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Multiple bubbles in the European Union Emission Trading Scheme

Anna Cretí[a,*], Marc Joëts[b]

[a] Université Paris Dauphine, PSL Research University, LEDa, Place du Maréchal Delattre De Tassigny, 75016 Paris, France
[b] Banque de France, International Macroecono mic Division, and EconomiX-CNRS, University of Paris Ouest, France

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ABSTRACT

The European Union Emission Trading Scheme (EU ETS) is the first large scale CO_2 emission trading system in the world. Carbon allowances are financial assets, potentially vulnerable to the behavior of traders and investors. In fact, the carbon price has been quite volatile since the inception of the market, and it has recently hit very low values. However, to date, no work exists to evaluate whether volatility and price spikes are due to episodes of speculation and price bubbles. Our paper fills this gap. We use the recent approaches developed by Phillips and Yu (2010), Phillips et al. (2011), and Phillips et al. (2015a, 2015b) who propose a recursive right sided unit root approaches to detect and date-stamp mildly explosive behaviors and carbon market exuberance. We complement this methodology by using the wild bootstrap procedure by Gonçalves and Kilian (2004) to control for the heteroschedasticity of carbon price data. Analyzing the EU ETS front month contract price, from 2005 to 2014, we find different episodes of price bubbles. These episodes are not explained by similar behavior of the fundamentals but seem related to energy and environmental policy announcements. Our results can provide insightful policy implications in the context of the actual carbon market reform, as well as the implementation of stricter financial regulations rules to CO_2 trading.

1. Introduction

The European Emission Trading Scheme (EU ETS) is the largest carbon market in the world, covering almost 11,000 installations. The EU ETS has been organized in three phases: the first period (2005–2007); the Kyoto phase (2008–2012); and the third one (2013–2020), this latter set to meet the European target of 20% greenhouse gas emission reduction in 2020 compared to 1990, in line with the 2008 Climate Energy Package. The first period is unanimously considered the "trial phase". Emitters were freely allocated an initial amount of permits. Phase II, instead, represented a more mature period. Emitters received again free allocations, but less than in the first period, and banking was introduced. Finally, in the current Phase, a single, EU-wide cap on emissions has been applied. Moreover, the system has shifted from free allocation to auctioning. In 2013, more than 40% of allowances have been auctioned to the electricity sector, and this share rises each year (DG Clima, 2016).

The rationale behind the establishment of the EU ETS is that emissions trading allows to achieve emission reduction targets in an efficient and effective way (Montgomery, 1972). Under a cap-and-trade system, the emissions intensive firms can buy and sell permits across both different sources of pollution and time periods (Rubin, 1996). Emission abatement under the form of carbon reduction technologies is undertaken whenever its costs is below the benefits, which include saving in carbon permits. In this manner, abatement will be realized where it comes at the least cost.

Overall, the EU ETS has been successful in creating a carbon price, whose drivers have clearly been identified: economic activity, fuel prices, abatement potential, extreme temperatures (Aatola et al., 2013; Creti et al., 2012; Alberola and Chevallier, 2009; Alberola et al., 2008; Mansanet-Bataller et al., 2007). Uncertainty and expectations also play an important role (Hintermann, 2010; Daskalakis et al., 2009; Paolella and Taschini, 2008). Moreover, within the carbon price drivers literature, several event studies have proven the impact of specific policy announcements on the carbon price (see Fan et al., 2017 and the references therein). Indeed, the carbon price remains sensitive to supply and demand shocks and to energy and environmental policy measures.[1] This volatility, however, does not seem to harm market efficiency.[2] According to Montagnoli and de Vries (2010), Crossland et al. (2013), Daskalakis (2013), Niblock and Harrison (2013), market

* Corresponding Authorauthor at: Université Paris Dauphine, PSL Research University, LEDa, Place du Maréchal Delattre De Tassigny, 75016 Paris, France.
E-mail address: marc.joets@banque-france.fr (A. Cretí).

[1] See Chevallier (2012) for en extensive survey on the carbon price drivers.

[2] We refer here to weak efficiency, achieved when permits' prices reflect all available information, to the extent that no investor can systematically gain abnormal risk-adjusted positive returns (Fama, 1970). We leave aside the models that focus on the cost-of-carry relationship (Alberola and Chevallier, 2009; Uhrig-Homburg and Wagner, 2009; Joyeux and Milounovic, 2010; Charles et al., 2013), which provide mixed results on the applicability of that concept to the EU ETS future and spot prices.

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efficiency increased during Phase II compared to Phase I, despite low trading volumes.

Nonetheless, the EU ETS has shown some weaknesses. Hintermann et al. (2016) affirm: “We cannot say with any degree of confidence whether the [CO_2] price is “right,” in the sense that it reflects marginal abatement costs, or whether there is a price wedge caused by transaction costs, price manipulation, or other sources of inefficiency”. Since 2008, more EUAs have been issued each year than were used, leading to a substantial stock of allowances in circulation. The permits surplus has reached 2100 Mt at the beginning of the EU ETS third phase (DG Clima, 2016) and the permits price has hit a minimum of 2.81 euros on January 23rd, 2013 (Financial Times, 2013). To avoid situations of persistent imbalances between demand and supply, as a short-term measure the Commission postponed the auctioning of 900 million allowances until 2019–2020 (Chaton et al., 2015). As a long-term intervention, the European regulator is actually proposing to reform the EU ETS. The key measure of such reform is a market stability mechanism, aimed at containing price fluctuations through an annual adjustment of the allowance supply (Neuhoff et al., 2015). Beside these market design issues, on the financial side, the risk of not attaining market integrity and the potential for gaming have been underlined by respectively the European court of auditors (2015) and EDF et al. (2015). Furthermore, the European Securities and Markets Authority (ESMA) has launched a consultation process that also addresses specific issues for the emission allowance market (ESMA, 2014). This consultation process takes place within the context of the implementation of the Market Abuse Regulation and follows other ongoing consultations for the implementation of the new Markets in Financial Instruments Directive and Regulation. For the time being, the implementing rules and standards are being prepared by the European Securities and Markets Authority, which will have important consequences in terms of the obligations for participants in the EU ETS. As from 2017, the carbon market will fall within the rules of regulatory oversight governing financial markets, to ensure a safe and efficient trading environment and to enhance confidence in the market.

In this challenging context, it is crucial to understand if price spikes (both positive and negative) are due to speculation or to market reactions to fundamentals. As a consequence, an intriguing research question is the impact of speculative trading on the EU ETS carbon price. So far, a few papers have tackled the issue of speculation in the carbon market. Colla et al. (2012) underline the analogy between permits and financial assets and develop a theoretical cap-and-trade model with firms, speculators and an environmental agency that optimally sets the aggregate amount of emission allowances and freely allocates them. The authors show that, if firms have to invest under uncertainty at the beginning of the trading period, and then produce and exchange permits, speculators hold positive inventories and have positive compensation for their risk-bearing activity. Social welfare depends on the relative risk attitude of firms, speculators and the agency. In particular, if the agency is sufficiently risk-neutral, speculators foster firms' production. An implicit reference to bubbles can be found in Hintermann (2010), who derives a semi-structural model to identify carbon price drivers under uncertainty. He finds that only a small part of price variation during Phase I of the EU ETS has been driven by fundamentals, and qualitatively interprets the difference between the price and the true value of a carbon tonne as a “price bubble”. Hintermann (2017) and André and De Castro (2015) develop models in which CO_2 price manipulation is driven by the oligopolistic structure of the polluting sectors.

Turning to the empirical literature, Lucia et al. (2015) explore the dynamics of the speculative and hedging activities in European futures carbon markets by using volume and open interest data. A comparison of the three phases in the EU ETS reveals that Phase II seems to be the most speculative period to date. The highest degree of speculative activity for every single phase occurs at the moment of listing the contracts for the first time. According to the literature on futures markets (Rutledge, 1979; Leuthold, 1983; Bessembinder and Seguin, 1993), this analysis builds on the idea that speculators are informed traders, and that volume gathers information about speculation, whereas open interest is related to hedgers' activity.

In our view, in the EU ETS speculation can only arise on a very limited time horizon, under the form of mild explosive processes or “bubbles” whose occurrence is empirically tested. To our knowledge, this is the first attempt to characterize this kind of speculative behavior in the EU ETS market. As suggested by Phillips et al. (2011), “bubbles are modeled using mildly explosive bubble episodes that are embedded within longer periods where the data evolve as a stochastic trend, thereby capturing normal market behavior as well as exuberance and collapse”. The existence of bubbles is not necessarily related to sustained and long term speculation, as it is for instance the case in the oil market where there is long lasting divergence between the market price and what would be implied by the fundamentals. Bubbles may exist due to the behavior of some traders/investors who make transactions not necessarily rational. A similar argument explains the presence of outliers in the volatility of carbon prices (Chevallier, 2011a, 2011b), or the impact of greedy and non-greedy speculators whose behavior may distort the EU ETS price behavior. For instance, Zhu et al. (2015) and Palao Sánchez and Pardo (2016) find occasional episodes of speculation. Mild explosive processes may also depend on the non-linear relationship between carbon prices and energy fundamentals (Lutz et al., 2013). Clearly bubbles, as long as they are detected, do originate from massive and homogeneous traders' behavior. Furthermore, bubbles quickly disappear. They do not affect market efficiency, which is well documented in for the EU ETS, in particular as from 2008 (see for instance Zhang et al., 2010; Rickels et al., 2015). Bubbles do not occur as the market becomes more mature and sticks to the fundamentals, that is as from the end of the second phase. Our findings contribute to the literature of carbon price drivers by investigating the nature of the few speculative events that have characterized the EU ETS market. For instance is has been recently claimed that in the European market for pollution permits “compliance transactions become more and more marginal as market activity grows and that they are drowned in a whirlpool of speculation” (Berta et al., 2016). Our paper also helps investigating some specific effects of this speculative component which needs to be explained in a rigorous setting. To reinforce our findings, we have identified some policy announcements that coincide with the bubbles dates and interpreted how these announcements might have impacted traders' behavior resulting in speculative episodes. We have also conducted event studies analyses to check whether at these dates returns changes at the EU ETS price series could be detected. This is actually not the case, meaning that the nature of the bubbles is clearly different from sudden price level changes or jumps.

We assume that permits are financial assets[3] and apply a modified asset pricing relationship, as permits do not generate dividends and must be hold by each installation to grant annual compliance to the emission cap. We then look for bubbles in the carbon market by applying the recent approaches developed by Phillips and Yu (2010, hereinafter PY), Phillips et al. (2011, hereinafter PWY), and Phillips et al. (2015a, 2015b), hereinafter PSY). This methodology develops rolling right-tailed superior Augmented Dickey Fuller testing procedures to detect and date stamp mildly explosive pricing behavior.[4] When applying PWY and PSY, we use the recursive wild bootstrap

[3] For instance, in October 2011, in the Market Financial Instruments Directive II (MiFID II) which proposed revisions to the financial requirements for trading in the market, the European Commission added EUAs and international credits by creating a separate category for marketable securities, derivatives and financial contracts. This inclusion in the revised MiFID II means EUAs are officially classified as financial instruments.

[4] These tests have been applied to the dollar-sterling exchange rate (Bettendorf and Chen, 2013) and to agricultural commodities (Etienne et al., 2014).