Energy Policy 54 (2013) 369–375

Contents lists available at SciVerse ScienceDirect

Energy Policy

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

On the efficiency of the European carbon market: New evidence from Phase II

George Daskalakis *

Norwich Business School, University of East Anglia, Norwich NR4 7TJ, UK

HIGHLIGHTS

- I investigate the efficiency of the EU Emissions Trading Scheme (EU ETS) in the period 2008–2011.
- I examine the potential presence of economically significant predictabilities in the prices of four carbon futures.
- The results from 2010 onwards are consistent with weak market efficiency indicating that the European carbon market is gradually attaining a state of maturity.

ARTICLE INFO

Article history:
Received 10 July 2011
Accepted 23 November 2012
Available online 14 December 2012

Keywords:
Emission allowances
EU Emissions Trading Scheme
Market efficiency

ABSTRACT

I examine in the period 2008–2011 the efficiency of four carbon dioxide (CO_2) emission allowance futures traded in the Intercontinental Exchange (ICE). To this end, I assess the profitability of trading strategies based on simple technical analysis rules and naïve forecasts. The results from 2010 onwards are consistent with weak market efficiency. In turn, this finding suggests that the European carbon market is gradually attaining a state of maturity.

1. Introduction

The European Commission decided in 2003 to establish a mandatory cap-and-trade system for CO_2 emission allowances (or permits) as the central policy for Europe to attain its Kyoto protocol obligations (see Daskalakis et al. (2011) for a historical overview and a thorough description of the system). Since its first year of operation in 2005, the so-called EU Emissions Trading Scheme (EU ETS) has witnessed a phenomenal growth. Specifically, according to data presented in Kossoy and Guigon (2012), an impressive 7.9 billion tonnes of CO_2 were traded in the form of EU emission allowances spot and derivatives contracts in 2011. This translates to a monetary value of approximately US$148 (€106) billion. Compared to 2005, this corresponds to an aggregate increase in the volume (value) of the carbon transactions of about 2340% (1703%). As a result, Europe currently dominates the global carbon trading arena with a market share during 2011 that exceeded 76%.

The rationale behind the establishment of the EU ETS is the economists' belief that through emissions trading any emissions reduction targets can be achieved in an effective and economically efficient manner (e.g., Montgomery, 1972). This follows from the fact that under a cap-and-trade system the emissions intensive firms can move the permits across both different sources of pollution and time periods (e.g., Rubin, 1996). Considering that emissions abatement eventually requires all polluters to proceed to investments either for upgrading their technological infrastructure currently used, or for a complete change of technology, the relevant installations have the flexibility in this setting to undertake such investments only when the (financial) benefits of the necessary projects outweigh their costs (see Daskalakis et al., 2011). In this manner, the abatement measures will be realised where it is the cheapest and consequently the environmental targets will be met at a minimum cost.

As it becomes clear, in a cap-and-trade system like the EU ETS, the emissions abatement decision is a capital budgeting decision tightly dependent on the cost of CO_2, or equivalently, the price of the traded emission allowances. For example, consider a European power utility with a plant portfolio that consists primarily of coal-fired generation units characterized by low thermal efficiency and therefore by increased levels of emissions. The firm assesses different options for emissions abatement including the replacement of one of its existing power plants with a new gas-fired generation unit. This is a particularly complex decision that entails, among others, a comparison of the expected cost (price) of the carbon permits over the lifetime

* Tel.: +44 1603 592309; fax: +44 1603 593343.
E-mail address: g.daskalakis@uea.ac.uk

0301-4215/$ - see front matter
http://dx.doi.org/10.1016/j.enpol.2012.11.055

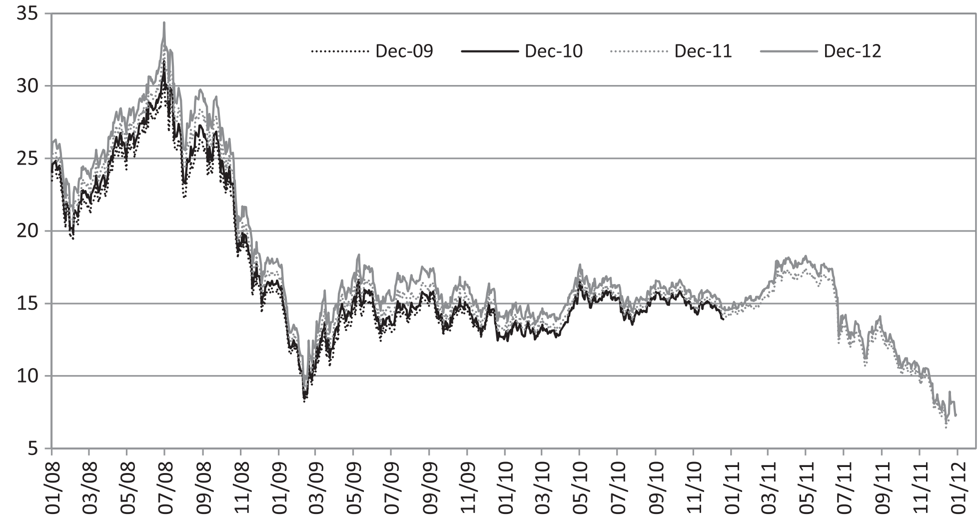

Fig. 1. Evolution of carbon futures prices (€/permit).

Table 1
Summary statistics of carbon futures prices (*P*) and logarithmic returns (LR).

	Dec-09		Dec-10		Dec-11		Dec-12	
	P	LR	*P*	LR	*P*	LR	*P*	LR
# Obs.	500	500	760	760	1019	1019	1027	1027
Mean	18.3515	−0.0009	17.3985	−0.0007	16.8491	−0.0012	17.5570	−0.0012
Median	15.6600	−0.0012	15.1450	−0.0008	15.3600	−0.0007	16.0400	−0.0006
Maximum	30.5300	0.1137	31.7100	0.1135	32.9000	0.1153	34.3800	0.1895
Minimum	8.2000	−0.0943	8.4300	−0.0930	6.4500	−0.1003	6.8600	−0.1004
Std. Dev.	5.6470	0.0270	5.2066	0.0242	5.2457	0.0239	5.4831	0.0245
Skewness	0.3272	0.0283	0.9630	−0.0361	1.0663	−0.1962	1.0257	0.2436
Kurtosis	1.6793	4.7030	2.5743	5.2603	3.3650	5.2873	3.3653	8.3236
Jarque–Bera	45.2615*	60.4913*	123.2028*	161.9532*	198.7391*	228.6734*	185.7988*	1222.8850*

* Statistical significance at the 99% level.

of the investment to the actual investment cost.[1] Naturally, a misspecification of this carbon cost will lead to a suboptimal capital budgeting decision: if it is underestimated then the firm may opt to postpone the investment while, if it is overestimated then the firm will proceed to a poor investment. Thus, the consequence for the power utility in both cases is increased costs in terms of abating emissions and attaining environmental compliance. Having a market for the trading of emission allowances allows the relevant installations to avoid such pitfalls. Specifically, as long as carbon prices reflect their fundamentals, i.e., marginal abatement costs, polluters can use the prices of the carbon futures traded under the EU ETS as input for the expected future carbon cost. This is the case, however, only if the established market itself is efficient (at least in a weak-form sense), that is, only if the permits' prices reflect all available information to the extent that no investor can systematically gain abnormal risk-adjusted positive returns (Fama, 1970).

Along this direction, Daskalakis and Markellos (2008) examined the efficiency of the European carbon market during Phase I of its operation (2005–2007). The authors provided evidence that the EU ETS was far from efficient, a finding they attributed to its short history.[2] Nonetheless, they further argued that this may also be a result of certain controversial aspects of the EU ETS design, with the most prominent being the ban of the intertemporal trading of the permits between different phases of the scheme (for a discussion regarding this issue and its implications see Daskalakis et al. (2011) inter-alia). In 2006, however, the EU Commission started reviewing the functioning of the EU ETS and adopted a year later several improvements regarding its operation from 2008 onwards. The most anticipated one was the removal of the inter-phase banking prohibition of the emission allowances (Directive 2009/29/EC).

Motivated by the aforementioned considerations, I investigate the efficiency of the European carbon market in the period January 2008–December 2011, i.e., for the main part of the so-called Phase II (2008–2012) of the EU ETS. Despite the importance of this issue, to the best of my knowledge, the only relevant study is the one by Montagnoli and de Vries (2010). The authors assessed the EU ETS market efficiency by performing a series of variance ratio tests on spot emission allowances from BlueNext. Their analysis indicated that following a period of inefficiency (Phase I), the EU ETS shows the first signs of restoring market efficiency.

In the present paper, I differentiate from them in several respects. Specifically, I focus on the carbon futures market instead of the spot one for three reasons: First, the futures market is the natural choice since, as in other commodity markets, this is where the price discovery of the carbon permits takes place (e.g., Chevallier, 2010). Second, the futures market accounts for most of the liquidity in the EU ETS. Particularly, during 2011 approximately 88% of the total carbon transactions in Europe were in futures, 2% in spot emission allowances and 10% in options (Kossoy and Guigon, 2012). In this manner, I am able to straightforwardly overcome the problem of thin trading in the spot

[1] I would like to thank an anonymous referee for pointing this out.
[2] Similar conclusions were recently drawn by Montagnoli and de Vries (2010).