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The European Emission Trading Scheme:

A Market Perspective

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Abstract

Title: The European Emission Trading Scheme: A Market Perspective

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Five key words: EU ETS, emission rights, EUA, emission markets, pricing

Purpose: The purpose of this thesis is to bring insight into and understanding of how the market for emission rights in Europe currently works and what problems it is currently facing.

Methodology: The research can be said to be based on positive theory, in the sense that it is grounded more on empirical theory on the subject than normative theory. Furthermore, a qualitative approach to generating data has been used. This has led to a pattern mode of explanation, where understanding a unique and complex field is the focus.

Theoretical perspectives: The theoretical perspective utilized in this thesis is mainly based on empirical research on similar market-based systems for emission control.

Empirical foundation: Interviews have been conducted with representatives of the important intermediaries and analysts involved in the European market for emission allowances. In addition, reports, documents and market data have been used.

Conclusions: The results of this study indicate that the market is surprisingly healthy for such a new system. However, regulatory issues are a major source of uncertainty. Liquidity and transparency are burdened by the large proportion of trade that takes place outside the exchanges. It cannot be ruled out that powerful companies can influence prices on the market.

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1. Introduction

1.1 Background

During the past few decades, the world has realized that global warming is a significant risk that needs to be managed. One of the primary culprits causing global warming is thought to be carbon dioxide, or CO_2. Carbon dioxide is released primarily by the burning of fossil fuels, and makes up about 60% of the greenhouse gas emissions in Europe.

In 1997, the United Nations produced a treaty designed to combat the greenhouse gas problem. It became known as the Kyoto Protocol and entered into force on February 16, 2005 after a sufficient number of countries agreed to be bound by its rules[1]. The Kyoto Protocol specifies limits on how much greenhouse gas each world region is allowed to emit. For Europe, the limit translates to an 8% reduction compared to 1990.
On average, CO_2 production in Europe has increased since then, and it is likely that there may be difficulties attaining the required reduction[2].

The Kyoto obligations have resulted in a European system for emission rights trading called the European Union Greenhouse Gas Emission Trading Scheme (EU ETS).
The European Union has developed a framework specifying how much carbon dioxide each of its member states are allowed to emit in order to have the total emissions meet Europe's Kyoto obligations. Each member state has then been free to allocate these emission rights between its companies. These so-called National Allocation Plans, or NAPs, have been under development in 2004 and 2005, and the European Union has now approved the majority of them. Because the total allowed emissions in the EU ETS are below the current level, some companies have been left with fewer emission rights than necessary to uphold current production levels. Carbon dioxide emissions are relatively linearly dependent of production level in some industries. The EU ETS allows these

[1] United Nations Framework Convention on Climate Change, http://unfccc.int/2860.php
[2] European Environment Agency – Projections of Greenhouse Gas Emissions and Removals (CSI 011) - May 2005 Assessment

companies to buy the missing emission rights from other companies that have a surplus, the so-called “cap and trade” method. The idea behind this is that companies that can decrease their emissions relatively cheaply will do so in order to make money by selling the extra emission rights on the market to companies that cannot lower their emissions as cheaply, for example coal-burning power plants. A high demand will drive up the price, thereby making it economically profitable for more companies to invest in cleaner production methods. This arrangement is meant to make it possible for the Kyoto obligations to be met at the lowest possible cost to society.

The EU ETS is currently the largest emission rights trading system in the world. All the current EU countries are required to participate. This mandatory system has created an entirely new market for emission allowances. Trading has taken place informally in an over the counter fashion for several years. In 2005 however, a number of marketplaces carrying standardized contracts have been established. The first market to open was NordPool, a Norwegian company whose primary business involves electricity trading. Several other actors have followed, including market intermediaries such as brokers and analysts.

The EU ETS can lead to sharply increased costs for some sectors. For example, the large multinational power company E.ON, which owns a number of coal-fired power plants in Germany, bought emission rights for €154 million during the first nine months of 2005[3]. Companies that fail to acquire enough emission rights will be fined €40 per ton of carbon dioxide during 2005-2007, and €100 per ton thereafter. 2005 has been a volatile year as the market has struggled to decide how to price this new security. There has been an atmosphere of hostility as companies that have been hit hard by the added costs have blamed the price inflation of the emission rights for the increase in price in electricity and other commodities that are heavily dependent on the price of carbon dioxide. The general public has also been hit indirectly via the electricity prices. On the other hand, hydro power plants have been making extreme profits due to the fact that electricity prices have risen without any increase in production costs for these companies.

[3] Carbon Finance, Issue 23 (November 2005)

In addition, the media has given negative signals as to the status of the market for European emission rights. For example, The Economist states in July 2005 that "Europe's carbon-trading markets have a touch of the Wild West about them"[4]. By reading articles such as this one, it is easy to get a gloomy impression of how the market works.

1.2 Problem Discussion

The market for carbon emission allowances in Europe has existed for almost a year as this thesis is being written. The first year has seen the development of an entirely new market, with several marketplaces in different countries. These make it possible for companies to trade and in that way adjust their allowance needs in order to fulfil their Kyoto protocol obligations. In many cases, the markets have spawned from existing marketplaces with differing activities. A number of entirely new marketplaces have also appeared that deal exclusively with emissions allowances.

As the smoke settles after this first year of trading, a number of observations pertaining to the market's operation have been made that invite further inquiry. At a quick glance, the most obvious issue is the change in price of the security in question, the European Emission Allowance (EUA). As discussed in the background, some companies have seen their cost structure change rapidly as the EUA price has grown, leading to increasing expenditures because of the ballooning prices. Understandably, this has led to a greater awareness among many large companies regarding their position in the emissions market, and has given market intermediaries an incentive for developing alternative ways to ensure compliance with the Kyoto Protocol. On the other hand, an aim of the system has been to minimize the burden on each individual company in order to make sure Europe's businesses are not disadvantaged among their international competitors. In this light, many companies have been given adequate emission rights for free to uphold current emission levels, which might lead to an insufficient amount of trade and liquidity on the market. In addition, there are several issues related to the development of the policy

[4] Article "Revving Up", Jul 7 2005, The Economist

governing the EU ETS that could affect companies' incentives for trade, and therefore the market liquidity, such as the fact that the national allocation plans have been the subject of heavy discussions in many nations and the inability of some countries to bring the emission registries online. A subsequent disconcerting issue related to liquidity is whether large participants in the market have the possibility to manipulate prices. This may be of concern in this market since there are companies such as RWE and E.ON that individually account for a large proportion of the carbon emissions within the system. All the while, the moment of truth when the first year's emission rights have to be surrendered draws closer, making a functioning market for EUAs ever more essential.

Since the performance of a market-based environmental policy relies on a functioning market, it is of interest to investigate the current status of this aspect of the EU ETS. As mentioned above, many issues and consequences of the system are not adequately elucidated. The research in this thesis therefore strives to address the following problem:

How is the European market for emission rights currently performing?

This problem will be approached by investigating problems common to market-based environmental policy such as liquidity, political uncertainty and market dominance.

1.3 Purpose

The purpose of this thesis is to bring insight into and understanding of how the market for emission rights in Europe currently works and what problems it is currently facing.

1.4 Target audience

The target audience of this thesis is anyone who has a stake or interest in the European market for carbon dioxide emission rights. Additionally, it is intended to further the academic research in the field of market-based environmental policy.

1.5 Delimitations

Much research has been done on the environmental impacts of the EU ETS and market driven emission reduction schemes in general. The research was particularly intense during the development of the ETS, and many of the new ideas presented during this time have been implemented in the European system. This thesis does not aim to further discuss the environmental impacts of the EU ETS.

There are several international systems in progress to reward emission cutbacks in developing countries. In some cases emission rights from these systems can be used in the EU ETS. However, these systems are still in their infancy and many things are still unknown regarding the monitoring and administration of these systems, so this thesis will only briefly study them in the context of what effect they might have on the European market.

The mainstream media has painted a picture of the EU ETS as a major reason for rising electricity prices. This thesis will not investigate the connection between the two.

This thesis will also not utilize any statistical methods to analyse the market. The primary reason for this is that the majority of the trade takes place outside the open exchanges, where per-transaction data is limited or non-existent. Therefore any results derived from such a procedure could be misleading.

1.6 Explanation of terms and abbreviations used in this thesis

CER: Certified Emission Reduction, an alternative security on the emission rights market.

CO_2: The chemical formula for carbon dioxide, the asset traded in the EU ETS.

EUA: European Allowance. The asset traded in the EU ETS. One EUA gives the right to emit one metric ton of carbon dioxide into the atmosphere.

EU ETS : European Union Greenhouse Gas Emission Trading Scheme. The official name of the EU's market-based environmental policy.

GHG: Greenhouse Gas. A greenhouse gas is a gas that adds to global warming.

NAP: National Allocation Plan. A country's NAP decides how its emission rights are allocated between companies.

OTC: Over-the-counter. This term is used when two companies trade between each other without using an exchange.

Registry: Each country in the EU needs to have a register of facilities and their allowances. This can not be done until the national allocation plan is approved. At the time this thesis was written, only about half of the EU countries had operational registries. A company cannot take part in the spot market until its country has an operational registry since the company does not receive its actual allowances until the registry becomes operational. [5]

SO_2: The chemical formula for sulphur dioxide, the commodity traded in the Acid Rain Program.

[5] IETA 2005 report "Greenhouse Gas Market 2005 - The rubber hits the road. "

2. Methodology

In this chapter the methods used to collect and analyse the empirical data in this research are presented and discussed.

2.1 Case Studies

When investigating financial markets, analysing quantitative data is the conventional route. By using statistical methods to analyse how variables interact with each other it is possible to measure aspects of a market. An event study is an example of a method employed to see how the market reacts to a certain shock. However, this type of research depends a lot on the quality of the quantitative data used. In some cases, reliable financial data is readily available for the researcher. In the case of the EU ETS, the obtainable quantitative data does not reflect the entirety of the market. The available data comes from scattered individual marketplaces, which altogether comprise only a fraction of the total volume. Also, trade has taken place for less than a year, and is dispersed unevenly on a day-to-day basis. Drawing any general conclusions from such data would be futile.

The method deemed most suitable for the subject matter concerned in this thesis is that of explanatory case studies. Since the purpose is to investigate and understand how the market for emission allowances in Europe works, the focus of the research is the actors on this market. It is reasonable to believe that the intermediaries, who handle a considerable amount of trade, have profound insight into the market. Other sources of information are analysts specialising on the market and reports produced by organisations that are involved in the market. Some of this information is publicly available, mostly the latter, whereas the intermediaries have thus far kept theirs to themselves. In order to obtain the most crucial data for the research, it has therefore been paramount to interview the unofficial sources of information; analysts, brokers and other participants on the market. This leads to a qualitative approach to generating data with the researchers taking the role of visitor at the subjects of research.

In a case study, it is possible to use a combination of multiple sources of information[6]. In this case, interviews and artefacts have been used. To be more specific, the sources of evidence are interviews with brokers and analysts, market data, and reports that contain pertinent information. The research can be said to be based on positive theory, in the sense that it is grounded more on empirical theory on the subject than normative theory. A strong reason for this is that the generalized explanans employed in normative theory appear less suitable to interpret this particular phenomenon than prior research in the field. Since the purpose of the thesis is to explore an emerging and complex market, rather than test normative theories, a purely theoretical approach would be likely to constrain the perspective of the researchers. Instead, the approach is to bear normative theory in mind, but rather use the empirical theory developed by researchers on market-based environmental policy in the analysis. This has led to a pattern mode of explanation, where understanding particular practices is the focus rather than deducing generalisations with statistical means.

2.2 Choice of Theory

Previous research in the field of the EU ETS has mainly been focused on environmental goals and consequences for the carbon producing industry. It is generally of little interest to the research performed in this study. In order to find research that is more relevant to this study, studies on prior policies that focus on the performance of the market for emission allowances have been of interest. Such research has been accessed through university databases such as ABI Inform as well as via references in papers and reports. Research in this field is somewhat sparse since most of the theorists seem more concerned with the environmental effects than the properties of the market.

After being studied carefully, the most relevant and applicable articles are condensed into the theory section in the thesis. The choice of empirical theory centres on the research performed by Stavins and other prominent researchers in the field. When choosing relevant research, the purposes of the studies and methods employed have also been taken

[6] Ryan et al 2002

into consideration. The research used has helped identify appropriate questions for, and influenced the approach to the empirical investigation. It is later used as a tool to help analyse the empirical results.

2.3 Written Sources of Evidence

In the process of discovering evidence for the research, one course of action has been to find written resources containing useful non-academic empirical information. These resources have mainly consisted of written reports and statements made by organisations involved in, or that monitor the market for emission allowances for other reasons. In order to gain access to these resources it has been necessary to first discover such organisations. This has primarily been achieved through the use of references mentioned in official research and thorough exploration of the Internet. Subsequently, when gathering the information, some of it has been readily available to access through the homepages of various market participants. In most cases, it has been necessary to request it directly from the organisation. Fortunately, the interviewed subjects have in some cases been complaisant beyond what could be expected and provided internal reports and other confidential material. These resources have provided a large amount of pertinent information as well as market data. However, many important questions needed additional exploration in order to create a more detailed comprehension of the subject matter. The filling of such informational gaps was therefore prioritised when preparing and performing the interviews.

2.4 Choice of Interviewees

The choice of people to interview has been decided by determining what actors are likely to have the greatest insight on the subject. As mentioned earlier, this appeared to be brokers and other market intermediaries as well as market analysts. Therefore, a selection of prominent actors has been taken into consideration. This selection comprised people from all of the most important marketplaces and brokerage firms, as well as certain independent traders. It originally started with a broad selection of possible interviewees, since it seemed unlikely to obtain interviews from every party. The sample was narrowed

down to the seven that finally responded positively. These seven represent some of the most influential organisations on the market and have managed quite satisfactorily to provide the insight initially sought. Judging from the similarity of their views, many of their opinions can be seen as somewhat general. The final roster consisted of:

Peter Filipsson, EU ETS Analyst at STEM. STEM is the Swedish energy authority. They were involved in the allocation of emission rights in Sweden and monitor the market.

Henrik Hasselknippe, Senior Analyst at Point Carbon. Point Carbon is a leading market analyst on the European carbon dioxide and gas market. They provide services such as consultancy to companies in market.

Per Otto Larsen, Project Manager for Allowances at NordPool. NordPool was the first organized marketplace to start trading in emission futures.

Martina Priebe, EU ETS Manager at IETA. IETA is an interest organization made up of large players in the carbon dioxide market.

David Rapin, Project Manager at Powernext SA. Powernext is Europe's largest spot trading market for carbon dioxide emission rights.

Sara Ståhl, Carbon Economist at the European Climate Exchange. The European Climate Exchange is Europe's largest futures market for emission rights.

Alexander Wintzer, Market Manager at Climate Corporation. Climate Corporation is a carbon dioxide emission rights broker.

Questions asked in the interviews are found in appendix 1.

2.5 Interview Method

The interviews have been conducted by telephone; this is due to the fact that the interviewees were dispersed all over Europe. There may be certain advantages to interviews performed face-to-face, such as the ability to observe physical gestures and a greater preponderance for the subject to be sincere[7]. These benefits are however deemed as marginal in the context of this thesis, as there are no obvious incentives for the interviewees not to answer credibly. Interviewees have also been offered to remain anonymous in case they preferred the information they surrendered as well as their opinions to be unofficial. The interviews have been moderately structured with the same questions posed to all subjects in order to achieve comparable answers. However, the approach has been flexible, where room has been left for the subjects to discuss their views from which occasionally new lines of enquiry have emerged. The interviews were performed using a telephone with loudspeaker and a tape recorder. Evidence collected this way was subsequently listened to and transformed into writing. When composing the empirical section of the thesis, the gathered evidence from all data sources has been condensed and organised to create a coherent text.

2.6 Validity and Reliability

In case studies, notions such as validity and reliability are unlikely to be appropriate. This has to do with the fact that reliability implies an independent, impersonal investigator and validity requires an objective reality. It is however possible to employ the concept of procedural reliability and contextual validity. Procedural reliability involves the design of the research, how clearly defined the questions are and the documentation of the analysis. Contextual validity relies on the credibility of the evidence collected and the conclusions drawn from it.[8] In this thesis, the procedural reliability relies on the clear purpose of the research and the method employed. The research's method and objective have gradually been refined during the process, but the primary questions have remained the same all along. By gathering evidence on the same issue from multiple sources and comparing it,

[7] Ryan et al 2002
[8] Ryan et al 2002

so called data triangulation, the validity is partly assured. The sources of information employed are deemed fairly reliable, stemming from credible organisations.

2.7 Criticism towards the Sources of Information and Method Used

When using case studies as research method, there are some problems that can arise. In the context of this thesis, one such problem is where to draw the boundaries around the subject matter. Since this thesis concerns a complex issue where a multitude of factors can be held as relevant, the authors have narrowed the research down to a manageable number of parameters. This results in a study that does not take into account all relevant sources of information, and does not investigate all lines of enquiry. Instead, the researchers have chosen to investigate the parameters and sources of information that were deemed most relevant. When such choices were made, prior research in this field was also taken into account. Some of the fields of research that were left out in this study, such as investigating the EU ETS from a participant company perspective, are mentioned in the Future Research section. Using the method of case studies, it is also hard to come to general conclusions, since the objects of the research are individual people and organisations that together account for their view of the system. The perspective chosen, the organisations that are involved in the EU ETS without being polluters themselves, is however well represented by most major actors.

3. Prior Research and Theory

This section will first present a brief historical overview of the theoretical development of tradable emission permit policy. Secondly, it will in more detail describe the most significant such policy that has been implemented prior to the EU ETS and the research that followed in its wake. This example is meaningful as it illustrates how a similar system worked and can be a useful learning tool and reference when investigating the market for CO_2 emission rights in the European Union. Finally, a summary of market-related terminology is presented in order to clarify the theoretical setting.

3.1 Previous Research on Market-Based Policies for Emission Control

Since the 1920s, welfare economics theorists have argued for a system for controlling pollution using specific taxes.[9] The idea of transferable emission allowances was introduced in the sixties by researchers Crocker (1966) and Dales (1968). They believed that such a system would be more cost-efficient and better promote the use of new technology than taxes. The theoretical structure for aforementioned system was further developed by Montgomery (1972), Tietenberg (1973) and others during the seventies[10]. The idea behind a market-based environmental policy is that it should minimize the total cost of achieving results by providing dynamic incentives for the adoption of better and less polluting technology. Despite the predicted advantages, governments have used so-called cost and control policies such as taxes much more frequently in order to attain lower amounts of pollution. The reason for this may be the fact that taxes to a greater extent generate revenues for the government.[11]

[9] Tietenberg 1973
[10] Hill & Kriström 2005
[11] Stavins 1998

3.1.1 The Acid Rain Program

The first major implementation of a market-based environmental policy took place in the USA. It was called the "Acid Rain Program" and sought to decrease the amount of sulphur dioxide (SO_2) let out by coal-driven power plants. This program, also known as Title IV of the Clean Air Act Amendments was implemented in 1990 but became binding the 1st of January 1995. 110 nationwide power plants took part and SO_2 allowances were distributed between them, related to their share of pollution during the period 1985-87. These allowances could later be traded between the parties, and there was also an auction once every year where a small amount of additional allowances could be obtained. If a participant at the end of a year did not hold enough allowances to cover their emissions of SO_2, a serious penalty ensued. The amount of allowances that were allocated among participants gradually declined from year to year so that the total amount of pollution would decrease accordingly. New actors on the market were forced to obtain allowances on the market or at the auction. If a participant had a surplus of allowances after one year, these could be banked for future usage.[12]

The Acid Rain Program proved to be a great success, SO_2 emission decreased to a lower amount than the target level. Prospective analysis calculated that the costs would be roughly equal to the benefits; however analysis afterwards indicates that the beneficial aspects in fact largely outweighed the costs[13]. Several researchers have studied this case in order to provide insight on how the outcome was achieved. In fact, the design of the EU ETS has been greatly inspired by the Acid Rain Program[14]. Here follows a summary of a selection of this research, where focus is on how the market for emission allowances functioned.

[12] Joskow et al, 1998
[13] Austin et al, 1997
[14] Springer & Varilek 2004

3.1.2 Pricing of Emission Allowances

In 1994, Coggins & Swinton designed a model for valuation of the emission allowances in the Acid Rain Program. They based their research on one power plant in Wisconsin and calculated the shadow prices for SO_2 output based on a method developed by Färe & Grosskopf in 1990. The reasoning behind their approach was that at equilibrium in a well-functioning allowance market, the value of one permit should be the marginal cost of achieving the last unit of SO_2 abatement. Their method resulted in an estimated price that seemed reasonable, but later proved to be roughly twice as high as the market price turned out. However, their estimation was based on one power plant, and they acknowledge that certain local conditions might increase the cost for abatement relative to other plants. The model may still be useful as a tool for approximation of the value of an emission permit for individual participants in the program.[15]

Later research striving to find an accurate price for greenhouse gas emission allowances has primarily studied CO_2. However, the results differ considerably, with estimates of a reasonable price varying between 3 and 77 USD per metric ton of carbon dioxide[16]. Furthermore, many of these studies assume a global market for these allowances, something that does not exist today but on the other hand does not seem unreasonable, given the ratification of the Kyoto protocol by most of the countries in the world. When the Acid Rain Program was new, a number of studies were done trying to predict the future sulphur dioxide prices, but all failed to accurately predict the price developments. Such failures cast doubt upon the reliability of price forecasts on tradable emission permits. In the case of the SO_2 market, this failure has been attributed to analysts not taking into account decreasing transportation costs making it economical to transport cleaner raw materials and not having to rely on locally produced coal, and technological advances[17]. However, estimating what effect technological progress will have on

[15] Coggins & Swinton 1994
[16] Springer 2002
[17] Springer & Varilek 2004

emission levels is notoriously difficult, so it is not unexpected to have a wide range of expected prices.

3.1.3 Performance of the SO_2 Program

Soon after the first phase of the Acid Rain Program, Stavins (1998) presented a study in which he discusses what made the system perform as well as it did basing his research on the theory by Hahn and Noll (1990). He concludes that the design of the system is crucial. Important components are; flexibility, simplicity, the role of monitoring and enforcement, and the capability of the private sector to make the markets for allowances to work. In regards to flexibility, the design should allow for many different compliance alternatives. In the Acid Rain Program, this included several feasible options to reduce SO_2 emissions, such as improved technology and using coal with lower sulphur content. The flexibility was further improved by allowing 'banking' of permits, which provided possibilities to preserve surplus permits for future use. In regards to simplicity, the system should have a unique formula used to allocate permits based on historical data that is hard to manipulate or contest. Trading rules should be clear and defined from the start. These criteria were well met in the Acid Rain Program in that it had an absolute amount of allocated permits based on historical emission levels. In regards to monitoring, Stavins means that it is crucial that authorities can measure the amount of emitted pollution in an unbiased way in order to minimise the possibility for manipulation from participants. In the case of the SO_2 Program, this was achieved by installing measurement devices in all power plants involved. When it comes to the private sectors creating tools for a functioning market, this includes such elements as fulfilling brokerage needs and providing pricing information. In the case of the SO_2 Program, entrepreneurs created a vast range of market-enhancing services, including private brokerage, electronic bid/ask bulletin boards and price forecasts. These factors decreased the amount of uncertainty that the participants faced and resulted in a working market with low transaction costs.[18]

[18] Stavins 1998

A research by Schmalensee et al (1998) evaluates the performance of the market for SO_2 allowances. By studying auctions and the markets for allowances, they come to the conclusion that a fairly efficient market, obeying the law of one price emerged as early as in 1994. Their conclusions are based on the turnover, the consistency in prices between marketplaces, the size of the bid-ask spread and transaction costs, atomistic competition, and the emergence of markets for derivatives.[19] Another similar study the same year by Joskow et al is more comprehensive in scope. It comes to the same conclusions as Schmalensee et al (1998), but also evaluates the importance of yearly auctions. According to their analysis, the auctions had at most a transitory impact on allowance pricing, which primarily took place in the other markets. The study also shows how the market steadily gained in efficiency and competitiveness over the years after the system's implementation.[20]

Baldurson & von der Fehr (2004) questioned the efficiency of a market-based environmental policy by studying the consequences of uncertainty and risk-aversion on the outcome of the Acid Rain Program and other market-based regulatory schemes. The implication of their theoretical model is a non-optimal ex ante allocation of allowances, decreasing the efficiency of the market. They base their conclusions on the presumptions that the marginal costs of abatement are not equalised, the allocation of allowances is quota-based, and that the behaviour of firms will vary under uncertainty and risk-aversion.[21]

A different kind of research, on which designers of emission trading programs have largely based their decisions, is the use of laboratory experiments. This type of experiment is usually performed by letting subjects participate in a controlled market. A wide range of such research has been performed aiming to investigate the potential efficiency of emission trade, the role of alternative instruments and institutions, the effect of permitting banking and the extent to which market power can be exercised. Muller & Mestelman (1998) have analysed a collection of recent such experiments performed by

[19] Schmalensee et al 1998
[20] Joskow et al 1998
[21] Baldursson & von der Fehr 2004

other researchers. The combined data indicates the importance of public information, banking and secure trading in rights to future permits for a functioning market. It also clearly shows that simply permitting trade in allowances will not guarantee the emergence of efficient markets. [22]

3.2 The Efficient Market Hypothesis

In order for parties to want to invest in a security, theorists have argued that the market for that security should be efficient. A way of describing an efficient market is one where the price of a security fully reflects all available information that affects it[23]. If this is not the case, investors would tend to avoid participating in the market in fear of losing money due to market imperfections. There are a number of assumptions underlying the hypothesis, different types of efficiency, and ways to test them. In the context of emission trade, researchers have mainly focused on certain aspects of efficient market theory that are most suitable for the subject matter. This section will describe these aspects.

3.2.1 Quality of Trading

Of the many factors that an efficient market depends upon, quality of trade is one of the most commonly used measurements. It is usually measured in three ways, the float, the turnover and the bid-ask spread. These measures are frequently used for stock markets but are equally relevant when reviewing other types of markets. The float is the number of units of a certain security that are openly traded on the market. Turnover is defined as the ratio of the number of securities that are traded over a specific period of time compared to the total amount of securities outstanding. The bid-ask spread is the difference between the price at which a security is bought and sold at a certain time. Quality of trading is higher the larger the float and turnover, and the smaller the bid-ask spread is.[24]

[22] Muller & Mestelman 1998
[23] Fama 1970
[24] Ogden et al 2002

3.2.2 Transaction Costs

When trading on a market, it is common that there are costs associated with performing transactions. Typical transaction costs are various kinds of commissions that brokers or market-makers charge. Transaction costs create friction on the market, prolonging the time for prices to reach equilibrium since less trade will occur in proportion to the size of the transaction costs. Empirical emission trade studies performed by Netusil et al (2001) have indicated that the size of transaction costs in market-based policies greatly affects the amount of trade, and thus the efficiency of the market[25].

3.2.3 Liquidity

A simple definition of the term liquidity is how simply and fast you can sell an asset on the market to the right price. To most investors, this is an extremely important aspect of any efficient market since it decreases the amount of uncertainty associated with holding a financial instrument. How liquid a market is greatly depends on the quality of trade and amount of transaction costs.

3.2.4 Market Participants are Atomistic

An important assumption underlying an efficient market is that market participants are atomistic. This means that no single market participant can affect the price through trade. If market participants are not atomistic, all participants are not able to trade on equal terms. An example of this would be that dominant firms or groups of firms can control and manipulate the price of a security with their market power. Researchers such as Godby (2002) and Svendsen et al (2002) have shown that this is a possible threat to a functioning market-based environmental policy.

[25] Netusil et al 2001

3.2.5 The Law of One Price

A definition of this law by Joseph Stiglitz is: "Under this law, there is a uniform price in the market and price differences are quickly eliminated by arbitrage"[26]. Subsequent theorists have expanded the equation to include parameters such as transportation, transaction and information costs. However, the basic implication is that under the same conditions at the same time, the price of one commodity should be uniform in an efficient market.

[26] McChesney 2004

4. Empirical results

This section presents the empirical evidence collected for this study that will form the basis of the analysis. In order to clearly present the data it is condensed and divided into subsections that each deal with a specific subject.

4.1 The market situation today

At the time of writing, the European greenhouse gas market has been operational for almost exactly one year. During this time, the volumes have increased sharply. In 2004, the global trade in carbon dioxide was an estimated 9.65 million tons, according to Point Carbon, a market analyst. For 2005, the cleared trade in the EU ETS system is estimated at 300 million tons, at a value of more than 4.5 billion Euros[27]. This is approximately three times more than what was forecast at the beginning of the year, and could be seen as a sign of the good health of the market. 2005 saw the opening of a number of marketplaces for emission allowances, which has led to a shift in market power away from brokers and to the open exchanges. However, according to a number of brokers interviewed for this thesis, only an estimated 30% of the trading takes place on the open marketplaces so far.

Much like the other big market-driven system for air pollution, the US Acid Rain Program, the first year saw a big change in price. The Acid Rain Program saw a large decrease in price during the first year, and the EUA market price almost quadrupled. This understandably made many market players nervous about the coming price level. Many European industries cannot decrease carbon dioxide emission much further with current technology at a reasonable cost[28]. A sharp increase in price has therefore led to a worsened international competitiveness for these companies. During the summer, there was great confusion about the price, having risen from €8 to €30 in only four months[29].

[27] IETA 2005 report "Greenhouse Gas Market 2005 - The rubber hits the road. "
[28] European Climate Exchange: European Union Emissions Trading Scheme : Managing opportunities and risks – 2004
[29] Carbon Market Europe Issue 22.07.05

It is interesting to note that while the total traded volume on a daily basis is at least an order of magnitude larger during 2005 than 2004, the average deal sizes are still about the same at around 10.000 tons, with the largest at 30.000 tons according to market data. The explanations for this vary, but the general idea seems to be that the supply and demand model for the market is characterized by a great deal of uncertainty. Sellers seem afraid to scare the market away by offering large deal sizes at once, and prefer to sell in many batches. Per Otto Larsen at NordPool explains that this might also have to do with uncertainty about what would happen to the price if a very large batch would be offered at once, since this has not happened in the past.

4.2 Pricing

The price of the EUA is dependent on a number of variables that affect the supply and demand. The following price drivers are unanimously put forward by all sources of information: the price of coal, oil and natural gas, weather conditions, energy consumption, political factors such as the NAPs and the marginal cost of reducing pollution. Other factors presented that may affect the pricing are speculation and the general behaviour of market participants. A price driver that has had a large impact on the sharp rise in price during the first half of the year is the change in relative price between coal and natural gas.

The reason why this affects the price of the EUA is that energy produced using gas emits less CO_2 than energy produced using coal. Thus, fuel-switching from coal to gas is one of the most plausible ways for power producing companies to decrease their CO_2 emissions and thereby their need for EUAs. This reasoning explains the impact of the price of other fuels as well as the effect of varying weather conditions. The amount of precipitation, sun and wind affects the output from alternative sources of power. So, a lack of these elements leads to a greater use of CO_2 emitting sources of power, and thereby increases the demand for EUAs.

Fig 4.1 The relation between the price of EUAs and the relative price of coal and natural gas during spring 2005. (Source: ECON Denmark)

Another possible alternative to generate less CO_2, when producing power, is investing in less polluting technology. However, such investments tend to be costly, and several interviewees mean that companies are reluctant to make such investments due to the uncertain future of the EU ETS. The risk of making such an investment when the payback is impossible to foresee makes the companies cautious. When the final plans for the second phase (2008-2012) of the EU ETS are disclosed, it is likely that stakeholders to a greater extent will engage in technological investments.

An important factor affecting the price of the EUA is political factors that affect the allocation of the emission rights. Even though the maximum total amount of emission rights in the EU is firmly set by the Kyoto agreement, the actual amount may vary. For example, certain countries have chosen to cap their allocation at a lower level than their initial share. This leads to uncertainty when it comes to the actual supply of available EUAs. An example of how this can affect the price is when the UK disclosed plans to try to increase their allocation of EUAs by 20mton in November 2005. Uncertainty arising

from this event initially led to a price drop from 23 to 19 euro[30]. At present, the NAPs of several countries in the scheme are still under negotiation. A general belief is that any large surprises in the final outcome of these NAPs might destabilise the market.

Another such political issue that has an impact on the supply and demand is the ability for companies to 'bank' allowances. Banking is the term used for transferring surplus allowances from one year to another. This increases the flexibility for companies in more ways than one, since it also becomes possible to use the following year's allowances to cover a short-term deficit. However, in the EU ETS banking is restricted from the first phase to the second. This means that the allowances for the period 2005-2007 cannot be kept and used during the second period between 2008 and 2012[31]. There do however exist certain variations regarding this matter, as the NAPs of France and Poland have contained elements that allow some degree of long-term banking[32]. Until the regulation concerning EUAs is finally settled, there exist a number of political uncertainties.

Another source of uncertainty is the fact that many of EU's new member states in Eastern Europe still have not sorted out the bookkeeping and registration of their pollution, and therefore do not participate in the market trading yet. A number of Eastern European marketplaces are ready to start trading as soon as this issue is sorted out, according to Martina Priebe at IETA. It is generally thought that Eastern European countries are among those that have the greatest potential for reducing their emission levels, due to an old and inefficient industry. Furthermore, the European allocation system is based on historical emissions, so it is possible that there will be a surplus of emission rights once Eastern European companies start improving their processes. This could have a significant impact on the price level.

[30] Point Carbon - Carbon Market Europe Issue 02.12.05
[31] CO2e report: EU Emission Trading Scheme: What is happening and why?
[32] European Union Emissions Trading Scheme: Managing opportunities and risks.

4.2.1 Price Development

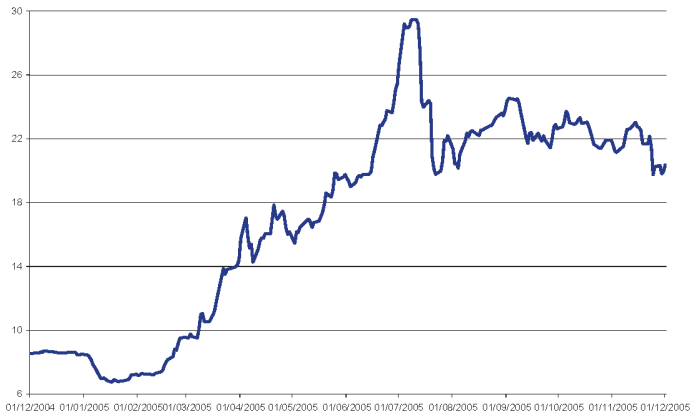

Fig 4.2: Price development on the EUA market. (Source: IETA report on GHG markets 2005)

The price on the EUA market rose sharply in the beginning of 2005, quickly reaching almost 30 euro per ton compared to an initial 6-7 euro. Such a sharp change in the price made the market nervous. The prices have since stabilized somewhat at around 22 Euro per ton. The volatility is to some extent inherent in the system, since the underlying parameters such as the price of natural gas in themselves are volatile means Henrik Hasselknippe at Point Carbon. Analysts and market participants have indicated that the volatility is likely to decrease somewhat in the future. This premonition is based on the belief that valuation will be continually refined as experience and information increases. Also, the volatility related to regulatory issues is likely to decrease, as the political uncertainties are resolved.

4.2.2 Price transparency

Prices are well publicized with the materialization of the open exchanges. Closing prices are almost exactly alike on the different exchanges. Mr. Wintzer claims that this is not as obviously true as on a stock or bond market, since there is no obvious way to make a large arbitrage even if the prices were to differ. Some markets do not see trading every day, and there are only a limited number of buyers of large batches of emission rights.

The fact that a majority of the trade takes place off the open marketplaces means that price information stays between the involved parties.

4.3 Liquidity

4.3.1 Volume

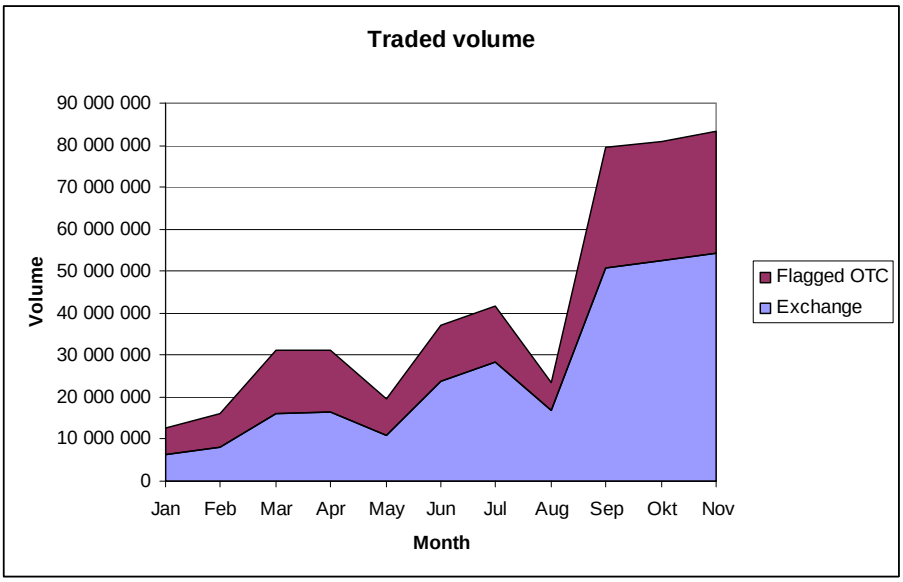

Figure 4.3: Traded volume per month on the exchanges and flagged OTC. Source: European Climate Exchange

The traded volume has increased steadily during the year, from approximately 14 megatons of carbon dioxide in January to almost 85 megatons in November. The average daily turnover has risen to approximately 2.5 million tons during the end of the year, according to Powernext. It is important to note however that the OTC figures only include so-called “flagged” OTC. Reporting OTC trade is not mandatory, which makes it difficult to estimate the total volume. Sources indicate that the unreported OTC trade is about as large as the flagged trade. Volume is expected to pick up rapidly during 2006, due to the fact that the registries in Eastern Europe are likely to become operational during the first half of the year.

Preliminary calculations of the amount of trade during 2005 conducted by ECX and NordPool indicate that the total cleared traded volume exceeds 300 million tons. To put

this into perspective, the annual allocation of emission rights is slightly more than 2.1 billion tons for all the European countries put together[33].

There are a number of exchanges ready to start trading in emission rights in Eastern Europe. One market actor indicated that the rapid addition of new marketplaces is a problem for the total market liquidity, and might increase big companies' preference for OTC trade. However, some elimination among the marketplaces is likely to occur. David Rapin at Powernext is of the opinion that in the long term, only one spot market and one futures market will survive. Other sources mean that there will be room for a few niche players that provide special services or cater to certain groups. Some brokers would prefer if there were only one large exchange, where trade was concentrated, so that the liquidity would not be spread out. In general, the market liquidity has improved during the last months of 2005 and is seen as sufficient by all sources interviewed.

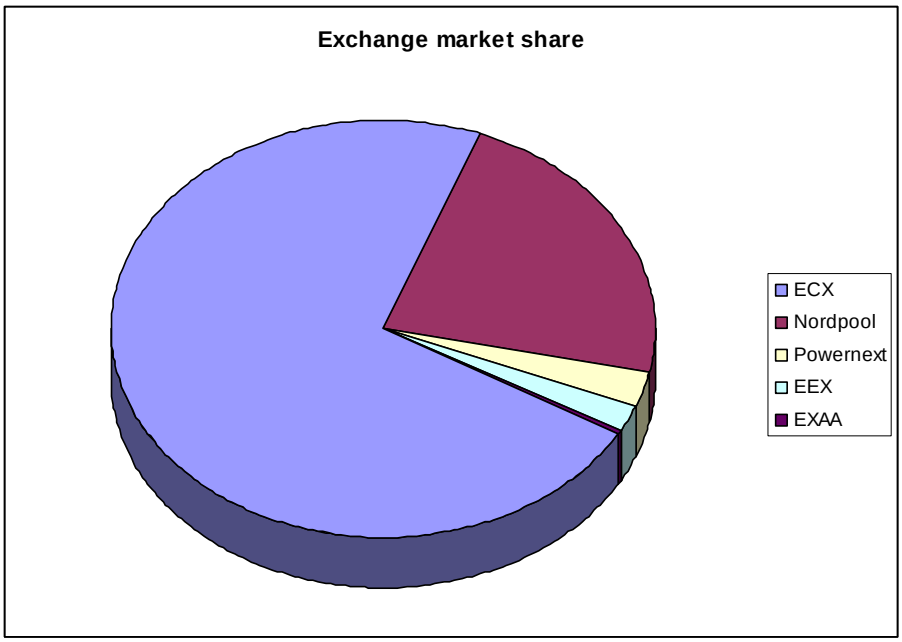

Figure 4.4: Relative market share of the open exchanges. Source: Market data from European Climate Exchange and NordPool.

[33] European Climate Exchange: What determines the price of carbon in the European Union? - 2004

As can be seen above, ECX (European Climate Exchange) is the dominant player. It is worth noting that both ECX and NordPool trade in futures. Powernext is the largest spot market, but still only accounts for around 2.5 percent of the total amount of trade. On average, the spot market makes up at best 4-5 percent of the total volume, according to Point Carbon. This is seen as a major problem for companies that cannot easily forecast their emissions for the entire year and need to adjust their emission rights holdings continuously. For example, calculating the optimal production for an electricity producing company is difficult because this number is dependent on a number of chaotic factors, such as the relative price level of inputs, the weather and production levels in the industry[34]. The lack of liquidity in the spot market forces companies to take up large positions in the futures market long in advance in order to be sure they have an adequate number of emission rights. The spot market is expected to grow during 2006 as more NAPs are approved and more registries become operational, and this will hopefully lead to a more balanced marketplace. A liquid spot market will also be needed as April 30 approaches, the day when companies need to turn in their spent emission rights for 2005, according to Powernext.

4.3.2 Transaction costs

Transaction costs have fallen proportionally with the number of brokers entering the market. According to Sara Ståhl at the European Climate Exchange, there has been a clear downward drift in brokers' prices during 2005, which has caused NordPool and other exchanges to lower their commissions as well in order to keep business. However, the exchanges are still much more expensive than the OTC market due to complicated procedure and high start-up fees, says Mr. Wintzer at Climate Corp. Some brokers have no fees at all and only finance themselves with the bid-ask spread. In this light, many market actors have chosen to stay with their established broker contacts, and have not yet started using the markets themselves due to the prohibitive costs. As mentioned above,

[34] IETA 2005 report "Greenhouse Gas Market 2005 - The rubber hits the road. "

the transaction costs have fallen during 2005 as the market has matured. However, the number of market participants on the exchanges is still very low compared to how many installations are covered by the EU ETS. Both ECX and NordPool have around 60 companies actively trading, with some overlap. Given that the total number of companies that participate in the EU ETS exceeds 12.000, it is safe to say only a few actors use the open exchanges.

4.3.3 Market intermediaries

In 2005, a number of market intermediaries have emerged, primarily in the form of brokers and banks. In the EU ETS system, numerous issues with the way trading on the open exchanges is done today make market intermediaries almost essential for the smooth operation of the market. For example, the minimum lot size on the exchanges is generally 1.000 tons of carbon dioxide according to the exchanges interviewed for this thesis, which is a very large amount even for medium-sized companies. Understandably, actual emissions from industrial processes seldom divide evenly into 1.000 ton units. This is where third parties can fill an important position by purchasing emission rights and reselling them in smaller lots to firms that have no use for an entire minimum exchange trading unit. One broker interviewed for this thesis runs an internal market-like system where buy and sell orders can be combined into larger orders that can then be filled on one of the open markets. In this way, the individual companies that only trade for compliance with their Kyoto obligations need not be members themselves on any exchange, thereby saving time and money. Many smaller companies only trade once or twice per year according to the broker, and the total costs involved in joining an exchange might prove prohibitive in this light. This broker, on the other hand, only makes money on the bid-ask spread, so smaller companies can access the market without the fixed costs that membership on an exchange entails.

However, not only the lack of smaller lot sizes can be a problem. A large company that has a significant shortage of emission rights may be reluctant to procure the necessary allowances on the open market, for a variety of reasons. Apart from the risk of driving up prices by placing a large market order, analysts mean that keeping such transactions

confidential might be a reason behind wanting to acquire the missing rights in a more anonymous fashion through a third party. Market intermediaries can stockpile rights more slowly, simply filling available sell orders, and then resell them in larger batches off the market. According to Point Carbon and the European Climate Exchange, this is what the banks that are registered clients on the exchanges do. There have been reports of speculative trading by these banks, but this is not the primary reason for the banks' presence on the market, according to the interviewees. Several sources mean that many companies prefer to leave their emissions trading to an external party as a way to benefit from these companies' expertise.

Furthermore, a more elaborate role of market intermediaries is to provide advanced derivative assets. At the moment, the majority of the trade takes place using forwards, with a limited spot market at the French company PowerNext. This does not lend itself well to risk management. Sara Ståhl at the European Climate Exchange expects that options, swaps, and other more advanced derivatives will appear during the first six months of 2006. NordPool also plans to introduce derivatives in the near future.

4.4 Market Dominance

Some industries are by their nature more polluting than others. Burning fossil fuels is still one of the cheapest ways to produce electricity, which means that power plants will use it as long as it is economical. The allocation of emission rights has favoured the fossil fuel burning companies because the allocation was done based on historical emissions[35]. Of the six European companies that have received the largest allocation, five specialize in electricity production, mainly by burning coal[36]. As a result, these large coal-burning companies in Europe have been given a powerful position on the market. When faced with the question whether these large companies try to use their power to manipulate the prices to their favour, the sources of evidence provided inconclusive views. One source indicated that it might be possible for a large company to shift the prices downwards by anonymously selling large batches on the market, and then buying it back in smaller

[35] Morgan Stanley report: Equity Plays on the Emerging Carbon Market
[36] Reuters: Kyoto: Waste of cash or green lifeline?

batches at the lower price. However, this was not seen as a major concern by the interviewees. All were in agreement about the fact that the risk of market dominance exists because of the large power companies, but given that most companies trade for compliance and not for speculation, this risk seemed small in comparison with the more obvious risks of the market, such as political factors.

4.5 Other Systems

The EU ETS is the first large-scale emission trading scheme in the world that recognizes alternative emission reduction credits. There are assets, for example the so called "Certified Emission Reductions" or CERs, that are allocated based on emission reductions in countries that have no obligation under the Kyoto protocol, i.e. developing nations. A third system, called "Joint Implementation", rewards so called "Emission Reduction Units" to investments in industrialized ("Annex-1") countries that have obligations under Kyoto, but are not members of the EU. The European system recognizes these credits as equivalents to EUAs, so companies can gain additional emission credits by reducing their emissions in areas outside the EU[37]. It is interesting to note that CERs sold on auctions for delivery in post-2007 currently change hands at around €4 per ton[38], while the EUA price for 2005 delivery currently holds steady at around €22 per ton. CER traded volume is still on the rise according to Martina Priebe at IETA, even though the asset is much riskier than plain EUAs because delivery happens in a more sporadic fashion and is difficult to predict. As discussed earlier, CERs can be used for compliance under the EU ETS, so they should theoretically be worth as much as EUAs. The added difficulties involved in CERs have kept the price low so far though, but some analysts nevertheless mean that the EUA price is more likely to fall to meet the CER prices rather than the other way around[39].

[37] IETA 2005 report "Greenhouse Gas Market 2005 - The rubber hits the road. "
[38] CO2e report: EU Emission Trading Scheme: What is happening and why?
[39] CO2e report: EU Emission Trading Scheme: What is happening and why?

4.6 Additional Remarks

Throughout the exploration of the subject a number of opinions have been identified as similar regardless of the source. The general view among the interviewees was that the EU ETS implementation is surprisingly efficient for such a young market. Despite initial problems in the first half of 2005, market activity has picked up and price is now believed to reflect the value of the asset accurately enough for the sources to feel confident that pure speculation will not drive the price to any significant degree. The general opinion is that the single most important source of insecurity on the market today is political risk. Firstly, the allocations are not firmly set thus far. Secondly, since the future of the EU ETS after 2012 is still uncertain, the long-term prospects of the scheme remain unclear. Market analysts have developed models that they believe accurately predict the price based on fundamental values, but these can only account for the variance around the price level decided by political factors.

As far as hedging is concerned, the most obvious method is to take appropriate positions in commodities that affect the price of emission rights until more developed derivatives appear. This is the method recommended by consultants such as Point Carbon.

5. Analysis

In this section the market for European emission rights will be analysed based on theory and lessons learned from similar systems. In addition, predictions on possible future developments of the system will be presented.

5.1 Pricing and Liquidity

Given the tremendous rise in price of the EUA during the first half of 2005, it may have seemed that the market was out of control. However, the latter half of the year has shown less erratic price movements, with a valuation that appears to approach a reasonable equilibrium in relation to fundamentals. The fact that none of the sources of empirical evidence show any serious concern regarding the pricing indicates that it is working relatively well for such a young market. This is further accentuated by signs such as that the prices are consistent between the different marketplaces, and that the price appears to react swiftly to such information as a probable change in a country's NAP. The accuracy of the pricing is hard to determine, but analysts appear to find ways to model the value. At least it is quite safe to say that the Law of One Price is obeyed with minor deviances depending on whether the trade takes place on an exchange, OTC or via other intermediaries.

In comparison to the Acid Rain Program, it is harder to decide whether the price of the EUA is equal to the relative cost of pollution abatement the way Coggins (1994) anticipated. This has several reasons; firstly, few companies appear to see investment in cleaner technology as a viable way of reducing pollution until the future of the scheme is disclosed. Secondly, many participants have already made efforts to reduce their CO_2 emission. Thirdly, decreasing pollution in the SO_2 Program did not require very large investments in many cases. In the EU ETS however, the marginal cost of abatement is more appropriate as a price signal when it comes to the relative price of fuels, the way cleaner coal was used in the SO_2 program. This way, the rising price of gas relative to the price of coal explains the increasing EUA price, in the same way that the supply of

cleaner coal explained the decreasing price of SO_2 emission rights in the Acid Rain Program. On the other hand, pricing CO_2 emission allowances is more complex, as Springer (2004) concluded. This is because there are a greater number of factors to take into account, such as the market being international, and that there are greater number of alternative fuels and possible investments.

According to Baldursson & von der Fehr's (2004) arguments concerning market efficiency, the EU ETS would as any other market-based environmental policy fall short. It is not likely that the allocation of emission rights is optimal, and one of the primary assumptions in the design of such a policy is that abatement is not equally costly for all participants. These factors may result in risk aversion and uncertainty causing the market to be incompletely efficient, leading to sub-optimal pricing. In the EU ETS it is safe to say that there is uncertainty and risk aversion in the market due to the political uncertainty. Therefore the market will lack in efficiency according to their theory.

When it comes to liquidity, an important factor for efficient pricing, the opinions have varied but it is clear that it has picked up during the year. The cleared volume traded has been about 300 million out of a float of 2,1 billion, so the yearly turnover is almost 15%. Considering that a majority of companies are supposed to have been allocated EUAs to cover their needs, and that most companies only trade for compliance, this value is surprisingly high. One factor argued to threaten the liquidity is that trade would be spread out between too many marketplaces. Since two marketplaces account for more than 90 % of the trade that takes place on exchanges, it is not as dispersed as one might suspect, judging from such statements. The large lot size problem and encumbering registration process at exchanges also appears to be mitigated by intermediaries such as Climate Corp that make it possible for companies with more modest needs to trade. However, the amount of OTC trade going on, mainly between large stakeholders, is concerning since trading in this way does not improve liquidity in the marketplaces. There are no clear indications of such trade moving to the open exchanges in the near future. So, albeit a relatively large turnover, the liquidity on the open market could be better.

Another important factor for an emission rights market's performance according to several of the empirical researchers including Joskow (1998) and Schmalensee (1998) is the existence of derivatives. In addition to futures, options are currently about to be introduced by marketplaces. Derivates, market intermediaries and price information seems, in general, to be developing quite well. It is likely that the introduction of a liquid options market would make external actors take a greater interest in the market as a way to diversify their investment portfolio. For example, if a mutual fund were to invest in the emission rights market as a risk-bearing asset, there would have to be more ways to do these investments without the problems involved in actual delivery of the assets. Increased involvement by third parties in such ways is likely to increase liquidity and transparency.

5.2 Market Dominance

The empirical evidence collected gives an inconclusive picture of the threat of market domination. None of the sources currently view this as being a problem. On the other hand, none of the sources are sure whether or not large stakeholders have tried to affect prices. A reason for the somewhat indifferent attitude displayed may have to do with that the sources of information do not have a direct stake in the scheme. Companies forced to comply may be more concerned about possible manipulation to their disadvantage. It appears clear that in this market, where some participants hold an immense amount of securities compared to others, there lies a risk in these companies' possibility to manipulate prices in their favour. No clear evidence of such manipulation has been revealed. On the other hand, so far a transaction of more than 30000 tons has never taken place on the open marketplaces. Also, the largest companies have thus far appeared to prefer to trade off the exchanges and therefore do little to affect the market price. At present, it is hard to say whether or to which extent market domination may affect the market. Suffice to say that this is a source of uncertainty in the European market for emission rights.

5.3 System Design and Other Regulatory Issues

An enforced market-based system for controlling companies' behaviour must provide sufficient flexibility and ease of use in order to be successful. The Acid Rain program provided several options designed to simplify the compliance procedure for companies trying to decrease their emissions, such as banking and flexible means of compliance. The EU ETS is somewhat lacking in this regard and has so far faced both confusing standardization problems and complicated regulatory issues hindering many companies from taking part in the market. As discussed earlier, Stavins' (1998) study identifies smooth regulatory procedures as an important contributing factor to the SO_2 market's success. It would be difficult to argue that the market aspect of the EU ETS is as thought through as the Acid Rain Program was at its inception; however, most of the remaining issues are political in nature and will probably be hammered out until the first "real" compliance period starts in 2008.

As it is, there are a number of possible ways for a company to adapt and ensure the long-term prospects for compliance flexibility. Worth considering is that climate researchers have caught the ear of politicians lately and will probably continue to have a large say in future EU regulations. Even though nobody knows what will happen after the Kyoto compliance period ends in 2012, many of the sources contacted for this thesis believe that it will be replaced by something similar that may have even more stringent limits on greenhouse gas emissions. It might be difficult to justify investments in emissions-reducing technology based on a "present value"-type calculation using the current emission price levels and the estimated cost up to 2012; however, one also have to consider the risk inherent in doing nothing and disregarding the risk of follow-up systems. It seems improbable that the EU would simply drop the emissions reduction program after 2012, and in that light it may be wise to consider long-term investments to decrease pollution if possible.

A method that could be used as a flexibility tool is the CER system. The uncertainty currently involved in the system means that trade takes place at a much lower price level

than on the EUA market. It could prove an effective strategy to purchase CERs for delivery during the second EU ETS period today, and then sell any overshooting EUAs once the CERs arrive. As with any long-term strategy, this would introduce some risk, but given the relatively low price of CERs today compared to EUAs the downside is comparatively small.

An additional negative aspect concerning flexibility is the fact that it is expensive and time-consuming to use most marketplaces for emission rights, as evidenced by the fact that the largest exchanges only have around 60 registered customers each. Smaller actors may be constrained by not having direct access to the market.

Stavins' 1998 study concludes that the most important aspect of an emission rights trading scheme is its design. The flexibility aspect has been discussed already. Simplicity and the role of monitoring and enforcement are two other important features of any emission trading scheme, according to Stavins. The simplicity issue is one that has not been worked out in the EU ETS so far, and this might be the reason so many companies are not yet participants in the market. Small companies simply do not have either the resources or the knowledge to actively participate in the market without the use of specialised intermediaries.

Further regulatory problems can be summarized as such:

- *Uncertain national allocation plans during the current period*

Stavins' observations regarding the Acid Rain Program's success identify the fact that trading rules and allocation plans were clearly defined from the start as an important factor. The EU ETS can so far be said to have failed on this point, with many allocation plans not finalized. Some countries still have not had their allocation plans approved by the EU. The practical implication of this is that the companies operating in affected countries have not been informed what their allocations are, and have not had any emission rights delivered. Spot trade is therefore impossible for these companies, because they cannot deliver emission rights. Additionally, trading via futures is more risky, since

it is uncertain when the plans will be finalized. Furthermore, the allocation methods for the second stage of the EU ETS are still unknown, making it difficult if not impossible to predict the long-term costs associated with the project. There have also been attempts by some countries during 2005 to increase their allocations above their set limit. If this is permitted, the risk of such actions by other countries increases creating additional uncertainty.

- *Future allocations still unknown*

No allocations plans for the second period are yet known. The allocations for 2005 were time-consuming, and some are still not finalized. However, chances are it will be easier the second time around because the affected installations are known in advance, and the first allocation can work as a benchmark. Better data of actual emissions harvested from the emission results during 2005-2007 will also make the process more efficient. After April 2006, when each company must provide verified emissions data for 2005, subsequent allocation plans can be based on the 2005 figures. An efficient allocation is important for an efficient market to develop according to Stavins (1998).

- *Great uncertainty about the system's future beyond 2012*

Nothing has been decided so far regarding what happens to the EU ETS when the Kyoto compliance period ends in 2012. This can be seen as an incentive to hold off investments in emission reductions, since it is impossible to know whether they will pay off beyond 2012.

- *The banking issue is still somewhat uncertain*

Whether banking is allowed is up to each member country to decide. Banking between the compliance periods is not allowed according to EU sources, so any surplus in 2007 cannot be used to fill a shortfall in 2008. Some countries have introduced elements in their allocation plans that nevertheless provide methods of banking between the periods, particularly in the French allocation plan. This issue threatens the standardized nature of the security since the properties of the asset would vary between countries. Inconsistencies such as these render the valuation of the security more difficult and may

create additional uncertainty. The current lack of a way to roll forward one's emission rights from 2007 to the next period starting in 2008 is a large issue and might lead to a "crunch" in 2007 when it will remain to be seen if there are enough emission rights to cover everyone's needs. Muller & Mestelman's study in 1998 indicates the importance of a clear and certain banking system as part of any emissions trading scheme. The regulation concerning banking in the EU ETS does not appear to fulfil these requirements.

- *Political differences might adversely affect the system*

The factors identified by Stavins as crucial for the Acid Rain Program's success were largely based on a clear framework of rules and regulations minimizing confusion and uncertainty about the future. The EU has many different wills, and countries have different industrial profiles. Some countries, such as Germany, that have a large presence in the power plant industry and therefore are one of the major polluters, clearly have different interests than countries with a large proportion of hydro power, such as Sweden and Finland. This conflict of interest may have created a situation in which the rule set is suboptimal for efficient operation of the market.

5.4 What does the future hold for the EU ETS?

The current phase of the system will only be in effect until the end of 2007. 2012 is EU's target year for full Kyoto compliance, which many believe will require countries to be stricter with their EUA allocations[40]. Many fast-growing industry sectors that are exempt from the system today may be included after 2007, such as aviation and the transport industry. It is anyone's guess how this will affect the market situation since allocation plans and the total ceiling for carbon dioxide emissions has not been finalized yet; however, it is believed that the total available emission rights will decrease.

[40] Investor guide to climate change, the Carbon Trust, January 2005. Page 13.

At the moment, the degree of incorporation between the EU ETS and other systems such as the CER and JI systems is limited to exchangeability between the assets. A natural extension would be to incorporate the different systems into a global project.

6. Conclusion

The research in this thesis has strived to explore how the market for European emission rights functions today. This has led to a number of insights that explain the current problems and positive aspects of the system. Some findings are more certain than others. The evidence primarily reflects the point of view of analysts and market intermediaries and not that of companies participating directly in the scheme. Bearing this condition in mind, the most conclusive results from this study are the following:

- The pricing is seen as quite accurate in relation to the fundamental value of the security, there are signs that indicate basic market efficiency and prices are uniform between marketplaces.
- Several problems the market is facing stem from political uncertainty related to the fact that the regulatory framework is still under construction and many countries are still negotiating their allocations and bringing their registries online. This can be interpreted as a sign of a hurried implementation of the scheme.
- Liquidity and transparency are burdened by the large share of trade taking place off the open market. The amount of trade is steadily growing.
- Market intermediaries that facilitate trade and provide services enabling smaller companies to participate have appeared.
- The introduction of derivatives, in addition to the existing futures, is in progress.
- One can not rule out the risk that some large participants can influence prices with their market power.

To summarize, the market is very difficult to predict. It is impossible to say what effect future political decisions will have on the market and on the prices, as well as in what form the actual trading will take place. The trading has shifted from over-the-counter brokerage in 2004 to a more exchange-centric system in 2005, even though brokers still handle the majority of the trading. If the positive trends continue however, we will probably soon see a more open market that will lend itself better to analysis.

6.1 Future Research

This thesis has focused on the qualitative aspects of the market. Since the market data is lacking in quantity and detail, it is difficult to perform a meaningful quantitative analysis. Once the market has matured, however, a quantitative analysis focusing on testing the efficient market hypothesis would be interesting.

The major topic of discussion concerning the EU ETS in the mainstream media has lately been how it affects the electricity prices, particularly in northern Europe where the majority of the electricity is produced by non-carbon based methods. Investigating this relation could provide an interesting basis for further research.

Once the derivatives market is more developed, it could be of interest to investigate what hedging strategies are available for companies to minimize the risk associated with their emissions.

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7.6 Interviews

Peter Filipsson, EU ETS Analyst at STEM. 2005-12-02

Henrik Hasselknippe, Senior Analyst at Point Carbon. 2005-12-06

Per Otto Larsen, Project Manager for Allowances at NordPool. 2005-12-06

Martina Priebe, EU ETS Manager at IETA. 2005-12-07

David Rapin, Project Manager at Powernext SA. 2005-12-08

Sara Ståhl, Carbon Economist at the European Climate Exchange. 2005-12-12

Alexander Wintzer, Market Manager at Climate Corporation. 2005-12-13

7.7 Electronic resources

Carbon Finance Online, http://www.carbon-financeonline.com

Climate Corporation, http://www.climatecorp.com

ECON Denmark, http://www.econdenmark.dk

EU ETS information page, http://europa.eu.int/comm/environment/climat/emission.htm

European Climate Exchange, http://www.europeanclimateexchange.com

International Emissions Trading Assoication, http://www.ieta.org

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Point Carbon, http://www.pointcarbon.com

PowerNext, http://www.powernext.fr

Reuters, http://www.reuters.com

STEM, http://www.stem.se

United Nations Framework Convention on Climate Change, http://unfccc.int/2860.php

Appendix 1

This section presents the questions used in the telephone interviews. Additional questions were sometimes asked in order to clarify the answers.

1. How well do you think the market works in general?
2. Some of the actors might have strong market power; do you think there's a risk for price manipulation on the market?
3. Do you see any obvious problems with the way the trading takes place today?
4. Why do you think much of the trade takes place bilaterally, outside the established exchanges?
5. Do you consider lack of liquidity on the markets to be a problem and if so, on what causes are there?
6. The number of exchanges is increasing. How does this affect the market?
7. Are high transaction costs a problem for the market?
8. Why do you think such a large part of the trading is done with futures as opposed to on the spot market?
9. Do you consider political uncertainty to be a problem? If so, specify.
10. What are your basic thoughts on the design of the EU ETS?
11. Is there a developed market for derivatives of emission rights besides futures?
12. The EUA price has increased greatly during 2005. Do you think the price will be more stable in the future? Why/ why not?
13. Which factors do you think affect the price of the EUA?
14. Do you think that the price correctly reflects the fundamental value of the EUA?
15. Do you think there is any speculation taking place on the market?
16. Which method of compliance do you think most companies use (or will use)?