



The market microstructure of the European climate exchange [☆]



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ARTICLE INFO

Article history:

Received 28 January 2013

Accepted 3 November 2013

Available online 20 November 2013

JEL classification:

G13

G32

E44

Keywords:

Carbon

Market microstructure

Bid-ask spread

Information share

Order imbalance

ABSTRACT

This paper analyzes the market microstructure of the European Climate Exchange, the largest EU ETS trading venue. The ECX captures 2/3 of the screen traded market in EUA and more than 90% in CER. Volume growth has averaged 277% in EUA between 2005 and 2009 and 724% in CER since 2007. Spreads range from €0.0188 to €0.0406 for EUA and €0.0276 to €0.0796 for CER. The median proportion of the spread due to adverse selection reaches 76% for EUA and 75% for CER. Realized volatility, bid-ask spreads and adverse selection costs decline with verified emission releases. Market impact estimates imply that an average trade will move the EUA market by 1.06 euro centimes and the CER market 1.45. The ECX is providing between 75% and 88% of price discovery for EUA trading and between 64% and 72% for CER. We find imbalances in the order book help predict returns for up to three days. A simple trading strategy that enters the market long or short when the order imbalance is strong is profitable even after accounting for spreads and market impact.

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1. Introduction

The largest market for carbon trading is the European Union Emissions Trading System (EU ETS), a cap and trade scheme that emerged out of the Kyoto Protocol. European Union Allowances (EUA), the primary compliance instrument, and project based credits called Certified Emission Reductions (CER), are currently traded on eight major exchanges, BlueNext, Climex, the European Climate Exchange (ECX), European Energy Exchange (EEX), Energy Exchange Austria (EXAA), Green Exchange, Gestore del Mercato Elettrico (GME) and Nord Pool.

The ECX has, since the start of carbon exchange trading in 2005, been the leading venue. In 2009, the ECX processed 65.6% of the screen based trading volume in EUA and 91.6% in CER. The current

paper analyzes the market microstructure of the ECX and contrasts it with more mature commodity markets. We find that, after less than five years of trading, the ECX has comparable spreads to markets like gasoil and natural gas. Furthermore, the futures market dominates price discovery as in many other commodity markets.

There are very few intra-day analyses of carbon emissions market. [Benz and Hengelbrock \(2008\)](#) is the first market microstructure study of EUA futures. They analyzed the liquidity and price discovery of two EUA futures markets, ECX and Nord Pool for the Phase I 2005–2007. They find that their bid-ask spread estimate in the market has narrowed, and the more liquid ECX dominates the contribution to price discovery. [Rittler \(2012\)](#) studies price discovery and volatility spillovers between the EUA spot and futures market in the first year of Phase II. [Conard et al. \(2012\)](#) analyze high-frequency volatility dynamics following EU policy announcements. [Medina et al. \(2013\)](#) calculate bid ask spreads for Phase I and Phase II EUA.

EUA prices collapsed well before the end of Phase I due to an excess supply of credits, and allowances could not be banked. These obstacles inhibited market liquidity. The total volume of EUA futures trading during 2005–2007 was approximately 1500 million metric tonnes of CO₂ equivalent (MMtCO₂e), which is less than half of the volume traded in the single year 2009. EUA prices have stabilized in the Phase II compliance period, 2008–2012. For these

[☆] We would like to thank the European Climate Exchange and BlueNext for providing data. We have benefited from comments at the CFTC Conference on Commodity Markets, the SNDE Conference in Istanbul, the Auckland Finance Meeting, Conference on Energy Finance in Trondheim, 51st Meeting of the EWGCFM, the seminar at the Luxembourg School of Finance and the University of Duisburg-Essen.

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reasons, we believe that a comprehensive market microstructure analysis of Phase II carbon trading is needed.

We extend the carbon pricing literature by analyzing market impact as well as spreads, using the structural Madhavan et al., 1997 model. While previous studies focused only on the EUA market, we also explore the CER market. We examine the price discovery contribution across spot and futures markets. Finally, we examine the predictive content of order imbalances for future EUA returns.

Our tick data from the ECX includes only trade prices, volumes, and the direction of trade initiation. To estimate the bid-ask spreads, we use the MRR (1997) GMM approach. Median spreads on the most liquid December 2009 expiry contracts are €0.0188 for EUA and €0.0276 for CER. Spreads decline with the release of European Commission (EC) data about allowances in April and accumulating information about the economy. The spreads rise with realized volatility and decline with trade frequency. The more illiquid 2010 to 2012 expiries are from 40% to nearly 200% larger.

The model allows us to examine the contents of the spread, the adverse selection cost and the cost of supplying liquidity. The median proportion of the EUA spread due to adverse selection is 76% which is consistent with a highly institutional market like the ECX. The model also provides a measure for market impact. We find a median market impact of €0.0106 for EUA and €0.0145 for CER.

We then examine the cointegration between ECX futures and the spot market which is dominated by BlueNext. From these estimates, we compute information shares using Hasbrouck (1995) approach and an alternative decomposition based on Gonzalo and Granger (1995). Using either measure, we find that the ECX is providing between 75% and 88% of price discovery for EUA trading. The information dominance of the ECX in CER trading is not as strong as EUA, with about 64% and 72% of price discovery coming from the futures. These estimates support the model of Figuerola-Ferretti and Gonzalo (2010) in which the more liquid market should lead price discovery.

Our final section examines return predictability when there is an imbalance between buyer and seller initiated trading volumes. We find persistence in returns lasting up to three days. We then devise a simple, profitable trading strategy that enters at the close on days of large imbalances and exits at the next day's open.

We begin with a description of the competitive environment faced by the ECX in Section 2. Then we analyze trading activity in EUA and CER in Section 3. We estimate spreads and market impact for EUA and CER futures in Section 4. Section 5 contains our IS analysis. Section 6 looks at return predictability and trading profits from order book imbalances. Section 7 concludes.c

2. Market Share

The two major instruments traded in the EU ETS are EUA and CER credits. Each security offsets one metric tonne of CO₂ equivalent (MtCO₂e). Demand and supply are determined from national allocations distributed at the individual facility level.¹ We examine market share in each, starting with EUA.

2.1. EUA

The top panel of Table 1 contains estimates of the ECX screen market share in EUA from 2005–2009. The ECX has 65.59% of

¹ There were 12,242 installations in the EU registry which were allocated 1966 MMtCO₂e in 2009.

Table 1
EUA and CER market shares in screen trading.

| | Market share | | | | |
|------------|--------------|---------|--------------|--------------|---------|
| | Volume | ECX (%) | Nordpool (%) | BlueNext (%) | EEX (%) |
| <i>EUA</i> | | | | | |
| 2005 | 55.8 | 63.57 | 23.63 | 7.81 | 4.66 |
| 2006 | 233.9 | 72.33 | 7.41 | 13.27 | 6.87 |
| 2007 | 451.0 | 83.30 | 5.92 | 5.26 | 5.46 |
| 2008 | 1,180.9 | 70.42 | 2.03 | 20.87 | 6.68 |
| 2009 | 3,293.6 | 65.59 | 0.63 | 32.79 | 0.98 |
| <i>CER</i> | | | | | |
| 2007 | 5.7 | 0.00 | 100.00 | 0.00 | 0.00 |
| 2008 | 185.4 | 91.43 | 4.23 | 3.02 | 1.32 |
| 2009 | 298.4 | 91.63 | 0.57 | 7.58 | 0.22 |

The market shares and volume are based on 2009 traded totals of EUA and CER futures, spot and options transactions in MMtCO₂e. We exclude EXAA from the table for space reasons. The data were collected directly from the exchanges.

screen trading activity.² Volumes are in MMtCO₂e. Volume growth has averaged 277% in EUA between 2005 and 2009.

The primary competition in EUA for the ECX is coming from BlueNext which was acquired by NYSE/Euronext in late 2007. They have steadily increased market share, reaching 32.8% in 2009, primarily through a dominance in spot trading.³ Nord Pool, which sold its clearing operation to Nasdaq OMX in October 2008, continues to erode.⁴ The EEX, peaked in 2006 with a 6.87% market share, but it has less than a 1% market share in 2009.⁵

2.2. CER

CER is project based. Article 12 of Kyoto created the Clean Development Mechanism (CDM) which enables developed countries to produce offsets through projects outside of Kyoto. There is now a well-established procedure for registering these credits through the United Nations. Mizrach (2012) estimates that, as of November 2010, 2463 projects have been approved which produce an annual average of 389.3 million CERs.

Once registered, credits can be traded in the secondary market to third parties. All of the exchanges which publicly report data also trade CERs. We tabulate trading volumes in spot, futures and options in the bottom panel of Table 1. Volume growth has averaged 724% in CER since 2007. The dominance of the ECX is even clearer from this table. The ECX has 91.63% of screen trading activity.⁶

3. EUA and CER futures trading

As shown above, ECX is the leading market for both EUA and CER trading. About 87% (68%) of EUA (CER) trades on ECX are screen based. Because the futures contracts are the most liquid, we focus primarily on the futures market. As such, our analysis

² There is also a substantial volume of trading in an over-the-counter (OTC) market that clears through the exchanges. In 2009, the ECX processed 2114.4 MMtCO₂e in EUA, representing a 98.85% market share.

³ In December 2012, the BlueNext spot market closed following a series of permit thefts from the EU registry. While ECX offers a "daily futures" contract as a substitute, the volume has remained very small. As of July 5, 2013, only 43,115 daily contracts have traded this year, only 1% of the 4.229 million longer term EUA futures contracts.

⁴ Nasdaq's acquisition of Nordpool has not increased trading activity on the exchange. In the past year, July 2012–June 2013, the re-branded Nasdaq OMX Commodities Europe has traded only 15,276 EUA and 2652 CER futures contracts.

⁵ The EEX is primarily an emissions auction market. In 2012 though, the combined volumes of screen and auction based trading were, according to Bloomberg June 11, 2013, "European Energy Exchange Approves New Carbon-Market Subsidiary," was less than 4% of the volumes traded on the ECX.

⁶ The majority of CER trading still takes place OTC. In 2009, the ECX processed 610.0 MMtCO₂e in CER, representing a 99.42% market share.

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