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A big data study on emitting companies' performance in the first two phases of the European Union Emission Trading Scheme

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ABSTRACT

As CO_2 emissions are quantified by allowances and traded in markets, wise trading strategies will bring emitting companies higher profits or lower costs. Based on the big data of Community Independent Transaction Log (CITL), this article hereby presents a micro study on the emitting companies' efforts in increasing profits and saving costs during the allowances trading in the first two phases of the European Union Emission Trading Scheme (EU ETS). The efforts are measured by an after-action factor of trading performance, which is built on a series of behaviour and monetary variables. By comparison, demanders of the emitting companies are more inclined to reach a higher trading performance, while that inclination is heterogeneous among the suppliers. In addition, emitting companies with lower emission levels had a better trading performance. With a higher proportion of low-emitting companies, the manufacturing sector had a better trading performance than the energy sector. The effect of the trading requirement on trading performance are investigated via a quantile regression mode. Results suggest that: (1) the selling requirement of suppliers has a positive effect on their trading performance, while the effect becomes weaker when the selling requirement increases; (2) the buying requirement has a positive effect on the demanders' trading performance only when the requirement is high, and the effect becomes stronger as the requirement increases; and (3) when the buying requirement is at a lower level, demanders' trading performance becomes worse as the requirement grows. The conclusion is that the emission level, industrial sector and trading requirement do have influences on the trading performance of emitting companies in emission trading.

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1. Introduction

Due to great concerns over climate change, the European Union (EU) have initiated a cap-and-trade system in 2005 to control the carbon dioxide (CO_2) emissions of the emitters in its domain, which is known as the European Union Emission Trading Scheme (EU ETS). In 2014, about 4 percent of the global green-house gas emissions were covered by the EU ETS (Olivier et al., 2014). As a mitigation strategy, emission trading is more preferable to the emitters than carbon tax (Simon and Albert, 2015).

The participants of this scheme can be divided into three types: the EU Commission, the emitting companies, and the third parties. The role of the EU Commission is the regulator and policy-maker; the emitting companies are the emitters whose CO_2 emissions are regulated by the EU Commission; the third parties are investors, exchanges, and some firms or institutes who have interests in the emission trading. Among those participants, the emitting companies, who share the overall emission gap, are the most impacted participants. In the first phase (Phase I) and second phase (Phase II) of the EU ETS, most of the carbon allowances were freely allocated to the emitting companies based on the national allocation plan (NAP). Meanwhile the compliance obligation requires them to cover CO_2 emissions with allowances. Allowances can be traded in markets to satisfy the compliance and financial requirement of emitting companies. The transfer of allowances can be tracked in the Community Independent Transaction Log (CITL) after a three-year delay. Therefore the EU ETS can be closely observed at a micro level.

There are some micro studies have focused on the trading behaviours and trading patterns in the data of CITL. A remarkable phenomena reflected by the CITL is that the trading was passive and primarily motivated by the compliance obligation (Trotignon and

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Nomenclatures

EU ETS	European Union Emission Trading Scheme
CITL	Community Independent Transaction Log
NAP	National allocation plan
ITL	International Transaction Log
UNFCC	United Nations Framework Convention on Climate Change
OHA	Operator Holding Account
PHA	Person Holding Account
PA	Party Account
CDM	Clean Development Mechanism
OLEED	Ownership Links and Enhanced EUTL Dataset
EUA	European Union Allowance
AAU	Assigned Amount Unit
CER	Certified Emission Reduction
ERU	Emission Reduction Unit
JI	Joint Implementation
ECX	European Climate Exchange
OTC	Over-the-counter
NACE Rev. 2	The second revised version of the Statistical Classification of Economic Activities in the European Community
e	Indicates an emitting company
k	The observable year of the EU ETS in the CITL
t	Time factor
N	Indicates the N^{th} phase of the EU ETS
$a_{e,k}$	The allowances allocation volume of emitting company e in year k
$s_{e,k}$	The allowances surrender volume of emitting company e in year k
$A_{e,N}$	Total allocation volume of emitting company e in Phase N
$S_{e,N}$	Total surrender volume of emitting company e in Phase N
$G_{e,N}$	Allowance gap between emitting company e's total allocation volume and total surrender volume.
$L_{e,N}$	Emission level of emitting company e in Phase N
$n_e(t_0,t_1)$	Net income of emitting company e's allowances trading from t_0 to t_1 (non-delivered trading is included)
$EUA_{e,t}$	The EUA net trading volume of emitting company e at the time t
$CER_{e,t}$	The CER net trading volume of emitting company e at the time t
$ERU_{e,t}$	The ERU net trading volume of emitting company e at the time t
$p_{EUA,t}$	The price of EUA at time t
$p_{CER,t}$	The price of CER at time t
$p_{ERU,t}$	The price of ERU at time t
$\mathbb{S}_N$	The set of emitting companies who are the market suppliers in Phase N.
$\mathbb{D}_N$	The set of emitting companies who are the market demanders in Phase N.
$AN_{e,N}$	The average net income of emitting company e in Phase N
$\angle\theta_{e,N}$	The dimensionless index for emitting company e's trading performance in Phase N

Delbosc, 2008; Martino and Trotignon, 2013; Betz and Schmidt, 2015). For the emitting companies, the EU ETS was a compliance instrument rather than a profitable market-based instrument (Martin et al., 2014). Although compliance is the core factor that impacts the trading behaviour of the emitting companies, it is not the only one. Jaraite-Kazukauske and Kazukauskas (2014) found that trading behaviour is constrained by the transaction cost, especially for smaller emitters. Zaklan (2013) incorporated the firms' balance sheet information into the transaction data, and found that a firm's trading volume is mostly impacted by its market-specific factors (i.e. size, sector, and ownership structure). Inter- and intra-firm trading were also examined in his study, and he found no evidence that the sample firms exhibited trading bias in self-selection. Martin et al. (2014) interviewed 429 manufacturing firms in EU ETS, and they found that on the supply side of the allowances markets, emitting companies start to sell allowances if the surplus of allowances reach a certain level (in their research, it is about 5000 tonnes). However, the emission trading activities had no obvious influence on the emitting companies' performance. Based on an event study of the allowances,Jong et al. (2014) found that firms' trading activity in allowances markets have no impact on their performance in stock markets when prices went down sharply in April 2006. However, due to the complicities in the data collecting, cleaning, and processing, the researches based on the CITL are rare, and no published research has ever studied the trading behaviour in Phase II of the EU ETS.

As a new financial instrument, the prices of allowances have a higher volatility. By means of a wise allowances trading, the emitting companies will increase profits or reduce costs (Fan et al., 2014). Emitting companies are also players in other markets, such as goods markets and stock markets. Tian et al. (2016) found that the stock prices of the EU energy sectors are significantly impacted by the EUA price volatility. So the profitability in the allowance markets influences the performances in other markets. This study examines the trading performance of emitting companies in the allowance markets. *Trading performance is defined in this study as the ability to increase the over profits or reduce the overall costs during allowance trading*. The three main aims of this study are: (1) to interpret the trading behaviour and to define the trading performance for the EU ETS from a micro perspective; (2) to find differences in trading performance based on emission levels and industrial sectors; and (3) to find the relationships between the emitting companies' trading requirement and their trading performance. The study employs microdata from the CITL and a firms' ownership links established by Jaraite et al. (2013a, 2013b). The CITL contains all the physical transfer of allowances at the account-level; and with the firms' ownership links, the CITL data can be aggregated into firm-level data. The next section introduces the CITL data and carbon prices data. In Section 3, variables of trading behaviour and a dimensionless indicator of trading performance are defined in accordance with the CITL data; the trading performance of companies with different emission levels and in industrial sectors is compared; then a quantile regression model was built to examine the effect of the trading requirement on trading performance. Section 4 offers conclusions of the study and recommendations for future research.

2. Data

This section introduces the structure of the CITL data. Based on a firms' ownership links, a firm-level transaction database was built

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