Market Efficiency in the EU Emissions Trading Scheme

An outlook for the third trading period*

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Abstract

Is the EU Emission Trading Scheme (ETS) ready for the challenge of cutting emissions by 20 %? This paper tries to provide an answer to this question by studying the efficiency of the scheme, both in the secondary and in the primary markets for allowances.

On the one hand, this paper draws conclusions from the operation of the scheme so far. For this purpose, it studies a wide variety of market data using economic and econometric techniques. On the other hand, building on this evidence, this paper presents and evaluates some of the changes introduced in the scheme for the third trading period.

Keywords: ETS, efficiency, energy, allocation, crisis

JEL-codes: Q58, Q57, Q54, G10, G18

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1. Introduction

By 2012, the European Union and its Member States have committed, under the Kyoto Protocol, to reduce emissions of greenhouse gases by 8% compared to the emission levels in 1990.[1] The European Union Emissions Trading Scheme (EU ETS) is a cap and trade system devised to help the EU attain this objective. It is a market mechanism that works by first setting a cap to carbon-dioxide emissions and then allowing market participants to trade their allowances.

According to the EU ETS, one allowance equals one ton of carbon-dioxide and it is initially allocated to one of the installations covered by scheme. As allowances can be freely traded among installations, the system allows for abatement at the lowest possible cost, under the assumption of efficient markets. Economic agents covered by the scheme have therefore three main options: (1) invest to reduce emissions and sell excess allowances; (2) reduce used capacity and sell excess allowances; or (3) maintain/expand capacity and buy additional allowances.

When Kyoto expires in 2012, it is hoped that a new international agreement will replace it within the United Nations Framework Convention on Climate Change (UNFCCC). However, so far negotiations have not brought any binding commitments. The accord of Copenhagen in December 2009 simply requests the parties to submit their unilateral targets. In January 2010, the European Union formally notified that it has unilaterally undertaken to reduce its emissions by 20% by 2020 compared to 1990 levels. Further, it restated its position in international negotiations; namely, its willingness to reduce an additional 10% on condition that "other developed countries commit themselves to comparable emission reductions and developing countries contribute adequately according to their responsibilities and respective capabilities".[2]

Under these circumstances, the key question is whether the ETS is ready for the challenge of cutting emissions by 20%. This paper will try to provide an answer to this question, which refers to the effectiveness and the efficiency of the scheme. In the following two chapters, trade in the secondary market for allowances and allocation in the primary market will be examined separately.

On the one hand, this paper will draw conclusions from the operation of the scheme so far. For this purpose, economic and econometric analysis will be employed to analyse a wide variety of market data. On the other hand, building from the evidence previously gathered, this paper will present and evaluate some of the changes introduced in the scheme by the European legislator.

[1] The European Union acceded to the Kyoto Protocol to the United Nations Framework Convention on Climate Change by Council Decision 2002/358/EC of 25 April 2002.
[2] Council of the European Union and European Commission: Expression of willingness to be associated with the Copenhagen Accord and submission of the quantified economy-wide emissions reduction targets for 2020. Brussels 28 January 2010.
This position was established by the European Council as early as in March 2007, and provision is made in Directive 2003/87/EC for its review when an international agreement that satisfies this position is reached (Article 28, Directive 2003/87/EC).

2. Efficiency in the secondary market for allowances

2.1. Introduction

In this chapter the performance of the European Union's Emission Trading Scheme (EU ETS) will be analyzed by referring to the functioning of the market for European Union Allowances (EUAs), that is, the secondary market for carbon-dioxide. With reference to the evolution of carbon prices, two main questions will be addressed: First, whether prices of EUAs are well grounded, that is, whether the price signals they provide are based on market fundamentals. Second, whether prices of EUAs follow an upward trend, that is, whether the evolution of prices is consistent with the logic of the scheme. Both these questions will prove relevant to assess the efficiency of the secondary market for allowances and the efficiency of the trading scheme in general.

2.2. The secondary market for allowances

During the first phase of the scheme, a demonstration period that lasted from 2005 until 2007, the market for allowances emerged and trading platforms developed. Nowadays, not only over-the-counter operations take place but also standardized spot and future contracts are entered into at high volumes every day. Several private trading platforms coexist; including BlueNext, the European Climate Exchange or Climex, among many others.

A brief observation of the evolution of allowance prices from 2005 until 2007 shows that, during the first half of the trading period, prices rose significantly up to 30€ per allowance. This was followed by a dramatic drop in April 2006 when the publication of emissions data showed an oversupply of allowances. It should be borne in mind that prior to April 2006, the amount of emissions generated by each installation had never been verified and hence expectations lacked appropriate reference. Later, prices converged towards zero as the end of the period approached and no banking was allowed towards the second phase of the ETS.[3]

The second trading period started in 2008 and will end in 2012. It is important to remember that operators have the obligation to surrender allowances yearly but it is possible for them to bank and borrow allowances inside the trading period. During this second phase, prices of carbon in Europe have followed a more constant path, when compared to the first trading period. Initially, prices rose from 20€ up to around 28€ in June 2008. They then started to decrease, falling under 10€ in February 2009.

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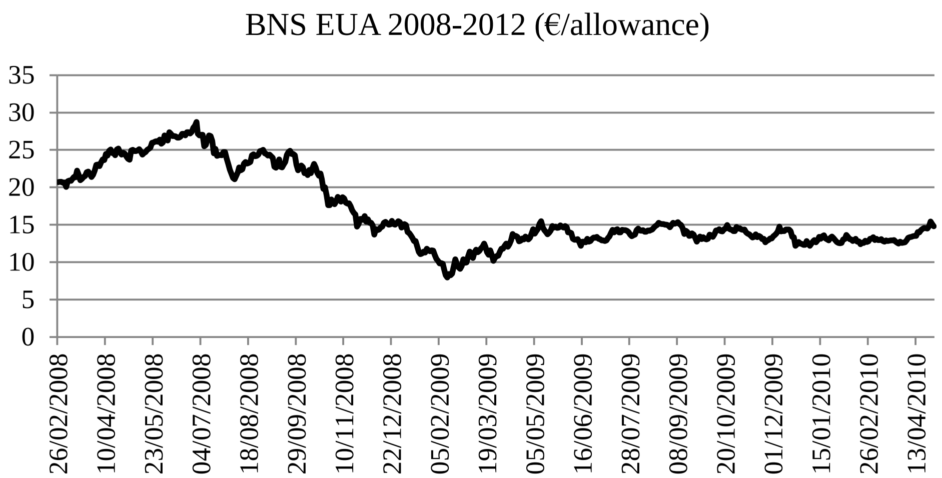
[3] Only in 2 Member States banking was allowed from the first to the second trading period, since the decision was left to the discretion of national authorities on condition that beneficiaries undertook supplementary emissions reductions. See page 11, Communication from the Commission on the assessment of National Allocation Plans for the allocation of greenhouse gas emission allowances in the second period of the EU Emissions Trading Scheme Taxes and ETS. COM (2006) 725 final, Brussels, 9.11.2006.

Afterwards, they recovered and have remained quite stable under 15€ until mid-April 2010.



2.3. Literature on the drivers of the price EUAs

A study frequently referred to in the literature is that of Alberola (2008) and others who analyzed the "Price drivers and structural breaks in European Carbon prices 2005-2007", that is, for the first trading period. In this study, the authors found statistical evidence of two structural changes in April 2006, where the Commission published its first report on verified emissions, and October 2006, where plans to make allocation more restrictive for the second period were announced.

Moreover, Alberola (2009) found that, before the compliance break (July 2005 - April 2006) prices of allowances mainly followed the evolution of prices of electricity power, probably because the market lacked sufficient maturity. However, after the compliance break (June 2006 - April 2007) prices of natural gas and coal became more significant, in a move towards "more energy fundamentals". They also found that weather conditions, assessed as extremely cold or hot days, did not significantly affect the prices of allowances over the period considered.

A later study that follows a similar approach was made by Bonacina (2009) and others. They analyzed the drivers of the price of allowances in the early part of the second phase of the trading scheme. They employed an error correction model and found that the market had reached maturity, "with energy fundamentals being the main drivers". They found that the price of crude oil was the main driver of the price of allowances, together with the prices of coal and gas. They estimated that the speed of adjustment towards the long-term path was 8%. However, they also found that, from August 2008, prices of allowances tended to follow more closely the variations in the stock exchange, without there being a structural break. The authors argue this might reflect the effect of the financial turmoil in the market for emission allowances.

Another study that is also of interest is the one by Bredin (2009) and others. It focused on whether the price of allowances follows a stationary path or whether it is rather non-stationary. Both the first and the second phase of the scheme are considered. The authors applied a wide variety of unit root tests and found that EUA prices follow a stochastic trend.

2.4. Do carbon prices follow market fundamentals?

In this section, econometric techniques will be employed in order to assess the extent to which the formation of carbon prices draws from the evolution of prices in energy markets. It is thought that prices of allowances should be heavily influenced by the relative prices of energy inputs, given that most emissions covered by the trading scheme are generated by the use of those inputs. In particular, electricity generation accounts for more than 60% of the emissions covered by the ETS. This also means that the impact of the prices of energy will be nuanced by the relative efficiency of each individual energy source, both in terms of their potential to generate power and their carbon-intensity. Alternatively, if it was found that energy prices had no bearing on allowance prices, this will most likely mean that the carbon market had not reached maturity and that allowances were rather the object of some kind of speculative trade.

2.4.1. Dataset used in the study

- *BNS EUA 08-12 (€ per allowance)*

For the purpose of this study, the dependent variable is the spot price of European Union Allowances (EUAs) during the second trading period. There is a choice among different trading platforms but BlueNext has been chosen since it is the most liquid one.

BlueNext is the leading spot exchange in the world for EUAs. It is a multilateral trading facility; a joint venture of the New York Stock Exchange (NYSE) and Caisse des Dépôts; a French financial institution that has a public nature and is committed to be a long term investor in projects of general interest.

In technical terms, the price considered here is the BlueNext Spot EUA 2008-2012, where the underlying is European Union Allowance 2008-2012 issued by the Member States according to their National Allocation Plans. The minimum volume per operation in BlueNext is 1,000 tones. Trading is continuous from 8:00 am to 6:00 pm, Monday to Friday. Delivery and Settlement are realized by BlueNext in real time. BlueNext operates a transit account in the French registry through which it transfers the underlying from the seller’s account to the buyer’s account in their respective registries.[4]

[4] Data series start on the 26th of February 2008 and is updated daily. Data can be found at the website of BlueNext following the link “Statistics” and then “Downloads” (http://www.bluenext.fr/)

- *Europe Brent Spot Price FOB (€ per barrel)*

Brent is a reference oil for the various types of oil in the North Sea, used as a basis for pricing (West Texas Intermediate and Dubai are other reference oils). FOB refers to Free On Board, which is a standard set of clauses used in international contract law. Prices are given in Dollars per barrel; the official exchange rates from the European Central Bank have been used to convert these prices into Euros.

Data are converted into Euros per Megawatt-hour, in order to make prices more readily comparable with those of the rest of energy sources employed in this study. According to the International Energy Agency, 1 barrel of oil equals 1.57162162 MWh.[5]

- *APX Gas ZEE (€ per thermal unit)*

APX Gas Zeebrugge BV is a day-ahead market that operates on Belgian business days, from 06:00 am to 18:00 pm. Spots contracts are traded on a continuous and anonymous basis and prices are expressed in Euros per thermal unit. APX Gas ZEE is one of the biggest gas markets in Europe and it is used by gas operators to balance their portfolios in the short term.

Data are converted into Euros per Megawatt-hour. According to the International Energy Agency, 1 thermal unit of natural gas equals 0.029307 MWh.[6]

- *Coal CIF ARA Stm 6000K Ppt (€ per million tons)*

Spot CIF ARA daily prices of coal are provided by Platts Energy Market Assessments. CIF stands for Coast, Insurance and Freight, under international contract law. ARA defines the price of coal delivered to the large North West European ports of Amsterdam, Rotterdam and Antwerp. Stm stands for steam coal, which is coal used for steam rising and space heating purposes; hence, for electricity production, which is the relevant use for this study. Technically, according to the OECD, it includes all anthracite coals and bituminous coals not classified as coking coal.

Data are converted into Euros per Megawatt-hour. According to the International Energy Agency, 1 ton of coal equals 8.141 MWh.[7]

- *Elspot prices (€ per Megawatt-hour)*

Elspot is the common power market for the Nordic countries and the largest physical power market in the world. The market functions daily and contracts are concluded one-

[5] Data can be found at the website of the EIA (US Energy Information Administration) following the link "Petroleum" and then "Spot Prices" (http://tonto.eia.doe.gov).
Foreign currencies have been converted into Euros, at the official rates from the European Central Bank, available at its website following the link "Statistical Data Warehouse" (http://www.ecb.int).
[6] Data can be found at the APX Group website following the link "Market Data" (http://www.apxgroup.com).
[7] Data can be purchased via the website of Platts (http://www.platts.com/). The data points obtained start on the 1st of January 2008 and end on the 31th of December 2009, imposing the upper time limit for this study. These data have been kindly offered by Platts, a McGraw-Hill company, for the purpose of this study. They may not be reproduced elsewhere.

day ahead of physical delivery of the energy through the grid. The system price used here is given by the balance between bids and offers in the market, that is, the equilibrium between supply and demand.[8]

- *FTSEurofirst 100 Index (€)*

The FTSEurofirst 100 Index measures the performance of the 100 largest capitalized European companies, both inside the European Monetary Union and in the United Kingdom. The index is calculated in Euros.[9] This index is used in this study to control for the influence of financial variables in the evolution of the prices of allowances.

2.4.2. Derived data

Following the methodology from Tendances Carbone (Caisse de Dépôts) published in 2007[10]; the following indicators were constructed on the basis of the previous dataset. These indicators bring in information about the relative efficiency of the different energy sources for the production of electricity. Both efficiency in terms of electricity produced per unit of energy input and carbon-dioxide generated are considered in these indicators.

- *Switch price (€ per Megawatt-hour)*

Switch price is the price of EUAs that will theoretically allow the switch from coal to natural gas in power generation. It is the price above which it becomes profitable in the short term for a power plant to move from coal to natural gas. It equates the marginal costs for each additional MWh produced from coal and from gas (cost of coal + cost of CO_2 when using coal = cost of gas + cost of CO_2 when using gas).[11]

$$\text{Price switch} = \frac{\text{cost(gas)/MWh} - \text{cost (coal)/MWh}}{\text{tCO}_2\text{(coal)/MWh} - \text{tCO}_2\text{(gas)/MWh}}$$

[8] Elspot is operated by Nord Pool Spot: "The largest physical power market in the world, offering both day-ahead and intraday markets Nord Pool Spot's system price is the reference price for futures, forwards and options traded in the financial market. The system price is also the reference price for the Nordic OTC/bilateral wholesale market and used by distributors as basis for quoting prices to end consumers. The Norwegian Water Resources and Energy Directorate (NVE) regulates Nord Pool Spot and issues the market place concession. The Norwegian Ministry of Petroleum and Energy (OED) has authorized Nord Pool Spot to organize the physical exchange of power with neighbouring countries."
Data can be found at Nord Pool Spot website, following the link "Elspot Market Data" (http://www.nordpoolspot.com/).

[9] Data can be found at NYSE Euronext website following the link "Indices" and then "Global Indices" (http://www.euronext.com).

[10] Tendances Carbone. Methodology – Version 3, September 2007. Caisse des Dépôts.

[11] The description of these variables is the following:

- cost (gas): Production cost of one MWh of electricity on base of net CO_2 emissions of gas in €/MWh = (€/therm)/0.02931
- cost (coal): Production cost of one MWh of electricity on base of net CO_2 emissions of coal in €/MWh = (€/tone)/0.8141
- tCO_2 (coal): Emissions factor (CO_2/MWh) of a conventional coal-fired plant: 0.86 tCO_2/MWh
- tCO_2 (gas): Emissions factor (CO_2/MWh) of a conventional gas-fired plant: 0.36 tCO_2/MWh

- *Clean Dark Spread (€ per Megawatt-hour)*

Clean Dark Spread is here the difference between the price of electricity and the price of coal used to generate that electricity, corrected for the energy output of the coal plant.[12]

$$\mathrm{CDS} = \mathrm{P_{electricity}} - \left(\mathrm{P_{coal}} \times \frac{1}{\mathrm{\rho_{coal}}}\right) + \mathrm{P_{EUA}} \times \mathrm{FE_{coal}}$$

- *Clean Spark Spread (€ per Megawatt-hour)*

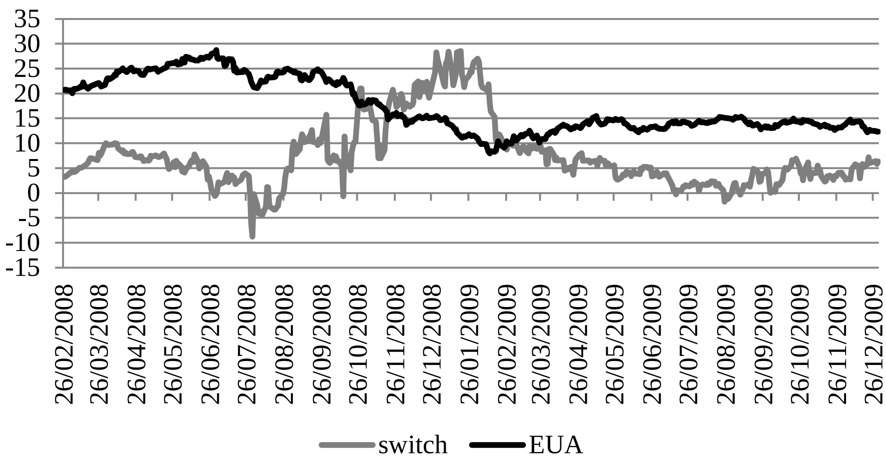
Clean Spark Spread is here the difference between the price of electricity and the price of gas used to generate that electricity, corrected for the energy output of the gas plant.[13]

$$\mathrm{CSS} = \mathrm{P_{electricity}} - \left(\mathrm{P_{gas}} \times \frac{1}{\mathrm{\rho_{gas}}}\right) + \mathrm{P_{EUA}} \times \mathrm{FE_{gas}}$$

Hence, the switch price can also be understood as the equilibrium between the clean dark spread and the clean spark spread:

$$\mathrm{SP} = \frac{\mathrm{P_{gas}} - \mathrm{P_{coal}}}{\mathrm{FE_{coal}} - \mathrm{FE_{gas}}}$$

Switch price and price of EUAs compared



[12] The description of these variables is the following:

- $P_{electricity}$: Price of electricity Elspot, in €/MWh
- P_{coal} : Price of coal CIF ARA in €/MWh
- ρ_{coal} : Net thermal Efficiency of a conventional coal-fired plant: 40%
- P_{EUA} : Price of CO_2 of BlueNext in €
- FE_{coal} : Emissions factor (CO_2/MWh) of a conventional coal-fired plant: 0.86 tCO_2/MWh

[13] The description of these variables is the following:

- $P_{electricity}$: Price of electricity Elspot, in €/MWh
- P_{gas} : Price of Zeebrugge gas in €/MWh
- ρ_{gas} : Net thermal Efficiency of a conventional gas-fired plant: 55%
- P_{EUA} : Price of CO_2 of BlueNext in €
- FE_{gas} : Emissions factor (CO_2/MWh) of a conventional gas-fired plant: 0.36 tCO_2/MWh

2.4.3. Discussion on methodology

The data series studied here present high volatility so that the assumption of homoskedasticity (constant variance) is not appropriate. On the one hand, implementing standard regressions and error correction models has shown that there is heteroskedasticity and that GARCH (1,1) behaviour is present. On the other hand, testing for higher order GARCH proved inconclusive.

GARCH (p,q) stands for Generalised Autoregressive Conditional Heteroskedasticity. It models the conditional variance of the dependent variable as an Autoregressive Moving Average Model (ARMA); meaning that the variance of the dependent variable depends on its past values and on the values of the error term. This way the model captures both periods of tranquillity and volatility in the dependent variable.[14]

The conditional variance in the GARCH (p,q) model is given by:

$$\sigma_t^2 = \omega + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_j \, \sigma_{t-j}^2 \equiv \omega + \alpha(L)\varepsilon_{t-1}^2 + \beta(L)\, \sigma_{t-1}^2$$

The model for the error term is given by an ARMA [max(p,q),p] model:

$$\varepsilon_t^2 = \omega + [\alpha(L) + \beta(L)]\varepsilon_{t-1}^2 - \beta(L)v_{t-1} + v_t$$

Generally, ARMA models offer a more parsimonious description of the temporal dependencies in the conditional mean than AR models; hence GARCH modelling usually gives better results than traditional ARCH modelling. GARCH (1,1) rather than ARCH (1), that is GARCH (0,1), is employed here.[15]

2.4.4. Regression specification

In sum, this econometric analysis, models the prices of EUAs as dependent variable on the following regressors:

- Past values of the prices of allowances.
- Energy fundamentals.
    - On the one hand, energy prices (prices of oil, coal, gas and power).
    - On the other hand, the switch price, the clean dark spread and the clean spark spread (in order to capture the relative efficiencies of energy sources).
- Financial fundamentals, using the value of the stock exchange to control for the effect of this variable.

Data series are expressed in logarithms whenever possible to allow for the interpretation of the coefficients in the regression in terms of elasticities or semi-elasticities. A further

[14] For the references used to decide upon the methodology used in this study and elaborate this section, please consult the bibliography.
[15] Idem.

motivation to take natural logarithms is for the distributions of the variables to become closer to the normal distribution, although given the large sample, asymptotic normality can be assumed.

Data series are expressed in first differences given the existence of unit root processes in the dependent variable and in some of the regressors. This way these series are transformed into stationary time series.

Finally, GARCH (1,1) modelling is used. As previously stated, GARCH processes of a higher order were rejected when testing for them.

The following specification is obtained after dropping irrelevant regressors of the highest lag and of the highest p-value:

$$\begin{aligned}\Delta \ln(\mathrm{EUA})_t = {} & \beta_0 + \beta_1 \Delta \ln(\mathrm{EUA})_{t-2} + \beta_2 \Delta \ln(\mathrm{COALmwh})_t + \beta_3 \Delta \ln(\mathrm{COALmwh})_{t-2} \\ & + \beta_4 \Delta \ln(\mathrm{POWER})_{t-2} + \beta_5 \Delta \mathrm{SWITCH}_t + \beta_6 \Delta \mathrm{SWITCH}_{t-2} + \beta_7 \Delta \mathrm{CDS}_t \\ & + \beta_8 \Delta \mathrm{CDS}_{t-2} + \beta_9 \Delta \mathrm{CSS}_t + \beta_{10} \Delta \mathrm{CSS}_{t-2} + v_t\end{aligned}$$

2.4.5. Interpretation of results

$$\begin{aligned}\Delta \ln(\widehat{\mathrm{EUA}})_t = {} & 0.000 - 0.138\, \Delta \ln(\mathrm{EUA})_{t-2} - 0.573\, \Delta \ln(\mathrm{COALmwh})_t \\ & - 0.093\, \Delta \ln(\mathrm{COALmwh})_{t-2} + 0.026\, \Delta \ln(\mathrm{POWER})_{t-2} \\ & + 0.129\, \Delta \mathrm{SWITCH}_t + 0.016\, \Delta \mathrm{SWITCH}_{t-2} - 0.142\, \Delta \mathrm{CDS}_t \\ & - 0.019\, \Delta \mathrm{CDS}_{t-2} + 0.142\, \Delta \mathrm{CSS}_t + 0.018\, \Delta \mathrm{CSS}_{t-2}\end{aligned}$$

Interesting conclusions can be drawn from these results that are a strong indicative of the quality of the price signal provided by the secondary market for allowances:

- The switch price, the clean dark spread and the clean spark spread are the main drivers of the price level of allowances. These regressors codify information about the evolution of allowances prices, the prices of gas and coal, their respective emission coefficients and their respective efficiencies when used to produce electricity.
- The price of coal also plays a substantial role in determining the price of allowances. This is a logical result as coal is the most carbon-dioxide intensive of all the energy sources taken into account.
- The prices of electricity also play some role.
- The coefficients associated with the prices of crude oil and gas are not relevant. This is surprising but, in the case of gas, can be explained by the inclusion of derived data like the switch price and the clean spark spread.
- Influence from the evolution of the stock exchange is ruled out.

- When the difference in the prices of allowances between t-3 and t-2 increases there is a tendency for the difference between t-1 and t to decrease.

It can therefore be concluded from these results that the formation of carbon prices in the most liquid trading platform, BlueNext, follows the evolution of energy fundamentals, which supports the argument of prices for allowances constituting a consistent price signal.

A detailed interpretation of each coefficient in the regression can be found in the annexes and will provide the reader with a deeper understanding of the mechanisms underlying the formation of prices in the secondary market for emissions.

2.5. Is there an upward trend in the price of allowances?

This is the second research question asked in this paper about the efficiency of the secondary market for allowances. It will, at the same time, serve as bridge to the next chapter on the efficiency of the primary market. Before looking for an answer, it is important to note the links that exist between both markets with regard to the emergence of an upward trend in prices. So far, emission allowances have been allocated for free almost in their entirety, which has lead to several types of distortions. For instance, it has arguably led to windfall profits, particularly for power generators in some European countries. These profits are pernicious, not only because they lead to higher prices for end-consumers but because, while doing the former, they reward the polluter and do not generate enough incentives to abate emissions.[16] The reader should hence be aware that, even though prices are well grounded in the secondary market, there remain distortions that are likely to affect the emergence of an upward trend in prices.

Is there then an upward trend in the price of EUAs? The number of allowances allotted sets a limit to the amount of carbon-dioxide that installations covered by the scheme can emit all together. As previously mentioned, trade between installations is allowed to facilitate abatement at the lowest possible costs. It is generally accepted that, as years go by, prices of carbon-dioxide should go up for the following reasons:

- Within the logic of the scheme, the overall cap is due to diminish yearly to take account of the reductions in emissions achieved the year before.

- The EU has committed itself to reduce emissions up to 20% by 2020. This target requires reductions to progressively increase. Hence, if the EU is to stick to its commitment, yearly caps will need to be reduced further.[17]

[16] It is understood that companies price their products adding a mark-up to their marginal costs. Since these costs include opportunity costs, like the profit missed by not selling an allowance on the market, the polluter may, under certain circumstances, extract profit as a consequence of the mere allocation of allowances.

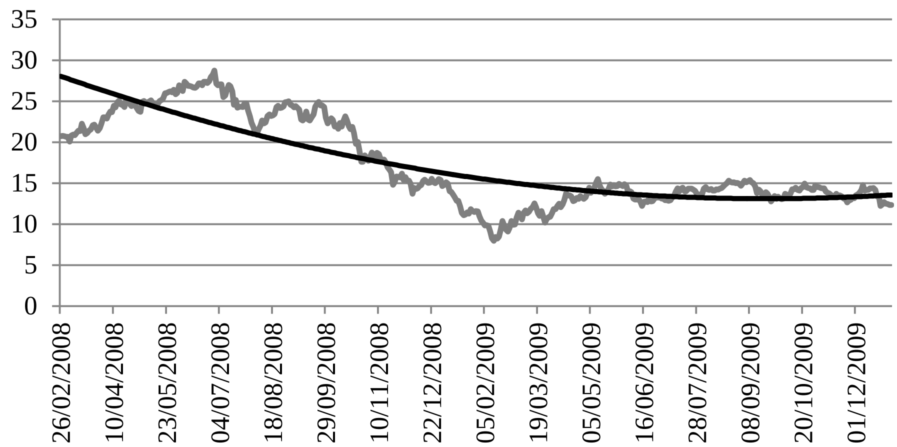
[17] According to article 9 of Directive 2003/87/EC, from 2013, the total number of allowances issued will decrease each year by a linear factor of 1.74% compared to the mean for the previous trading period.

- As relatively cheap abatement options are undertaken, relatively expensive abatement options will be left. The quantity of "low-hanging fruits" is difficult to estimate and new ones may present themselves as technology evolves. However, it is understood that prices of carbon-dioxide will need to go up in the future in order to provide enough incentives to achieve reductions in emissions.

From this it can be seen that the presence of an upward trend in prices would be a strong indicative of the scheme functioning properly. That trend cannot be observed and the series of EUA spot prices during 2008 and 2009 rather shows a random-walk type of behaviour.

In order to reach this conclusion, the augmented Dickey-Fuller test has been employed here. Under the null hypothesis the process follows an AR (1) process with ρ equal to 1. Following this test, the null cannot be rejected, which means that the presence of an upward time trend can be excluded. In fact, a downward trend can be observed in the graphical representation of the prices of allowances.

Polynomic trend in BNS EUA 2008-2012 (€/allowance)



The results of this test should be taken with caution as it is only two years since the second phase of the scheme began. Additionally, global recession has contracted production and hence has had a negative impact on the prices of allowances (acting as a demand shock). Nevertheless, the results of this test indicate that more stringent caps may be required in the future for the scheme to remain effective. An estimation of the impact of the recession on the market for allowances will be provided in the next chapter.

2.6. Conclusions

Two main conclusions can be drawn from this study on the efficiency of the secondary market for allowances:

First, using GARCH modelling it has been shown that energy fundamentals, rather than financial ones, are the main drivers of the prices of EUAs. This is an indication of the secondary market for emission permits having reached maturity in the EU. This study has focused on energy prices, emission coefficients of energy sources and efficiency rates of coal and gas when used for producing electricity. However, these are not the only drivers of the prices of allowances. The literature beliefs that other factors like economic growth, abatement costs or the level of competition in the markets are key drivers over the medium to long term. Given the recent introduction of the emissions trading scheme and hence the few number of observations available, studying the impact of the mentioned factors is not yet possible. Nevertheless, it is shown here that energy fundamentals are indeed relevant factors in determining the evolution of the prices of carbon-dioxide, at least over the short to medium term.

Second, it has been shown that there is no upward trend in prices, even though the scheme can be deemed to be functioning properly and to provide clear and well grounded price signals. It should be borne in mind that whether the upward trend in prices appears over the years remains the responsibility of the European and national authorities. Ultimately, only by generating scarcity in the market for allowances the objective of the scheme can be fulfilled. The total number of allowances allotted and the methodology followed for allocating them are the central research questions of the next chapter.

3. Efficiency in the primary market for allowances

3.1. Introduction

In the previous chapter key aspects of the secondary market for allowances were analysed and two main conclusions were drawn: (1) formation of prices follows market fundamentals but (2) it is feared the price signal is not sufficiently strong given the absence of an upward trend. A caveat was made with regard to the provision of allowances for free in first instance and the distortion for prices this may entail. Efficiency in the primary market is hence an issue of great concern.

In this chapter, reference will be made to the different methods to allocate allowances in the primary market; namely grandfathering, benchmarking and auctioning. The Union will be introducing important changes in 2013 to ensure the system is fit for meeting the ambitious targets set for 2020. In this sense, reference will be made to the 2009 revision of Directive 2003/87/EC[18] and to the proposal for a regulation on harmonised auctioning.[19]

[18] Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community.

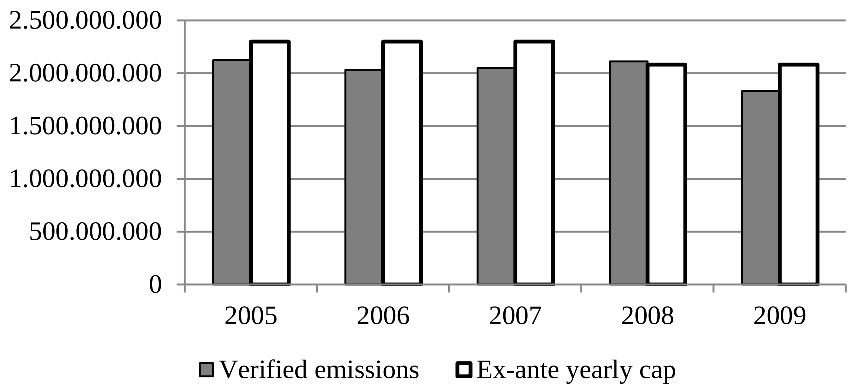
[19] This proposal became Commission Regulation No 1031/2010 of 12 November 2010 on the timing, administration and other aspects of auctioning of greenhouse gas emission allowances pursuant to Directive 2003/87/EC of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowances trading within the Community.

From a more empirical point of view, the level of allowances allocated and the level of emissions verified will be compared. In particular, the allocation for the second trading period will be scrutinised. Following the methodology of the Commission, an approximation to the impact of the economic downturn on allocation will be unveiled. This will give the reader more insight into the reasons why no upward trend can be observed in the prices of EUAs.

3.2. Allowances allocated and verified emissions compared

Before going into more detailed analysis, it is useful to compare how the yearly cap set at the beginning of each trading period relates to verified emissions. The following graph and table compare these two magnitudes and provide an approximation as to the difference between both of them.

Overallocation / Excess-emissions in the ETS



Ex-ante caps for each trading period and verified emissions (million allowances)[20]							
first trading period				second trading period			
ex-ante yearly cap	verified emissions			ex-ante yearly cap	extended scope (yearly)	verified emissions	
	2005	2006	2007			2008	2009
2.298,50	2.122,16	2.033,64	2.049,93	2.080,93	54,61	2.111,57	1.909,59
% of cap	92%	88%	89%	% of cap	2%	101%	88%

[20] European Commission: *Emissions trading: EU-wide cap for 2008-2012 set at 2.08 billion allowances after assessment of national plans for Bulgaria*. IP/07/1614, Brussels, 26 October 2007.
&
European Commission: *Emissions trading: 2007 verified emissions from EU ETS businesses*. IP/08/787, Brussels, 23 May 2008.
&
Compliance data available at:
http://ec.europa.eu/environment/climat/emission/citl_en_phase_ii.htm#reports
[Files "2008 Compliance Data, extract from CITL 26/08/2009" and "Verified Emissions for 2008-2009 and allocations 2008-2009"]

It is found that, in four out of the five years the scheme has been operational so far, more allowances had been issued than tons of carbon-dioxide were emitted to the atmosphere; only in 2008 there was no overallocation.

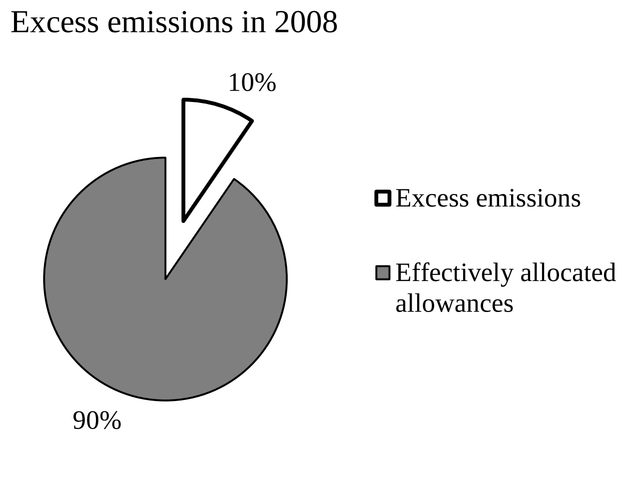
With regard to the first trading period, it should be borne in mind that it was a trial period. In fact, despite overallocation, the first phase of the scheme can be judged to have been rather successful, since its main objectives were attained; carbon markets emerged and a price for carbon materialized.

As for the second trading period, a far more stringent cap made overallocation less likely. Thus, in 2008, emissions were higher than allocated allowances. However, in 2009, verified emissions were again lower than allotted permits. The following discussion will analyse this phenomenon into greater detail.

Moreover, the reader should be aware of the quantitative differences that exist between yearly caps set ex-ante for each period and the final number of allowances that are effectively allocated each year. These differences arise because the overall ex-ante cap for the EU is formally the addition of the caps set in every National Allocation Plan (NAP). Further, these national caps are themselves the sum of the number of allowances allotted to each installation. In the end, allowances belong to installations and, as their number varies given closures and openings, differences arise between the cap set at the beginning of the trading period and the effective cap in a given year.

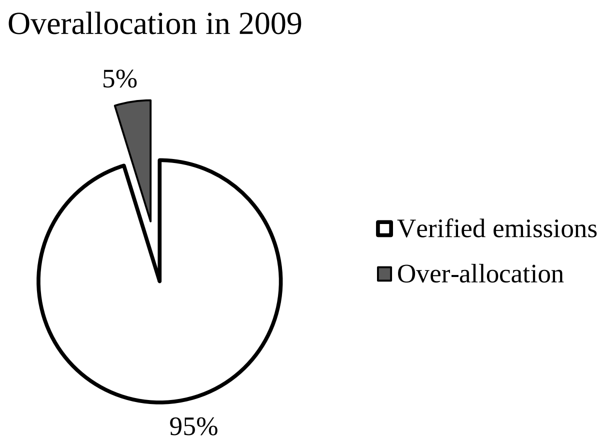
Verified data are stored in the Community Independent Transaction Log (CITL). Following these data for the second trading period it is possible to provide a more accurate picture of the difference between emissions and allocated allowances.

- In 2008, verified emissions were 10.50% higher than the allowances allocated to installations.[21]



[21] Verified emissions in 2008 were 2.111.565.406 tones of CO_2 and allocated emissions were 1.909.588.781 tones of CO_2 for the 12.229 installations computed.
Data available at: http://ec.europa.eu/environment/climat/emission/citl_en_phase_ii.htm#reports
[File: 2008 Compliance Data, extract from CITL 26/08/2009]

- However in 2009, verified emissions were 5% lower than allowances allocated.[22]



3.3. Allocation in the second trading period

As explained before, verified emissions in the first trading period significantly exceeded the number of allowances allocated, which led to the collapse of the carbon price. Emissions were first verified in 2005 where it was unveiled that just over 2 billion tons of carbon-dioxide had been emitted that year, while overall allowances allocated amounted to more than 2.2 billion.[23]

When the time came for the Commission to approve the National Allocation Plans (NAPs) for the second trading period, it was essential to avoid overallocation. The Commission made clear that otherwise, "the development and deployment of existing and new clean technologies would stall, and the evolution of a dynamic and liquid global market would be seriously undermined".[24]

While NAPs for the first trading period were approved based on estimated emissions, since 2005 high quality data per installation are available, verified by independent sources. Hence, national authorities and the Commission did not have in 2006 the same information deficit with regard to actual emissions that they faced for the first (trial) trading period.

To determine the annual cap for each country, the Commission follows the following formula, which takes into account verified emissions, GDP growth, carbon intensity and extensions in the scope of the scheme.

$$\mathbf{MAAAC} = (\mathbf{GIVE} \times \mathbf{GTD} \times \mathbf{CITD}) + \mathbf{ADD}$$

$$\mathbf{MAAAC} = \textbf{maximum allowed annual average cap}$$

[22] Verified emissions in 2009 were 1.830.278.158 tones of CO_2 and allocated emissions were 1.926.803.921 tones of CO_2 or the 12.598 installations computed.
Data available at: http://ec.europa.eu/environment/climat/emission/citl_en_phase_ii.htm#reports
[File: Verified Emissions for 2008-2009 and allocations 2008-2009]
[23] Page 2, COM (2006) 725 final.
[24] Page 2, COM (2006) 725 final.

$$\mathbf{CIVE} = \mathbf{corrected\ independently\ verified\ emissions\ (for\ 2005)}^{25}$$

$$\mathbf{GTD} = \mathbf{growth\ trend\ development\ (2005\ to\ 2010)}$$

$$\mathbf{CITD} = \mathbf{carbon\ intensity\ trend\ development\ (2005\ to\ 2010)}$$

$$\mathbf{ADD} = \mathbf{additional\ emissions\ covered\ by\ an\ extended\ scope}$$

Ex-post adjustments of the absolute quantity of allowances in each NAP are not allowed by Directive 2003/87/EC.[26] The EU emissions trading scheme operates by setting an up-front cap to emissions; it is understood that there cannot be any possibility of modifying the cap after the start of a given trading period; otherwise, it would not be possible for the carbon market to operate with a sufficient level of certainty and stability. Further, positive differentials between the cap and verified emissions cannot always be blamed on overallocation, that is, poor ex-ante estimation, but may well be the consequence of reductions in emissions undertook as a consequence of the incentives set up by the scheme. Hence, careful analysis needs to be carried out not only ex-ante but also ex-post, the later one in order to determine the efficiency of the scheme and ameliorate subsequent estimates when setting caps for the following trading periods.

The Commission estimated the Carbon Intensity Trend Development (CITD) as -2.5% from 2005 to 2010 (5 years), that is -0.5% each year. It is understood that reduction in carbon intensity, that is, emissions per unit of Gross Domestic Product (GDP), leads to lower emissions.

With regard to the Growth Trend Development (GTD), the Commission followed its own estimates of GDP growth for the period 2005-2010, which predicted an average growth in output of over 2% per year[27]. It is assumed for setting the cap that higher growth leads to higher emissions, although, under appropriate incentives such as the ETS, intense growth may well lead to deployment of more efficient technologies and even to absolute reductions in emissions. This type of inter-relations is what makes the setting of ex-ante caps particularly complex. In fact, emissions in Europe remained stable from 1990 to 2000, given that carbon intensity decreased at a similar rate as GDP increased.[28] It is arguable what share of the reduction in carbon intensity is due to more efficient technologies and what share is due to the decline of the industrial sector in Europe.

Given the methodology and estimates mentioned above, the Commission reviewed each NAP and came up with a total of 2.081 billion allowances per year from 2008 to 2012

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[25] Page 6, COM (2006) 725 final.

[26] Article 11 and Annex III (criterion 10), Directive 2003/87/EC.

[27] European Commission, Directorate General for Economic and Financial Affairs: *European Economic Forecast - autumn 2006*. Brussels, October 2006.
&
European Commission, Directorate-General for Energy and Transport: *European Energy and Transport: Trends to 2030 - Update 2005*. Brussels, 22 May 2006.

[28] Page 5, Communication from the Commission on further guidance on allocation plans for the 2008 to 2012 trading period of the EU Emission Trading Scheme. COM (2005) 703 final, Brussels, 22.12.2005.

for the whole of the Union.[29] During this process, the Commission managed to reduce the initial number of allowances proposed by the Member States by 10.5%.[30] In comparative terms, this cap represents 140 million allowances less than 2005 verified emissions; this is a reduction of almost 7% in the number of allowances issued, when the extension in scope of the scheme for the second trading period is taken into account.[31]

3.3.1. Impact of the economic downturn

Following the methodology used by the Commission to determine the Maximum Allowed Annual Average Cap (MAAAC), in this section, the impact of the economic downturn, or rather the impact of the lack of anticipation of this downturn, will be discussed.

The Commission used data from DG Economy and Finance and DG Transport to determine the Growth Trend Development (GTD); in the following table these data are reproduced. While the Commission used forecasts about GDP growth available in 2006, the following table also contains the most recent statistics and forecasts published by the same sources.

Growth Trend Development (GTD)									
Date of report	2003	2004	2005	2006	2007	2008	2009	2010	2011
DG ECFIN forecasts* of real GDP growth in the EU (in percentage per year)[32]									
Autumn 2006	1,3	2,4	1,7	2,8*	2,4*	2,4*	-	-	-
Autumn 2009	-	-	-	3,2	2,9	0,8	-4,1*	0,7*	1,6*
DG TREN forecasts* of real GDP growth in the EU (in percentage per year)[33]									
Update 2005	1,94*							2,13*	
Update 2007	2,15*							2,06*	

In the previous table, one can see the difference between forecasted and real growth, given the difficulty to anticipate the financial turmoil and the later recession from 2007.

[29] Page 14, COM (2005) 703 final.
[30] Page 14, COM (2005) 703 final.
[31] European Commission: Emissions trading: *Commission adopts amendment decision on the Slovak National Allocation Plan for 2008 to 2012*. IP/07/1869, Brussels, 7 December 2007.
[32] Page 4, European Commission, Directorate General for Economic and Financial Affairs: *European Economic Forecast - autumn 2006*. Brussels, October 2006.
&
Page 20, European Commission, Directorate General for Economic and Financial Affairs: *European Economic Forecast - autumn 2009*. Brussels, October 2009.
[33] Page 16 European Commission, Directorate-General for Energy and Transport: *European Energy and Transport: Trends to 2030 - Update 2005*. Brussels, 22 May 2006.
&
Page 31, European Commission, Directorate-General for Energy and Transport: *European Energy and Transport: Trends to 2030 - Update 2007*. Brussels, 8 April 2008.

When assessing the NAPs for the 2008-2012 trading period, it is understood that the Commission determined the GTD as detailed in the following table, that is, by using data available in 2006 and 2007 to determine the average yearly growth for 2005-2010.

GTD 2005-2010 estimation based on data available in 2006-2007 (in percentage)							
2005	2006	2007	2008	2009	2010	2005-10	GTD
1,7	2,8*	2,4*	2,4*	1,94*	2,13*	14,13	2,36
GTD 2005-2010 estimation based on data available in 2009-2010 (in percentage)							
2005	2006	2007	2008	2009	2010	2005-10	GTD
1,7	3,2	2,9	0,8	-4,1*	0,7*	5,13	0,85

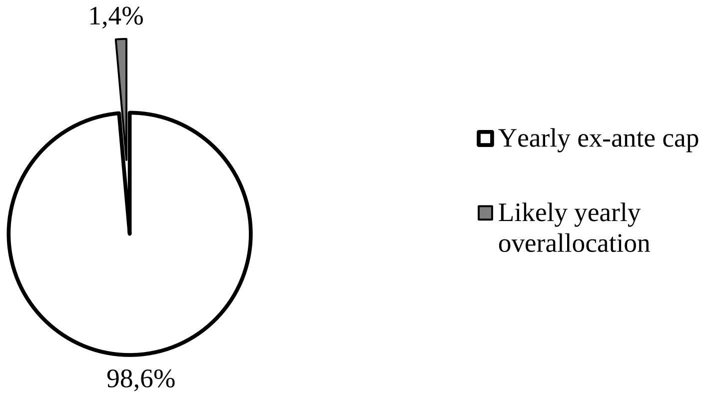
GTD for the period 2005-2010 calculated on the basis of data available in 2006-2007 equals approximately an average growth of GDP of 2,36% per year. However, using data available in 2009-2010, GTD is reduced to 0,85% per year. The difference is very significant and could potentially have resulted in an overallocation of allowances for the second trading period.

In the following table, the maximum allowed annual average cap (MAAAC) calculated by the Commission is traced back using both estimates of GTD. The purpose is to assess what the ex-ante yearly cap on emissions would have been for the whole of the EU if the growth trend development for the period 2005-2010 had been correctly identified by the Commission at the time it issued its decisions on the National Allocation Plans.

Tracing back the maximum allowed annual average cap (MAAAC)						
Estimates	IVE	CIVE*	GTD	CITD	ADD	MAAAC
Data 2006-2007	2.122,16	1989,65	2,36%	-0,5%	54,61	2080,93
Data 2009-2010	2.122,16	1989,65	0,85%	-0.5%	54,61	2.051,23
Difference	-	-	1,50%	-	-	29,70
* GIVE is calculated here by taking the rest of the variables in the equation fixed.						

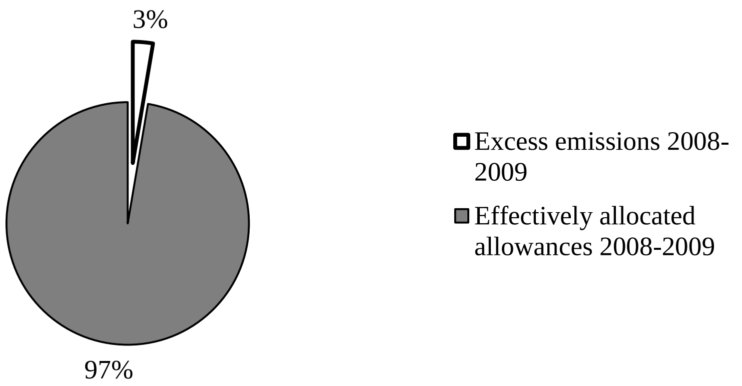
It is found that there is an overallocation of 30 million allowances for each year of the second trading period, that is, 150 million allowances in total. This overallocation is attributable to the change in GDP growth brought by the global recession, which was not anticipated at the time.

Likely overallocation due to the economic downturn



It should be taken into account however, that overallocation of allowances should rather be assessed at the end of a trading period. As previously stated, in 2009, verified emissions were 5% lower than allowances allocated while in 2008 verified emissions were 10.50% higher. This means that in 2008, there were around 200 million tons of excess emissions while in 2009 there were around 95 million allowances overallocated. The overall effect is that, so far in the second trading period, there has been more than 100 million tons of carbon-dioxide emitted in excess to the atmosphere. It should be remembered that banking of allowances is permitted in the scheme.

Excess emissions so far in the second trading period



What matters is whether by the end of the trading period, the balance of emissions stays below the addition of the yearly caps. Moreover, what matters is that the overall cap is in accordance with the commitments of the European Union to reduce emissions and with scientific evidence about the level of abatement required to keep the rise in temperatures under reasonable bounds. Changes have been introduced in the architecture of the scheme to ensure this, as explained in the next section on the future of the overall cap.

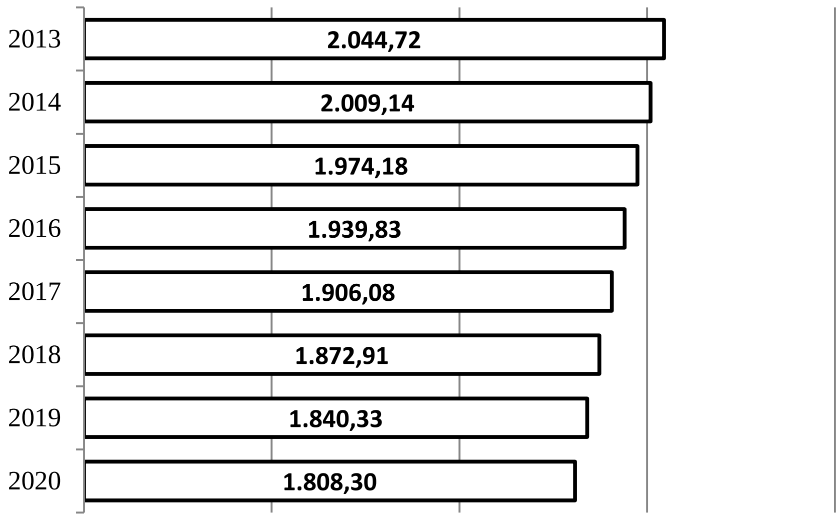
3.4. Future of the overall cap

The setting of caps through National Allocation Plans will be phased-out, given changes brought in by the 2009 revision of Directive 2003/87/EC[34], as well as by Directive 2008/101/EC[35], which introduced aviation into the ETS. Linear reduction paths will be introduced, which will bring in more consistency, greater predictability and a higher likelihood of attaining the desired reductions in emissions.

For aviation, in 2012 the total amount of allowances allocated will be 97% of the mean average of the actual emissions in 2004, 2005 and 2006. From 2013 onwards the percentage will be reduced to 95%.[36]

For stationary installations, starting from 2013, the total number of allowances issued will decrease each year by a linear factor of 1.74% compared to the mean for the previous trading period.[37] This linear reduction path will amount to a reduction of 21% in emissions by 2020, compared to verified emissions in 2005[38]. Taking the cap for phase two and applying the linear factor, it is possible to find good projections today of the caps for the third trading period. This is a step-change in terms of the legal certainty and predictability of the scheme that will surely bring investments forward and improve the quality of carbon price signals.

Estimated caps for the third trading period (million allowances)



[34] Directive 2009/29/EC.
[35] Directive 2008/101/EC of The European Parliament and of the Council of 19 November 2008 amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community
[36] Articles 3c.1 and 3c.2, Directive 2003/87/EC.
[37] Article 9, Directive 2003/87/EC.
[38] The 21% reduction target for the ETS is coupled with a 10% reduction target for the sectors not covered by the scheme. Both these targets together will bring the UE to fulfil its commitment to reduce green house gas emissions by 20% by 2020 compared to 1990 levels (that is down by 14% by 2020 compared to 2005 levels). See page 3 of European Commission: *Questions and Answers on the Commission's proposal to revise the EU Emissions Trading System*. MEMO/08/35, Brussels, 23 January 2008.

3.5. Assessment of the different methods to allocate allowances

It is understood that moving from free allocation to auctioning is a key element to avoid the distortions likely generated by the former during the first trading period and the current one. Basic economic principles suggest that free allocation distorts price signals, providing wrong incentives for installations and hence running against the objective of reducing emissions. Furthermore, free allocation may, under certain circumstances, generate windfall profits, rewarding the polluter, which is against the basic "polluter pays principle" at the heart of the environmental law of the EU.[39]

For the first and second trading period, the number of EUAs allotted to each installation covered by the scheme was based on grandfathering almost in their entirety.[40] However, Directive 2003/87/EC was modified in 2009 in order to take account of scientific evidence favouring auctioning and strict benchmarking. In the following sections these changes will be presented and assessed.

3.5.1. Future of the allocation methods

Directive 2008/101/EC integrated aviation in the emissions trading scheme from 2012 while allowing for a differential treatment. Although the factual characteristics of aviation that justify these differences are not the matter of this paper, since allowances can be traded among all operators covered by the scheme, it is necessary to refer also to allocation to aircraft operators.

- There will be no grandfathering of allowances but allocation based on benchmarks in terms of tonne-kilometre.[41]
- Only 15% of the total allowances will be auctioned from 2012, there being no provision to increase this ratio, although the possibility is left open for this ratio to be increased in a future general review of Directive 2003/87/EC.[42]
- All revenues obtained by Member States through the auctioning of aviation allowances shall be employed for the purposes of tackling global warming both within the Union and abroad. This is a legal requirement imposed by Directive 2003/87/EC, notwithstanding the liberty of Member States to choose the specific projects they desire to finance with the proceeds from auctioning.[43]

For stationary installations, the 2009 revision of Directive 2003/87/EC[44] introduces radical changes with regard to the methodologies used to allocate allowances, phasing-out the system based on National Allocation Plans (NAPs).

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[39] Article 191.2, Treaty on the Functioning of the European Union.
[40] Information about auctions that have taken place during the second trading period can be found at: http://ec.europa.eu/environment/climat/emission/auctioning_en.htm
[41] Articles 3e.3, Directive 2003/87/EC.
[42] Articles 3d.1 and 3d.2, Directive 2003/87/EC.
[43] Article 3d.4, Directive 2003/87/EC.
[44] Directive 2009/29/EC.

- Grandfathering is discarded and the Union undertakes to harmonise the rules for allocation by determining Union-wide ex-ante benchmarks. These benchmarks will be set per products (instead of per inputs) and will be based on the performance of the 10% most efficient installations for each product in 2007 and 2008.[45]

  The aim is to avoid incentives to maintain or increase emissions, by taking into account "the most efficient techniques, substitutes, alternative production processes, high efficiency cogeneration, efficient energy recovery of waste gases, use of biomass and capture and storage of CO_2, where such facilities are available".[46]

- From 2013 the amount of allowances auctioned will be 20% of the total number of allowances issued. This ratio will progressively increase until reaching 70% auctioning in 2020 and 100% in 2027.[47]

- In addition, there will be no free allocation to electricity generators from 2013, given claims of windfall profits during the first trading period.[48] It is worth noting that, as the sector faces particularly low competitive pressure from electricity producers outside the EU, it has consistently been the target for the most constraining provisions; ever since the first trading period where almost the full burden of reduced emissions was placed in this sector.[49] There are however some transitional derogations from this provision, in order to encourage the modernisation of production and distribution capacities in some of the recently acceded Member States.[50]

- With regard to the proceeds from auctioning for stationary installations, the requirement to destine revenues generated by auctioning to environmental projects is limited to 50% of those revenues. However, the type of projects that can be financed is further specified in Directive 2003/87/EC, while respecting the capacity of Member States to select those projects.[51]

The impact of this change in the methodology to allocate allowances will likely be significant. Benchmarking will induce investments given that it would be based on the emissions performance of the most advanced technologies in use. Furthermore, the move from free allocation towards auctioning will improve the quality of the price signals in carbon markets.

However, it could be argued that opting for benchmarking, even though as a transitory instrument, is a poor decision. On the one hand, benchmarking is still free allocation and therefore distorts carbon price signals and goes against the "polluter pays" principle. On the other hand, developing benchmarks could potentially become more burdensome and costly than the European legislator seems to anticipate.

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[45] Articles 10a.1 and 10a.2, Directive 2003/87/EC.
[46] Article 10a.1, Directive 2003/87/EC.
[47] Article 10a.11, Directive 2003/87/EC.
[48] Article 10a.3, Directive 2003/87/EC.
[49] See Denny (2008).
[50] Article 10c, Directive 2003/87/EC.
[51] Article 10.3, Directive 2003/87/EC.

Administrative costs could be high given that, even though emissions data per installation are reliable, difficulties may arise when determining which are the most efficient installations. Why incurring these costs when the Directive itself, as well as most scientific literature, present benchmarking as a second-best alternative to auctioning? By the end of 2010 the Commission should come up with detailed principles to determine those benchmarks.[52]

3.6. Conclusions

It can be concluded that the scheme so far has lacked efficiency in the primary market for allowances. On the one hand, grandfathering and lack of reliable emissions data caused overallocation in the first trading period. Furthermore, given the lack of anticipation of the economic downturn, allocation based on 2005 verified emissions has also caused oversupply in the second trading period. On the other hand, free allocation has been the source of windfall profits and reduced quality of price signals in general.

However, the necessary reforms have been undertaken. First, a clear reduction path of the overall cap has been inserted into the law, so that the Union will more likely meet its objective of 20% less emissions by 2020. Second, the phase-out of National Allocation Plans (NAPs) and the full harmonisation of allocation methods will improve consistency. Moreover, benchmarking based on most efficient installations will help to make caps more stringent for those sectors with more potential to reduce emissions. Finally, the move towards auctioning will tackle the issue of windfall profits; generate revenues that can be invested in the transition to a low-carbon economy; and, most importantly, substantially improve the quality of price signals in the carbon markets aligning both the primary and secondary market for emission allowances.

4. Carbon leakage, allocation and border tax adjustments

4.1. Introduction

In the previous chapters, issues of efficiency in the primary and secondary market for allowances have been discussed. However, a fundamental question about the efficiency of the EU ETS remains since, given low barriers for movements of capital and production capacities around the world, business may delocalize to countries where environmental policies are less constraining. This phenomenon is known as carbon leakage.

On the one hand, delocalization of EU firms in order to avoid the costs of purchasing allowances, runs against the efficacy of the European trading scheme. Further, if emissions move from one country to another and are not reduced overall, the wider

[52] Article 10a.1, Directive 2003/87/EC.

objective of keeping global temperatures under control will not be attained. It is understood that climate change is a global problem, characterized by externalities so that there is little connection between where emissions are generated and where disruptions occur.

On the other hand, if a level playing field for products produced at home and abroad is not ensured, the quality of the carbon price signal will be distorted to a certain extent. Ideally, many countries would have instruments similar to the ETS linked together so that a world price for carbon would emerge. However, for as long as this remains unachieved, adjustments to account for the emissions of imported products might be necessary to reinforce the quality of the carbon price inside existing trading schemes, like the ETS.

In addition, border adjustments could also address concerns about the loss of competitiveness that costs derived from the ETS impose on certain sectors and businesses in Europe, by imposing similar costs on similar activities carried elsewhere.

In this concluding chapter, the way the EU plans to address carbon leakage will be examined, together with the effects of possible border adjustments for the overall consistency and efficiency of the scheme. The aim is to cover this important aspect of emissions-trading so that the reader gains a more comprehensive understanding of the issues at stake when considering the efficiency of the ETS.

4.2. Carbon leakage policy in the European Union

There is carbon leakage, according to Directive 2003/87/EC, where a sector or subsector cannot increase prices to pass on the costs derived from the ETS without a "significant loss of market share to less carbon efficient installations outside the Community". Both direct costs, resulting from the purchase of allowances, and indirect costs, resulting from higher electricity prices, are taken into account in order to assess this exposure.[53] Currently, three actions have been devised to confront carbon leakage in the European Union:

- First and foremost, sectors or subsectors significantly exposed to carbon leakage qualify for support in the form of free allocation of allowances that would otherwise be auctioned.[54]

- Second, the sectors affected might receive financial support from the Member States to compensate the increase in the cost of electricity brought by the ETS. This support should respect state aid rules and be based on ex-ante benchmarks of indirect emissions of carbon-dioxide per unit of production.[55]

[53] Article 10a.14, Directive 2003/87/EC.
[54] Article 10a.12, Directive 2003/87/EC.
[55] Article 10a.6, Directive 2003/87/EC.

- Third, the Union will consider, based on an analytical report to be presented to the European Parliament and the Council by 30 June 2010, the suitability of including importers within the emissions trading scheme.[56]

According to Directive 2003/87/EC a sector or subsector is exposed to carbon leakage when, either the increases in production costs and intensity of trade[57] are alternatively above 30%, or those increases are above 5% and 10% cumulatively.[58] In December 2009, the Commission published the list of these sectors[59]; it contains around 151 subsectors at NACE4[60] level of disaggregation and below. Most of them qualify because of their exposure to international trade (up to 117 subsectors). Only the manufacturing of cement and lime qualify because production costs for those products will increase by more than 30% due to the ETS.

It is worth noting that the assessment carried by the Commission considered 258 subsectors and assumed a price of allowances of EUR 30[61] and average 75% auctioning[62]. As for the increase in costs of electricity, the assessment assumed average emission factors of power plants. Hence, it could be argued that the analysis lacks dynamic components. This issue is of particular concern given that inclusion in the list is valid for 5 years and, although the list will be reviewed yearly, it will only be reviewed for the purpose of examining if other sectors qualify for inclusion.[63] Another concern is that sectors which do not qualify under the quantitative criteria can be included in the list on the basis of qualitative analysis, which gives way for private interests to exert influence and expand the scope of the list.[64]

Installations included in the list automatically qualify for the free allocation of 100% of the allowances allotted to them. It follows that this restriction of auctioning will distort the carbon price signal in the third trading period to an extent dependent on the amount of allowances deemed to be at risk of carbon leakage. In total, around 25% of emissions covered by the ETS qualify for free allocation of allowances due to carbon leakage, that is, more than 75% of the emissions from the manufacturing industry covered by the

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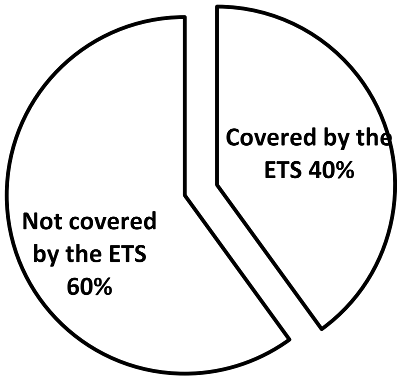
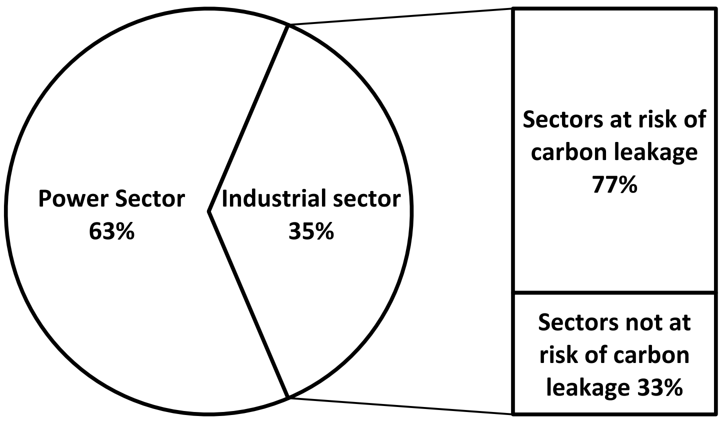
[56] Article 10b.1 (b), Directive 2003/87/EC.
[57] Intensity of trade is defined as "the ratio between the total value of exports to third countries plus the value of imports from third countries and the total market size for the Community (annual turnover plus total imports from third countries)" See article 10a.15 (b), Directive 2003/87/EC..
[58] Articles 10a.15 and 10a.16, Directive 2003/87/EC.
[59] Commission Decision of 24 December 2009 determining, pursuant to Directive 2003/87/EC of the European Parliament and of the Council, a list of sectors and subsectors which are deemed to be exposed to a significant risk of carbon leakage.
[60] NACE (Nomenclature statistique des activités économiques dans la Communauté européenne) is the Statistical Classification of Economic Activities in the European Community.
[61] The assumption of this price level is required by Article 10a.14, Directive 2003/87/EC.
[62] Page 16, Impact assessment accompanying the Commission Decision determining a list of sectors and subsectors which are deemed to be exposed to a significant risk of carbon leakage pursuant to Article 10a (13) of Directive 2003/87/EC.
[63] Article 10a.13, Directive 2003/87/EC.
[64] Article 10a.17, Directive 2003/87/EC.

ETS.[65] A clearer picture of the relationships between these percentages can be seen in the following two graphs.[66]

Emissions of green house gases in the EU



Emissions of green house gases covered by the ETS



Impact on the primary market for allowances

From the graphs above, it can be calculated that the total amount of emissions deemed at risk of carbon leakage equals more than 10% of total green house gases emitted in the European Union. Given that this is approximately 25% of emissions covered by the ETS, it is possible to find a good approximation to the amount of allowances that will be auctioned in the third trading period. The following table presents these estimates and describes the procedure set in Directive 2003/87/EC to allocate allowances. The reader should remember that the power sector will receive no free allowances from 2013.[67] The calculations assume that the share of each sector in total emissions remains unchanged until 2020.

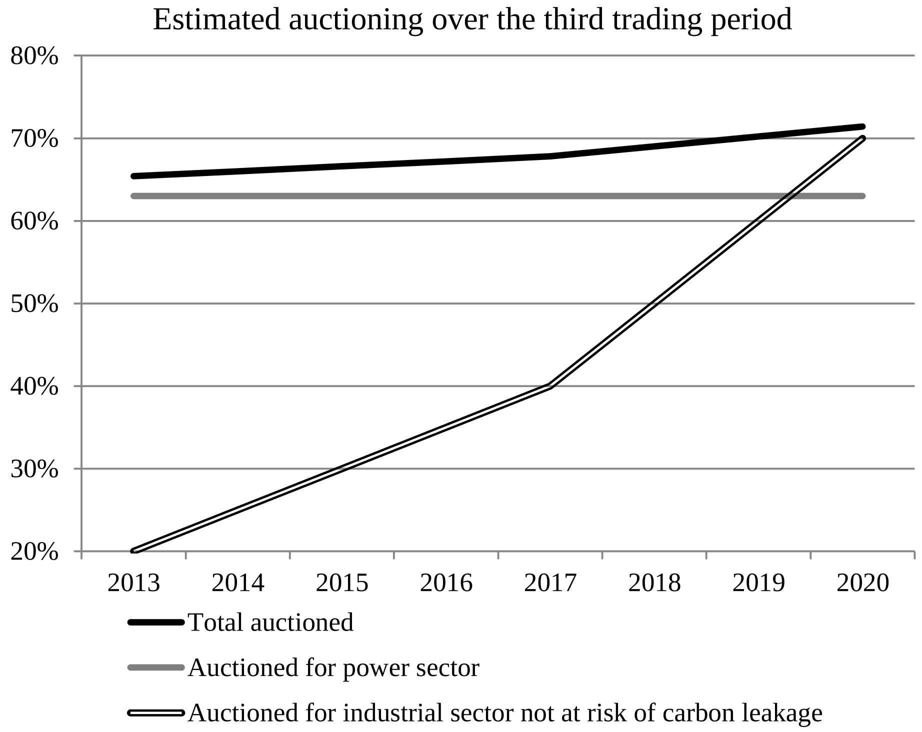
65 European Commission on frequently asked questions on carbon leakage, available at http://ec.europa.eu/environment/climat/emission/carbon_en.htm

66 According to data published by the European Commission, available at http://ec.europa.eu/environment/climat/emission/carbon_en.htm

67 Article 10.a.3, Directive 2003/87/EC.

Estimated auctioning over the third trading period (million allowances)									
Year	Estimated total cap	At risk of carbon leakage (100% free allocation)	Residual	From electricity generators (100% auctioning)	Residual	Assumed auction rate for residual[68]	Residual auctioned	Total auctioned	Total auctioned over estimated total cap
-	A	B	C	D	E	F	G	H	I
-	-	25% x A	A - B	63% x A	A - B - D	-	E x F	D + G	H / A
2013	2.044.722	511.180	1.533.541	1.288.175	245.367	20%	49.073	1.337.248	65%
2014	2.009.144	502.286	1.506.858	1.265.761	241.097	25%	60.274	1.326.035	66%
2015	1.974.185	493.546	1.480.638	1.243.736	236.902	30%	71.071	1.314.807	67%
2016	1.939.834	484.958	1.454.875	1.222.095	232.780	35%	81.473	1.303.568	67%
2017	1.906.081	476.520	1.429.560	1.200.831	228.730	40%	91.492	1.292.323	68%
2018	1.872.915	468.229	1.404.686	1.179.936	224.750	50%	112.375	1.292.311	69%
2019	1.840.326	460.082	1.380.245	1.159.405	220.839	60%	132.503	1.291.909	70%
2020	1.808.304	452.076	1.356.228	1.139.232	216.997	70%	151.898	1.291.129	71%
2013-20	17.476.440	4.369.110	13.107.330	11.010.157	2.097.173	36%	750.159	11.760.316	67%

[68] Lower and upper bounds are given by art.10.a.11 Directive 2003/87/EC.



It could be thought that given the relatively low share of emissions exposed to carbon leakage, even though the award of free allowances is set for them at 100%, the effect on the overall percentage of allowances allocated would not be very significant. The methodology followed above can also provide good estimates of the impact of the provisions about carbon leakage on the primary market for allowances, in terms of reductions in the amount of allowances auctioned.

Estimated impact of carbon leakage on the primary marker for allowances (amount of auctioned allowances)								
Year	2013	2014	2015	2016	2017	2018	2019	2020
No carbon leakage	70%	72%	74%	76%	78%	82%	85%	89%
25% carbon leakage	65%	66%	67%	67%	68%	69%	70%	71%
Difference	5%	6%	8%	9%	10%	13%	15%	18%

Hence, on average for the third trading period, the exclusion of 25% of emissions covered by the ETS from any auctioning will cause the total number of allowances auctioned to decrease from an average 76% to an average 67%, that is, 9% less. This represents a reduction in auctioning of about 12%. It can be seen that, although moderate, the impact is significant.

4.3. The proposal to introduce importers in the ETS

As previously stated, the Union will consider in the second half of 2010, the suitability of deepening the scope of the ETS to also comprise undertakings that import products of the sort covered by the scheme. Within the logic of emissions-trading, it is thought that any extension in scope, like the inclusion of importers, will further the purpose of the scheme and improve the quality of the price signal. Nevertheless, it should be borne in mind that it is a second best option to the creation of similar schemes in third countries. Hence, it follows that imports subject to equivalent measures, like carbon taxes, in the country of production, should be exempted from any obligation to purchase European allowances.

An alternative to the inclusion of importers in the ETS is found in border tax adjustments. These are taxes payable at the point of entrance of imports in the European Union. In a similar fashion as emissions-trading for imports, border tax adjustments would reduce the amount of carbon-dioxide emissions that would not be reduced due to the delocalization of production capacities. In order to achieve this, both types of measures reduce the cost differential of products imported from countries where carbon-dioxide emissions are not controlled for.

There is extensive literature that analyses the possibility of implementing border tax adjustments. Most of the conclusions drawn by this literature can be extended to the inclusion of importers in the ETS. If the Union is rather looking at the later option, it is because the ETS has been proved to work reasonably well and provide, in practice, for relatively more efficient abatement than carbon taxes. It is not the purpose of this paper to detail the reasons that brought the Union to discard carbon taxes and opt for emissions-trading. However, it can be argued that implementing border tax adjustments in the Union would probably amount to an inefficient duplication of regulatory instruments.[69] Hence, including importers in the ETS appears as the most efficient option for the EU to cope with carbon leakage.

The question that remains unanswered is why installations at risk of carbon leakage should be allocated allowances for free if there is a less distortive option available; namely the inclusion of importers in the ETS. It might be that there are more difficulties than perceived at first sight for the extension of emissions-trading to imported products. In fact, as Mattoo (2009, p.16) points out “current World Trade Organization (WTO) rules and jurisprudence are not settled” and it is unclear whether both border tax adjustments or emissions-trading for importers would be compatible with WTO rules. While the specific problems that exist should not be treated here, it is worth noting some of the key aspects that the Union will have to take into consideration if it finally is to bring forward a proposal to include importers in the ETS. Cendra (2009) provides some general principles that should guide border adjustments of this kind:

[69] See Böhringer (2006) for a detailed discussion on the relative efficiency of emissions trading and carbon taxes when used together.

- The measure should avoid arbitrary or unjustifiable discrimination between countries where the same conditions prevail (p.144).
- It should not be protectionist, that is, it should not restrict international trade per se but rather be devised to ensure a level-playing field. This entails that importers should not face higher costs than local producers.
- It should not apply for countries where similar measures to the ETS are operational, including possibly carbon taxes but maybe not voluntary commitments (p.145).

The extension of the ETS to importers will nevertheless also face many technical difficulties. In particular, assessing the amount of emissions generated by production facilities abroad may prove nearly impossible. This is where the determination of benchmarks per products based on the performance of the 10% most efficient installations from the EU may reveal itself useful. It will allow for easy administration of the scheme and ensure importers are not unduly discriminated. Furthermore, the option of basing border adjustments on the carbon content of domestic production would be less burdensome for third countries, which are in general more carbon-intensive than the EU. Hence, as Mattoo (2006. p.17) points out, this option is more likely to succeed in international negotiations.

4.4. Conclusions

Following the estimations presented in this chapter, free allocation of allowances for the subsectors deemed at risk of carbon leakage will have a moderate but significant impact on the total amount of allowances auctioned in the third trading period.[70] This will likely reduce the quality of the price signal and diminish the level of efficiency in the primary market for allowances that otherwise would had been achieved.

Instead, border adjustments could be used to protect domestic sectors at risk of carbon leakage while at the same time preserving the efficiency of the primary market for allowances. In this regard, extending the scope of the ETS to importers, rather than devising a separate instrument, appears as the most efficient option.

Directive 2003/87/EC presents free allocation and the extension of the ETS to importers as complementary instruments. However, there are strong arguments that call for these instruments to be considered as alternative options. In particular, if importers are included in the trading scheme while domestic producers receive 100% of their allowances for free, it would be necessary to extend free allocation to importers. Otherwise, there would be undue discrimination between domestic and foreign producers, contrary to WTO rules.[71]

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[70] A reduction in auctioning of about 12%, according to the author's own calculation detailed above.
[71] Cendra (2009), p. 144.

If free allocation to domestic producers is discarded, it could also be discarded for importers, hence improving the efficiency of the primary market for allowances and avoiding the risk of windfall profits. Importers could be allocated a number of allowances based on benchmarking against domestic producers and buy them either in the primary or the secondary market. This way, both objectives, protecting domestic producers from carbon leakage and achieving high efficiency within the ETS, could be achieved simultaneously.

5. Conclusion

The European Union has unilaterally undertaken to reduce its emissions by 20% by 2020 compared to 1990 levels. Further, the EU is willing to commit to 30% reductions if a comprehensive international agreement is achieved. The key question is whether the ETS is fit for the purpose of achieving such deep cuts in emissions. In the search for an answer, this paper has looked at certain aspects of the efficiency of the scheme. On the one hand, a wide variety of market data have been analysed using economic and econometric techniques. On the other hand, building from this evidence, the changes brought by the 2009 reform of Directive 2003/87/EC have been discussed.

In the first chapter, the focus was on trade in the secondary market for allowances. It was concluded that although price formation is based on energy fundamentals, no upward trend in the evolution of carbon prices can be observed. For this purpose, GARCH econometric modelling was applied on energy prices and derived data, which accounted for the emission coefficients and efficiency rates of coal and gas when used to produce electricity. In addition, unit root testing was used to unveil the lack of upward trend in the prices of allowances during the second trading period.

In the second chapter, the focus was on the primary market for allowances. Based on market data, it was concluded that allocation has lead to inefficient outcomes so far, particularly in the form of oversupply and windfall profits. For the second trading period, the extent of overallocation due to the economic downturn was estimated at 150 million allowances. For the third trading period, changes in allocation methodology due to take place were presented. It was concluded that these changes are likely to substantially improve the efficiency of the primary market for allowances. In addition, the proposal of the Commission of April 2010 for a regulation to fully harmonise auctioning was discussed and welcomed.

In the third and final chapter, carbon leakage and the regime devised by the EU to mitigate this phenomenon were introduced in the discussion. Following this, an estimation of the overall percentage of allowances to be auctioned in the third period was carried out. It was unveiled that free allocation for subsectors deemed at risk of carbon leakage will have a moderate but significant impact in the total amount of allowances auctioned.[72] Then, the concept of border adjustments was introduced and it was argued that the inclusion of importers into the ETS should be regarded as an alternative to free allocation rather than as a complementary instrument, contrary to the current approach of the EU. It was concluded that the inclusion of importers in the ETS was a better alternative than free allocation for the purpose of enhancing the overall efficiency of the scheme and the efficiency of the primary market for allowances in particular.

On the whole, there are three main conclusions to the analysis carried out in this paper. First, the emissions trading scheme of the EU is functioning relatively well; carbon markets are well developed and the carbon price is well grounded. Second, there are nevertheless significant inefficiencies, particularly with regard to the allocation of allowances; a primary market for allowances has not yet emerged given that allocation remains still a political process to a large extent. Third and final, changes brought by the 2009 reform of Directive 2003/87/EC are likely to significantly improve the process of allocation and this way equip the EU ETS for the challenge of reducing emissions by 20% by 2020. Although there are several caveats to this latest proposition, which can be found throughout the text, it is the opinion of the author that, on balance, the changes brought into the scheme are the right ones to achieve the proposed targets and to secure the move towards a low-carbon economy in Europe.

[72] A reduction in auctioning of about 12%, according to the author's own calculation detailed above.

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