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Environmental innovation and takeover performance

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Abstract

Drawing from the resource-based view (RBV), we examine the effect of environmental innovation on mergers and acquisitions (M&As) announcement returns. Using an international sample of M&As for the period of 2003–2021 and an event study methodology, we document that acquirers with higher environmental innovation—innovative acquirers—earn average deal announcement abnormal returns that are 0.10–0.50 percentage points higher than those earned by their non-innovative counterparts. These results are consistent across three important forms of environmental innovation (i.e., product, process, and organizational innovation) and are partly explained by the transfer of environmental innovation from the acquirer to the target. We further find that environmentally innovative acquirers are more likely to engage in majority control and cross-border acquisitions, thus emphasizing the transfer effect. Overall, we contribute to RBV by providing evidence that environmental innovation is a distinctive resource or dynamic capability that is transferable from bidders to targets in the takeover market.

KEYWORDS
announcement returns, environmental innovation, international M&As, resource based view

1 | INTRODUCTION

Environmental innovation involves the production of a novel product, process, or service to achieve a reduction in environmental risk, emissions, and waste (Kotani & Kakinaka, 2017). It includes the manufacturing of products that require fewer raw materials and use less energy (Dangelico & Pujari, 2010), the recycling of production waste (Dangelico et al., 2017), and the decrease in environmental pollution (Dangelico, 2016).[1] Prior research on mergers and acquisitions (M&As) suggests that bidders may acquire specific targets with higher levels of environmental innovation to learn from their innovative practices (Liu et al., 2021; Song & Yu, 2018; Wu & Qu, 2021). The research suggests that targets in such deals earn higher returns or extract higher premiums from such bidders (Testoni, 2022). Nonetheless, little is known about how bidders' environmental innovation capabilities influence their own returns in the takeover market. Our work extends prior research and answers two important yet unanswered research questions: (i) Do environmentally innovative acquirers earn higher returns than their non-innovative counterparts? (ii) Does the acquirer–target environmental innovation gap moderate the relation between innovative acquirers and announcement returns?

[1]Environmental innovation enhances firms' competitive advantage, performance, and value (Hall et al., 2012; Han et al., 2019; Ortega-Lapiedra et al., 2019; Rahman et al., 2021; Song et al., 2017) by reducing information asymmetry (Zaman et al., 2021), mitigating financial constraints (Zhang et al., 2022), and reducing manufacturing costs (Han et al., 2019), among others.

Abbreviations: 2SLS, two-stage least squares; CAR, cumulative abnormal returns; CEO, chief executive officer; CSR, corporate social responsibility; M&A, mergers and acquisitions; pp, percentage points; PSM, propensity score matching; RBV, resource-based view.

When firms acquire or merge with other firms, they can gain access to new resources, technologies, and expertise that allow them to innovate quickly and also to generate synergies by amalgamating innovation-related resources (Ahuja & Katila, 2001; Bresciani & Ferraris, 2016; Dezi et al., 2018; Rahman & Lambkin, 2015; Stiebale, 2016; Tunyi & Ntim, 2016). Studying environmental innovation within the context of M&As is interesting for two main reasons. Firstly, by studying this context, we can neatly isolate the value of environmental innovation to firms using an event study approach. This is, otherwise, empirically challenging as environmental innovation may coincide with other forms of innovation that are unrelated to environmental protection. Secondly, this context can be exploited to empirically determine whether firms can transfer their innovative resources/capabilities to others by exploring whether value creation in M&As is moderated by differences in levels of environmental innovation in merger parties.

In light of the importance of sustainable development, we examine the extent to which acquirers' environmental innovation determines the value created (captured by M&A announcement returns) in subsequent M&A transactions. Drawing on the resource-based view (RBV) (Barney, 1991; Hart, 2005; Hart & Hart, 1995), we hypothesize that acquirers' level of environmental innovation partly explains their performance in M&As. This is mainly because environmental innovation is a distinct resource or dynamic capability that is not available to all acquirers. Consequently, the acquirers with higher environmental innovation (i.e., innovative acquirers) should earn higher returns because they can create synergies by transferring their innovative resources and capabilities to less environmentally innovative targets. If our argument around synergy creation through the transfer of environmental innovation is valid, we should further find that the association between environmental innovation and M&A returns is moderated by the environmental innovation gap between the acquirer and the target. Specifically, the transfer of environmental innovation between the acquirer and the target is expected to be prominent in cases where the merging firms have a significant difference in the level of environmental innovation.

To test our hypotheses, we use an international sample of 8336 M&As involving public acquirers from 26 countries and deals announced between 2003 and 2021 (19 years). We first explore whether the acquirer's pre-deal environmental innovation is associated with higher cumulative abnormal returns (CARs) around the announcement day. Here, we measure the acquirer's pre-merger environmental innovation using its environmental innovation score provided by c, which is commonly used in prior studies (Arena et al., 2018; Zaman et al., 2021). Our results show that innovative acquirers earn higher CARs relative to non-innovative acquirers, suggesting that, as predicted, environmentally innovative acquirers potentially transfer their innovative resources/capabilities to targets after the acquisition. Economically, on average, innovative acquirers earn CARs of 0.10–0.50 percentage points (pp) higher than CARs earned by their less innovative counterparts. The results persist across different types of environmental innovation—product, process, and organizational innovation—and are robust to several firm, country, and year controls. Our results are also robust to several endogeneity checks, including the use of the propensity score matching (PSM) technique and two-stage least squares (2SLS) regressions.

We next explore our second hypothesis that the pre-deal environmental innovation gap between the acquirer and target moderates the effect of environmental innovation on the acquirer's returns. Specifically, we explore whether the relationship between acquirers' environmental innovation and the value creation in M&As is higher when the acquirer is more innovative relative to the target. On average, acquirers in our sample have significantly higher levels of environmental innovation than their targets. Our evidence suggests that they create value by transferring or sharing this environmental innovation resource or capability to/with their targets. Specifically, the environmental innovation gap positively enhances announcement returns.

In additional analyses, consistent with our transfer hypothesis, we further show that innovative acquirers have particular acquisition choices. Specifically, they engage in majority control acquisitions (i.e., deals that lead to the acquisition of more than 50% share of the target firm) and cross-border acquisitions (acquirer and target are from different countries). These deals potentially allow acquirers to transfer their innovative resources or capabilities more easily. Finally, we examine how innovative acquirers affect takeover premiums. Our results show that, on average, innovative acquirers pay comparatively lower premiums, suggesting that environmental innovation enhances acquirers' bargaining power.

We make two important contributions to the innovation, business strategy and environmental literature. First, we contribute to the RBV literature by identifying environmental innovation as an important resource or capability that is transferable across firms and countries. Our work uses the M&A context as a unique setting to directly test the extent to which resource-rich firms can create value, not just by using but also by transferring resources to their resource-poor counterparts. Our evidence is consistent with and extends other studies suggesting that environmental innovation (including product, process, and organizational) is an important resource or capability that yields positive financial benefits to its owners (Birkinshaw et al., 2008; Carrillo-Hermosilla et al., 2010; Cruz et al., 2006; Negny et al., 2012; Zaman et al., 2021; Zhang et al., 2022).

Second, we provide evidence on how a certain resource or capability, specifically environmental innovation, can enhance firms' bargaining power in competitive markets. For example, we show that innovative acquirers pay lower M&A premiums to their targets. These acquirers also tend to seek control acquisitions that can allow them to exert more influence over their targets. Our findings extend prior evidence on firms' use of environmental resources to establish a competitive advantage (Chen et al., 2014; Desarbo et al., 2005; Hussain & Shams, 2022) and suggest that innovative acquirers bargain on better terms.

The rest of the study is organized as follows: Section 2 discusses relevant theory and develops hypotheses; Section 3 describes the data and methodology; Section 4 presents empirical results; and Section 5 concludes the study.

2 | LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 | Environmental innovation and M&As

Following recent efforts to address global warming at the national[2] (Zhang et al., 2017) and transnational levels,[3] several corporations have improved their products (product innovation) and organizational processes (process and organizational innovation) to meet environmental legislation requirements (e.g., emission quotas), achieve sustainable development, establish competitive advantage, and maintain a good firm persona (Aftab et al., 2022; Bose et al., 2021; Centobelli et al., 2022; Liao & Tsai, 2019; Ortega-Lapiedra et al., 2019). Given this increased emphasis on environmental sustainability, environmental innovation (whether through eco-design or the introduction of environmentally friendly processes and products) has become an important resource or, indeed, a capability that firms can leverage to strengthen their competitive advantage while also protecting the environment (Kemp & Pontoglio, 2011; Smith et al., 2010; Song et al., 2017) and improving their brand reputation (Cheng et al., 2023).

Indeed, prior empirical research has explored the antecedents and consequences of firms' environmental innovation activities. Antecedents can be understood as particular factors that significantly reduce pressure on the environment (Bleischwitz et al., 2009). Based on the literature, there are three key sets of antecedents of environmental innovation; regulatory, demand-side, and supply-side antecedents (Guoyou et al., 2013; Kesidou & Demirel, 2012). For instance, Horte and Halila (2008) suggest that customer demand, corporate social responsibility, and pressure from interest groups incentivize organizations to develop environmentally friendly products. Kemp and Pearson (2007) argue that firms improving organizational capabilities in green product design, pollution control, and efficient energy use are more likely to be environmentally innovative. Governments can encourage organizations to decrease their environmental effect by enhancing green process innovation, and those who fail to comply with rules should be penalized (Darnall, 2006). As far as the consequences of environmental innovation are concerned, the conventional economic view suggests that environmental innovation brings additional costs to firms, resulting in poor financial performance (Doran & Ryan, 2016). Conversely, the win-win view contends that environmental innovation is linked to higher firm performance and portrays it as a win-win situation for firms (Hojnik & Ruzzier, 2017; Porter & Linde, 1995). Central to this view is the idea that firms applying innovative strategies can enjoy a first-mover advantage, a niche market, and increased competitiveness contingent on their environmental innovation capabilities (Demirel & Kesidou, 2011).

Meanwhile, the empirical research on value creation in M&As concedes that shareholders of target firms earn large positive returns while bidders earn negative or, at best, zero returns (Danbolt et al., 2016; Tunyi, 2021). This suggests that bidders do not generally create value through acquisitions. Bidder returns are dependent on several firm and deal characteristics including, among several others, the target's listing status (private vs. public) (Fuller et al., 2002), the deal size (Moeller et al., 2005), the level of deal anticipation (Tunyi, 2021), bidder overconfidence (Tunyi & Machokoto, 2021), industry-relatedness (Masulis et al., 2007), the method of payment (Graham et al., 2002), managerial ability (Cui & Leung, 2020), chief executive officer (CEO) gender (Levi et al., 2014), bidder's governance, and corporate social responsibility (CSR) (Hussain & Loureiro, 2022; Hussain & Shams, 2022). Importantly, Hussain and Loureiro (2022) and Hussain and Shams (2022) argue that bidders earn higher returns when they have better governance and CSR practices than their targets because such bidders can transfer their practices to the target through the acquisition.

Related to our study, some studies explore environmental innovation within the context of M&As. These studies provide evidence that M&A is a channel for increasing the environmental innovation of acquiring firms (Liu et al., 2021; Liu & Zou, 2008; Wu & Qu, 2021). The evidence suggests that bidders that acquire targets with higher levels of environmental innovation experience an increase in their innovative capability after the acquisition (Liang et al., 2022; Song & Yu, 2018). This occurs because such bidders learn from their targets' innovative capabilities, thus creating important synergies through the acquisition (Liang et al., 2022; Song & Yu, 2018; Vastola & Russo, 2021). Similarly, research suggests that when firms with high levels of emissions (pollution) acquire environmentally responsible firms, they send a positive signal to the capital market about their determination, aspirations, or efforts to converge to cleaner production (Bose et al., 2021). Such deals therefore generate comparatively higher returns for shareholders. Finally, there is evidence that M&As result in the productive use of combined environmental resources post-acquisition (Bresciani & Ferraris, 2016; Dezi et al., 2018; Stiebale, 2016) as M&As provide an opportunity to access complementary resources.

To the best of our knowledge, the literature does not provide an understanding of how environmental innovation (including product, process, and organizational innovation) as a firm resource influences acquirer returns. Our study contributes to this literature by exploring whether environmental innovation is a valuable resource and/or capability that can be transferred from more innovative firms to their less innovative counterparts. We develop our arguments by drawing on the RBV.

2.2 | Theoretical perspective: RBV

RBV emphasizes the significance of the firm's resources as the source of its competitive advantage (Barney, 1991; Lockett et al., 2009; Peteraf, 1993; Srivastava et al., 2001). Within the RBV framework, resources are those assets that are valuable, scarce, and hard to copy and are owned or controlled by the firm (Cheng et al., 2014; Lockett

[2]Many governments used environmental subsidies to enhance the environmental performance of firms (Heres et al., 2017). For instance, the Chinese governments launched environmental policy interventions to decrease environmental pollution (Jia & Chen, 2019).
[3]For instance, the Paris Agreement of 2015 and the United Nations Climate Change Conferences (Dimitrov, 2016).

et al., 2009; Penrose & Penrose, 2009). These resources are historically determined, accrued, and accumulated over time (Barney, 1991; Cheng et al., 2014; Penrose & Penrose, 2009) and are semipermanently tied to the firm (Wernerfelt, 1984). Some resources are obvious and tangible, such as physical capital and brand names, while others are less obvious and intangible, such as organizational routines and capabilities (Teece et al., 1997). Some resources may be static, such as a firm's stock of assets, which can be used for specific purposes over a finite period (Barney, 1991), while others may be dynamic (Teece et al., 1997). Dynamic resources are those embedded within a firm's capabilities (Lockett et al., 2009; Rahman et al., 2023). Their dynamism results from their ability to not only benefit the firm today but also generate additional opportunities in the future (Lockett et al., 2009; Teece et al., 1997). A firm's ability to effectively acquire and efficiently deploy these resources critically distinguishes it from its peers (Barney, 1991; Cheng et al., 2014; Penrose & Penrose, 2009). Firms with high competencies can, for example, deploy fewer resources to achieve better outcomes relative to their peers (Makadok, 2001; Rahman et al., 2023). Hence, RBV suggests that the heterogeneity of resource endowments (as inputs) and competencies across firms explains important firm outcomes such as productivity, competitiveness, performance, and survival.

In the context of M&As, several studies have used RBV to explain the role of resources (financial, managerial, experience, etc.) in the takeover market (Capron & Pistre, 2002; King et al., 2008; Larsson & Finkelstein, 1999; Puranam et al., 2006; Rahman et al., 2016; Testoni, 2022). A commonly held view among the latter studies is that acquirers with ample resources can generate better value for their shareholders by identifying better targets and navigating the resulting financial, operational, and integration challenges. Also, the M&A literature suggests that complementary resources of merging firms create room for the development of synergies through the transfer of knowledge between merging parties (Hussain & Shams, 2022; Riikka & Vaara, 2010). Although these studies improve our understanding of the importance of resources in M&As, they do not provide insights into the role of environmental innovation. Below, we draw on RBV to develop our testable hypotheses on the role of environmental innovation in M&As.

2.3 | Hypothesis development

2.3.1 | Acquirer's environmental innovation and value creation in M&As

The current study explores whether environmental innovation is a valuable resource that can be leveraged by its holders to extract certain benefits when engaging in takeover deals. Indeed, as previously noted, environmental innovation, as a resource, is non-substitutable, valuable, inimitable, and rare and therefore represents a scarce resource per the RBV framework (Laffont & Tirole, 1996; Tan et al., 2018). The rare and valuable attributes of environmental innovation enable organizations to gain competitiveness over their counterparts without access to these resources. Meanwhile, the non-substitutable and inimitable attributes enable these organizations to sustain this competitiveness in the long run (Laffont & Tirole, 1996; Tan et al., 2018). Therefore, environmental innovation as an important resource enables their holders to gain and sustain long-run competitiveness (Cainelli et al., 2015; Farza et al., 2021; Li, 2014).

We argue that an acquirer's competitive advantage emerging from its environmentally innovative resources could result in higher M&A returns for three key reasons: (i) better deal bargaining power, (ii) more efficiency in the target selection, and (iii) higher potential of resource transfer and synergy creation. We discuss these channels further below.

Firstly, we argue that the competitive advantage of environmental innovation alters the relative bargaining power and position among potential acquirers. Resource-rich acquirers have better bargaining power or ability due to competitive positioning within their industry, the quality of their management team, their access to reputed financial advisors, and the depth of their networks (Humphery-Jenner & Powell, 2011; King et al., 2008; Yeung et al., 2009). An M&A deal is a bargaining process in which the acquirer, if rational, seeks to buy its target at the optimal price—a price that is low enough so that the acquirer creates takeover value net of takeover costs (Ahern, 2012; Hussain et al., 2022) but high enough so that the acquirer wins the bid (Humphery-Jenner & Powell, 2011; Hussain & Loureiro, 2023). The offer price is contingent on the bargaining power of competing acquirers, as well as the relative bargaining power between the acquirer and the target (Danbolt et al., 2016; Tunyi et al., 2019, 2024), and the acquirer with higher bargaining power is more likely to win the bid and create value for its shareholders (Lee, 2018). Acquirers with bargaining power face lower competitive pressures (competing bids) and less resistance from their targets. Also, acquirers with higher levels of environmental innovation may be more attractive to targets than non-innovative counterparts, thus strengthening their bargaining position. Therefore, these acquirers may complete deals quicker, pay fairer deal premiums, be less likely to post revised (increased) bids, and be more likely to acquire their ideal targets (Alexandridis et al., 2010; Humphery-Jenner & Powell, 2011; Hussain et al., 2022; Tunyi, 2021). Consequently, such acquirers might create relatively higher value in M&A deals than their less innovative counterparts. This view is consistent with prior research suggesting that acquirers earn higher returns if they have superior bargaining power (Alexandridis et al., 2010; Hussain et al., 2022; Shams, 2019).

Secondly, we argue that the relative competitive advantage resulting from environmental innovation enables innovative acquirers to be more efficient in the selection of targets relative to their less innovative counterparts. Environmentally innovative acquirers may have stronger networks, including relationships with M&A advisers, consultants, and bankers, due to their reputation and access to resources. Hence, such acquirers might be in a better position to engage in due diligence and thorough scrutiny of targets, resulting in more informed decisions such as the true value of their targets. In other words, innovative acquirers might be better placed to reduce the risk of information asymmetry between merging firms (Bena &

Li, 2014) and be more cautious in selecting targets. Additionally, the managers of innovative acquirers may be less susceptible to achieving personal goals (De Beule & Sels, 2016), thus leading to more value-enhancing decision-making around takeovers. For example, such acquirers may be less prone to overpaying for their targets, hence leading to relatively higher M&A returns.

Finally, we argue that the competitive advantage of environmentally innovative acquirers enables them to potentially transfer innovative resources to targets after the acquisition that non-innovative acquirers cannot. The transfer of important resources from acquirers to targets will enhance the target firm's resource portfolio, thus creating substantial synergies through M&As. Indeed, other M&A studies find that the level of resource endowments in acquirers partly explains the cross section of returns earned by acquirers in takeover deals (Ellis et al., 2017; Hussain et al., 2022; Starks & Wei, 2013). Specifically, drawing from an RBV perspective, prior studies find that resource-rich acquirers perform better than resource-poor acquirers, particularly when the acquirer's resources complement rather than substitute their target's resources (King et al., 2008; Testoni, 2022). The underlying argument is that resource-rich acquirers extract greater synergies and, consequently, earn higher deal returns by transferring their excess resources to their targets (King et al., 2008; Martynova & Renneboog, 2008). Importantly, Capron and Pistre (2002) find that bidders earn positive abnormal returns from M&As when they export their own resources to their targets but earn negative abnormal returns when they seek deals that allow them to obtain resources from their targets. Overall, these studies emphasize the importance of resource endowments in M&As by suggesting that resource-rich acquirers outperform their resource-poor counterparts because of their potential to transfer excess resources to targets. We, therefore, argue that a higher potential for the creation of substantial synergies will lead to higher M&A returns in deals initiated by environmentally innovative acquirers.

Summarily, drawing from the RBV perspective, we contend that environmentally innovative acquirers would earn higher returns from M&A deals than their less innovative counterparts due to their higher bargaining power, more efficient target selection, and potential to transfer their innovative resources to targets. Given these arguments, we present our first hypothesis as follows:

> **Hypothesis 1.** *There is a positive relationship between the acquirer's level of environmental (including process, product, and organizational) innovation and value creation in M&As.*

2.3.2 | Environmental innovation gap and acquirer returns

We argue that the potential for higher acquirer returns should be more pronounced when acquirers hold significantly more environmental innovation resources than their targets, that is, when the environmental innovation gap between bidders and targets is higher. This is because a higher environmental innovation gap between merging firms creates an opportunity for the acquirer to transfer its environmentally innovative resources to targets (Capron & Pistre, 2002; King et al., 2008; Testoni, 2022). Also, targets can learn from bidders to enhance their level of environmental sustainability, resource base, and competitiveness, therefore realizing more synergistic benefits from the M&A deal. This will result in higher M&A returns for acquirers upon deal initiation. Indeed, the extant research acknowledges that merging firms (i.e., the acquirer and target) have different resources (Jové-Llopis & Segarra-Blasco, 2020; Lindell & Karagozoglu, 2001), and the disparity in levels of resources is associated with better takeover performance (Ellis et al., 2017; Martynova & Renneboog, 2008; Riikka & Vaara, 2010). Prior studies drawing from an RBV perspective argue that resource heterogeneity between bidders and targets results in positive takeover outcomes due to the creation of synergies (King et al., 2008; Testoni, 2022; Wang & Xie, 2009). These synergies arise due to the transfer of resources from one party to the other (Hussain & Shams, 2022; Testoni, 2022; Wang & Xie, 2009).

However, in deals where targets have better environmental innovation than acquirers, the acquirer shareholders are likely to earn lower returns because targets, having better bargaining power, are likely to demand higher premiums due to their exposure to inferior bidder environmental practices (Bose et al., 2021; Hussain & Shams, 2022; Starks & Wei, 2013). As Capron and Pistre (2002) note, acquirers only create value from takeovers if they have better resources than their targets and so can transfer their excess resources to such targets. If, on the other hand, the target has better resources than the acquirer, Capron and Pistre (2002) argue that the acquirer will pay a significant takeover premium to the target, which will negate any value created from the acquisition. Taken together, we contend that the environmental innovation gap between the acquirer and target is a critical factor in explaining acquirer returns from M&As. Hence, we present the second hypothesis as follows:

> **Hypothesis 2.** *A higher environmental innovation gap between the acquirer and the target strengthens the association between environmental innovation and acquirers' cumulative abnormal returns, ceteris paribus.*

3 | DATA AND METHODOLOGY

3.1 | Data

M&A data are collected from the Securities Data Corporation (SDC) database. The data cover M&As across 26 countries announced between January 1, 2003, and December 31, 2021. We obtain deal-level information from SDC, including the date of the announcement, deal type (domestic or cross border), mode of payment (cash, equity, or mixed), merging firms' nations and industries, takeover premium, deal value, acquirer, and the target status. We require that the acquirer is a publicly listed firm so that we can assess takeover performance using an event study methodology. We focus on completed

deals with a value of at least $1 million. We exclude deals where acquirers belong to financials (SIC codes 6000–6999) or utilities (SIC codes 4900–4949) industries because these industries have different regulations. To avoid noise in our analysis, we also dropped all deals from countries with less than five deals in our sample period.

Accounting and stock price data come from Thomson Reuters' WorldScope and DataStream, respectively. We use the ASSET4 ESG database to obtain data on firm-level environmental innovation. We match our ESG data with SDC data by year and drop all observations where acquirers have missing information on environmental innovation. The data for county-level characteristics—gross domestic product (GDP), environmental protection, and GDP growth is obtained from the World Bank website. Our final data covers 8336 deals across 26 countries.

3.2 | Dependent variable: CARs

The impact of unanticipated M&A deals on the value of the firm can be estimated by exploring abnormal returns generated around the deal announcement (Tunyi, 2021). Per our established hypotheses, we posit that environmental innovation should have a positive impact on the acquirers' CARs. Consistent with the literature (Alexandridis et al., 2017; Tunyi, 2021; Tunyi & Machokoto, 2021), we use an event study approach to estimate abnormal returns as the difference between actual and expected returns. Our estimation window covers 230 trading days, starting 255 days and ending 25 days before the M&A is announced. We compute CARs earned by acquirers in the 3 days (−1,+1), 5 days (−2,+2), and 7 days (−3,+3) around the bid.

3.3 | Independent variable: Environmental innovation

Our data for firm-level environmental innovation are extracted from the ASSET4 ESG database. This database defines environmental innovation as "a company's capacity to reduce the environmental costs and burdens for its customers, and thereby creating new market opportunities through new environmental technologies and processes or eco-designed products." These data have been widely used in the literature (Doung et al., 2015; Drempetic et al., 2020; Mervelskemper & Streit, 2017). ASSET4 ESG provides firm-level performance scores across 36 environment-related attributes, as shown in Appendix C. Following the definitions of (Chen et al., 2014), we categorize these attributes into the product (11 attributes), process (nine attributes), and organization innovation (16 attributes) and compute average scores under each category to reflect firms' performance across these different categories/types of environmental innovation. Finally, we compute an overall environmental innovation score that reflects the arithmetic mean of all 36 attributes. We use this as our main measure of environmental innovation. To identify environmentally innovative firms, we create a dummy variable that takes a value of 1 if the environmental innovation score is above the sample median score and 0 otherwise. Similarly, we create dummies using the scores of product, process, and organizational innovation categories and define firms as innovative in these categories if the score is above the sample median. In additional tests discussed later, we also use other distributions as a cutoff (i.e., tercile, quartile, and quintile) and obtain qualitatively similar results.

3.4 | Control variables

We employ three groups of controls associated with acquirer returns: country, acquirer, and deal characteristics. These variables are fully defined, and their construction is explained in Appendix A. First, macroeconomic indicators that can affect acquirer returns include GDP per capita and GDP growth (Fauver et al., 2017), regulatory efficiency (Ellis et al., 2017),[4] and financial development (Aghion et al., 2004). The level of economic development of a country in which firms operate can affect profits earned by firms (Díaz et al., 2009). Since GDP per capita and GDP growth capture a country's development level, they can affect announcement returns to bidder shareholders (Gleason et al., 2005). Ellis et al. (2017) argue that bidder shareholders earn higher returns when they are from a better regulatory environment. Aghion et al. (2004) state that countries in the phase of lower financial development are unstable in the short-term period, which can affect firm profits. Given our international sample, we additionally control for country-level environmental quality in order to isolate the effect of firm-level environmental quality independent of the country in which they are embedded. To capture country-level environmental quality, we construct the country environment index using country-level environmental innovation variables (see Appendix B) from the World Bank database.

Second, we control for acquirer firm characteristics that potentially influence acquisition returns, including CSR performance (Hussain & Shams, 2022), leverage (Lang et al., 1991), firm size (Moeller & Schlingemann, 2005; Tunyi, 2019), Tobin's q (Lang et al., 1991), profitability (Tunyi, 2021), book to market (Masulis et al., 2007), sales growth (Tunyi, 2021), liquidity (Cornett et al., 2011), cash flow (Martynova & Renneboog, 2008), and bidder industry. The underlying reasons for the inclusion of these control variables are as follows: Prior research suggests that bidders with better CSR practices earn higher returns because they make value-enhancing deals, and the stock market positively reacts to such deals (Deng et al., 2013). A high level of leverage limits managerial discretion (Lang et al., 1991), provides incentives for managers to enhance organizational performance (Gilson, 1990), and positively affects bidder returns (Wang & Xie, 2009). The overvalued firms (captured by high values of Tobin's q) can acquire less overvalued targets using their stock as a cheap currency (Danbolt et al., 2016; Dong et al., 2006). The larger acquirers earn comparatively lower returns because such

[4] In Appendix E, we find that our baseline results are unchanged after controlling for individual dimensions of regulatory efficiency—business freedom, labor freedom, monetary freedom, trade freedom, investment freedom, and financial freedom.

firms pay hefty premiums for winning the bidding auction (Moeller & Schlingemann, 2005; Tunyi, 2019). The better-performing bidder managers (proxied by profitability) may fire inefficient managers of the target and create value for their shareholders (Danbolt et al., 2016; Palepu, 1986). Ratcliffe and Dimovski (2012) report a negative association between bidder returns and high book-to-market ratio, suggesting that shareholders penalize firms with high book to market in M&As. Guo et al. (1995) find that sales growth positively affects returns, arguing that bidders entering new markets receive extra benefits emerging from their higher growth. A higher level of bidder firm liquidity negatively affects bidder returns (Chatterjee et al., 2021), proposing that managers in firms with higher liquidity have incentives to unproductively overinvest. Jensen (1986) states that the managers of firms having higher cash flows invest in negative net present value (NPV) projects. Corroborating Jensen's (1986) hypothesis, McCabe and Yook (1997) find that returns to bidder shareholders decrease if the level of free cash flows decreases. The bidder returns can also vary depending on the nature of the bidder firm industry (i.e., technological vs. manufacturing firms).

Third, we control for deal-related characteristics, including cross-border deals, payment methods, target status, relative deal size, stock price run-up, and same-industry deals. The rationale for this is as follows: Prior studies suggest that the acquirer's stock payment negatively affects announcement returns because of adverse selection problem (Myers & Majluf, 1984). Cross-border deals can be value-enhancing due to access to different markets (Erel et al., 2012), different tax systems (Col, 2017), and governance standards (Martynova & Renneboog, 2008). The same industry deals generate gains from economies of scale (Masulis et al., 2007), while diversified deals destroy shareholder wealth (Morck et al., 1990). Takeovers of private targets generate higher returns than acquiring public targets (Fuller et al., 2002). The relative deal size is positively associated with returns (Moeller & Schlingemann, 2005). The acquirer's stock price reaction before the deal announcement negatively affects the acquirer's announcement returns (Golubov et al., 2012). Fuller et al. (2002) show that acquirers earn positive returns when acquiring private targets due to liquidity discounts.

We also used dummies to control for year, λ_t, industry, η_f, and country, γ_c, omitted factors. To mitigate the effect of outliers, we winsorize CARs and firm characteristics at the bottom and top 1% of the distribution.

3.5 | Model

We use the following cross-sectional regression model to test our first hypothesis:

$$AcquirerCAR_{it} = \beta_0 + \beta_1 High\ environmental\ innovation_{i,t-1} + \sum \beta_k Controls_{i,t-1} + \lambda_t + \eta_j + \gamma_k + \epsilon_{it-1} \quad (1)$$

where *Acquirer CAR*$_{it}$ is the cumulative abnormal return around the announcement day for acquirer i at time t over the 3-day, 5-day or 7-day event window. The variable of interest, *High environmentalinnovation*$_{i,t-1}$ is a dummy variable that takes the value of 1 if the acquirer's environmental innovation score is above the sample median 1 year prior to the deal announcement; *Controls*$_{i,t-1}$ is a vector of the firm-, deal-, and country-level characteristics. The deal characteristics include cross-border-deal (Martynova & Renneboog, 2008), same-industry deal (Masulis et al., 2007), payment method (Bhagat et al., 2005; Tunyi, 2021), relative deal size (Asquith, 1983; Moeller & Schlingemann, 2005), acquirer's stock price run-up (Golubov et al., 2012), and target status (Fuller et al., 2002).

Acquirer firm characteristics include CSR performance (Hussain et al., 2022), leverage (Lang et al., 1991), firm size, Tobin's q (Lang et al., 1991; Wang & Xie, 2009), profitability (Tunyi, 2021), book to market (Masulis et al., 2007), sales growth (Tunyi & Machokoto, 2021), liquidity (Cornett et al., 2011), and cash flow (Martynova & Renneboog, 2008). Finally, we control for country-level factors, including GDP per capita (Fauver et al., 2017), GDP growth (Fauver et al., 2017), the country environment index, regulatory efficiency (Ellis et al., 2017), and financial development (Aghion et al., 2004).

To test Hypothesis 2, we use Equation (2) which includes all variables as those used in Equation (1) except high environmental innovation gap (HEIG) and the interaction term between high environmental innovation (HEI) and HEIG. To capture the portability effect, we follow existing studies (Ellis et al., 2017; Martynova & Renneboog, 2008) and calculate the difference between the acquirer's and target's environmental innovation scores. A positive innovation gap denotes that the acquirer has better environmental innovation levels than the target and vice versa. Our variable of interest in Equation (2) is the interaction term between the innovation gap and the acquirer's environmental innovation.

$$AcquirerCAR_{it} = \beta_0 + \beta_1 HEI_{i,t-1} + \beta_2 HEIG_{i,t-1} + \beta_3 HEI_{i,t-1} \times HEIG_{i,t-1} + \sum \beta_k Controls_{i,t-1} + \lambda_t + \eta_j + \gamma_k + \epsilon_{it-1} \quad (2)$$

4 | EMPIRICAL RESULTS

4.1 | Descriptive statistics

Table 1 shows the sample distribution by year (panel A), acquirer industry (panel B), and acquirer country (panel C). We observe in panel A that the most active year in the international takeover market is 2016, with 8.09% deals. As shown in column 3, the percentage of deals by environmentally innovative firms (EI) gradually increased until 2013, and afterward, the observed trend shows fluctuations. More strikingly, during the COVID-19 pandemic period (2020–2021), innovative acquirers appear to engage in more takeover activity than their non-innovative counterparts. Specifically, over 54.87% (2020) and 68.31% (2021) of takeover deals in our sample were initiated by

TABLE 1 Sample distribution by year, acquirer industry, and country.

	N (1)	% (2)	% by EI firms (3)
Panel A: Announcement year distribution			
2003	231	2.77	12.98
2004	299	3.59	19.06
2005	487	5.84	12.73
2006	581	6.97	22.03
2007	561	6.73	19.96
2008	559	6.71	42.75
2009	455	5.46	51.42
2010	595	7.14	57.47
2011	667	8.00	59.07
2012	643	7.71	63.76
2013	519	6.23	66.66
2014	622	7.46	61.25
2015	635	7.62	64.25
2016	674	8.09	56.52
2017	157	1.88	53.50
2018	195	2.34	51.79
2019	191	2.29	48.69
2020	164	1.97	54.87
2021	101	1.21	68.31
Panel B: Acquirer industry distribution (top 10 showing 61.95% of the M&As)			
Medical equipment	330	3.96	34.84
Drugs	367	4.40	24.25
Chemicals	286	3.43	80.41
Machinery	297	3.56	60.94
Telecommunication	514	6.17	55.83
Business services	900	10.80	29.88
Computers	534	6.41	79.77
Computer software	1001	12.01	37.16
Electronic equipment	549	6.59	64.66
Retail	385	4.62	56.10
Panel C: Acquirer country distribution			
Australia	119	1.43	32.77
Austria	63	0.76	39.68
Belgium	68	0.82	55.88
Brazil	77	0.92	19.48
Canada	412	4.94	37.86
Chile	17	0.20	23.52
China	16	0.19	43.75
Denmark	34	0.41	64.70
Finland	146	1.75	60.27
France	636	7.63	49.52
Germany	596	7.15	60.90
Greece	16	0.19	6.25
India	42	0.50	66.66
Italy	44	0.53	9.09
Japan	250	3.00	47.6
Malaysia	7	0.08	57.14
Mexico	43	0.52	16.27
Norway	71	0.85	29.57
Poland	14	0.17	7.14
Portugal	15	0.18	66.66
Singapore	23	0.28	34.78
Spain	98	1.18	57.14
Sweden	181	2.17	46.96
Switzerland	225	2.70	61.33
United Kingdom	176	2.11	28.97
United States	4947	59.35	47.62
Total	8336	100.00	

environmentally innovative acquirers. Panel B presents the acquirers' industry distribution. Here, the top 10 industries accounted for almost 62% of takeovers during the sample period. The computer software industry is dominant, with 12% of takeovers, while innovative firms in the chemical industry accounted for over 80% deals in that industry.

Panel C shows the distribution of acquirers by country. Not surprisingly, the United States[5] dominates in the international takeover market with 59.35% deals. Innovative acquirers in the United States account for 47.62% of M&As. Overall, we observe significant dispersion in our sample across the year, industry, and country.

Table 2 documents descriptive statistics for variables in our study, further split by innovative and non-innovative acquirers. In the full sample (column 1), the acquirer's average 3-day, 5-day, and 7-day CARs are 1%, 1.2%, and 1.3%, respectively, consistent with studies reporting positive acquirer returns (Alexandridis et al., 2017; Hussain et al., 2022). The average environmental innovation score is 47.5, and three categories of environmental innovation—product, process, and organizational innovation—account for mean scores of 56.3, 75, and 76.9, respectively.

We additionally show descriptive statistics for five country characteristics—country environment index, GDP growth, GDP per capita, regulatory efficiency, and financial development—with mean values of 5.79, 1.86, 10.71, 73.90, and 0.84, respectively. The average acquirer CSR, leverage, firm size, Tobin's q, profitability, book to market, sales growth, liquidity, and cash flow are 39.94, 0.17, 16, 2.12, 0.07, 0.46, 0.10, 0.09, and 0.08, respectively. We further show summary statistics for deal-related variables: run-up, cross-border deal, same industry deal, target status, payment method, and relative deal size. The mean of the acquirer stock price run-up is −1%. Almost 47% of takeovers are cross-border, 33% deals conducted in the same

[5]Although the US dominates our sample, our results remain robust after dropping US firms.

TABLE 2 Descriptive statistics and difference of means test.

Variables	Full sample					Innovative	Non-innovative	T test	
	Mean (1)	Median (2)	SD (3)	p5 (4)	p95 (5)	Mean (6)	Mean (7)	Difference (8)	*p*-value (9)
Panel A: Cumulative abnormal returns (CARs)									
3-day CARs	0.010	0.008	0.031	−0.034	0.058	0.011	0.009	0.002	0.025
5-day CAR	0.012	0.010	0.038	−0.046	0.074	0.013	0.011	0.003	0.000
7-day CARs	0.013	0.012	0.043	−0.056	0.080	0.015	0.011	0.004	0.000
Panel B: Environmental innovation and categories									
Environmental innovation	0.475	0.000	0.499	0.000	1.000				
Product innovation	0.563	0.571	0.050	0.500	0.643	0.562	0.565	−0.003	0.023
Process innovation	0.750	0.857	0.208	0.444	0.964	0.763	0.739	0.024	0.000
Organizational innovation	0.769	0.769	0.002	0.769	0.769	0.769	0.769	0.000	0.024
Panel C: Country characteristics									
Country environment index	5.795	14.559	16.981	−24.698	19.643	9.443	2.494	6.950	0.000
GDP growth	1.861	2.250	1.95	−2.537	3.925	54.879	24.520	30.358	0.000
GDP per capita	10.714	10.778	0.389	10.311	11.052	0.182	0.166	0.017	0.000
Regulator efficiency	73.901	75.450	8.497	62.515	81.016	16.503	15.560	0.944	0.000
Financial development	0.846	0.901	0.123	0.624	0.917	1.984	2.247	−0.262	0.000
Panel D: Firm characteristics									
CSR	38.946	35.250	36.181	0.000	95.590	0.082	0.074	0.007	0.007
Leverage	0.174	0.160	0.134	0.000	0.413	0.474	0.461	0.013	0.175
Firm size	16.008	15.938	1.445	13.712	18.364	0.060	0.137	−0.076	0.000
Tobin's Q	2.122	1.739	1.753	0.962	4.301	0.098	0.100	−0.002	0.332
Profitability	0.078	0.076	0.120	0.003	0.184	0.083	0.079	0.004	0.013
Book to market	0.467	0.367	0.438	0.100	1.090	−0.007	0.004	−0.011	0.002
Sales growth	0.100	0.077	0.241	−0.142	0.392	0.527	0.417	0.110	0.000
Liquidity	0.099	0.073	0.092	0.008	0.280	0.307	0.356	−0.049	0.000
Cash Flow	0.081	0.076	0.069	−0.017	0.193	0.011	0.002	0.009	0.000
Panel E: Deal characteristics									
Run-up	−0.001	−0.002	0.161	−0.252	0.243	0.068	0.144	−0.076	0.000
Cross-border	0.469	0.000	0.499	0.000	1.000	0.647	0.616	0.032	0.003
Same industry	0.333	0.000	0.471	0.000	1.000	0.143	0.184	−0.042	0.000
Manufacturing industry	0.006	0.000	0.076	0.000	0.000	0.001	0.001	0.000	0.117
Technological industry	0.108	0.000	0.310	0.000	1.000	1.570	2.126	−0.555	0.000
Target status	0.631	1.000	0.483	0.000	1.000	10.764	10.668	0.096	0.000
Payment method	0.165	0.000	0.371	0.000	1.000	73.790	74.002	−0.212	0.256
Relative deal size	0.001	0.000	0.002	0.000	0.003	0.845	0.847	−0.003	0.361
Premium (1 day)	0.027	−0.001	0.152	−0.009	0.193	0.016	0.036	−0.021	0.000
Premium (1 week)	0.030	−0.001	0.162	−0.008	0.223	0.018	0.041	−0.023	0.000
Premium (4 weeks)	0.033	−0.001	0.180	−0.007	0.247	0.020	0.045	−0.026	0.000
No. of days	42.531	10.000	113.387	3.000	172.000	2.450	3.030	−0.581	0.000
Observations	8336					3961	4375		

Fama–French industry, 63% takeovers involved private targets, and 16% acquisitions were financed with stock.

We conduct univariate analysis (columns 6–9) to examine the average difference in the characteristics of acquirers with and without ex-ante environmental innovation. We split our M&A sample into two groups of acquirers with and without environmental innovation. Using the median value of environmental innovation score as a cutoff[6]

[6]Findings are qualitatively similar when we define innovative acquirers by tercile, quartile, and quintile.

between innovative and non-innovative acquirers, we find that 3961 deals (47.5%) out of 8,336 deals involve innovative acquirers, while 4375 deals involve acquirers categorized by our framework as non-innovative. The mean 3-day CARs for innovative and non-innovative acquirers are 1.1% and 0.9%, respectively. The return gap between the two groups (0.2%) is statistically and economically significant at the 1% level. A similar pattern is observed in 5-day and 7-day CARs. These findings supply prefatory subsistence for our conjecture that innovative acquirers earn higher CARs than their non-innovative counterparts. On average, innovative acquirers' engagement in the same industry is lower by 4.2%, when compared to non-innovative acquirers, and this disparity is significant at 1% level.

Non-innovative acquirers mostly pay in stock more than innovative acquirers, with a gap of 2.12%. Innovative acquirers, relative to non-innovative acquirers, frequently engage in cross-border deals, and the difference is significant at the 1% level. Among other acquirer characteristics, CSR, leverage, profitability, and cash flow show positive differences (i.e., innovative acquirers have greater values than non-innovative acquirers) between innovative and non-innovative acquirers.

For all variables used in the regression analysis, Appendix D reports Pearson correlation coefficients. The results show low correlations between our independent variables assuaging concerns around multicollinearity.

4.2 | Environmental innovation and acquirer M&A returns

We estimate Equation (1) to examine the impact of the acquirer's ex-ante environmental innovation on acquirer CARs. Our results from the cross-sectional regressions are presented in Table 3.

In columns 1–3 of Table 3, we show the effect of environmental innovation on 3-day, 5-day, and 7-day CARs without using any control variable. In columns 4–6, we add country, firm, and deal characteristics as additional controls. Across each column, we find a positive and statistically significant association between high environmental innovation and CARs, suggesting that acquirers with high environmental innovation achieve comparatively higher returns from M&A activity. Economically, taking, for instance, column 4, we find that innovative acquirers earn 0.40 percentage points higher CARs than their non-innovative counterparts. This finding corroborates our hypothesis (Hypothesis 1)—high acquirer environmental innovation (pre-deal) is associated with higher acquirer announcement abnormal returns.[7] The findings extend earlier work showing that apart from acquirer better governance (Ellis et al., 2017; Martynova & Renneboog, 2008), acquirer market power (Hussain & Shams, 2022), and unanticipated deals (Tunyi, 2021), environmental innovation could be an important driver of takeover value.

[7]In robustness tests, we show that our results are not sensitive to alternative measures of environmental innovation and CARs.

Our models (columns 4–6) include several control variables. The estimated coefficients of controls across the three-column specifications (columns 4–6) are qualitatively similar in statistical significance and magnitude. Further, the results from these controls are qualitatively similar to those of previous studies (Masulis et al., 2007; Tunyi, 2021; Wang & Xie, 2009). We find, for example, as expected, that country environmental innovation, book-to-market ratio, and relative deal size positively affect acquirer returns. For brevity, we do not discuss this further.

Consistent with earlier work on the benefits of CSR (Arouri & Pijourlet, 2017; Fauver et al., 2018; Hussain & Shams, 2022) in general and environmental innovation (Cheng et al., 2014; Song et al., 2017; Zaman et al., 2021; Zhang et al., 2022) in particular, our findings provide evidence that acquirers with ex ante environmental innovation earn, on average, higher returns. The theoretical support for the results is derived from the RBV (Barney, 1991), suggesting that better resources or capabilities (e.g., environmental innovation) are transferable from the bidders to the targets. Our findings are consistent with the view that environmental innovation is an important resource that can be leveraged by acquirers to generate value in M&As.

In Table 4, we further investigate the effect of three important kinds of environmental innovation; process (Negny et al., 2012; Rennings, 2000), product (Carrillo-Hermosilla et al., 2010), and organizational innovation (Birkinshaw et al., 2008; Cruz et al., 2006) on CARs. If our base results on environmental innovation are valid, we should observe a positive association between CARs and different kinds of environmental innovation. Table 4 shows the results from the regressions of environmental innovation types. We find that all types of environmental innovation show a positive and statistically significant effect on CARs. These results provide further insights and enhance our understanding of the role of environmental innovation in the takeover market.

Importantly, the results suggest that while different types of innovation are important, in the context of M&As, acquirers with high organizational innovation generate higher returns relative to acquirers with other types of environmental innovation. Specifically, acquirers with high organizational innovation generate CARs that are 40 percentage points relative to their counterparts with low organizational innovation. Meanwhile, acquirers with high process innovation only enjoy CARs that are 1.9 percentage points higher than those of their low process innovation counterparts. These findings suggest that, while environmental innovation is important as a whole, the benefits of environmental innovation may depend on the type of environmental innovation.

4.3 | Channel analysis: Portability of environmental innovation

We use Equation (2) to test our second hypothesis: Hypothesis 2. Specifically, to capture the portability effect, we follow existing studies (Ellis et al., 2017; Martynova & Renneboog, 2008) and calculate the difference between the acquirer's and target's environmental innovation scores—the environmental innovation gap. A positive

TABLE 3 Environmental innovation and acquirer cumulative abnormal returns (CARs).

Variables	CAR(−1,+1) (1)	CAR(−2,+2) (2)	CAR(−3,+3) (3)	CAR(−1,+1) (4)	CAR(−2,+2) (5)	CAR(−3,+3) (6)
High environmental innovation	0.001* (1.715)	0.002** (2.297)	0.003*** (2.790)	0.004*** (4.065)	0.004*** (4.102)	0.005*** (4.197)
Country environment index				0.000*** (5.316)	0.000*** (4.664)	0.000*** (3.837)
CSR				0.000 (1.266)	0.000 (0.747)	0.000 (0.282)
Leverage				0.003 (0.813)	0.005 (1.284)	0.002 (0.440)
Firm size				−0.002*** (4.041)	−0.002*** (3.568)	−0.002*** (3.180)
Tobin's Q				0.000 (0.209)	0.000 (0.621)	0.000 (0.169)
Profitability				−0.004 (1.058)	0.001 (0.217)	0.005 (0.780)
Book to market				0.003*** (2.721)	0.004*** (3.132)	0.006*** (3.628)
Sales growth				0.001 (0.499)	0.002 (0.573)	0.005 (1.378)
Liquidity				0.001 (0.201)	−0.006 (0.946)	−0.002 (0.272)
Cash flow				−0.002 (0.187)	−0.007 (0.705)	−0.005 (0.393)
Run-up				−0.038*** (14.308)	−0.047*** (13.511)	−0.054*** (13.818)
Cross-border				−0.005*** (7.513)	−0.006*** (6.501)	−0.006*** (5.625)
Same industry				−0.004*** (4.491)	−0.004*** (4.003)	−0.003*** (3.017)
Manufacturing industry				0.011 (1.243)	0.010 (1.000)	0.015 (1.265)
Technological industry				0.014* (1.930)	0.012 (1.484)	0.008 (0.731)
Target status				−0.001 (1.336)	0.000 (0.442)	0.000 (0.330)
Payment method				0.001 (0.601)	0.000 (0.317)	−0.001 (0.532)
Relative deal size				0.351* (1.648)	0.356* (1.877)	0.105 (0.422)
GDP growth				0.000 (0.593)	0.000 (0.460)	0.000 (0.514)
GDP per capita				−0.008 (1.557)	−0.009 (1.305)	−0.015** (2.016)
Regulatory efficiency				0.000 (0.390)	0.000 (0.305)	0.000 (0.139)
Financial development				0.046*** (2.780)	0.070*** (3.340)	0.090*** (3.641)
Constant	0.002 (0.282)	0.009 (1.005)	0.008 (0.682)	0.076 (1.447)	0.064 (1.000)	0.110 (1.477)
N	8336	8336	8336	8336	8336	8336
R^2	0.038	0.035	0.035	0.100	0.095	0.093
Year, industry, country FE	Yes	Yes	Yes	Yes	Yes	Yes

TABLE 4 Innovation types, portability, and acquisition choices (7-day CARs).

Variables	Innovation type			Portability	Acquisition choice		Premium 4-week
	Product (1)	Process (2)	Organizational (3)	(4)	Majority (5)	Cross-border (6)	(7)
High environmental innovation (HEI)	0.074*** (4.397)	0.019*** (5.253)	0.400** (2.225)	0.002 (0.800)	0.203*** (3.852)	0.131*** (3.269)	−0.011** (2.494)
High environmental innovation gap (HEIG)				−0.163*** (12.999)			
HEI × HEIG				0.167*** (9.722)			
Country environment index	0.000*** (4.055)	0.000*** (3.756)	0.000*** (3.979)	0.000*** (3.107)	0.005** (2.352)	−0.003 (1.593)	0.000 (0.237)
CSR	0.000 (0.386)	0.000 (0.288)	0.000 (0.251)	0.000 (0.245)	−0.001 (0.982)	0.001 (1.260)	0.000 (0.786)
Leverage	0.003 (0.659)	0.003 (0.615)	0.002 (0.366)	−0.011* (1.840)	−0.372** (2.176)	0.014 (0.108)	0.014 (0.866)
Firm size	−0.001*** (2.787)	−0.001*** (2.698)	−0.001*** (2.710)	−0.002*** (2.976)	−0.113*** (5.155)	0.057*** (3.509)	0.006*** (2.970)
Tobin's Q	0.000 (0.254)	0.000 (0.448)	0.000 (0.228)	0.000 (0.353)	−0.047*** (3.501)	−0.042*** (2.950)	−0.003*** (2.614)
Profitability	0.005 (0.840)	0.005 (0.732)	0.004 (0.684)	0.009 (0.696)	−0.089 (0.496)	−0.101 (0.758)	−0.023 (1.139)
Book to market	0.006*** (3.582)	0.006*** (3.565)	0.006*** (3.571)	0.003* (1.863)	−0.002 (0.051)	−0.115*** (2.799)	−0.008* (1.768)
Sales growth	0.005 (1.400)	0.005 (1.337)	0.005 (1.368)	0.002 (0.486)	0.135 (1.268)	−0.006 (0.091)	0.015 (1.286)
Liquidity	−0.001 (0.212)	−0.002 (0.312)	−0.001 (0.141)	−0.011 (1.353)	−0.056 (0.198)	0.263 (1.342)	−0.026 (1.201)
Cash flow	−0.004 (0.372)	−0.006 (0.492)	−0.003 (0.285)	0.027 (1.600)	0.428 (1.060)	0.665** (2.192)	0.017 (0.381)
Run-up	−0.055*** (13.966)	−0.055*** (13.982)	−0.055*** (13.912)	−0.060*** (10.919)	−0.097 (0.790)	0.247*** (2.634)	0.049*** (3.803)
Cross-border	−0.006*** (5.549)	−0.006*** (5.523)	−0.006*** (5.426)	−0.010*** (8.706)	0.050 (1.175)		−0.004 (0.936)
Same industry	−0.003*** (2.845)	−0.003*** (2.882)	−0.003*** (2.928)	−0.009*** (6.716)	−0.219*** (5.063)	0.194*** (5.718)	−0.001 (0.178)
Manufacturing industry	0.017 (1.463)	0.018 (1.558)	0.015 (1.271)	0.003 (0.143)	0.715* (1.712)	0.465 (0.843)	−0.015 (0.717)
Technological industry	0.008 (0.739)	0.008 (0.836)	0.005 (0.495)	−0.007 (0.315)	0.261 (1.219)	0.438 (0.837)	0.009 (0.493)
Target status	0.000 (0.463)	0.000 (0.456)	0.000 (0.312)	0.000 (0.199)	0.587*** (14.259)	0.086*** (2.597)	−0.069*** (16.267)
Payment method	−0.001 (0.609)	−0.001 (0.520)	−0.001 (0.606)	−0.002 (1.311)	2.283*** (16.206)	−0.131*** (3.151)	0.119*** (14.403)
Relative deal size	0.117 (0.488)	0.108 (0.439)	0.106 (0.441)	−1.705** (2.400)	73.464*** (3.419)	12.994 (1.465)	−2.685*** (3.834)
GDP growth	0.000 (0.527)	0.000 (0.489)	0.000 (0.557)	0.000 (0.326)	0.003 (0.129)	0.008 (0.424)	−0.004** (2.198)
GDP per capita	−0.015** (2.022)	−0.015** (1.995)	−0.015** (2.029)	−0.010 (0.894)	0.358 (1.339)	−0.586*** (2.578)	−0.005 (0.171)
Regulatory efficiency	0.000 (0.158)	0.000 (0.128)	0.000 (0.147)	0.000 (1.125)	−0.001 (0.301)	0.008*** (3.130)	0.000 (0.417)
Financial development	0.091*** (3.701)	0.091*** (3.691)	0.089*** (3.620)	0.050 (1.564)	0.454 (0.502)	0.508 (0.634)	0.048 (0.616)

TABLE 4 (Continued)

Variables	Innovation type			Portability	Acquisition choice		Premium 4-week
	Product (1)	Process (2)	Organizational (3)	(4)	Majority (5)	Cross-border (6)	(7)
Constant	0.059 (0.791)	0.084 (1.130)	−0.202 (1.273)	0.116 (0.997)	−1.949 (0.714)	3.682 (1.544)	−0.008 (0.032)
N	8336	8336	8336	4120	8319	8332	8336
R^2 or pseudo R^2	0.093	0.094	0.091	0.1535	0.309	0.159	0.178
Year, industry, country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

innovation gap signifies that the acquirer has better environmental innovation than the target and vice versa. Our variable of interest in Equation (2) is the interaction term between the innovation gap and the acquirer's environmental innovation. Our results are presented in column 4 of Table 4.

The estimated coefficient on interaction term in column 4 of Table 4 shows that the effect of higher environmental innovation on acquirer CARs is more pronounced when the environmental innovation gap is positive. Economically, innovative acquirers earn 16.7 percentage points higher when they have better environmental innovation than targets. The results suggest that the portability of higher environmental innovation practices is a potential channel through which innovative acquirers drive takeover value. This finding also suggests that within countries, there is considerable heterogeneity in environmental innovation practices, which creates the potential for takeover value through the portability channel.

4.4 | Acquisition choices and takeover premium

To further highlight the role of environmental innovation in M&As, we examine how innovative acquirers affect acquisition choices. To that end, we focus on majority control and cross-border acquisitions. The rationale behind this analysis is to examine whether innovative acquirers have certain acquisition choices to make the portability of higher environmental innovative practices easier. Accordingly, we estimate the following Probit model:

$$\begin{aligned} \textit{Acquisition choice}_{it} = {} & \beta_0 + \beta_1 \textit{High environmental innovation}_{i,t-1} \\ & + \sum \beta_k \textit{Controls}_{i,t-1} + \lambda_t + \eta_j + \gamma_k + \epsilon_{it-1} \end{aligned} \quad (3)$$

where *Acquisition choice*$_{it}$ in separate regressions shows the binary variable that is equal to one for (i) majority control acquisitions (i.e., the acquirer has less than 50% shares of the target before the acquisition and ends up with more than 50% shares after the acquisition), (ii) cross-border acquisitions. We report results in Table 4 (columns 5 and 6) that corroborate our intuitions—innovative acquirers are more likely to engage in majority control and cross-border acquisitions. The results on acquisition choices elaborate on the preference of innovative acquirers to transfer their environmentally innovative practices.

The literature attributes poor takeover performance to high premiums paid by acquirers (Alexandridis et al., 2010; Humphery-Jenner & Powell, 2011; Shams et al., 2013). Takeovers involve a bargaining process in which the acquirer, if rational, attempts to buy the target at the lowest possible price so that it can create value for shareholders (Ahern, 2012; Hussain & Shams, 2022) or pay a higher price for winning the bidding contest (Alexandridis et al., 2010). The bargaining position of the merging firms determines the final price, and the firm with higher bargaining power can achieve its prospective outcome (Lee, 2018). An innovative acquirer may have higher bargaining power and can negotiate on better terms leading to lower acquisition premiums. Building on this, we propose that environmentally innovative acquirers pay lower premiums due to their environmental resources and competitive advantage. Therefore, we re-estimate Equation (1) by replacing *Acquirer CAR*$_{it}$ with *Premium*. The results in Table 4 (column 7) support our conjectures and suggest that, on average, innovative acquirers pay low takeover premiums, providing further insight into RBV.

4.5 | Endogeneity

Our results so far suggest a positive association between the acquirer's ex ante environmental innovation and CARs. However, the findings may suffer from endogeneity-related issues, notably sample section, reverse causality, and omitted variable biases. Hence, our evidence might not imply causation. We use three techniques to address the endogeneity problem.

First, innovative firms may not be randomly distributed in our sample, and we use the PSM technique to address the sample selection problem. We use, without replacement, a one-to-one matching algorithm (0.01 caliper distance) and identify a subsample of non-innovative acquirers (control group) that have very similar observable characteristics (deal, firm, and country level) as innovative acquirers (treatment group).[8]

Second, higher announcement returns may affect investment in environmental innovation—reverse causality. We addressed this issue using 2SLS and employed industry-adjusted environmental innovation

[8]In unreported results, we find that the descriptive statistics for the difference in means between the treatment and control groups are very similar, suggesting a good match.

TABLE 5 Addressing endogeneity.

Panel A: PSM and two-stage least squares			
		Two-stage least squares	
	PSM (1)	First stage (2)	Second stage (3)
High environmental innovation	0.006*** (4.241)		
Country environment index	0.000*** (3.912)	0.003*** (6.366)	0.000*** (3.475)
Industry median environmental innovation		0.350*** (32.453)	
Environmental innovation (fitted)			0.013*** (5.244)
CSR	0.000 (0.509)	0.003*** (20.470)	−0.000* (1.739)
Leverage	0.002 (0.450)	−0.043 (1.274)	0.002 (0.529)
Firm size	−0.002*** (3.249)	0.050*** (11.902)	−0.002*** (4.010)
Tobin's Q	0.000 (0.581)	0.000 (0.144)	0.000 (0.005)
Profitability	0.005 (0.918)	−0.123*** (3.538)	0.005 (0.800)
Book to market	0.004*** (3.028)	0.005 (0.480)	0.005*** (3.183)
Sales growth	−0.004 (1.164)	0.010 (0.533)	0.006 (1.431)
Liquidity	−0.008 (1.161)	0.097* (1.892)	0.001 (0.202)
Cash flow	0.013 (1.029)	0.163** (2.107)	0.004 (0.328)
Run-up	−0.058*** (16.561)	−0.028 (1.182)	−0.055*** (13.654)
Cross-border	−0.008*** (6.858)	0.025*** (2.948)	−0.006*** (5.443)
Same industry	−0.007*** (5.927)	0.020** (2.267)	−0.003** (2.458)
Manufacturing industry	0.031 (1.521)	0.159 (1.170)	0.004 (0.741)
Technological industry	0.017 (0.849)	−0.243* (1.913)	0.001 (0.551)
Target status	−0.001 (0.435)	0.012 (1.455)	0.001 (1.098)
Payment method	−0.002 (1.536)	−0.015 (1.413)	−0.001 (0.557)
Relative deal size	0.094 (0.300)	1.397 (0.554)	0.102 (0.430)
GDP growth	0.000 (0.086)	−0.015*** (3.195)	0.000 (0.718)
GDP per capita	−0.010 (1.171)	−0.141** (2.405)	−0.017** (2.186)
Regulatory efficiency	0.000 (1.256)	−0.001** (2.046)	0.000 (0.205)
Financial development	0.042	−0.257	0.094***

TABLE 5 (Continued)

Panel A: PSM and two-stage least squares			
		Two-stage least squares	
	PSM (1)	First stage (2)	Second stage (3)
	(1.519)	(1.300)	(3.928)
Constant	0.087 (0.992)	0.768 (1.252)	0.133* (1.794)
Underidentification test (Anderson canon. corr. LM statistics)		90.747	
P value		(0.000)	
Weak identification test (Cragg–Donald Wald *F* statistics)		91.481	
Overidentification test (Sargan statistics)		0.521	
P value		(0.742)	
N	5467	8336	8336
R^2	0.120	0.521	0.073
Year, industry, country FE	Yes	Yes	Yes

Panel B: Omitted variable bias (Oster, 2019)						
	Controlled		Uncontrolled			
	β (1)	R2 (2)	β (3)	R2 (4)	Identified set (5)	Includes zero? (6)
Assume $\delta = 1$; $R_{MAX} = min(2.2R, 1)$						
High environmental innovation	0.004	0.100	0.001	0.038	[0.006 0.004]	No
Assume $\delta = 1$; $R_{MAX} = 1$						
High environmental innovation	0.004	0.100	0.001	0.038	[0.093 0.004]	No

as an exogenous instrument (Zaman et al., 2021). The results in panel A of Table 5 show that after controlling for sample selection (column 1) and reverse causality (columns 2 and 3) biases, the positive relationship between ex ante environmental innovation and acquirer CARs persists, as hypothesized.

Although we used year, industry, and country fixed effects in all of our regression analyses to account for omitted variable bias, finally, we use Oster (2019) indicative test of omitted variables. The logic of this test is that we can construct an identifiable set using the R-squares and coefficients without and with control variables. The identified set is expressed as $[\beta, \beta']$ where β' is calculated using the following formula:

$$\beta' = \beta - \delta[\beta^* - \beta]\frac{R_{MAX} - R^*}{R - R^*} \quad (4)$$

where β shows the estimated coefficient of high environmental innovation variable; R denotes the R-square value from the baseline model with control variables (model 4 of Table 3); and β^* and R^* are estimated values from our baseline model without control variables (model 1 of Table 3). We select δ and R_{MAX} values by relying on the Oster (2019) argument that the upper bound for δ is one because omitted and included variables are equally important. Importantly, the value of R_{MAX} cannot be greater than one because it shows a hypothetical value from the regression of included and omitted variables. Therefore, following Mian and Sufi (2014), we create upper and lower Oster bound values for the identified set as $R_{MAX} = min(2.2R, 1)$ and $R_{MAX} = 1$, respectively. Our results from panel B of Table 5 show that neither identified set involves zero, and thus, we conclude that inferences from the baseline models (Table 3) are not affected by the omitted variable bias.

4.6 | Robustness tests

To ascertain the validity of our findings, we perform some further tests and show the results in Table 6. One possible issue that may arise with our results is related to the short-term announcement returns, and to allay this issue, we use long-term returns of 21-day CARs. We present our results in column 1 of Table 6 and argue that innovative acquirers still earn higher returns irrespective of whether we consider shorter or longer event windows.

Our definition of innovative acquirers (with an environmental score above the sample median) may be biased in assessing acquirer M&A performance. Therefore, for robustness, we compute tercile, quartile, and quintile distributions of environmental innovation to

TABLE 6 Robustness tests.

Variables	21-day CARs	Tercile	Quartile	Quintile	PCA	Excl. 2016	Excl. computer software	Excl. US
Dependent variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
High environmental innovation	0.010*** (4.689)				0.008*** (5.322)	0.005*** (3.521)	0.005*** (3.799)	0.006*** (2.975)
High environmental innovation (tercile)		0.003*** (4.006)						
High environmental innovation (quartile)			0.002*** (4.166)					
High environmental innovation (quintile)				0.002*** (4.084)				
Country environment index	0.000*** (4.933)	0.000*** (3.890)	0.000*** (3.906)	0.000*** (3.949)	0.000*** (3.641)	0.000*** (3.358)	0.000*** (3.600)	0.003*** (4.480)
CSR	0.000 (0.017)	0.000 (0.208)	0.000 (0.285)	0.000 (0.313)	0.000 (0.352)	0.000 (0.244)	0.000 (0.736)	−0.000** (2.164)
Leverage	0.004 (0.449)	0.002 (0.474)	0.002 (0.435)	0.002 (0.433)	0.003 (0.578)	0.004 (0.749)	0.001 (0.164)	−0.001 (0.060)
Firm size	−0.001* (1.700)	−0.002*** (3.124)	−0.002*** (3.212)	−0.002*** (3.168)	−0.001*** (2.645)	−0.002*** (2.977)	−0.002*** (2.910)	−0.001 (1.267)
Tobin's Q	0.000 (0.118)	0.000 (0.184)	0.000 (0.170)	0.000 (0.188)	0.000 (0.512)	0.000 (0.186)	0.000 (0.143)	0.000 (0.390)
Profitability	−0.002 (0.153)	0.005 (0.750)	0.005 (0.748)	0.005 (0.749)	0.004 (0.679)	−0.001 (0.145)	0.007 (0.933)	0.023*** (2.794)
Book to market	0.013*** (3.510)	0.006*** (3.606)	0.006*** (3.619)	0.006*** (3.611)	0.006*** (3.560)	0.008*** (4.471)	0.006*** (3.583)	0.004*** (2.633)
Sales growth	0.008 (1.094)	0.005 (1.399)	0.005 (1.401)	0.005 (1.392)	0.005 (1.293)	0.006 (1.384)	0.005 (1.207)	0.003 (0.824)
Liquidity	0.008 (0.716)	−0.002 (0.265)	−0.002 (0.263)	−0.002 (0.304)	−0.002 (0.326)	−0.001 (0.116)	−0.007 (0.914)	0.006 (0.412)
Cash flow	0.012 (0.592)	−0.004 (0.367)	−0.004 (0.364)	−0.005 (0.395)	−0.006 (0.540)	0.003 (0.276)	−0.009 (0.641)	−0.009 (0.455)
Run-up	−0.102*** (13.661)	−0.055*** (13.856)	−0.055*** (13.827)	−0.055*** (13.838)	−0.055*** (13.990)	−0.054*** (13.208)	−0.052*** (12.120)	−0.049*** (7.484)
Cross-border	−0.007*** (4.104)	−0.006*** (5.571)	−0.006*** (5.576)	−0.006*** (5.568)	−0.006*** (5.514)	−0.006*** (5.163)	−0.006*** (5.415)	−0.004** (2.333)
Same industry	−0.008*** (4.640)	−0.003*** (3.011)	−0.003*** (3.004)	−0.003*** (3.014)	−0.003*** (2.896)	−0.003*** (2.958)	−0.003** (2.558)	−0.005*** (2.956)
Manufacturing industry	−0.035** (2.195)	0.014 (1.223)	0.014 (1.225)	0.014 (1.169)	0.018 (1.554)	0.018 (1.526)	0.016 (1.346)	0.064* (1.782)
Technological industry	−0.039*** (2.577)	0.007 (0.625)	0.007 (0.677)	0.007 (0.641)	0.008 (0.831)	0.007 (0.694)	0.009 (0.845)	0.013 (0.594)
Target status	0.001 (0.466)	0.000 (0.359)	0.000 (0.346)	0.000 (0.338)	0.000 (0.422)	0.001 (0.747)	0.000 (0.447)	0.000 (0.232)
Payment method	−0.003 (1.126)	−0.001 (0.531)	−0.001 (0.518)	−0.001 (0.522)	−0.001 (0.499)	−0.001 (0.708)	−0.001 (0.838)	−0.002 (1.106)
Relative deal size	−0.377 (0.794)	0.105 (0.426)	0.103 (0.416)	0.102 (0.410)	0.104 (0.420)	0.092 (0.391)	0.245 (1.121)	−0.795 (0.776)
GDP growth	0.000 (0.269)	0.000 (0.544)	0.000 (0.565)	0.000 (0.538)	0.000 (0.495)	0.000 (0.261)	0.000 (0.448)	0.000 (0.713)
GDP per capita	−0.011 (0.994)	−0.015** (1.995)	−0.015** (1.982)	−0.015** (2.002)	−0.015** (1.988)	−0.017** (2.235)	−0.015** (1.994)	−0.003 (0.358)
Regulatory efficiency	0.000	0.000	0.000	0.000	0.000			

TABLE 6 (Continued)

Variables	21-day CARs	Tercile	Quartile	Quintile	PCA	Excl. 2016	Excl. computer software	Excl. US
	(0.747)	(0.115)	(0.140)	(0.109)	(0.102)	0.000	0.000	0.000
Financial development	0.117***	0.090***	0.090***	0.090***	0.090***	(0.264)	(0.027)	(0.318)
	(3.240)	(3.644)	(3.623)	(3.631)	(3.669)	0.097***	0.098***	0.104***
Constant	0.115	0.106	0.106	0.109	0.094	(3.870)	(3.859)	(3.530)
	(0.972)	(1.428)	(1.431)	(1.461)	(1.259)	0.122	0.111	−0.070
N	8336	8336	8336	8336	8336	7741	7335	3389
R^2	0.104	0.092	0.093	0.093	0.094	0.093	0.093	0.151
Year, industry, country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

make sure that our results are not driven by the measurement choices. As a second average score, we also conduct principal component analysis (PCA) and compute environmental innovation scores based on the three kinds of environmental innovation (product, process, and organizational). Our results are still persistent with all these alternative specifications of environmental innovation, as shown in columns 2–5 of Table 6.

Further, descriptive statistics in Table 2 reveal the dominant year (2016), industry (computer software), and country (the United States) in our M&A sample. To ensure that our results are not driven by these dominant factors, we drop all deals from the dominant year, industry and country. We re-estimate Equation (1) for sub-samples in separate regressions, and our results hold after these exclusions as shown in columns 6–8 of Table 6.

5 | DISCUSSION AND CONCLUSION

5.1 | Summary

We examine the effect of the acquirer's pre-deal environmental innovation on M&A value-creation captured by CARs around the announcement date. Our results show that a higher level of environmental innovation positively affects acquirer returns, suggesting that innovative acquirers can transfer their environmentally innovative resources to targets, and this transfer is not possible for non-innovative counterparts. We also find that three individual environmental innovation dimensions—product, process, and organizational innovation—have a similar effect on acquirer returns, thus highlighting the value of each of these forms of environmental innovation. The positive effect of the bidder's environmental innovation on returns is clearly related to other studies in the realm of resource transferability in takeovers (Capron & Pistre, 2002; King et al., 2008; Riikka & Vaara, 2010; Testoni, 2022). For instance, using survey data, Capron and Pistre (2002) show that acquirers earn higher (lower) returns when they export (import) their product innovation, marketing, and managerial resources to targets. Our work directly extends Capron and Pistre (2002) by exploring other forms of innovation, including process and organizational innovation, and by using a substantially larger dataset with more objective data. Further, (King et al., 2008) find that the complementarity in marketing and technology resources between merging firms leads to the generation of relatively higher abnormal returns in M&As. Contrary to King et al. (2008), our work emphasizes the importance of acquirer resource superiority and how value creation results from the transfer of resources from the acquirer to the target. Testoni (2022) argues that valuable technology resources are acquired through takeovers to realize financial gains. Overall, our study extends this strand of literature by showing that environmental innovation (including product, process, and organizational) is also an important firm resource that derives takeover value through the transferability channel.

Furthermore, some studies (Alexandridis et al., 2010; Hussain et al., 2022; Shams & Gunasekarage, 2019) find that acquirers earn positive returns if they have superior bargaining power. For example, Hussain et al. (2022) find that powerful acquirers pay lower premiums and earn higher returns, suggesting that such acquirers have a competitive advantage and bargain on better terms. Also, Alexandridis et al. (2010) and Shams and Gunasekarage (2019) find that acquirers from non-competitive industries earn positive returns due to their better bargaining ability. Collectively, these studies highlight the importance of bargaining ability in the takeover market. Our findings suggest that acquirers with environmental innovation resources have a competitive advantage and potentially higher bargaining power, as evidenced by the lower premiums they systematically pay. Consequently, we enhance the understanding and importance of bargaining ability in creating takeover value and argue that environmental innovation being a critical firm resource provides a competitive advantage and enables firms to bargain on better terms.

5.2 | Theoretical contributions

This study provides evidence that environmental innovation (as a resource or capability) enhances the performance of acquiring firms in the international takeover market. In doing so, our work contributes to the RBV by introducing environmental innovation as an important resource that is transferable from the acquirer to the target (Capron & Pistre, 2002; King et al., 2008; Testoni, 2022). Our work partly addresses the question of how firms can benefit from superior environmental innovation capabilities or excess environmental innovation

resources. We identify the market for corporate control (M&As) as an important channel for redeploying or monetizing excess environmental innovation capacity. Consistent with King et al. (2008), our results emphasize the importance of understanding the complex dynamics between environmental innovation capabilities of acquirers and targets and how this shapes M&A outcomes. While gaining access to the target's unique resource base is frequently touted as a motive for acquisitions, our results suggest that this may partly explain the systematic underperformance of acquirers in takeover deals. Rather, acquirers create value from deals when they transfer their own resources to their targets.

Further, to better understand the role of environmental resources, we point out the boundary condition that magnifies the transferability of environmental resources in M&As, which eventually affects acquirer returns. Notably, our results on the moderating role of the environmental resource gap between bidders and targets contribute to RBV by showing that the transferability effect is not similar across all M&A deals (Ellis et al., 2017; Hussain & Loureiro, 2022; Hussain & Shams, 2022; Martynova & Renneboog, 2008). Actually, we identify the unique role of the environmental innovation gap as a contingency factor that shapes the association between environmental innovation and acquirer returns. This contingency perspective assists us in understanding the condition under which environmentally innovative acquirers can easily transfer their innovative resources. In doing so, we respond to Tampakoudis and Anagnostopoulou (2020) and Chen et al. (2014) who call for more work around contingency factors when exploring the impact of environmental innovation.

RBV suggests that resources are critical in achieving a competitive advantage (Chen et al., 2014; Desarbo et al., 2005; Lockett et al., 2009; Makadok, 2001; Peteraf, 1993; Rahman et al., 2023). Our results on takeover premiums further support this perspective by showing that environmentally innovative acquirers can purchase targets at relatively lower prices. We argue that this is so because acquirers with higher environmental innovation resources have better bargaining power and can secure better transaction terms, leading to improved realized takeover gains (Hussain & Shams, 2022; Tampakoudis & Anagnostopoulou, 2020). This view is supported by our finding that environmentally innovative acquirers are more likely to pursue deals that lead to majority ownership as well as cross-border deals—deal features that allow them to transfer their resources to their targets more easily.

5.3 | Implications for managers

This study has several implications for managers. Our evidence suggests that environmentally innovative bidders outperform their less innovative counterparts in the takeover market. For prospective bidders, this implies that investment in environmental innovation (whether process, product, or organizational) is critical in ensuring future M&A success, whether measured by acquisition returns, acquisition premiums, bargaining power, or acquisition choices. Our evidence suggests that organizational innovation may have a stronger impact than other types of environmental innovation. Hence, managers should prioritize investment in organizational innovation initiatives.

Importantly, our evidence shows how managers can extract rent from excess innovation capacity by sharing with or transferring to other firms through M&A engagements. This is particularly important for firms that have built substantive or excess environmental innovation capacity over time and need to reorganize, redeploy, and extract value from this capability. Managers should recognize that environmental innovation is a critical asset that is tradeable in strategic factor markets.

Our work provides evidence that the selection of targets with low innovation capabilities is important for acquirers seeking to derive synergies through the redeployment of their excess innovation capability. Specifically, we show that the source of value creation in deals by environmentally innovative acquirers was their ability to transfer excess capacity to less innovative targets. Acquiring managers through their pre-merger due diligence should prioritize targets with low environmental innovation capabilities as this creates opportunities for synergy creation in M&As.

For firms with limited innovation capacity, our evidence suggests that innovation capacity can be enhanced by soliciting takeover deals from highly environmentally innovative firms. Therefore, managers seeking to enhance their firm's environmental innovation capabilities may seek alliances with firms that have developed these capabilities.

5.4 | Implications for policymakers

Our results also provide important insights for policymakers on how an international takeover market can be seen as a channel for enhancing environmental innovation across firms. This is in addition to existing mechanisms such as carbon markets (e.g., the European Union's Emission Trading Scheme). Our evidence suggests that takeovers could be an effective market-based mechanism for enhancing environmental innovation as firms with excess environmental innovation can extract additional rents and create value from this by sharing or transferring it to their less innovative counterparts. The importance of this mechanism cannot be overemphasized, given the high number of M&A deals that take place across different countries in different years. It is, therefore, important for policymakers to emphasize the adequate measurement and disclosure levels of environmental innovation across firms to improve information flow and, hence, the effectiveness of this particular market.

5.5 | Limitations and future research

The study is subject to some limitations that open avenues for further work in the area of environmental innovation and strategy. First, this study uses secondary data that does not allow us to obtain information about private acquirers. Meanwhile, a large proportion of M&A deals involve private firms either as acquirers or targets. Future

research on private targets using primary data could provide additional insights into the generalizability of our findings. A comparison between the environmental innovation of public and private targets and their effect on returns will extend the debate over environmental innovation.

Second, the results and implications are drawn from the sample of M&As. We caution against generalizations to other restructuring activities such as joint ventures and strategic alliances. Further work could extend our study and investigate the extent to which our results hold for other restructuring activities.

Finally, it is noteworthy that our work is a preliminary step toward the empirical examination of the impact of environmental innovation on M&A outcomes. We have focused on a limited set of outcomes, notably M&A returns and merger premiums. Scholars may examine the effect of environmental innovation on other takeover outcomes, including the probability of M&A deal completion, days required to complete the deal, governance performance, and the combined firm's value. This will allow new inferences to be drawn. Moreover, our study focuses on the real implementation of environmental innovation without paying attention to the antecedents of environmental innovation. This opens up opportunities for further exploration on whether firms engage in environmental innovation purposefully to eventually extract rent by sharing or transferring their excess innovation capacity or resources to other firms.

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APPENDIX A: VARIABLE DEFINITIONS

Variable	Description or definition
Panel A: Cumulative abnormal returns	
Acquirer CARs	3-day, 5-day, and 7-day cumulative abnormal returns for the period commencing 1, 2, and 3 days before the deal announcement and ending 1, 2, and 3 days after the deal completion, respectively. *Source*: DataStream
Panel B: Environmental innovation and categories	
Environmental innovation	"Reflects a company's capacity to reduce the environmental costs and burdens for its customers, and thereby creating new market opportunities through new environmental technologies and processes or eco-designed products." *Source*: ASSET4 ESG
Product innovation	Based on lagged average score of 11 variables that are defined in Appendix C. *Source*: ASEET4 ESG
Process innovation	Based on lagged average score of 9 variables that are defined in Appendix C. *Source*: ASSET4 ESG
Organization innovation	Based on lagged average score of 20 variables that are defined in Appendix C. *Source*: ASSET4 ESG
Panel C: Acquirer characteristics	
Country environment index	It is the average index based on 25 country environment dimensions (Appendix B) proposed by the World Bank. *Source*: World Bank
GDP growth	Annual growth in real GDP. *Source*: World Development Indicators
GDP per capita	Log of real GDP (current US dollars)/average population. *Source*: World Development Indicators
Regulatory efficiency	Overall and individual dimensions scores (minimum 1 to maximum 100). *Source*: data.imf.org
Financial development	A binary variable with values of 0 (minimum) or 1 (maximum). Source: www.heritage.org
Panel D: Firm characteristics	
CSR	Percentage score on firm's CSR performance. *Source*: ASSET4 ESG
Leverage	Ratio of long-term debt to total assets. *Source*: WorldScope
Firm size	Natural logarithm of total assets. *Source*: WorldScope
Tobin's *q*	Sum of equity's market value and debt's book value, divided by asset's book value. *Source*: WorldScope
Profitability	Ratio of EBIT to capital employed. *Source*: WorldScope
Book to market	Ratio of equity's book value to market value. *Source*: WorldScope.
Sales growth	Percentage change in sales from previous to current year. *Source*: WorldScope
Liquidity	Ratio of short-term investments and cash to total assets. *Source*: WorldScope
Cash flow	Operational cash flows minus capital expenditures scaled by total assets. *Source*: WorldScope
Panel E: Deal characteristics	
Run-up	The sum of abnormal returns using the market model for a window of 90 days up to 20 days before deal announcement. *Source*: DataStream
Cross-border	Binary variable: 1 for cross border deal and 0 otherwise. *Source*: Securities Data Corporation (SDC)
Same industry	Binary variable: 1 for deals where the acquirer and target share same Fama–French 48 industrial category and 0 otherwise. *Source*: SDC
Manufacturing industry	Binary variable: 1 for deals where the acquirer belongs to manufacturing industry of Fama–French 48 industrial category and 0 otherwise. *Source*: SDC
Technological industry	Binary variable: 1 for deals where the acquirer belongs to technological industry of Fama–French 48 industrial category and 0 otherwise. *Source*: SDC
Target status	Binary variable: I for private target and 0 otherwise. *Source*: SDC
Payment method	Binary variable: 1 for the purely stock-financed deal and 0 otherwise. *Source*: SDC
Relative deal size	Deal value scaled by the acquirer's market value of equity. *Source*: World Scope and SDC
Premium (1 day)	Ratio of acquirer's offer price to target's stock price 1 day before the deal announcement. *Source*: SDC
Premium (1 week)	Ratio of acquirer's offer price to target's stock price 1 week before the deal announcement. *Source*: SDC
Premium (4 weeks)	Ratio of acquirer's offer price to target's stock price 1 day before the deal announcement. *Source*: SDC

APPENDIX B: COUNTRY-LEVEL ENVIRONMENTAL INNOVATION

Variable	Description or definition
1. Natural resources depletion	Sum of forest, energy, and mineral depletion
2. Net forest depletion	Product of unit resource rents and the excess of roundwood harvest over natural growth
3. Agricultural land	Share of the land area that is arable
4. Agriculture, forestry, and fishing	Agriculture, forestry, and fishing corresponds to ISIC divisions 1–3 and includes forestry, hunting, and fishing
5. Annual freshwater withdrawals	Annual freshwater withdrawals refer to total water withdrawals, not counting evaporation losses from storage basins
6. CO_2 emissions	Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement
7. Cooling degree days	It is the number of degrees that a day's average temperature is above 18°C
8. Droughts, floods, extreme temperatures	Annual average percentage of the population that is affected by natural disasters
9. Electricity production from coal sources	Inputs used to generate electricity
10. Energy imports	Net energy imports are estimated as energy use less production, both measured in oil equivalents
11. Energy intensity level of primary energy	Ratio between energy supply and gross domestic product measured at purchasing power parity
12. Energy use	Use of primary energy before transformation to other end-use fuels
13. Food production index	Covers food crops that are considered edible and that contain nutrients
14. Forest area	Land under natural or planted stands of trees
15. Fossil fuel energy consumption	Fossil fuel comprises coal, oil, petroleum, and natural gas products
16. GHG net emissions	Changes in atmospheric levels of all greenhouse gases
17. Heat Index 35	Total count of days per year where the daily mean heat index rose above 35°C
18. Mammal species, threatened	Number of species classified by the IUCN as endangered and vulnerable
19. Maximum 5-day rainfall, 25-year return level	Maximum precipitation sum over any 5-day period that can be expected once in an average 25-year period
20. Mean Drought Index	The Standardized Precipitation Evapotranspiration Index (SPEI), or Mean Drought Index
21. Methane emissions	Those stemming from human activities such as agriculture and from industrial methane production
22. Nitrous oxide emissions	Emissions from agricultural biomass burning, industrial activities, and livestock management
23. PM2.5 air pollution, mean annual exposure	Average level of exposure of a nation's population to concentrations of suspended particles
24. Population density	Midyear population divided by land area in square kilometers
25. Renewable electricity output	Share of electricity generated by renewable power plants in total electricity generated by all types of plants

APPENDIX C: FIRM-LEVEL ENVIRONMENTAL INNOVATION

Innovation attributes	Definition	Assigned category
1. ESG assets under management	Total amount of assets under management (AUM) according to an ESG criteria or ESG investment strategy as reported by the company	Organization innovation
2. Fossil fuel divestment policy	Does the financial company have a public commitment to divest from fossil fuel?	Organization innovation
3. Percentage of green products	Percentage of green products or services as reported by the company	Product innovation
4. Products recovered to recycle	Total weight of end-of-life products recovered as take back initiative to recycle or refurbish in tons	Product innovation
5. Revenue from environmental products	Percentage of revenue from environmental products and services offered by the company	Product innovation
6. Agrochemical 5% revenue	Are the revenues generated by the company from agrochemicals like pesticides, fungicides, or herbicides 5% or more of company sales?	Organization innovation
7. Agrochemical products	Does the company produce or distribute agrochemicals like pesticides, fungicides, or herbicides?	Product innovation
8. Animal testing	Is the company directly or indirectly involved in animal testing?	Process innovation
9. Animal testing cosmetics	Is the company directly or indirectly involved in animal testing for cosmetics?	Process innovation
10. Animal testing reduction	Has the company established a program or an initiative to reduce, phase out, or substitute for animal testing?	Process innovation
11. Eco-design products	Does the company report on specific products that are designed for reuse, recycling, or the reduction of environmental impacts?	Product innovation
12. Env R&D expenditures To revenues in millions	Total amount of environmental R&D costs (without clean up and remediation costs) divided by net sales or revenue in millions	Organization innovation
13. Environmental assets under mgt	Does the company report on assets under management that employ environmental screening criteria or environmental factors in the investment selection process?	Organization innovation
14. Environmental products	Does the company report on at least one product line or service that is designed to have positive effects on the environment or that is environmentally labeled and marketed?	Product innovation
15. Environmental project financing	Does the company claim to evaluate projects on the basis of environmental or biodiversity risks as well?	Organization innovation
16. Environmental R&D expenditures	Total amount of environmental R&D costs (without clean up and remediation costs)	Organization innovation
17. Equator principles	Is the company a signatory of the equator principles (commitment to manage environmental issues in project financing)?	Organization innovation
18. Equator principles or env project financing	Is the company a signatory of the equator principles (commitment to manage environmental issues in project financing), or does it claim to evaluate projects on the basis of environmental or biodiversity risks as well?	Organization innovation
19. Fleet CO_2 emissions	Total fleet's average CO_2 and CO_2 equivalent emissions in g/km	Process innovation
20. Fleet fuel consumption	Total fleet's average fuel consumption in L/100 km	Process innovation
21. GMO products	Does the company produce or distribute genetically modified organisms (GMO) or seeds?	Product innovation
22. Hybrid vehicles	Is the company developing hybrid vehicles?	Organization innovation
23. Labeled Wood	Does the company claim to produce, source, or distribute wood or forest products that are labeled (e.g., Forest Stewardship Council [FSC])?	Organization innovation
24. Labeled wood percentage	The percentage of labeled wood or forest products (e.g., Forest Stewardship Council [FSC]) from total wood or forest products	Process innovation
	Does the company develop new products that are marketed as reducing noise emissions?	

Innovation attributes	Definition	Assigned category
25. Noise reduction	Does the company develop new products that are marketed as reducing noise emissions?	Process innovation
26. Nuclear	Does the company construct nuclear reactors or produce nuclear energy or is active in another way in the nuclear energy industry?	Organization innovation
27. Nuclear production	Percentage of total energy production from nuclear energy.	Process innovation
28. Organic products initiatives	Does the company report or show initiatives to produce or promote organic food or other products?	Organization innovation
29. Product environmental responsible use	Does the company report about product features and applications or services that will promote responsible, efficient, cost-effective, and environmentally preferable use?	Product innovation
30. Product impact minimization	Does the company reports about take-back procedures and recycling programs to reduce the potential risks of products entering the environment, or does the company report about product features or services that will promote responsible and environmentally preferable use?	Product innovation
31. Real estate sustainability certifications	Does the company claim to lease, rent, or market buildings that are certified by BREEAM, LEED, or any other nationally recognized real estate certification?	Organization innovation
32. Renewable energy supply	Total energy distributed or produced from renewable energy sources divided by the total energy distributed or produced	Organization innovation
33. Renewable/clean energy products	Does the company develop products or technologies for use in the clean, renewable energy (such as wind, solar, hydrothermal and geothermal, and biomass power)?	Product innovation
34. Sustainable building products	Does the company develop products and services that improve the energy efficiency of buildings?	Product innovation
35. Take-back and recycling initiatives	Does the company reports about take-back procedures and recycling programs to reduce the potential risks of products entering the environment?	Organization innovation
36. Water technologies	Does the company develop products or technologies that are used for water treatment or purification or that improve water use efficiency?	Process innovation

APPENDIX D: CORRELATION MATRIX

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	VIF
1. 3-day CARs	1.00											
2. 5-day CARs	0.81	1.00										
3. 7-day CARs	0.71	0.87	1.00									
4. Environmental innovation	0.02	0.04	0.05	1.00								1.38
5. Product innovation	0.05	0.06	0.06	−0.02	1.00							1.06
6. Process innovation	0.06	0.07	0.07	0.06	0.93	1.00						1.36
7. Organizational innovation	0.02	0.02	0.02	−0.02	−0.01	−0.02	1.00					1.01
8. Country environment index	0.02	0.02	0.02	0.20	−0.40	−0.31	−0.01	1.00				1.38
9. CSR	−0.05	−0.03	−0.02	0.42	−0.01	0.02	−0.01	0.11	1.00			1.68
10. Leverage	0.01	0.01	0.00	0.06	−0.20	−0.17	−0.01	0.17	0.02	1.00		1.15
11. Firm size	−0.07	−0.05	−0.04	0.33	0.17	0.16	0.02	−0.07	0.57	0.08	1.00	1.84
12. Tobin's q	0.00	0.00	0.00	−0.07	0.17	0.14	0.00	−0.15	−0.08	−0.17	−0.15	1.57
13. Profitability	−0.03	−0.01	0.01	0.03	−0.07	−0.04	0.00	0.09	0.08	0.06	0.13	1.08
14. Book to market	0.02	0.03	0.04	0.01	−0.08	−0.07	0.01	0.16	0.04	−0.03	0.07	1.26
15. Sales growth	0.03	0.02	0.03	−0.16	0.05	0.05	0.01	−0.05	−0.11	−0.05	−0.17	1.09
16. Liquidity	0.03	0.02	0.02	−0.01	0.04	0.06	−0.01	−0.05	−0.09	−0.19	−0.28	1.31
17. Cash flow	0.00	−0.01	0.00	0.03	0.20	0.20	0.01	−0.22	0.01	−0.23	−0.01	1.58
18. Run-up	−0.21	−0.21	−0.21	−0.03	0.00	0.00	0.00	−0.01	−0.01	0.01	0.00	1.01
19. Cross-border	−0.08	−0.07	−0.06	0.11	−0.04	−0.04	0.00	0.16	0.11	0.01	0.04	1.05
20. Same industry	−0.05	−0.05	−0.04	−0.05	−0.02	−0.01	0.00	−0.02	−0.02	−0.02	−0.08	1.02
21. Target status	0.00	0.01	0.02	0.03	−0.04	−0.03	0.02	−0.03	−0.09	−0.05	−0.12	1.12
22. Payment method	0.01	0.00	−0.01	−0.06	0.01	0.00	−0.01	−0.04	−0.02	−0.01	−0.04	1.04
23. Relative deal size	0.02	0.01	0.01	0.02	0.03	0.03	0.00	−0.07	−0.02	−0.09	−0.05	1.17
	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
12. (Tobin's q	1.00											
13. Profitability	−0.10	1.00										
14. Book to market	−0.37	0.09	1.00									
15. Sales growth	0.08	−0.07	0.03	1.00								
16. Liquidity	0.35	−0.11	−0.18	0.04	1.00							
17. Cash flow	0.48	0.02	−0.33	−0.09	0.29	1.00						
18. Run-up	0.03	0.01	0.00	−0.01	−0.04	−0.04	1.00					
19. Cross-border	−0.08	0.03	0.05	−0.04	−0.03	−0.08	0.03	1.00				
20. Same industry	0.04	−0.03	0.01	0.04	0.07	0.02	0.04	0.05	1.00			
21. Target status	0.04	−0.02	−0.10	−0.05	0.06	0.12	−0.01	0.02	−0.05	1.00		
22. Payment method	−0.01	−0.06	0.02	0.05	0.02	−0.03	0.01	−0.04	0.02	−0.15	1.00	
23. Relative deal size	0.23	−0.14	−0.19	0.06	0.12	0.26	−0.01	−0.01	0.03	0.19	−0.10	1.00

APPENDIX E: CONTROLLING FOR INDIVIDUAL DIMENSIONS OF REGULATORY EFFICIENCY

Variables	CAR(−3,+3) (1)	CAR(−3,+3) (2)	CAR(−3,+3) (3)	CAR(−3,+3) (4)	CAR(−3,+3) (5)	CAR(−3,+3) (6)
High environmental innovation	0.004*** (4.062)	0.004*** (4.060)	0.004*** (4.073)	0.004*** (4.069)	0.004*** (4.071)	0.004*** (4.072)
Country environment index	0.000*** (5.429)	0.000*** (5.422)	0.000*** (5.363)	0.000*** (5.275)	0.000*** (5.505)	0.000*** (5.344)
Business freedom	0.000 (1.101)					
Labor freedom		0.000 (1.453)				
Monetary freedom			0.000 (0.672)			
Trade freedom				0.000 (0.401)		
Investment freedom					0.000 (1.028)	
Financial freedom						0.000 (0.464)
CSR	0.000 (1.266)	0.000 (1.288)	0.000 (1.260)	0.000 (1.266)	0.000 (1.245)	0.000 (1.253)
Leverage	0.003 (0.812)	0.003 (0.788)	0.003 (0.803)	0.003 (0.818)	0.003 (0.798)	0.003 (0.808)
Firm size	−0.002*** (4.053)	−0.002*** (4.042)	−0.002*** (4.044)	−0.002*** (4.040)	−0.002*** (4.064)	−0.002*** (4.032)
Tobin's Q	0.000 (0.218)	0.000 (0.197)	0.000 (0.208)	0.000 (0.210)	0.000 (0.185)	0.000 (0.214)
Profitability	−0.004 (1.045)	−0.004 (1.063)	−0.004 (1.053)	−0.004 (1.057)	−0.004 (1.057)	−0.004 (1.061)
Book to market	0.003*** (2.721)	0.003*** (2.740)	0.003*** (2.730)	0.003*** (2.723)	0.003*** (2.711)	0.003*** (2.714)
Sales growth	0.002 (0.510)	0.002 (0.512)	0.001 (0.501)	0.001 (0.500)	0.001 (0.497)	0.001 (0.500)
Liquidity	0.001 (0.195)	0.001 (0.206)	0.001 (0.193)	0.001 (0.200)	0.001 (0.207)	0.001 (0.204)
Cash flow	−0.002 (0.202)	−0.001 (0.164)	−0.002 (0.198)	−0.002 (0.188)	−0.002 (0.224)	−0.002 (0.188)
Run-up	−0.038*** (14.295)	−0.038*** (14.286)	−0.038*** (14.302)	−0.038*** (14.307)	−0.038*** (14.301)	−0.038*** (14.307)
Cross-border	−0.005*** (7.485)	−0.005*** (7.487)	−0.005*** (7.500)	−0.005*** (7.514)	−0.005*** (7.493)	−0.005*** (7.511)
Same industry	−0.004*** (4.473)	−0.004*** (4.452)	−0.004*** (4.489)	−0.004*** (4.492)	−0.004*** (4.497)	−0.004*** (4.495)
Manufacturing industry	0.011 (1.254)	0.011 (1.254)	0.011 (1.248)	0.011 (1.243)	0.011 (1.237)	0.011 (1.231)
Technological industry	0.014* (1.952)	0.014* (1.942)	0.014* (1.937)	0.014* (1.930)	0.014* (1.922)	0.014* (1.911)
Target status	−0.001 (1.344)	−0.001 (1.354)	−0.001 (1.335)	−0.001 (1.338)	−0.001 (1.341)	−0.001 (1.338)
Payment method	0.001 (0.617)	0.001 (0.591)	0.001 (0.612)	0.001 (0.602)	0.001 (0.598)	0.001 (0.593)
Relative deal size	0.352* (1.660)	0.342 (1.590)	0.352* (1.654)	0.351* (1.650)	0.351* (1.645)	0.351 (1.642)

(Continues)

Variables	CAR(−3,+3) (1)	CAR(−3,+3) (2)	CAR(−3,+3) (3)	CAR(−3,+3) (4)	CAR(−3,+3) (5)	CAR(−3,+3) (6)
GDP growth	0.000 (0.534)	0.000 (0.150)	0.000 (0.632)	0.000 (0.573)	0.000 (0.845)	0.000 (0.648)
GDP per capita	−0.008 (1.456)	−0.008 (1.500)	−0.008 (1.445)	−0.008 (1.560)	−0.008 (1.516)	−0.008 (1.598)
Financial development	0.047*** (2.890)	0.048*** (2.938)	0.046*** (2.752)	0.046*** (2.792)	0.045*** (2.761)	0.046*** (2.822)
Constant	0.074 (1.394)	0.073 (1.381)	0.073 (1.378)	0.076 (1.443)	0.077 (1.447)	0.078 (1.466)
N	8336	8336	8336	8336	8336	8336
R^2	0.100	0.101	0.100	0.100	0.100	0.100
Year, industry, country FE	Yes	Yes	Yes	Yes	Yes	Yes