ENVIRONMENTAL SCIENCE & POLICY 14 (2011) 569–577

available at www.sciencedirect.com

ScienceDirect

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

Optimal pricing instruments for emission reduction certificates☆

Srinivasan Sunderasan *

Verdurous Solutions Private Limited, 145, Navillu Road 7th Cross, Mysore 570023, India

ARTICLE INFO

Published on line 17 April 2011

Keywords:
Certified emission reduction
Carbon trading
Pricing currency
Basket currency
Terms of trade
Random walk
Efficient securities markets

ABSTRACT

The clean development mechanism (CDM), launched under the Kyoto Protocol is intended to internalize environmental externalities and to help developing countries achieve their developmental objectives employing cleaner, albeit possibly more expensive, technologies, inter alia creating markets for trading of emission reduction certificates ('certified emission reduction' CER). Statistical analyses reveal trends in pricing of Euro denominated CERs, which is interpreted as market inefficiency. Since the exporting countries are required to "liquidate", "package" and "export" a natural asset, and in real terms, surrender the option to employ certain technologies or to undertake certain initiatives, they should be recompensed through an asset of comparable quality, and more importantly, one on whose valuation the sellers have sufficient control. A currency-basket consisting of major CER exporting country currencies is considered. A specially constructed synthetic currency named the CERO, a weighted average of the CER exporting countries' import partners' currencies is proposed as a second alternative. It is strongly recommended that policy makers negotiating a successor to the Kyoto Protocol actively consider the basket approach to valuation proposed herein.

1. Introduction

Security prices evolve in random patterns in an efficient market where historical price movements cannot be employed to earn abnormal returns. Baillie and Bollerslev (1989) have observed that when a stochastic trend is detectable, the parameters being investigated could be predicted using currently available information, which has over time, gone on to be interpreted as market inefficiency (Crowder, 1994). In reality, arbitrage opportunities emerging from time to time within otherwise efficient markets are offset by transaction costs, thus negating the prospects for abnormal returns. This article begins by investigating the market efficiency for certified emission reductions (CER) designed and traded under the Kyoto protocol, and then proceeds to ascertain predictability and market efficiency. Alternative pricing mechanisms, intended at enhancing market efficiency, are discussed.

2. Background

The clean development mechanism (CDM), one of the flexibility mechanisms under the Kyoto Protocol, "stimulates sustainable development (in emerging market economies) and (global) emission reductions, while giving industrialized countries some flexibility on how they meet their emission

☆ The views expressed in this article are of the author himself and do not necessarily reflect those of any organization.

* Fax: +91 821 2547 553.
E-mail address: sunderasan@yahoo.com.
URL: http://www.verdurous.in

1462-9011/$ – see front matter
doi:10.1016/j.envsci.2011.03.013

reduction targets[1]". The scheme is an attempt to set-up a market-based mechanism to ensure least-cost mitigation of emissions. In other words, "projects that cut or prevent emissions of greenhouse gases in poor countries earn credits, which can be bought by rich countries in lieu of curbing their own emissions" (The Economist, 2007). In more colloquial terms, avoided emissions and the consequent clean air are *notionally* packaged and traded as an asset, domiciled in developing countries but "credited" to or "owned" by polluting entities within developed nations. Implicit within the 'flexible' Kyoto mechanisms is the creation of a market for emission reductions, wherein the price discovery process could unravel.

The CDM Executive Board has registered a total of 1909 projects and has issued over 354.8 million CERs as of end-November 2009, while the projects are expected to generate close to 1.68 billion CERs by 2012.[2] Interestingly, five of the host countries – China, India, Brazil, South Korea and Mexico – contribute 84.20% of all (average annual) CERs, the next five host nations contribute about 6.5% of the CERs while the remaining 48 countries cumulatively contribute over 9% of the CERs. This article employs the daily Euro denominated price per CER on the European Climate Exchange (ECX)[3] and France's BlueNext environmental trading exchange, for year-end settlement, to analyze the predictability and hence the efficiency of the price-discovery process.

3. Statistical predictability

If p_t denotes the closing CER price on day 't' and Δp_t the change in price between days '(t − 1)' and day 't', the augmented Dickey–Fuller test (Lee and Lee, 2009; Hamilton, 2008) could be implemented as below to model a random walk and to ascertain whether the lagged level helps predict the change in price. We test the hypothesis that the coefficient $\eta = 0$ in the following equation:

$$\Delta p_t = \eta p_{(t-1)} + \zeta_1 \Delta p_{(t-1)} + \cdots + \zeta k \Delta p_{(t-k)} + \varepsilon_t,$$
for a chosen k, the lag order of the autoregressive process. (1)

The results for the regression for various lag lengths for CERs due for delivery in the months of December 2008, 2009[4] and 2010[5] are displayed in Tables 1–3, respectively.

For CERs due in December 2008, the coefficient η of the price for trading day $(t - 1)$ is statistically significant at the 95% level for lag lengths of 4, 5, 6, 8 and 10, thereby prompting a rejection of the null hypothesis for those lag orders. Additionally, the coefficient ζ_4 for lag lengths 4 through 10 is significant at the 99% level indicating a trend wherein, changes in price are consistently influenced by changes witnessed 4 days past.

Table 1 – Results of the augmented Dickey–Fuller test for statistical predictability of CER prices for CERs due in 2008.

Lag length	η	ζ_1	ζ_2	ζ_3	ζ_4	ζ_5	ζ_6	ζ_7	ζ_8	ζ_9	ζ_{10}
1	−0.01439 (0.06328)	0.03047 (0.52273)									
2	−0.01375 (0.07682)	0.03140 (0.51008)	−0.05144 (0.28097)								
3	−0.01484 (0.05612)	0.03721 (0.43465)	−0.05321 (0.26339)	0.09124 (0.05578)							
4	**−0.01653* (0.03280)**	0.02696 (0.56963)	−0.04457 (0.34631)	0.08818 (0.06262)	**0.12908** (0.00674)**						
5	**−0.01581* (0.04302)**	0.03287 (0.49190)	−0.04076 (0.39095)	0.08514 (0.07303)	**0.12979** (0.00654)**	−0.05075 (0.28958)					
6	**−0.01688* (0.03198)**	0.03786 (0.42936)	−0.04968 (0.29912)	0.07959 (0.09436)	**0.13414** (0.00500)**	−0.05234 0.27493	0.07666 0.11056				
8	**−0.01598* (0.04578)**	0.04135 (0.39175)	−0.05313 (0.26993)	0.08270 (0.08599)	**0.13548** (0.00513)**	−0.05536 (0.25143)	0.07612 (0.11501)	−0.03498 (0.47077)	0.01134 (0.81530)		
10	**−0.01614* (0.04717)**	0.04323 (0.37290)	−0.05550 (0.25248)	0.08879 (0.06792)	**0.13111** (0.00719)**	−0.04819 (0.32452)	0.07673 (0.11710)	−0.04000 (0.41351)	0.01428 (0.77009)	−0.04102 (0.40037)	0.02821 (0.56300)

'p' value shown in brackets.
* Significant at 95% level.
** Significant at 99% level.

[1] http://cdm.unfccc.int/about/index.html.
[2] http://cdm.unfccc.int/index.html (accessed 30.11.09).
[3] www.reutersinteractive.com and http://www.bluenext.fr/statistics/downloads.html for data relating to CERs deliverable in December 2010.
[4] Data through mid-August 2009.
[5] BlueNext data from 2 June 2008 through 29 November 2010.