

Acquirer Carbon Risk and M&A Performance: Evidence from China

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Article History

Received: 16.08.2023

Accepted: 19.09.2023

Published: 21.09.2023

Abstract: This paper selects a sample of cross-border M&A events by Chinese acquirers over the period 2000-2021 and uses a multiple regression model to investigate the relationship between acquirer's carbon risk and M&A performance. On the one hand, it explores whether the acquirer's carbon risk promotes M&A performance and whether the selection of other developing economies as host countries by Chinese acquirers can strengthen the above relationship. On the other hand, the impact of changes in post-merger carbon risk on M&A performance is explored. The results show that: (1) The higher the acquirer's carbon risk the better the post-merger performance, but this relationship is not strengthened by the choice of other developing economies as the host country. (2) For acquirers with high initial carbon risk, their M&A performance increases if the post-merger firm reduces its carbon risk by practicing CSR, etc.; for acquirers with low initial carbon risk, there is no significant relationship between M&A performance and the change in carbon risk. Our findings contribute to further understanding of the impact of acquirers' carbon risk on M&A performance.

Keywords: Carbon risk, Cross-border M&A, M&A performance, corporate social responsibility.

1. INTRODUCTION

With the rapid development of economic globalization and the optimization of market resources, international exchanges of capital, services and people are becoming closer and closer, and the global economy is beginning to develop in depth. As the world's largest developing country, China's overseas direct investment is increasing year by year, and the "China Corporate M&A Market Review and Outlook 2021" published by PricewaterhouseCoopers 2022 shows that the number of M&A deals in China hits a record high in 2021, increasing by 21% from 2020, and China accounts for approximately 20% and 13% of the global M&A market in terms of deal volume and deal value, and China is deeply integrated into the global economy (Liu *et al.*, 2021).

In the past few decades, the booming global economy has led to an increase in greenhouse gas emissions and problems such as global warming (Phan *et al.*, 2022), which has caused concern among society and environmental experts (Jung *et al.*, 2018). Therefore, in 2016, the United Nations introduced the Paris Agreement, the second legally binding climate agreement under the United Nations Framework Convention on Climate Change, an agreement that brings member states to a consensus on environmental protection and places certain limits on their carbon emissions. China, as a responsible power, has taken the initiative to take responsibility for protecting the environment. In 2021, the State Council of China issued the "Opinions on Fully Implementing the New Development Concept and Achieving Carbon Peak and Carbon Neutrality" with the aim of reducing carbon dioxide emissions.

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CITATION: Jianquan Guo, Qi Hua, Junyang Ma (2023). Acquirer Carbon Risk and M&A Performance: Evidence from China. *South Asian Res J Human Soc Sci*, 5(5): 165-178.

In this background, highly polluting firms need to bear higher cleaning costs (Eccles *et al.*, 2011), higher interest rates on loans (Palea and Drogo, 2020), and higher reputational risks (Bose *et al.*, 2021). Based on this, Chinese firms need to effectively reduce their carbon emission levels, but reducing carbon risk is not simple for firms; some firms reduce carbon emissions by improving technology or increasing investment in environmental protection (Boiral *et al.*, 2012), but require higher investment costs (Choi *et al.*, 2022). However, not all countries have such strict requirements on environmental protection (Wen and Zhou, 2014). Therefore, firms that are unwilling or unable to bear the higher cost of investment protection prefer to choose countries with lower environmental regulations for cross-border M&A activities to avoid the high environmental protection costs in their home countries (Bose *et al.*, 2021; Choi, 2022).

In summary, this paper takes a sample of 539 cross-border M&A transactions of Chinese listed firms from 2000 - 2021. We first explore whether the acquirer's carbon risk promotes M&A performance and whether the selection of other developing economies as host countries by Chinese acquirers strengthens the above relationship. Second, we analyze the relationship between changes in post-merger carbon risk of acquirers with different initial carbon risks and M&A performance. This is used to investigate whether firms practicing corporate social responsibility in their M&A activities can achieve higher M&A performance.

The rest of the paper is organized as follows: section 2 presents Literature review and hypotheses, section 3 presents the sample data and model, section 4 presents the analysis of the empirical results, section 5 presents the robustness tests, and section 6 concludes.

2. LITERATURE REVIEW AND HYPOTHESES

2.1 Carbon Emissions and Cross-Border M&A

With the development of economic globalization, cross-border M&A has become an important means for enterprises to expand their production scale, acquire strategic resources, and increase their market share to realize their global strategies (Guo and Cheng, 2023). As a result, more and more scholars are focusing on cross-border M&A activities. Previous scholars have confirmed that M&A performance is related to factors such as host country governance capacity, industry relevance, and target transparency (Bhagat *et al.*, 2011; Liu *et al.*, 2021; Guo and Chen, 2022). In recent years, due to technological advancements and improvements in the quality of education, the public and governments have been paying increasing attention to environmental issues (Chandrika *et al.*, 2023). Some scholars have further analyzed the impact of environmental issues on M&A activities. Chandrika *et al.*, (2022) confirms that home country CO₂ emissions act as a deterrent to cross-border M&A by MNCs in developing countries. Yoon and Heshmati. (2021) showed that host country environmental regulations can prevent highly polluting firms from entering the country by means of cross-border M&A. Pollution haven hypothesis (PHH) argues that the operating costs of high polluting firms increase when the home country deals with environmental pollution by enacting stringent laws and regulations. Bose *et al.*, (2021) suggest that high carbon risk firms are more likely to engage in cross-border mergers and acquisitions rather than opting for domestic mergers and acquisitions to avoid stringent environmental standards in their home countries. Therefore, companies are more inclined to transfer high-pollution production processes to host countries with weaker regulations through cross-border mergers and acquisitions in order to reduce risks (Singhania and Saini., 2021). Firms can extend the life cycle of their original industries to some extent by transferring highly polluting production processes to countries with lower environmental regulations (e.g., developing countries) through cross-border M&A. In addition, the low labor costs and huge markets can bring them profits and obtain positive short-term returns (Liu *et al.*, 2021; Coccia, 2019).

Most of the existing literature examining the impact of firms' pollution intensity on M&A performance still examines the relationship between firms' carbon risk and M&A performance using firms in developed countries as acquirers, and some literature examines M&A performance using Chinese listed firms as acquirers, but it has not yet covered firms' carbon risk factors. Therefore, this study aims to fill this gap by examining the relationship between carbon risk and the performance of Chinese listed firms as acquirers. Based on this, we propose the following hypotheses:

Hypothesis 1: Acquirer's carbon risk is positively related to post-merger performance, where host countries being other developing economies will strengthen the above relationship.

2.2 Corporate Social Responsibility and Cross-Border M&A

In 2020, General Secretary Xi Jinping pointed out at a symposium for entrepreneurs that enterprises have both economic and legal responsibilities, as well as social and moral responsibilities. Corporate Social Responsibility (CSR) usually refers to corporate social activities that benefit stakeholders (i.e., suppliers, employers, society, and customers) (Zheng *et al.*, 2023). Stakeholder theory states that practicing CSR can help companies have a better reputation, access to scarce resources, as well as improve their ability to manage and avoid risks, further increasing stakeholder engagement (Elliott *et al.*, 2014; Gregory *et al.*, 2016). However, Friedman (1970) points out that unless the concerns of stakeholders other than the controlling owner of the firm will contribute to the long-term performance of the firm, the controlling owner and other stakeholders will disagree more on the decision of whether to practice CSR or not.

The study of CSR is important for cross-border M&A, which further analyzes the relationship between maximizing corporate shareholder value and practicing CSR (Bose *et al.*, 2021). Previous studies have pointed out that acquirers who practice CSR in M&A activities usually have a better business reputation, which reduces the negative impact of corporate pollution problems (Chakravarthy *et al.*, 2014) and contributes to the promotion of sustainable corporate development (Bénabou and Tirole, 2010). The role of CSR on M&A performance is more prominent especially when environmental issues are more serious (Godfrey *et al.*, 2009). Zheng *et al.*, (2023) demonstrate from an ESG perspective that the post-merger decline in performance of firms with better initial social responsibility performance has a negative impact on M&A performance.

In this paper, we explore the relationship between CSR and M&A performance by taking the reduction of carbon risk after M&A of initially high carbon risk firms as a reflection of CSR and the increase of carbon risk after M&A of initially low carbon risk firms as a reflection of the acquirer's neglect of CSR. Based on this, we propose the following hypotheses:

Hypothesis 2a: For acquirers with high initial carbon risk, the decrease in post-merger carbon risk is positively related to post-merger performance.

Hypothesis 2b: Acquirers with low initial carbon risk, the increase in post-merger carbon risk is negatively related to post-merger performance.

3. DATA AND METHODS

3.1 Variables

3.1.1 Measurement of M&A Performance

We refer to the approach of (Zheng *et al.*, 2023) using two types of metrics to represent post-merger performance. One is the stock market metric, represented by one-year buy-and-hold abnormal returns (BHARs). The calculation is as follows:

$$BHAR_s = \prod_{t=0}^{s+T} (1 + R_{i,t}) - \prod_{t=0}^{s+T} (1 + R_{m,t}) \quad (1)$$

where i , t , and T are the index acquirer, the month of the deal announcement, and the holding period, respectively. $R_{i,t}$ is the simple return of acquirer i , and $R_{m,t}$ is the return of the market portfolio. The event window period is 12 months after the M&A announcement.

Another indicator relates to post-merger accounting-based performance. This paper draws on the approach of Zheng *et al.*, (2023) using the ratio of assets to the book value of assets one year after the acquisition, i.e., return on equity (ROA), to measure the acquirer's profitability.

3.1.2 Measurement of Acquirer Carbon Risk

In this paper, we refer to the method of Wang *et al.*, (2022), which uses the natural logarithm of the acquirer's fossil energy combustion emissions to measure the acquirer's carbon risk, which is manually compiled from the social responsibility reports, sustainability reports, and environmental reports disclosed by the companies annually. In addition, according to the Ministry of Ecology and Environment of the People's Republic of China in 2021 *Measures for the Administration of Carbon Emission Trading (for Trial Implementation)* states that enterprises with annual GHG emissions reaching 26,000 tons of carbon dioxide equivalent should be included in the list of key GHG emitters. Therefore, this paper treats enterprises with annual fossil fuel emissions exceeding 26,000 tons as high carbon risk enterprises, and enterprises with annual fossil fuel emission release less than 26,000 tons as low carbon risk enterprises.

We also set two main variables, *Increase* and *Reduce*, to represent the change in the acquirer's carbon risk after the merger. The carbon risk increase is a dummy variable that is 1 if the acquirer's fossil energy combustion emissions increase in the year after the M&A and 0 otherwise; similarly, the carbon risk decrease is a dummy variable that is 1 if the acquirer's fossil energy combustion emissions decrease in the year after the M&A and 0 otherwise.

3.1.3 Control Variables

Our control variables in the regression analysis refer to the control variables considered by Guo and Cheng (2023) in their study of cross-border M&A. Such variables as firm size (*SIZE*), acquirer's cash holdings (*CASH*), and acquirer's share of independent directors (*BIND*), which have been shown to affect the firm's carbon risk and post-merger performance, were additionally selected to control for some of these variables. See Table 1 for the specific meanings of all variables.

Table 1: Definition of variables and data sources

Variable Name	Variable Definition	Data source
<i>BHAR_1year</i>	Abnormal returns on value-weighted market portfolios bought and held by the acquirer during the year following the month of the announcement.	CSMAR
<i>ROA_1year</i>	Return on assets of the acquirer for the year following the year of the merger	CSMAR
<i>LN_CE</i>	Natural logarithm of fossil energy combustion emissions of the acquirer firm in the year prior to the M&A announcement	Corporate Annual Report
<i>Increase</i>	Dummy variable that takes the value of 1 if the acquirer's carbon risk rises in the year following the year of the M&A announcement and 0 otherwise	Corporate Annual Report
<i>Reduce</i>	Dummy variable that takes the value of 1 if the acquirer's carbon risk decreases in the year following the year of the M&A announcement and 0 otherwise	Corporate Annual Report
<i>DC (Dummy)</i>	Dummy variable with a value of "1" when the M&A target is a firm from another developing country and "0" otherwise	UNCTAD
<i>D_GDP</i>	The difference between the GDP growth rate of the home country (China) and the host country during the year	WDI Database
<i>BIND</i>	Ratio of the number of independent directors to the size of the board in the year	CSMAR
<i>AGE</i>	Length of establishment of the acquirer's business	CSMAR
<i>GD</i>	Natural logarithm of the distance (in kilometers) between the capital of the home country and the capital of the host country (China), Beijing	CEPII
<i>CD</i>	Establishing a composite indicator from Hofstede's five dimensions of national culture: power distance, individualism, masculinity, uncertainty avoidance, and long-term tendency	Hofstede Cultural Dimensions Website
<i>A_LAW (Dummy)</i>	Dummy variable, whether the host country is a country using civil law, if yes, "1", otherwise "0"	World Bank
<i>ACR</i>	Total current assets/total current liabilities one year prior to the merger announcement	CSMAR
<i>SIZE</i>	Log of total company assets in the year prior to the merger	CSMAR
<i>CASH</i>	Cash assets as a percentage of current assets	CSMAR
<i>Tobin'Q</i>	Market value of equity/total assets	CSMAR

3.2 Sample Selection and Descriptive Statistics

3.2.1 Sample Selection

In this paper, cross-border M&A events of Chinese companies from 2000 to 2021 are selected as the initial sample, and the sample is screened according to the following criteria: the acquirer is a Chinese company; the acquirer is listed on the Shanghai Stock Exchange or Shenzhen Stock Exchange; the M&A transaction has been completed; the financial industry sample is excluded; the sample of ST (Special treatment) and *ST samples; excluding samples with multiple M&A transactions within 3 months; excluding samples with equity share less than 10% of the target company after acquisition; excluding samples with missing data. After the above processing, 539 M&A events were finally screened out. We did correlation analysis as well as VIF test on the independent variables, and the VIF values of the variables were all less than 10, thus concluding that there is no need to worry about multicollinearity for all independent variables.

The data on cross-border M&A transactions in this paper are obtained from the BvD_Zephyr database; the carbon emissions and fossil energy combustion emissions used in this paper are manually collected and compiled from the social responsibility reports, sustainability reports, and environmental reports disclosed by companies every year. Corporate characteristics and stock data are obtained from the CSMAR database.

3.2.2 Descriptive Statistics

To explore the relationship between the acquirer's carbon risk and M&A performance, this paper classifies host countries into developing and developed economies according to the degree of economic development, in which 87 M&A events were selected for developing economies as host countries and 452 M&A events were selected for developed economies as host countries. The distribution of the number of specific M&A transactions is shown in Tables 2 and 3.

Table 2: cross-border M&A transactions (cases) by developed economies (M&A recipients)

Number	Developed economies	Number of cross-border M&A deals, 2011-2021 (cases)
1	Chile	2
2	United Kingdom	49
3	United States	69
4	Hong Kong	177
5	Germany	52
6	Luxembourg	4
7	Italy	21
8	Australia	13
9	France	5
10	Spain	2
11	Netherlands	3
12	Mexico	3
13	Canada	6
14	Finland	5
15	New Zealand	2
16	Taiwan	3
17	Switzerland	6
18	Korea	3
19	Poland	3
20	Denmark	7
21	Slovenia	1
22	Japan	13
23	Sweden	2
24	Austria	1

Table 3: cross-border M&A transactions (cases) in other developing economies (M&A recipients)

Number	Developing Economies	Number of cross-border M&A deals, 2011-2021 (cases)
1	Brazil	9
2	Pakistan	1
3	Peru	1
4	Russia	4
5	Singapore	18
6	Malta	1
7	Bangladesh	3
8	Vietnam	6
9	Malaysia	10
10	Czech Republic	2
11	Indonesia	4
12	India	13
13	Thailand	10
14	Croatia	2
15	Colombia	2
16	Venezuela	1

Table 4 shows the descriptive statistics (mean and median) for the full sample of variables used to analyze the impact of acquirer's carbon risk on cross-border M&A performance, as well as the difference between the mean and median for the sample classified according to the level of economic development of the host country (developing and developed economies). We find that acquirer's carbon risk (LN_CE) is higher for acquirers choosing developing economies for cross-border M&A than for those choosing developed economies for cross-border M&A, and is statistically significant at the $p=0.05$ level.

Table 4: Descriptive statistics - mean and median

Variable	Full sample		Host country (developing economy)		Host countries (Developed economies)		developing economy— developed economies	
	n=539		n=87		n=452			
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
BHAR_1year	0.027	-0.098	0.006	-0.114	0.031	-0.088	0.025	0.321
ROA_1year	0.051	0.046	0.043	0.0390	0.053	0.048	0.010*	3.886**
LN_CE	9.481	9.365	9.830	9.855	9.414	9.333	-0.415**	1.150
CD	13.26	12.02	8.446	8.590	14.19	12.02	5.740***	23.032***
GD	8.473	8.812	8.563	8.408	8.456	8.904	-0.106	27.557***
AGE	9.301	8	8.839	8	9.389	8	0.550	0.000
SIZE	22.44	22.35	22.59	22.42	22.41	22.32	-0.173	1.150
ACR	2.490	1.652	1.897	1.456	2.604	1.689	0.707	3.018*
D_GDP	4.839	4.673	4.957	4.684	4.816	4.665	-0.141	0.800
A_LAW(Dummy)	0.323	0	0.690	1	0.252	0	-0.437***	63.863***
Acquire Cash	0.567	0.581	0.591	0.625	0.563	0.575	-0.028	2.374
BIND	0.381	0.364	0.374	0.353	0.382	0.364	0.008	0.826
Tobin'Q	1.952	1.531	1.634	1.181	2.014	1.558	0.379**	4.699**

Note: *, **, *** represent significance at 10%, 5% and 1% levels, respectively.

Table 5 depicts the descriptive statistics and the significant differences between the mean and median for the entire sample and for the samples of high and low carbon risk acquirers, respectively. We find that the means of post-merger performance (*BHAR_1year* and *ROA_1year*) for initially high carbon risk firms are larger than for firms with low initial carbon emissions, but do not reflect significance.

Table 5: Descriptive statistics - mean and median

Variable	Full sample		Low carbon emission (carbon emission<26000)		High carbon emission (carbon emission>26000)		High-Low	
	n=539		n=358		n=181			
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
<i>BHAR_1year</i>	0.027	-0.098	0.009	-0.101	0.060	-0.073	-0.050	0.725
<i>ROA_1year</i>	0.051	0.046	0.049	0.046	0.056	0.047	-0.007	0.093
<i>LN_CE Increase</i>	9.481	9.365						
<i>Reduce</i>	0.620	1						
<i>CD</i>	0.380	0						
<i>GD</i>	13.26	12.02	13.38	12.02	13.03	12.02	0.347	0.71
<i>AGE</i>	8.473	8.812	8.438	8.709	8.544	8.904	-0.107	1.069
<i>SIZE</i>	9.301	8	7.525	6	12.81	12	-5.287***	65.743***
<i>ACR</i>	22.44	22.35	21.79	21.75	23.74	23.51	-1.948***	238.521***
<i>D_GDP</i>	2.490	1.652	3.012	1.915	1.457	1.257	1.556***	48.889***
<i>A_LAW</i>	4.865	4.673	4.863	4.673	4.799	4.663	0.072	1.465
<i>CASH</i>	0.323	0	0.293	0	0.381	0	-0.088**	4.251**
<i>BIND</i>	0.567	0.581	0.573	0.582	0.555	0.567	0.018	0.059
<i>Tobin'Q</i>	0.381	0.364	0.384	0.364	0.375	0.333	0.009	4.780**
	1.952	1.531	2.344	1.919	1.177	0.798	1.168***	86.532***

Note: *, **, *** represent significance at 10%, 5% and 1% levels, respectively.

3.3 METHODOLOGY

3.3.1 Carbon Risk and M&A Performance

In this paper, we draw on the approach of Guo and Cheng (2023) to study the impact of acquirer’s carbon risk on cross-border M&A performance in China using multiple linear regression, and consider the moderating role of other developing economies as host countries in this impact process. To first explore the impact of acquirer’s carbon risk on cross-border M&A performance, we develop the following model:

$$M\&A\ performance_{i,t} = \alpha_1 + \alpha_2 LN_CE_{i,t-1} + \sum \alpha_i Controls_{i,t} + \sum \alpha_i Year_{i,t} + \varepsilon_1 \quad (3)$$

The moderating role of other developing economies as host countries in the above effects is then added and the study model is:

$$M\&A\ performance_{i,t} = \beta_1 + \beta_2 LN_CE_{i,t-1} + \beta_3 DC_{i,t} + \beta_4 LN_CE_{i,t-1} \times DC_{i,t} + \sum \beta_i Controls_{i,t} + \sum \beta_i Year_{i,t} + \varepsilon_2 \quad (4)$$

where, *i* is the acquirer firm, and *t* is the year of transaction announcement. *M&A performance_{i,t}* is the M&A performance, representing the acquirer firm's *BHAR_s*, *ROA* in the coming year. the main dependent variable is the acquirer's fossil energy combustion emissions (tons) at the end of t-1. *DC_{i,t}* is whether firm *i* selects other developing economies for cross-border M&A activities in year *t*; *controls* are control variables; this paper controls for time, considering that year may introduce unobservable effects; α_1, β_1 are the intercept term, $\alpha_2, \alpha_i, \beta_2, \beta_3, \beta_i$ are the regression coefficients, ε is the random disturbance term.

3.3.2 Carbon Risk Changes and M&A Performance

This paper divides the sample according to the condition of whether the acquirer's fossil energy combustion emissions reach 26,000 tons in the year before the M&A. For acquirers with carbon emissions greater than 26,000 tons, they are called initial high carbon risk acquirers, and those with carbon emissions less than 26,000 tons are called initial low carbon risk acquirers. Based on the above conditions, this paper uses a multiple linear regression model to analyze the impact of changes in carbon risk on M&A performance after M&A.

First, to explore the impact of the decline in post-merger carbon risk on M&A performance for acquirers with high initial carbon risk, we build the following model:

$$M\&A\ performance_{i,t} = \alpha_1 + \alpha_2 Reduce + \sum \alpha_i Controls_{i,t} + \sum \alpha_i Year_{i,t} + \varepsilon_1 \quad (5)$$

Second, to investigate the impact of the rise in carbon risk on M&A performance after the acquisition of an acquirer with low initial carbon risk, we develop the following model:

$$M\&A\ performance_{i,t} = \beta_1 + \beta_2 Increase + \sum \beta_i Controls_{i,t} + \sum \beta_i Year_{i,t} + \varepsilon_2 \quad (6)$$

Where *i* is the acquirer firm and *t* is the year of transaction announcement. *M&A performance_{i,t}* is the M&A performance, representing the *BHAR_s*, *ROA* of the acquirable firm in the coming year. *Reduce* represents the reduction of the firm's carbon risk in the year after the M&A announcement, and *Increase* represents the increase of the firm's carbon risk in the year after the M&A announcement. *controls* are control variables; this paper controls for time, considering that year may introduce unobservable effects; α_1, β_1 are the intercept term, $\alpha_2, \alpha_i, \beta_2, \beta_3, \beta_i$ are the regression coefficients, ε is the random disturbance term.

4. Analysis of Regression Results

4.1 Acquirer's Carbon Risk and M&A Performance

Table 6 shows the regression results of acquirer's carbon risk and M&A performance. Column (1) shows that the acquirer's carbon risk (*LN_CE*) has a significant positive effect on M&A performance and is significant at the p=0.05 level, and each unit increase in the acquirer's carbon risk increases the post-merger *BHAR_s* by 0.089; Column (2) shows that the acquirer's carbon risk has a significant positive effect on M&A performance and is significant at the p=0.01 level, and each unit increase in acquirer's carbon risk increases the post-merger *ROA* by 0.012. This indicates that high carbon risk firms can achieve higher performance after M&A. However, the moderating variable of host country being other developing economies (*LN_CE * DC*) has a non-significant negative moderating effect in the above impact relationship.

So, Hypothesis 1 is partially supported, i.e., The higher the acquirer's carbon risk the higher the post- merger performance, but the choice of other developing economies as host countries does not strengthen these relationships. Possible reasons for the negative regulation of the modulating variable are as follows: Firstly, there are many factors that affect the performance of corporate M&A. Sartor and Beamish (2018) confirmed that corruption in the host government may lead to increased transaction costs for foreign investors. Considering that corruption is more prevalent in developing countries, acquirers may need to bear additional costs of dealing with the government (Yang *et al.*, 2022; Chandrika *et al.*, 2022). In addition, there may be cases where some or all of the incentives promised to the acquirer by the host country are not implemented, leading to worse performance of the acquirer after M&A in other developing countries. In addition, there may be cases where some or all of the preferential policies promised to the acquirer by the host country are not implemented, resulting in worse performance of the acquirer after the M&A in other developing countries. Secondly, with the deepening of China's industrialization process, Chinese industrial chains and supply chains have begun to show their advantages in some fields (Song and Yang, 2022). The low degree of industrial chain development and weak undertaking capacity in other developing countries have led to the decline of Chinese firms' performance after M&A. Thirdly, *the 2021*

edition of the Country (Regional) Guide to Foreign Investment Cooperation published by the Ministry of Commerce points out the existence of a lower quality labor force in developing countries. For example, although Vietnam has an abundant labor force, only about 20% of the labor force is well educated and trained in vocational skills, and labor efficiency is relatively low, which means that enterprises have to increase the cost of training workers, thus leading to a decline in performance. Fourth, the market size of developing countries is smaller compared to developed countries (Wang and Lei, 2018) which indicates that the consumption power of developing countries is weaker compared to developed countries and therefore the performance of acquirers decreases after selecting developing countries for M&A activities.

The possible reasons why the variable of host country as other developing economies plays a negative but insignificant moderating role are as follows: Firstly, with the rapid development of China’s economy, M&A has become one of the important ways to obtain natural and strategic resources in China (Wang *et al.*, 2022; Liu, 2018), and there is a possibility that some firms' M&A is aimed at obtaining resources rather than obtaining higher M&A performance. Therefore, the negative moderating effect of host countries as other developing countries or regions is not significant. Secondly, there exists the possibility that Chinese firms' M&A activities are in the service of politics rather than to obtain higher performance. Wang *et al.*, (2022) point out that State-owned enterprises tend to be influenced by political factors such as national foreign policy when making overseas investments, sometimes even choosing countries with which China has better diplomatic relations, but whose economic development is more backward, for their M&A activities. This makes the transfer effect of choosing other developing countries or regions for M&A activities insignificant. Third, the market size of the host country is an important reason to attract investors (Liang, 2017). In recent years, the domestic market has become saturated and the problem of overcapacity has become more serious, so Chinese enterprises try to use the "Belt and Road" policy to carry out foreign cooperation to open the international market and solve the overcapacity (Wang *et al.*, 2022). Based on this, the negative moderating effect of host country being other developing countries on the effect of acquirer’s carbon risk on M&A performance is weakened.

In summary, there are four possible reasons why the moderating variable of the choice of M&A in other developing economies negatively moderates the effect of acquirer’s carbon risk on M&A performance: institutional-level factors in the host country, weak absorptive capacity in the developing country or region, low quality of labor in the host country, and limited market consumption capacity. However, there may be acquirers' cross-border M&A with the purpose of acquiring resources, acquirers with aid M&A purposes, and acquirers seeking markets, and the more direct influence of these factors leads to a non-significant negative moderating effect.

Table 6: Multiple linear regression results and analysis

Variables	BHAR_1year	ROA_1year
	(1)	(2)
LN_CE	0.089** (2.44)	0.012*** (4.23)
DC (Dummy)	0.234 (0.60)	0.019 (0.60)
LN_CE*DC (Dummy)	-0.028 (-0.72)	-0.003 (-0.98)
CD	-0.010 (-1.32)	-0.000 (-0.52)
GD	0.089 (1.18)	0.004 (0.72)
AGE	-0.003 (-0.70)	-0.001*** (-2.73)
SIZE	-0.043 (-0.97)	-0.000 (-0.07)
ACR	0.032*** (4.59)	0.001 (1.29)
A_LAW	-0.149** (-2.04)	-0.002 (-0.40)
CASH	-0.233 (-1.48)	0.012 (0.96)
BIND	-0.282 (-0.81)	-0.067** (-2.38)
Tobin'Q	0.015	0.016***

Variables	BHAR_1year	ROA_1year
	(1)	(2)
	(0.79)	(10.81)
<i>D_GDP</i>	-0.020**	-0.000
	(-2.13)	(-0.49)
<i>Constant</i>	-0.342	-0.068
	(-0.36)	(-0.89)
<i>Year Dummy</i>	YES	YES
<i>Observations</i>	539	539
<i>R²</i>	0.116	0.264

Note: *, **, *** represent significance at 10%, 5% and 1% levels, respectively.

4.2 Change in Acquirer’s Carbon Risk and M&A Performance

Table 7 shows the regression results of the change in carbon risk after M&A and M&A performance. First, the regression results for the initially high carbon risk firms show that in column (1), the coefficient of the post-merger carbon risk reduction variable is positive and significant at the p=0.05 level for the acquirer with high initial carbon risk, and each unit reduction in carbon risk increases the acquirer’s *BHAR_S* by 0.172 in the coming year. The coefficient of this variable is positive and significant at the p=0.1 level, and each unit reduction in carbon risk increases the acquirer’s *ROA* in the next year by 0.010. This indicates that the reduction of carbon risk by the acquirer after the M&A due to the practice of corporate social responsibility by the initially high carbon risk firm can lead to better M&A performance. Therefore, Hypothesis2a is supported.

The regression results for the initial low carbon risk firms show that in column (1), the increase in post-merger carbon risk for the acquirer with initial low carbon risk is negatively insignificant for *BHARS* one year after the merger. In column (2), the rise in post-merger carbon risk for acquirers with initial low-carbon risk is positively insignificant for *ROA* one year after the merger. Therefore, H2b is not verified, i.e., the rise in post-merger carbon risk for acquirers with initial low-carbon risk has a non-significant effect on M&A performance. The reasons may be as follows: first, the host government may provide certain tax breaks or incentives to attract firms to conduct investment activities locally (Chu *et al.*, 2022), and the support from the host country can provide a better operating environment for the acquirer, which reduces the impact of rising carbon risk on performance. Second, there are many factors that affect the acquirer’s M&A performance, such as the acquirer’s corporate governance level (Guo, and Han, 2021), the acquirer’s financial status (Yang *et al.*, 2019), and institutional factors in the host country (Li *et al.*, 2020). Considering the uncertainty of financial systems and institutions in developing countries, the effect of carbon emissions on M&A performance is therefore diluted. Third, in order to attract low-carbon venture firms to invest in their home countries, host country governments will introduce some preferential policies to improve the business environment. Chu *et al.*, (2022) show that in order to attract firms to invest in their home countries, host country governments often introduce preferential policies to improve the business environment. Low carbon emitting firms may have more advanced clean production technologies, so the host government will enact some preferential policies to attract such firms, such as relaxing market access, reducing taxes and fees, and reducing land rent. Therefore, it reduces the risk of rising carbon risk after M&A.

Table7: Multiple linear regression results and analysis

High carbon risk acquirers (Carbon emissions >26000)			Low Carbon Risk Acquirer (Carbon emissions <26000)		
Variables	BHAR_1year	ROA_1year	Variables	BHAR_1year	ROA_1year
	(1)	(2)		(1)	(2)
<i>Reduce</i>	0.172**	0.010*	<i>Increase</i>	-0.004	0.001
	(2.19)	(-1.70)		(-0.06)	(0.15)
<i>CD</i>	-0.008	-0.000	<i>CD</i>	-0.011	0.000
	(-0.81)	(-0.11)		(-1.26)	(0.44)
<i>GD</i>	0.072	0.003	<i>GD</i>	0.108	-0.001
	(0.66)	(0.34)		(1.18)	(-0.15)
<i>AGE</i>	-0.003	-0.001**	<i>AGE</i>	-0.002	-0.002***
	(-0.49)	(-2.40)		(-0.34)	(-3.03)
<i>SIZE</i>	0.023	0.003	<i>SIZE</i>	0.050	0.016***
	(0.66)	(1.15)		(1.08)	(4.25)
<i>ACR</i>	-0.058	0.011***	<i>ACR</i>	0.031***	0.000
	(-1.32)	(3.44)		(4.11)	(0.66)

High carbon risk acquirers (Carbon emissions >26000)			Low Carbon Risk Acquirer (Carbon emissions <26000)		
Variables	BHAR_1year (1)	ROA_1year (2)	Variables	BHAR_1year (1)	ROA_1year (2)
<i>D_GDP</i>	-0.039*** (-2.69)	0.002* (1.70)	<i>D_GDP</i>	-0.015 (-1.24)	-0.002* (-1.78)
<i>A_LAW</i>	-0.125 (-1.19)	0.001 (0.09)	<i>A_LAW</i>	-0.180* (-1.87)	0.001 (0.08)
<i>CASH</i>	-0.261 (-1.28)	-0.016 (-1.05)	<i>CASH</i>	-0.141 (-0.64)	0.022 (1.19)
<i>BIND</i>	-0.449 (-1.00)	-0.030 (-0.90)	<i>BIND</i>	-0.118 (-0.24)	-0.090** (-2.21)
<i>Tobin'Q</i>	0.161*** (4.51)	0.025*** (9.27)	<i>Tobin'Q</i>	-0.003 (-0.14)	0.014*** (7.67)
<i>D_GDP</i>	-0.039*** (-2.69)	0.002* (1.70)	<i>D_GDP</i>	-0.015 (-1.24)	-0.002* (-1.78)
<i>Constant</i>	-0.845 (-0.68)	-0.036 (-0.38)	<i>Constant</i>	-1.821 (-1.42)	-0.255** (-2.37)
<i>Year FE</i>	YES	YES	<i>Year FE</i>	YES	YES
<i>Observations</i>	181	181	<i>Observations</i>	358	358
<i>R-squared</i>	0.319	0.533	<i>R-squared</i>	0.147	0.228

Note: *, **, *** represent significance at 10%, 5% and 1% levels, respectively.

5. Robustness Test

First, we used an alternative metric to proxy for the acquirer’s carbon risk, namely the natural logarithm of the firm’s total carbon emissions, rather than the natural logarithm of fossil fuel carbon emissions. The acquirer’s total carbon emissions are the sum of emissions from combustion and fugitive emissions, production process emissions, waste emissions, and emissions from land use change (forest to industrial land). This data was obtained and compiled from the acquirer’s annual reports and corporate social responsibility reports. In addition, considering that political affiliation is a specific attribute of Chinese SOEs (Guo and Han, 2021) we include a control variable of whether the acquirer is a state-owned enterprise (SOE), with 1 if the acquirer is a SOE and 0 otherwise. Attaoui *et al.*, (2021) confirm that the method of payment (PayM) in an acquisition transaction has an impact on the acquisition, so we control for the payment the data are obtained from the CSMAR database. Tables 8 and 9 show the results of the robustness tests, the significance of the relevant variables does not change too much, so the results obtained in this paper have good robustness.

Table 8: Robustness tests 1

Variables	BHAR_1year (1)	ROA_1year (2)
<i>LN_CE</i>	0.075** (2.33)	0.011*** (4.13)
<i>DC (Dummy)</i>	0.524 (1.07)	0.036 (0.91)
<i>LN_CE* DC (Dummy)</i>	-0.045 (-1.13)	-0.004 (-1.11)
<i>PayM (Dummy)</i>	-0.007 (-0.13)	0.001 (0.11)
<i>CD</i>	-0.009 (-1.23)	-0.000 (-0.49)
<i>GD</i>	0.084 (1.10)	0.004 (0.73)
<i>AGE</i>	-0.005 (-0.99)	-0.001* (-1.66)
<i>SIZE</i>	-0.020 (-0.53)	0.004 (1.35)
<i>ACR</i>	0.032*** (4.54)	0.001 (1.18)
	-0.152**	-0.003

Variables	BHAR_1year (1)	ROA_1year (2)
<i>A_LAW</i> (Dummy)	(-2.04)	(-0.44)
<i>CASH</i>	-0.244 (-1.53)	0.007 (0.54)
<i>BIND</i>	-0.279 (-0.80)	-0.068** (-2.41)
<i>Tobin'Q</i>	0.013 (0.71)	0.016*** (10.84)
<i>SOE</i> (Dummy)	0.040 (0.60)	-0.021*** (-3.86)
<i>D_GDP</i>	-0.022** (-2.30)	-0.001 (-0.84)
<i>Constant</i>	-0.875 (-1.02)	-0.175** (-2.55)
<i>Year FE</i>	YES	YES
<i>Observations</i>	539	539
<i>R-squared</i>	0.117	0.247

Note: *, **, *** represent significance at 10%, 5% and 1% levels, respectively.

Table 9: Robustness tests 2

High carbon risk acquirers (Carbon emissions >26000)			Low Carbon Risk Acquirer (Carbon emissions <26000)		
Variables	BHAR_1year (1)	ROA_1year (2)	Variables	BHAR_1year (1)	ROA_1year (2)
<i>Reduce</i> (Dummy)	0.165** (2.12)	0.010* (1.72)	<i>Increase</i> (Dummy)	-0.008 (-0.13)	0.001 (0.10)
<i>PayM</i> (Dummy)	-0.176** (-2.28)	-0.006 (-1.09)	<i>PayM</i> (Dummy)	0.076 (0.94)	0.002 (0.33)
<i>SOE</i>	-0.009 (-0.11)	-0.019*** (-3.26)	<i>SOE</i>	0.070 (0.71)	-0.012 (-1.48)
<i>CD</i>	-0.007 (-0.70)	-0.000 (-0.43)	<i>CD</i>	-0.010 (-1.14)	0.000 (0.42)
<i>GD</i>	0.037 (0.34)	0.005 (0.61)	<i>GD</i>	0.109 (1.18)	-0.001 (-0.13)
<i>AGE</i>	-0.003 (-0.48)	-0.001 (-1.13)	<i>AGE</i>	-0.003 (-0.50)	-0.001** (-2.42)
<i>SIZE</i>	0.020 (0.57)	0.005* (1.94)	<i>SIZE</i>	0.049 (1.06)	0.016*** (4.20)
<i>ACR</i>	-0.048 (-1.07)	0.010*** (2.95)	<i>ACR</i>	0.032*** (4.23)	0.000 (0.64)
<i>A_LAW</i>	-0.138 (-1.31)	-0.003 (-0.41)	<i>A_LAW</i>	-0.163 (-1.65)	0.002 (0.21)
<i>CASH</i>	-0.302 (-1.49)	-0.019 (-1.24)	<i>CASH</i>	-0.161 (-0.72)	0.019 (1.04)
<i>BIND</i>	-0.356 (-0.80)	-0.020 (-0.61)	<i>BIND</i>	-0.115 (-0.24)	-0.095** (-2.31)
<i>Tobin'Q</i>	0.166*** (4.68)	0.025*** (9.71)	<i>Tobin'Q</i>	-0.005 (-0.22)	0.015*** (7.70)
<i>D_GDP</i>	-0.043*** (-3.01)	0.002* (1.75)	<i>D_GDP</i>	-0.015 (-1.23)	-0.002* (-1.81)
<i>Constant</i>	-0.352 (-0.27)	-0.090 (-0.96)	<i>Constant</i>	-1.881 (-1.46)	-0.251** (-2.33)
<i>Year FE</i>	YES	YES	<i>Year FE</i>	YES	YES
<i>Observations</i>	181	181	<i>Observations</i>	358	358
<i>R-squared</i>	0.341	0.564	<i>R-squared</i>	0.151	0.234

Note: *, **, *** represent significance at 10%, 5% and 1% levels, respectively.

6. CONCLUSION

Using a sample of 539 M&A events completed by Chinese acquirers from 2000 to 2021, we find that (1) Chinese acquirers with higher carbon risk have higher M&A performance, but this relationship is not strengthened by acquirers' choice of other developing economies as host countries. (2) For acquirers with high initial carbon risk, the reduction of post-merger carbon risk can lead to better M&A performance for firms. (3) For acquirers with low initial carbon risk, an increase in post-merger carbon risk has no significant effect on M&A performance.

6.1 Theoretical Contributions

Based on the content and results of our study, there are two main theoretical contributions as follows:

First, most previous studies have studied carbon emissions and M&A activities with developing countries as host countries (Guo and Cheng, 2023; Chandrika *et al.*, 2022), and few scholars have analyzed the relationship between carbon emissions and cross-border M&A with developing country firms as acquirers. This paper complements the gap in this area by studying the relationship between acquirer's carbon risk and M&A performance from the perspective of a developing country (China).

Second, we add to the research on CSR and post-merger performance, the most similar to our study when the literature is Zheng *et al.*, (2023) who find that the change in acquirer's post-merger ESG score depends on the firm's previous ESG level. This paper confirms that post-merger carbon risk reduction for acquirers with high initial carbon risk has a positive impact on M&A performance, i.e., firms with higher pre-merger carbon risk can have better financial returns after M&A due to the reduction in carbon emissions as a result of practicing corporate social responsibility. However, there is no significant effect on M&A performance for post-merger carbon risk increase for acquirers with low initial carbon risk, i.e., acquirers with low pre-merger carbon risk do not have a significant effect on M&A performance by not practicing CSR (carbon emission increase) after M&A.

6.2 Management Significance

This paper focuses on the impact of carbon risk of Chinese acquirers on M&A performance. It also analyzes the relationship between CSR and M&A performance by using the reduction of post-merger carbon risk of initially high carbon risk firms as a proxy for the acquirer's CSR, as well as exploring the impact of post-merger carbon emission increase on M&A performance when the acquirer of initially low carbon risk does not fulfill its CSR after the merger. Implications for Chinese firms and governments:

- (1) On the one hand, the government should provide support to encourage enterprises to reduce carbon emissions, for example, by giving an appropriate range of tax breaks and subsidies to enterprises that actively reduce carbon emissions. On the other hand, it should also establish and improve the laws and regulations on carbon emission management, and accelerate the pilot trading of carbon emission rights; at the same time, it should also increase the policy implementation and environmental governance, focusing on high carbon emission industries and high carbon emission enterprises, and implement the *Comprehensive Work Plan for Energy Conservation and Emission Reduction during the 14th Five-Year Plan* period as issued by the State Council in 2021. To achieve the "carbon peak" by 2030 and "carbon neutral" by 2060.
- (2) An effective way for enterprises to solve carbon emission problems is to transfer polluting industries through M&A activities. Secondly, the acquirer should actively fulfill its corporate social responsibility to reduce carbon emissions after M&A, especially for high carbon emitting enterprises, so as to mitigate the business risks brought by high carbon emissions and reduce business costs; in this paper, we also consider the difference between M&A in developing economies and M&A in developed economies when studying M&A performance. This suggests that Chinese firms can achieve better M&A performance by choosing a country with a smaller difference in GDP growth rate than their own. This has implications for the decision making of Chinese firms in cross-border M&A activities.

STATEMENTS AND DECLARATIONS

Acknowledgements: This research was funded by the National Natural Science Foundation, China (No. 71631007, 71471110).

Author Contribution

Jianquan Guo: Conceptualization, supervision, verification, funding acquisition.

Qi Hua: Validation, methodology, investigation, original draft writing, software, data collection, debugging.

Junyang Ma: Validation, methodology, investigation, original draft writing, data collection.

Data Availability: All data generated or analyzed during this study are included in this published article [and its supplementary information files].

DECLARATIONS

Ethics Approval and Consent to Participate: Not applicable.

Consent for Publication: Not applicable.

Competing Interests: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

ACKNOWLEDGEMENT

This research is supported by 2023 USST Research and Reform Key Project: Construction of an internationalization at home world-class scientific and engineering talent training system driven by international certification.

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