SHORT-TERM INTERACTIONS BETWEEN CARBON MARKETS GIVEN THE FINANCIAL NATURE OF CARBON PERMITS

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(1) Overview

Carbon markets are developing around the world. The European Union Emission Trading Scheme (EU ETS) started in 2005. Carbon credits from the Clean Development Mechanism (CDM) and the Joint Implementation (JI) are accepted for compliance into the EU ETS. Besides the EU ETS, national or sub-national systems are already operating in Australia, Japan, New Zealand and the United States, and are planned in Canada, China, South Korea and Switzerland. In August 2012, the European Commission and Australia announced agreement on a pathway for linking the EU ETS and the Australian emissions trading scheme. A full link between the two cap-and-trade systems will start no later than July 1st 2018. Within the United Nation Framework Convention on Climate Change (UNFCCC), new market mechanisms such as sectoral trading are also considered to have Non-Annex I countries involved in a global carbon market beyond the CDM. These examples show that interactions between different carbon markets are likely to develop. Economic analyses are needed to enlighten the impacts to expect from them.

Macroeconomic studies using computable general equilibrium models have been done to assess the long-term impacts of such interactions. Hamdi-Cherif et al (2010) analyzed sectoral trading if it were to be used between all Annex I and Non-Annex I countries. Gavard et al (2011a) evaluated the impact of sectoral trading on a hypothetical US-China coupling using the Emission Prediction and Policy Analysis (EPPA) model. They then quantified the impacts to expect from coupling the EU ETS with the electricity sector of China, India, Brazil and Mexico (Gavard et al, 2011b). More analysis is needed to examine short-term interactions between carbon markets, taking into account the potential consequences of the fact that carbon derivatives are now traded like financial commodities.

The purpose of the paper is to enlighten the short-term interactions between different carbon markets given the potential financial nature of carbon permits. To do so, we take advantage of the coexistence of different kinds of permits in the phase II of the EU ETS: the European Union Allowance (EUA) and the Certified Emission Reductions (CER) issued under the Clean Development Mechanism. We first build a model that combines the fundamental dynamics of carbon price and its potential financial nature. Using time series analysis, we estimate it on EUA and CER prices to determine the dominant factors. In particular, we examine to what extent carbon price is influenced by its own volatility, as would be the case for a financial asset. We then look at the short term interactions between EUA and CER price series.

(2) Methods

We develop a model combining the fundamental carbon price drivers identified by Hintermann (2010) and the Capital Asset Pricing Model (CAPM) developed by Sharpe (1964), Lintner (1965a, 1965b), and Mossin (1966). On the one hand, Hintermann developed a model to explain the carbon price drivers, based on fuel switching opportunities between coal and gas in the power sector. His assumption is that the power sector is the main source of demand for European allowances. He validated his model on the European allowance price series in the first phase of the EU ETS. He finds that carbon price variability is well explained by the changes in coal and gas prices as well as the general economic activity. On the other hand, carbon permits can be traded on financial markets. If carbon permits are financial assets, their volatility should be related to their return, following the CAPM: the higher the volatility of an asset, the riskier this asset, the higher the return expected by agents who could hold it. The Hintermann-CAPM model we develop combines these two dimensions: the power sector related carbon price dynamic and the potential financial dimension of carbon permits.

We test the model on CER and EUA time series from the Phase II of the EU ETS using time series analysis: the Autoregressive Conditional Heteroskedasticity (ARCH) model (Engle, 1982), the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model (Bollerslev, 1986) and the GARCH in the mean model (GARCH-M) (Engle, Lilien and Robins, 1987). Indeed ARCH and GARCH models are commonly employed in modeling financial time series that exhibit time-varying volatility clustering, i.e. periods of high volatility followed by periods of low variability. This is the case for CER and EUA price series. The GARCH-M model well describes the fact that the return of a financial asset may depend on its volatility. Given the fact that the volume of EUA and CER futures contracts is dominant over the volume of spot contracts, we test the Hintermann-CAPM model on futures price series that are constructed by rolling over futures contracts after their expiration date.

(3) Results

We first find that there is a co-integration relationship (Engle, Granger, 1987) between the carbon price, the coal price and the gas price. This means that there are a long-term relationship between these variables and a short-term relationship between these variables (in line with Hintermann's results) and a term depending on the previous period error term, which tends to bring carbon price back to the long-term equilibrium. We observe that the use of ARCH, GARCH and GARCH-M is justified by the presence of heterosckedasticity in the short-term relationship. Finally, we detect no significant impact of the carbon price volatility on the price series. These results are valid both for EUA and CER price series.

We then examine the interactions between these price series. Even if they are driven by similar factors, no long-term relationship is observed between the EUA and CER prices. But in the short term, impulse-shock response analysis and analysis using vector autoregressive (VAR) models show a causal link between EUA and CER price: the EUA price influences the CER price. The EUA volatility explains 60% of the CER volatility. Such results are consistent with the fact that the main demand for CER is the EU ETS, which causes the CER price to be influenced by the EUA price and not the opposite.

(4) Conclusions

Given the fact that carbon prices are driven by economic fundamentals but also by financial dynamics, we develop a model that combines these two components. We estimate it on EUA and CER prices in order to test the impact of each component relative to the other. We find that the main drivers remain related to the switching opportunities between coal and gas in the power sector, as presented by Hintermann (2010). But contrary to what Hintermann finds on the phase I of the EU-ETS, we find that there is a co-integration relationship between the carbon price, the coal price, the gas price and the economic activity. This means there are a long-term relationship between these variables and a short-term relationship that includes an error correction term and brings carbon price back to the long-term equilibrium. These results are valid both for EUA and CER price series.

The EUA and CER futures return do exhibit time-varying volatility clustering, which is often the case for financial time series. But the volatility is not significantly related to the return, contrary to what is usually observed for financial assets. This confirms the specific nature of carbon permits at the border between a commodity and a financial product.

Regarding the interactions between EUAs and CERs, we find no evidence of long-term relationship between these two price series, even if they are driven by similar factors. But in the short-term, we observe that the EUA price influences the CER price, and that 60% of the CER price volatility is explained by the EUA volatility. This is consistent with the fact that the EU ETS is the main source of demand for CERs in the world.

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