Carbon Prices during the EU ETS Phase II: Dynamics and Volume Analysis

Julien Chevallier

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Abstract

The European Union Emissions Trading Scheme (EU ETS) is the largest emissions trading scheme to date. This article summarizes the principle elements behind the trading system, and details the carbon price dynamics during Phase II (2008-2012), along with an analysis of traded volumes. The main findings emphasize that the EU ETS is a rapidly growing market, which yields to innovative learning process for all participants involved: policy makers, industrial operators, and financial analysts. Besides, these results shed some light on the usefulness of credit project mechanisms, which may result in the medium-term in integrated 'world' carbon markets between various regional and/or national ETS.

Keywords: EU ETS; Carbon Price; Phase II; CER ; Spot Price ; Futures Price ; Options Price

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1. Introduction

When the EU ratified the Kyoto Protocol, it committed itself to reduce Greenhouse Gases emissions (GHGs) by 8% during the period 2008-2012 compared to 1990 levels. The EU therefore decided to set a ceiling on emissions from around 12,000 industrial installations in the most energy-intensive sectors, and to implement an emissions market with the aim of reducing CO_2 emissions and achieving the Kyoto Protocol target. The European Union Emissions Trading Scheme (EU ETS) was thus created by the Directive 2003/87/EC on January 1, 2005 with a pilot phase going from 2005 to 2007. We are currently under the Phase II of the EU ETS (2008-2012), which has been confirmed until 2020 at least (Phase III goes indeed from 2013 to 2020). European Union Allowances (EUAs), which represent the right to emit one ton of CO_2 in the atmosphere, are traded under this scheme.

By doing so, the EU clearly indicated its will to take the lead in the fight against global warming. The EU ETS is a cap-and-trade scheme, which means that the overall level of emissions is capped and up to this limit participants are allowed to buy/sell allowances (emissions rights) according to their needs[2]. The scheme covers nearly half of the EU's CO_2 (Carbon Dioxide) emissions, and 40% of the EU's total GHGs emissions. The EU ETS sets a price on carbon, which can be related to market fundamentals such as institutional events, weather events, other energy market prices' influences and macroeconomic determinants (Alberola et al. (2008), Alberola et al. (2009a,b), Chevallier (2009a)). Phase I was introduced as a "warm-up" period from 2005 to 2007 in order to put in place the policy infrastructure of permits trading. However, the early environmental benefits were limited because of over-allocation concerns among Member States (Ellerman and Buchner (2008), Ellerman et al. (2010)) and the implementation of banking restrictions between 2007 and 2008 which caused

[2] See Chevallier (2009b) for more details on the functioning of cap-and-trade schemes.

carbon spot prices and futures of maturity December 2007 to plummet towards zero (Alberola and Chevallier (2009)). This first experience also highlighted the need for reliable verified emissions data, for harmonized monitoring and reporting rules, as well as potential distortions of competition between Member States. Despite these problems, Phase I was considered as a "success"[3], which fostered various initiatives for ETS schemes around the world.

Once the EU ETS's coming into force was secured, the EU recognized (under certain conditions) credits issued via flexibility mechanisms in the Kyoto Protocol: namely, the Clean Development Mechanism (CDM) and Joint Implementation (JI) projects. Limits on the import of Certified Emissions Reductions (CERs[4]) and Emission Reduction Units (ERUs[5]) within the EU trading system appeared rapidly as part of the scheme design (Trotignon and Leguet (2009), Chevallier (2010a)). Extensions, concerning the inclusion of additional sectors such as aviation and petrochemicals for instance, are expected from 2013 onwards. More details on the characteristics of the EU emissions market, including cap and period, the definition of emissions rights, allocation, registries, penalties, monitoring and reporting of emissions, may be found in Chevallier (2010b).

To reflect on the rapid development of the EU ETS, this article proposes a review of the current dynamics in carbon prices, as well as on the volumes exchanged on this market. Our central results feature that the EU emissions trading system is rapidly growing, with various emissions rights being traded simultaneously: spot, futures, and options prices. We also

[3] Note the notion of success may be approximated by various effects (pre-existing regulatory environment, technology innovation and diffusion, reduction of regulatory uncertainty, aggregate cost savings, etc) but we will focus on the efficiency of the permits price, *i.e.* its ability to reflect current information on spot and future prices.
[4] CER means a unit issued pursuant to Article 12 of the Kyoto Protocol. These are tradable units generated by projects in non-Annex B Parties under the Clean Development Mechanism. They may be counted by Annex B Parties towards compliance with their UN and EU emissions target and are equal to one tonne of carbon dioxide equivalent gases.
[5] ERU is a unit issued pursuant to Article 6 of the Kyoto Protocol. These are tradable units generated by projects in Annex 1 Parties under Joint Implementation. Annex 1 Parties may count them towards compliance with their emissions target. Each ERU is equal to one tonne of carbon dioxide equivalent gases.

highlight the rise of CER credits issued from project mechanisms, which can be used in the medium-term to 'link' separate regional and/or national emissions trading schemes initatives.

The remainder of the article is structured as follows. Section 2 details carbon price dynamics during Phase II. Section 3 provides an analysis of traded volumes. Section 4 concludes.

2. Price Dynamics

During Phase I (2005-2007) of the scheme, the demand for allowances did not follow the actual level of emissions, as documented by Ellerman and Buchner (2008). Between the launch of the market in January 2005 and the first consolidated results of verified emissions in April 2006, the carbon price has been rising continuously due to risk-averse behaviours from installations in excess of allowances and potentially to speculative activity from brokerage firms and investment banks. Against this background, the carbon prices of all maturities encountered a dramatic downward shift in April 2006 when the rumours of 'over-allocation' hit the market a few weeks before the official audit report from the European Commission by May 15, 2006. Carbon prices fell by more than 54% in a few days, as explained by Alberola et al. (2008). Then, due to the banking restrictions implemented between 2007 and 2008 (essentially not to report excess allowances towards Phase II which coincides with the start of the Kyoto Protocol), spot prices and futures prices of maturity December 2007 have been decreasing towards zero (Alberola and Chevallier (2009)).

By contrast, Phase II carbon prices present a more stable and healthy price pattern. As shown in Table 1, spot allowances exchanged on BlueNext (BNX) have been oscillating between €10 and €30/ton of CO_2, depending on the levels of allowances demand (Alberola et al.

(2009a,b)) due to industrial production, and the likely depressive impact of the credit crunch crisis on all commodities markets (Chevallier (2009)).

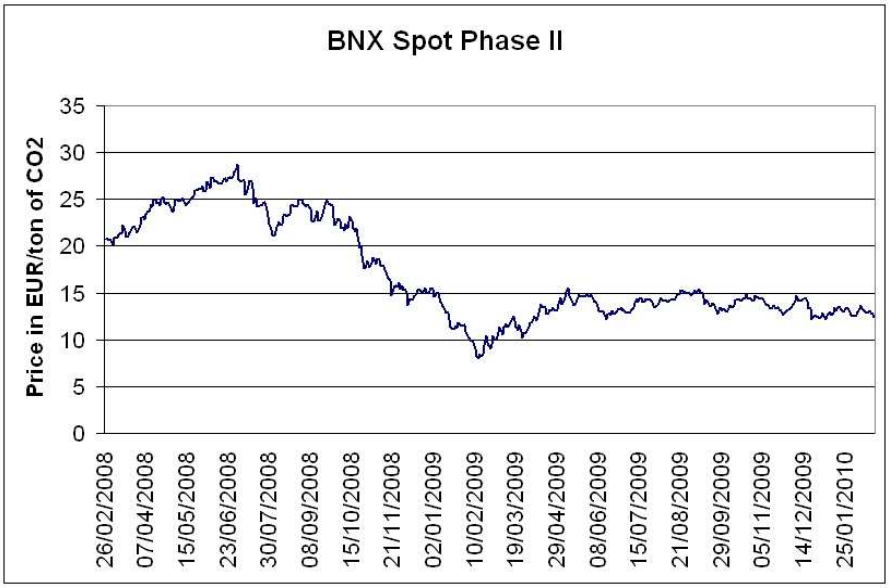

Figure 1: Price (in €/ton) of EUA Spot Allowances
Source: BlueNext

As shown in Figures 2 to 4, futures prices of maturities December 2008 to December 2010, exchanged on the European Climate Exchange (ECX), also exhibit a relatively stable price path.

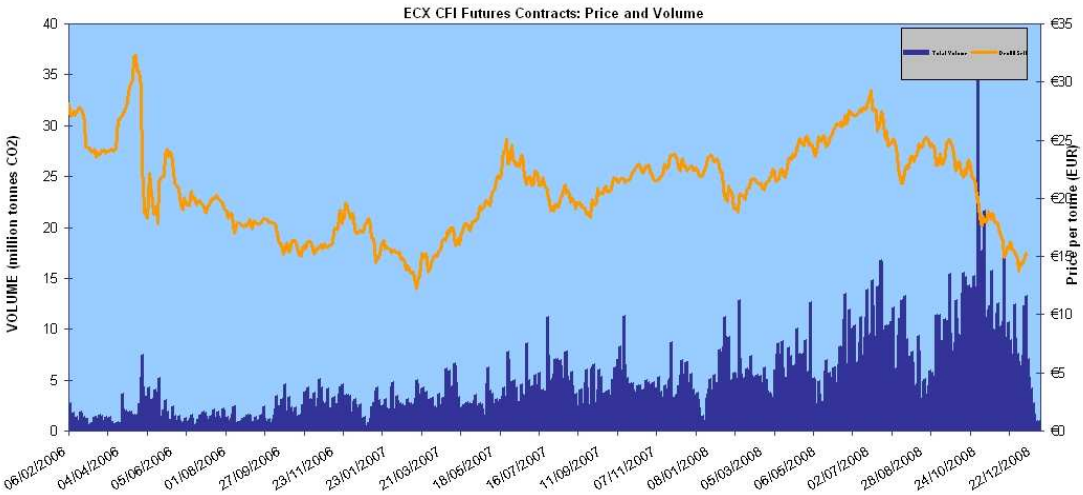

Figure 2: Price (in €/ton) and Volume (in million ton) of the December 2008 EUA Futures Contract
Source: ECX

The December 2008 futures contract has been rising above €35/ton of CO_2, and its historical mean value is close to €20/ton of CO_2.

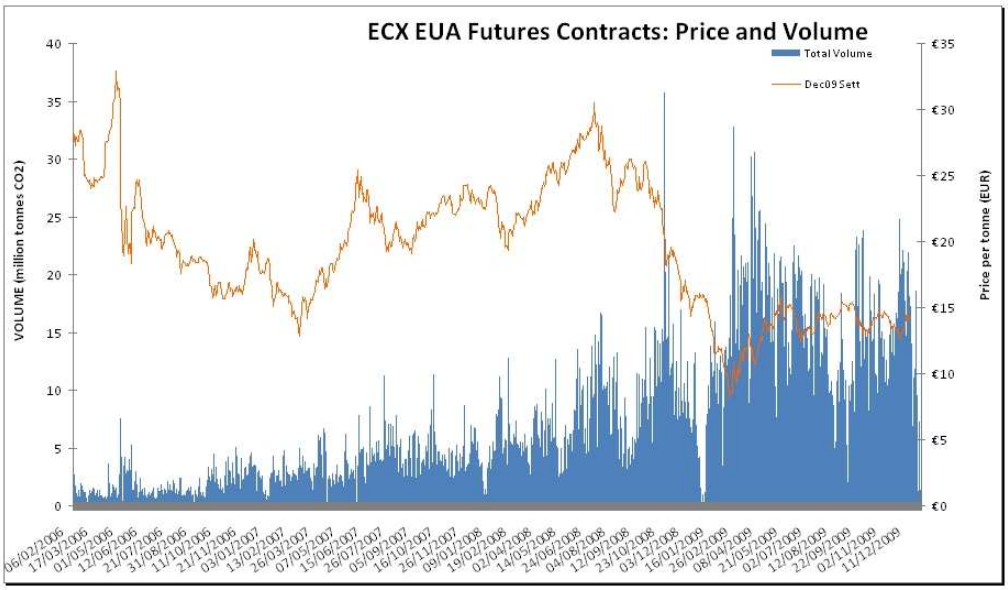

Figure 3: Price (in €/ton) and Volume (in million ton) of the December 2009 EUA Futures Contract
Source: ECX

Similarly, the December 2009 futures contract has been increasing to €37 ton of CO_2. Starting in October 2008, we can nevertheless notice a delayed effect of the financial crisis on the carbon market, as allowance futures prices fell below €15/ton of CO_2.

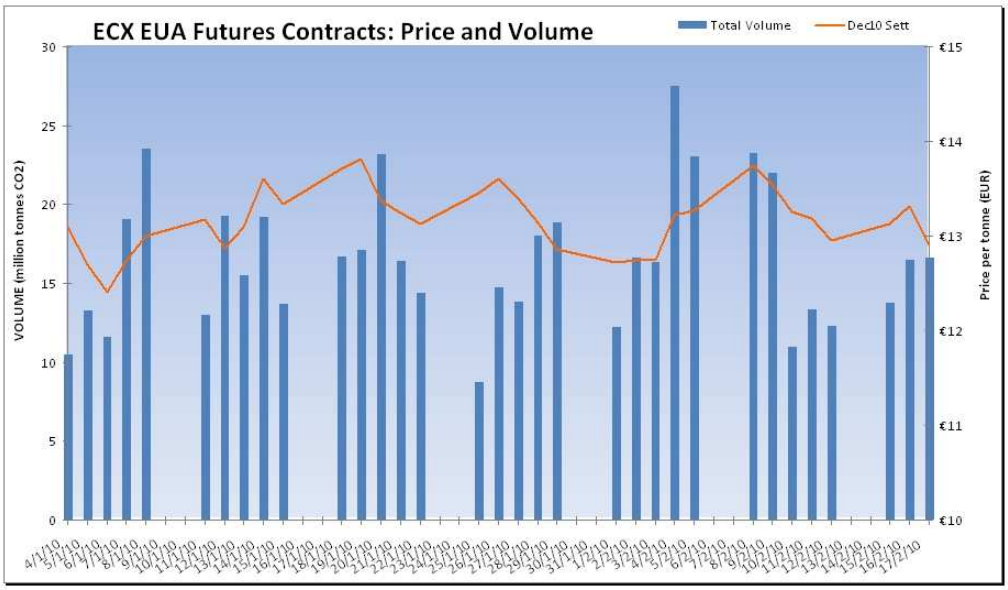

Figure 4: Price (in €/ton) and Volume (in million ton) of the December 2010 EUA Futures Contract
Source: ECX

Until present, December 2010 futures prices have been trading in the range of €15 to €25/ton of CO_2, which also corresponds to a relatively stable price pattern compared to Phase I prices.

In Figures 5 to 7, we look at the CER futures prices of maturity December 2008 to December 2010 exchanged on ECX.

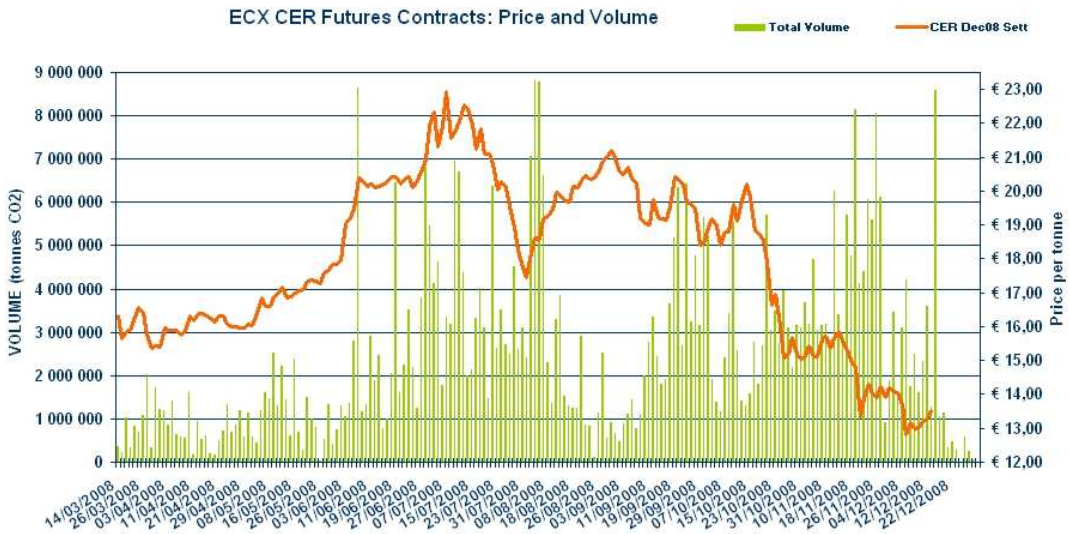

Figure 5: Price (in €/ton) and Volume (in ton) of the December 2008 CER Futures Contract
Source: ECX

It appears very clearly in Figure 5 that the price path of CER futures prices for the contract expiring in December 2008 has been very different from the EUA futures price contract of the corresponding maturity. We notice a sharp price difference during the year (above €22 in July *vs*. below €15/ton of CO_2 in December). This figure reveals two different price regimes: *before* and *after* October 2008, which can be related to the transmission of the financial crisis to global commodity markets (including the carbon market). CER futures prices therefore exhibit a stronger adjustment to the crisis than EUA futures prices. It may be explained by the fact that various levels of risks are embedded within CER prices (including the risk of non-delivery of projects) and also by the fact that CER prices are tradable on a more global scale than EUAs (namely within all countries which ratified the Kyoto Protocol) and the crisis may have been more severe in other regions compared to Europe (thereby resulting in a relatively more important decrease in the demand for CERs).

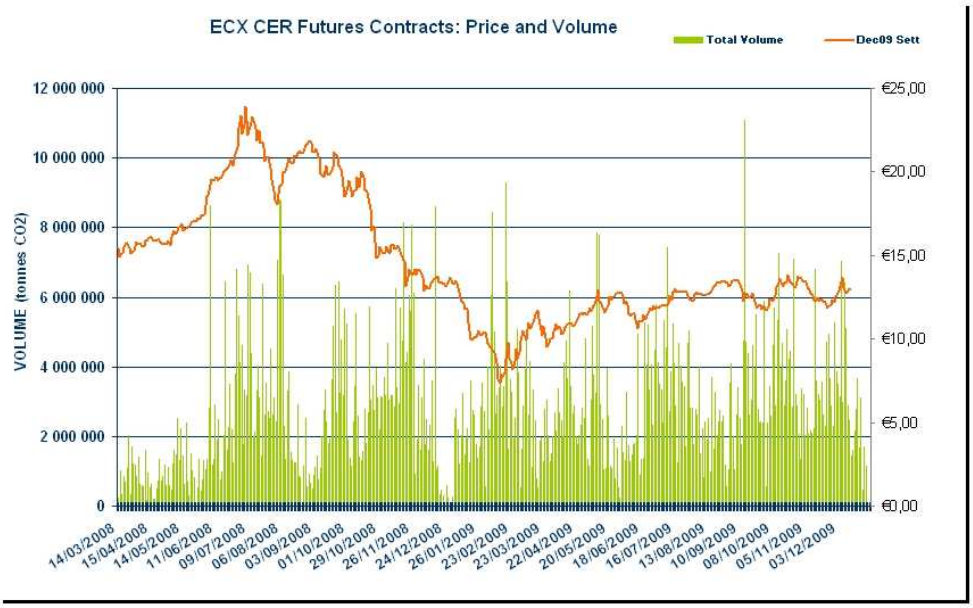

Figure 6: Price (in €/ton) and Volume (in ton) of the December 2009 CER Futures Contract
Source: ECX

In Figure 6, we also notice the strong adjustment in CER futures prices of maturity December 2009 during the end of the year 2008. The price pattern has been stabilizing in 2009 between €10 and €15/ton of CO_2.

Figure 7: Price (in €/ton) and Volume (in ton) of the December 2010 CER Futures Contract
Source: ECX

This diagnostic is confirmed in 2010: CER futures prices of maturity December 2010 have been traded until present around €12/ton of CO_2.

In this section, we have seen that all kinds of carbon prices (spot, futures, credits from project mechanisms) are relatively stable in 2010 (in the range of €10 to €15/ton of CO_2), awaiting for the economic recovery after a period of strong adjustment to the financial crisis during late 2008. We have also emphasized that these effects are somewhat more pronounced for CERs than for EUAs.

In the next section, we complement our analysis of the *dynamics* of carbon prices with an analysis of the *volumes* traded for each type of contract.

3. Volume Analysis

In Figure 8, we observe that Phase II BNX spot allowances have been actively traded during the period going from January to May 2009, which corresponds to the 2008 compliance event.

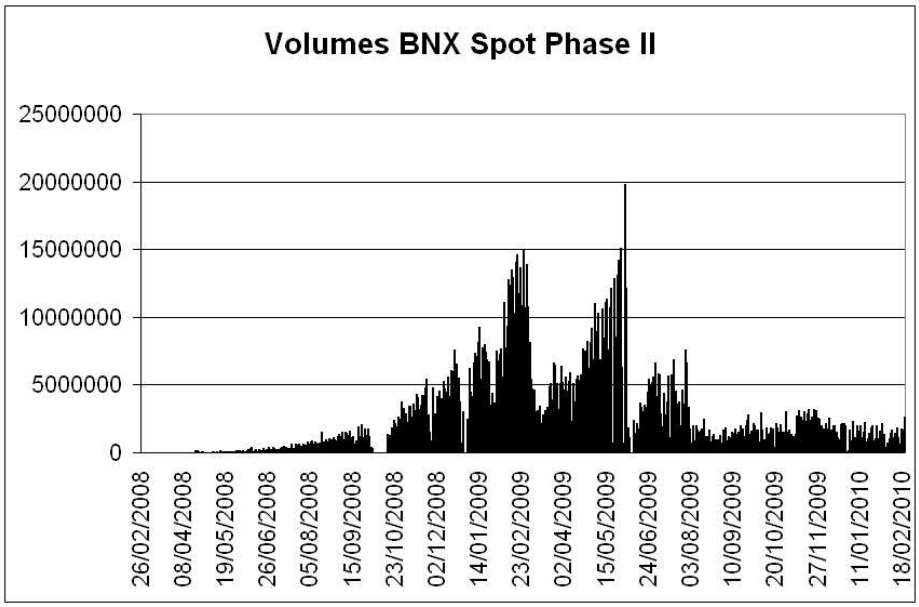

Figure 8: Volume (in ton) of EUA Spot Allowances
Source: BlueNext

During this period, installations need to surrender as many allowances as the amount of carbon dioxide emitted during the reference year. Therefore, installations in shortage (excess) of allowances with respect to their individual allocation level may purchase (sell) allowances on the spot market in order to meet their compliance requirement in the EU ETS (Alberola et al. (2008)). A penalty of €100/ton of CO_2 occurs if installations do not meet their target.

In Figures 2 to 4, we notice that EUA Futures prices have been traded actively during October 2008 (when companies were selling allowances for cash in order to cope with the financial crisis), February to May 2009 (which also corresponds to the 2008 compliance event in a context of decreasing carbon prices), and in February 2010 as well.

Figures 5 to 7 show that CER futures prices have been heavily traded during August 2008 (in a context of sharp decrease of CER prices), October to December 2008 (as an adjustment to the financial crisis), in October 2009 and in January 2010 as well. We may therefore identify similar patterns with the trading of EUA futures. This situation may be explained by the fact that CER prices are discounted with a “risk premium” from EUA prices by market participants due to their higher level of risk (as discussed previously) and their limited fungibility within the EU ETS (CER prices may be imported within the EU trading system up to 13.4% on average).

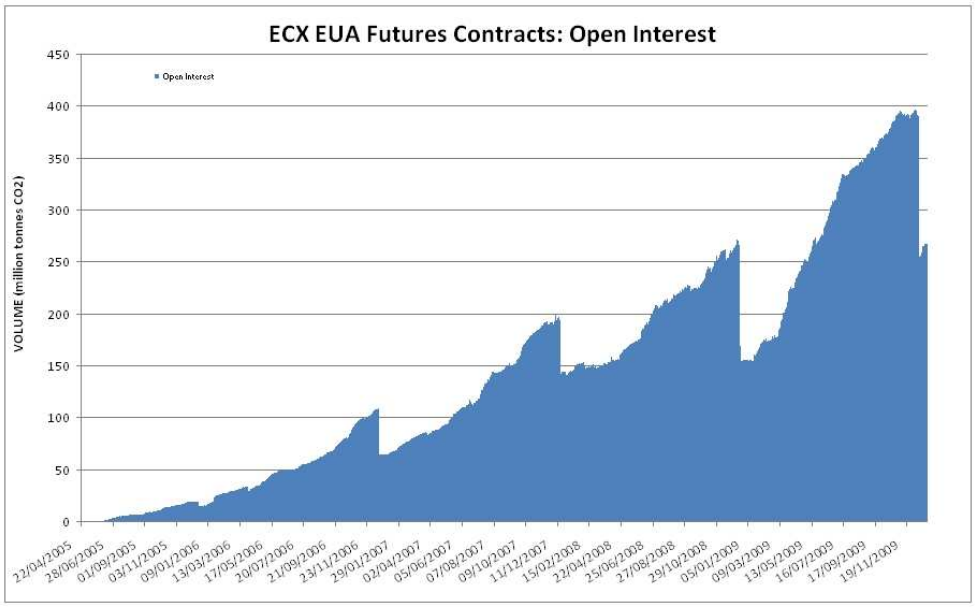

Figure 9: Open Interest on EUA Futures Contracts from April 22, 2005 to February 22, 2010
Source: ECX

Figure 9 provides another interesting piece of information, as it displays the open interest available for EUA futures contracts exchanged on ECX. This amount has been continuously increasing since 2005. It is currently close to 400 million ton of CO_2. We also note that the open interest is periodically subject to wide variations (from 50 to 100 million ton), as futures contract of a given year expire.

Taken together, these elements highlight that carbon prices (be it spot, futures or project mechanisms) have been rapidly growing since 2005. This trend is confirmed during Phase II. Point Carbon analysts estimate that the volume of transactions on the European carbon market has been growing from 262 million ton in 2005 to 809 million ton in 2006, 1,455 million ton in 2007, 2,713 million ton in 2008, and 5,016 million ton in 2009. These estimates[6] account for exchange-based trading as well as over-the-counter trading of emissions rights.

[6] Available at http://www.pointcarbon.com/

Let us now have a look at the options markets for carbon prices, which have been introduced by ECX in October 2006 for EUA futures (see Chevallier et al. (2009) for a detailed presentation of the options market) and in May 2008 for CER futures.

Contract	Total Options Volume (in ton)
ECX Futures December 2008	**243,166,000**
ECX Futures December 2009	**415,567,000**
ECX Futures December 2010	**79,446,000**
CER Futures December 2008	**67,800,000**
CER Futures December 2009	**91,930,000**
CER Futures December 2010	**7,750,000**

Table 1: Number and volume of options contracts exchanged on ECX
Source: ECX
Note: The statistics are reported for the period going from January 1, 2008 to February 22, 2010 for ECX EUA Futures, and from May 16, 2008 to February 2010 for ECX CER Options.

Table 1 highlights that the use of options prices has been steadily growing since their creation, going from 243 million ton in 2008 to 416 million ton in 2009 for EUA futures, and from 68 million ton in 2008 to 92 million ton in 2009 for CER futures.

As for any financial market, the emergence of liquid options markets constitute another derivative asset that may be used by energy companies, brokers and investment banks in order to insure themselves against unwanted price movements. Hence, option prices have the ability to reflect various levels of risk-aversion embedded within market participants' utility function (in economic terms). Risk-averse agents will tend to insure themselves against 'high' carbon price levels (according to their expectations) while risk-lover agents will tend to bet against sudden price changes in market participants' expectations (around compliance events) so as to

generate net profits from arbitrage activities. Risk-neutral agents, such as utilities regulated by the scheme, may also neutralize the effects of carbon price changes during compliance events by buying/selling in advance a pre-determined quantity of carbon prices at a fixed price.

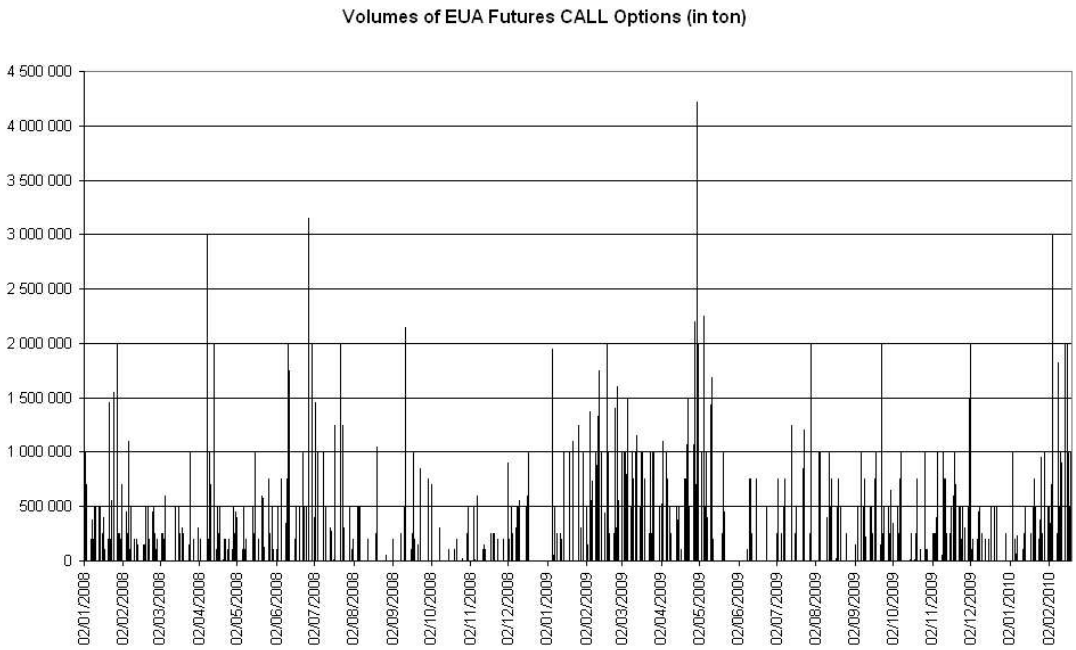

Figure 10: Volumes of EUA Futures Call Option Prices exchanged from January 1, 2008 to February 22, 2010
Source: ECX

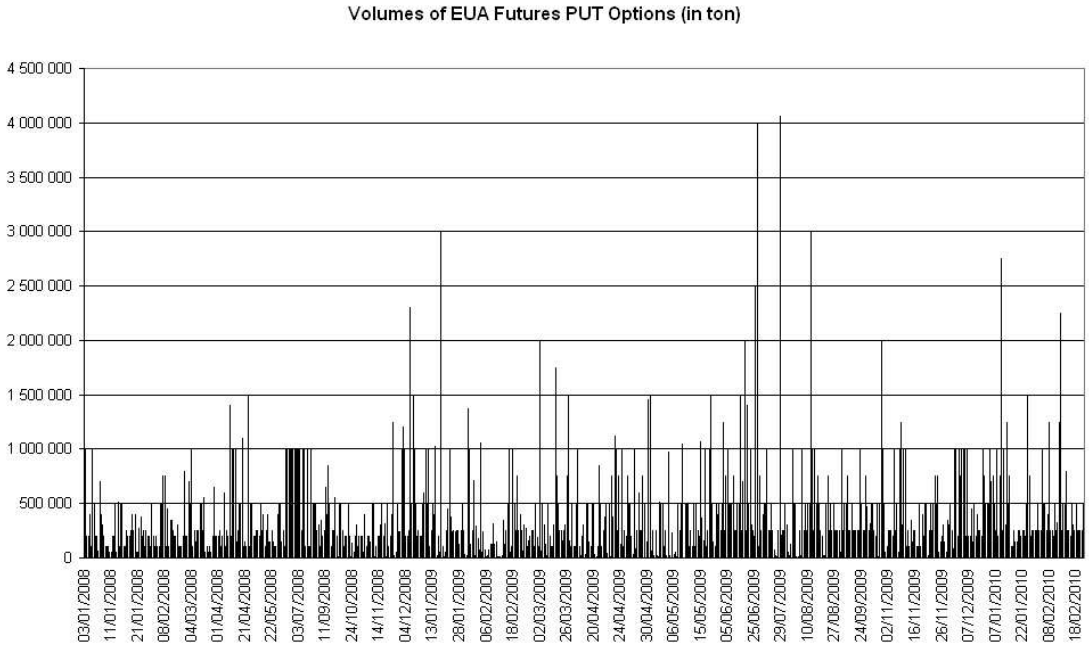

Figure 11: Volumes of EUA Futures Put Option Prices exchanged from January 1, 2008 to February 22, 2010
Source: ECX

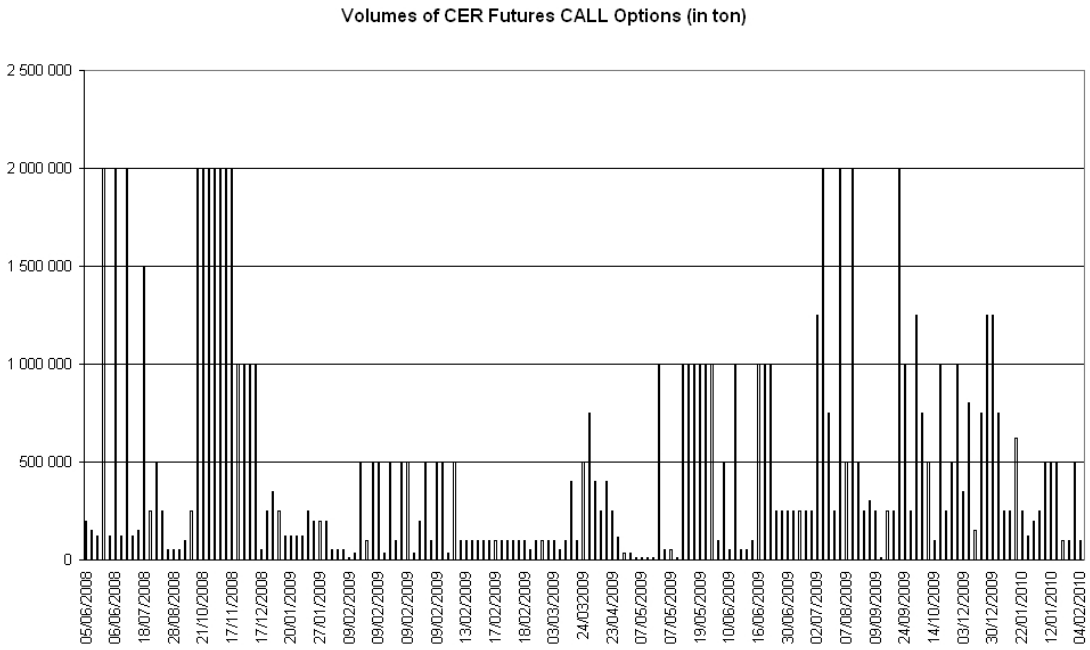

Figure 12: Volumes of CER Futures Call Option Prices exchanged from May 16, 2008 to February 22, 2010
Source: ECX

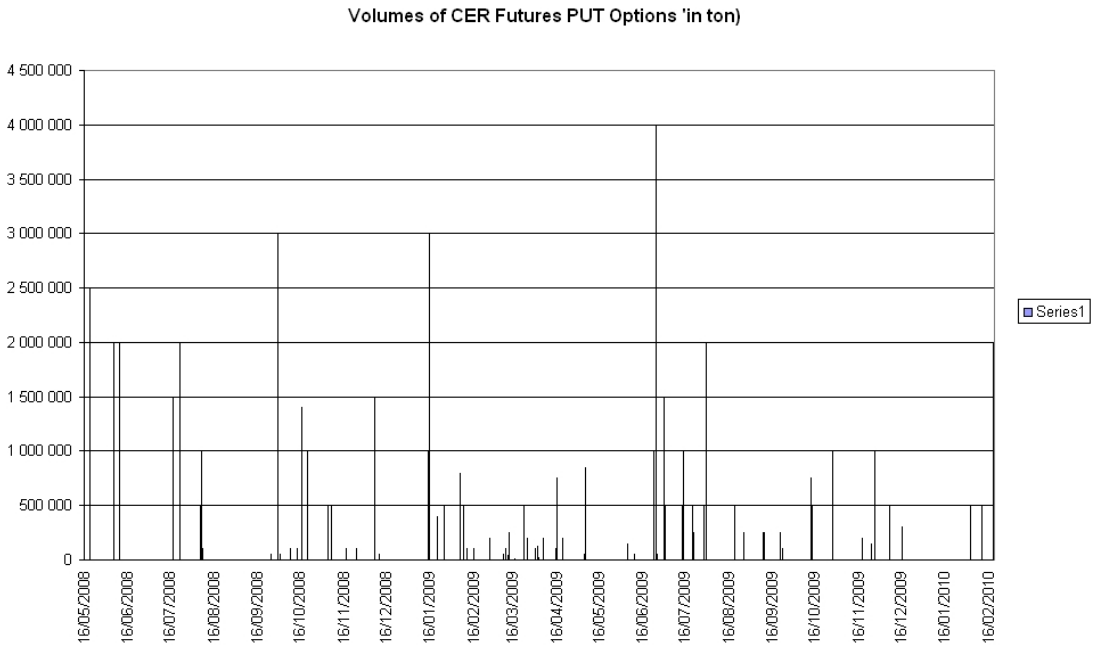

Figure 13: Volumes of CER Futures Put Option Prices exchanged from May 16, 2008 to February 22, 2010
Source: ECX

Figures 10 to 13 show the amount of call and put option prices exchanged during Phase II for EUA futures and CER futures, respectively, on ECX. We document that calls are more actively traded than puts for ECX EUA and ECX CER futures contracts. Chevallier et al.

(2009) explain this situation by the fact that the main fear on the carbon market is that prices increase. On such a market, the easiest way to hedge again this risk is by selling calls: call option prices are therefore more actively traded than puts.

Finally, we document that strike prices range from €10 to €100 for EUA Call Options, and from €0.95 to €26 for EUA Put Options. As discussed above, this variability reflects various levels of risk-aversion which are embedded within the trading of options prices, and can go as high as €100/ton of CO_2 for EUA futures. Similarly, strike prices from €10 to €50 for CER Call Options, and from €6 to €16 for CER Put Options. The level of uncertainty attached to CER options prices also appears quite high in a context of post-Kyoto negotiations (and the fact that CERs are not confirmed to be operating after 2013 to date).

4. Conclusion

The first Phase of the EU ETS has demonstrated the difficulty of ensuring uniform rules and limiting over-allocation when it is made by Member States. This specific design problem was addressed – along with many others including provisions for new entrants, banking mechanisms, etc. – with the EU Commission's more severe review of National Allocation Plans. Besides, during 2005-2007, the emissions market lacked the reference data to monitor the actual level of emissions and potential purchases/sells on the market among installations. The fears of harming competitiveness of businesses also led some Member States to place too much faith in expected benchmark figures from industrials. During Phase II, the audited figures for each installation are known, and installations that received initially a substantial surplus generally received much less during the second phase.

Since 2008, the European carbon market and credits from projects mechanisms have continued their development. The supply and demand of allowances are being adjusted

through exchanges and over-the counter transactions based on price levels, institutional characteristics of the market (compliance requirements, banking provisions, etc.), fundamentals identified during Phase I (linked to other energy markets prices, weather events, economic growth, etc.), and anticipations of the reduced allocation which will be linearly enforced through time.

2008 and 2009 have been specific years for carbon markets with the conjunction of unusual events: the adjustment to the financial crisis, the delays in post-Kyoto negotiations due to the Copenhagen Summit, and various decisions by the EU Commission regarding allocation in Eastern European countries. The decrease in carbon prices recorded may be linked to the economic crisis, with a price range currently comprised between €10 and €15/ton of CO_2 for EUA spot, EUA futures, and CER futures prices as well.

Despite these adjustments, this article shows that carbon markets have continued they rapid development, by achieving record activity levels since 2005. Our analysis highlighted that EUA futures prices tend to be more actively traded than spot allowances, while CER futures prices are useful mechanisms to 'link' carbon markets worldwide, in a context of rapid development of other schemes at the regional and/or national levels. 'Financial' fundamentals in carbon prices (as opposed to 'physical' fundamentals identified during Phase I) may also be underlined as being a salient characteristic of Phase II carbon prices, with strong adjustment to the financial crisis and new behaviours from installations to sell allowances for cash when the need for liquidities rises.

References

Alberola, E., and Chevallier, J. 2009. 'European Carbon Prices and Banking Restrictions: Evidence from Phase I (2005-2007)'. *The Energy Journal* 30(3), 51-80.

Alberola, E., Chevallier, J., and Chèze, B., 2008. 'Price Drivers and Structural Breaks in European Carbon Prices 2005-2007'. *Energy Policy* 36(2), 787–797.

Alberola, E., Chevallier, J. et Chèze, B. 2009a. Emissions Compliances and Carbon Prices under the EU ETS: A Country Specific Analysis of Industrial Sectors. *Journal of Policy Modeling* 31(3), 446-462.

Alberola, E., Chevallier, J. et Chèze, B. 2009b. The EU Emissions Trading Scheme: the Effects of Industrial Production and CO_2 Emissions on European Carbon Prices. *Economie Internationale* 116, 95-128.

Chevallier, J. 2009a. Carbon Futures and Macroeconomic Risk Factors: A view from the EU ETS, *Energy Economics* 31(4), 614-625.

Chevallier, J. 2009b. Emissions Trading: What Makes It Work? *International Journal of Climate Change Strategies and Management* 1(4), 400-406.

Chevallier, J. 2010a. Price relationships in the EU emissions trading system. *Working Paper* HAL-SHS # 00458728.

Chevallier, J. 2010b. The European carbon market (2005-2007): banking, pricing and risk-hedging strategies. *Working Paper* HAL-SHS # 00458787.

Chevallier, J., Ielpo, F. et Mercier, L. 2009. Risk Aversion and Institutional Information Disclosure on the European Carbon Market: a Case-Study of the 2006 Compliance Event. *Energy Policy* 37(1), 15-28.

Ellerman, D. and Buchner, B. 2008. 'Over-Allocation or Abatement? A Preliminary Analysis

of the EU ETS Based on 2005 Emissions Data'. *Environmental and Resource Economics* 41, 267-287.

Ellerman, D., Convery, F. and De Perthuis, C. 2010. *Pricing Carbon: The European Union Emissions Trading Scheme*. Cambridge University Press.

Trotignon, R. and Leguet, B. 2009. How Many CERs by 2013? *Mission Climat Working Paper* #2009-05.