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**Working Paper**

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CoFE Discussion Paper, No. 05/11

**Provided in Cooperation with:**

University of Konstanz, Center of Finance and Econometrics (CoFE)

*Suggested Citation:* Franke, Günter (2005) : What can we expect from the new trade of CO<sub>2</sub>-allowances?, CoFE Discussion Paper, No. 05/11, University of Konstanz, Center of Finance and Econometrics (CoFE), Konstanz

This Version is available at:

<https://hdl.handle.net/10419/32176>

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# What Can We Expect From the New Trade of CO<sub>2</sub>-Allowances?

by  
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In 2003 the European Union passed a Directive on the Trade of CO<sub>2</sub>-allowances within the European Union aiming at a substantial contribution of the European Union to the objectives of the Kyoto-protocol. One allowance gives the owner the right to emit one ton(t) of CO<sub>2</sub>. Industries included in this system are those which use much energy in their production process and emit substantial amounts of CO<sub>2</sub>, in particular electricity producers, steel, ceramics, glass and paper manufacturers. The states of the European Union allocate the allowances to their national industries based primarily on a grandfathering system. This means that the companies report their annual CO<sub>2</sub>-emissions over the last years and get about the same quantities as annual emission allowances for free. These quantities have been slightly reduced for Germany and the UK relative to the observed emissions in 2000/2 so as to cut back the CO<sub>2</sub>-emissions as agreed upon in the Kyoto-protocol.

The trade of CO<sub>2</sub>-allowances started over the counter last year (a price index is available from October 2004 on). On March 9, 2005 the European Energy Exchange started its auction trade. In October 2004 the price was around 8.70 €/t, in January 2005 it came down to 6.65 €/t, then it reached its peak of 29.30 €/t in July and at the end of August it traded at about 23 €/t. So far we observe an enormous price volatility. This raises the question (1) as to what determines these price movements, (2) who benefits/suffers from these movements and (3) does the high volatility make emissions-trade rather ineffective for long-term investments in emissions-saving production technologies.

Before addressing these questions, let me make some general comments on the usefulness of an emission allowance-trading system. Since the production technologies for electricity, steel etc. differ strongly in their CO<sub>2</sub>-emissions, it is difficult to reduce the aggregate level of emissions by governmental directives. A more effective coordination instrument is a price mechanism which imposes the same cost per CO<sub>2</sub>-ton on all CO<sub>2</sub>-emitters. This can be achieved by assigning all emitters CO<sub>2</sub>-allowances which they can trade in a market at a price equating supply and demand. Then every emitter asks himself which production technology he should use in order to minimize his overall production cost. In an ideal system, all emitters operate under the same conditions so that the most CO<sub>2</sub>-intensive production technologies are used least and will be replaced by investing in less CO<sub>2</sub>-intensive technologies.

Even though the EU-Directive on trade of CO<sub>2</sub>-allowances seems to be a promising step, much needs to be done to approach the ideal system. First, national governments in the EU allocate the CO<sub>2</sub>-allowances in different ways, being more or less generous. Second, an intensive lobbying of national industries tries to redistribute allowances between industries and to set the path for the allocation of CO<sub>2</sub>-allowances in future periods. Third, outside the EU there is no such system so that CO<sub>2</sub>-intensive industries outside the EU have no incentive to economize on their CO<sub>2</sub>-emissions. Similarly, electricity-intensive industries outside the EU get electricity cheaper than within the EU and, thus, have a competitive advantage. The EU-Directive at least takes a first step to mitigate these problems. A company located in the EU may obtain additional allowances from Joint Implementation Projects reducing CO<sub>2</sub>-emissions in other countries which have signed the Kyoto-protocol, and from Clean Development Projects reducing CO<sub>2</sub>-emissions in third countries. Thus, if a German company cooperates with a Russian CO<sub>2</sub>-intensive power plant to reduce its emissions, the German company can obtain additional allowances.

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<sup>1</sup> I am grateful to the Zentrum für Europäische Wirtschaftsforschung for some data, Jürgen Rothmund for his computational assistance, Thilo Franke for legal information and Wolfgang Bühler for comments.

Movements of the CO<sub>2</sub>-price are driven by supply and demand. In order to better understand these, first ask the question who benefits and who loses from price increases. The CO<sub>2</sub>-emitters/polluters are given CO<sub>2</sub>-allowances for free so as to enable them to continue their production without additional cost. This does not imply, however, that they sell their products in the presence of emission-trading at the old prices. Let us look, for example, at the wholesale electricity price. In Europe, electricity is generated by different technologies which are given below with their respective average CO<sub>2</sub>-emission in tons per MWh.

Energy source	Percent of power generation	CO <sub>2</sub> -emission
Water, wind, sun, biogas	14	--
Nuclear energy	32	--
Natural gas	18	0.5
Hard coal	19	0.9
Brown coal	11	1.0
Oil	6	0.9

Taking a weighted average this implies an emission of 0.425 t/MWh . Given a time-series of daily CO<sub>2</sub>-allowances from November 01, 2004 until August 30, 2005 we derive the daily price changes. Similarly, we take the first differences of the daily wholesale prices for electricity from the European Energy Exchange for the same time period. Since the daily spot prices vary strongly because of immediate weather changes and other short-term factors, we take the baseload future contract 4/05 which matures in the last quarter of 2005. A regression of the electricity price changes on the CO<sub>2</sub>-price changes shows a regression coefficient of 0.4 with a t-value of 7.7 and an R<sup>2</sup> of 0.23. Hence the regression coefficient is very close to the average emission of .425. This clearly demonstrates that the electricity price is raised by the average cost of CO<sub>2</sub>-emissions (see graph). Taking a CO<sub>2</sub>-price of 20 €/t means that the price of a MWh goes up by about 8 € due to emission trade. This corresponds to a wholesale price increase of 25 to 30 % for a MWh. Interestingly, including the daily spot price changes for the main CO<sub>2</sub>-burdened energy sources natural gas, coal and crude oil in the regression basically has no effect. All the regression coefficients are not significantly different from zero, the adjusted R<sup>2</sup> goes down. (Using future instead of spot price changes might have stronger effects.) This underlines the importance of the allowance price for the electricity price.

Hence the electricity producers who get the allowances for free, strongly benefit from the trade system even if they use them and do not sell any. Since they sell electricity at a price including the emission costs, they cash in the value of the allowances. Is that substantial? Given that the German government allocated 500 mio allowances for each year 2005/6/7 to the German industry, this represents an annual value of roughly 500 x 23 = 11.5 bio €. The beneficiaries are mainly the companies' owners. Therefore many people would prefer an auction of allowances by governments instead of an allocation for free. Who pays? All those who buy the products from the companies endowed with the allowances. Consumers, for example, pay these costs through higher electricity prices. This would be alright if the price increase would equal the marginal pollution damage created by the electricity production.

This helps to answer the question what drives the movements of the allowance price. Given the recent sharp increase in the allowance price up to more than 29 €/t, some people speculate that the electricity producers might have manipulated the allowance market so as to move up the allowance price which then triggers an electricity price increase. Even though in Germany there are only four substantial electricity producers who might tacitly collude to drive up the allowance price, on a European scale there are many more producers. If many producers act as price takers, it should not be easy to move prices up artificially. Also hedge funds might try to benefit from artificial price increases by short selling allowances in the over the counter

market. But it is questionable whether the companies endowed with allowances, act competitively. Since all of them benefit from a price increase, they might collude to manipulate the market. Does collusion explain that a change of the allowance price of 1 € on average leads to a price change on the next day of about .3 € of the same sign? This issue should be investigated thoroughly.

Of course, many other forces also affect the CO<sub>2</sub>-price. First, there is strong uncertainty about the prospective demand for allowances from the various industries in the EU-countries over the period 2005/7. For example, the demand for electricity which is estimated to increase annually by 3 %, may grow faster or slower and the technological progress in developing less CO<sub>2</sub>-intensive production technologies is hard to predict. Second, there is much political uncertainty. This refers to the distribution of allowances and also to the political attitude towards the use of nuclear energy. Third, changes in the prices of yellow cake (nuclear energy), natural gas, coal and crude oil may affect the CO<sub>2</sub>-price. But a regression of the allowance price changes on the spot price changes of the main CO<sub>2</sub>-burdened energy sources natural gas, coal and crude oil shows no significant results. So, at least for the short observation period of this study, allowance prices cannot be explained by the prices of these energy sources. The high volatility of the allowance price may also be in the interest of companies having real options whose value increases with the allowance price volatility.

This leads to the final question: Can the allowance price act as reliable price signal for companies to invest in less CO<sub>2</sub>-intensive production technologies? The answer is manifold. Regarding a move to technologies without CO<sub>2</sub>-emissions, the price mechanism itself may be rather ineffective. The reason is that a company using these desirable technologies, may not be awarded allowances in the future so that it cannot sell these. Thus, the net benefit from switching to a technology without CO<sub>2</sub>-emissions is questionable. If, however, electricity consumption increases year by year, but aggregate allowances are reduced over time, then companies may be forced to reduce the use of CO<sub>2</sub>-intensive technologies. This would reinforce the discussion about the use of nuclear energy. An alternative would be to produce more electricity using natural gas because it generates only half of the CO<sub>2</sub>-emissions compared to coal. If many producers would do this, it is likely to drive up the price of gas relative to other energy sources rendering the technology substitution perhaps unattractive, apart from political issues like dependence on foreign gas supply. Regarding the impact of the allowance price on the investment decisions, it is plausible that even a highly uncertain price would give an incentive to use a less CO<sub>2</sub>-intensive technology based on the **same** energy source. But it is questionable whether a highly uncertain price would have a strong impact on substituting one technology for a technology using a **different** energy source.

