*Claire Gavard and Djamel Kirat*

# IMPACT OF THE FLEXIBILITY IN THE INTERNATIONAL CARBON CREDITS MARKET ON THE EUROPEAN ALLOWANCES PRICE

Claire Gavard, Centre d'Economie de la Sorbonne
106-115 Boulevard de l'Hôpital, 75013 Paris, France
Phone : +32.487.104.971, email : Claire.gavard@polytechnique.edu
Djamel Kirat, Laboratoire d'Economie d'Orléans
Université d'Orléans, rue de Blois, BP 26739, 45067 Orléans cedex 2
Phone : +33.2.38.49.49.88, email : djamel.kirat@univ-orleans.fr

## 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. Links between carbon markets may develop. For example, within the United Nation Framework Convention on Climate Change (UNFCCC), new market mechanisms have been discussed to have Non-Annex I countries involved in a global carbon market beyond the CDM. Economic analysis is needed to anticipate what to expect from such interactions. Macroeconomic studies using computable general equilibrium models have been done to assess the long-term impacts of such interactions, for example Hamdi-Cherif et al (2010) or Gavard et al (2011a, 2011b). More analysis is needed to examine short-term interactions between carbon markets.

The purpose of the paper is to enlighten the short-term interactions between different carbon markets given the potential financial nature of carbon permits and to examine whether the flexibility in the market for international carbon credits has some impact on the national carbon markets. 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. While the volume of EUA in the market is function of the cap that is set at the European level (supply by issuance of allowances) and the demand by installations that have to cover their emissions, the volume of CER available is actually flexible: CDM projects are constantly developed, including by companies that are covered by the European carbon market. Hence, CER and EUA are not perfect substitutes even if installations covered by the EU ETS can use some CER to cover part of their emissions (the EU ETS is the main source of demand for CER).

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.

## Methods

We develop a model combining the fundamental carbon price drivers identified by Hintermann (2010) and the Capital Asset Pricing Model (CAPM). 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.

## Results

We find that there is a co-integration relationship (Engle, Granger, 1987) between the carbon price, the coal price and the gas price. There are a long-term relationship between these variables and a short-term one between these variables 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. 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. These results are valid both for EUA and CER price series.

A main difference we find between EUA and CER is that, in the long-term relationship, the impact of the coal and gas price on the EUA price is explained by a demand-side effect, while the impact of the same variables on the CER price seems driven by a supply-side effect. This would reflect the flexibility that is inherent to the CER market. In the short-term, we do not find such differences between EUA and CER, meaning that some actors may vary the supply of CER to the market as a function of the coal and gas prices in the long-term but not from day to day.

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. 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. This would suggest that, although there is flexibility in the CER market, there is no visible impact of it on the EUA time series. 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. It is also interesting in terms of policy when considering potential new market mechanisms to couple the electricity sector of some developing countries to the carbon market developed in Europe, Japan or North America.

## Conclusions

In order to analyze the impact of the flexibility in the market for international carbon credits on the national carbon markets, we develop a model that combines the economic fundamentals of carbon permits and their potential financial nature. We estimate it on EUA and CER prices. 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. We find that, while the long-term relationship is explained by a demand-side effect for EUA, it seems driven by a supply-side effect for CER. However, the flexibility that this reflects in the CER market does not seem to have consequences on the EUA trading scheme. We indeed find no evidence of long-term relationship between these two price series, even if they are driven by similar factors. In the short-term, we observe that the EUA price influences the CER price, but that the opposite is not true.

## References


Hintermann Beate (2010) “Allowance Price Drivers in the First Phase of the EU ETS”, *Journal of Environmental Economics and Management*, 59 (2010) 1, 43-56.

Engle, Robert F. (1982) “Autoregressive conditional heteroskedasticity with estimates of the variance of United Kingdom inflation”, *Econometrica: Journal of the Econometric Society*, 50 (1982) 4, 987-1007.

Engle, Robert F., Granger, Clive W.J (1987) “Co-Integration and Error Correction: Representation, Estimation and Testing, *Econometrica: Journal of the Econometric Society*, 55 (1987) 2, 251-276.

Bollerslev, Tim (1986) “Generalized autoregressive conditional heteroskedasticity”, *Journal of Econometrics*, 31(1986)3, 307-327.

Gavard, Claire, Winchester, N., Jacoby, H.D., Paltsev S. (2011a) “What to Expect from Sectoral Trading : a US-China Example” *Climate Change Economics*, 2 (2011)1, 9-27.

Gavard, Claire, Winchester, N., Jacoby H.D., Paltsev S (2011b) “Sectoral Trading between the EU ETS and Emerging Countries”, *MIT JPSPGC Report* 193, Appendix A.

Hamdi-Cherif, Meriem, Guivarch, C., Quirion, P. (2010) “Sectoral Targets for Developing Countries: Combining ‘Common but Differentiated Responsabilities’ with ‘Meaningful Participation’”, *Climate Policy*, 11(2011)1, 731-751.