



# Managing Financial Risks in the Petrochemical Industry: A Corporate Social Responsibility Approach to Sustainable Development



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**Received:** 10-15-2024

**Revised:** 12-18-2024

**Accepted:** 12-25-2024

**Citation:** Imeni, M., Puška, A., Edalatpanah, S. A., & Karimi, H. (2024). Managing financial risks in the petrochemical industry: A corporate social responsibility approach to sustainable development. *Oppor Chall. Sustain.*, 3(4), 208-222. <https://doi.org/10.56578/ocs030402>.



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**Abstract:** This study investigates the relationship between financial risk management, corporate social responsibility (CSR), and sustainable development within the petrochemical industry. The research aims to explore the impact of financial risk management practices on CSR initiatives and to assess how these factors collectively contribute to the long-term sustainability of petrochemical companies. A key focus of the study is the role that CSR plays in advancing sustainable development, particularly in sectors facing significant financial and operational risks. The research is applied in nature, offering practical insights for improving risk management strategies in petrochemical corporations. The study sample consisted of 130 experienced managers from the petrochemical industry, selected based on the number of items in the survey questionnaire. The measurement tool used was a researcher-developed questionnaire, which was designed following an extensive review of relevant literature and consultations with subject matter experts. To ensure the validity of the instrument, content validity was assessed, and reliability was confirmed through the calculation of Cronbach's alpha coefficient. Data were analyzed using Partial Least Squares (PLS) software, which revealed significant findings regarding the influence of financial risk management on CSR and sustainable development. The results underscore the crucial role of effective financial risk management in facilitating CSR initiatives and enhancing the sustainability of petrochemical companies. Additionally, CSR was found to positively affect sustainable development, with a particular emphasis on the integration of social activities, product and service innovation, and human resource management practices. It is concluded that prioritizing CSR, along with strategic financial risk management, is essential for achieving long-term sustainability in the petrochemical sector. These findings offer valuable insights for both academic research and industry practice, contributing to the development of more effective risk management frameworks in the context of sustainable development.

**Keywords:** Financial risk management; Corporate social responsibility (CSR); Petrochemical industry; Sustainable development

## 1. Introduction

Following the global financial crisis of 2007-2008, a prevailing sense of uncertainty has shaped economic fluctuations worldwide (Saberhoseini et al., 2022). Haase (2023) characterized uncertainty as the inability of individuals to anticipate the probability of incidents. While uncertainty is a unified concept, it encompasses a blend of risk and uncertainty. In the context of an investment, the risk is labeled as potential and quantifiable loss (Muranaga & Ohsawa, 1997). The distinction between uncertainty and risk lies in the fact that risk can be

controlled, unlike uncertainty (Qiu et al., 2023). Risk can be categorized into two main types: uncontrollable systematic risk and manageable non-systematic risk (Spikin, 2013). Examples of systematic risk include political, interest rate, inflation, and exchange rate risk.

On the other hand, non-systematic risk can be further categorized into commercial risk, liquidity risk, and financial risk (Li et al., 2022). A broad risk model can be conceptualized by reviewing the current risk classifications. Financial risk embodies the risk taken in financial activities (Zhang, 2022). This risk primarily arises from using debt, meaning that an increase in debt level leads to a heightened financial risk. Financial risk materializes within a company's financial interactions and is recognized as the risk associated with the company's method of securing finance. It represents the risk of the inability to meet the company's past obligations, a substantial part of which involves commitments tied to debt. The study of financial risk has incorporated various dimensions in the past few years, including risks related to the composition of the financial statement, risks associated with the framework of revenue and earnings, risks concerning capital sufficiency, yield rate, market risk, liquidity risk, and exchange rate risk (Muranaga & Ohsawa, 1997). Deregulation, financial innovations, the increase in capital resources, the substitution of financial services convergence, and the changing role of non-bank institutions and intermediaries have diverse consequences on financial risk, encompassing both the respective sector and the overall financial market (Danielsson et al., 2022).

CSR has recently gained significant prominence within corporate management. This can be attributed to the rise of non-governmental organizations, protests against corporate power, heightened social awareness, developing capital markets, and public scrutiny of ethical scandals involving major corporations. One notable example is the Volkswagen scandal which caused the company's market value to plummet by a third within four trading days after the scandal broke. This event has prompted investors, policymakers, and environmental and social activists to increasingly focus on CSR strategies (Benlemlih & Girerd-Potin, 2017). In the petrochemical industry specifically, companies bear a heavier burden of social responsibility due to the inherent pollution associated with this industry (Tilsted et al., 2022; Wang et al., 2021).

As a result, over the past approximately ten years, the emergence of a conceptual framework known as CSR has been witnessed (Fallah Shayan et al., 2022). During this period, many distinguished intellectuals in management and economics have dedicated their efforts to designing frameworks to increase the efficiency of social programs and promote a friendly approach by companies. Furthermore, they have aimed to align these programs with the broader strategies of the companies (Fallah Shayan et al., 2022).

For the most part, companies possess a voluntary and discretionary nature, and their social and environmental responsibility may reflect evolving societal expectations. This responsibility pertains to activities beyond mere compliance with the law (Carroll, 2016). CSR refers to the coherence and alignment between a company's actions and its values, reflecting the interests of all stakeholders (Wirba, 2024). This includes shareholders, customers, employees, investors, and the broader community, as manifested in the organization's policies and performance. An organization should perceive itself as an integral part of society, acknowledge its responsibility towards the community, and endeavor to enhance public welfare independently of its direct interests (Geva, 2008).

Social responsibility has also gained prominence in our country, and examples of it can be observed through charitable and humanitarian initiatives (Aguinis & Glavas, 2012). However, it is crucial to understand that social responsibility goes beyond these individual acts. There is currently a broad agreement on the increasing significance of social responsibility. Various ethical, logical, and economic aspects are intertwined with this notion. Most of these discussions revolve around the social competence of organizations and the significance of their stakeholder groups as a tool for financial stability. However, cost constraints also come into play in business operations (Fallah Shayan et al., 2022). Companies discover that CSR goes beyond mere expenses or charitable donations when they can analyze and explore the hidden opportunities within their social responsibilities, treating them as integral to their core business (Zhao, 2021). This realization not only incurs ethical benefits but also creates a competitive advantage for the organization. CSR in Iran has taken various forms, including establishing endowments and interest-free loans (Daniali et al., 2021). However, endowments have historically focused on building schools and mosques, aligning with the Islamic national tradition. Traders and industrialists have actively contributed to these institutions' construction and financial support (Chapardar & Khanlari, 2011). During the early 1910s, as the industrial landscape gradually emerged in Iran, the number of industrial workers was relatively small (Ehsani, 2014). Most industrial owners had strong social connections with their community members and employees. The significant influence of religion and tradition led to their active involvement in widespread social contributions (Kim, 2003). The recent growth of the country's private sector and capital market has prompted companies to embrace Iranian ethical and social work standards. This has facilitated the institutionalization of CSR within these companies, promoting a drive toward sustainability (Matten & Moon, 2008). Hence, CSR is a company obligation and should not be viewed as a means for attaining superiority or privileges. However, the prevailing economic and industrial structure in Iran's economic and political environment is such that companies not only consider social responsibility activities as a cost but also perceive them as potential hindrances to their competitive position (Morid Moshtagh Sefat, 2016).

This research examines the correlation between CSR and risks, particularly in financial risks in petrochemical

companies. It is well-documented that employee performance plays a critical role in the operational period of these companies, and a decrease in performance often leads to an escalation of financial risks. In today's business environment, companies have recognized that pursuing profit alone is insufficient for growth and sustainability (Geissdoerfer et al., 2018). However, striking a balance between commercial growth and social advancement is predicted to enhance a company's profitability (Crane et al., 2013). Therefore, focusing on the principle of CSR among employees can create opportunities to safeguard the company's interests and mitigate financial risks. The increasing competitiveness has prompted numerous industrial owners and many top Iranian companies to incorporate this concept into their management practices (Farida & Setiawan, 2022). In the modern world, financial risks in large international companies highlight the importance of addressing financial distress as a crucial component of financial management. Therefore, it is vital to examine the underlying causes of these financial risks from a financial standpoint and evaluate those using highly significant and widely recognized models. Ignoring financial risks can be a critical stage on the path to bankruptcy, as it challenges companies to meet their debt obligations. The escalation of financial risks directly impacts a company's profitability, leading to an important question: Can employees' commitment to sustainable social responsibility help mitigate these financial risks the company faces?

## 2. Theoretical Background and Development of Hypotheses

### 2.1 Financial Risk

In a broad sense, risk refers to the likelihood that a particular action or interaction will result in negative and unintended consequences or outcomes (Aven, 2016). Nearly all human endeavors involve some degree of risk, although certain endeavors carry higher levels of risk than others. In financial literature, risk is commonly described as unforeseen events that typically lead to fluctuations in the value of assets or liabilities. Businesses face different types of risks, broadly classified as commercial and non-commercial (Cavusgil et al., 2020).

Companies need new investments to progress and expand their operations in competitive and growing environments (Teece, 2018). New investments require financial resources and cash funds. Companies must secure their financing through diverse methods, including obtaining debts as part of their financial provisioning (Nashtaei et al., 2017). When employed strategically, the use of this type of financing by companies has varying effects on the company's value. The inclusion of debt in the financial structure of companies, driven by tax advantages, contributes to an increase in accounting profits and subsequently boosts Earnings Per Share (EPS) (Imeni et al., 2019). However, the presence of interest expenses and the potential risk of failing to meet obligations at maturity can lead to heightened financial risk, resulting in decreased stock market prices and a decline in stock returns (Fauzi & Wahyudi, 2016).

Financial risk emerges within the domain of corporate finance and refers to the risk stemming from the company's financing approach (Gennaro, 2021). It signifies the risk of being unable to fulfill the company's previous obligations, with a substantial portion involving debt commitments. Financial risk has been explored in recent years from various dimensions, including risks stemming from the structure of financial statements, income and profitability structure, capital adequacy, return rate, market, liquidity, and currency risks (Kassi et al., 2019). The deregulation of financial innovations, increased capital resource mobilization, the substitution of financial services convergence, and the evolving role of non-banking institutions and intermediaries have different consequences for financial risk. These consequences affect both the respective sector and the overall financial market (Cummins & Weiss, 2009).

Although financial risk is not desirable, comprehending it enables more informed decision-making (DM) in trade and investment, facilitating the evaluation of the risk-reward trade-off. The assessment and prediction of financial risk contribute to determining the value of assets (Sun et al., 2022). Failure to control financial risk can lead to irreparable consequences that are challenging to mitigate. Furthermore, there is a possibility of their proliferation and impact across different sectors and markets (Menezes et al., 2021). Financial ratios play a significant role in predicting financial risk, business discontinuation, and financial crises for companies. These ratios provide valuable insights into a company's operational performance and financial position, making it easier to assess relevant information (Gleißner et al., 2022; Roodposhti & Kharadyar, 2016).

Consequently, specific ratios have been analyzed and interpreted based on their intended purpose and applications. The research by Harinuridin (2023) and Gao (2022) suggests the presence of a meaningful correlation between financial risks and financial ratios. In the current study, it is assumed that this relationship exists, and therefore, financial ratios can be utilized accordingly. Previous studies have primarily utilized a limited and well-known set of variables to investigate their effects. These studies have employed statistical or machine learning techniques to examine financial risks and incorporate capital structure. However, the focus has been on the impact of these factors, overlooking other factors (Dao & Ta, 2020). The primary purpose of this study is to achieve a comprehensive understanding of financial risk by focusing on the explanatory power of selected variables and evaluating their simultaneous impact. To accomplish this, structural equation modeling was utilized in this study

to analyze and assess the theoretical foundations of the topic, including the influence of all factors, such as financial variables (Deng et al., 2018).

Financial ratios were constructed using numerical values extracted from financial statements to obtain meaningful information about a company. These ratios can be broadly classified into two categories: solvency ratios, which are derived from the balance sheet and income statement, encompassing ratios that reflect financial commitments, profitability, liquidity, and leverage; and cash ratios, which are derived from the cash flow statement and balance sheet, comprising ratios that focus on cash flows and working capital (Coulon, 2020).

## 2.2 CSR

By implementing organizational risk management, organizations enhance their performance and, accordingly, enhance the quality of corporate governance (Gordon et al., 2009; Imeni & Edalatpanah, 2023). This enables shareholders to effectively manage company risks and ultimately improve the efficiency of company operations.

Based on theory, the representation of CSR may be driven by managers' personal interests (Pfajfar et al., 2022). Managers may engage in improper company activities to evade or neglect their social responsibilities (Johnston et al., 2021). Wirba (2024) discovered that managerial motivations and corporate governance are significant in implementing CSR activities. Furthermore, Guo (2022) concluded that managers actively pursue CSR, as they believe that fulfilling these responsibilities within the company contributes to enhancing their personal and professional reputation.

In general, companies that remain committed to their social responsibilities tend to desire lower levels of acceptable risk because they possess higher social capital and prioritize the interests of shareholders, investors, and customers (Cheung, 2016; Hillman & Keim, 2001).

Over the past few decades, there have been various debates surrounding the implications of CSR. While some researchers have contended that high levels of social responsibility are linked to better company performance, higher value, reduced financial risk, lower information asymmetry, easy access to financial resources, and cost of capital reduction, others have argued that social responsibility activities may create conflicts among different stakeholders, deplete company resources through unnecessary expenses, and potentially result in a competitive disadvantage compared to companies with lower levels of social responsibility (Cui et al., 2018). The two aforementioned contrasting viewpoints often reflect the financial consequences associated with CSR activities. On the one hand, Friedman's perspective (Friedman, 2007), highlighted in a prominent study, suggests that social responsibility creates conflicts among different shareholders (Ferrell, 2022). He asserted that business responsibility is solely focused on earnings generation and supported the notion that a negative relationship exists between the extent of social responsibility and company value (Pfajfar et al., 2022).

Additionally, according to the balance theory put forth by Preston & O'bannon (1997), it is argued that involvement in environmental and social activities is likely to deplete firm resources and create a competitive drawback, thereby negatively impacting the company's value. Conversely, another viewpoint posits that CSR increases employee loyalty, reputation, and customer satisfaction. According to the theory of good management put forth by Waddock & Graves (1997), managerial and strategic skills enhance CSR within companies, potentially aiding them in achieving high performance. High social performance allows companies to pursue their objectives and maximize their value. Nowadays, the concept of CSR has expanded beyond the activities of the past. It typically encompasses a set of voluntary actions undertaken by capital owners and economic entities, aiming to actively and meaningfully contribute to society's well-being (Pfajfar et al., 2022). According to a theoretical definition, social responsibility is a multi-dimensional construct. Carroll (1991), using activity coding related to social responsibility, assessed the impact of one of its dimensions on investment returns. In strategic management, social responsibilities have become an indispensable and integrated component of discussions on strategy development and implementation, commonly referred to in general terms and primarily seen as an ethical and creative aspect. Supporters and critics of social responsibility can be divided into opponent and proponent groups (Platonova et al., 2018). Some proponents of free-market economics, like Milton Friedman, oppose social responsibility and view it as conflicting with the principles of a free market. Friedman (2007) believed that reducing product prices to combat inflation, hiring employees to address unemployment, and allocating resources to environmental pollution reduction are essentially using shareholders' funds and capital. He considered social responsibility to be a fundamentally destructive doctrine. Friedman's perspective is that the sole social responsibility of a commercial company is to utilize community resources and participate in activities aimed at profit growth while adhering to fair play and avoiding deception (Hunger & Wheelen, 2013).

Conversely, Carroll (1991), who advocated for social responsibility, believed that as part of their role, managers in a business organization are accountable for four main responsibilities: legal, economic, philanthropic, and ethical. In addition, the author asserted that philanthropic and ethical responsibilities may eventually become legal and economic obligations. Carroll & Shabana (2010) put forth the theories based on the effect of social responsibilities on company profits. Carroll (1991) argued that disregarding social responsibilities leads to

increased government intervention and, as a result, reduced efficiency. According to Buchanan et al. (2018), if a company voluntarily embraces certain social and ethical responsibilities, it can still attain its desired profits.

### 2.3 Social Responsibility and Sustainable Development

Social responsibility catalyzes transformative changes across various organizational levels, emphasizing managerial support, community engagement, environmental compatibility, addressing societal needs and expectations, long-term investment, strategic DM, collaboration with non-governmental and community-based organizations and local authorities, community empowerment, trust-building, employment generation, promotion of sustainable business practices, environmental understanding, and fulfillment of societal expectations for achieving sustainable development (Abiddin et al., 2022; Di Gerio et al., 2020; Fallah Shayan et al., 2022; Singh & Hong, 2023).

For a considerable period, industrial and commercial activities were pursued solely to maximize profitability for organizations. In such circumstances, the adverse effects stemming from industrial activities, such as air pollution, environmental degradation, loss of marine and terrestrial habitats, and others, were not given significant attention by industry owners and governments (Manisalidis et al., 2020; Zhang et al., 2022). Sustainable development entails addressing running needs while ensuring that future generations can meet them (Tomislav, 2018). It aims to balance economic activities, societal support, and environmental preservation (Skene, 2022). Sustainable development plays a crucial role in promoting biodiversity, smart utilization of natural resources, waste and pollution reduction, and fostering resilience to mitigate climate change, thereby contributing to the protection and development of the human social environment (Silvestre & Țircă, 2019). CSR aligns with sustainable development principles, and some researchers view it as a pathway to achieving sustainable development (Xia et al., 2018).

In a study by Yang et al. (2019) on financial risk management in the internet supply chain, a data science-based model was proposed to enhance the supply chain's capabilities and resilience against potential threats. The analysis started by identifying and analyzing various financial risks within the Internet supply chain. Data science techniques were utilized to analyze and evaluate the risk management model, incorporating multi-variable regression analysis and an effective DM game for financial provisioning. The study perused the relationship between financial risk management in the supply chain and organizational performance within the framework of an Internet financial provisioning model. The credibility of financial DM in the Internet supply chain was examined, and a descriptive statistical analysis approach was used to develop a DM model for the Internet supply chain. Fuzzy DM techniques were applied to assess the risks in the Internet supply chain. At the same time, the Simulink algorithm was employed to investigate the correlation between risk management and the Internet supply chain model. To enhance the risk management capabilities, a comprehensive statistical analysis and holistic DM approach were utilized to control risks using fragmented sample regression analysis. Based on the results, the model seems highly suitable for managing financial risk and supply chain operations under the Internet financial provisioning model. This model is robust for effectively managing financial risks and assessing supply chain performance.

According to the study by Oláh et al. (2019), risk management is an important process for all companies, regardless of size. Identifying risk sources is especially important, which is why this study focused on analyzing and comparing economic and financial risk sources in Small and Medium-sized Enterprises (SMEs) across the V4 countries (Czech Republic, Hungary, Poland, and Slovakia) and Serbia within the context of each country's business environment. To achieve this goal, a survey was conducted with 2,110 SMEs from these countries, asking about the significance of risks and their understanding of risk management. Statistical tools such as descriptive tables, Z-scores, and a generalized non-hierarchical log-linear model were used to test the formulated hypotheses. The research revealed differences between the V4 countries and Serbia, with Serbia being more susceptible to financial risk sources. Inadequate profits were identified as a major risk source for all countries. The paper concludes with a discussion and a comparison to previous international research studies.

According to the research by Naseem et al. (2020), there is a connection between a company's risk management and its social responsibilities. The study indicates that effective risk management can positively impact a company's ability to invest in social responsibilities, resulting in a positive correlation between the two.

Additionally, Kuo et al. (2021) suggested that Enterprise Risk Management (ERM) can influence a company's CSR engagement. The study found that companies with more effective ERM are more likely to participate in CSR activities. Additionally, when Chief Executive Officers (CEOs) are confident and engage in real activity manipulation, their CSR efforts tend to be greater.

Based on the given information, the following hypotheses were formulated in this study:

Hypothesis 1: Financial risk management has an impact on social responsibility.

Hypothesis 2: Financial risk management affects corporate sustainable development.

Hypothesis 3: Social responsibility influences corporate sustainable development.

Hypothesis 4: Social activities have an impact on CSR.

Hypothesis 5: Focus on products and services affects CSR.

Hypothesis 6: Effective human resource management influences social responsibility.

Hypothesis 7: Attention to the customer segment impacts company responsibilities.

### 3. Research Variables

The variables examined in this study can be categorized into three groups:

a) Social responsibility (mediating variable);

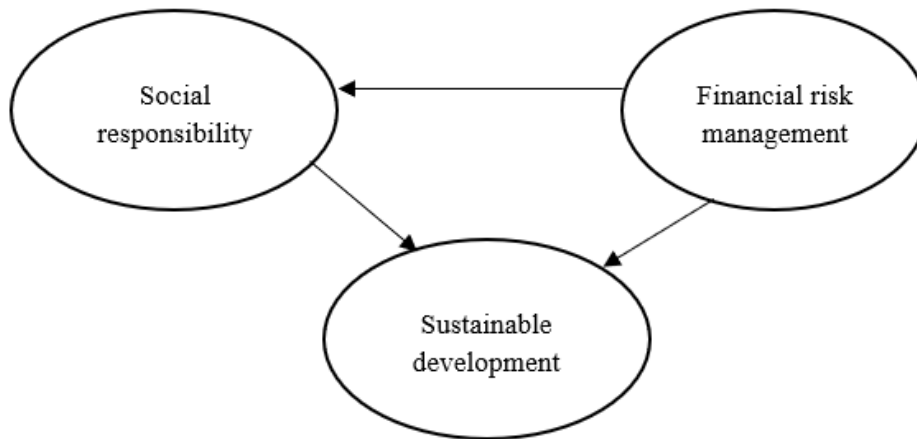
b) Financial risk management (independent variable);

c) Sustainable development (dependent variable). Table 1 presents the questionnaire items for investigation.

**Table 1.** Examination of questionnaire items

Variable	Dimensions	Question
Social responsibility	Human resources	1-5
	Products and services	6-9
	Customers	10-13
	Social activities	14-17
Financial risk management		18-21
Sustainable development		22-26

Based on this, the research conceptual model is shown in Figure 1.



**Figure 1.** Conceptual model of the questionnaire

### 4. Statistical Population

This study determined the sample size based on the principles used in the multivariate regression analysis. It is recommended to have a ratio of at least five observations per independent variable in the multivariate regression analysis. Similarly, in structural equation modeling, the sample size is typically between 5 to 15 observations per variable, i.e.,  $5q \leq n \leq 15q$  (Fan et al., 2016), where  $q$  represents the number of research variables, and  $n$  represents the sample size.

Considering that this study involves 26 questionnaire items, the sample size should range from 130 to 390 individuals. For this research, a purposive sampling method was applied to choose a sample of 130 participants. It is important to note that the questionnaire reliability was assessed using Cronbach's alpha coefficient, and for all research variables, the coefficient exceeded 0.70. Data analysis was conducted using SPSS 26 software and SmartPLS.

### 5. Findings

The research includes both descriptive and inferential findings. The descriptive findings involve analyzing the demographic information of each sample, while the inferential findings focus on conducting structural equation modeling.

## 5.1 Description of Demographic Information

Table 2 presents respondents' demographic information descriptions, including variables such as age, gender, occupation, and income level. This information helps to understand the characteristics of the sample population. Table 3 presents the educational backgrounds of the respondents, including variables such as educational level, field of study, and educational institution. This information provides insights into the educational profiles of the participants in the study. Table 4 provides information about the work experience of the respondents, including variables such as years of experience, current job position, and industry. This data offers a perspective on the participant's professional backgrounds and experience levels.

**Table 2.** Description of the demographics

Gender	Frequency	Frequency%
Male	86	66%
Female	44	34%
Total	130	100%

**Table 3.** Description of respondents' educational backgrounds

Educational	Frequency	Frequency%
Bachelor's degree	96	74%
Master's degree and above	34	26%
Total	130	100%

**Table 4.** Description of respondents' work experience

Experience	Frequency	Frequency%
10-15 years	57	44%
15-20	50	38%
>20	23	18%
Total	130	100%

## 5.2 Measurement Model Test

To determine whether the data is suitable for analysis, the Kaiser-Meyer-Olkin (KMO) index and Bartlett's test were utilized in this study. For analysis, the KMO index should be over 0.6 and near 1, and the significance level of Bartlett's test should be under 0.05. Table 5 shows the results of these tests.

**Table 5.** KMO and Bartlett's test results

KMO	.889	
Bartlett's	5236.563	$\chi^2$
	903	d.f
	.001	Sig.

According to Table 5, the KMO index value is above 0.6, it suggests that the samples used in the analysis are adequate. The results of Bartlett's test revealed that the obtained matrix is sufficiently adequate, indicating that the data in this study possess factorability.

## 5.3 Research Questionnaire Factor Analysis

In the current study, the model was validated by examining agent loads, composite reliability, and the extracted mean-variance. The correlation between the structures was determined using the extracted variance mean, as shown in Table 6.

Based on the findings presented in Table 6, none of the factor loadings for any question are below 0.5. Therefore, all the questions should be retained in the analysis, and none should be eliminated. Cronbach's alpha coefficients greater than 0.7 were obtained for all questionnaire components, indicating the model's high internal consistency reliability. Composite reliability greater than 0.7 was reported for all structures, indicating that the structures exhibit satisfactory composite reliability. Convergent validity was evaluated by calculating the Average Variance Extracted (AVE), exceeding 0.5 for all structures see Table 7. When the square root of the mean-variance of a variable is larger than its correlation with other variables, it indicates the presence of discriminant validity.

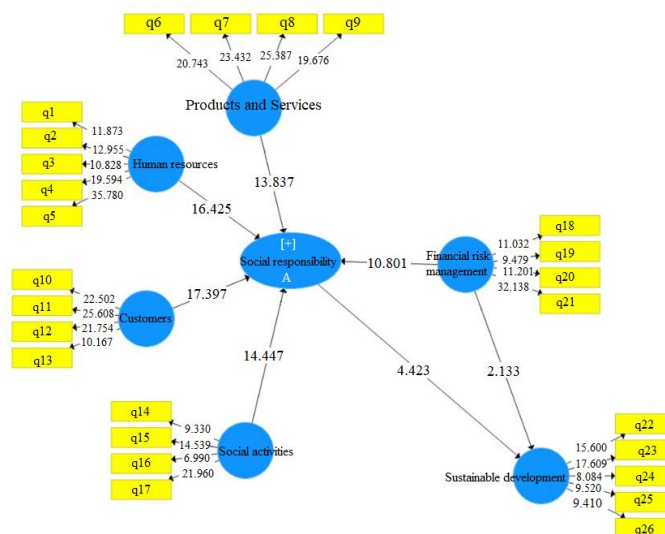
**Table 6.** Examination of factor loadings, significance statistics, mean-variance, composite reliability, and Cronbach's alpha for the questionnaire

	Object	Factor Load	t	Mean-Variance	Reliability	Cronbach's
Human resources	Q1	.731	11.873	0.501	.946	.940
	Q2	.742	12.955			
	Q3	.720	10.828			
	Q4	.808	19.594			
	Q5	.849	35.780			
Products and services	Q6	.809	20.743	.690	.899	.850
	Q7	.844	23.432			
	Q8	.848	25.387			
	Q9	.822	19.676			
Customers	Q10	.818	22.502	.635	.874	.808
	Q11	.826	25.608			
	Q12	.801	21.754			
	Q13	.739	10.167			
Social activities	Q14	.708	9.33	.690	.826	.722
	Q15	.776	14.539			
	Q16	.632	6.990			
	Q17	.824	21.960			
Financial risk management	Q18	.736	11.032	.572	.842	.755
	Q19	.703	9.479			
	Q20	.735	11.201			
	Q21	.845	32.138			
Sustainable development	Q22	.773	15.6	.515	.841	.763
	Q23	.804	17.609			
	Q24	.661	8.084			
	Q25	.673	9.520			
	Q26	.664	9.410			

**Table 7.** AVE and correlations between the research variables

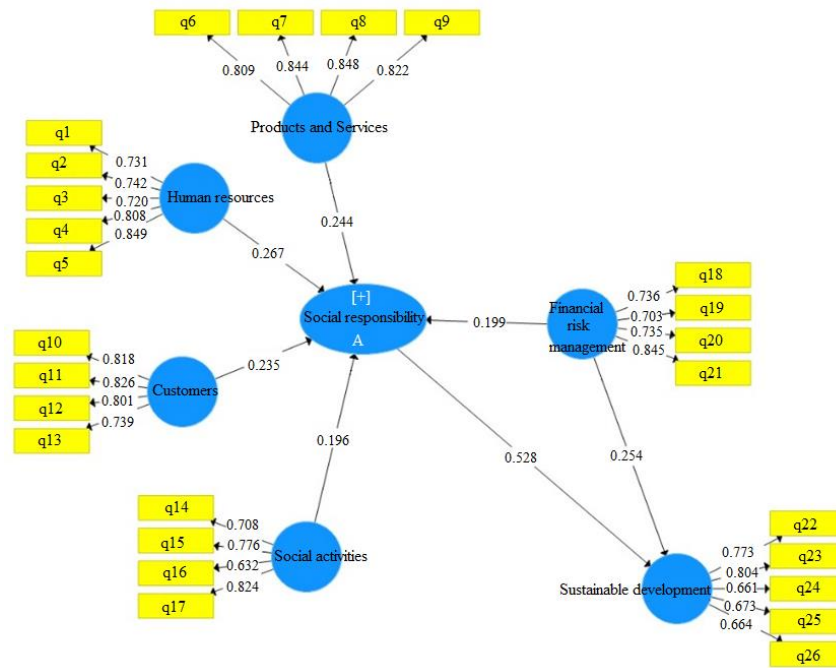
No.	Index	1	2	3	4	5	6	7
1	Sustainable development	.718						
2	Social activities	.657	.898					
3	Products and services	.624	.649	.831				
4	Financial risk management	.687	.734	.632	.757			
5	Social responsibility	.705	.864	.820	.710	.681		
6	Customers	.622	.748	.817	.685	.922	.797	
7	Human resources	.640	.673	.744	.610	.876	.742	.772

#### 5.4. Structural Model



**Figure 2.** Structural model in the standardized coefficient form





**Figure 3.** Model in the significance coefficient mode

After examining and testing the measurement model, the structural model was evaluated. Figure 2 displays the graphical representation of the research model.

In the structural model, the paths are marked with numbers that indicate their coefficients. To determine the significance of each coefficient, the bootstrapping method was used. This involved computing t-values, which were obtained in this analysis stage. If a t-value exceeds 1.96, the corresponding path coefficient is considered statistically significant at a confidence level of 0.05. The outcomes are illustrated in Figure 3.

## 6. Model Adequacy Evaluation

### 6.1 R<sup>2</sup> Criterion

This criterion pertains to the model-dependent variables. R<sup>2</sup> signifies the impact of an exogenous variable on an endogenous variable. From Table 8, we can see that the values exceeding 0.33 are regarded as a strong R<sup>2</sup> value.

**Table 8.** R<sup>2</sup> values for research variables

No.	Variables	R <sup>2</sup>
1	Sustainable development	.563
2	Social responsibility	.98

### 6.2 Q<sup>2</sup> Criterion

This criterion reflects the model's predictive strength, where values of 0.2, 0.15, and 0.35 indicate the model's weak, moderate, and strong predictive abilities, respectively. Therefore, from Table 9, we can see the predictive strength of our model.

**Table 9.** Q<sup>2</sup> values of research variables

No.	Index	Q <sup>2</sup>
1	Sustainable development	.277
2	Social activities	.262
3	Products and services	.470
4	Financial risk management	.301
5	Social responsibility	.403
6	Customers	.391
7	Human resources	.393

## 7. Research Hypothesis Investigation

To examine the research hypotheses and test the significance of the obtained path coefficients, the outputs of statistical software were utilized, and the results are presented in Tables 4-9.

### 7.1 Hypothesis 1: Financial Risk Management Impacts Social Responsibility

Table 10 presents the results obtained from the bootstrapping method for examining the impact of financial risk management on social responsibility.

**Table 10.** Test results of the first hypothesis

Direction	$\beta$	t-Value	Sig.	Result
Financial risk management on social responsibility	.199	10.801	.001	Confirmed

Based on the coefficient of 0.199 and the significance level (0.001), the findings suggest that financial risk management has a statistically significant positive influence on social responsibility.

### 7.2 Hypothesis 2: Financial Risk Management Impacts Corporate Sustainable Development

Table 11 provides the results obtained from the bootstrapping method for examining the impact of financial risk management on sustainable development.

**Table 11.** Test results of the second hypothesis

Direction	$\beta$	t-Value	Sig.	Result
Financial risk management on sustainable development	.254	2.133	.001	Confirmed

According to the findings of this study, a correlation coefficient of 0.254 was determined between the variable of financial risk management and sustainable development. With a significance level of 0.001, it can be concluded that financial risk management has a meaningful and positive impact on the company's sustainable development.

### 7.3 Hypothesis 3: Social Responsibility Influences Corporate Sustainable Development

Table 12 shows the results obtained from the bootstrapping method to investigate the social responsibility influence on sustainable development.

**Table 12.** Test results of the third hypothesis

Direction	$\beta$	t-Value	Sig.	Result
Social responsibility on sustainable development	.528	4.423	.001	Confirmed

The correlation coefficient between the CSR and sustainable development variable in this research was determined to be 0.528. With a significance level of 0.001, it can be concluded that CSR has a meaningful and positive influence on the company's sustainable development.

### 7.4 Hypothesis 4: Social Activities Have an Impact on Social Responsibilities

Table 13 shows the results obtained from the bootstrapping method to examine the influence of social activities on social responsibilities.

**Table 13.** Test results of the fourth hypothesis

Direction	$\beta$	t-Value	Sig.	Result
Social activities on social responsibility	.196	14.447	.001	Confirmed

Based on the findings of this research, the correlation coefficient between social activities and CSR was determined to be 0.196. With a significance level of 0.001, it can be concluded that social actions significantly and positively impact CSR.

### 7.5 Hypothesis 5: Attention to Products and Services Impacts Social Responsibilities

Table 14 shows the results obtained from the bootstrapping method to examine the influence of products and services on social responsibilities.

**Table 14.** Test results of the fifth hypothesis

Direction	$\beta$	t-Value	Sig.	Result
Products and services on social responsibility	.244	13.837	.001	Confirmed

According to the research findings, the correlation coefficient between the variable of attention to products and services and CSR was calculated as 0.244. With a significance level of 0.001, it can be concluded that a statistically significant and positive relationship exists between attention to products and services and CSR.

### 7.6 Hypothesis 6: Effective Human Resource Management Impacts Social Responsibilities

Table 15 shows the results obtained from the bootstrapping method to examine the influence of effective human resource management on CSR.

**Table 15.** Test results of the sixth hypothesis

Direction	$\beta$	t-Value	Sig.	Result
Human resource management on social responsibility	.267	16.425	.001	Confirmed

The correlation coefficient between effective human resource management and CSR was calculated as 0.267 based on the research findings. With a significance level of 0.001, it can be concluded that effective human resource management has a significant and positive impact on CSR.

### 7.7 Hypothesis 7: Attention to the Customer Segment Impacts CSR

Table 16 shows the results obtained from the bootstrapping method to examine the influence of customers on CSR.

**Table 16.** Test results of the seventh hypothesis

Direction	$\beta$	t-Value	Sig.	Result
Human resource management on social responsibility	.235	17.397	.001	Confirmed

The correlation coefficient between the variable of customer segment attention and corporate responsibilities in this research was determined to be 0.235. With a significance level of 0.001, it can be concluded that paying attention to the customer segment has a meaningful and positive impact on corporate responsibilities.

## 8. Discussion and Conclusion

This study aims to investigate the impact of financial risk management on the CSR of petrochemical companies, with a secondary focus on the influence of financial risk management on the sustainable development of these companies. This research falls under the applied research category, aiming to provide practical and applicable insights specifically for the petrochemical industry.

CSR, financial risk management, and sustainable development were investigated in the present study. The target population comprises experienced managers in the petrochemical industry. The sample size, determined based on the number of questionnaire items, consisted of 130 individuals. The research employed a researcher-developed questionnaire as the measurement instrument, which was designed after reviewing the study's theoretical foundations and gathering expert input. The questionnaire content validity was assessed using a content validity examination method, while the reliability was evaluated using Cronbach's alpha coefficient calculation method.

In the present work, the correlation analysis revealed important findings regarding the relationships between the variables. The correlation coefficient between financial risk management and CSR was 0.199. The corresponding t-value was 10.801, and the significance level obtained was less than 0.05. Thus, the first hypothesis of the research was confirmed with a 99% confidence level, indicating a significant positive correlation between financial risk management and CSR. Similarly, the correlation coefficient between financial risk management and sustainable development was 0.254. The corresponding t-value was 2.133, and the significance level was less than 0.05. Hence,

the second hypothesis of the research was confirmed with a 99% confidence level, suggesting a significant positive correlation between financial risk management and sustainable development.

The research findings indicate that the correlation coefficient between attention to products and services and CSR variables was determined to be 0.244. The obtained t-value was 13.837, and since the significance level was less than 0.05, the fifth hypothesis was confirmed with a 99% confidence level. This suggests that attention to products and services significantly and positively impacts CSR. The research yielded a correlation coefficient of 0.267 between the variable of effective human resource management and CSR. The calculated t-value was 16.425, and considering that the significance level was below 0.05, the sixth hypothesis was confirmed with a 99% confidence level. These results suggest that attention to effective human resource management significantly and positively influences CSR. The research yielded a correlation coefficient of 0.235 between the variable of customer focus and CSR. The t-value associated with this coefficient was 176.397, and given that the obtained significance level was less than 0.05, the seventh hypothesis was confirmed with a 99% confidence level. Thus, it can be concluded that customer focus significantly and positively influences CSR. The study results align with the findings of previous research conducted by Kuo et al. (2021), Naseem et al. (2020), Oláh et al. (2019), and Yang et al. (2019).

The financial risk, according to Adachi-Sato & Vithessonthi (2021) and Çamlıbel et al. (2021), provides further support for the relationship between financial risk management, attention to products and services, effective human resource management, customer focus, and CSR. Financial risk management plays a crucial role in the economy, aiming to improve the investment climate and stimulate consumption while increasing government financing in priority areas (Li et al., 2023). Sustainable development, which encompasses economic growth and innovation, measures the success of socio-economic systems. By investing in CSR, companies can reduce the social illegitimacy risk and increase their overall value. The more companies invest in this area, the greater the potential for achieving sustainable development and creating value beyond their customer base. The investment deficit in the economy destroys development opportunities; that is, it prevents the passing of the crisis and causes sustainable development not to happen. Sustainable development measures the success of socio-economic systems, such as economic growth and innovation. In other words, the more investment increases, the more sustainable development will be achieved. On the other hand, CSR aims to generate and provide value for companies that extends beyond their customers who buy their products and services (Lindgreen & Swaen, 2010; Matten & Moon, 2008). The more companies invest in this area, the more they can reduce the risk of social illegitimacy and increase the value of their company.

## Data Availability

The data used to support the research findings are available from the corresponding author upon request.

## Conflicts of Interest

The authors declare no conflict of interest.

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