

THE IMPACT OF CORPORATE CARBON TRADING ON FIRM PERFORMANCE: EVIDENCE FROM CLEAN DEVELOPMENT MECHANISM IN VIETNAM

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Abstract: *This paper investigates the impact of corporate carbon trading on the performance of Vietnamese listed companies from 2010 to 2022, with a specific focus on the Clean Development Mechanism (CDM) in Vietnam. The regression results indicate a positive association between corporate carbon trading and firm performance. This suggests that companies engaging in carbon trading activities experience notable improvements in profitability. These results offer valuable insights for policymakers and businesses, underlining the significance of integrating carbon trading into sustainability strategies to capitalize on financial advantages and facilitate the transition towards a low-carbon economy.*

• Keywords: *carbon trading, Clean Development Mechanism (CDM), firm performance.*

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1. Introduction

The impact of climate change is evident in every facet of our lives worldwide. Businesses suffer from climate change in various ways, both through physical and transition risks. Physically, extreme weather events such as storms and floods can cause damage to infrastructure and supply chains, leading to business closures. Climate change also affects the availability of resources on which businesses rely, resulting in disruptions or even closures. Furthermore, as governments worldwide take action to mitigate climate change, costs and regulations for corporations are being and will be introduced. Companies that neglect this environmental aspect and continue emitting heavily will not only suffer a loss of market share, which demands sustainability in businesses, but also experience reputational damage for polluting, leading to the loss of customers and investors. Hence, it is essential for companies to take steps to reduce their carbon emissions. Despite some skepticism, methods and mechanisms have been introduced for firms to address this global issue. The Clean Development Mechanism (CDM) is one of the three market-based mechanisms developed by the Kyoto Protocol, intending to enable investors (in developed countries) to achieve their emission reduction goals cost-effectively and support developing countries to achieve sustainable development. CDM has experienced ups and downs, with a rise in market value in 2005 and a subsequent price decrease since 2008 for various reasons. Nevertheless, it is undeniable

that CDM has achieved significant results, preventing billions of tonnes of greenhouse gases (GHG), thus avoiding at least 3.6 billion USD in negative social impacts (Maraseni & Cadman, 2015).

While Vietnam's economy has grown rapidly in terms of greenhouse gas (GHG) emissions in recent decades, the country is also highly vulnerable to climate change (Zimmer et al, 2015). Particularly, the Northern area has been experiencing extreme weather with the highest and lowest recorded temperatures in recent decades, while the Middle and Southern areas face floods. Being aware of this issue, the Vietnamese government and policymakers have introduced regulations and policies to mitigate climate change, committing to realizing Net Zero by 2050. One of the efforts made is the adoption of the carbon trading mechanism - CDM. The first CDM project in Vietnam started in 2008, indicating that the carbon trading market in Vietnam is still in its growth stage and has plenty of potential and opportunities. In this context, a question arises about whether listed companies conducting CDM projects can improve their financial performance. Therefore, we examine the impact of corporate carbon trading on firm performance in Vietnamese listed companies to provide a basis for both listed companies and regulatory authorities to develop reasonable strategies to promote carbon trading activities and firm performance.

2. Literature review and hypotheses development

The literature on the impact of corporate carbon trading on firm performance has been examined in

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previous studies, yielding mixed results. While the majority advocate for the positive impact of corporate carbon trading on firm performance, some authors suggest that this correlation is negative or varies over time and among studied subjects. Chen et al. (2022), in their study of pilot A-share listed firms in China, found that the carbon emission trading scheme promoted these firms' market-based financial performance, suggesting that investors had more confidence in them than in others. Similarly, Zhang et al. (2020) showed that carbon trading contributes to the economic gains of all industrial sectors, although the impacts vary among industrial sub-sectors. Notably, the whole industry benefits more when carbon trading is implemented over a long period. Marin et al. (2018) found that, contrary to previous predictions, the European Emission Trading Scheme (EU ETS) not only did not affect economic performance but even boosted it in relative terms. Moreover, firms that exited the EU ETS but remained on the market witnessed a significant decline in size. Additionally, Zhang and Gan (2023) strongly advocated for the positive impact of corporate carbon trading on firm performance, suggesting that participation in the carbon emission trading market boosts financial performance, with mediation and moderation effects observed. The enhancement of green innovation ability and the decrease of strategic choice variety partially mediate how carbon trading improves firm performance. Furthermore, executive background heterogeneity positively moderates the relationship between carbon trading schemes and firms' performance.

However, some existing literature suggests a negative impact of corporate carbon trading on financial performance. For instance, Ramiah et al. (2017) found that nullifying the carbon trading system had a positive impact on the stock market, benefiting Australian businesses. Wang et al. (2023) showed that the corporate emission trading policy could reduce turnover of companies' fixed assets while expanding their fixed assets investment, leading to disorderly capacity expansion, which is not a positive outcome.

Additionally, some authors found mixed results depending on the studied subjects. Zhang and Liu (2019) found that implementing carbon emission trading policy led to a drop in the financial performance of listed firms in the nonferrous metal industry but a boost in that of the power industry, with effects becoming more significant over time. The emission trading scheme also experienced a lag effect on the financial performance of firms in the chemical, paper, and aviation industries, changing from negative to positive over time. Jia (2023) suggested that the impact of carbon trading on downstream enterprises changed over time, from negative to positive overall. Notably, Peng et al. (2021) advocated that the emission

trading scheme had a muted impact on returns on assets, suggesting that firms may face costs due to the ETS but also benefit from carbon trading.

Given the predominance of literature suggesting a positive correlation between corporate carbon trading and firm performance, we hypothesize that the firm performance of corporations participating in the carbon trading market in Vietnam will also be positively affected.

H1: Corporate carbon trading has a positive impact on the performance of Vietnamese listed companies

3. Research methodology

3.1. Data and sampling

Our initial sample, aimed at examining the impact of corporate carbon trading on firm performance, includes 728 companies listed on both the Hanoi Stock Exchange (HNX) and the Ho Chi Minh City Stock Exchange (HOSE) during the period of 2010-2022. However, to align with the research models and methods presented in Section 3.2, we apply some exclusive criteria. Firstly, we remove all companies belonging to the financial sector such as banks, financial companies, and stock and insurance companies. Secondly, we exclude all companies that provide insufficient data for use in Eq. (1) below. Following this data cleaning process, the final sample comprises 595 companies, corresponding to 7735 observations.

Additionally, we divide our sample into various industries according to the Industrial Classification Benchmark with modifications for Vietnam. The results from Table 1 indicate that the majority of CDM projects conducted in Vietnam belong to the Community Services industry. The remainder are in other industries, including Industry, Consumer Goods, and Oil & Gas.

Table 1: Firms' breakdown by industry

Industry	Number of firms	Number of CDM observations
Information & Technology	30	0
Industry	222	4
Consumer services	80	0
Medicine & Healthcare	26	0
Consumer goods	87	4
Raw materials	95	0
Community services	50	12
Oil & gas	5	1

3.2. Empirical models and research methods

To assess the impact of corporate carbon trading on the performance of Vietnamese listed companies, we employ regression analysis approach with three consecutive methods: Pool Ordinary Least Square (OLS), Fixed Effect Model (FEM) and Random Effect Model (REM). This quantitative approach allows us to systematically analyze the relationships between the binary variable indicating independent performance and the qualitative control variable arising. The model (1) is constructed as follows:

$$(1) \text{Tobin}Q_{it} = \alpha_0 + \alpha_1 \text{CDM}_{it} + \alpha_2 \text{SIZE}_{it} + \alpha_3 \text{LEV}_{it} + \alpha_4 \text{LIQ}_{it} + \alpha_5 \text{BIG4}_{it} + \alpha_6 \text{AGE}_{it} + \varepsilon_{it}$$

Where the subscripts *i* and *t* represent firm *i* and year *t* respectively. The dependent variable, Firm Performance, is measured by market index (Tobin’s Q). Meanwhile, the independent variable of corporate carbon trading is measure by whether the listed company has a project with the Clean Development Mechanism (CDM) or not. In addition to both dependent and independent variables, we also include firm-level controlling variables consisting of firm size, firm leverage, firm liquidity, audit quality and firm age in Eq. (1). All variables are defined in Table 2 below:

Table 2: Variables definitions in Eq. (1)

Variables	Explanation	
Dependent variable		
TobinQ	Firm performance	Market capitalization divide by total assets
Independent variable		
CDM	Corporate carbon trading	A dummy variable, taking the value of 1 if the company has a CDM project; and 0 otherwise
Control variables		
SIZE	Firm size	Natural logarithm of total assets
LEV	Firm leverage	Total debt divided by total equity
LIQ	Firm liquidity	Current assets dividend by current liabilities
BIG4	Audit quality	A dummy variable, taking the value of 1 if the company was audited by the big four audit firms, including Deloitte, PwC, EY, KPMG; and 0 otherwise
AGE	Firm age	Natural logarithm of years since the business was established

Notes: Table 2 presents the detailed calculations for each variable identified in model (1) as discussed in the Empirical Model and Research Method section above.

4. Empirical results

4.1. Descriptive statistics and correlation matrix

The descriptive statistics provided in Table 3 below offer a comprehensive overview of variables in Eq. (1) characterizing Vietnamese listed companies from 2010 to 2022. Tobin’s Q, which measures market value relative to book value, reveals an average of 1.739 with notable variability spanning from 0.049 to 11.610, indicating diverse levels of market valuation among the observed firms. The low mean value of 0.005 for Clean Development Mechanism (CDM) projects suggests that only a small fraction of companies in the sample engage in such initiatives, underscoring the limited adoption of carbon trading practices. Moreover, the average firm size, reflected by the natural logarithm of SIZE, stands at 26.716, with variation ranging from 20.369 to 33.585, indicating a diverse spectrum of company sizes within the dataset. Additionally, the mean leverage ratio (LEV) of 0.2119 signals a moderate level of debt financing across firms, with some companies exhibiting higher leverage up to a maximum of 0.870. Liquidity (LIQ) statistics, with an average ratio of 2.149 and significant variability from 0 to 15.811, highlight differences in firms’ ability to meet short-term obligations. Furthermore, the proportion of firms audited by one of the Big Four auditing firms (BIG4) is relatively

low, as indicated by the mean of 0.270, suggesting varying levels of audit quality within the sample. Lastly, the average age of firms (AGE) at 3.131 years, with variation ranging from 0 to 4.356 years, provides insights into the distribution of firms across different stages of maturity. These descriptive metrics not only illuminate the characteristics of the dataset but also lay the groundwork for further analysis.

Table 3: Descriptive statistics

Variables	Observations	Means	Std. Dev.	Min	Max
TobinQ	7735	1.739	0.929	0.049	11.610
CDM	7735	0.005	0.067	0	1
SIZE	7735	26.716	1.879	20.369	33.585
LEV	7735	0.2119	0.187	0	0.870
LIQ	7735	2.149	2.008	0	15.811
BIG4	7735	0.270	0.444	0	1
AGE	7735	3.131	0.692	0	4.356

Note: Table 3 presents descriptive statistics of the variables in Eq. (1). The definitions of these variables are provided in Table 2.

Table 4 below presents the results of correlation matrix of all variables in Equation (1). The positive correlation coefficient between CDM and Tobin’s Q aligns with our expectation, implying that companies engaging in CDM projects may enhance their firm performance. Moreover, all correlation coefficients among independent and controlling variables in Equation (1) are very low, indicating the absence of multicollinearity in our model.

Table 4: Correlation matrix

	TobinQ	CDM	SIZE	LEV	LIQ	BIG4	AGE
TobinQ	1.000						
CDM	0.038	1.000					
SIZE	0.145	-0.023	1.000				
LEV	-0.116	0.041	0.120	1.000			
LIQ	0.188	0.018	0.192	-0.176	1.000		
BIG4	-0.014	0.007	0.026	0.009	0.012	1.000	
AGE	0.017	0.023	0.122	0.025	-0.053	-0.043	1.000

Note: Table 4 presents the correlation coefficient results of the variables in Eq. (1). The definitions of these variables are provided in Table 2.

4.2. Results and discussions

To investigate the impact of corporate carbon trading on the performance of Vietnamese listed companies from 2010 to 2022, particularly focusing on CDM projects, we conducted three regression methods comprising OLS, FEM, and RE). Additionally, we applied the F-test and Breusch-Pagan LM test to determine the most suitable method. The results of these tests are presented in Table 5 below. Both the Prob>F and Prob>chi2 values are below 5%, leading to the selection of the FEM. However, upon using the modified Wald test, we identified the presence of heteroskedasticity. Consequently, we ran the FEM with robust standard errors to address this issue.

The regression coefficient between CDM and TobinQ is 0.436, which is statistically significant at the very high level of 1%, indicating that the Clean Development

Mechanism (CDM) has a positive impact on Tobin's Q. This suggests that companies engaged in carbon credit trading projects under the CDM framework enhance firm performance, as reflected in the Tobin's Q market value. These results support our research hypothesis and align with previous studies such as Zhang et al. (2020), Chen et al. (2022), and Zhang and Gan (2023).

The positive impact of carbon trading activities on the business performance of listed companies in Vietnam can be explained by several reasons. Firstly, in the current context of Vietnam's green economy orientation, companies involved in environmentally supportive activities signal their commitment to sustainable development, emphasizing long-term effectiveness to stakeholders. Secondly, companies with CDM projects fulfill commitments to the community, society, and the environment, aligning stakeholder interests with the financial performance of the company. Finally, implementing CDM projects signifies recognition of the potential of the carbon market in Vietnam. As information about the establishment of a carbon trading exchange in the future emerges, companies listed on the stock exchange that have implemented CDM projects serve as evidence of effective analysis, forecasting, and anticipation of future development directions. This effectively builds trust with investors and the market regarding the long-term growth potential of the enterprise. Consequently, companies continually strive to develop appropriate strategies to maintain and enhance business efficiency.

Among the control variables, the SIZE variable and the AGE variable have demonstrated a positive relationship with Tobin's Q, while the LEV variable has a negative impact on firm performance. This indicates that companies with larger size and longer establishment times tend to achieve better financial performance, but high financial leverage acts as a hindrance to the Tobin's Q index of the company. The R-squared coefficient of 0.1621 indicates that the independent and control variables in model (1) explain 16.21% of the variance in firm performance measured through the Tobin's Q index.

Table 5: Regression results for the impact of corporate carbon trading on firm performance of Vietnamese listed companies during 2010-2022

Variable	OLS	FEM	REM	Robust FEM
CDM	0.4357** (2.57)	0.436*** (2.79)	0.400*** (2.57)	0.436*** (7.01)
SIZE	0.090*** (15.32)	0.096*** (15.89)	0.090*** (15.32)	0.097*** (12.72)
LEV	-0.679*** (-11.87)	-0.688*** (-12.03)	-0.679*** (-11.87)	-0.690*** (-16.30)
LIQ	0.024 (1.26)	0.156 (1.05)	0.057 (1.02)	0.062 (1.04)
BIG4	-0.039 (-1.65)	-0.027 (-1.14)	-0.039 (-1.65)	-0.028 (-1.00)
AGE	0.156* (2.69)	0.024** (1.25)	0.027* (1.15)	0.025** (1.75)

Variable	OLS	FEM	REM	Robust FEM
Constant	0.572* (0.24)	0.692** (0.25)	0.238* (0.15)	0.710** (0.34)
No of obs.	7735	7735	7735	7735
R ²	0.1557	0.1562	0.1560	0.1621
F-test	Prob>F = 0.024			
Breusch - Pagan LM test	Prob>chi2 = 0.000			
Modified Wald test	Prob>chi2 = 0.023			

Notes: Table 5 presents regression results in Eq. (1). The definitions of these variables are provided in Table 2. The symbols *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively.

5. Conclusion and recommendations

This paper aims to examine the impact of corporate carbon trading on firm performance in Vietnamese listed companies during the period of 2010-2022, wherein corporate carbon trading is measured by whether a company has a CDM project or not. By employing various regression alongside other tests to choose the most suitable model, the results demonstrate that FEM is the most appropriate selection. The FEM results indicate a positive relationship between corporate carbon trading and firm performance, proving that Vietnamese listed companies with CDM projects can enhance firm performance, as represented by Tobin's Q.

Given the positive correlation between corporate carbon trading and financial success, businesses are encouraged to integrate carbon trading schemes as a key component of their sustainability plans to secure foreseeable profits from these initiatives. Moreover, since the impacts of carbon trading initiatives on financial performance require thorough monitoring and evaluation, prioritizing them will enable firms to effectively engage in carbon markets over time. However, businesses may not adopt this approach unless there is a favorable investment environment for carbon trading, and the responsibility to create such an environment lies with local authorities. Through the implementation of precise and consistent legislative actions and policies, governments can support and incentivize increased participation in carbon markets while preserving environmental integrity.

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