures. Finally, the model focused on direct relationships and did not incorporate potential mediating or moderating variables such as corporate reputation, disclosure quality, firm size, leverage, profitability, governance quality, environmental risk, ownership structure, or regulatory pressure.

Future studies can extend the present research by employing longitudinal or panel designs capable of examining whether improvements in environmental and social responsibility precede changes in financing conditions over time. Researchers may also combine questionnaire data with archival financial indicators, including the effective interest rate on debt, credit spreads, weighted average cost of capital, market-based cost of equity, leverage, and market valuation, in order to improve measurement precision and reduce dependence on self-reported assessments. Comparative research across petrochemical, petroleum, mining, steel, cement, pharmaceutical, and other industries would be useful for determining whether the strength of these relationships varies according to environmental exposure and capital intensity. Future models could examine corporate reputation, information asymmetry, risk perception, disclosure quality, stakeholder trust, and investment efficiency as mediators, while firm size, ownership structure, governance quality, regulatory intensity, export orientation, and financial constraints could be assessed as moderators. Multi-group analysis could further determine whether the effects differ across large and small firms, private and state-affiliated companies, or companies with different levels of environmental exposure. Finally, future studies could distinguish more explicitly between substantive environmental and social

performance and symbolic sustainability disclosure to identify which dimension has the greatest influence on capital providers.

Managers of petrochemical companies should integrate environmental and social responsibility into financial strategy, capital budgeting, enterprise risk management, and investor-relations activities rather than treating sustainability as an isolated compliance function. Environmental investments aimed at emission reduction, waste management, energy efficiency, pollution prevention, and regulatory compliance should be evaluated not only in terms of their direct environmental benefits but also in terms of their potential effects on corporate risk and financing conditions. Companies should likewise strengthen occupational health and safety, employee development, community engagement, supplier responsibility, grievance mechanisms, and transparent stakeholder communication. Financial managers should systematically communicate credible environmental and social performance indicators to banks, institutional investors, shareholders, and other capital providers and demonstrate how these initiatives reduce operational, regulatory, and reputational risks. Firms should also establish measurable sustainability targets, internal monitoring systems, and reliable reporting mechanisms so that responsibility initiatives can be verified and distinguished from symbolic disclosure. By integrating these practices into strategic and financial decision-making, petrochemical companies may strengthen stakeholder confidence, improve their financing position, enhance shareholders' equity, and support more sustainable long-term corporate value creation.

Acknowledgments

We would like to express our appreciation and gratitude to all those who helped us carrying out this study.

Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

Funding

This research was carried out independently with personal funding and without the financial support of any governmental or private institution or organization.

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