Managing transition climate risk: Evidence from green mergers and acquisitions in China

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Abstract: Firms increasingly face transition climate risk as policy, regulatory, and market forces accelerate the shift toward decarbonization. We examine whether, and under what conditions, firms respond to transition risk by undertaking green mergers and acquisitions (M&As), and whether such deals deliver tangible environmental outcomes. Drawing on the resource-based view and legitimacy theory, we hypothesize and find that transition risk spurs green M&A activities. This relation is stronger for firms that attract greater media coverage, consistent with external scrutiny elevating deal visibility and expected payoffs. However, green-oriented leaders and ISO 14001 certification attenuate the effect, suggesting that stronger preexisting internal governance reduces the incremental benefit of M&A-based adaptation. To address endogeneity concerns, we employ an instrumental variable approach and obtain similar results, and we further exploit the staggered implementation of the Low Carbon Cities Program as a quasi-natural experiment, documenting that high-risk firms located in pilot cities increase green M&As after the policy is adopted. Additional analyses show that the baseline effect is concentrated among firms facing fewer financing constraints and is driven by transition rather than physical risk. Finally, green M&As undertaken by high-risk firms are followed by increases in green innovation, indicating substantive capability building rather than symbolic greenwashing.

Keywords: Transition Climate Risk; Green Mergers and Acquisitions; Social Monitoring; Green Governance; Green Innovation

JEL Classification: G32, G34, O32, Q54

1. Introduction

As global temperatures rise, the past decade has witnessed a clear escalation of extreme meteorological events and natural catastrophes. Climate changes have become one of the most consequential challenges for humanity. Recent scholarly works have shown that climate-related risks can erode firm performance (Huang et al., 2018, Ozkan et al., 2023), increase bankruptcy risk (Feng et al., 2024), and raise the cost of bank financing (Ge et al., 2025, Huang et al., 2022). Against this backdrop, the 2024 United Nations Climate Change Conference reiterates the ambition of limiting global warming to 1.5°C and underscores the urgency of investing in climate action.[1]

As governments worldwide implement stringent climate policies, firms confront transition climate risk when their operations lag behind the economy's shift toward sustainable practices (Li et al., 2024). Prior research documents firms' proactive adaptation to climate risk through risk management practices (Huang et al., 2022), incentive contracts (Hossain et al., 2023), human capital investment (Cao et al., 2025), and disclosure behavior (Ge et al., 2025). However, we lack a coherent account of how transition risk shapes firms' capital reconfiguration choices and whether such choices deliver substantive outcomes.[2] Transition risk is conceptually distinct from physical risk because the former arises from policies and regulations, as well as societal expectations and market pressures (Francis et al., 2025, Li et al., 2024). From a resource-based view (RBV), firms may mitigate transition risk by sourcing and internalizing low-carbon capabilities for the long term, and green mergers and acquisitions (M&As) represent a prominent vehicle for doing so. Meanwhile, uncertainty persists about whether green investment produces tangible improvements or reflects symbolic greenwashing incentives (e.g., Cao et al., 2025, Hagendorff et al., 2025, Orazalin et al., 2024, Yang and Chi,

[1] See https://unfccc.int/cop29/about-cop29 and https://unfccc.int/news/cop29-un-climate-conference-agrees-to-triple-finance-to-developing-countries-protecting-lives-and.

[2] "Transition climate risk" and "transition risk" are used interchangeably in this study.

2023, Zhao and Jia, 2022). Our study addresses these gaps by examining whether transition risk increases firms' propensity to undertake green M&As and whether such acquisitions subsequently advance firms' sustainable operations. This question holds direct relevance for managers, investors, policymakers, regulators, and the broader community.

We situate our analysis in China due to the following three reasons. First, the question is highly salient in China. Rapid economic growth has brought substantial environmental challenges, thereby elevating transition risk to an urgent concern in the country. Firms seeking to remain competitive must adapt to evolving expectations for a greener trajectory. Second, China provides a policy environment that is well suited for identification. The staggered implementation of the Low Carbon Cities Program (LCCP) creates exogenous variations in local transition risk exposure and in firms' incentives to manage such risk. Third, the relatively weak regulatory enforcement and the opaque information environment in China tend to bias our tests toward detecting the hypocritical use of green M&As as a vehicle for greenwashing. If the evidence instead points against greenwashing and toward substantive outcomes, we can reasonably infer that green M&As constitute an effective approach for firms to manage transition risk and that our findings are generalizable to more developed markets.

Using firms' annual reports, we develop a firm-level measure of transition climate risk by calculating the proportion of text in the Management Discussion and Analysis (MD&A) section devoted to this issue. The empirical results indicate that firms with higher transition risk exhibit a greater tendency to engage in green M&As. Economically, a one-standard-deviation increase in transition risk elevates the likelihood that an M&A deal is classified as green by 24.03% relative to the sample mean. This baseline finding survives extensive robustness checks.

We next investigate the underlying mechanisms through which transition risk affects green M&As. First, as transition risk rises, social scrutiny tightens disclosure requirements,

increases reputational and financial penalties for inaction, and rewards progress toward decarbonization. Green M&As are particularly effective because they are costly and observable, trigger mandatory disclosures and independent vetting, attract broad public attention that amplifies their information content, and enable the efficient deployment of the target's assets and talent to accelerate the green transition. Social monitoring therefore raises the payoff from acquisitions relative to internal projects and increases the cost of delay. Consistent with this reasoning, we document that the link between transition risk and green M&As is more evident among firms that attract greater media coverage.

Second, transition risk compresses the timetable for technological upgrading, asset reconfiguration, and process redesign. Firms with weak internal green governance, such as limited board oversight of climate issues, immature risk management systems, or incentive contracts that are weakly tied to decarbonization, face high coordination and execution costs when pursuing a "build" strategy. In these settings, the "purchase" option becomes more attractive, since green M&As deliver preconfigured green capabilities that are difficult to assemble quickly in-house. Firms that have already implemented strong green governance systems, however, can absorb transition risk through precommitted internal programs that redesign production and reskill employees, which reduces the marginal need for, and incremental benefit of, acquiring external green capabilities through green M&As. This reasoning is supported by the evidence that the adverse consequences of climate changes are attenuated among socially responsible firms (Ozkan et al., 2023). As predicted, we observe a weaker relationship between transition risk and green M&As among firms with stronger internal green governance in place, measured by the presence of a top leader with green experience or the firm's ISO 14001 certification.

Thus far, our baseline result indicates that transition risk increases the likelihood that firms pursue green M&As. However, this interpretation could be contaminated by endogeneity

problems. As a first step in addressing endogeneity concerns, we apply an instrumental variable (IV) approach, and our inference remains unchanged. In addition, we utilize the staggered implementation of the LCCP as a quasi-natural experiment. The program requires designated regions to set greenhouse gas emission caps and transition toward low-carbon industrial systems, making it particularly salient for firms facing elevated transition risk. The results of our multi-period difference-in-differences (DiD) analysis reveal that, following the adoption of the LCCP, firms facing higher transition risk located in pilot cities exhibit a greater likelihood of engaging in green M&As than firms with lower risk. A dynamic analysis shows no pre-policy divergence and detects significant treatment effects only after the launch of the LCCP.

Before concluding this study, we conduct three additional analyses. First, our findings indicate a stronger impact for firms whose financing constraints are less binding, suggesting that adequate and reliable access to capital is a prerequisite for deploying green M&As to manage transition risk. Second, we perform a comparative analysis to assess whether our baseline effect is absent for physical climate risk. A standardized horse racing test reveals that the impact of transition risk is almost five times the impact of physical risk and that the latter is statistically indistinguishable from zero. Lastly, to rule out the alternative explanation related to greenwashing, we examine post-deal economic consequences and find that green M&As undertaken by high-risk firms are followed by increases in granted green invention patents, whereas such an effect is absent for low-risk firms.

Our study makes several important contributions. Although prior studies predominantly emphasize the detrimental consequences of climate-related risk for market value (Berkman et al., 2024), operating performance (Ozkan et al., 2023, Pankratz et al., 2023), labor productivity (Zhu et al., 2021), financing conditions (Ge et al., 2025, Huang et al., 2022, Huynh et al., 2020), and bankruptcy risk (Feng et al., 2024), relatively less attention has been paid to firms'

responses. A nascent body of literature highlights proactive management. For instance, Hossain et al. (2023) show that firms recalibrate incentive contracts to reflect their exposure to climate change risk. Ge et al. (2025) document that disclosure mitigates the unfavorable impact of climate risk on bank loan spreads. Distinct from and complementary to these studies, our focus is on transition-oriented green M&As, a proactive strategy for managing transition risk. The closest study to ours is Cao et al. (2025), who examine human capital investment and show that firms reduce over-hiring when climate risk intensifies. Our research advances this ongoing discussion, and our findings align with the interpretation that firms rebalance away from excessive internal human capital accumulation toward the acquisition of external green capabilities through acquisitions. We further illuminate the underlying mechanisms and show that transition risk has a larger effect on green M&As when external social monitoring is more intense and when preexisting internal green governance is weaker.

Over the past fifty years, the M&A literature has examined motives grounded in agency costs (Jensen and Meckling, 1976), market power (Eckbo, 1983), synergies (Grossman and Hart, 1988), and mispricing (Shleifer and Vishny, 2003). Although prior literature has identified many determinants of M&As in general, the drivers unique to green M&As remain insufficiently understood. We extend this strand of literature by exploring green M&As that prioritize environmental responsibility, corporate resilience, and sustainable development. A related study by Hu et al. (2023) shows that the environmental tax policy motivates firms in high-polluting industries to undertake green M&As. However, a policy-specific focus alone does not capture the broader and more pervasive uncertainties associated with transition climate risk, and the majority of green M&As are undertaken by non-polluting firms.[3] We introduce transition risk as a novel catalyst for green M&As and develop a theoretical lens at

[3] In our sample, non-polluting firms account for 64.4% of green M&As. The share of green M&As among all M&As is 23.9% for polluting firms and 20.9% for non-polluting firms, suggesting that green M&As are relevant for both groups rather than being confined to heavily polluting industries.

the intersection of environmental adaptation and legitimacy management that explains why and how firms turn to M&As to obtain and internalize green capabilities. In doing so, our study lays a foundation for integrating environmental and sustainability dimensions into M&A theory, thus broadening the scope of risk management and corporate governance research.

With respect to the motivations and consequences of green investment, the literature reports rather mixed evidence on whether it yields measurable improvements or instead reflects symbolic greenwashing. On the one hand, Zhao and Jia (2022) investigate the governance consequences of green M&As and document a lower likelihood of environmental violations, and Hagendorff et al. (2025) similarly report improved environmental performance associated with investment in green skills. On the other hand, Yang and Chi (2023) conclude that green M&As in general are not conducive to the transition. Orazalin et al. (2024) show that firms employ climate initiatives to create positive impressions, consistent with greenwashing incentives. Building on this ongoing debate, we advance a motivation-contingent view of the effectiveness of green M&As, arguing that benefits arise when green M&As are undertaken to manage transition risk. Consistent with the disciplinary role of transition risk, heightened transition pressure induces firms to pursue green M&As, particularly under strong external monitoring, when corporate leaders lack prior green experience, or when firms lack established environmental management frameworks. We further document increases in green innovation following green M&As, indicating substantive synergy gains that help firms adapt to climate change.

Finally, our research enriches the literature on climate finance and management by juxtaposing physical and transition risks and examining how they differentially shape corporate behavior. Cao et al. (2025) examine human capital investment and show that firms reduce over-hiring in response to physical and regulatory risks. We complement this line of research by incorporating the broader construct of transition risk and by comparing how different types of

climate risk affect corporate responses. Transition risk is shaped not only by policies and regulations but also by social pressures and market forces (Francis et al., 2025, Li et al., 2024). Accordingly, while regulatory risk centers on the enactment of more stringent rules and regulations, transition risk represents a broader complementary set of climate-related exposures beyond physical risk. Within this broader lens, we find that transition risk, rather than physical risk, imposes the primary influence on green M&As. This finding advances the theoretical understanding of the drivers behind green M&A decisions by documenting that policy-induced and market-driven transition pressures exert a stronger influence on firms than do losses from climate-related disasters. This insight also informs policy making and resource allocation decisions. Policy design and assessments of corporate strategies should explicitly account for the regulatory environment and market expectations.

2. Literature review and theoretical framework

2.1. Climate risk taxonomy

The literature generally classifies climate-related risks into physical risk and transition risk (e.g., Li et al., 2024). Of these, physical risk concerns the direct and immediate operational disruptions caused by climate changes, such as storms or floods that impair firms' fixed assets. Transition risk, by contrast, arises from the economy's shift toward low-carbon production and consumption. It reflects, but is not limited to, regulatory pressures (Shui et al., 2025), intensified competition in green technologies (Hussain and Kumar, 2025), and low-carbon preferences of investors and customers (Lim et al., 2025, Ceccarelli et al., 2024), all of which can alter expected asset values, reduce profits for carbon-intensive firms, and impose structural pressures on business sectors.

We parse the implications of transition climate risk into two intertwined dimensions. One is the firm's substantive green capability, and the other is the extent to which this capability is accepted and recognized by outsiders. Both dimensions can reshape managerial incentives

and the propensity to pursue green M&As. First, transition risk increases the demand for green capabilities. Green M&As embed climate-related objectives into M&A activities with the aim of advancing corporate sustainability and environmental performance (Salvi et al., 2018). By acquiring targets that possess green assets, acquirers can leapfrog internal development, accelerate the accumulation of green know-how and routines, and thereby temper their exposure to transition risk. Second, because transition risk is rooted in evolving economic and social norms, firms must address information asymmetries that may otherwise prevent outsiders from recognizing substantive green actions. Green M&As are costly and visible, which makes them effective in conveying credible signals of commitment. In doing so, they reduce information asymmetries, protect legitimacy, and enhance market willingness to accept and reward green actions.

2.2. Theoretical perspectives

2.2.1. Resource-based view

The RBV emphasizes firm internal factors as sources of sustained competitive advantage (Wernerfelt, 1984). Within the RBV, the valuable, rare, inimitable, and non-substitutable (VRIN) framework provides a benchmark for assessing whether a target's resources are worth acquiring in an M&A, as such resources can underpin durable performance advantages (Barney, 1991). The natural RBV extends this logic by linking competitive advantage specifically to pollution abatement and corporate sustainability (Hart, 1995, Hart and Dowell, 2010). Recent work situates green M&As within this RBV-grounded capability acquisition logic and empirically shows that green capabilities enter meaningfully into M&A decisions (Hussain and Kumar, 2025). When transition risk intensifies, green capabilities are likely to satisfy VRIN conditions, which raises the strategic value of acquiring such capabilities through green M&As relative to relying exclusively on internal development.

2.2.2. Dynamic capabilities

Developed as a complement to the RBV (Wernerfelt, 1984), the dynamic capabilities perspective (Teece et al., 1997) explains how firms adjust their capabilities in rapidly changing markets by sensing environmental shifts, seizing opportunities, and transforming their asset base (Helfat and Martin, 2014, Hart and Dowell, 2010, Cristofaro et al., 2025). This theoretical perspective is particularly useful for understanding strategic adaptation in settings characterized by transition risk, where regulatory regimes, technologies, and social expectations evolve continuously, requiring firms to employ reconfiguration vehicles to remain aligned with these shifting demands (Girod and Whittington, 2017). Within this context, green M&As, which source and internalize low-carbon capabilities for the long term, take on a distinctive role. By enabling firms to acquire and embed bundles of green capabilities that are difficult to build rapidly through internal development, green M&As provide incremental value beyond purely organic adjustment and function as an important reconfiguration mechanism for adapting to environments shaped by transition risk.

2.2.3. Legitimacy theory

Beyond economic and resource-based perspectives, legitimacy theory explains the link between transition risk and green M&As through a social lens. Legitimacy theory concerns how firms seek social approval as norms and rules evolve (Suchman, 1995, Patten, 1992). As transition pressures intensify, stakeholders such as investors, regulators, the media, and local communities increasingly expect visible and verifiable evidence of environmental commitment. Prior studies show that environmentally legitimate firms face less scrutiny and exhibit lower unsystematic risk, motivating firms to take actions that align with environmental expectations (Ortiz-de-Mandojana and Bansal, 2016, Hagendorff et al., 2025, Bansal and Clelland, 2004).

Although environmental activities carry legitimacy value, empirical evidence indicates that firms often adopt process-based climate initiatives that facilitate greenwashing rather than

substantive transformation (Orazalin et al., 2024). Green M&As, however, tend to attract prominent public attention and scrutiny, especially under heightened exposure to transition risk. Once this scrutiny and the possibility of legitimacy gaps are taken into account, green M&As are less likely to be purely cosmetic or hypocritical. When public claims about such deals are not supported by post-deal outcomes, the resulting loss of environmental legitimacy becomes visible and can trigger penalties through adverse coverage, boycotts, and sanctions, which erode reputational capital and destroy firm value (Bansal and Clelland, 2004, Gatti et al., 2019).

3. Hypothesis development

3.1. Transition climate risk and green M&As

Growing emphasis on climate governance has made transition risk central to corporate strategic decisions. Transition risk intensifies regulatory scrutiny and tightens constraints on firms' access to both product and capital markets (Francis et al., 2025, Li et al., 2024, Shui et al., 2025). Failure to implement timely and credible transition plans can trigger substantial remediation costs, heighten exposure to environmental litigation, and erode reputational capital, thereby jeopardizing firms' long-term viability.

Because transition risk is long-lived and systemic, firms need to accumulate stocks of strategic green capabilities. However, such stocks develop only gradually and are constrained by time compression diseconomies (Dierickx and Cool, 1989). At the same time, transition risk shortens the time window available for technological upgrading, asset reallocation, and production-process redesign, which limits the feasibility of a purely internal build strategy. Green M&As offer a comparatively rapid route to embed stocks of cleaner capabilities into operations, enabling firms both to ameliorate the negative consequences of transition risk and to capitalize on climate-related opportunities. Consequently, the make-versus-buy tradeoff tilts toward green M&As when transition risk is elevated, especially when the target's resources are cospecialized with the acquirer's asset base and, once integrated, are likely to satisfy the VRIN

conditions given the firm's risk profile.

Viewed through the lens of legitimacy management, firms also face a dilemma. Green initiatives that do not alienate outside stakeholders may still fail to attract attention when they are indistinguishable from peers' actions (Elsbach and Sutton, 1992). Green M&As serve as a credible legitimacy device because they are costly and highly observable, and they are typically accompanied by detailed disclosures and resource-committing actions that withstand external scrutiny. These features render the firm's alignment with societal expectations both visible and verifiable, thus enhancing legitimacy in a way that routine, low-salience initiatives often cannot (Elsbach and Sutton, 1992, Deegan, 2002, Hawn and Ioannou, 2016).

The preceding discussion leads to our main hypothesis:

H1. *Firms with higher transition climate risk are more likely to engage in green M&As*.

3.2. The moderating effect of external social monitoring

As transition risk rises, external social monitoring reshapes the payoff from green M&As by increasing the costs of inaction and raising the rewards for visible, verifiable green activities, consistent with legitimacy and dynamic capabilities perspectives.

Social monitoring elevates the expected net benefits of green investment as a proactive response to transition risk. Intense media coverage heightens the salience of transition risk and increases the reputational and financial penalties associated with delay, while credible actions related to the green transition receive greater visibility and market recognition. Among alternative green investment strategies, firms are therefore more likely to turn to green M&As when external social monitoring is strong. Green M&As are costly and observable, and they are subject to third-party evaluation and continued coverage, enabling them to convey information to capital markets with high information content relative to noise (Spence, 2002). Greater scrutiny amplifies the value of this signal, updates stakeholder beliefs about the firm's environmental trajectory, and bolsters legitimacy against accusations of greenwashing. Strong

external social monitoring thus raises the informational yield and reputational returns from green M&As and, in turn, increases managerial willingness to pursue such deals.

From a dynamic capabilities perspective, external social monitoring enhances the sensing, seizing, and reconfiguring processes through which transition risk exposure is transformed into acquisition value. Ongoing scrutiny provides timely feedback on stakeholder expectations and helps reveal gaps in decarbonization plans. Continued monitoring surrounding green M&As facilitates the rapid combination of physical assets and human capital across firm boundaries, accelerating green technological upgrading once the deal is completed. Taken together, these forces reduce integration frictions, lower execution risk, and raise the expected payoff from green M&As when transition risk is high.

Building on the reasoning above, we develop the following hypothesis:

H2. *The positive effect of transition climate risk on the probability that a firm undertakes green M&As is stronger when the firm is subject to more intensive external social monitoring.*

3.3. The moderating effect of internal green governance

We posit that as the quality of internal green governance improves, both the urgency for additional environmental initiatives and the marginal value of green M&As as a response to transition risk decline. As regulators, investors, and customers increasingly penalize inaction, firms with well-established governance systems can absorb these pressures through precommitted internal programs, such as green technology development, production process redesign, and targeted reskilling of existing human capital. Hence, for these firms, the incremental effect of transition risk on further green activities, including green M&As, is limited because ongoing projects and incentives have already internalized transition risk exposure. These arrangements substitute for M&A-based capability sourcing and attenuate the additional informational or legitimacy benefits that green M&As would otherwise deliver. By contrast, weaker governance leaves room for M&As to be a more attractive adaptation path.

The dynamic capabilities perspective further suggests that internal green governance shapes the "make-or-buy" decision in green investment (Teece, 2007, Helfat and Martin, 2014). Firms with weak internal green governance face substantial coordination and execution costs when attempting an in-house transition. Green M&As allow them to seize externally developed solutions by importing an already configured bundle of low-carbon technologies, operating routines, and specialized capital that would be difficult to assemble quickly or reliably through internal development. As internal green governance becomes weaker, the comparative advantage of green M&As for a given level of transition risk is expected to increase.

Accordingly, our final hypothesis is stated as follows:

H3. *The positive effect of transition climate risk on the probability that a firm undertakes green M&As is weaker when the firm has stronger internal green governance in place.*

Figure 1 summarizes these hypotheses in a conceptual model.

4. Research design

4.1. Sample and data

We start with all Chinese A-share main-board firms over the 2008-2023 period. Transition risk is measured using annual reports downloaded from CNINFO.[4] Data on M&As and control variables are sourced from CSMAR.

To obtain the final sample, we (1) drop Special Treatment and Particular Treatment firms, (2) drop financial firms, (3) keep equity acquisitions and exclude land or other asset purchases, (4) drop deals in which the acquirer's ownership stake in the target exceeds 30% prior to the transaction, (5) exclude asset divestitures, asset exchanges, debt restructurings, and share repurchases, (6) exclude deals with values below RMB 1 million or stakes below 30%, (7) drop failed transactions, and (8) keep the largest deal for each firm in each year. Our final sample covers 4,156 M&As undertaken by 2,103 firms.

[4] https://www.cninfo.com.cn/new/index.

4.2. Dependent variable

Following Li et al. (2020), we classify an M&A as "green" when the acquirer's public announcement explicitly references intentions or actions related to the green transition. To operationalize this concept, we analyze each M&A announcement and flag a deal as "green" if any term from a prespecified "green" lexicon appears in the transaction overview, the name or description of the target, or the line of business of the target or the seller.[5] For each firm-year, we define *Green_MA* as an indicator variable coded as one if the firm undertakes at least one green M&A, and zero if the firm undertakes at least one M&A but none is classified as green.

4.3. Independent variable

We quantify a firm's transition risk using information contained in the Management Discussion and Analysis (MD&A) section of its annual report. The MD&A mainly presents management's narrative of firm performance, risks, and forward-looking plans. Climate-related issues are typically discussed in this section, which limits contamination from unrelated boilerplate. Our climate risk dictionary is constructed using a three-step approach. First, we draw on the lexicons used by Sautner et al. (2023), Berkman et al. (2024), and Li et al. (2024). We translate these sources faithfully for the Chinese context and, relying on the China Meteorological Disaster Yearbook and the National Meteorological Science Data Center, compile a preliminary lexicon. Second, following Li et al. (2024), we identify MD&A sentences that contain seed terms and extract compound expressions and collocations that embed these seeds. Third, through multiple rounds of review and cleaning, we revise the dictionary to broaden coverage while retaining precision.

We operationalize transition climate risk by counting the frequency of transition-risk terms appearing in the MD&A section. To facilitate interpretation, our independent variable *CT_risk* equals 1,000 times the ratio of transition-risk dictionary hits to the length of MD&A.

[5] The "green" keywords are listed in Appendix A.

Similarly, we define *CP_risk* using the count of physical-risk dictionary hits.

4.4. Model specification

To test whether transition risk affects green M&A decisions, we fit the following linear probability model:

$$Green_MA_{i,t+1} = \beta_0 + \beta_1 \times CT_risk_{i,t} + \gamma' \times Controls_{i,t} + Industry\ FEs + Year\ FEs + \varepsilon_{i,t+1} \quad (1)$$

where *i* refers to firms, *t* refers to years, and $\varepsilon_{i,t+1}$ represents the error. *Green_MA* and *CT_risk* are defined in earlier sections. We align transition risk measured in the current year with green M&As in the subsequent year to reduce simultaneity concerns. The specification includes industry fixed effects and year fixed effects.[6] Standard errors are clustered along the firm dimension to accommodate serial correlation.

Following prior research (e.g., Bose et al., 2021), we incorporate a rich set of firm-level control variables, including firm size (*Ln_assets*), firm age (*Ln_firm_age*), leverage (*Leverage*), profitability (*ROA*), operating cash flow (*CFO*), administrative expenses (*AE*), sales growth (*Sales_growth*), market-to-book ratio (*MB*), Tobin's Q (*Tobin_Q*), capital expenditures (*Capex*), tangible assets (*PPE*), earnings volatility (*EBIT_volatility*), cash flow volatility (*CF_volatility*), ownership concentration (*Concentration*), separation of control and ownership rights (*Separation*), managerial ownership (*Mgr_holding*), institutional ownership (*Inst_holding*), CEO-chair duality (*Dual*), board independence (*Independence*), board size (*Ln_board*), CEO age (*Ln_CEO_age*), analyst coverage (*Ln_coverage*), and Big 4 auditor (*Big4*). We also control for several M&A deal characteristics, including purchase price (*Price*), equity stake acquired (*Ratio*), and payment method (*Payment*). Variables are winsorized at the 1st and 99th percentiles, and detailed variable definitions are provided in Appendix A.

[6] We are not able to include firm fixed effects because there is little within-firm variation in *Green_MA* over time (Breuer and DeHaan, 2024).

4.5. Summary statistics

Table 1 reports the summary statistics. *Green_MA* has a mean of 0.2190, implying that 21.90% of M&A events are classified as green. Figure 2 documents a steady rise in *Green_MA* and its share among total M&A deals, increasing from single-digit percentages in the late 2000s to nearly 30% in recent years. The mean and median of *CT_risk* are 1.4216 and 0.6319, respectively, while the standard deviation is 2.0645, suggesting relatively large variation in transition risk across our sample observations.

5. Empirical results

5.1. Baseline results

Table 2 presents our estimates of how transition climate risk affects firms' green M&A activities. Column (1) provides a univariate benchmark and shows a positive linear correlation between transition risk and green M&As. In column (2), we include all the controls. The effect of *CT_risk* remains significantly positive. Column (3) further includes fixed effects to rule out the confounding influences of time-invariant industry attributes and common time-series shocks. The inference remains unchanged. The estimated effect is economically meaningful. Moving transition risk up by one standard deviation (2.0645) increases the likelihood of entering a green M&A deal by 0.0526 (0.0255×2.0645) in absolute terms. This corresponds to a 24.02% increase relative to the sample mean (0.2190) or a 12.72% increase relative to the sample standard deviation (0.4136). These findings corroborate H1.

5.2. Robustness tests

We evaluate the robustness of the baseline estimates with an extensive set of sensitivity checks. First, we use alternative nonlinear specifications, including logit and probit models. Second, we add province fixed effects to absorb confounding variation arising from time-invariant location-related factors. Third, we use two alternative measures of green M&A activities, namely the number and the proportion of green deals. Fourth, we broaden the sample

to include firm-year observations with no M&A activity. This substantially enlarges the sample, but it no longer allows us to include deal-level characteristics as controls. Lastly, to mitigate endogeneity concerns arising from functional form misspecification and nonrandom sample selection, we implement propensity score matching and a Heckman two-stage procedure, respectively. The baseline findings survive all of these exercises. Table 3 offers a summary of these tests, and the Online Appendix contains full details.

5.3. Mechanism analysis

5.3.1. The moderating effect of external social monitoring

Climate issues are tightly linked to public well-being. As environmental awareness rises, the public's role in climate governance has become increasingly important. Failure to adopt sustainable practices in response to climate change exposes firms to transition risk arising from regulatory and policy shifts, changing social expectations, and market forces (Li et al., 2024). As hypothesized in H2, under external monitoring by social stakeholders, firms are incentivized to manage transition risk proactively, mitigate potential adverse consequences, and signal a credible commitment to sustainability.

We measure external social monitoring using the count of media reports that cover the firm (*Media*). The data are obtained from CNRDS. Because M&A activities exhibit waves over our sample period and green investment has certain industry characteristics, we classify sample observations into high *Media* and low *Media* groups based on the industry-year median.[7] The regression results are shown in Table 4. The coefficient on *CT_risk* for the high *Media* group is 0.0352, which is significant at the 1% level and twice as large as the effect, 0.0176, for the low *Media* group. A Chow test of coefficient difference suggests that the effect for the high *Media* group is significantly larger at the 5% level than the low *Media* group. Consistent with

[7] We conduct a median-split subsample analysis because this approach allows the coefficients on all the regressors and the fixed effects to vary with the moderator.

H2, stronger external social monitoring amplifies the positive relation between transition risk and the likelihood of undertaking a green M&A deal.

5.3.2. The moderating effect of internal green governance

Upper echelons theory suggests that attributes of top leaders affect major firm decisions, and a CEO's or board chairman's prior experience is a particularly important trait. We define a CEO's or board chairman's green background as education or work experience related to environmental protection, such as service in environmental agencies or associations, or the attainment of environment-related professional credentials. Such leaders can strengthen firms' internal green governance. For instance, environmental work experience heightens attention to long-run transition risk, encouraging ambitious emission-reduction targets and greater internal development in green technologies. Consistent with this view, Homroy and Slechten (2019) find that firms whose directors possess stronger skills and networks achieve superior environmental performance. We hence expect weaker incremental benefits of acquiring outside capabilities through green M&As in mitigating transition risk for firms led by green CEOs or board chairmen, because stronger internal green governance lowers coordination frictions and enables firms to build green capabilities in-house.

ISO 14001 provides an internationally accepted framework for environmental management systems (EMS). Firms certified under ISO 14001 typically exhibit stronger internal green governance because the EMS standard reinforces the internal control of environmental risks. ISO 14001 certification requires systematic identification, monitoring, and optimization of operational environmental impacts. It also mandates periodic internal audits and management reviews that foster continuous improvement in environmental performance. Therefore, ISO 14001 certification institutionalizes the implementation of green objectives. Prior research shows that ISO 14001 certification reduces environmental violations by more than 40% (Potoski and Prakash, 2005) and raises energy efficiency by roughly 15%

(Testa et al., 2014). Accordingly, we expect the marginal benefits of green M&As to be muted for ISO-certified firms.

To test our predictions, we define an indicator variable, *Env_leader*, which equals one if the resume of the firm's CEO or board chairman includes any predefined "green" keyword, and zero otherwise. The second proxy is *ISO_14001*, a dummy variable that equals one if the firm is certified under ISO 14001, and zero otherwise. Next, we split the sample into two groups using these two dummy variables and reestimate the baseline regression within each subsample. As reported in Table 5, the regression results in columns (1) and (3) suggest that the effects of *CT_risk* are positive and significant at the 1% level for the weak-governance subsamples. Columns (2) and (4) for the strong-governance subsamples reveal much smaller coefficients that are not statistically significant. The differences in coefficient estimates are significant at the 1% level. The evidence aligns with H3, indicating that transition risk has a stronger effect for firms whose internal green governance in place is weaker.

5.4. Endogeneity tests

Our baseline results suggest that greater exposure to transition climate risk corresponds to a higher probability that firms engage in green M&As. One concern about this finding is that it may be driven by omitted variables, simultaneity, or measurement error. We therefore conduct the following tests to mitigate these endogeneity problems.

5.4.1. Instrumental variable approach

To ameliorate endogeneity concerns, we implement an IV design. First, we use the industry average of *CT_risk* (excluding the focal firm), *CT_risk_ind*, as the IV. This choice satisfies the relevance condition insofar as the industry average is likely related to the *CT_risk* of the focal firm, given that exposure to transition climate risk has certain inherent industry-level characteristics. Green M&As are firm-specific because deals require a precise match between the acquirers' idiosyncratic capability gaps and the availability of suitable targets. This

matching process depends on firm governance, managerial preferences, technology needs, and target supply rather than the average transition risk of industry peers. Therefore, we view the exclusion restriction as plausible. The two-stage least squares estimates are reported in columns (1) and (2) of Table 6. Instrumented *CT_risk* positively affects green M&As, and this effect is significant at the 1% level.

Additionally, we utilize the third moment of transition risk, *CT_risk_Lewbel*, as another IV. As shown in Lewbel (1997), exploiting higher-order moments can attenuate measurement-error bias and improve estimation efficiency. This choice satisfies the relevance condition since the third moment is mechanically correlated with the level of *CT_risk*. We view the exclusion restriction as plausible since, to our knowledge, there is no theory indicating that higher-order moments of *CT_risk* have a direct effect on green M&As. The regression results are provided in the last two columns of Table 6. The coefficient on instrumented *CT_risk* remains positive and significant at the 1% level.[8]

5.4.2. Quasi-natural experiment: Low Carbon Cities Program

To combat global warming, China's National Development and Reform Commission launched the LCCP in 2010 and then expanded it through two subsequent, staggered adoption waves in 2012 and 2017. As an exogenous policy shock, the LCCP affects firms located in pilot cities, with arguably stronger policy effects for firms facing high transition risk. On the one hand, official evaluations emphasize extensive public education and the propagation of low-carbon norms, which have fostered broad social participation. Firms that fail to align with this trend face heightened public scrutiny. On the other hand, the LCCP specifies annual work plans and concrete implementation targets for local governments. These policy targets guide and pressure local authorities, who transmit requirements from higher authorities to firms under their jurisdiction and, in turn, intensify local firms' climate transition priorities.

[8] Untabulated results show that our IVs pass the underidentification and weak identification tests.

We therefore expect that transition risk exerts a stronger influence on green M&As for firms located in the pilot cities after the implementation of the LCCP. We test this prediction using a multi-period DiD design and estimate the following model:

$$Green_MA_{i,t+1} = \beta_0 + \beta_1 \times High_CT_risk_{i,t} \times LCCP_{i,t} + \beta_2 \times High_CT_risk_{i,t} + \beta_3 \times LCCP_{i,t} + \gamma' \times Controls_{i,t} + Industry\ FEs + Year\ FEs + \varepsilon_{i,t+1} \quad (2)$$

where *High_CT_risk* equals one if the firm's exposure to transition risk lies in the top quartile of the annual distribution within the industry, and zero if it falls in the bottom quartile; *LCCP* equals one if the firm is located in a pilot city after the implementation of the LCCP, and zero otherwise. To ensure a clean design, we drop observations in the policy year since it is unclear whether the *LCCP* would immediately change firms' responses to transition risk.

As presented in the first column of Table 7, the coefficient on *High_CT_risk*×*LCCP* is 0.1260 and significant at the 1% level, suggesting that the LCCP further strengthens the positive influence of transition climate risk on green M&As. The second column of Table 7 reports the regression results of the dynamic analysis. We observe no significant divergence between the two groups prior to policy implementation. Immediately after the launch of the LCCP, firms in the high-risk group exhibit a significant increase in green M&A activities relative to the low-risk group. The treatment effects for year $t = +1$ and years $t \geq +2$ are both positive and significant at the 5% level. Taken together, these results buttress a causal interpretation of how transition risk drives green M&As and lend strong support to the parallel trends assumption underlying our DiD analysis.

5.5. Additional analysis

5.5.1. Financing constraints and green M&As under transition climate risk

Adequate financing capacity is a key prerequisite for undertaking green M&As and often a necessary condition for deal completion (Harford, 1999). Tighter financing constraints raise capital costs, impede deal execution, and lower the attractiveness of green M&As as a response to transition risk. Therefore, the positive association between transition risk and green M&As is expected to be attenuated when financing frictions are more severe.

Using the method of Whited and Wu (2006), we compute *WW_index* as a measure of financing constraints. For each industry-year, we split the observations at the median into low *WW_index* and high *WW_index* groups and then estimate the baseline specification separately. As reported in Table 8, the effect of *CT_risk* is positive and significant at the 1% level in the low *WW_index* subsample, whereas the corresponding estimate in the high *WW_index* subsample remains positive but is much smaller in economic terms. The difference in coefficient estimates is positive and significant at the 5% level, suggesting that transition risk more strongly promotes green M&As when financing constraints are less binding.

5.5.2. Transition climate risk versus physical climate risk

Climate risk is conceptualized as comprising physical climate risk and transition climate risk. As a falsification test, we ask whether physical climate risk also explains green M&As. Our argument centers on transition climate risk. The objective behind green M&As is to promote a green transition by acquiring low-carbon capabilities, rather than to hedge against climate-related disasters. Physical climate risk, however, gives rise to location-specific hazards, business interruptions, and insurance or replacement costs. The natural responses are adaptation and hardening of existing assets, diversification, relocation, or insurance, rather than purchasing a green target. Physical climate shocks can also tighten liquidity and result in cash flow shortfalls, which dampen the appetite for discretionary acquisitions. Accordingly, we replace *CT_risk* with *CP_risk* and reestimate the model. If our hypothesized effect and proposed mechanisms are valid, *CP_risk* should either show no relationship with green M&As or display a substantially weaker association.

As shown in the first column of Table 9, the coefficient on *CP_risk* is 0.0621 and its *p*-value is 0.0983, indicating only a weak relation. We then run a horse racing test between physical risk and transition risk. To place effects on a common scale, we standardize *Green_MA*, *CT_risk*, and *CP_risk* by mean-centering and scaling by the standard deviation.

Using these standardized measures, the second column of Table 9 shows that *CT_risk_std* enters with a coefficient of 0.1391 and is significant at the 1% level, while the coefficient on *CP_risk_std* is 0.0307 and statistically nonsignificant. Their difference is positive and highly significant, with a *p*-value of 0.0003. In terms of the economic magnitude, the transition-risk effect is approximately 4.5 times the physical-risk effect. This pattern implies that pressures from policymakers and other stakeholders to decarbonize weigh more heavily on green M&A decisions than do direct losses from climate-related natural disasters.

5.5.3. Green M&As and green innovation

Whether green M&As reflect genuine green development or merely serve as window dressing remains contested. A plausible alternative explanation for our results is that observed green M&As are largely greenwashing responses to heightened regulatory and social pressures. Our maintained proposition is that firms undertake green M&As to achieve a substantive green transformation. If our interpretation is correct, firms with greater exposure to transition climate risk should demonstrate measurable post-deal improvements in real outcomes, such as green innovation. If greenwashing were the dominant motive, we would not expect a subsequent rise in green innovation output. To test our prediction, we estimate split-sample regressions for high-transition-risk and low-transition-risk firms using the following model:

$$Green_grainv_{i,t+1\sim t+3} = \beta_0 + \beta_1 \times Green_MA_{i,t} + \gamma' \times Controls_{i,t} + Industry\ FEs + Year\ FEs + \varepsilon_{i,t+1\sim t+3} \quad (3)$$

where *Green_grainv* is the number of applied green invention patents that are subsequently granted.[9] We focus on invention patents, which are arguably less susceptible to greenwashing. The data are retrieved from CNRDS. Control variables and fixed effects follow Model (1). Because innovation is a long-term process and unfolds over multiple years, *Green_grainv* is

[9] *Green_grainv* is defined based on the application year. That is, at any point in time, we count patent applications that are granted within a fixed four-year window to mitigate truncation bias. We choose a fixed four-year window because of data availability.

aggregated from t+1 to t+3. We fit Model (3) using Poisson regression, which yields consistent estimates for count outcomes (Cohn et al., 2022).

Table 10 presents the results. For high-risk firms, the influence of *Green_MA* is positive and significant at the 5% level. Hence, this post-deal improvement in green innovation performance is unlikely to be merely an artifact of greenwashing aimed at appeasing stakeholders. For the low-risk group, *Green_MA* has a negative, statistically nonsignificant effect, and the cross-group difference is positive (p-value = 0.0343). In sum, green M&As initiated under heightened transition risk reflect substantive green transformation, as evidenced by increases in granted green invention patents that help firms build capabilities and support their sustainable development.

6. Conclusion

In this study, we examine a large sample of Chinese firms and find that firms with greater transition risk exhibit a higher likelihood of undertaking green M&A deals. This effect proves robust and economically sizeable. We further show that this relation is more evident among firms that attract stronger media attention, whereas the presence of environmentally oriented leaders and ISO 14001 certification attenuates this baseline effect. To mitigate endogeneity concerns, we implement an IV strategy, and our inference remains qualitatively unchanged. More importantly, a quasi-natural experimental design leveraging the staggered adoption of the LCCP demonstrates that high-risk firms located in pilot cities become more proactive in pursuing green M&As after the implementation of the LCCP, relative to their low-risk peers. In additional analyses, we first show that capital availability conditions the response, with the effect being concentrated among firms for which financing constraints are less binding. Second, a falsification test that benchmarks transition climate risk against physical climate risk produces no statistically reliable association for physical risk and yields an economic magnitude that is much smaller than transition risk. Third, we document that green M&As

undertaken by firms exposed to high transition risk are followed by subsequent increases in granted green invention patents. This finding lends strong support to the capability-building explanation and is difficult to reconcile with a purely greenwashing viewpoint of corporate green M&A behavior under heightened transition risk.

Our study has several important theoretical implications. First, we redirect scholarly attention from the adverse consequences of climate risk to corporate strategic responses by establishing a causal link between transition risk and green M&As. This finding broadens the RBV, the dynamic capabilities perspective, and legitimacy theory, and complements previous works (e.g., Cao et al., 2025, Hagendorff et al., 2025) by showing that heightened transition risk spurs firms to reallocate capital toward external acquisition of green capabilities. Second, we enrich M&A theory by identifying transition risk as a distinct determinant of M&As in the green segment, thus incorporating environmental and sustainability considerations into classic accounts of agency problems, market power, synergy, and mispricing. Third, we refine theory on firm adaptation to transition risk by showing that firm responses are jointly shaped by external pressure and internal expertise. Media attention operates as a social disciplining mechanism that elevates the salience and payoffs of visible green moves, in line with legitimacy and dynamic capabilities perspectives. At the same time, when firms have stronger internal green governance in place, internal development tends to be a more natural route, whereas firms without green expertise tend to rely on the capital market and deal-making skills to obtain preassembled green resources through acquisitions, which is consistent with a comparative-advantage perspective on green investment modes. Fourth, we advance a motivation-contingent view of green investment by showing that acquisitions undertaken under transition pressure are followed by greater green innovation, which supports substantive capability building rather than symbolic greenwashing. Lastly, we theoretically differentiate transition risk from physical risk and empirically show that transition risk has a stronger

influence on green M&As. This refinement sharpens theories of climate finance and corporate adaptation by identifying social expectations and regulatory requirements as the dominant drivers that elicit genuine green efforts.

Our findings also yield several practical implications. First, firms should respond proactively to social monitoring and stakeholder expectations by engaging more openly with the public, undertaking visible and resource-committing actions that convey credible progress, and participating in regional green initiatives. In addition, transition risk and physical risk should be managed using differentiated policies and controls because they arise from distinct sources and affect firms through different channels. Second, effective green transition requires that firms match their strategies to the capabilities of their leadership teams and governance systems. When executives possess strong environmental expertise, firms may be better positioned to rely on internal development. However, when leaders have limited green expertise, acquisition-led transitions are likely to be the more effective lever for building green capabilities. In this sense, internal green governance and managerial background guide firms toward a mix of internal projects and external deals that can deliver the most effective response to transition risk, rather than relying on a one-size-fits-all approach to green investment. Third, for policymakers, our analysis of the impact of the LCCP implementation provides evidence that well-designed climate policies can incentivize firms to actively manage transition risk. Programs modeled on the LCCP merit carefully calibrated expansion, supported by fiscal instruments and targeted credit provision. For regulators, our results indicate that green M&As are unlikely to be purely greenwashing. Green M&As should be encouraged, on the condition that transition performance is assessed in a timely and holistic manner using contractible post-deal indicators such as green innovation outputs and reductions in emission intensity.

Given the global push toward decarbonization and the central role of M&As in reallocating resources and capabilities, this study advances our understanding of how climate-

related pressures reshape corporate investment decisions and, ultimately, real economic outcomes. Future research could extend our analysis by investigating how policy regimes and the stage of market development moderate the link between transition risk and green M&As. A limitation of our study is that green M&As represent only one adaptation margin. Subsequent research could jointly model substitution and complementarity among internal R&D, strategic alliances, joint ventures, divestitures, and M&As to capture the full portfolio of adaptation strategies. Another limitation is that we focus only on green patents as a post-deal economic consequence. It would be valuable to examine additional outcomes, such as emissions intensity, green performance, and social consequences, to trace the real transition payoffs of acquisition-led strategies.

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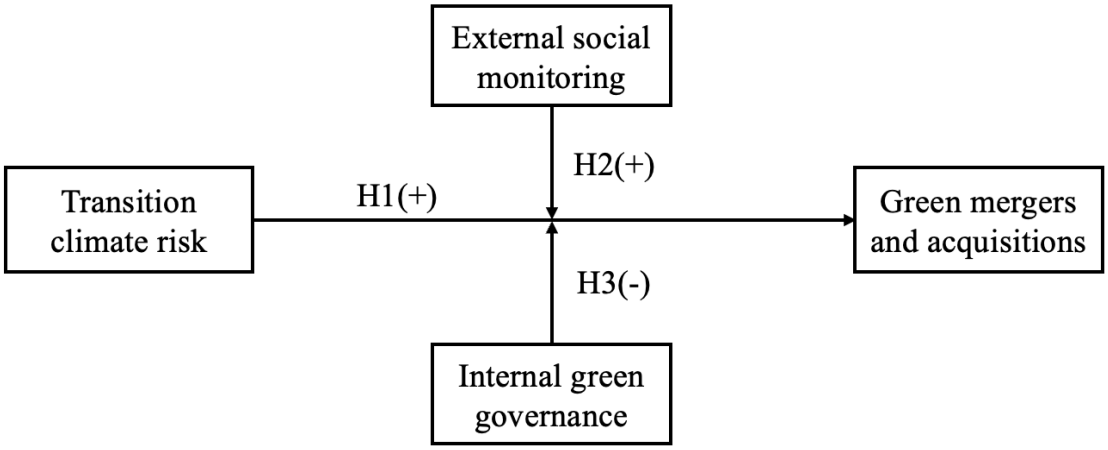


Figure 1. Conceptual model

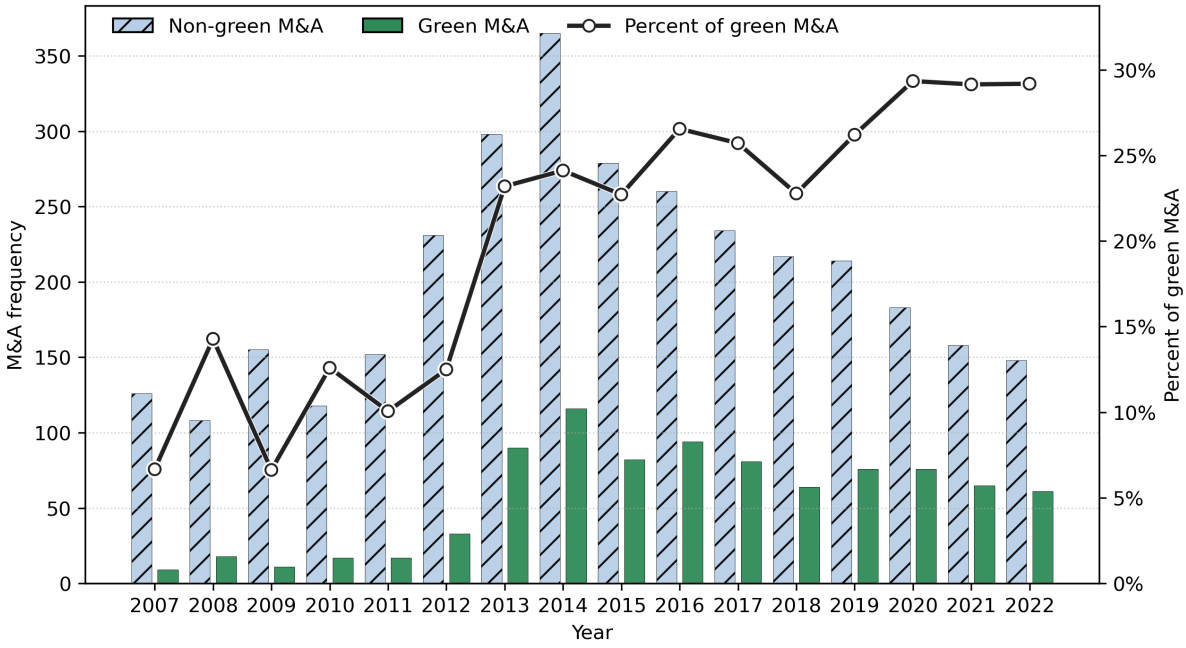


Figure 2. Green and non-green M&A activities and the share of green deals

Table 1. Descriptive statistics

(N=4,156)	Mean	Std. Dev.	P75	Median	P75
Green_MA	0.2190	0.4136	0.0000	0.0000	0.0000
CT_risk	1.4216	2.0645	0.1869	0.6319	1.7526
Ln_assets	22.2531	1.2353	21.3505	22.1050	22.9881
Ln_firm_age	2.2173	0.6907	1.6094	2.3026	2.8332
Leverage	0.4389	0.1980	0.2841	0.4400	0.5889
ROA	0.0587	0.0548	0.0321	0.0548	0.0849
CFO	0.0486	0.0692	0.0090	0.0471	0.0883
AE	0.0890	0.0695	0.0421	0.0721	0.1138
Sales_growth	0.2246	0.4637	0.0004	0.1328	0.3212
MB	3.6178	2.7803	1.7897	2.8140	4.4478
Tobin_Q	2.0865	1.3140	1.2727	1.6615	2.3924
Capex	0.0522	0.0483	0.0169	0.0382	0.0717
PPE	0.2163	0.1613	0.0889	0.1843	0.3095
EBIT_volatility	0.0272	0.0332	0.0085	0.0162	0.0314
CF_volatility	0.0450	0.0394	0.0186	0.0338	0.0574
Concentration	0.3653	0.2139	0.1814	0.3500	0.5358
Separation	0.0545	0.0785	0.0000	0.0006	0.0980
Mgr_holding	0.1156	0.1817	0.0000	0.0022	0.1998
Inst_holding	0.4619	0.2384	0.2778	0.4822	0.6478
Dual	0.2500	0.4331	0.0000	0.0000	0.5000
Independence	0.3714	0.0505	0.3333	0.3333	0.4286
Ln_board	2.2559	0.1786	2.0794	2.3026	2.3026
Ln_CEO_age	3.8858	0.1328	3.8067	3.8918	3.9890
Ln_coverage	1.5766	1.1517	0.6931	1.6094	2.5649
Big4	0.0570	0.2319	0.0000	0.0000	0.0000
Price	18.9917	1.7957	17.7668	19.0881	20.2525
Ratio	0.7801	0.2393	0.5200	0.9000	1.0000
Payment	0.0845	0.2781	0.0000	0.0000	0.0000

Notes. This table presents the descriptive statistics. Appendix A defines the variables.

Table 2. Transition climate risk and green M&As

	(1)	(2)	(3)
	Green_MA	*Green_MA*	*Green_MA*
CT_risk	0.0441***	0.0403***	0.0255***
	(0.0039)	(0.0040)	(0.0043)
Ln_assets		0.0332***	0.0139
		(0.0099)	(0.0108)
Ln_firm_age		-0.0150	-0.0054
		(0.0147)	(0.0141)
Leverage		0.0534	0.0575
		(0.0494)	(0.0528)
ROA		0.0064	0.1396
		(0.1517)	(0.1542)
CFO		-0.3693***	-0.3104***
		(0.1064)	(0.1029)
AE		0.1277	0.0535
		(0.1112)	(0.1239)
Sales_growth		0.0159	0.0125
		(0.0138)	(0.0135)
MB		-0.0021	-0.0011
		(0.0051)	(0.0055)
Tobin_Q		-0.0013	-0.0062
		(0.0109)	(0.0112)
Capex		0.0092	0.0744
		(0.1573)	(0.1479)
PPE		0.0111	-0.0318
		(0.0529)	(0.0587)
EBIT_volatility		0.1172	0.1302
		(0.2066)	(0.2140)
CF_volatility		-0.0499	0.2982
		(0.1800)	(0.1856)
Concentration		0.0613	-0.0007
		(0.0403)	(0.0423)
Separation		0.0651	0.0457
		(0.1052)	(0.0944)
Mgr_holding		0.0648	0.0037
		(0.0636)	(0.0627)
Inst_holding		-0.0714	-0.0114
		(0.0458)	(0.0461)
Dual		-0.0181	-0.0189
		(0.0168)	(0.0162)
Independence		0.1095	0.1939
		(0.1556)	(0.1501)
Ln_board		-0.0025	0.0599
		(0.0481)	(0.0466)
Ln_CEO_age		0.1151**	0.0665
		(0.0506)	(0.0507)
Ln_coverage		-0.0101	-0.0015
		(0.0079)	(0.0080)
Big4		-0.0692**	-0.0373
		(0.0283)	(0.0267)
Price		-0.0025	-0.0069*
		(0.0042)	(0.0041)
Ratio		-0.0245	-0.0132
		(0.0285)	(0.0276)
Payment		-0.0119	0.0126
		(0.0243)	(0.0240)
Observations	4,156	4,156	4,155
R-squared	0.0484	0.0666	0.1338
Industry FEs	No	No	Yes
Year FEs	No	No	Yes

Notes. This table presents the OLS regression results. Appendix A defines the variables. Standard errors are clustered by firm and reported below the point estimates. *, **, and *** correspond to significance at the 10%, 5%, and 1% levels, respectively.

Table 3. Robustness tests

Robustness test	Research design and empirical result
Alternative regression model specification	We reestimate the regression using a logit model and a probit model. The effects of *CT_risk* are positive and significant at the 1% level.
Alternative fixed effect structure	Province fixed effects are added to the regression model to absorb time-invariant, location-specific heterogeneity. The effect of *CT_risk* is positive and significant at the 1% level.
Alternative measures of green M&A activities	We use the total number of green M&A deals and the proportion of green M&A deals as two alternative measures of green M&A activities. The results are similar and significant at the 1% level.
Alternative sample selection procedure	In this robustness test, we include all firm-year observations, including those that do not undertake any green M&As. The effect of *CT_risk* is positive and significant at the 1% level.
Propensity score matching approach	The propensity score matching approach can be used to address the endogeneity issue due to function form misspecification. In this robustness test, we first sort observations within each industry-year into quartiles. Observations in the top (bottom) quartile are assigned to the treatment (control) group. We then match treatment firm-year observations with higher transition climate risk to control firm-year observations with lower transition climate risk, and run the baseline regression using the matched sample. The effect of *CT_risk* is positive and significant at the 1% level. None of the differences in covariates is significant at the 10% level, suggesting that the matched sample is balanced.
Heckman procedure	We use the Heckman procedure to mitigate sample selection bias. We sort observations within each industry-year into quartiles. Observations in the top (bottom) quartile are assigned to the treatment (control) group. For identification, the selection equation for transition risk includes *CT_risk_ind* as an explanatory variable, while the outcome equation for green M&As does not. After including the inverse Mills ratio as an additional control variable in the outcome equation, *CT_risk* still has a positive coefficient, and its effect is significant at the 1% level.

Table 4. The moderating effect of external social monitoring

	(1)	(2)
	High *Media*	Low *Media*
	Green_MA	*Green_MA*
CT_risk	0.0352***[A]	0.0176***[B]
	(0.0066)	(0.0055)
Observations	1,898	2,256
R-squared	0.1915	0.1230
Controls	Yes	Yes
Industry FEs	Yes	Yes
Year FEs	Yes	Yes
p-value of A>B	0.0173**	

Notes. This table presents the OLS regression results. Appendix A defines the variables. Standard errors are clustered by firm and reported below the point estimates. *, **, and *** correspond to significance at the 10%, 5%, and 1% levels, respectively.

Table 5. The moderating effect of internal green governance

	(1)	(2)	(3)	(4)
	Env_leader=0	*Env_leader*=1	*ISO_14001*=0	*ISO_14001*=1
	Green_MA	*Green_MA*	*Green_MA*	*Green_MA*
CT_risk	0.0273***[A]	0.0051[B]	0.0319***[A]	0.0083[B]
	(0.0052)	(0.0066)	(0.0050)	(0.0082)
Observations	3,568	524	3,204	816
R-squared	0.0936	0.2756	0.1484	0.1934
Controls	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
p-value of A>B	0.0029***		0.0052***	

Notes. This table presents the OLS regression results. Appendix A defines the variables. Standard errors are clustered by firm and reported below the point estimates. *, **, and *** correspond to significance at the 10%, 5%, and 1% levels, respectively.

Table 6. Instrumental variable approach

	(1)	(2)	(3)	(4)
	CT_risk	*Green_MA*	*CT_risk*	*Green_MA*
CT_risk (instrumented)		0.0763***		0.0220***
		(0.0232)		(0.0057)
CT_risk_ind	0.7741***			
	(0.1104)			
CT_risk_Lewbel			0.0193***	
			(0.0005)	
Observations	4,152	4,152	4,155	4,155
R-squared	0.3057	-0.0266	0.6803	0.0249
Controls	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes

Notes. This table presents the OLS regression results. Appendix A defines the variables. Standard errors are clustered by firm and reported below the point estimates. *, **, and *** correspond to significance at the 10%, 5%, and 1% levels, respectively.

Table 7. Transition climate risk, Low Carbon Cities Program, and green M&As

	(1)	(2)
	Green_MA	*Green_MA*
High_CT_risk×*LCCP*	0.1260***	
	(0.0395)	
High_CT_risk× $LCCP_{=-3}$		-0.1198
		(0.0831)
High_CT_risk× $LCCP_{=-2}$		0.0057
		(0.1029)
High_CT_risk× $LCCP_{=-1}$		-0.0159
		(0.0887)
High_CT_risk× $LCCP_{=+1}$		0.1756**
		(0.0842)
High_CT_risk× $LCCP_{\geq+2}$		0.1063**
		(0.0467)
High_CT_risk	0.0403	0.0542
	(0.0341)	(0.0411)
LCCP	-0.0394	
	(0.0282)	
$LCCP_{=-3}$		0.0714
		(0.0584)
$LCCP_{=-2}$		0.0211
		(0.0552)
$LCCP_{=-1}$		-0.0285
		(0.0404)
$LCCP_{=+1}$		-0.0766*
		(0.0421)
$LCCP_{\geq+2}$		-0.0253
		(0.0327)
Observations	2,002	2,002
R-squared	0.1955	0.1969
Controls	Yes	Yes
Industry FEs	Yes	Yes
Year FEs	Yes	Yes

Notes. This table presents the OLS regression results. Appendix A defines the variables. Standard errors are clustered by firm and reported below the point estimates. *, **, and *** correspond to significance at the 10%, 5%, and 1% levels, respectively.

Table 8. Transition climate risk, financing constraints, and green M&As

	(1)	(2)
	Low *WW_index*	High *WW_index*
	Green_MA	*Green_MA*
CT_risk	0.0320***[A]	0.0177***[B]
	(0.0061)	(0.0059)
Observations	2,082	1,739
R-squared	0.1886	0.1275
Controls	Yes	Yes
Industry FEs	Yes	Yes
Year FEs	Yes	Yes
p-value of A>B	0.0436**	

Notes. This table presents the OLS regression results. Appendix A defines the variables. Standard errors are clustered by firm and reported below the point estimates. *, **, and *** correspond to significance at the 10%, 5%, and 1% levels, respectively.

Table 9. Transition climate risk, physical climate risk, and green M&As

	(1)	(2)
	Green_MA	*Green_MA_std*
CP_risk	0.0621*	
	(0.0375)	
CT_risk_std		0.1391***[A]
		(0.0237)
CP_risk_std		0.0307[B]
		(0.0210)
Observations	4,155	4,155
R-squared	0.1229	0.1343
Controls	Yes	Yes
Industry FEs	Yes	Yes
Year FEs	Yes	Yes
p-value of A>B	N/A	0.0003***

Notes. This table presents the OLS regression results. Appendix A defines the variables. Standard errors are clustered by firm and reported below the point estimates. *, **, and *** correspond to significance at the 10%, 5%, and 1% levels, respectively.

Table 10. Transition climate risk, green M&As, and green innovation

	(1)	(2)
	High_CT_risk=1	*High_CT_risk*=0
	Green_grainv	*Green_grainv*
Green_MA	0.4092**[A]	-0.1156[B]
	(0.1710)	(0.2328)
Observations	457	487
Pseudo R-squared	0.4453	0.3876
Controls	Yes	Yes
Industry FEs	Yes	Yes
Year FEs	Yes	Yes
p-value of A>B	0.0343**	

Notes. This table presents the Poisson regression results. Appendix A defines the variables. Standard errors are clustered by firm and reported below the point estimates. *, **, and *** correspond to significance at the 10%, 5%, and 1% levels, respectively.

Appendix A. Variable definitions

Variable	Definition
Green_MA	A dummy variable equal to one if the firm undertakes at least one green M&A, and zero if the firm undertakes at least one M&A but none is green. An M&A deal is categorized as green if any predefined "green" keywords appear in the transaction overview, the name of the target, the description of the target, or the business scope of the target or the seller. The "green" keywords include environment, ecology, sustainability, conservation, green, clean, virescence, lucid waters and lush mountains, low carbon, carbon neutrality, carbon assets, carbon management, carbon market, carbon trading, carbon cycle, energy saving, low energy consumption, new energy, emission reduction, pollution, desulfurization, denitrification, dust removal, waste, recycling, regeneration, circulation, and transformation and upgrading.
CT_risk	Number of transition climate risk bigrams scaled by number of bigrams in the MD&A section of the annual report, multiplied by 1,000.
Ln_assets	Natural logarithm of total assets.
Ln_firm_age	Natural logarithm of one plus the difference between current year and listing year.
Leverage	Total liabilities divided by total assets.
ROA	Sum of total profit and financial expenses, divided by total assets.
CFO	Net operating cash flow divided by total assets.
AE	Administrative expenses divided by operating revenue.
Sales_growth	Operating revenue in the current year minus operating revenue in the previous year, divided by operating revenue in the previous year.
MB	Market value of equity divided by book value of equity.
Tobin_Q	Market value of assets divided by book value of assets.
Capex	Capital expenditures divided by total assets.
PPE	Net fixed assets divided by total assets.
EBIT_volatility	Standard deviation of earnings before interests and taxes divided by total assets computed over the current and previous two years.
CF_volatility	Standard deviation of cash flows divided by total assets computed over the current and previous two years.
Concentration	Sum of tradable shares held by the firm's top ten shareholders as a proportion of total shares outstanding.
Separation	Difference between control rights and ownership rights of the ultimate controlling shareholder.
Mgr_holding	Sum of shares owned by directors, supervisors, and senior managers as a proportion of total shares.
Inst_holding	Sum of shares owned by institutional investors as a proportion of total shares outstanding.
Dual	A dummy variable equal to one if the board chairman also serves as the CEO, and zero otherwise.
Independence	Proportion of independent directors on the board.
Ln_board	Natural logarithm of one plus the number of board members.
Ln_CEO_age	Natural logarithm of the age of the CEO.
Ln_coverage	Natural logarithm of one plus the number of analysts following the firm.
Big4	A dummy variable equal to one if the audit is provided by a Big 4 audit firm, and zero otherwise.

continued

Variable	Definition
Price	Natural logarithm of deal purchase price.
Ratio	Proportion of shares acquired.
Payment	A dummy variable equal to one if the M&A transaction is paid with stock, and zero otherwise.
Media	Number of media reports about the firm.
Env_leader	A dummy variable equal to one if any predefined "green" keywords appear in the resume of the firm's CEO or board chairman, and zero otherwise. The "green" keywords are provided in Footnote 5.
ISO_14001	A dummy variable equal to one if the firm is certified under ISO 14001, and zero otherwise.
CT_risk_ind	Industry average of *CT_risk*, excluding the focal firm.
CT_risk_ Lewbel	Third moment of *CT_risk*.
High_CT_risk	A dummy variable equal to one if *CT_risk* lies in the top quartile of the annual distribution within the industry, and zero if it falls in the bottom quartile of the annual distribution within the industry.
LCCP	A dummy variable equal to one if the firm is located in an LCCP pilot city after the implementation of the program, and zero otherwise.
$LCCP_{=-3}$	A dummy variable equal to one if the firm is located in an LCCP pilot city in year $t = -3$ relative to the program's implementation, and zero otherwise.
$LCCP_{=-2}$	A dummy variable equal to one if the firm is located in an LCCP pilot city in year $t = -2$ relative to the program's implementation, and zero otherwise.
$LCCP_{=-1}$	A dummy variable equal to one if the firm is located in an LCCP pilot city in year $t = -1$ relative to the program's implementation, and zero otherwise.
$LCCP_{=+1}$	A dummy variable equal to one if the firm is located in an LCCP pilot city in year $t = +1$ relative to the program's implementation, and zero otherwise.
$LCCP_{\geq+2}$	A dummy variable equal to one if the firm is located in an LCCP pilot city in years $t \geq +2$ relative to the program's implementation, and zero otherwise.
WW_index	Measure of firm financing constraints calculated following Whited and Wu (2006).
CP_risk	Number of physical climate risk bigrams scaled by number of bigrams in the MD&A section of the annual report, multiplied by 1,000.
Green_MA_std	Standardized measure of *Green_MA*.
CT_risk_std	Standardized measure of *CT_risk*.
CP_risk_std	Standardized measure of *CP_risk*.
Green_patents	Number of green patent applications classified according to the International Patent Classification Green Inventory published by the World Intellectual Property Organization.

Online Appendix

Managing transition climate risk: Evidence from green mergers and acquisitions in China

1. Alternative regression model specification

Our baseline specification uses a linear probability model for ease of interpretation and its good behavior with high-dimensional fixed effects. As a robustness check, we reestimate the main specification using logit and probit models. As shown in Table OA-1, the effects of transition climate risk remain positive and significant at the 1% level.

2. Alternative fixed effects structure

Model (1) includes industry fixed effects and year fixed effects in order to mitigate the endogeneity concerns arising from the omission of any unobserved time-invariant industry-level characteristics and time-varying common shocks to all the sample firms. Given the possibility that firm-level exposure to transition climate risk may also exhibit location-specific components, we additionally include province fixed effects to control for time-invariant province-level factors that could simultaneously affect transition risk exposure and green M&A activities. The regression results in Table OA-2 show that *CT_risk* continues to load positively, and its effect is significant at the 1% level.

3. Alternative measures of green M&A activities

To ensure robustness, we use the total number of green M&A deals (*Green_MA_num*) and the proportion of green M&As among all the M&A transactions (*Green_MA_ratio*) as two alternative measures of green M&A activities. Variables are defined in Appendix OA-A. The regression results are presented in Table OA-3. The effects of *CT_risk* are positive and significant at the 1% level.

4. Alternative sample selection procedure

In our baseline specification, we focus on firm-year observations with at least one M&A

and test whether transition climate risk affects the likelihood that an M&A deal is classified as green rather than non-green. As an additional robustness check, we redefine the outcome variable to capture green M&As versus all other cases (i.e., non-green M&As or no M&A). Specifically, we define *Green_MA_FS*, which equals one if the firm undertakes at least one green M&A, and zero if the firm undertakes only non-green M&As or does not undertake any M&A. Using this definition substantially enlarges the sample but precludes the inclusion of deal characteristics as controls. As shown in Table OA-4, the positive effect of *CT_risk* is statistically significant at the 1% level.

5. Propensity score matching approach

Model (1) identifies the effect of transition climate risk only if the included control variables adequately capture all relevant confounders. If the true relationship between the control variables and green M&A behavior is nonlinear, a linear specification may fail to adjust for these nonlinear components. This constitutes a specific form of endogeneity arising from functional form misspecification. The omitted nonlinear components are absorbed into the error term, which may then correlate with our transition climate risk measure and bias the coefficient estimates.

To mitigate this concern, we employ a propensity score matching (PSM) strategy. We define firms as being treated if their exposure to transition climate risk lies in the top quartile of the annual distribution within the industry. Control firms are those in the bottom quartile. Each treated firm is then matched to a control firm with the same or closest values of the control variables but lower exposure to transition climate risk. This procedure helps balance covariates without imposing a particular functional form. Propensity scores are estimated using a logit model. Control variables and fixed effect structure are the same as Model (1). Our PSM research design choices are as follows. First, we choose one-to-one matching because the second- and third-nearest control firms are arguably farther from the treated firm. Adding them

would increase bias in treatment effect estimation. Second, we set the caliper width to 0.05, which reflects the tradeoff between bias and efficiency. Third, we match treatment firm-year observations without replacing previously matched cases, as matching with replacement would erode the representativeness of the control firms and increase sampling variance.

Implementing this aforementioned PSM procedure yields valid matches for 301 treated firm-year observations. Panel A of Table OA-5 shows that post-matching covariate differences are statistically indistinguishable from zero at the 10% level. Using the matched sample, Panel B of Table OA-5 indicates that the effect of *CT_risk* is positive and significant at the 5% level.

6. Heckman procedure

A remaining concern is the nonrandom assignment to the higher versus lower transition risk group, which could induce selection bias. To address this issue, we implement a Heckman two-step procedure and test whether the effect of transition climate risk survives this correction.

In the first step, we estimate a probit selection equation in which the dependent variable is *High_CT_risk*. The regressors and fixed effects are the same as Model (1). For identification, we add *CT_risk_ind* to the selection equation but exclude it from the outcome equation. In the second step, we estimate the outcome equation in which *Green_MA* is the dependent variable, while additionally controlling for the inverse Mills ratio derived from the first step. As reported in Table OA-6, the coefficient on *CT_risk* remains positive and statistically significant at the 1% level.

Table OA-1. Alternative regression model specification

	(1)	(2)
	Green_MA	*Green_MA*
CT_risk	0.1204***	0.0733***
	(0.0217)	(0.0128)
Observations	4,107	4,107
R-squared	0.1205	0.1194
Regression model	Logit	Probit
Controls	Yes	Yes
Industry FEs	Yes	Yes
Year FEs	Yes	Yes

Notes. In this table, column (1) presents the logit regression results, and column (2) presents the probit regression results. Appendix A defines the variables. Standard errors are clustered by firm and reported below the point estimates. *, **, and *** correspond to significance at the 10%, 5%, and 1% levels, respectively.

Table OA-2. Alternative fixed effect structure

	(1)
	Green_MA
CT_risk	0.0257***
	(0.0042)
Observations	4,155
R-squared	0.1426
Controls	Yes
Industry FEs	Yes
Province FEs	Yes
Year FEs	Yes

Notes. This table presents the OLS regression results. Appendix A defines the variables. Standard errors are clustered by firm and reported below the point estimates. *, **, and *** correspond to significance at the 10%, 5%, and 1% levels, respectively.

Table OA-3. Alternative measures of green M&A activities

	(1)	(2)
	Green_MA_num	*Green_MA_ratio*
CT_risk	0.0633***	0.0246***
	(0.0132)	(0.0041)
Observations	4,117	4,155
(Pseudo) R-squared	0.0953	0.1405
Controls	Yes	Yes
Industry FEs	Yes	Yes
Year FEs	Yes	Yes

Notes. In this table, column (1) presents the Poisson regression results, and column (2) presents the OLS regression results. Appendix A and Appendix OA-A define the variables. Standard errors are clustered by firm and reported below the point estimates. *, **, and *** correspond to significance at the 10%, 5%, and 1% levels, respectively.

Table OA-4. Alternative sample selection procedure

	(1)
	Green_MA_FS
CT_risk	0.0036***
	(0.0008)
Observations	35,511
R-squared	0.0260
Controls	Yes
Industry FEs	Yes
Year FEs	Yes

Notes. This table presents the OLS regression results. Appendix A and Appendix OA-A define the variables. Standard errors are clustered by firm and reported below the point estimates. *, **, and *** correspond to significance at the 10%, 5%, and 1% levels, respectively.

Table OA-5. Propensity score matching approach

Panel A. Balancing *t*-test

	High_CT_risk=0		*High_CT_risk*=1		Difference	*p*-value
	N	Mean	N	Mean		
Ln_assets	301	22.159	301	22.106	0.053	0.584
Ln_firm_age	301	2.191	301	2.171	0.020	0.731
Leverage	301	0.448	301	0.453	-0.006	0.725
ROA	301	0.058	301	0.056	0.002	0.606
CFO	301	0.046	301	0.042	0.004	0.463
AE	301	0.089	301	0.092	-0.003	0.562
Sales_growth	301	0.224	301	0.224	-0.000	0.999
MB	301	3.782	301	3.938	-0.155	0.522
Tobin_Q	301	2.089	301	2.171	-0.081	0.460
Capex	301	0.050	301	0.051	-0.001	0.714
PPE	301	0.195	301	0.199	-0.004	0.763
EBIT_volatility	301	0.026	301	0.026	0.000	0.992
CF_volatility	301	0.048	301	0.049	-0.001	0.771
Concentration	301	0.351	301	0.359	-0.009	0.623
Separation	301	0.047	301	0.053	-0.006	0.320
Mgr_holding	301	0.124	301	0.115	0.009	0.549
Inst_holding	301	0.446	301	0.459	-0.013	0.506
Dual	301	0.266	301	0.276	-0.010	0.784
Independence	301	0.374	301	0.373	0.001	0.819
Ln_board	301	2.250	301	2.248	0.003	0.848
Ln_CEO_age	301	3.884	301	3.888	-0.004	0.707
Ln_coverage	301	1.571	301	1.461	0.110	0.232
Big4	301	0.063	301	0.053	0.010	0.602
Price	301	18.978	301	18.944	0.034	0.823
Ratio	301	0.788	301	0.789	-0.001	0.973
Payment	301	0.090	301	0.083	0.007	0.772

Panel B. Regression result based on the propensity score matched sample

	(1)
	Green_MA
CT_risk	0.0192**
	(0.0084)
Observations	597
R-squared	0.2142
Controls	Yes
Industry FEs	Yes
Year FEs	Yes

Notes. Panel A of this table presents the results of balancing *t*-test. Panel B of this table presents the OLS regression results based on the propensity score matched sample. Appendix A defines the variables. Standard errors are clustered by firm and reported below the point estimates. *, **, and *** correspond to significance at the 10%, 5%, and 1% levels, respectively.

Table OA-6. Heckman procedure

	(1)
	Green_MA
CT_risk	0.0245***
	(0.0046)
Observations	2,036
R-squared	0.1866
Controls	Yes
Inverse Mills ratio	Yes
Industry FEs	Yes
Year FEs	Yes

Notes. This table presents the OLS regression results. Appendix A defines the variables. Standard errors are clustered by firm and reported below the point estimates. *, **, and *** correspond to significance at the 10%, 5%, and 1% levels, respectively.

Appendix OA-A. Variable definitions

Variable	Definition
Green_MA_num	Total number of green M&A deals.
Green_MA_ratio	Proportion of green M&As of all the M&A transactions.
Green_MA_FS	A dummy variable equal to one if the firm undertakes at least one green M&A, and zero if the firm undertakes only non-green M&As or no M&A.