Volatility Spillovers and Causality of Carbon Emissions, Oil and Coal Spot and Futures for the EU and USA

Chia-Lin Chang

Department of Applied Economics Department of Finance
National Chung Hsing University, Taiwan

Michael McAleer

Department of Quantitative Finance National Tsing Hua University, Taiwan
And Discipline of Business Analytics University of Sydney Business School, Australia
And Econometric Institute Erasmus School of Economics Erasmus University Rotterdam, Netherlands and
Department of Quantitative Economics Complutense University of Madrid, Spain
and Institute of Advanced Sciences Yokohama National University, Japan

Guangdong Zuo

Department of Quantitative Finance
National Tsing Hua University, Taiwan

Abstract

Recent research shows that efforts to limit climate change should focus on reducing emissions of carbon dioxide over other greenhouse gases or air pollutants. Many countries are paying substantial attention to carbon emissions to improve air quality and public health. The largest source of carbon emissions from human activities in some countries in Europe and elsewhere is from burning fossil fuels for electricity, heat, and transportation. The price of fuel influences carbon emissions, but the price of carbon emissions can also influence the price of fuel. Owing to the importance of carbon emissions and their connection to fossil fuels, and the possibility of Granger (1980) causality in spot and futures prices, returns and volatility of carbon emissions, it is not surprising that crude oil and coal have recently become a very important research topic. For the USA, daily spot and futures prices are available for crude oil and coal, but there are no daily spot or futures prices for carbon emissions. For the EU, there are no daily spot prices for coal or carbon emissions, but there are daily futures prices for crude oil, coal and carbon emissions. For this reason, daily prices will be used to analyse Granger causality and volatility spillovers in spot and futures prices of carbon emissions, crude oil, and coal. A likelihood ratio test is developed to test the multivariate conditional volatility Diagonal BEKK model, which has valid regularity conditions and asymptotic properties, against the alternative Full BEKK model, which has valid regularity conditions and asymptotic properties under the null hypothesis of zero off-diagonal elements. Dynamic hedging strategies using optimal hedge ratios will be suggested to analyse market fluctuations in the spot and futures returns and volatility of carbon emissions, crude oil and coal prices.

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