How Does Acquirer Climate Change Risk Impact Mergers and Acquisitions Deal Success?

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ABSTRACT

This study investigates the impact of acquirer climate change exposure on (merger and acquisition) M&A deals success. We use a novel cross-country dataset of firm-level exposure to climate change risks and integrate it with data from 19,261 M&A deals conducted by 1,516 acquirers from 62 countries from 2002 to 2020. We find a negative effect of acquirer climate change exposure on deal success. We also find that the CSR strategy of firms positively moderates the relationship between climate risk exposure and the deal success of firms. Our results are robust with alternative climate risk measures and correcting for endogeneity.

Keywords: *Climate change, M&A, deal success, CSR*

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INTRODUCTION

"We are the first generation to feel the effect of climate change and the last generation who can do something about it."- Barack Obama, former US president.

The increasing impact of global climate change[4] on economic and human losses are unevenly distributed across geographies and detrimental to society and business (Cepni et al., 2024; Huang et al., 2018, 2022; Yoon et al., 2024). The increasing intensity and frequency of extreme weather events are results of climate change, affecting economies and businesses through physical (e.g., floods, droughts, wildfires, rise in global temperature and sea level), regulatory[5] (introduction of new policies and regulations across countries) and liability (owing to regulatory and legal restrictions) exposures (Cepni et al., 2024; Sautner et al., 2023). Climate change has direct and indirect impacts on long and short-term economic and business growth (Ren et al., 2022), challenging the simultaneous economic growth and environmental protection (Ren et al., 2022; Sautner et al., 2023; Yoon et al., 2024). It led to academic research on the impact of climate change on economic growth and firms' operations (Auffhammer, 2018; Huang et al., 2022; Ren et al., 2022).

[4] IPCC (2007) predicts 2-4 C increases in global mean temperature between 2023 and 2060 may lead to a 1.3 percent loss in global income. Similarly, climate change has caused USD 3.08 trillion in losses worldwide between 1996 and 2015, with about $4.2 trillion in manageable assets currently under climate change risk (Hossain et al., 2023).

[5] The United States recently announced investing USD 1.7 trillion in the next ten years, aiming for a 50 percent reduction in greenhouse gas emissions by 2023 (compared to 2005). European Commission started the European Green Deal in 2019, aiming to target net-zero greenhouse gas emissions in the European Union by 2025 (Ozkan et al., 2023).

The extant literature has primarily examined the impact of macro-economic climate changes on the economic outcomes of various countries (Auffhammer, 2018; Dell et al., 2014) and various firm-level outcomes, such as firm performance (Huang et al., 2018), operations (Diaz & Moore, 2017; Iyke, 2024; Ren et al., 2022) and financing (Huang et al., 2018). However, these studies are primarily limited to examining the impact of the geographic area (e.g., country) level climate change on firm performance and financing, with limited attention to the focal firms' level climate change exposure. Recently, the studies have shifted their focus from overall geography (macro country-level) to firm-level exposure to climate change for various reasons (Huang et al., 2022; Sautner et al., 2023). First, the extreme and frequent climate change events in a geographic region are not directly informative for firm managers to assess business impact. Second, it does not differentiate the focal firms' level of exposure and makes it difficult for firm managers to adopt practices to overcome the climate threat posed to the firm(can put some footnotes). To address these challenges of assessing climate change impact, recent studies have shifted to firm-level analysis by focusing on firm-specific climate change exposure. However, these studies are limited to firms' financial decisions and performance (reference), with limited attention to firms' strategic decisions. It is important due to the mounting demand on the firms for strategic adaptations to the climate change issues (provide footnote) and consideration of climate risk by investors and stakeholders in the strategic decisions (footnotes). Therefore, it is of more theoretical and practical relevance to examine the impact of firm-level climate change exposure on corporate decisions and managerial actions to overcome these risks.

In this study, we fill this gap and advance the research on firm-level climate change exposure by examining its impact on firm mergers and acquisitions (M&A) success. M&A is an essential strategy for the growth of firms to acquire resources and market (Haleblian et al., 2009; Steigenberger, 2017). M&A transactions involve a massive flow of money, such that in

2016, 48,736 transactions with an aggregate value of $3.6 million took place worldwide (according to the Institute for Mergers, Acquisitions, and Alliances (IMAA) (IMAA, 2016). However, M&A deal success remains a persistent challenge for firms, as the firms participating in the announced deal face adverse market reactions to the failure of the deal (Fuad & Venugopal, 2023; Steigenberger, 2017). Prior studies have found various firms, industry, and country-level factors impacting the success of M&A deals (for detailed review, see Fuad and Venugopal, 2023). Though the early evidences show that socially responsible acquirers have higher likelihood of deal success (Deng et al., 2013; Just et al., 2023; Waqar & Ma, 2022) and face less uncertainty around the deal success (Arouri et al., 2019). However, the impact of firms' climate change exposure on M&A deal completion has not been explored, which remains an important determinant of firm strategy and performance in recent times with the increasing impact of climate change across businesses and geographies (Ren et al., 2022, 2024). Given the large-scale and irreversible nature of M&A transactions, the risk related to firm climate change exposure poses significant challenges of information asymmetry by firms with higher risk. Therefore, this study examines how acquirer firms' climate change exposure impacts M&A deal completion.

Furthermore, we argue that the acquiring firms with high climate risk exposure can take proactive action to reduce the negative impact on M&A deal completion. In this study, we focus on firm corporate social responsibility (CSR) as an strategy to mitigate the detrimental effect of climate risk.[6], where firms' commitment to the environment, society, and appropriate governance practices (ESG practices) reduces the negative implications of climate risk through various mechanisms. Prior studies show acquirer CSR as an important determinant of M&A

[6] A recent survey by Bain and Company, 2022 shows that only 11 percent of executives consider ESG during the M&A transaction process, with a 65 percent expected increase in focus on ESG (Bain & Company, 2022).

deal completion (Deng et al., 2013; Waqar & Ma, 2022) and timing of completion (Just et al., 2023). Based on the CSR literature, we argue that acquirer CSR performance acts as an governance tool to reduce agency conflicts and information asymmetry (reference), enabling social trust (reference), and acting as an insurance mechanism to build legitimacy (reference) to overcome the adverse effect of climate change risk on M&A deal completion.

We examine the impact of acquirer climate change risk on M&A deal completion using a sample of 19,261 deals by 1,516 acquirers in 62 countries. Our results show that acquirer climate risk has a negative impact on deal completion, while their CSR performance attenuates this effect. This study advances and makes three significant contribution to the existing literature. First, we extend the prior literature on the impact of firm-level climate change exposure on their strategic outcomes beyond the firm performance and external financing (Huang et al., 2022; Jung & Song, 2023; Ren et al., 2024). It extends the prior literature focusing on the macro-economic (country or geography) level of climate change on country and firm-level outcomes (Auffhammer, 2018; Iyke, 2024; Yoon et al., 2024). We argue that it is more relevant to access the firm-level climate risk to inform the strategic decision of the manager. We emphasize the microeconomic (firm-level) risk and outcomes of climate risk in the context of M&A, which remains an important strategy for firms' growth and survival. Second, we contribute to the M&A literature by identifying acquirer climate change risk exposure as an important determinant of deal success. Despite the significant impact of climate change on firms' performance, existing literature lacks a coherent understanding of how it impacts M&A deal success (Bose et al., 2021; Deng et al., 2013; Fuad & Venugopal, 2023). We argue that acquirers with high climate change risk exposure face agency conflict with target and stakeholder (e.g., external financer) and have higher information asymmetry and legitimacy deficit, which negatively impact deal completion due to conflict in the public acquisition process. Target firms' sense of value depreciation due to adverse stock market

reactions and the cost of handling acquirer climate risk increases their resistance to deal success. It advances the prior literature on M&A deal completion, limited to acquirer experience, motivation, and networks as determinants of deal completion (reference). Finally, it enriches the scholarly talks on how firms can overcome the adverse effects of climate change exposure (Chen et al., 2023; Feng et al., 2024; Ozkan et al., 2023). We show that firms can use CSR as a strategy to overcome the adverse effects of climate change. Firm-level CSR provides reputational and social capital insurance to overcome the information asymmetry and legitimacy deficit, which reduces the negative effect of climate risk of M&A deal completion. Our findings add to the literature on the relevance of CSR in reducing climate change risk and using it to firm advantage (Ozkan et al., 2023). In the unsettling and risk-taking event of M&A, CSR reduces the risk associated with acquirer climate exposure in the due diligence process (Arouri et al., 2019). It provides insights for firm managers and policymakers on tackling climate risk by using CSR to their strategic advantage for success.

The rest of the paper is organized as follows. In the next section, we provide a literature background and develop hypotheses, further section explains the data, valuables, and methods used for empirical estimation. Further, we discuss the results and robustness tests. Finally, we conclude with contributions and provide direction for future research.

LITERATURE AND HYPOTHESES

Climate Change Risk and Firm Outcomes

The discussion on the climate change risk have transitioned from the science to the management discipline in the last three decades. For instance, the Kyoto Protocol in 1997 focused on reducing the greenhouse gas emission, UK government release of the Stern Review in 2006 to assess the impact and cost of climate change, and signing of Paris agreement treaty

by 196 nations at the UN Climate Change Conference (COP21) in 2016 have emphasized the importance of climate change. This has increased the attention of investors and other stakeholders (e.g., government, customers, and suppliers) on the impact of climate change risk on businesses, such as many firms have started releasing voluntarily reports on strategies to tackle the climate change risk[7]. Management scholars argue that the climate change exposure to the firms falls in the three categories: physical, transitional and regulatory (Cepni et al., 2024; Sautner et al., 2023). Physical risk in damage to the firm's assets and operation due to rising exposure to carbon emission and more frequent extreme events. Similarly, the transitional risk is related to firm operational risk due to shifting from the 'brown to green' (e.g., fossil fuel to the green energy) to deter the impact of climate change in the future. Moreover, firm also face regulatory risk due to introduction of policies and regulation across countries to combat the climate risk, leaving exposed firms liable to these institutional changes.

Therefore, climate changes disrupt the global supply chain, impacting the supply of goods and services and causing political instability, which has implications for firms' operations and strategy (Iyke, 2024; Ozkan et al., 2023; Sautner et al., 2023). One stream of the research examines the impact of country level climate change on the firms, such as rising temperature and climate risk diminish labor and firm productivity (Ren et al., 2022, 2024) and increase operating costs (Pankratz et al., 2023). However, these studies assume the homogeneous impact of geographical climate change risk on all the firms across and within industries. This has motivated the scholar to focus on the firm-level climate change exposure to acknowledge the heterogeneity across firms and provide relevant implications for managers. This stream of research shows that under the unfavorable climate risk, firms face adverse market reactions and undervaluation (Bolton & Kacperczyk, 2021; Jung & Song, 2023). The

[7] Fortune Global 250 firms reporting on climate change have increased from 44% in 2011 to 78% in 2017. 95 % of these firms report carbon target and more than 50% have sustainability leaders in 2024 (Stancu, 2024).

negative perception of the stakeholders and shareholders about firm climate change exposure increases information asymmetry and agency cost. Studies report that firms-level climate change exposure increases the cost of equity (Cepni et al., 2024) and debt financing (Huang et al., 2022), increase bank loan spread (Huang et al., 2022) and overall cost of capital (Agoraki et al., 2024), increase use of short term debt (Choi, 2024), increase risk of bankruptcy (Feng et al., 2024) and hamper firms performance (Ozkan et al., 2023). In addition, the inferior public image caused by high carbon emissions also impacts firm cash holding and downside risk (Chen et al., 2023; Heo, 2021). Conversely, Jung and Song (2023) show that significant climate change exposure of the firms increases firms' shareholders' and analysts' attention, leading to less risk of a stock crash. We extend this stream of the research by examining the impact of firms-level climate change exposure on the M&A deal success.

Climate Change Risk and M&A Deal Success

M&A has been an essential strategy for firm growth, while the failure to complete the deal leads to a negative market reaction with significant financial and reputation loss for the acquiring firms (Chakrabarti & Mitchell, 2016; Fuad & Venugopal, 2023). The M&A process includes a pre-merger-phase and the post deal completion integration phase. The per-merger process is classified into the private and public takeover phases (Fuad & Venugopal, 2023). In the private takeover phase, the target (or selling) firms negotiate with multiple potential buyers, followed by an official announcement with the final acquirer. Following this, Public takeover begins with the acquirer and target renegotiating the initial offering and due diligence processes (Fuad & Gaur, 2019). The availability of new and relevant information about the transacting parties impacts the success or abandonment of the final deal (Fuad & Venugopal, 2023). Prior research has found various country, industry, deal and firms-level factors as determinant of the deal success (Fuad & Venugopal, 2023; Kumar & Sengupta, 2020; Welch et al., 2020). At the

firm-level studies have primarily focused on acquirer and target firms ownership, boards and CEO characteristics, performance, and prior M&A experience as determinants of the deal success (Kumar & Sengupta, 2020; Welch et al., 2020). Recently, a few studies have focused on the impact of climate change on M&A decisions and outcomes. Literature provides conflicting evidence on the propensity of firms with high climate risk to engage in M&A. For example, (K. Liu et al., 2024) show that acquirers with high carbon risk are encouraged to improve investment efficiency by engaging in M&A, while (Lodh et al., 2024) finds that acquirers with high climate change risk have less propensity to engage in M&A and face negative market reaction. Studies also find that acquirers with high carbon emission have higher likelihood to conduct foreign M&A (compared to domestic) (Bose et al., 2021), especially in the less developed markets (Bose et al., 2021; Guo & Cheng, 2024) to have favourable market reactions (Bose et al., 2021). However, these studies have limited evidence on the success on the M&A deals, which has implications for acquirer performance. There, we explore the impact of acquirers' climate change exposure on M&A deal completion.

Firm-level Climate Change Exposure and M&A Success

We propose that the acquirer's higher exposure to climate change risk negatively impacts the success of the M&A deal. First, firm-level climate change exposure induces the agency cost for transacting parties and stakeholders due to conflicting attitudes towards the imposed risk (Jensen & Meckling, 1976). For example, the cost of acquirer climate risk is shared with the target firms stakeholders (including shareholders), without any potential benefits of climate risk. The acquirer climate risk increases the risk to assets (owned and borrowed), leading to a higher cost of external financing of the cash-heavy M&A transaction, as they face a higher cost of debt (Huang et al., 2022) and equity financing (Cepni et al., 2024). Second, acquirer climate change exposure also heightens the information asymmetry with the

target firm and stakeholders of transacting firms. Acquirer climate risk pauses the risk of information asymmetry due to target firms' inability to access the complete risk associated with climate change exposure of the acquirer, causing incomplete contract-based post-deal opportunism by the acquirer (Bose et al., 2021). For example, the acquirer may use the M&A activity to off-load and diversify their climate change risk, leaving target firms vulnerable to future costs (Bose et al., 2021). In addition, the market penalizes (with adverse market reactions) the M&A transaction with firms having a higher risk of climate change (Bose et al., 2021), increasing the risk of deal abandonment by the target firms and stakeholder resistance on deal completion. Third, acquirers with high climate change exposure lack legitimacy and send negative signals, which is an important determinant of M&A deal failure (Fuad & Venugopal, 2023). Acquirers with a high climate change risk are not perceived as socially responsible and cause de-legitimacy challenges by regulatory approval authorities (Fuad & Venugopal, 2023). Acquirer high climate risk exposure causes a lack of transparency and opaqueness for stakeholders, increasing informational asymmetry and transaction cost of M&A deal completion (Li et al., 2019). In addition, acquirers and target firms used various signaling mechanisms to appreciate the quality of their assets and reduce information asymmetry for deal success (Fuad & Venugopal, 2023). Therefore, the acquirer climate risk exposure leads to a bad corporate image (Bose et al., 2021) and negatively impacts target firms' value and reputation (Arouri et al., 2019), causing resistance to deal completion by target firms. Finally, acquirer climate risk exposure is likely to increase merged (or acquired) entity operating costs in the short and long run, causing stakeholders resistance to deal completion. Climates risk exhibits the cost of direct damage to firm assets (e.g., plant, equipment, and machinery) used in the operations. Firms with higher climate risk bear the cost of adapting new technology, meeting societal expectations (e.g., spending on social responsibility projects), environmental regulation, and litigation risks (Huang et al., 2022). The post-M&A uncertainties related to

high-polluting firms' clean-up costs increase operating and financing costs (Bose et al., 2021; Guo & Cheng, 2024). In sum, the higher agency cost and information asymmetry, lower legitimacy and a negative signal, and higher cost of post-M&A operation due to the acquirer's higher climate risk exposure reduce the likelihood of deal completion.

Hypothesis 1. *Higher climate risk exposure of the acquirer is negatively associated with M&A deal success.*

Moderating Role of CSR

Prior studies show that acquirers high CSR reduces the uncertainty around the M&A deal (Arouri et al., 2019), increase the completion likelihood and increases post-acquisition performance (Zheng et al., 2023). Building on this literature, we argue that acquirer with higher CSR performance can reduce the negative effects of climate change risk exposure on M&A deal success through various mechanisms. First, studies show that acquirers' high CSR reduces shareholder-stakeholder conflicts for faster M&A integration (Arouri et al., 2019), reducing the negative effect of climate risk on deal completion. CSR reduces firms' cash flow volatility and financial distress (Ozkan et al., 2023), reducing the risk of stock price crashes due to adverse events (Jia et al., 2020). It is likely to reduce the negative effect of acquirer climate risk on constraint and cost of financing. Second, (Deng et al., 2013) show that US acquirers with a high CSR focus are less likely to breach contracts, showing less opportunism and faster deal completion. It reduces the information asymmetry related to climate risk and enables quick stakeholder (e.g., deal financers and legal authorities) support (Just et al., 2023). Third, we argue that acquirer CSR overcomes the legitimacy and positive signalling deficits, attenuating the negative effect of climate change risk on M&A deal completion. CSR builds acquirer social capital and trust, which leads to shared belief and trust with the stakeholders (Lins et al., 2017). It is likely to provide reputational insurance to overcome the firm's specific idiosyncratic risk

due to higher exposure to climate change. Additionally, the acquirer's high CSR increases the reputation among regulators, reducing the risk of regulatory intervention during M&A transactions for firms with high climate risk (Ozkan et al., 2023). Based on the above discussion, we expect that CSR reduces the adverse effect of the acquirer climate change risk on M&A deal completion by providing a governance tool to reduce agency conflicts and information asymmetry, enabling social trust, and acting as an insurance mechanism to build legitimacy.

Hypothesis 2. *Acquirer CSR performance weakens the negative association between acquirer climate risk exposure and M&A deal success.*

DATA AND METHOD

Data Description

In this study, we use a sample of 19261 M&A deals comprising 1516 firms across 62 countries. We use this data for a sample period from 2002 to 2020. We use the deal success of the firm as our dependent variable. Deal success is a dummy variable that equals 1 for the completed M&A deals and 0 otherwise. We obtain the required data from the Refinitiv Eikon database. Furthermore, we use the climate change exposure of firms as our main explanatory variable in the study. Climate change exposure indicates the climate change events at the firm-level. It is measured based on the frequency with which certain climate change bigrams occur in the earnings transcript, scaled by the total number of bigrams in the transcript. This measure is developed by Sautner et al. (2023)[8] and has been extensively used in studies (Adegbile &

[8] Please see https://osf.io/fd6jq/.

Sarpong, 2018; Faccini et al., 2023; Pankratz et al., 2023; Pástor et al., 2022). Sautner et al. (2023) construct this measure based on the conversation in earnings conference calls. It is similar to the construction method used by Hassan et al. (2023).

Next, we use deal-level and firm-level variables as control variables. We use friendly deal, acquirer public status, target public status, % acquired, and CBA deals as the deal-level variables. Here, Friendly deal equals 1 for a friendly deal attitude and 0 otherwise. Acquirer Public status and Target Public status equal 1 for a deal with an acquirer firm and target firm as a publicly listed firm, respectively, and 0 otherwise. % Acquired represents the percentage of shares of the target firm acquired by the acquirer firm in a deal. We define CBA deals as cross-border deals, which equals 1 for a cross-border deal and 0 otherwise. Additionally, we also incorporate the Deal industry as a dummy that equals 1 for deals between the same industries and 0 otherwise. We also use firm-level control variables in our study, namely, profitability, liquidity, age, size, and leverage of the firm. Profitability equals the ratio of Earnings before Interest, tax, depreciation, and amortization to the total assets of the firm. We measure Liquidity as the quick ratio of the Age equals the number of years since the incorporation of the firm. We define Size as the logarithm of the total assets of the firm and Leverage as the ratio of debt to equity of the firm. We winsorize all the financial variables at the 1st and 99th percentile to control for the outliers in the study.

Next, we use firm CSR as a moderating variable that impacts the relationship between climate change exposure and the deal success of firms. We use a set of variables to measure firm CSR, represented by ESG score, environmental score, and social score of firms in the study, Here, ESG score equals the overall score of firms based on its environmental score, social score, and governance score. Environmental score is based on the firm's impact on the natural system.

Social score is based on firm's capacity to generate trust and loyalty among its stakeholders by implying the best management practices. These proxies have been extensively used in the literature to measure the CSR strategies of firms (Bofinger et al., 2022; Gillan et al., 2021; Uyar et al., 2022).

Methodology

We employ a panel fixed-effects model to study the impact of climate change exposure on the deal success of firms. Specifically, we represent our model using the following equation:

$$Y_i = \beta_0 + \beta 1 Climate\ change\ exposure_{y-1} + \beta 2 Zi + \beta 3 Xi_{,y-1} + \delta_p + \alpha_{ay} + \gamma_{jy} + \theta_t + \epsilon_{py} \quad (1)$$

where, Climate change exposure represents the main explanatory variable. Y shows the dependent variable representing the deal success of the firm. Z represents a vector of all the deal-level control variables, which include friendly deal, acquirer public status, target public status, % acquired, CBA deals, and deal industry. We show all the firm-level control variables using X, which consists of profitability, liquidity, age, size, and leverage. Furthermore, we control for firm-level time-invariant heterogeneity using firm fixed effects shown as δp in Equation 1. We control for the time-varying country-level heterogeneity and industry-level heterogeneity using αay and γjy, respectively, where a, j, and y represent country, industry, and year respectively. Additionally, we also control for time-invariant target country-level heterogeneity using target country fixed effects shown by θt, where t represents the target country. We cluster the standard errors at the firm, year, acquirer industry, and the acquirer country level.

Next, we show the moderating role of firm corporate social responsibility on the proposed relationship between climate change exposure of firms and deal success. We show the relationship using the following equation:

$$Y_i = \beta_0 + \beta 1 Climate\ change\ exposure_{y-1}\ \mathrm{X}\ CSR_{,y-1} + \beta 2 Climate\ change\ exposure_{y-1} + \beta 3 CSR_{y-1} + \beta 4 Zi + \beta 5 Xi_{,y-1} + \delta_p + \alpha_{ay} + \gamma_{jy} + \theta_t + \epsilon_{py} \quad (2)$$

Here, we introduce a moderator for the firm CSR strategy shown by CSR in Equation 2. We measure firm CSR using three variables in the study, namely, ESG score, environmental score, and social score of firms. All other variables are explained in the previous subsection.

RESULTS

Table 1 presents the summary statistics of the study variables. In our sample, 73 percent of deals were completed (or 27 percent failed or not completed), with acquiring firms having significant variation in the climate change exposure (minimum= 0.000, maximum= 0.012). The sample firms also show high variation in their CSR performance or ESG score (SD=18/519). In the M&A deal level characteristics, 88.1 percent are friendly M&A, 54.5 percent are cross border acquisitions (CBA), and the average acquired percent by the acquirer in the target is 51.32. In the firm level characteristics, 99.8 percent of acquirers are public, 20.2 percent of target firms are public, and 43.5 deals have acquirers and targets from the same industry.

Table 2 reports the regression results examining the impact of acquirer climate change exposure on the M&A deal completion. Model 1 shows that acquirer climate change exposure has a significant negative impact on deal completion. The results are consistent after the inclusion of the control variables (at the deal and firm levels) and fixed effects (at the firms' industry and country levels). It is aligned with our prediction that in the public takeover phase of the announced deal, the acquirer's high climate change risk exposure poses agency cost and

information asymmetry challenges due to the inherent and invisible future risk associated with the firms with a high risk of climate change impact.

In Table 3, we examine the moderating role of the firm's CSR performance on climate change exposure and the M&A deal success relationship. Model A shows that the acquirer ESG score has a significant positive interaction effect on the climate change exposure risk and deal success relationships. In line with our prediction, acquirers with high ESG scores are able to reduce the stakeholders' conflicts and reduce the agency cost and information asymmetry gap with the target firms (and other stakeholders of participating firms). ESG score sends a positive signal and reflects the legitimacy of the acquirer towards stakeholders and attains a positive reaction from the firms' shareholders. Thereby, reducing the negative effect of the acquirer climate change risk exposure on the M&A deal completion. As alternative measures, we also use the environmental and social dimension score of the firm's CSR performance as the moderating variables. Our results show that the acquirer's social score has a significant positive moderating effect on the firm's climate change exposure and deal success relationship (Model 3).

Robustness Tests

Firm-level climate change sentiment. In Table 4, we use an alternative measure of the firm's climate change exposure based on the firm-level climate change sentiment. Based on the machine learning analysis of the quarterly earning conference calls transcript, climate change sentiment measures the relative number of the climate change bigrams based on the positive and negative tone words. Firms with a high value of the climate change sentiment carry a brown perception, while those with a low value carry a green perception for the stakeholders, shareholders, and analysts. In line with the baseline results, we find that acquirer firms' level climate change sentiments have a significant negative impact on the M&A deal success (Model 1), while firms' ESG scores attenuate this negative effect (Model 2). Additionally, the social

dimension of the ESG score also weakens the negative. effect on the acquirer firm climate change sentiments and deal success (Model 4).

Propensity score matching. We use propensity score matching (PSM) to reduce the self-selection bias of firms with high or low climate change exposure due to various observable and unobservable factors. The non-random assignment of the firms into the high or low climate change exposure group controls for the self-selection bias and causal interferences (Wellalage & Fernandez, 2019). We perform the PSM on a matched pair of acquirers with high (treated group) and low (control group) climate change exposure based on the median of the sample firms' climate change exposure. Based on the one-to-one nearest matching technique, we calculate the propensity score of the treatment acquirers (using the psmatch2 command in STATA 17). Based on the matched sample from the PSM, we estimate the impact of firm-level climate exposure on deal success. The PSM analysis results are shown in Table 5. In line with our baseline results, the matched sample results confirm a negative impact of acquirer climate change exposure on M&A deal success, while firm ESG score attenuates this relationship.

Moderating role of Paris Agreement. Next, we study the moderating role of the Paris Agreement on the deal success of firms. In 2015, the United Nations Framework Convention on Climate Change entered into an agreement with 197 countries, known as the Paris Agreement, to deal with climate change problems (Lee et al., 2023). The agreement mainly focused on stabilizing global warming and reducing greenhouse gas emissions (Alessi et al., 2024; W. Liu et al., 2020). It marked a landmark in the climate change process as it was the first legally binding treaty to bring all the nations to deal with climate change. Accordingly, we study the impact of the Paris agreement on the deal success of firms. We define the Paris Agreement as a dummy variable that equals 1 for the years 2015 onwards and 0 otherwise. We present these results in Table 6.

Table 6 shows that climate change exposure negatively impacts the deal success of firms after the Paris Agreement enforcement. Our results show that the deal success of firms has reduced by 14.20% for firms with high climate change exposure after the implementation of the Paris Agreement. These results suggest that the firms with more climate change exposure after the Paris Agreement are less likely to successfully complete their deals. It shows that the increased information asymmetry and agency costs due to climate change exposure after the Paris Agreement further reduces the deal success of firms.

DISCUSSION AND CONCLUSION

The extant literature has primarily examined the impact of macro-economic climate changes on the economic outcomes of various countries (Auffhammer, 2018; Dell et al., 2014) and various firm-level outcomes, such as firm performance (Huang et al., 2018), operations (Diaz & Moore, 2017; Iyke, 2024; Ren et al., 2022) and financing (Huang et al., 2018). However, these studies are primarily limited to examining the impact of the geographic area (e.g., country) level climate change on firm performance and financing, with limited attention to the focal firms-level climate change exposure. Recently, the studies have shifted their focus from overall geography (macro country-level) to firm-level exposure to climate change for various reasons (Huang et al., 2022; Sautner et al., 2023).

We study the impact of firm-level climate change exposure on the deal success of firms. We find that climate change exposure has a negative impact on the deal completion propensity of firms. We show that the increased exposure of firms increases the agency costs and information asymmetry for the transacting party to complete the deal. As a result, the deal success of firms is reduced for firms with increased climate change exposure. Additionally, we find that the negative relationship between climate change exposure and deal success is altered by the CSR strategy of firms. We show that the ESG score of firms positively moderates the

relationship between climate change exposure and the success of firms. Overall, our results show the importance of maintaining a CSR strategy for firms in mitigating and managing the other risks associated with the firms.

Contributions

This study advances and makes three significant contribution to the existing literature. First, we extend the prior literature on the impact of firm-level climate change exposure on their strategic outcomes beyond the firm performance and external financing (Huang et al., 2022; Jung & Song, 2023; Ren et al., 2024). It extends the prior literature focusing on the macro-economic (country or geography) level of climate change on country and firm-level outcomes (Auffhammer, 2018; Iyke, 2024; Yoon et al., 2024). We argue that it is more relevant to access the firm-level climate risk to inform the strategic decision of the manager. We emphasize the microeconomic (firm-level) risk and outcomes of climate risk in the context of M&A, which remains an important strategy for firms' growth and survival. Second, we contribute to the M&A literature by identifying acquirer climate change risk exposure as an important determinant of deal success. Despite the significant impact of climate change on firms' performance, existing literature lacks a coherent understanding of how it impacts M&A deal success (Bose et al., 2021; Deng et al., 2013; Fuad & Venugopal, 2023). We argue that acquirers with high climate change risk exposure face agency conflict with target and stakeholder (e.g., external financer) and have higher information asymmetry and legitimacy deficit, which negatively impact deal completion due to conflict in the public acquisition process. Target firms' sense of value depreciation due to adverse stock market reactions and the cost of handling acquirer climate risk increases their resistance to deal success. It advances the prior literature on M&A deal completion, limited to acquirer experience, motivation, and networks as determinants of deal completion (reference). Finally, it enriches the scholarly talks

on how firms can overcome the adverse effects of climate change exposure (Chen et al., 2023; Feng et al., 2024; Ozkan et al., 2023). We show that firms can use CSR as a strategy to overcome the adverse effects of climate change. Firm-level CSR provides reputational and social capital insurance to overcome the information asymmetry and legitimacy deficit, which reduces the negative effect of climate risk of M&A deal completion. Our findings add to the literature on the relevance of CSR in reducing climate change risk and using it to firm advantage (Ozkan et al., 2023). In the unsettling and risk-taking event of M&A, CSR reduces the risk associated with acquirer climate exposure in the due diligence process (Arouri et al., 2019). It provides insights for firm managers and policymakers on tackling climate risk by using CSR to their strategic advantage for success.

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TABLE 1 Summary Statistics

Variable	N	Mean	SD	Min	p10	p25	p50	p75	p90	Max
Deal success	19261	0.730	0.444	0.000	0.000	0.000	1.000	1.000	1.000	1.000
Climate change exposure	19261	0.001	0.002	0.000	0.000	0.000	0.000	0.001	0.003	0.012
ESG score	11036	53.606	18.519	5.540	26.890	40.625	55.315	67.590	77.610	86.990
Environmental score	11036	52.486	27.894	0.000	8.110	30.845	56.290	76.465	86.450	95.070
Social score	11036	57.243	23.694	2.120	22.820	38.670	58.920	77.170	87.760	95.070
Friendly deal	19261	0.881	0.324	0.000	0.000	1.000	1.000	1.000	1.000	1.000
Acquirer public status	19261	0.998	0.044	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Target Public status	19261	0.202	0.401	0.000	0.000	0.000	0.000	0.000	1.000	1.000
% Acquired	19261	51.325	45.393	0.000	0.000	0.000	50.000	100.000	100.000	100.000
CBA deals	19261	0.545	0.498	0.000	0.000	0.000	1.000	1.000	1.000	1.000
Profitability	19261	0.059	0.078	-2.304	0.005	0.028	0.054	0.091	0.134	0.348
Liquidity	19261	1.313	1.417	0.043	0.581	0.794	1.030	1.417	2.136	41.779
Age	19261	37.173	31.330	-10.000	6.000	13.000	27.000	59.000	87.000	117.000
Size	19261	15.915	1.740	7.728	13.683	14.759	15.964	17.176	18.151	19.840
Leverage	19261	0.895	1.183	-1.266	0.055	0.281	0.574	1.106	1.933	9.517
Deal industry	19261	0.435	0.496	0.000	0.000	0.000	0.000	1.000	1.000	1.000

Notes: Min. & Max. show the minimum and maximum value of each variable respectively. SD and P represent the standard deviation and percentile respectively.

TABLE 2
Impact of Climate Change on Deal Success

	(1)	(2)
Climate change exposure	-6.101***	-8.284*
	(2.105)	(3.963)
Friendly deal		0.055
		(0.034)
Acquirer Public status		-0.181
		(0.107)
Target Public status		0.092***
		(0.026)
% Acquired		0.007***
		(0.000)
CBA deals		-0.007
		(0.013)
Profitability		-0.029
		(0.066)
Liquidity		-0.003
		(0.003)
Age		-0.009
		(0.006)
Size		-0.008
		(0.016)
Leverage		-0.001
		(0.005)
Deal industry		-0.033***
		(0.006)
Constant	0.738***	0.953**
	(0.003)	(0.345)
Observations	26,118	19,261
Firm fixed effects	Yes	Yes
Acquirer country-year fixed effects	Yes	Yes
Acquirer industry-year fixed effects	Yes	Yes
Target country fixed effects	Yes	Yes
Adjusted R^2	0.132	0.561

Note: The dependent variable in the models (1) & (2) is the deal success propensity of firms. Climate change exposure is climate change exposure of firms. The robust standard errors are displayed in brackets, which are clustered at the firm, year, acquirer industry, and the acquirer country level. The significance level at 1%, 5%, and 10% is denoted by ***,**,*, respectively.

TABLE 3
Moderating Role of CSR

	(1)	(2)	(3)
Climate change exposure x *ESG score*	0.289*		
	(0.149)		
ESG score	-0.001		
	(0.001)		
Climate change exposure x *Environmental score*		0.063	
		(0.116)	
Environmental score		-0.001	
		(0.001)	
Climate change exposure x *Social score*			0.285**
			(0.092)
Social score			-0.001
			(0.000)
Climate change exposure	-24.326*	-11.668*	-24.845***
	(11.025)	(5.357)	(7.188)
Friendly deal	0.078*	0.078*	0.078*
	(0.036)	(0.037)	(0.036)
Acquirer Public status	-0.076	-0.080	-0.078
	(0.414)	(0.390)	(0.398)
Target Public status	0.095**	0.096**	0.095**
	(0.030)	(0.031)	(0.031)
% Acquired	0.007***	0.007***	0.007***
	(0.000)	(0.000)	(0.000)
CBA deals	-0.011	-0.011	-0.011
	(0.020)	(0.019)	(0.019)
Profitability	0.007	0.013	0.007
	(0.074)	(0.085)	(0.075)
Liquidity	-0.008	-0.007	-0.007
	(0.005)	(0.006)	(0.005)
Age	-0.004	-0.004	-0.004
	(0.011)	(0.011)	(0.011)
Size	0.002	0.004	0.002
	(0.016)	(0.016)	(0.016)
Leverage	-0.003	-0.003	-0.003
	(0.010)	(0.010)	(0.009)
Deal industry	-0.028**	-0.028***	-0.028**
	(0.009)	(0.009)	(0.009)
Constant	0.551	0.541	0.558
	(0.742)	(0.749)	(0.735)
Observations	10,923	10,923	10,923
Firm fixed effects	Yes	Yes	Yes
Acquirer country-year fixed effects	Yes	Yes	Yes
Acquirer industry-year fixed effects	Yes	Yes	Yes
Target country fixed effects	Yes	Yes	Yes
Adjusted R^2	0.558	0.558	0.558

Note: The dependent variable in all the models is the deal success propensity of firms. Climate change exposure is climate change exposure of firms. The robust standard errors are displayed in brackets, which are clustered at the firm, year, acquirer industry, and the acquirer country level. The significance level at 1%, 5%, and 10% is denoted by ***,**,*, respectively.

TABLE 4
Impact of Climate Change on Deal Success: Alternative Proxy for Climate Change

	(1)	(2)	(3)	(4)
Climate change sentiment	-13.946**	-33.290***	-20.875	-29.453***
	(5.433)	(6.511)	(20.231)	(8.395)
Climate change sentiment x *ESG score*		0.499***		
		(0.139)		
ESG score		-0.000		
		(0.001)		
Climate change sentiment x *Environmental score*			0.258	
			(0.297)	
Environmental score			-0.001	
			(0.001)	
Climate change sentiment x *Social score*				0.404*
				(0.181)
Social score				-0.000
				(0.000)
Friendly deal	0.054	0.078*	0.078*	0.078*
	(0.034)	(0.037)	(0.040)	(0.038)
Acquirer Public status	-0.182	-0.080	-0.084	-0.082
	(0.108)	(0.392)	(0.386)	(0.390)
Target Public status	0.092***	0.096**	0.096**	0.096**
	(0.026)	(0.031)	(0.030)	(0.030)
% Acquired	0.007***	0.007***	0.007***	0.007***
	(0.000)	(0.000)	(0.000)	(0.000)
CBA deals	-0.007	-0.011	-0.011	-0.011
	(0.012)	(0.019)	(0.019)	(0.019)
Profitability	-0.029	0.009	0.012	0.009
	(0.067)	(0.078)	(0.083)	(0.081)
Liquidity	-0.003	-0.008	-0.008	-0.008
	(0.003)	(0.005)	(0.005)	(0.006)
Age	-0.009	-0.004	-0.004	-0.004
	(0.005)	(0.011)	(0.011)	(0.011)
Size	-0.008	0.002	0.004	0.002
	(0.016)	(0.014)	(0.016)	(0.015)
Leverage	-0.001	-0.003	-0.003	-0.003
	(0.005)	(0.010)	(0.010)	(0.009)
Deal industry	-0.033***	-0.028**	-0.028**	-0.028**
	(0.006)	(0.010)	(0.010)	(0.011)
Constant	0.952**	0.526	0.524	0.528
	(0.335)	(0.748)	(0.747)	(0.742)
Observations	19,261	10,923	10,923	10,923
Firm fixed effects	Yes	Yes	Yes	Yes
Acquirer country-year fixed effects	Yes	Yes	Yes	Yes
Acquirer industry-year fixed effects	Yes	Yes	Yes	Yes
Target country fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.561	0.558	0.558	0.558

Note: The dependent variable in all the models is the deal success propensity of firms. Climate change sentiment is climate change sentiment of firms. The robust standard errors are displayed in brackets, which are clustered at the firm, year, acquirer industry, and the acquirer country level. The significance level at 1%, 5%, and 10% is denoted by ***,**,*, respectively.

TABLE 5
Impact of Climate Change on Deal Success: Propensity Score Matching Analysis

	(1)	(2)	(3)	(4)
Climate change exposure	-8.216*	-24.337*	-11.673*	-24.754***
	(3.968)	(11.051)	(5.373)	(7.168)
Climate change exposure x *ESG score*		0.289*		
		(0.150)		
ESG score		-0.001		
		(0.001)		
Climate change exposure x *Environmental score*			0.064	
			(0.116)	
Environmental score			-0.001	
			(0.001)	
Climate change exposure x *Social score*				0.284**
				(0.091)
Social score				-0.001
				(0.000)
Friendly deal	0.055	0.079*	0.078*	0.079*
	(0.035)	(0.036)	(0.037)	(0.036)
Acquirer Public status	-0.181	-0.076	-0.080	-0.079
	(0.107)	(0.414)	(0.390)	(0.398)
Target Public status	0.092***	0.095**	0.096**	0.095**
	(0.026)	(0.030)	(0.031)	(0.031)
% Acquired	0.007***	0.007***	0.007***	0.007***
	(0.000)	(0.000)	(0.000)	(0.000)
CBA deals	-0.007	-0.011	-0.011	-0.011
	(0.013)	(0.020)	(0.019)	(0.019)
Profitability	-0.032	0.008	0.015	0.008
	(0.066)	(0.074)	(0.086)	(0.075)
Liquidity	-0.003	-0.007	-0.007	-0.007
	(0.003)	(0.006)	(0.006)	(0.005)
Age	-0.009	-0.004	-0.004	-0.004
	(0.006)	(0.011)	(0.011)	(0.011)
Size	-0.007	0.002	0.004	0.002
	(0.016)	(0.016)	(0.016)	(0.016)
Leverage	-0.001	-0.003	-0.003	-0.003
	(0.005)	(0.010)	(0.010)	(0.009)
Deal industry	-0.033***	-0.028**	-0.028***	-0.028**
	(0.006)	(0.009)	(0.009)	(0.009)
Constant	0.942**	0.549	0.540	0.556
	(0.348)	(0.740)	(0.747)	(0.733)
Observations	19,187	10,894	10,894	10,894
Firm fixed effects	Yes	Yes	Yes	Yes
Acquirer country-year fixed effects	Yes	Yes	Yes	Yes
Acquirer industry-year fixed effects	Yes	Yes	Yes	Yes
Target country fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.561	0.557	0.557	0.557

Note: The dependent variable in all the models is the deal success propensity of firms. Climate change exposure is climate change exposure of firms. The robust standard errors are displayed in brackets, which are clustered at the firm, year, acquirer industry, and the acquirer country level. The significance level at 1%, 5%, and 10% is denoted by ***,**,*, respectively.

TABLE 6
Impact of Climate Change on Deal Success: Moderating Role of Paris Agreement

	(1)	(2)
Climate change exposure x *Paris agreement*	-14.201**	-8.364*
	(6.217)	(4.613)
Climate change exposure	0.423	-4.352
	(4.257)	(3.471)
Friendly deal		0.055
		(0.034)
Acquirer Public status		-0.187*
		(0.107)
Target Public status		0.092***
		(0.026)
% Acquired		0.007***
		(0.000)
CBA deals		-0.007
		(0.013)
Profitability		-0.029
		(0.067)
Liquidity		-0.003
		(0.003)
Age		-0.009
		(0.005)
Size		-0.007
		(0.016)
Leverage		-0.001
		(0.005)
Deal industry		-0.033***
		(0.008)
Constant	0.737***	0.960**
	(0.004)	(0.346)
Observations	26,118	19,261
Firm fixed effects	Yes	Yes
Acquirer country-year fixed effects	Yes	Yes
Acquirer industry-year fixed effects	Yes	Yes
Target country fixed effects	Yes	Yes
Adjusted R^2	0.132	0.561

Note: The dependent variable in the models (1) & (2) is the deal success propensity of firms. Climate change exposure is climate change exposure of firms. The robust standard errors are displayed in brackets, which are clustered at the firm, year, acquirer industry, and the acquirer country level. The significance level at 1%, 5%, and 10% is denoted by ***,**,*, respectively.