THE EFFECT OF EMISSIONS TRADING ON THE RELATIONSHIP BETWEEN FOSSIL FUEL PRICES AND RENEWABLE ENERGY STOCK PRICES

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Overview

The European emission trading system (EU ETS), part of the EU's policies to combat climate change, is a market-based mechanism designed to help achieve greenhouse gas emissions reduction targets. Under this system, companies are required to buy emission allowances (EUAs) in an amount corresponding to their annual carbon emissions. To meet emission targets or to reduce the cost of relying on carbon-based fuels, the options available to power generators are fuel switching in the short run and/or investment in renewable energy technologies in the long run (Bruninx et al., 2020; Delarue and Van den Bergh, 2016; Chen and Tseng, 2008). Higher fossil fuel prices are often seen as an incentive for the power sector to use RES (Kumar et al., 2012; Apergis and Payne, 2014). However, emission trading schemes obscure the logical relationships between carbon-intensive fuel and renewable energy stock prices. For example, when carbon-intensive fuel prices increase, there is an incentive for power plants to use low carbon fuel rather than carbon-intensive fuel, which reduces the demand for emission allowance, placing downward pressure on allowance prices (Aatola et al., 2013; Batten et al., 2021; Weigt et al., 2013). The profits of renewable energy companies, which remain low, are closely related to allowance prices. Therefore, higher prices for carbon-intensive fuel have both a positive influence (owing to renewable energy penetration) and a negative influence (owing to decreased demand for allowances) on renewable energy stock prices.

Methods

In this study, we investigate the dependent relationship between a renewable energy index and the price of coal, the most carbon-intensive fuel, by considering the price of carbon. Focusing on the EU ETS Phase III, our empirical study uses European data for the period from January 2013 to December 2019. As a representative index of the European renewable energy sector, we consider the European renewable energy index (ERIX). For the price of carbon, we use the EUA futures price, which has been actively traded since the start of the EU ETS. To reduce noise, trend, and seasonal components and reconstruct time series with specific time scales of interest, we apply a discrete wavelet transform and obtain denoised and detrended series, namely wavelet-adjusted series.

Results

Using wavelet-adjusted series, we perform regression and vector autoregressive (VAR) analyses to examine the causality and direction of influence. The regression results imply that the coal price has a negative effect on the carbon price, the carbon price has a positive effect on the ERIX, and the coal price has a negative effect on the ERIX. Utilizing estimates from our VAR analyses we obtain the connectedness measure and impulse response functions. In a VAR system consisting of prices for coal, carbon, and ERIX, we find that the carbon price responds negatively to coal price shocks, ERIX responds positively to carbon price shocks, and finally, ERIX responds negatively to coal price shocks.

Conclusions

Although previous studies present evidence on the relationship between the EU ETS and the electric power sector, few consider how the ETS influences the way in which renewable energy stock prices depend on the price of carbon-intensive fuel. To fill this gap, we thoroughly investigate the relationships among the prices of coal and carbon, and the renewable energy index. Specifically, using wavelets we provide solid evidence of the negative relationship between ERIX and the price of carbon-intensive fuel. The analysis based on wavelets provides a better understanding of the dynamic dependence across different time scales (Hamdi et al., 2019; Jammazi and Aloui, 2010; Jiang and Yoon, 2020; Reboredo et al., 2017). The wavelet analysis shows that the original time series contains various levels of persistence, and based on wavelet decomposition we disentangle the components and reconstruct the time series. Using the wavelet-adjusted series we unveil significant relationships that are not explicitly seen in the original series and show that the results are robust across different specifications and estimation methods.

References

Aatola, P., Ollikainen, M., and Toppinen, A. (2013). Price determination in the EU ETS market: Theory and econometric analysis with market fundamentals. Energy Economics, 36:380–395.

Apergis, N. and Payne, J. E. (2014). Renewable energy, output, CO2 emissions, and fossil fuel prices in Central America: Evidence from a nonlinear panel smooth transition vector error correction model. Energy Economics, 42:226–232.

Batten, J. A., Maddox, G. E., and Young, M. R. (2021). Does weather, or energy prices, affect carbon prices? Energy Economics, 96:105016.

Bruninx, K., Ovaere, M., and Delarue, E. (2020). The long-term impact of the market stability reserve on the EU emission trading system. Energy Economics, 89:104746.

Chen, Y. and Tseng, C.-L. (2008). Climate policies and the power sector: Challenges and issues. Journal of Energy Engineering, 134(2):31–32.

Delarue, E. and Van den Bergh, K. (2016). Carbon mitigation in the electric power sector under cap-and-trade and renewables policies. Energy Policy, 92:34–44.

Hamdi, B., Aloui, M., Alqahtani, F., and Tiwari, A. (2019). Relationship between the oil price volatility and sectoral stock markets in oil-exporting economies: Evidence from wavelet nonlinear denoised based quantile and Granger-causality analysis. Energy Economics, 80:536–552.

Jammazi, R. and Aloui, C. (2010). Wavelet decomposition and regime shifts: Assessing the effects of crude oil shocks on stock market returns. Energy Policy, 38(3):1415–1435.

Jiang, Z. and Yoon, S. M. (2020). Dynamic co-movement between oil and stock markets in oil-importing and oil-exporting countries: Two types of wavelet analysis. Energy Economics, 90:104835.

Kumar, S., Managi, S., and Matsuda, A. (2012). Stock prices of clean energy firms, oil and carbon markets: A vector autoregressive analysis. Energy Economics, 34(1):215–226.

Reboredo, J. C., Rivera-Castro, M. A., and Ugolini, A. (2017). Wavelet-based test of co-movement and causality between oil and renewable energy stock prices. Energy Economics, 61:241–252.

Weigt, H., Ellerman, D., and Delarue, E. (2013). CO2 abatement from renewables in the German electricity sector: Does a CO2 price help? Energy Economics, 40:S149–S158.