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Impacts of Emissions Trading Scheme Initiatives on Corporate Carbon Proactivity and Financial Performance

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Abstract: This study introduces the concept of carbon proactivity and considers not only the quantity of emissions but also corporate carbon-reduction efforts and actions to explore the relationship between carbon proactivity, the emissions trading scheme (ETS) mechanism, and corporate financial performance. A matched-pair approach was adopted to explore the difference in carbon proactivity between ETS and non-ETS firms. The study aims to investigate the impacts of an ETS on corporate carbon proactivity and whether participating in an ETS can help a firm achieve a desired outcome in which it can improve both environmental and economic performance. Using manually collected data on carbon disclosure, it was found that carbon proactivity is higher among firms that participate in an ETS than among those that do not, and carbon proactivity is trending upward for the participating firms. In addition, evidence suggests that while investing more resources in carbon proactivity decreases current financial performance, it will boost future financial performance. This relationship is observed among firms that participate in an ETS. This study extends the understanding of the relationship between ETSs, corporate carbon proactivity, and corporate financial performance. It also provides evidence on how to improve the ETS mechanism.

Keywords: emissions trading scheme; carbon proactivity; financial performance

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1. Introduction

Environmental protection is one dimension of corporate social responsibility, and there has been a long-running debate on the association between corporations' actions for environmental protection and the influence of these actions on their operations. The topic of carbon emissions is now gaining more and more attention from corporations and many of them view carbon emissions reduction as an integral goal of their continuing operations (Sun et al. 2020) and an essential effort that the corporation must make to protect the environment. Research on corporate carbon-reduction activity has increased in the past decade (An et al. 2021; Andrew and Cortese 2011; Freedman and Jaggi 2011; Hahn et al. 2015; Haigh and Shapiro 2012; Haque and Deegan 2010; Kim and Lyon 2011; Kolk et al. 2008; Luo et al. 2021; Matsumura et al. 2011, p. 201; Peng et al. 2015; Prado-Lorenzo et al. 2009a; Stanny and Ely 2008; Stoerk et al. 2019). However, prior studies have heavily relied on measures looking into the quantity of carbon emissions and have ignored essential corporate efforts (e.g., green investments, carbon-management strategies, and participation in carbon assurance). This paper fills a research gap by introducing the concept of carbon proactivity and considering not only the quantity of emissions but also corporate carbon-reduction efforts and actions to extend the investigation among corporate carbon proactivity, ETS mechanisms, and financial performance. We refer to carbon proactivity as a strategic orientation manifested in the corporate governance that facilitates carbon initiatives and managerial support for environmentally-friendly corporate activities.

The paper empirically analyzes the effects of an ETS on carbon proactivity and whether participating in an ETS can help carbon-proactive firms achieve a desired outcome by

improving both environmental and financial outcomes. Expanding the work of prior scholars (Berry and Rondinelli 1998; Sharma and Vredenburg 1998), we expect that adopting a proactive carbon strategy can reduce a firm's level of environmental pollution and optimize the balance of corporate management between financial and environmental performance (González-Benito and González-Benito 2006; Gao et al. 2020).

Firms with proactive carbon strategies tend to design new methods, processes, and products to avoid (instead of simply correct) the negative impacts of carbon emissions (Aragón-Correa and Sharma 2003). The diversity of carbon practices and strategies among firms (Aragón-Correa and Sharma 2003; Russo 2009) highlight the complex nature of carbon proactivity. This complexity may have resulted in a lack of consensus in the literature for an optimal way to measure carbon proactivity (not merely the quantity of carbon emissions but also carbon-related disclosures). This study developed an innovative method to measure and proxy carbon proactivity. Specifically, we manually extracted carbon-related information from CSR (Corporate Social Responsibility) reports, sustainability reports, and environmental responsibility reports with a structured questionnaire, which was developed using a methodology adopted by the CDP and global reporting initiatives.[1] We then scored the corporate carbon information disclosed pursuant to ISO14064-1[2] and used the scoring to measure the extent of corporate carbon proactivity.

The results indicate that firms that participated in a Chinese pilot ETS (ETS firms) had more carbon proactivity than firms that did not (non-ETS firms). Current-year financial performance was found to be negatively related to current-year carbon proactivity but positively related to prior-year carbon proactivity. This finding suggests that firms that assigned more resources to carbon proactivity risked reduced current-year profits, but this practice might support their financial performance in the following year. This relationship was observed in ETS firms but not among non-ETS firms.

The study makes several contributions. First, a lot of previous research has been conducted against the background of the EU ETS (or the US scheme of cap-and-trade for sulfur dioxide), and little research has explored related issues in other ETS settings. This study is one of the first to investigate the world's largest carbon emitter, China, and its pilot ETSs. Taking into account differences in national contexts, this study extends our knowledge of the implementation of ETSs in a developing economy and its influence on corporate carbon disclosure and financial performance.

Second, we use a novel method of measuring corporate carbon disclosures. Carbon emissions are merely a number, tied to a single measure, and they do not tell us what efforts a corporation has made to reduce emissions. The concept we have developed of carbon proactivity includes many aspects of corporate carbon reduction, including carbon emissions disclosures, carbon-reduction strategies, green investment, carbon assurance, and other factors related to carbon. To the best of our knowledge, this is the first study to use this type of measurement to examine connections among ETS participation, corporate carbon disclosure, and financial performance.

Third, this study suggests that an ETS is a mediator between corporate carbon reduction and financial performance. In the short run, corporations may have challenges, face higher costs, and accrue lower profits in the implementation of comprehensive carbon reductions (carbon active) and involvement in an ETS. However, in the long run, participating in an ETS might lead a firm to perform better, both financially and environmentally.

Finally, this study supports, on a corporate level, prospect theory, which posits that individuals act more quickly when their decisions are framed as a response to threat or risk rather than to opportunity (Dutton and Jackson 1987; Fiegenbaum and Thomas 1988; Kahneman and Tversky 2013). In our setting, ETSs are a new factor for mainland China accompanied by enormous uncertainty. Thus, firms that participate in them are initially more likely to view them as a risk, not as an opportunity. If regression analysis shows that ETS firms tend to respond more proactively to carbon issues than similar non-ETS firms, this might indicate that Chinese firms recognize ETSs as a business risk rather than a business opportunity. Because an ETS can be a mediator between environmental

performance and financial performance, carbon regulators must make ETSs economically attractive and less risky.

The remainder of this paper is organized as follows. The next section introduces the background of the study and reviews the relevant literature. Hypotheses are then developed, followed by a discussion of the sample, data, and research models. The empirical findings are explored, followed by the conclusion to the paper.

2. Background and Literature Review

2.1. Chinese Pilot ETSs

China has been the world's largest greenhouse gas (GHG) emitter since 2007 (Zhang and Xu 2017). It has since pledged to reduce the level of its carbon emissions and has committed to ensuring its carbon emissions peak before 2030 (Zhang et al. 2017; Stoerk et al. 2019). The green policy initiatives include carbon restrictions, carbon fees, energy taxes, and cap-and-trade schemes (Stagliano 2017). Chinese firms are facing pressure and are responsible for carbon emissions disclosure and reductions.

Since 2013, China has launched nine regional carbon-trading markets (Zhang et al. 2017).[3] Under such ETSs, the government determines a maximum emissions intensity, or cap, for participating firms. Firms whose emissions exceed the cap must procure additional carbon allowances to cover their excess (McKibbin et al. 2015). Firms whose actual emissions are below the cap earn tradable allowances that they can sell (trade) to other firms. These nine pilot regional ETSs have some commonalities in their general regulatory framework and the length of each compliance period, but they differ greatly in the regulatory elements and their start dates (Zhang and Xu 2017). The settings for emissions reductions allow insights into the operations of ETSs and corporate reactions.

2.2. Corporate Social Responsibility and Financial Performance

Some theorists (Aupperle et al. 1985) have argued that firms that engage in CSR incur extra costs that might otherwise be avoided or that would be borne by others. There are few readily measurable economic benefits to CSR, but the numerous costs clearly reduce profits directly and thus shareholder wealth (Friedman 1970). This means that there is an inverse relationship between CSR (e.g., carbon reduction) and corporate financial performance. Other researchers contend that there is simply no relationship between CSR and financial performance. Proponents of this line of reasoning (Bancilhon et al. 1986) posit that the multitude of intervening factors allow no reason to expect a meaningful relationship to be found between CSR and performance, except possibly by chance. In addition, the measurement errors that have plagued studies on CSR could mask any link that exists.

However, the link between CSR and corporate financial performance may be best evaluated from the stakeholder theory. It proposes that a tension exists between a firm's explicit costs (e.g., payments to bondholders) and its implicit costs to other stakeholders (e.g., carbon-reduction costs). In this way, a firm that acts in a socially irresponsible manner may incur higher implicit costs, which results in a competitive disadvantage. Conversely, if a firm does something to support a local community (e.g., engage in environmental protection), it gains support from other local stakeholders and enhances its competitiveness. Thus, there is a positive relationship between CSR and financial performance. A compatible view is that the actual costs of doing CSR, such as reducing carbon emissions, are minimal, but the potential benefits are great. Excellent community relations may offer incentives for local governments to provide support for businesses by increasing tax breaks or reducing regulatory burdens, thereby decreasing costs for the firm and improving the bottom line, developing a virtuous circle.

2.3. Environmental Proactivity, Environmental Performance, and Financial Performance

Environmental protection is one dimension of CSR, and there has been a long-running debate on the association between corporations' actions for environmental protection and the influence of these actions on firms' financial performance. The literature uses the terms

corporate environmental performance and environmental proactivity interchangeably, although the concepts differ. González-Benito and González-Benito (2006) defined environmental proactivity as "the voluntary implementation of practices and initiatives aimed at improving environmental performance." This definition suggests that environmental proactivity refers to environmental strategy and practices, and environmental performance is the outcome. Corporate environmental proactivity thus may consist of an environmental management system, environmental accounting, and a process of stakeholder engagement. This study used this concept to measure corporate carbon reduction, in which a corporation was considered to be more carbon proactive if it had a carbon-management strategy, carbon-reduction targets, green investment, and carbon assurance.

In the literature, it is not difficult to find major discussions of the relationship between environmental performance (but not environmental proactivity) and financial performance (Gao et al. 2020). Previous work, however, has provided controversial findings (Bansal and Song 2017). Some researchers have contended that environmental responsibility is part of CSR, and CSR generates costs and reduces returns (Hatakeda et al. 2012; Waddock and Graves 1997). Thus, environmental performance would be negatively associated with financial performance (Bansal 2005; Jaggi and Freedman 1992; Sharma 2000). Moreover, delays in realizing the effects of investments in the environment increase uncertainty and risk for current and future corporate profitability (Aragón-Correa and Sharma 2003), which could cause the company's management to deprioritize green investment (Makni et al. 2009; Waddock and Graves 1997).

However, some researchers have proposed a hypothesis of positive synergy between the environmental and financial performance of a corporation (Albertini 2013; Endrikat et al. 2014). They have argued that pollution control can facilitate the effective use of resources, introduce innovation, and enhance competitive advantages and management capabilities (Aschehoug et al. 2012; Porter and Van der Linde 1995; Russo and Fouts 1997). Second, corporate environmental efforts can help firms improve their environmental image, employee commitment, and customer loyalty (Dögl and Holtbrügge 2014; Waddock and Graves 1997) and thus increase productivity and profitability (Hart and Ahuja 1996). Many empirical studies have supported this perspective. For example, using a two-stage least squares model, King and Lenox (2002) found a significant positive impact of waste reduction on financial performance in US firms. Martínez-Ferrero and Frias-Aceituno (2015) examined an international database using a generalized method of moments estimation and concluded that a positive relationship existed between the environmental performance and financial performance of a corporation.

Studies on the impacts of environmental proactivity on corporate financial performance have been limited. Garcés-Ayerbe and Cañón-de-Francia (2017) investigated the role of innovation-related resources on the relationship between corporate environmental efforts and the related financial performance in Spanish industrial firms. Their environmental proactivity concept met the definition of dynamic capability established by González-Benito and González-Benito (2006). Using the resource-based view and the dynamic capabilities approach, they found that a win–win situation is more likely when environmental proactivity is adopted with a proactive innovation strategy.

2.4. Studies in Corporate Carbon Proactivity

Attention in CSR studies has recently shifted to corporate climate change strategies (Akbas and Canikli 2014; Al-Tuwaijri et al. 2004; Deegan 2002; Elijido-Ten 2011; Jose and Lee 2007; Lee and Hutchison 2005; Odera et al. 2016; Powers et al. 2011; Prado-Lorenzo et al. 2009b; Sulaiman et al. 2014; Uwalomwa and Marte Uadiale 2011; Wang et al. 2004; Yu et al. 2017; Zhang et al. 2008). As ETSs and carbon disclosure in general are attracting more attention in business environments, many CSR scholars have shifted their focus to carbon disclosure (e.g., reviewing self-assessments of corporate carbon emissions, whether scope 1 or scope 2, or scoring corporate carbon disclosure) (Kolk et al. 2008). For example, Luo et al. (2012) and Luo and Tang (2016) examined managerial incentives for carbon

disclosure. Other studies have shown that carbon disclosure (many studies have used emissions figures as an index) is significantly associated with factors such as firm size (Stanny 2013; Stanny and Ely 2008; An et al. 2021), shareholder resolutions (Reid and Toffel 2009), corporate financial structure (Li et al. 2014), and corporate governance (Elsayih et al. 2018; Liao et al. 2015). Apart from carbon emissions and carbon-related disclosure, to the best of our knowledge, no works have addressed corporate carbon proactivity or have explored the relationships among ETSs, corporate carbon reduction, and their influence on corporate financial performance.

3. Hypothesis

3.1. Corporate Pressure under an ETS

This study considered three pressures that corporations face under an ETS. Legitimacy theory suggests that firms are bound by social values (Deegan and Rankin 1997). Thus, firms face social pressures, and a social contract exists between a firm and the wider community (Solomon and Lewis 2002). Concerns regarding climate change have led to an expectation that firms should be aware of climate change and be proactive in reducing their emissions. If a corporation simply ignores this pressure, stakeholders may conclude that its management does not care about climate change. The establishment of an ETS involves a contract for the firms involved in it, and stakeholders may penalize them (with environmental restoration charges or a pollution levy, for example) if they do not see that the firms are participating in the scheme, especially for a firm in a sector that is considered highly polluting. . In this circumstance, the company's management is more likely to be carbon proactive than merely provide carbon disclosure.

Corporations face financial pressure to participate in an ETS, and the pressure is clearly produced by carbon-emissions pricing. From a corporate perspective, carbon emissions are no longer free. A firm that emits carbon above its allowances must purchase extra emissions permits to cover the deficit. This carbon price and the costs are additional operating costs, which motivate the firm to control its carbon emissions and become more carbon proactive.

Corporations are facing institutional pressure in ETS settings. Institutional theory posits that firms' social behaviors are influenced to a certain extent by transformation institutions, which are "symbolic, rule-based, and regulative processes" (Cormier et al. 2005). Corporations that are exposed to different institutions might make different strategic decisions to conform to the framework of their existing sociocultural system (DiMaggio and Powell 1991). When a firm takes part in an ETS, it is influenced by isomorphic processes due to institutional changes. ETS firms tend to institutionalize their carbon reduction, but this may not occur in non-ETS firms.

In addition, prospect theory suggests that decision makers exhibit an asymmetrical response to possible risk/loss versus possible opportunity/gain. According to this theory, individuals are more sensitive to loss than to gain (Kahneman and Tversky 2013). In fact, individuals tend to be unwilling to take risks when faced with potential gain but are willing to take risks when faced with potential loss. Evidence (CDP/PwC 2013) shows that 70% of carbon emissions are attributable to business activities, but their responses to climate change vary from reactive to proactive (Boiral 2006; Buysse and Verbeke 2003; Sharma and Vredenburg 1998). As discussed above, prospect theory predicts that decision makers may react more quickly when the decisions they are faced with are framed as a response to threat or risk rather than to opportunity. ETSs were a new concept in China, and they came out with numerous uncertainties. Firms that participate in them are more likely to treat them as a risk than an opportunity and thus can be expected to respond more proactively than non-ETS firms. Likewise, participants in an ETS are expected to have a higher level of carbon proactivity than non-ETS firms, so long as carbon trading is considered more as a risk than as an opportunity. In the light of this theoretical discussion, we proposed the following hypotheses:

H1a. *Firms that participate in an ETS have higher carbon proactivity than those that do not.*

H1b. *Firms that participate in an ETS tend to increase their carbon proactivity more than those that do not.*

3.2. Corporate Carbon Proactivity and Financial Performance in an ETS Setting

We argue that the nature and direction of the relationship between a corporation's carbon proactivity and its financial performance is influenced by the firm's operating context. This argument is consistent with institutional theory and prospect theory. Previous research has also shown evidence in this area. For example, Peng et al. (2015) found that firms with more sales were more likely to have better carbon disclosure, but this link was industry specific. He et al. (2016) found weak evidence that carbon emissions are linked with financial performance. However, this result was obtained from a sample of US firms operating in a specific business environment. At the time of their study, the United States had not ratified the Kyoto Protocol, which places the findings in a specific context. Recent studies on the carbon emissions and market values of firms (Matsumura et al. 2014; Tang and Luo 2014) have found that, although carbon reduction is relevant to firm value, the magnitude of the relationship is highly dependent on the context (e.g., is there a carbon tax?), the time studied, and the location of the firm.

We predict a positive relationship between corporate carbon proactivity and financial performance in an ETS setting. Participating in an ETS provides significant motivation for the management to reduce carbon emissions, which can also push them to invest in more green products, improve operations, and lower production costs. If an ETS firm is not proactive, it will face substantial punishment, both financially (e.g., paying more for carbon emissions or experiencing other financial pressure) and socially (through community and institutional pressures). However, it can be argued that improving carbon performance may reduce profitability, as it requires significant investment (in the long term) in low carbon production and paying for carbon emissions (in the short term). Managers may not be happy to allocate adequate resources to carbon reduction even if they are operating in an ETS setting. We could call this a carbon-market failure.

A recent study (Alexopoulos et al. 2018) found that certain contextual factors can mediate the relationship between financial and environmental performance. These factors include well-developed CSR codes, well-designed environment taxes and efficient environment regulations. Qi et al. (2014) investigated possible effects on the link between environmental and financial performance, using a data set of Chinese industrial firms. Their results showed that improving environmental performance significantly influences financial performance, and slack resources (but not industrial munificence) play a significant mediating role in this relationship. These considerations prompted us to investigate whether an ETS can mediate the relationship between a corporation's environmental performance and its financial performance. For empirical evidence to develop our conclusions, we required a comparison between firms in an ETS setting and firms outside of an ETS. Accordingly, the following hypotheses were proposed:

H2a. *Corporate carbon proactivity is associated with financial performance.*

H2b. *There is a positive association between carbon proactivity and financial performance in ETS firms.*

4. Research Design

4.1. Measurement of Carbon Proactivity

The measures of carbon proactivity were based on indicators of corporate behavior in both practice and results, including carbon-management strategies, carbon-emissions reductions, carbon-reduction targets, low-carbon investment, and carbon assurance. We considered carbon proactivity as a four-dimensional construct: carbon governance, which included four items (2, 4, 5, and 11; Appendix A) that assessed the level of integration of carbon governance and systems; operational responsibility for carbon, in five items (1, 3, 6, 10, and 14) that reflected the importance of mitigation actions and standard operating procedures in reference to climate change; control of carbon performance, measured by four

items (7, 9, 12, and 13) that related to tracking carbon emissions and energy-consumption records; and stakeholder engagement and carbon disclosure, in four items (8, 15, 16, and 17), which addressed the communication of carbon-control values to members and stakeholders. Our measure of carbon proactivity was intended to capture the involvement of top management in the development of carbon-reduction policies, formal systems of carbon-emissions management, long-term sustainable initiatives, recycling programs, intelligent carbon management in the supply chain, life-cycle assessment, the use of clean energy and technologies, the design of ecologically-friendly products, and the adequate management of carbon risk.

4.2. Sample and Data

A matched-pair approach was adopted to investigate the difference in carbon proactivity between ETS and non-ETS firms. Following previous studies, the industry membership and size of the companies in the groups were similar (de Aguiar and Bebbington 2014; Deegan and Rankin 1997). In addition, the groups were subject to similar pressure with regard to climate change. Two data sets were created to measure carbon proactivity and explore connections among the ETS, carbon proactivity, and financial performance. The sample period was from 2014 to 2016. Table 1 shows the specific sampling process.

Table 1. Sampling Process.

Criterion and Step	ETS	Non-ETS	All
Firms on the list of the Chinese pilot ETS program [1]	2065		
Firms listed on either the Shanghai Stock Exchange or Shenzhen Stock Exchange	114		
Firms with both environmental and financial data available in their annual reports, CSR reports, sustainability reports, or environmental responsibility reports	52	52	104
Financial institutions excluded from the sample	8	8	16
Number of firms in the sample	44	44	88
Total	132	132	256

[1] Lists of companies participating in the Chinese ETS pilot programs are published by the National Development and Reform Commission. Major of participants are non-listed and privately owned.

As mentioned earlier, a questionnaire was created to quantify corporate carbon proactivity (Appendix A). It was developed using a methodology adopted by CDP and global reporting initiatives (GRI). In all, 17 standards were formulated, and the related information were manually extracted. We then scored each firm's carbon proactivity based on these 17 standards. Scores for each item ranged from 0 to 7 (Table 2). The total score thus reflects the level of carbon proactivity. The scoring system was developed in accordance with ISO14064-1.

Table 2. Scoring Standards.

Measurement	Score
No answer to the question (item) is provided	0
An answer to the question is provided, but the answer is qualitative, with brief and/or insufficient information	1–2
The answer to the question is qualitative, with sufficient detail or some brief quantitative information	3–4
The answer is given using quantitative or monetary information, concerning the timing of initiatives, quantitative carbon dioxide reduction targets, completion of projects, etc.	5–7

In particular, each sample firm was assigned scores using the following formula:

$$\text{Score (carbon proactivity)}_i = \sum_{j=1}^{17} \text{score}\left(I_i^j\right)$$

where Score (carbon proactivity)$_i$ describes the total score for corporate carbon proactivity for firm i, and I_i^j is the score of the jth item for firm i, in which j = 1, 2, . . . , 17. All 17 items were weighted equally. Thus, the score for each firm ranged from 0 to 119 (17 × 7).

4.3. Models

We developed the following two equations to test the proposed hypotheses.

$$CP_{i,t} = \alpha + \beta_1 * ETS_{i,t} + \beta_2 * CP(-1) + \beta_3 * control_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$FP\_index_{i,t} = \alpha + \beta_1 * CP_{i,t} + \beta_2 * CP_{i,t-1} + \beta_3 * ETS_{i,t} + \beta_4 * control_{i,t} + \varepsilon_{i,t} \quad (2)$$

where CP indicates carbon proactivity, the FP_index is a dependent variable representing financial performance, and control represents the sum of the control variables. In order to address the endogeneity issue, CP(−1) is added in Equation (1). CP(−1) is a time-lagged variable. Pooled OLS estimates are initially adopted.

Consistent with the literature (Kumarasiri and Jubb 2016; Lun 2011; Mao et al. 2017; Tang and Luo 2016; Tian et al. 2016), this study controlled for firm size, capital structure, firm age, cash holdings, growth ability, capital intensity, year, and industry. In addition to these, further controls were induced by dividing firms into state-owned enterprises (SOEs) or non-SOEs. In China, state control of corporate entities is common, and such organizations are closely linked to the government. SOEs are more likely to act in a way that is aligned with governmental policy, such as in joining an ETS. SOEs were thus expected to respond more proactively to carbon emissions than non-SOEs. Table 3 presents the definitions of terms and the measurement of the variables.

Table 3. Definition and Measurement of Variables.

Variable	Abbreviation	Measurement
Carbon proactivity	CP	The total score obtained from the 17 items assessing CP
Emissions trading scheme	ETS	A dummy variable that equals 1 if the firm participates in the ETS pilot program and 0 otherwise
Return on assets	ROA	Net income divided by average total assets in year t
Return on equity	ROE	Net income divided by average shareholder equity in year t
Tobin's Q	TQ	The total market value of the company based on the year-end price and the number of shares outstanding, plus preferred stock, as well as the book value of long-term debt and current liabilities, divided by the book value of total assets
Leverage ratio	LEV	Total debt divided by total assets in year t
Firm age	AGE	The number of years since the company's IPO
Growth ability	GROW	The operating income growth rate of the firm
Firm size	SIZE	The natural logarithm of total assets in year t
Capital intensity	CAPIN	Capital spending divided by total sales revenues
Cash holdings	CASH	The ratio of cash to total assets in year t
State-owned enterprise	SOE	A dummy variable that equals 1 if the firm is a state-owned enterprise and 0 otherwise

5. Empirical Results

5.1. Result Analysis

Table 4 presents the summary statistics. The minimum, maximum, and standard deviation for CP were 0, 57, and 10.7, respectively, which implies considerable variation in corporate carbon proactivity. The mean for CP was 9.52/119, indicating that Chinese firms were, on average, taking action on carbon reduction. In addition, a few companies presented no CP at all (CP score = 0). This is not a surprising result because the Chinese ETSs were a pilot experiment, and the firm data were from only its first 3 years.

Table 4. Descriptive statistics: All Firms.

	CP	ETS	ROA	ROE	TQ	LEV	CAPIN	GROW	SIZE	CASH	AGE	SOE
Mean	9.53	0.50	0.05	0.09	1.49	0.51	2.06	0.11	10.24	0.15	12.88	0.64
Median	6.00	0.50	0.03	0.08	1.24	0.51	1.59	0.07	10.15	0.13	13.50	1.00
Max.	57.00	1.00	0.85	2.40	8.92	0.91	20.86	2.51	11.77	0.57	24.00	1.00
Min.	0.00	0.00	−0.17	−0.53	0.00	0.12	0.30	−0.90	9.16	0.01	0.00	0.00
Std. Dev.	10.74	0.50	0.09	0.19	1.15	0.17	1.73	0.32	0.57	0.10	5.98	0.48
Obs.	264	264	264	264	264	264	264	264	264	264	264	264

Statistics for the ETS firms and non-ETS firms are shown in Table 5. The mean CP of ETS firms was 11.15, which was higher than that of non-ETS firms, which scored 7.9 on average. This result was consistent with H1a. We used a *t*-test to compare the means for CP between ETS and non-ETS firms, and the difference was significant at the 5% level (t = 2.48, $p < 0.05$). In addition, differences between ETS and non-ETS firms in the means of the control variables, such as SIZE, CASH, and AGE, were negligible, which indicates that the ETS group and the benchmark non-ETS group were comparable.

Table 5. Descriptive statistics: ETS Firms and Non-ETS Firms.

ETS Firms											
	CP	**ROA**	**ROE**	**TQ**	**LEV**	**CAPIN**	**GROW**	**SIZE**	**CASH**	**AGE**	**SOE**
Mean	11.15	0.05	0.09	1.47	0.52	1.98	0.11	10.25	0.16	13.33	0.73
Median	8.00	0.03	0.08	1.25	0.51	1.48	0.06	10.11	0.12	15.00	1.00
Max.	42.00	0.85	2.40	5.36	0.91	20.86	2.51	11.77	0.57	24.00	1.00
Min.	0.00	−0.12	−0.51	0.85	0.12	0.30	−0.90	9.16	0.01	0.00	0.00
Std. Dev.	10.88	0.11	0.24	1.04	0.19	2.10	0.34	0.58	0.11	6.34	0.45
Obs.	132	132	132	132	132	132	132	132	132	132	132
Non-ETS Firms											
	CP	**ROA**	**ROE**	**TQ**	**LEV**	**CAPIN**	**GROW**	**SIZE**	**CASH**	**AGE**	**SOE**
Mean	7.90	0.05	0.09	1.51	0.51	2.14	0.10	10.22	0.15	12.43	0.55
Median	5.00	0.04	0.08	1.24	0.51	1.72	0.08	10.17	0.13	12.50	1.00
Max.	57.00	0.26	0.36	8.92	0.79	8.02	2.40	11.31	0.51	23.00	1.00
Min.	0.00	−0.17	−0.53	0.19	0.17	0.69	−0.57	9.20	0.02	0.00	0.00
Std. Dev.	10.38	0.06	0.12	1.26	0.15	1.24	0.30	0.56	0.09	5.58	0.50
Obs.	132	132	132	132	132	132	132	132	132	132	132

Table 6 reports the correlations. All the correlation coefficients were below the critical value of 0.8 (except for the figures for ROA and ROE), suggesting that multicollinearity was not an issue in our sample.

The results of Equation (1) are reported in Table 7. The result indicates that the coefficient for the ETS was significant at the 1% level and was positively correlated with CP. This result is consistent with our argument that participating in an ETS changes a corporation's reaction to carbon. Thus, H1a is supported. The results in Table 7 further indicate that the coefficient of SOE was significant at the 5% level and positively related to CP in an ETS setting in Result (2), but it was not observed in a non-ETS setting, as seen in Result (3). This indicates that SOEs showed a higher level of carbon proactivity than non-SOEs in an ETS setting. This supports our argument that SOEs are more likely to take action to align themselves to government policies than non-SOEs. CP(−1) was incorporated into Equation (1) to mitigate endogeneity and the results are robust. Table 8 shows the descriptive statistics of carbon proactivity in sample firms by calendar year. We calculated the annual growth rate of carbon proactivity between EST firms and non-EST firms and found that ETS firms had a higher growth rate (9.8% per annum) than non-ETS firms (6.6%),

indicating that the ETS firms were more carbon proactive than the non-ETS firms. H1b is supported.

Table 6. Correlation matrix.

	CP	ETS	ROA	ROE	TQ	LEV	CAPIN	GROW	SIZE	CASH	AGE	SOE
CP	1.00											
ETS	0.15	1.00										
ROA	−0.12	−0.00	1.00									
ROE	−0.05	0.00	0.92	1.00								
TQ	−0.27	−0.02	0.19	0.09	1.00							
LEV	0.14	0.03	−0.32	−0.17	−0.41	1.00						
CAPIN	−0.07	−0.04	0.21	0.08	−0.06	−0.03	1.00					
GROW	−0.01	0.02	0.07	0.14	0.06	0.03	−0.29	1.00				
SIZE	0.50	0.03	−0.01	0.10	−0.53	0.47	−0.02	0.04	1.00			
CASH	0.06	0.03	0.14	0.09	0.16	−0.26	0.00	0.03	−0.10	1.00		
AGE	0.02	0.08	−0.16	−0.12	−0.16	0.15	−0.03	−0.10	0.14	0.04	1.00	
SOE	0.23	0.19	−0.17	−0.14	−0.11	0.18	0.08	−0.13	0.23	0.03	0.31	1.00

Table 7. Regression results: Equation (1).

CP	All Firms	ETS Firms	Non-ETS Firms
	Result (1)	Result (2)	Result (3)
ETS	0.705 ***		
SIZE	4.077 ***	4.339 **	3.980 ***
LEV	−4.326 ***	−6.236 ***	−3.733
CAPIN	−0.286 ***	−0.391 ***	0.006
GROW	−0.242	−2.028 ***	1.447
CASH	3.379 ***	−0.940	8.541
AGE	−0.086	−0.117	−0.039
SOE	1.365 **	0.582 **	1.611
CP(−1)	0.589 ***	0.541 ***	0.618 ***
YEAR_CON	YES	YES	YES
C	−35.590	−33.955	−37.416

** $p < 0.05$; *** $p < 0.01$ (two-tailed).

Table 8. Descriptive Statistics of Carbon Proactivity by Calendar Year.

CP	All Firms			ETS Firms			Non-ETS Firms		
	2014	2015	2016	2014	2015	2016	2014	2015	2016
Mean	8.73	10.08	10.32	10.20	12.09	12.31	7.25	8.07	8.24
Median	6	6.5	6.5	8	8	7.5	4.5	5	5
Max.	49	57	54	40	42	37	49	57	54
Min.	0	0	0	0	0	0	0	0	0
Std. Dev.	10.02	11.59	10.62	10.25	11.66	10.86	9.68	11.30	10.31
Obs.	88	88	88	44	44	44	44	44	44
Carbon Proactivity Growth		8.7%			9.8%			6.6%	

The figures reported in Table 9 represent the empirical association between a firm's carbon proactivity and its financial performance. To mitigate the endogeneity issue, ROA(−1) was incorporated in all regressions. The results indicated that the coefficients of CP were negatively associated with ROA. However, the coefficients for lagged CP showed no statistical connection with FP. These results indicate that corporate financial performance was adversely affected where the corporation exhibited carbon proactivity in the given financial period. This finding is further supported when the samples are divided into ETS and non-ETS firms. Our findings support H2a but are contrary with H2b. We argue that in

order to improve a firm's carbon performance, it will reduce short term profitability due to the significant investment in technology innovation. The benefit of emissions reduction from those green investments is expected to be received in the long-term. Our findings diverge from those of Garcés-Ayerbe and Cañón-de-Francia (2017). In an EU ETS setting, they demonstrated that pressure on a corporation to reduce carbon emissions was not as high as expected in for the first (2005–2007) or second (2008–2012) trading phases because too many free permits were allocated. The excess permits in the market drastically reduced the incentive to be more carbon proactive. It appears that the Chinese ETS learned from the EU ETS. We observed a statistical impact from the ETS on Chinese firms. We expect that as long as the mechanism can be run in an appropriate manner (e.g., allocating fewer free permits or making an ETS more economically attractive but less risky) it will push Chinese firms to be more carbon proactive and reduce carbon emissions in the long term. These results further indicate that ETS firms had more carbon proactivity than non-EST firms. Firms that assigned more resources to carbon proactivity risked reduced current-year profits but they can support their financial performance in the future.

Table 9. Regression results: Equation (2).

Dependent: ROA	All Firms	ETS Firms	Non-ETS Firms
	Result (4)	**Result (5)**	**Result (6)**
ETS	0.011 ***		
CP	−0.001 ***	−0.001 ***	−0.001 **
CP(−1)	0.000	0.001	0.000
SOE	−0.014 ***	−0.033 ***	−0.008 ***
ROA(−1)	0.371 ***	0.241 **	0.590
LEV	−0.133 ***	−0.146 ***	−0.099 ***
SIZE	0.031 ***	0.034 ***	0.022 ***
CAPIN	0.015 **	0.023 ***	−0.005 **
GROW	0.021 ***	0.002	0.030 ***
CASH	0.041 ***	0.021	−0.012
AGE	−0.001 **	0.001 ***	0.000
YEAR_CON	YES	YES	YES
C	−0.241 ***	−0.261	−0.144 ***

** $p < 0.05$; *** $p < 0.01$ (two-tailed).

5.2. Additional Tests

In order to validate the results, additional tests were conducted. We used return on equity (ROE) to index corporate financial performance. To mitigate the endogeneity, ROE(−1) was incorporated in those additional regressions. The results are summarized in Table 10. It can be seen that these results are consistent with our main findings in Table 9.

ROA and ROE are accounting-based measurements. We further investigate this relationship by using market-based measurement, Tobin's Q (TQ) as a corporate performance index. Again, to mitigate the endogeneity, TQ(−1) was incorporated in all additional regressions. Table 11 show the results. Result (10) supports our argument that an ETS mediates the carbon-reduction performance and financial performance. However, CP is not found to be statistically significant with TQ. This result may indicate that the market may not have reacted quickly when the pilot ETS was introduced. Interestingly, Results (8) and (11) show that the coefficients for CP(−1) were positively associated with ROE and TQ at the 5% and 1% levels, respectively, in ETS firms. These results support our argument that in long-term and in an ETS setting, the firm's financial performance have been improved if it had been carbon proactive in previous years. These findings were not duplicated for non-ETS firms (Results [9,12]).

Table 10. Additional regression results: Equation (2).

Dependent: ROE	All Firms	ETS Firms	Non-ETS Firms
	Result (7)	Result (8)	Result (9)
ETS	0.018 ***		
CP	−0.002 ***	−0.003 ***	−0.001
CP(−1)	0.000	0.001 **	−0.001
SOE	−0.036 ***	−0.055 ***	−0.022 ***
ROE(−1)	0.258 **	0.204 **	0.565 ***
LEV	−0.241 ***	−0.256	−0.154
SIZE	0.090 ***	0.103 ***	0.054 **
CAPIN	0.018	0.029 ***	−0.006
GROW	0.070 ***	0.034	0.086 ***
CASH	0.069 ***	0.067	−0.045 ***
AGE	−0.001	−0.001	0.001
YEAR_CON	YES	YES	YES
C	−0.737 ***	−0.857 ***	−0.411 **

** $p < 0.05$; *** $p < 0.01$ (two-tailed).

Table 11. Additional regression results: Equation (2).

Dependent: Tobin's Q	All Firms	ETS Firms	Non-ETS Firms
	Result (10)	Result (11)	Result (12)
ETS	0.060 ***		
CP	−0.001	−0.002	0.002
CP(−1)	0.003	0.004 ***	−0.002
SOE	0.105 ***	0.200 ***	0.110
TQ(−1)	0.597 ***	0.793 ***	0.514 ***
LEV	−0.802 **	−0.431 **	−0.717 **
SIZE	−0.477 ***	−0.373 ***	−0.580 ***
CAPIN	−0.033 ***	−0.022 ***	−0.039
GROW	−0.012	0.044	−0.004
CASH	−0.383 ***	−0.715 **	0.569
AGE	0.001	0.003	−0.008
YEAR_CON	YES	YES	YES
C	5.890 ***	4.343 ***	7.013 ***

** $p < 0.05$; *** $p < 0.01$ (two-tailed).

6. Conclusions

This paper examined the impacts of ETSs on corporate carbon proactivity and whether participating in an ETS can mediate the carbon-reduction performance and financial performance of a corporation. We found that the corporate carbon proactivity among the Chinese firms sampled was relatively low. However, firms that were part of an ETS were more carbon proactive than non-ETS firms. Furthermore, the results showed that an EST can mediate the relationship between carbon performance and financial performance. Our empirical evidence is in line with the theoretical argument derived from the literature and hypotheses. The findings represent a step forward in the study of carbon disclosure, ETSs, and corporate financial performance. A proactive carbon strategy can bring sustainable competitive advantages for corporations that participate in a carbon-trading market. However, the trading market must be set up in such a way that corporate managers consider it to be more economically attractive but with less risk.

A novel and innovative approach was developed here to measure corporate carbon reduction. The measurement we developed is different from the measurements used in the literature. Although emissions reductions are a desired result, understanding the drivers that make corporations more carbon proactive is more broadly important. This knowledge will not only help corporations reduce their carbon emissions but also support their financial performance in the long term. The question of the effectiveness of an ETS

remains unestablished, but our discussion and findings point to a bright future ahead, so long as managers are willing to pursue it and do not incur financial penalties for their actions.

Interpretation of the results should approached with caution as there are a number of factors to consider. First, potential errors in scoring the carbon proactivity may exist. The measurement of carbon proactivity may not be as accurate as expected, which may lead to biased regression results. Second, the sample primarily mixed private firms and stated-owned firms. The results may apply to Chinese operational environments only. Finally, this study investigated the impacts of ETSs with a short sample period and in mixed industries. With more collectable data, a more detailed investigation could be carried out in different industries.

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Appendix A. Carbon Proactivity Questionnaire

1. Does the organization have carbon reduction targets?
Yes No
If yes, provide details of the targets (e.g., scope 1/scope 2, whether the targets have been met, and so forth):
2. Does the organization have an emissions reduction/energy conservation committee or a committee with a similar mandate?
Yes No
If yes, provide details on the committee, including its duties, the number of people on the committee, its chair's background, and so on.
3. Does the organization have projects that aim to lower its carbon footprint and save energy (e.g., using clean energy)?
Yes No
If yes, provide details (e.g., are there any actual figures on energy savings and completion percentages for the projects?):
4. Does the organization have an electricity management policy?
Yes No
If yes, provide details (for example, electricity consumption figures, how the policy is implemented, and so on):
5. Does the organization have a carbon management strategy, policy, or system?
Yes No
If yes, provide details:
6. Does the organization produce or provide low carbon/green products or services?
Yes No
If yes, provide a brief description of these offerings:

7. Does the organization have any policy and action for carbon mitigation of its supply chain?
Yes No
If yes, provide brief details:
8. Does the organization disclose specific information on carbon emissions (e.g., carbon or greenhouse gas emissions, scope 1, scope 2, or scope 3)?
Yes No
If yes, provide details:
9. Did the organization reduce absolute carbon emissions compared to the previous year?
Yes No
If yes, provide details:
10. Does the organization trade carbon and disclose information on it?
Yes No
If yes, provide details, such as the location of the ETS, and so forth:
11. Does the organization set an internal carbon price?
Yes No
If yes, provide details, such as how the price is determined and how it is used for carbon control purposes:
12. Has the organization reduced its carbon emissions compared to the previous year?
Yes No
If yes, provide details (e.g., total actual carbon emissions for each of the 2 years, scope 1 or 2, and so forth):
13. Are the organization's actual emissions higher or lower than its carbon allowance?
Higher Lower Equal
Provide details, for example, on total carbon allowances of the organization, actual carbon emissions, the shortfall in the allowance, reasons for these, and so on:
14. Does the organization have energy consumption and savings policy and projects?
Yes No
If yes, please provide details on the targeted energy savings figures, actual figures, actual energy consumption figures, rewards given to staff for saving energy, and reducing the carbon footprint, and so on:
15. Does the organization disclose its energy consumption (traditional, and renewable) information?
Yes No
If yes, provide details here:
16. Is stakeholder engagement carried out related to carbon reduction and energy savings?
Yes No
If the answer is yes, provide details (e.g., customer, employee, shareholders, government, or supplier engagement):
17. Please provide any additional important information not mentioned above regarding the sustainability of the organization.

Notes

[1] Global reporting initiatives are a framework reflecting the multiple dimensions of environmental practices by firms. It provides a method of summarizing and scoring corporate environmental information disclosure.

[2] ISO14064-1 specifies the quantification and reporting of GHG emissions and removal with guidance at the organization level.

[3] On 16 December 2016, the Sichuan carbon market opened. Sichuan became the first non-pilot ETS area in China and the eighth province with a carbon-trading institution, called the Sichuan Provincial Environmental Exchange. On 22 December 2016, carbon-emissions trading began in Fujian province. Because the period under investigation was 2014 to 2016, these two areas were omitted from data collection.

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