Journal of Cleaner Production 183 (2018) 786–796

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

The impacts of liquidity dynamics on emissions allowances price: Different evidence from China's emissions trading pilots

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ARTICLE INFO

Article history:
Received 6 October 2017
Received in revised form
30 January 2018
Accepted 14 February 2018
Available online 16 February 2018

Keywords:
Liquidity dynamics
Emissions allowances
Pricing efficiency
Illiquidity ratio
Trade-based liquidity
Volatility clustering

ABSTRACT

The liquidities of China's emissions trading markets have significant impacts on emissions allowances price movement and pricing efficiency. Liquidity measures on illiquidity ratio and trade values indicate Hubei emissions allowances (HBEA) product has the highest liquidity, Shenzhen allowances (SZA) and Guangdong emissions allowances(GDEA) products have the higher liquidity than Beijing emissions allowances (BEA) and Shanghai emissions allowances (SHEA) products, while Tianjin emissions allowances (TJEA) product has the lowest market liquidity in considered China's emissions trading pilots. The dynamics of the illiquidity ratios for all selected emissions allowances products are negatively related with emissions allowances returns, and trade volumes for BEA, TJEA, SZA and HBEA products are also negatively related with emissions allowances returns. The dynamics of daily illiquidity ratios and trade-based liquidity in Beijing, Tianjin, Guangdong, Shenzhen, Hubei emissions pilots have significant volatility clustering impacts on the variances of regional emissions allowances returns. Previous market shocks of overnight and intraday price variations have the more persistent influences on the GDEA returns than HBEA returns, reflecting greater inter-day price ranges clustering effect.

1. Introduction

China has announced eight regional emissions trading market including Shenzhen, Beijing, Shanghai, Tianjin, Guangdong, Hubei, Chongqing and Fujian pilots since May 2013. Accumulative trading volume for eight emissions allowances pilots have 132.41 million ton, their total trading values have 2798.67 million Yuan from June 19, 2013 to July 31, 2017, accordingly Chinese emissions market scale has become one of the largest emissions trading markets in the world. The China's emissions trading scheme (CETS) has confirmed transformative and explorative practices, and gradually generated a greater interest among academics and practitioners alike try to estimate market liquidity, emissions allowance pricing and market efficiency.

Markets perform two key functions: the provision of liquidity and price discovery (OHara, 2003). Market liquidity plays an important role in increasing price discovery and pricing efficiency and by extension market efficiency. Many scholars pay much attention to energy market liquidity and efficiency. Cross-market liquidity and energy stocks prices have significant causality with energy trading volume and stocks spread (Sari et al., 2012; Sklavos et al., 2013). Money supply amount of China's real M_2 have the statistically significant and cumulative impact on crude oil price than that of G3 (U.S. Eurozone and Japan) real M_2 (Ratti and Vespignani, 2013). Legislation targeting energy efficiency and peak demand reduction has spatial-difference impacts on electricity prices, and the influence of coal on electricity prices increases relative to natural gas in the USA (Ardakani et al., 2012). Emissions allowances market and fossil energy markets have significantly positive correlation across time, there is significant unidirectional volatility spillover from coal market to carbon market and from carbon market to natural gas market(Zhang and Sun, 2016).

The operation and success of the European Unions emissions trading scheme (EU ETS) has significantly inform the direction of global climate policy to provide cost-efficient market tool for

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https://doi.org/10.1016/j.jclepro.2018.02.150
0959-6526/

greenhouse emissions mitigation. Market microstructure and liquidity from the EU ETS has generated greater interests for many scholars and practitioners in decade years. Trading volume and liquid traders have the significant impacts on the volatility for all emissions futures contracts by assessing Ultra high frequency data in futures market of the EU emissions trading scheme (Bredin et al., 2014). Three different groups of informed, fundamental and uninformed trader have different trading behaviors in European Carbon Futures Market, OTC (exchange traded) trades are used strategically by the informed traders who perform the informed counteract by increasing their trade size and speed, fundamental traders react faster in phase II, and different traders enhance market transparency and increase market maturity (Kalaitzogloua and Ibrahim, 2013). The price and size of futures contracts in European emissions futures market are complementary, and emissions trader round both the price and the size of their orders (Palao and Pardo, 2014). A personal emissions trading scheme is progressive and provided a buffer between energy and emissions allowances prices, affected consumers' welfare changes (Li et al., 2015). Emissions trading and carbon tax regulations have important impacts on production price, firm's profit and social welfare (Xu et al., 2015). The volatility-activity of European emissions allowances prices exhibits a positive and significant relation, which can be mainly attributed to energy providers in the EU ETS phase I, however other players remain inactive and trade more emissions allowances when the volatility is lower (Balietti, 2016). The volatility of stock returns of electricity companies is significantly driven in the same direction by the volatility of the EU allowances market in EU ETS (Tian et al., 2016). European carbon futures market shows the existence of herding behavior, it is characterized by leading the emissions price discovery and by being highly dominated by professional traders, and then herding behaviors are strongly related with the speculative periods, trader number, intraday volatility and days with extreme returns (Palao and Pardo, 2017). Different trader types in EU emissions markets exhibit different trading behaviors, and play the important role in price discovery and pricing efficiency of emissions allowances.

Trading patterns and intensity, order flow, market depth and OTC transactions confirm possible distinct effects on market liquidity from the EU emissions trading markets. An increase and incline of trading intensity and OTC transactions have significant impacts on price volatility, both the liquidity and information price impact components increase following an OTC trade (Kalaitzogloua and Ibrahim, 2013). Order submission of emissions allowances in European emissions markets influence the price discovery process and provide stronger price leadership in the period before the allowances submission data, and then the futures market play the predominant informational role thereafter (Philip and Shi, 2015). Adding an environmental weight and lower bids below cost have the potential to reduce emissions intensity of power generation without reducing overall profitability to generators or enhancing cost to consumers in bid-based electricity market dispatch (Deardorff, 2016). OTC trading volume show significant Granger causality to spot and futures price volatility, and uni-directional causality from OTC to futures volumes is mainly driven by heterogeneous investor beliefs (Rannou and Barneto, 2016). The flow imbalances of electronic limit order book have a moderate capacity to predict short term price changes, the consolidated status of the order book reduce a high level of market uncertainty and a low degree of information efficiency (Rannou, 2017). A surprise increase of verified emissions announcement enhance emissions futures returns, the announcements in volatility and trading volumes exhibit a wait-and-see stylized trading behavior (Chen et al., 2017).

Moreover, trading flexibility and increased liquidity may significantly improve efficiency and price discovery of emissions allowances markets. Emissions price pass-through is critical to the survival of existing coal generation assets, and emissions cost would ultimately be reflected in higher electricity prices (Kim et al., 2010). The efficiency and price discovery are both improved by allowing intermediation in linked emissions markets, intergovernmental trading treatment and direct firm-to-firm trading benefit the greatest from linking emissions markets for the buyers and sellers (Cason and Gangadharan, 2011). EU futures market show long-run price discovery process and spillovers from the futures to the spot market, therefore the information role of the futures market increases over time (Rittler, 2012). Trading costs are a more important determinant of price discovery in the EU ETS, securities with low trading costs display greater price discovery than those with high trading costs (Schultz and Swieringa, 2014). Platform operators and regulators in China may understand how the market evolution of liquidity could influence the price discovery of emissions allowances.

However, price clustering in emissions markets is taken as a sign of market inefficiency. The emissions price history information is not fully reflected in current carbon price in the EU ETS, emissions futures prices exhibit short-term memory, and emissions futures market is mildly chaotic, indicating both market and fractal market characteristics (Feng et al., 2011). The European emissions futures markets exhibit the strong presence of price clustering regime-switching process and volatility persistence, and emissions future prices are strongly and immediate related with national allocation plan and unexpected news on future economic development as well as current economic activity(Palao and Pardo, 2012; Conrad et al., 2012; Segnona et al., 2017). The persistence of shocks to emissions allowances prices is markedly reduce when allowing for structure breaks (Gilalana et al., 2016). Emissions trading activities in the EU non-competitive emissions trading markets often not occur on the frequent basis, the trial phase I was inefficient, whereas the Kyoto phase II shows signs of restoring market efficiency (Montagnoli and Vries, 2010). European emissions put-call options with short-term contracts are efficient priced than that of long-term options contracts, covered firms can trade options on emissions permits to achieve mitigation strategy and manage greenhouse gas emissions decisions (Krishnamurti and Hoque, 2011). Main European emissions futures markets are inefficient and bring arbitrage opportunities the trial phase I, and futures market are consistent with weak market efficiency and gradually attaining a state of maturity in Kyoto phase II (Charles et al., 2013; Daskalakis, 2013). European emissions prices have continuously move nearer to unity with efficient and random walk benchmarks in Phase II of the EU ETS, trading quality has improved markedly and matures, liquidity and market efficiency exhibit a strong relationship when price spreads narrow (Ibikunle et al., 2016). Intermediate levels of emissions allowances uncertainty may increase option value of abatement investment in EU ETS, however higher level of uncertainty may postpone option value of abatement investment (Maarten and Venmans, 2016; Mayer et al., 2017). Covered companies in Japan are confirmed to have low awareness and modest approval of market-based instruments, such as energy saving, carbon tax and emissions trading scheme(Liu et al., 2014). Emissions reductions for international companies generate positive impacts on their financial performance, and the companies promote greater environmental behaviors in order to obtain higher financial performance in EU ETS (Alvarez et al., 2015). Emissions level, industrial sector and permits trading requirement have significant impacts on the trading performance of emitting companies in EU ETS (Liu et al., 2017). Emissions allowances price and the link between liquidity and pricing efficiency is even more important for market participants to incorporate new information into their allowances trading strategies and investment strategies.

China's emissions trading pilots are newly emerging markets, and many scholars and practitioners home and abroad may learn