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Short Communication

Energy prices and CO₂ emission allowance prices: A quantile regression approachShawkat Hammoudeh^{a,b}, Duc Khuong Nguyen^{b,*}, Ricardo M. Sousa^{c,d}^a LeBow College of Business, Drexel University, Philadelphia, PA, USA^b IPAG Lab, IPAG Business School, 184 Boulevard Saint-Germain, 75006, France^c London School of Economics, LSE Alumni Association, London, United Kingdom^d Department of Economics and Economic Policies Research Unit (NIPE), University of Minho, Braga, Portugal

HIGHLIGHTS

- We study the impact of energy prices on CO₂ allowance prices in the United States.
- Quantile regressions are used to conduct the empirical analysis.
- Energy prices have generally different impacts on the CO₂ prices.
- These impacts also depend on whether CO₂ prices are at the low or the high quantiles.
- Policy implications are discussed.

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ABSTRACT

We use a quantile regression framework to investigate the impact of changes in crude oil prices, natural gas prices, coal prices, and electricity prices on the distribution of the CO₂ emission allowance prices in the United States. We find that: (i) an increase in the crude oil price generates a substantial drop in the carbon prices when the latter is very high; (ii) changes in the natural gas prices have a negative effect on the carbon prices when they are very low but have a positive effect when they are quite high; (iii) the impact of the changes in the electricity prices on the carbon prices can be positive in the right tail of the distribution; and (iv) the coal prices exert a negative effect on the carbon prices.

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1. Introduction

The literature on the dynamics of the CO₂ allowance prices and volatility has grown rapidly over the last decade. Previous works that mainly use univariate and multivariate linear models have strongly been challenged by the plausibility of nonlinear dynamics for the CO₂ prices (e.g., Daskalakis et al., 2005; Paoletta and Taschini, 2008; Seifert et al., 2008; Benz and Strück, 2009). For instance, Daskalakis et al. (2005) show that the spot prices of the CO₂ emission allowances exhibit a random walk volatility behaviour which can be captured by a jump-diffusion model. Paoletta and Taschini (2008) find that that a parametric GARCH with a generalized asymmetric *t*-distribution works well for

modelling the CO₂ allowance prices. Seifert et al. (2008) argue that the CO₂ prices exhibit a time- and price-dependent volatility structure. Benz and Strück (2009) reproduce the nonlinear dynamics of the CO₂ price returns by means of a Markov-switching model.

There is another strand of the literature that focuses on the price drivers of the CO₂ emission allowance markets. For example, Hintermann (2010) highlights the roles of fuel prices, summer temperature, and precipitation in governing the post-2006 crash CO₂ allowance prices. Kim and Koo (2010) show that the prices of crude oil, coal and natural gas significantly affect the trading of the carbon allowance prices over the short-run.

Other studies have considered the linkages between the spot and futures carbon allowance markets. Chevallier (2010a) emphasizes that the CO₂ futures prices are relevant for the price discovery in the spot emission allowance market. Chevallier (2010b) finds evidence of a positive time-varying risk premium in the CO₂ allowance prices, which is strictly higher for the post-2012 contracts than

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