




“The level of climate risk reporting performance and firm characteristics: Evidence from the Saudi Stock Exchange”

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THE LEVEL OF CLIMATE RISK REPORTING PERFORMANCE AND FIRM CHARACTERISTICS: EVIDENCE FROM THE SAUDI STOCK EXCHANGE

Abstract

In recent decades, stakeholders have begun to place a greater emphasis on sustainability-related issues, including climate change. Furthermore, the implementation of climate change initiatives has prompted companies to disclose information regarding their evaluation and handling of climate-related risks and potential benefits. However, there is a lack of existing literature that investigates this issue in less developed markets, particularly in Saudi Arabia, where the capital market is rapidly developing. The objective of this study is to assess the degree of performance in reporting climate risk and investigate potential correlations between climate risk reporting performance and firm characteristics among non-financial firms in Saudi Arabia during the period from 2018 to 2021. To achieve the objectives of the study, a total of 515 firm-year observations were utilized, representing 140 non-financial firms in the context of Saudi Arabia. The study's findings illustrate that the climate risk reporting performance level has steadily improved in Saudi companies over the years. In addition, the findings reveal that firm size and industry exhibit a positive correlation with climate risk reporting performance. Conversely, firm leverage and profitability do not demonstrate such associations. The results are in line with alternative measures of climate risk reporting performance, as well as when climate risk reporting performance is broken down into the four core elements. Policymakers and market regulators could use these results to promote awareness of the factors that influence climate risk reporting performance and to enhance sustainable practices.

Keywords

risk, climate change, risk reporting, firm size, firm profitability, Saudi Arabia, non-financial companies

JEL Classification G32, G34

INTRODUCTION

In recent years, concerns about the state of the environment and efforts about how to protect it have increased considerably amongst regulators, society, and governments (Da Silva Monteiro & Aibar-Guzmán, 2010). This made rise to the concept of sustainability which became very critical for the planet. As a result, over the last decade, sustainability has become a critical dimension for various stakeholders, putting pressure on organizations to adhere to its principles (Gulluscio et al., 2020). Although there are three main pillars of sustainability: environmental, social, and economic, the environmental one has received the most attention, specifically climate risk.

The topic of climate change has emerged as a prominent subject of discussion in both public and political spheres, being recognized as a significant and urgent global challenge (Andrew & Cortese, 2011). It also became one of the most pressing concerns facing governments, societies, and businesses; and managing the risks associated with this phenomenon became the most challenging objective of business organi-

zations (Daradkeh et al., 2023). The United Nations has formulated a set of 17 Sustainable Development Goals (SDGs) with the aim of addressing a diverse range of global challenges (United Nations, n.d.). Among these 17 goals, goal number 13, which is “climate action”, aims to “take immediate action to fight against climate change and its effects” (United Nations, n.d.), has become a pressing issue. Therefore, countries initiated measures and collaborated to address this phenomenon, ultimately leading to the establishment of the Paris Agreement in 2015. Representatives from 195 countries proposed measures to restrict the acceleration of global warming (Park et al., 2023). The objective posits that an increase in greenhouse gas (GHG) and carbon dioxide (CO₂) emissions is the root cause of climate change, and that addressing these causes is necessary to combat this phenomenon (Gulluscio et al., 2020).

These challenges and objectives have in turn led to the creation of sustainability reporting, through which companies provide information to their stakeholders about the social and environmental impacts of their operations (Pellegrino & Lodhia, 2012) as businesses and industries are often regarded as the main contributors to environmental problems (Amran et al., 2012). In particular, climate risk reporting, which is providing information about a company’s climate change practices, risks, and mitigation policies (Venugopal et al., 2009), became a main requirement from investors, regulators, and the public. As a result, scholarly literature addressing the scope, quality, and factors influencing climate risk disclosure by firms on a global scale started to emerge and grow. However, previous research has failed to establish a unanimous agreement regarding the characteristics and extent of the effects of factors influencing climate risk reporting.

1. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

In literature from around the globe, the extent and quality of climate risk reporting performance (CRRP) have been analyzed at length. Previous literature thought of trying to identify the critical factors that affect the performance of climate risk reporting and categorized these factors into firm characteristics factors (Aguilera-Caracuel et al., 2012; Giannarakis et al., 2016), corporate governance factors (De Aguiar & Bebbington, 2014; Mathuva et al., 2017; Khalid et al., 2022), and ownership structure factors (Juhmani, 2013; Al-Gamrh & Al-Dhamari, 2016; Alsaadi, 2022). Moreover, a variety of indices and parameters were used to define climate risk reporting as some studies focused on Corporate Social Responsibility (CSR) reporting (Holder-Webb et al., 2009; Alkayed & Omar, 2022); others focused on corporate social and environmental voluntary disclosure (Brammer & Pavelin, 2008; Boshnak, 2020); while others used greenhouse gas (GHG) emissions (Comyns & Figge, 2015; Comyns, 2016) as a parameter to define climate risk reporting. Therefore, within the framework of this study, the present review focuses on studies that have assessed the influence of firm characteristics on the extent of climate risk reporting.

Several theories have been employed to explain the determinants of climate risk disclosure, including legitimacy, stakeholder, and institutional theories (Mathuva et al., 2017). As per Suchman’s (1995) definition, legitimacy is “a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions” (p. 574). Consequently, firms typically seek approval of their goals and actions to ensure their continued existence in the society in which they operate (Reverte, 2009). This implies that legitimacy is contingent upon the degree to which firms align their goals and actions with the accepted social and cultural norms (Zimmerman & Zeitz, 2002). Consequently, legitimacy has become a vital asset that companies must possess to ensure their survival and expansion (Suárez-Rico et al., 2018). One method for achieving this legitimacy is through sustainability reporting (Hooghiemstra, 2000), which has established the legitimacy theory as the primary theoretical explanation for the disclosure of social and environmental information (Jenkins & Yakovleva, 2006).

In line with the legitimacy theory, stakeholder theory explains how companies manage their stakeholders since these stakeholders have control over their resources (Comyns, 2016). The stakeholder theory emphasizes that, in addition to shareholders and

creditors, there exists a diverse array of entities, including NGOs, media, and regulatory bodies, that possess an interest in the environmental and social performance of firms. Consequently, these stakeholders seek information pertaining to the effects of a firm's activities on both society and the environment (Moneva & Llena, 2000). Consequently, firms tend to divulge information pertaining to these activities to fulfil stakeholder demands and establish their standing within the broader societal context (Da Silva Monteiro & Aibar-Guzmán, 2010).

The final point to be addressed is the argument put forth by the institutional theory, which posits that firms react to various institutional pressures, namely regulatory, normative, and cognitive pressures, by adjusting their actions and structure (Amran et al., 2012). Accordingly, firms tend to be more environmentally conscious if there are strong regulatory forces, institutionalized normative calls for environmentally conscious behavior, and a successful benchmark (Campbell, 2006). Thus, it is frequently employed to explicate the impact of alterations in societal values, advancements in technology, and regulatory measures on firms' determinations regarding sustainable practices and environmental management (Hanna et al., 2023).

Despina et al. (2011) posit that a direct relationship can be observed between the size of a company and its inclination to divulge environmental data, with the intention of bolstering public confidence. Additionally, these firms are subject to heightened public visibility and scrutiny, necessitating increased disclosure of environmental information to maintain their legitimacy (Cincalova & Hedija, 2020). Furthermore, as the public closely monitors the actions of large companies, regulators tend to impose stricter regulations on them to improve their public image. The regulations are frequently focused on stricter environmental standards and performance. Therefore, to avoid disciplinary action, large firms tend to comply with these regulations and disclose a greater amount of information regarding their environmental activities. Lastly, large firms attract more interest from stakeholders, they are more likely be subjected to increased stakeholders' pressure and they respond by complying with their disclosure requirements to seek their approval. These arguments have been used and supported by previous research in the

climate risk reporting domain such as Brammer and Pavelin (2008) Al-Gamrh and Al-Dhamari (2016), and Boshnak (2020).

Firms that are highly leveraged are under greater pressure to attempt to legitimize their activities to both the public and stakeholders, as stated by Haniffa and Cooke (2005). Furthermore, as these companies are perceived as being riskier, they tend to offer additional information to their stakeholders to alleviate their concerns (Alkayed & Omar, 2022). Moreover, firms that borrow large sums of money are typically subjected to heightened monitoring. Consequently, they are required to provide additional information to ensure their compliance with regulations (Malone et al., 1993). However, there is a lack of consensus in the literature on climate risk reporting regarding the influence of a firm's leverage on the extent of climate risk reporting. Several studies, including Juhmani (2013), Chithambo and Tauringana (2014), and Boshnak (2020), have found a positive relationship between a firm's leverage and the level of climate risk disclosure. Conversely, other studies such as Prado-Lorenzo et al. (2009), Salehi et al. (2019), and Desai (2022) have reported a negative association.

Boshnak (2020) posits that corporations experiencing higher levels of profitability are susceptible to heightened scrutiny from both the general public and regulatory entities. Consequently, these corporations exhibit a tendency to adhere to the principles of legitimacy and institutional theories through the practice of disclosing a larger quantity of information regarding their social and environmental endeavors. Furthermore, organizations that possess greater financial advantages are inclined to maintain favorable connections with their stakeholders in order to safeguard their profits. As a result, they are more likely to conform to the demands of disclosing additional information imposed upon them by these stakeholders. Nevertheless, the current body of scholarly literature concerning the relationship between profitability and the level of climate risk disclosure has yielded inconclusive results. In the studies by Kouloukoui et al. (2019) and Khalid et al. (2022), a positive correlation was observed. Conversely, Salehi et al. (2019) and Desai (2022) reported a negative correlation. In contrast, previous studies conducted by Juhmani (2013) and Cuadrado-Ballesteros et al. (2015) did not find any statistically significant relationship between the two variables.

The extant literature indicates that climate risk disclosure quality is significantly affected by the industry type, as evidenced by several studies (Brammer & Pavelin, 2008; Bayoud et al., 2012; Amran et al., 2014; Suárez-Rico et al., 2018; Boshnak, 2020). These studies argued that firms belonging to industries that have bigger impact on the environment are more eager to prove their legitimacy to the public and are subjected to higher stakeholder and institutional pressure to comply with all environmental regulations (Alkayed & Omar, 2022).

The majority of studies examining climate risk reporting have identified a significant positive relationship between the size of firms and the extent of climate risk disclosure in developed nations (Brammer & Pavelin, 2008; Reverte, 2009; Da Silva Monteiro & Aibar-Guzmán, 2010; Berthelot & Robert, 2012; Eleftheriadis & Anagnostopoulou, 2015; Alkayed & Omar, 2022; Daradkeh et al., 2023). At the same time, this relationship also holds for firms in developing countries (Amran & Haniffa, 2011; Suttipun & Stanton, 2012; Juhmani, 2013; Nurunnabi, 2016; Mathuva et al., 2017; Boshnak, 2020). Similarly, most of the studies in the literature found that firms that belong to the manufacturing sector or environmentally sensitive industries tend to disclose more information and climate risk and their environmental performance (Brammer & Pavelin, 2008; Bayoud et al., 2012; Amran et al., 2014; Al-Gamrh & Al-Dhamari, 2016; Suárez-Rico et al., 2018; Boshnak, 2020; Alkayed & Omar, 2022).

The impact of a firm's profitability on climate risk reporting was frequently examined in the literature, making it another firm characteristic that was studied. However, there was no unanimous agreement in the literature regarding the extent and type of impact that this parameter has on climate risk reporting. Several studies have indicated a positive relationship between firm profitability and the extent of disclosure regarding climate risk and environmental impact (Amran et al., 2012; Kouloukoui et al., 2019; Bidari & Djajadikerta, 2020; Khalid et al., 2022). Previous studies have indicated that the level of climate risk reporting is negatively influenced by profitability (Salehi et al., 2019; Desai, 2022). However, other researchers such as Reverte (2009), Juhmani (2013), Chithambo and Tauringana (2014), Cuadrado-Ballesteros et al. (2015), and Boshnak (2020) have found no significant association be-

tween a firm's profitability and the extent of climate risk reporting. A similar pattern was also observed with regards to the impact of a firm's leverage on climate risk reporting. Juhmani (2013), Chithambo and Tauringana (2014), and Boshnak (2020) all documented a positive correlation between a firm's leverage and the extent of climate risk disclosure. Conversely, Prado-Lorenzo et al. (2009), Alkayed and Omar (2022), Salehi et al. (2019), Alshahrani et al. (2022), and Desai (2022) reported a negative correlation. On the other hand, Reverte (2009) and Eleftheriadis and Anagnostopoulou (2015) found no significant relationship between these two variables.

As mentioned earlier, since there is no definitive conclusion regarding the association between a firm's characteristics and climate risk reporting, studying this relationship in Saudi firms for the most recent dataset (2018–2021) is considered a necessity in the current time due to various reasons. First, Saudi Arabia's Vision 2030 emphasizes environmental protection through the implementation of various programs aimed at reducing pollution and ensuring sustainable growth for future generations (Alotaibi, 2020). Furthermore, due to Saudi Arabia's rapid economic development, the Saudi Arabian General Investment Authority has placed a greater emphasis on the transparency of reporting firms' social, environmental, and governance performance (Boshnak, 2020). This is due in part to the country's reliance on oil and the negative perception of the oil industry in terms of environmental impact (Issa, 2017). In addition, Saudi Arabia adopted a number of climate change initiatives in accordance with the sustainable development plan adopted by the United Nations and signed by the nation (Alotaibi, 2020). Finally, Saudi Arabia has adopted a green initiative aimed at reducing emissions, afforestation, and protecting land and sea (Saudi Arabia Green Initiatives, n.d.); thus, effectively reporting the impacts and strategies of Saudi companies on climate risk will aid in achieving these goals.

The existing body of research has examined the effects of different firm attributes on the disclosure of corporate social responsibility (CSR) by Saudi Arabian firms during the period from 2007 to 2014 (Al-Gamrh & Al-Dhamari, 2016; Habbash, 2016; Issa, 2017). The results of their study suggest that the size of a firm has a notable and favorable im-

pact on the level of CSR disclosure. Nevertheless, the findings pertaining to the profitability aspect exhibited variability among the various samples that were examined. Furthermore, Alsaeed (2006), Al-Janadi, Abdul Rahman, and Omar (2013), and Alturki (2014) assessed the impacts of firm characteristics on the voluntary disclosure of Saudi companies within the timeframe of 2003 to 2013. Consistently, the size of a firm was found to have a noteworthy positive influence on voluntary disclosure. However, the findings regarding the impact of profitability varied across the studies. The last set of studies in the Saudi context (Habbash, 2015; Alotaibi, 2020; Boshnak, 2020) examined the impact of firm characteristics on the level of environmental disclosure over a period from 2007 to 2018 with varying results regarding the impacts of a firm's size, profitability, leverage, and industry type.

However, it is worth noting that the studies conducted on firms from Saudi Arabia did not investigate the effects of climate risk reporting, nor did they extend their sample beyond the year 2018. Furthermore, it is apparent from prior scholarly investigations that the influence of a firm's characteristics is contingent upon the characteristics of the sample.

Hence, the objective of this study is to examine the influence of firm-specific attributes on climate risk disclosure among non-financial companies in Saudi Arabia between the years 2018 and 2021. The hypotheses that are empirically tested in this study are:

- H_1 : *Firm Size has a significant positive impact on climate risk reporting performance of Saudi non-financial firms.*
- H_2 : *Leverage has a significant positive impact on climate risk reporting performance of Saudi non-financial firms.*
- H_3 : *Profitability has a significant positive impact on climate risk reporting performance of Saudi non-financial firms.*
- H_4 : *Industry Type has a significant positive impact on climate risk reporting performance of Saudi non-financial firms.*

2. RESEARCH METHOD

The sample for this study comprised 515 firm-year observations derived from 140 non-financial companies that were publicly listed on the stock market of Saudi Arabia during the period spanning from 2018 to 2021. The sample initially comprised 568 observations, as presented in Table 1. Despite this, 53 observations were eliminated from the sample because these companies did not issue a board report that would enable us to collect non-financial data. Additionally, the sample comprised financial and non-financial data for a total of 140 companies. The financial data were collected using various electronic sources, such as the Thomson Reuter EIKON database, Wall Street Journal, Argaam, and Yahoo Finance websites. On the other hand, the non-financial data were manually gathered from the annual board reports of these companies. The content analysis technique was used to analyze the non-financial data. Finally, the sample excluded data from financial firms because these companies have special regulations and disclosure practices (Beretta & Bozzolan, 2004; Linsley & Shrivs, 2006), and to prevent industry bias (Sudradjat & Mai, 2022).

Table 1. Sample selection

Number of observation available for non-financial firms in Saudi Stock Market	568
Less: Firm-year with unavailable board report	(53)
Total firm-year observations	515

The dependent variable for this study is the level of climate risk reporting performance (CRRP) for non-financial listed Saudi companies. The CRRP is calculated by utilizing the four main elements, namely governance, strategy, risk management, and metrics and targets. These elements are based on the 11 sub-items of disclosures recommended by the Task Force on Climate-related Financial Disclosures (TCFD)¹, as displayed in Appendix A. The calculation involves taking the average of the 11 CRRP disclosure items, as stated by Alshahrani et al. (2022).

This study employed four independent variables to investigate the factors influencing CRRP among non-financial firms in Saudi Arabia. These var-

¹ <https://assets.bbhub.io/company/sites/60/2020/10/2019-TCFD-Status-Report-FINAL-0531191.pdf>

ables include Firm Size (FSize), Leverage (Lev), Profitability (ROA), and Industry Type (Industry). In line with previous studies investigating the factors that affect the disclosure of climate risk, this research utilized the natural logarithm of total assets as a metric to assess the impact of firm size (FSize) (Brammer & Pavelin, 2008; Da Silva Monteiro & Aibar-Guzmán, 2010; Al-Gamrh & Al-Dhamari, 2016; Boshnak, 2020). Furthermore, scholars such as Chaklader and Gulati (2015), Halimah and Yanto (2018), Boshnak (2020), and Desai (2022) have employed the ratio of total debt to total assets as a measure of leverage (Lev). Similarly, the impact of a firm's profitability has been assessed using the Return on Assets (ROA), as examined by Amran et al. (2014), Chaklader and Gulati (2015), Halimah and Yanto (2018), Boshnak (2020), and Desai (2022). Furthermore, the previous reporting on climate risk depicted the industry type variable (Industry) as a dummy variable, indicating whether a firm belonged to a specific industry or not. In line with prior scholarly works (Bayoud et al., 2012; Alkayed & Omar, 2022; Boshnak, 2020), a dummy variable was employed to evaluate the influence of industry on climate risk reporting. Specifically, this variable takes a value of 1 for industrial firms and 0 for service firms. Consequently, the present study adopted a comparable approach in representing the industry-type variable. Table 2 displays the measurements of the variables along with their corresponding explanations.

Table 2. Measurements of variables

Variable	Measurement
CRRP	The level of climate risk reporting performance
FSize	The natural logarithm of total assets
Lev	The ratio of total debt to total assets
ROA	Net income divided by total assets
Industry	A dummy variable is assigned a value of 1 for industrial firms and 0 for service firms

To investigate the hypotheses pertaining to the impact of firm characteristics on the performance of climate risk reporting, a regression model was employed as follows:

$$CRRP_i^t = \beta_0 + \beta_1 FSize_i^t + \beta_2 Lev_i^t + \beta_3 ROA_i^t + \beta_4 Industry_i^t + \varepsilon_i^t, \quad (1)$$

where β_0 , β_1 , β_2 , β_3 , and β_4 are correlation coefficients, ε_i^t is error of company i in year t , $CRRP$

is the level of climate risk reporting performance, $FSize$ is the natural logarithm of total assets, Lev is the ratio of total debt to total assets, ROA is Net income divided by total assets, and $Industry$ is a dummy variable set to 1 for industrial firms and 0 for service firms.

3. RESULTS AND DISCUSSION

Table 3 displays the descriptive statistics for the variables that have been included in the regression model. The research conducted revealed that the mean and variability of the CRRP were determined to be 0.2161 and 0.3179, respectively. These results suggest that the level of climate risk reporting performance among the companies in the sample is relatively low, with an average of 21.6%, compared to previous studies conducted in the Saudi context, which reported mean index of 68% for social and environmental disclosure (Boshnak, 2020), 36% for social responsibility disclosure (Abdulhaq & Muhamed, 2015), and 30% for environmental disclosure (Habbash, 2015). Furthermore, it is noteworthy that the SD for the CRRP in the sample is relatively high. This observation suggests that there exists a significant degree of variability in the extent of climate risk reporting among the sample participants involved in the study. Regarding the independent variables, the average firm size of the sample is 9.3057, with a range spanning from 7.3802 to 12.335. This is similar the samples used in previous social responsibility reporting and environmental reporting studies in Saudi Arabia (Abdulhaq & Muhamed, 2015; Habbash, 2015). In the sample, the mean values of the leverage and profitability levels were 0.496 and 0.292, respectively. The leverage had a high SD of 0.5735. It is worth mentioning that some companies in the sample reported net losses, given that the minimum value of the ROA is -58.3%. Finally, in the sample, the manufacturing industry comprised the vast majority of firms (84.27%), while only 81 companies (15.73%) belonged to the service industry.

Moreover, Table 4 demonstrates that, concerning the reporting performance level of the four elements considered in the calculation of the CRRP index, Saudi companies generally disclose a greater amount of information regarding governance

Table 3. Descriptive statistics

Panel A. Descriptive statistics for continuous variables					
Variable	N	Mean	S.D	Min	Max
CRRP	515	0.2161	0.3179	0	1
FSize	515	9.3057	0.7602	7.3802	12.3350
Lev	515	0.4960	0.5735	0.0053	6.9226
ROA	515	0.292	0.1001	-0.5833	0.3696

Panel B. Descriptive statistics for dummy variables			
Variable	N	No of 0 (%)	No of 1 (%)
Industry	515	81 (15.73%)	434 (84.27%)

compliance associated with climate risk reporting. This is followed by information concerning risk management linked to climate risk. The least disclosed of the four CRRP elements is information about metrics and targets. Furthermore, the level of performance in climate risk reporting across all four elements exhibited a consistent improvement over the years during which the sample was chosen, as depicted in the table provided. The improvement in the level of CRRP over the years implies that Saudi firms are becoming more aware of and compliant with the country's sustainability initiatives and Vision 2030. Finally, Table 5 displays the performance level of climate risk reporting according to industry type. It is evident from the table that, on average, industrial firms have a higher level of climate risk reporting than service firms over the entire period of the study. This finding concurs with the results obtained from previous studies by Amran et al. (2012), Alotaibi (2020), Boshnak (2020), and Alkayed and Omar (2022). The reason for this is that companies in the

industrial sector have a greater impact on the environment compared to those in the service sector. Therefore, they feel a greater compulsion to disclose information regarding their impact on climate risk in order to improve their image. This aligns with both the legitimacy and stakeholder theories.

Table 6 shows the correlation and significance levels of the various variables used in the model during the four-year period. The table below shows that a firm's size, profitability, and industry type all have a positive and substantial link with the CRRP. However, there is no substantial relationship between the CRRP and the company's leverage level.

The result of a firm's size is consistent with findings from previous research in the literature, as the vast majority of these studies concluded that the size of the firm has a significant and positive effect on the level of climate risk report-

Table 4. Descriptive statistics of CRRP by elements and year

CRRP Elements	Mean					S.D	Min	Max
	Year							
	2018	2019	2020	2021	Total			
Governance	0.2893	0.3492	0.3915	0.4676	0.3777	0.4632	0	1
Strategy	0.1433	0.1746	0.1886	0.2429	0.1909	0.3777	0	1
Risk Management	0.1598	0.1931	0.2429	0.3094	0.2291	0.4092	0	1
Metrics and Targets	0.0716	0.1032	0.1344	0.1655	0.1209	0.3016	0	1
Total	0.1548	0.1919	0.2255	0.2825	0.2161	0.3179	0	1

Table 5. Descriptive statistics of CRRP by industry and year

Type of Industry	Mean					S.D	Min	Max
	Year							
	2018	2019	2020	2021	Total			
Industrial	0.1757	0.2082	0.2452	0.3022	0.2345	0.2398	0	1
Services	0.0267	0.1005	0.1182	0.1927	0.1178	0.2220	0	1
Total	0.1548	0.1919	0.2255	0.2825	0.2161	0.3179	0	1

ing. Notable examples include Da Silva Monteiro and Aibar-Guzmán's (2010) study in Portugal, Chithambo and Tauringana's (2014) study in the United Kingdom, and Nurunnabi's (2016) study in Bangladesh. Similarly, Abdulhaq and Muhamed (2015) and Boshnak (2020) conducted studies in the Saudi context and discovered a comparable connection between firm size and the extent of corporate social and environmental reporting.

The results of this study are consistent with prior investigations carried out by Amran et al. (2014) and Bidari and Djajadikerta (2020) regarding the relationship between a firm's profitability and the level of disclosure on climate risk. Furthermore, the findings align with previous studies conducted by Brammer and Pavelin (2008), Bayoud et al. (2012), Suárez-Rico et al. (2018), and Boshnak (2020) regarding the correlation between a firm's industry classification and the extent of climate risk disclosure. In contrast, existing scholarly literature on climate risk reporting has consistently demonstrated that leverage plays a significant role in determining the extent of climate risk reporting (Chithambo & Tauringana, 2014; Desai, 2022).

Although the correlation matrix indicates the absence of multicollinearity, as the highest correlation between any two independent variables is 0.2795, which falls below the maximum threshold of 0.8 or 0.9 (Field, 2009), a Variance Inflation Factor (VIF) analysis was performed to validate the regression model's reliability. According to Table 7, the VIF with the highest value is 1.12. This value is still below

the threshold of 10, which is considered the point at which multicollinearity becomes a significant issue (Kennedy, 2008) and the recommended value of 5 (Hair et al., 2008).

Regression analysis was utilized to assess the hypotheses outlined in Table 8 of this study. Based on the R-squared value of 0.214 presented in the table, it can be inferred that the model explains 21.4% of the variability in the CRRP. It was postulated that the magnitude of the firm would exert a noteworthy and favorable influence on the CRRP, with a significance level of 1%. The results indicate that a positive correlation exists between the company's size and the extent of CRRP. The result mentioned above is consistent with findings from previous studies conducted in different countries worldwide (Berthelot & Robert, 2012; Chithambo & Tauringana, 2014; Nurunnabi, 2016). The results of the regression analysis offered empirical evidence in favor of the fourth hypothesis, suggesting that the industry type had a statistically significant and positive impact on the CRRP, with a 1% level of significance. Previous studies have found that manufacturing firms are more likely to divulge information regarding their climate risk activities (Amran et al., 2012; Amran et al., 2014; Suárez-Rico et al., 2018; Boshnak, 2020). On the contrary, the results of the regression model did not provide support for the second or third hypotheses, as there was no significant impact of leverage or profitability on the CRRP.

This can be attributed to the fact that larger firms in the manufacturing industry are subjected to more

Table 6. Pearson correlation matrix

	CRRP	FSize	Lev	ROA	Industry
CRRP	1				
FSize	0.3911***	1			
Lev	-0.0258	-0.0506	1		
ROA	0.1249***	0.2795***	-0.0525	1	
Industry	0.1336***	-0.1793***	-0.0164	-0.0508	1

Note: *** denote significance at 1%.

Table 7. Variance inflation factors

Variable	VIF	1/VIF
FSize	1.12	0.893
ROA	1.09	0.920
Industry	1.03	0.967
Lev	1.00	0.995
Mean VIF	1.06	

monitoring from the societies in which they operate, as well as greater public scrutiny of their actions; as a result, they must disclose more climate risk information to maintain their legitimacy and comply with increased pressure from their stakeholders. Furthermore, institutional pressure on these companies is high because their actions have a greater environmental impact. To avoid disciplinary action, large manufacturing companies typically comply with these regulations and disclose more information regarding their environmental activities. In contrast, although the findings did not support hypotheses 3 and 4, they are consistent with those of Alturki (2014), Eleftheriadis and Anagnostopoulou (2015), and Habbash (2016), as the level of climate risk reporting in the sample was not influenced by the firm's leverage and profitability.

Table 8. Regression results

Dependent Variable (CRRP)	
FSize	0.1530*** 5.02
Lev	-0.0375 -1.40
ROA	0.0490 0.51
Industry	0.1917*** 4.66
Constant	-1.4123*** -4.88
No. of Obs	515
R-squared	%21.40

Note: *** denote significance at 1%.

The study conducted a robustness test to recheck the main results. In this test, an alternative measure of the dependent variable (CRRP2) for regression model 1 was used. The alternate measure (CRRP2) is calculated by taking the log of the total number of the 11 CRRP disclosure items. A similar measure was utilized in previous studies, such as the one conducted by Kouloukoui et al. (2019) in Brazil. They employed the log of the index to capture the extent of reporting on climate risk.

The regression results for the alternative dependent variable measurement are displayed in Table 9. The findings that are presented in Table 9 are consistent with the outcomes of the preliminary test. These findings indicate that the size and industry classification of non-financial firms in Saudi Arabia have a positive and statistically significant effect on the

CRRP. However, the analysis revealed that the leverage and profitability of the firm do not exert a significant influence on the CRRP. However, this model's R-squared value is only 13.06%, indicating that the results from the initial analysis were more reliable. Consequently, the main conclusion of this research remains unchanged when the alternative measure for the CRRP is applied, indicating that hypotheses 1 and 4 are supported while hypotheses 2 and 3 lack sufficient support.

Table 9. Regression results (CRRP2)

Dependent Variable (CRRP2)	
FSize	0.2947*** 3.06
Lev	0.0347 0.34
ROA	0.0058 0.01
Industry	0.4586** 2.37
Constant	-2.1318** -2.14
No. of Obs	515
R-squared	%13.06

Note: ** and *** denote significance at 5% and 1%, respectively.

Further analysis was performed in this study, utilizing the four primary sections of the CRRP, to validate the results and ensure their consistency. As a result, four further models were computed: Model 1, which represents the governance element of the CRRP; Model 2, which pertains to strategy; Model 3, which concerns risk management; and Model 4, which concerns metrics and targets. Based on this analysis, and as presented in Table 10, the size of non-financial firms in Saudi Arabia and the industry they belong to exhibit a positive and noteworthy influence on all four elements. However, the profitability of a firm does not demonstrate any significant impact on any of the four elements, which aligns with the initial findings. Nevertheless, the sole disparity observed between the outcomes of the additional test and the initial test employing the CRRP lies in the fact that the firm's leverage exhibits a noteworthy adverse influence on the strategy element, with a significance level of 10%. It is important to acknowledge that the outcomes obtained from these models exhibit lower robustness compared to the initial model, as indicated by their lower R-squared values.

Table 10. Regression results (Elements of CRRP)

	Dependent Variable (CRRPGov)	Dependent Variable (CRRPStr)	Dependent Variable (CRRPRM)	Dependent Variable (CRRPMT)
FSize	0.1220***	0.1619***	0.1882***	0.1371***
	2.98	4.30	4.58	3.83
Lev	-0.0320	-0.0661*	-0.0179	-0.0285
	-1.02	-1.91	-0.57	-0.92
ROA	0.2816	-0.0809	0.0278	0.0412
	1.33	-0.73	0.17	0.64
Industry	0.2887***	0.1947***	0.1889***	0.1257***
	3.62	3.67	3.20	3.18
Constant	-1.0849***	-1.4878***	-1.7402***	-1.2976***
	-2.78	-4.24	-4.47	-3.84
No. of Obs	515	515	515	515
R-squared	%11.75	%14.99	%15.81	%16.88

Note: * and *** denote significance at 10% and 1%, respectively.

To sum up, the research findings show that hypotheses 1 and 4 are supported while hypotheses 2 and 3 are rejected. Thus, the findings suggest that firm size and industry are likely to have higher significance in determining the climate risk reporting performance level.

CONCLUSIONS

The objective of this study was to examine the effectiveness of climate risk reporting among non-financial companies in Saudi Arabia. Furthermore, the study examined the impact of different firm characteristics on the level of climate risk reporting. Based on an analysis conducted on a sample of non-financial firms in Saudi Arabia spanning from 2018 to 2021, the findings indicate that although the level of CRRP was initially modest, there was a noticeable enhancement in the performance of climate risk reporting over the examined period. Hence, efforts and awareness of the need of reporting on climate risk performance have expanded among Saudi non-financial firms to meet stakeholders' demands and demonstrate their legitimacy in society. In addition, the results confirmed that there are positive and statistically significant relationships between a firm's size and the industry to which it belongs and the CRRP, whereas leverage and profitability have no significant effect on the CRRP. The study employed alternative measures for the dependent variable, CRRP, to assess its robustness. Thus, it was discovered that the findings are consistent with the primary findings of this study. Furthermore, the findings align with the four major elements of CRRP, thereby validating the conclusions of the study.

This study makes a number of contributions. To the best of the authors' knowledge, this research study stands as the only endeavor to assess the degree of climate risk reporting within the Saudi Arabian context. Most previous studies have examined the extent of CSR and voluntary reporting. Moreover, this specific study represents the only investigation undertaken in the Saudi Arabian context that examines the determinants that impact the degree of disclosure regarding climate risks. To accomplish this, the study utilizes a collection of eleven components that are associated with risk management, policy, strategy, metrics, and objectives. Moreover, it is imperative to mention that the sample utilized in this specific investigation has never been used before in the Saudi Arabian context. Therefore, the primary objective of this study is to provide the latest findings regarding the impact of firm attributes of non-financial firms in Saudi Arabia on the CRRP. The findings of this study can help investors make well-informed decisions about their investments in these companies and their compliance with various environmental regulations. It also improves managers' understanding of the significance of CRRP and aids them in their climate risk management planning and decision-making tasks. Finally, the findings of this study can assist policymakers and market regulators in raising awareness of CRRP determinants and promoting sustainable practices.

AUTHOR CONTRIBUTIONS

Conceptualization: Awatif Hodaed Alsheikh, Warda Hodaed Alsheikh.

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APPENDIX A

Table A1. CRRP INDEX

CRRP	Items
Climate Risk Reporting Performance	<p>A. Governance (CRRPGov) 1. Board oversight: Explain the board’s oversight of the risks and possibilities associated with climate change. 2. Management’s role: Clarify the function of management in evaluating and handling dangers and possibilities related to climate.</p> <p>B. Strategy (CRRPStr) 3. Risks and opportunities: Describe the short-, medium-, and long-term climate threats and possibilities the organization has recognized. 4. Impact on organization: Explain the impact that the risks and opportunities associated with climate change will have on the organization’s businesses, as well as its approach and financial planning. 5. Resilience of strategy: Assess the resilience of the organization’s strategic plan, while considering various climate-related eventualities, encompassing a scenario of 2 °C or less.</p> <p>C. Risk management (CRRPRM) 6. Risk ID and assessment processes: Discuss the procedures employed by the organization to recognize and evaluate risks associated with climate change. 7. Risk management processes: Outline the steps taken to mitigate climate-related risks inside the organization. 8. Integration into overall risk management: Explain how the organization’s general risk management includes methods for recognizing, evaluating, and handling climate-related risks.</p> <p>D. Metrics and targets (CRRPMT) 9. Climate-related metrics: (a) Declare the metrics used by the organization to evaluate climate-related risks and opportunities in accordance with its strategy and risk management procedure. 10. Scope 1, 2 and 3 GHG emissions: Identify Scope 1, Scope 2, and, if applicable, Scope 3 greenhouse gas (GHG) emissions and associated risks. 11. Climate-related targets: Explain the organization’s aims for managing climate-related risks and opportunities, as well as its performance against those targets. Each item, if it exists, is assigned a value of 1, and 0 otherwise.</p>