Emission Trading

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1 Introduction

According to the Kyoto targets negotiated in 1997, European Union member states had committed to reduce their CO_2 emissions by 8% by 2012. In order to reach this goal efficiently, the European Commission established the European Emission Trading Scheme (EU-ETS), a cap-and-trade scheme for emission allowances (EUA), in 2005. Each country defines their total amount of emission allowances in their respective National Allocation Plans (NAP), making only a limited amount of emission allowances available to installations operating under the ETS.

Only a small fraction of allowances had been auctioned in 2008, and firms were allocated most allowances at zero cost. Hence, with its creation, the EU-ETS established carbon emissions as a new tradable commodity. The majority of installations within the EU-ETS are in the energy and heat sector.

The EU-ETS is designed to operate in phases. Phase I (running from 2005 to 2007) could be regarded as a start-up and test period. Phase II (2008–2012), which coincided with the Kyoto commitment period. Currently in the Phase III, this is designed to run from 2013 to 2020. EUA prices were quite volatile in Phase I. After the first verification reports in May 2006 revealed an over-allocation of EUAs, prices decreased sharply and practically hit zero by mid-2007. The price dynamics of EUAs in Phase I could be explained (1) the EUA price seems to violate the Markov property and that arbitrage opportunities exist (e.g., Hinterman, 2010), and (2) that the EUA market differs from the price formation in other markets (e.g. , Nazifi,2013). The price dynamics of EUAs in Phase II could be explained (1) by analyzing the role of fuel price selection

(e.g. Rickels, Gorlich, and Peterson, 2014), and (2) with the help of market fundamentals (e.g. Hinterman, 2010).

Theoretically, the price for EUAs should reflect marginal abatement costs. Carbon abatement can be achieved by investing in cleaner technologies, by reducing production levels, or by fuel switching, which involves switching from more carbon-intensive power generation methods (e.g. coal) to less carbon-intensive ones (e.g. gas). While the former is a rather long-term decision, the latter two are short-term decisions. In particular, fuel switching remains to be the single most important abatement mechanism in the short run, as power producers can change the dispatch order of their power plants for the provision of peak load. They decide on the order in which its coal- or gas-fired power plants are put into operation, resulting in higher or lower CO2 emissions (depending on the direction of the switch). The cost of fuel switching is determined by the (relative) prices of fossil fuels. Consequently, in an efficient market, the EUA price should react to changes in these prices, too. In addition to changes in fossil fuel prices, the EUA price should reflect unexpected changes in energy demand due to extreme weather events and volatility in economic activity. However, as the share of renewable energy capacity (hydro, wind, and solar power) increases in Europe, weather variations also influence the provision of carbon-free renewable energy supply.

The supply and demand of EUAs, which essentially determines their price, are influenced by policy and fundamental aspects, respectively. Since the market for EUAs, the European Emission Trading Scheme, was artificially created by policy-makers, policy decisions mainly determine the supply of allowances. Policy decisions were made on the total amount of allowances available, the allocation and auctioning of allowances, usage of Certified Emission Reductions (CER) from the Clean Development Mechanism (CDM) and Emission Reduction Unit (ERU) from Joint Implementation (JI), the extent of banking and borrowing, and penalty for non-compliance.The possibility to bank or borrow EUAs also influences their supply. Throughout Phase I, banking and borrowing was allowed over the years, but no bringing forward into Phase II was permitted. From Phase II onwards, unlimited banking is allowed. Demand is driven by two fundamental factors: economic activity and fuel prices (Rickels, Gorlich, and Peterson, 2014).

2. Literature Review

Entire discussion are divided into three parts where the initial part are indicating on the emission trading of United Nation and focusing on the design of the SO_2 emission trading allowances (Joskow , Shmalensee and Bailey (1998). Second portion emphasizes on the emission trading in the European Union and the explanatory variables to determine the EUA prices (e.g.Hinterman, 2010, Nazifi2013, Rickels, Gorlich, and Peterson, 2014). At the end discussion will move toward in the explanation of the price spread between EUA and CER (Nazifi, 2013).

Joskow, Shmalensee and Bailey (1998) had mentioned the success of the Title 4 of the 1990 Clean Air Act Amendment. It was tradable allowance program for reducing SO_2 emissions and depended critically on the emergence of an effective private allowance market. The initial version of Title 4 did not contain provisions for either the mandatory Environmental Protection Agency (EPA) auctions or the Direct Sales Reserve. But later it was added due market imperfections. Author also pointed out the shortcoming in this mechanism, particularly in the design of the annual allowance auctions. They also paid attention on the regulatory mechanism followed by EPA. It was based on discriminatory auction rather than uniform market clearing price. Due the substantial inefficiencies in the design of EPA auctions, it was unable to capture the larger size of the economy and had become a small part of the overall market. At the end, author empirically examined the strategic bidding behavior on the market price which came out to be negative i.e. the aspects of those auctions that had no effect at all on the actual operation of the market for $S0_2$ allowances. Hintermann(2009) focused on the first phase of the EU ETS where the allowance price exhibited high volatility and followed a peculiar path. He had focused on the market fundamentals to explain the variations. Initial EUA prices were examined. High EUA price in the first phase were the result of free allocation and over abatement due to the asymmetric about the firm's actual emission. This had led to the price crash in 2006. He also focused on the determinants of EUA prices (after price crash). Where the model expressed as a function of fuel prices, temperatures, availability of hydroelectric power and stock market index and found that the data fitted well after the first round of emission verification but not before. He also mentioned the nonlinear expression of these variables on the EUA allowance prices. His results implied that the equality of allowance prices and marginal abatement cost did not hold

before the price crash due to the market inefficiency. In order to explain the explanatory variables of the EUA prices, following table is constructed.

Dependent variable	Nazifi,2013	Rickels, Gorlich, and Peterson, 2014
Influence of fuel switching	A decrease in oil and gas prices in second half of 2008 and early of 2009 made it cheaper for power companies to switch away from burning coal for the production of electricity. This switch led fewer allowances as the demand for European Allowances decreased and a decrease in EUA prices	They emphasized on the fuel price selection and mentioned that the available studies on the fuel switching had not used the same price series for the coal and gas prices. They found weak evidence for an impact of fuel switching on EUA prices. They also pointed out that the relationship between fuel prices and abatement was complex and could not be observed by just looking at the fuel prices.
Influence of Economic activity	He mentioned that a worldwide recession (2008), global financial crisis, could have contributed to the decrease in EUA prices. Due to a reduction in industrial production, a decrease in energy demand and consequently a fall in emissions led to a drop in prices. Eurozone debt crisis (2011) had contributed to fall in EUA prices. In the anticipation of selling off a significant amount of EUAs in order to obtain liquidity in a tight credit environment contributed to a further reduction in EUA prices. Also found positive relationship between EUA price and equity index.	They had used an auxiliary expressions to show a significant influence of economic activity as measured by equity index (also captured the general market disturbance such as financial crisis) and the oil prices. Both had a significant positive influence on EUA price dynamics (Phase II).
Influence of Renewable energy		Did not find strong evidence for the influence of renewable on EUA prices except for the influence of reservoir levels in Norway. Also mentioned the influence of hydropower in France on EUA price increase. As the hydropower provision is influenced by weather variations through the resulting reservoir levels. At the end they mentioned that the effect of renewable should be investigated on a regional level rather than on the EU levels.
Other explanatory variables	Increase of EUA prices in 2009 due to more stringent emissions targets had put by EU ETS. This led to include more industrial production and GHGs, phasing out the free allocation of allowances and setting auctioning, and also allowed to bank EUAs from Phase II to Phase III.	

Nazifi(2013) examined the factors impacting on price spread between EUAs and CERs. This paper had focused on the dynamic interaction with CERs because CERs dominated the project based carbon market in 2012. The analysis had suggested that the different market framework of CERs and EUAs, the regulatory changes concerning both and uncertainty surrounding CERs with respect to the default risk of financial institutions who guaranteed secondary CERs, could be considered as a primary factor underlying the price spread. He did not found any co integration relationship between EUA and CER. He had shown the significant influence of fuel switching on EUA prices in 2008 but that factor did not influence the CERs prices. Because the primary market of CERs did not respond to short term price signals as compared to EUAs prices.

3. Conclusion

Influence of Global Financial crisis in 2008 on CERs was not as big as on EUAs prices due to the existence of potential demand for CERs in other industrialized Annex B countries. Influence of EU sovereign debt crisis, regulatory restrictions on the import of credits and uncertainty associated with CERs had contributed towards a widening of price spread. Due to a lack of competitive conditions in markets, such as access constraints on the use and availability of CERs and the lower substitutability of CERs within the EU ETS, as a key factor behind the price spread.

4. References

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