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Trade with emission allowances –

the impact on the Swedish paper and pulp industry's competitiveness

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Titel:	**Handel med utsläppsrätter – dess påverkan på den svenska pappers- och massaindustrins konkurrenskraft**
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Sammanfattning

I januari 2005 introducerades ett handelssystem med utsläppsrätter av koldioxid, CO_2, i Europa. Införandet har påverkat såväl elpriset som priset att producera varor som genererar koldioxid. Pappers och massaindustrin är stora elförbrukare och släpper ut koldioxid och valdes därav. Den här branschen undersöks för att ta reda på om konkurrenskraften har påverkats av införandet av handelssystemet. Eftersom prövotiden är för kort för att analysera och kunna se resultat så har samma industri i USA analyserats för att sedan kunna jämföras med Sverige. Olika teorier behandlar detta ämne tillsammans med data för elpriset och produktionspriser hämtade från Statistiska Centralbyrån. En modell som mäter konkurrenskraften genom produktionskostnader beräknas och visar att Sverige relativt sett har ökat sin konkurrenskraft jämfört med USA sedan 1995. Detta kan bero på införandet av ett handelssystem av utsläppsrätter i USA 1995. Om så är fallet, kan den svenska pappers- och massaindustrin möta en tid av minskad konkurrenskraft de närmaste åren.

Master Thesis in Economics

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Abstract

In January 2005 a trading scheme with emission allowances, including carbon dioxide (CO_2), was introduced in Europe. This has influenced the electricity price as well as the price of CO_2 emitting production. The paper and pulp industry uses a high share of electricity and emits CO_2 and is therefore chosen. This industry is investigated to see if the competitiveness for the industry has been influenced by the emission trading scheme. Since the trial period is too short to give any clear results, USA has been investigated to make comparisons with Sweden. Different theories about the subject together with electricity price and production price data from Statistiska Centralbyrån. A competitiveness model is calculated with help from production prices and show that Sweden has become relatively more competitive compared to the USA since 1995. A reason for this can be the introduction of an emission trading scheme in the USA in 1995. If this is the case, the Swedish paper and pulp industry can face a decrease in competitiveness in the near future.

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1 Introduction

Trading markets with pollution rights or permits have gained increased attention during the last two decades (Liski and Montero 2005). The emissions are a global problem, and therefore it has to be solved through international cooperation. By following the Kyoto protocol agreed upon in Kyoto 1997, a healthier environment will be reached by decreasing the carbon dioxide (CO2) emissions. Unfortunately, one of the largest industrialised countries, the USA, has not yet signed the agreement and the same is true for Australia. This settlement defines absolute targets to reach. One way of attaining these, is to trade CO_2 allowances, which will take place in the first commitment period for the Kyoto protocol, 2008-2012. Jointly, the main aim for the industrialised countries is a 5.2 per cent reduction in emission of greenhouse gases.

A thesis investigating emission allowances first requires a definition of the concept. Firms with different prerequisites, some with a large share of emissions and others with a lower share, meet each other on a single market to trade. A firm is a buyer in the market when facing marginal cost of reducing the emissions higher than the cost of one more allowance. A firm with a low marginal cost is a seller. Since the market is determined by supply and demand, the reduction of emissions will always take place at the lowest cost.

According to a report from the Swedish Institute for Growth Policy Studies (ITPS 2005) the competition situation for different industries will be affected through increased prices, as a result of the price of CO_2 allowances together with an increased price of electricity. Since electricity is an important factor of production, the production price will increase. Why this increase occurs is closer explained in section 5.1. A reduction in CO_2 tax will occur in order to keep companies competitive.

The European Union has decided to introduce a trade system with CO_2 allowances within the Union (directive 2003/87/EC) to give guidance and to create a framework for emissions trading. 1st of January 2005 the trade started and can be seen as an opportunity given to regulators and firms to receive early experience, a trial period until 2007, in order to have a solid scheme prepared by 2008. The aim is to reduce the emissions with 8 per cent within the European Union. Countries receive different amount of allowances at the opening and these allowances will thereafter be redistributed through trade. Trade with emission allowances is the least economic costly alternative to reach a better environment, since the market is lowering the emissions wherever the abatement cost is the lowest. The costs of administrating the system are also relatively low; the government determines the overall emission target and allocates the permits to different actors. Its only purpose is then to supervise the market and take action towards the firms that do not collaborate (Hansjürgens 2005). Although it may be difficult to evaluate a system after a short time-period, the way the trading program is designed do fulfil the elements for a successful trading scheme. Experience has been gathered by evaluating other similar trading schemes, but a problem that might occur is to piece the whole system together (Kruger and Pizer 2004). Only CO_2 emissions are included in the first trial period for the European Union and each allowance equals the right to emit one ton of CO_2, and the minimum size of a contract is 1000 allowances.

Five different industries are included in the main part of the first trial period, these industries are:

- Power and heat generation

- Mineral oil refineries
- Iron and steel (including coke ovens)
- Pulp and paper
- Building materials (cement, ceramics and glass) (Zapfel 2005)

The pulp and paper industry is emitting one per cent of the total CO_2 emissions within the EU, this compared to the power and heat industry that commit with nearly 30 per cent. These industries are both included in the trading sector (Svendsen 2005). Sweden is the 2nd European country after Finland when looking at the capacity of producing within the pulp and paper industry and cover more than 10 per cent of the demand within the Union. The largest competitors in this sector are: Brazil, Canada, USA, Indonesia, Chile, Germany, Finland and France. The price of pulp and paper is expected to be influenced by an introduction of emission allowances together with an increased price of electricity. Since the same scenario will occur for all countries within the European Union, the competition among them are assumed to be unaffected. About 60 per cent of the Swedish pulp production is exported, while for the paper production as much as 90 per cent is exported (ITPS 2004). These numbers make the paper and pulp industry interesting to investigate in the question of competition and how it has changed after the introduction of trade with emission allowances.

The purpose of this thesis is to investigate the competition effects of the trade with CO_2 allowances on the Swedish paper and pulp industry. Different theories about emission allowances are used and in the empirical section a competitive model will be calculated and analysed. To investigate the influences on the paper and pulp industry in Sweden after such a short time period the situation in the USA will be examined in the empirical part since they have experience from a cap-and-trade system.

A problem with markets with emission allowances is initially to find the perfect level of emissions and to define the property right in a fair way (Pihl, 2003). By investigating USA and see the change in the competition situation that occurred for them after the introduction of the Acid Rain Program, this will be applied on the Swedish paper and pulp industry and the introduction of emission allowances. Different theories will be studied to see the impact that the emission allowances market has got on the paper and pulp industry. A competitiveness model that looks closer into the price of production will be investigated to receive results. Production prices and price of electricity is data collected from Statistiska Centralbyrån. The combination of theories at the national level and at the firm level and with empirical result from the USA is the base for examining the problem at both the macro and the micro level.

Earlier studies have been made on a national level and also a few studies have looked closer upon the steel industry and the effects that have arisen from the introduction of emission allowances. This study will focus on the paper and pulp industry but otherwise be similar to other studies.

2 The Coase Theorem

Ronald Coase received the Nobel price in economics in 1991one reason to this was that he defined the importance of proprietorship in economic theory. One of his contributions is that he argued that as long as the proprietorship is well defined, the best solution is to let the market[1] find its equilibrium, which will be economically optimal. This theorem only holds with certain restrictions, such as low transaction costs and the fact that only two parts can be included (Brännlund and Kriström, 1998).

To maximize total profit the optimal level of emission, i.e. be at a point where marginal benefit equals marginal cost is a Pareto optimal solution (Frech, 1973). An important question is if the environmental situation should be viewed from a long run perspective or if the economic revenue of today is more important. This can be viewed in the following Table where the pay-off differs between the two perspectives.

Year	1	2	3	4	5	6	7	8	9	10	11
Long-Run Perspective	50	50	50	50	50	50	50	50	50	50	50
Short-Run Perspective	100	90	80	70	60	50	40	30	20	10	0

The time preference will decide which perspective to see from, with a 5-year perspective the short-run version would be used. This table can be considered in the problem finding the perfect emission level. According to Pihl (2003) as long as the positive aspects are larger then the negative emissions can be motivate, since the revenues will be greater than the costs (Pihl, 2003).

The Coase Theorem works independently of who will receive the emission allowances. This is shown in an example with a fisher and a factory, if the fisher has the property rights of the environment to emission, to be able to emit anything the factory is willing to compensate the fisher as long as marginal benefit (MB) is larger then marginal cost (MC). This implies that the trade with emission allowances will continue until MB equals MC, both actors gain from this trade. The requirements for the Coase Theorem to hold are not always fulfilled in the real world; since the environment influences the whole humanity, the transaction costs tend to be very high (Brännlund and Kriström 1998). In conclusion, the allocation of resources is unaffected no matter which one of the participants receiving the property right (Frech, 1973). An important point is that the allocation of income is dependent on the allocation of property rights (Klein and Foldvary, 2003). The right to pollute will have a certain value given by the market price for pollution (Perman et al., 2003).

In Figure 2.1 the situation with the fisher and the factory will be shown graphically. Here we can see that the total cost of the damage for the fisher increases steadily when the emissions from the factor increases. The Marginal Cost (MC) for the factory also increases together with the increase of emissions. The reason to this is that the first parts of emission

[1] "A voluntary market economy is one where resources are allocated on the basis of bargains freely struck by many consumers and producers" (Mumey, 1971).

might not be visible but at the end each extra part of emission will increase the Marginal Cost for the factory and therefore also the Total Cost (TC).

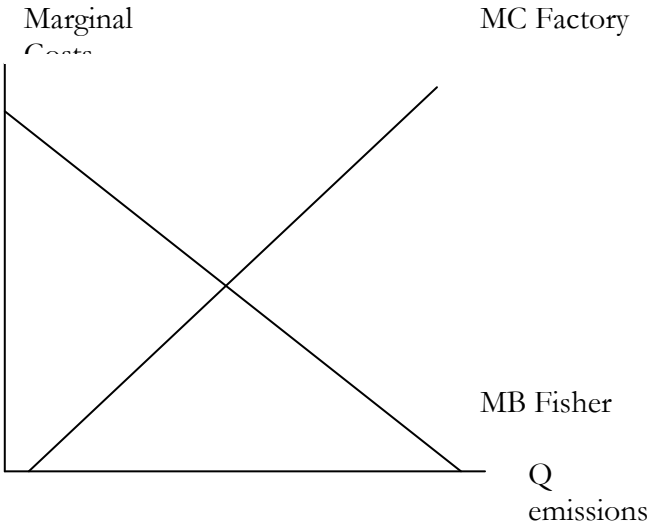

Figure 2.1 Marginal Costs for emissions

Coase (1960) considered business firms actions that affected others in a harmful way. If A causes harm to B the question will not be how to restrain A since this, according to Coase, is a problem of mutual art. The main issue is to be able to keep away from the more serious damage.

To be able to carry out a market transaction information must be gathered and administrative work has to take place, which can be extremely costly. When a firm has estimated the transaction costs, such an agreement will only take place when the increase in the production value, strictly according to the rearrangement of rights, is larger than the costs of realising the market transaction. Different arrangements will bring about different values of production. An alternative solution to solve the arrangement is the use of direct government regulation where they can deal with certain methods of production (which are allowed to use and which are forbidden) as well as restricting a particular business to a certain area. The main difference between the government and the firm is that the government can completely avoid the market, which is impossible for a firm. The authorised methods used by the government can prevent extra effort as well as lowering the cost for the firm. Observe that a direct governmental regulation is no matter of course for a better result than the result received by the market or by the firm. Different solutions are possible to solve the problem of property rights and social costs and the difficulty will be to find the most suitable social arrangement to treat the problem with harmful effects (ibid).

The concept of a factor of production is incorrect according to Coase (1960) and is a reason to the approach to develop a theory adequate to deal with the problem of harmful effects to fail. The factors of production would preferably be looked upon as rights, this would facilitate to look at the actions generating a harmful effect as a factor of production as well. The cost that occurs from utilizing such a right or factor of production will constantly equal the loss suffered somewhere else as an effect from exercising that right. An advantageous situation would be if only projects where the gain exceeds the loss were accomplished. The total effect is important when social arrangements are determined.

Property rights can help to prevent environmental problems, according to Conda (1995) "in England and Scotland, private ownership of the rivers and waterways has successfully prevented overfishing and controlled water pollution for 800 years. The owners simply charge others for the right to fish in their section of the river. Consequently, the owners have an economic incentive to maintain the fish population and keep the waterway clean." An efficient outcome is always possible to achieve by private agreements regardless of the liability according to the law (Miceli, 2004).

The transaction costs are of great importance in the Coase Theorem, when insignificant low the shape of the law and liabilities are less likely to influence the allocation of resources. If the transaction costs for private coordination are prohibitive then the law has to impose liability or specify the property rights. The alternative methods to cope with transaction costs and find the most economically alternative is the important analyse according to Coase (Posner, 1993).

3 Emission allowances

To achieve the goals of the Kyoto protocol, a trading system of emission allowances will be applied within the European Union. This section will look at the history of the environmental policy in Europe, and also investigate the system of emission allowances.

3.1 Environmental Policy in Europe

The European Parliament made the first decision to measure the concentration of CO_2 in the atmosphere already in 1986 in order to obstruct the negative development. The environmental policy in Europe is build upon a close relationship between economic viability and a direction towards a better environment (Andersen 2005).

Throughout history, there has been a discussion whether or not it is beneficial to be an early starter in order to fight green house gases, such as CO_2. The combat against climate changes can be seen as a global public good, therefore the problem with free-riders occur. In order to avoid the free-rider problem an international trade with emissions in the form of a cap-and-trade[2] scheme turned out to be the best solution instead of using restrictions to countries. A change in the climate cannot be reached by the action taken by one single country, or even one single continent (Zapfel 2005). By looking at the reduction costs in divide trading schemes, as long as the cost is different between diverse trading schemes a linkage might result in an overall increase in cost-efficiency (Bode 2005).

One of the key officials in the Commission states that the European Union "is focused on the integration of environmental considerations into economic and sectoral policies, and on the broadening of the range of environmental instruments, in order to improve both effectiveness and efficiency of environmental management". Clearly pointed out is "the need simultaneously to protect Europe's environment and to maximize the competitiveness of European industry" (Sors 1996). Interacting the economy and the environment is not to be seen as a zero-sum game, rather protecting the environment are actually seen as a part of economic efficiency (Zapfel 2005).

3.2 Trading with emission allowances

Emission allowances can be seen as a good alternative to reach environmental goals. The closer the system is to perfect competition the higher is the cost-efficiency (Hill and Kriström 2005). Diverse perspectives about emission allowances exists, some with a more environmental view while other focus more on the economical perspective. Trading with emissions is above all for environmental protection, secondly an instrument with the lowest impact on competitiveness (CEU 2001).

3.2.1 Why emission allowances?

Using emission allowances results in a maximum level for emissions within a certain geographical area, e.g. the European Union. The total level is determined and allowances equivalent to this level is distributed among the different participants (Brännlund and Kriström 1998). An advantage with emission allowances compared to other environmental instruments, as taxes, is that the level of emissions can be determined prior to the start of

[2] A maximum level of emissions is aloud and trade is used up to this level (Hill and Kriström 2005).

applying the instrument (Bode 2005). However, there are negative effects associated from such a system; e.g. the costs of administration (Brännlund and Kriström 1998).

According to Margot Wallström (2001) the emission trading is a "cornerstone in a low-cost strategy for reducing greenhouse gas emissions" for the European Union. In June 2003 an agreement between the parliament and the council was reached, allowing the trade with Co_2 allowances to start in 2005 (Andersen 2005). The path of emissions will differ with the trading system of emission allowances, it is cheaper to lower the emissions in certain industries than other, compared to if only national policies should be used to reach the targets of the Kyoto protocol. The change of the path might be seen already before 2008 (Bode 2005).

3.2.2 How to allocate the allowances

Before the two trading periods, 2005-2007 and 2008-2012, each member state has to prepare the National Allocation Plan (NAP) to the Emission Trading Scheme (ETS) (Klepper and Peterson 2004). The Triptique approach[3] shows the burden differentiation of CO_2 emission reduction among the European Union member states and a negotiation process to find an allocation of targets that could be seen as just and equal. In this approach the demand for energy was divided into three different groups:

- The light domestic sector including households
- The energy intensive sector with export-oriented industries
- The electricity generation sector

To minimize the undesirable effects on the competitiveness in the energy intensive sector between the member states the Triptique approach applies identical targets for the participants (Andersen 2005). The main advantage of harmonized coverage across the internal market of industries with large emission sources is a firm included by the rules of the scheme can be certain that any competing firm within the European Union will face the same rules and the same market price for CO_2 allowances (Zapfel 2005).

When the target for each member state is set, the emission allowances are allocated. Fundamentally there are two ways of distributing the licenses among firms:

- To allocate the licenses for free
- To allocate through an auction

If the choice is to allocate the allowances for free, the most common method is the so called grandfathering principle; implying that a firm receives allowances in relation to the initial emissions[4]. This is considered to be a simple and just way of allocation. A negative aspect of this method is that firms with a large historical level of emissions will be favoured

[3] The Triptique approach shows the differentiation of targets among the European Community's member states.

[4] A base year is decided to give a just allocation of emission allowances. Different countries may use different years as base years.

in comparison to firms that already have invested in new technology to reduce CO_2 emissions (Brännlund and Kriström 1998).

To allocate the allowances through an auction gives an authority the right to sell licenses and firms or even environmental organisations get the opportunity to buy them (Brännlund and Kriström 1998). An advantage with this system is according to SOU (2000) that the state receives a compensation for the reduction in the revenue for taxation that occurs. The agreement in the European Union stated that at least 95 per cent of the total amount of allowances should be free of charge in the first period, while in the second period a minimum of 90 per cent (Zapfel 2005). In a press release from the Swedish ministry of industry (Näringsdepartementet) in 2004 the goal when allocating the emission allowances was to "maintain the international competitiveness of the Swedish industry as far as possible" (ITPS 2004).

The two alternative ways in allocating the emission allowances yield the same environmental effect, as the market is working. A third alternative would be to combine the two methods described above (Brännlund and Kriström 1998). According to Hill and Kriström (2005) an auction providing capital to the state would be preferable, but in this case where only ten per cent is allowed to be distributed through auction, the revenue will be negligible. To allocate the allowances gratis and in a disproportional way is a policy used to spare the heavy industry, but the main effect will be a decrease in capital losses for the owners. The cost for the national finances will be high and in the same time the heavy industry will not be protected (ITPS 2004).

Figure 3.1 explains the varied effects of different environmental policies, tax, gratis allocation and auctioning. Revenue of consumers, revenue of the firms, tax revenue and environmental benefits are included in the model. The optimal production level seen from an economic society perspective is Q_1 , this implies that it will be defendable to reduce production from Q_0 to Q_1 . When the production is reduced the emissions will automatically decrease. No matter which environmental instrument that will be used, tax or emission allowances, a cost will occur. The market price will increase and so a decrease in quantity demanded occur. (Hill and Kriström 2005).

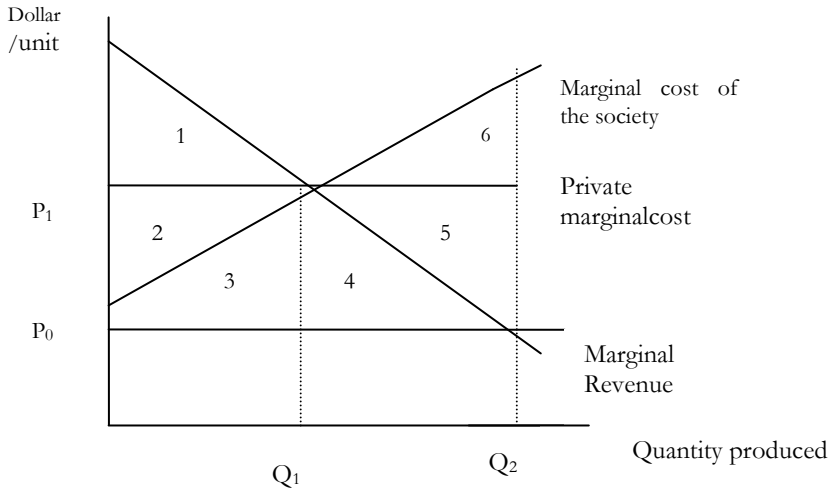

Figure 1. Allocation effects from grandfathering, auction and environmental tax.

Source: Hill and Kriström 2005

Table 3.1 reveals that the effect of an auction equals the effect of using an environmental tax, where the revenue goes back to the consumers. If the emission allowances instead would be allocated costless, the firms are to retain the marginal interest rate (2+3). When an environmental tax is implemented consumer price increases from P_0 to P_1 (Hill and Kriström 2005).

Table 3.1 Allocation effects from Grandfathering and auction.

Policy	Consumer	Revenue of the firm	Tax revenue	Environmental Benefits
Gratis	-(2+3+4)	2+3	0	4+5+6
Auction	-(2+3+4)	0	2+3	4+5+6

Source: Hill and Kriström 2004

According to Bohm and Convery (2004) there are more disadvantages of the system of gratis allocation which is used in the European Union compared to an auction allocation.

- A costless allocation makes non-efficient firms survive longer than they should otherwise.
- To allocate the allowances gratis only among existing firms will increase the difficulties for new firms to enter the market.
- No tax revenue will appear when the allowances are allocated gratis, to lower biased taxes

In Sweden all plants within the industrial sector will receive 100 per cent of historical emissions; the heating sector will be given only 80 per cent. Different time periods are used to decide the allocation and this can lead to inequality between different countries. Germany for instance is using the period 2000–2002 this compared to Sweden that uses 1998-2001 (Hill and Kriström 2005).

3.2.3 Banking

The question on whether or not to allow banking has been an issue in the debate. Banking is when you are allowed to carry forward allowances that have not been utilised during the present time period. A positive effect from allowing banking is that it can encourage the firms to make early reductions in emissions and could also improve economic efficiency. A problem with banking could occur from this first period when no Kyoto commitments exist to the second period. This would imply that firms with banked allowances are promised a share of the Kyoto budget of allowances that the country receives. Further negative effects would appear if only a few of the member states took the decision to allow banking, which could yield in flows of allowances to these states towards the end of 2007 (Zapfel 2005). Bode (2005) also points out the importance of banking when considering the ability to reach an intertemporal optimization, to reduce costs.

3.3 Participation

It has been discussed whether the participation should be mandatory or voluntary, a mandatory participation would result in a more environmentally efficient system. When all firms are involved the system gets fairer since everyone follows the same regulations. Along with a voluntary system comes the risk of only having firms that are sellers appearing on the market, which in turn would lead to an excess supply of allowances (Bode 2005).

The national government - or in this case the European Commission - is restricted to decide the level of emissions and to make sure that the rules are followed. It is then up to the firms to decide where, how and when to reduce the emissions. This approach differs from existing command-and-control policies (Hansjürgens 2005).

4 Competitiveness and environmental impact

When talking about international competition, the firm is often assumed to be a price taker, yielding a price determined on the world market. This is the case in the paper and pulp industry, and the possibility to transfer the extra cost on the consumer is considered to be almost non-existent. Easily expressed, the price elasticity for commodities in this group is infinite. To keep the competitiveness of a firm, a reduction in production can be done since the marginal cost for the production is increasing. This is possible due to the fact that a price taking will never be able to compete with price; therefore they have to compete with quality instead. Firms who have the greatest ability to pay for the emission allowances will be able to maintain or increase their production (ITPS, 2005).

A firm is considered competitive as long as it has the potential to produce as cheap as international competitors. What is estimated is what the market is willing to pay for the inputs in the production; the production of a firm does not have a surplus value seen from a rational economic behaviour. Looking at the cost components for a firm, in the short as well as in the long run it is the value of the factors of production on the market that can be seen as relevant. Capital as well as emission allowances are parts of the resources for a firm which are received in an earlier period or without costs. In the short run the capital does not have any alternative costs since it takes time to convert capital, after a time period the capital can be seen as sunk costs. The market value of the emission allowances, are the alternative cost for the firm. Again the alternative cost decides if the firm is competitive enough. The method of allocating the allowances does not matter; as long as the cost of production does not exceed the production costs of other firms the firm is competitive. The comparative advantages for firms in different countries are of importance. The real price of the factors of production in relation to their productivity is also important to consider; an increase in the price of raw material does not matter as long as the productivity increases in the same way (ITPS 2004). To estimate the competitiveness of a firm, following equation (1) can be used:

$$C = (r^h/p^h)/(r^a/p^a)e \qquad (1)$$

C indicates the level of competitiveness.
r = The price of the raw material used in the production in the home (h) country, a symbolizes abroad
p = The productivity, production per share of raw material input, h is home and a symbolizes abroad.
e = The price of the foreign currency.

If C increases the competitiveness decreases. The purpose of the model is to capture the fact that adjusting the domestic prices of the inputs to changes in productivity and exchange rate is the most important variable. The weakness with this model is that it measures average costs instead of marginal costs. Instead of investigating the raw material, the factors of production, labour or capital can be considered. ITPS (2004) presents this model with labour as the only factor of production. Since this industry is crude material intensive, the model in this thesis will examine the influence of raw material on the level of competitiveness. Costs of transportation are not taking into account in this specific model, but is according to IVA (2006) one of the weaknesses for the Swedish paper and pulp industry, since they are relatively high. As mentioned earlier, Coase theorem also indicates the importance of transaction costs (Posner, 1993).

The competitiveness of the industry and the relationship to environmental goals has included a trade-off between social benefits for the society and private costs for the firm. Two sides with widely different incentives, one who wants to increase the tough standards and the other who wants to relax the present standards. At the industry level the

competitiveness arises from superior productivity, a product with superior value is produced, which entitles a higher price, or the firm produces at a lower cost compared to other firms. Keep in mind that firms that are competitive on the international market are not the ones with the largest scale or the lowest price of inputs, but the ones with the ability to improve and innovate continuously. An environmental regulation will encourage the innovative side of a firm and may partly or in some cases fully offset the costs of acting in accordance with them. The focus should be on how to decrease the trade-off that occurs between the environment and the competitiveness, instead of taking it as given. Since the world does not fit into the Panglossian belief[5] the probability that an environmental regulation inspires a firm to innovations increases.

Correctly crafted regulation for the environment can fulfil at least six different purposes.

- A regulation can serve as an alert for firms about inefficiencies in resources and thus revealing possible technological improvement.
- When a regulation focuses on gathering information, the awareness of the environment increases, often leading to environmental improvements.
- Regulations decrease the uncertainty of how valuable investments within the environmental sector might be. An increased certainty will lead to further investments within any industry.
- Pressure will occur from a regulation, motivating innovations.
- Regulations help keeping the levels in the transitional period. In the period towards more innovation intensive results the regulation will make sure that a firm will not gain position by keeping away from environmentally investments.
- In the case of incomplete offsets, a regulation will be required (Hill and Kriström, 2005).

Most economists generally argue that pressure which will lead to innovations comes from strong competitors, customers that are demanding or high prices of raw material. According to Porter and Van der Linde (1995) pressure can, as in the fourth purpose, come from environmental regulations.

Innovation that occurs because of environmental regulations can take two different shapes. First, when pollution occurs firms simply find a way to deal with it, i.e. they get smarter. Reductions in the cost to comply with the environmental regulation and in the same way keep everything else intact. The second includes an improvement of the whole product, even if the innovation was directed towards environmental improvement. Offsets by innovation can be considered as product offset or process offset, the former one improves both the environment and the product. Process offsets on the other hand improves the environment together with better resource productivity. This can occur from better utilization of the material, lower levels of energy inputs during production or through materials savings, e.g. reducing unnecessary packing or simplifying the design of the product. These two offsets are closely related and therefore if one is achieved the possibility of reaching other offsets is evident (Porter and Van der Linde, 1995).

[5] A belief that firms always makeoptimal choices (Porter and Van der Linde, 1995).

Inform is an environmental research organisation who investigated waste-reduction among companies. 181 activities leading to waste-reduction could be found, of these 181 only one lead to an increase in the net costs (Dorfman et al., 1992). Early mover might have an advantage as long as the national policy is consistent with the environmental trends in the world. Another study investigating the result from changes towards a more environmentally friendly production is King (1994) who looked at process changes in ten printed circuit board manufacturers. 13 changes were made to regulate pollution, 12 of these resulted in a reduction of the costs (King, 1994). Improving the productivity among resources within a firm results in not only the pollution elimination; the true economic costs can decrease and the true economic value of the product increase. Industries that are competitive from an international perspective are more likely to be innovative and to deal with environmental regulations in a satisfactory way compared to firms initially uncompetitive from the start. In 1993 Jaffe et al. surveyed more than 100 research papers and came to the conclusion that USA environmental regulation not can be proved to have a large effect on the competitiveness.

In the USA the American environmental law investigated the best technology for production and legislated in order with the law. Arguing like this will definitely prevent innovations to a larger extent than encourage changes in the production process. Regulations must to the utmost possible extent include the use of market incentives, as in tradable permits (Porter and Van der Linde, 1995).

A good regulatory process must include that the regulations themselves are clear, as well as clearly state who will meet them and those firms must accept the regulation and work to comply them rather than to relax and delay them. To make it possible for different firms to meet the regulations, it is of importance that different parts and levels of the government are coordinated and organized (Porter and Van der Linde, 1995).

ITPS (2004) examined labour in the competitiveness model and concluded that rigidity in wages is not a problem in the long run, but other factors of production e.g. energy prices, can matter. The wage will then reflect the willingness to pay for labour, i.e. the cost of labour will be a consequence of competitiveness rather than an indication of it. These analyses can be seen from the point of view of the firm, where regulations and subsidies might help the firm to be internationally competitive. This will influence the growth rate negatively; the best solution seen from a market perspective would be to let the non profitable firms exit the market.

The tax on carbon dioxide in Sweden is not removed resulting in the fact that some of the industries have to pay twice. The industries with high intensity of CO_2 emissions were already free from the tax of CO_2 before (ITPS, 2005). According to Hill and Kriström (2005) the revenue from removing this tax in the trading sector can exceed the financial cost. The removal of the tax could increase the competitiveness in some industries.

The trade with emission allowances implies a relative rise in the cost of CO_2, which implies a decrease in the relative price of other factors of production. This change in comparative advantages can lead to a relatively lower economic growth that has to be compared to the effects in the environment. One indication used to measure differences in competitiveness is the export elasticity for diverse industries, or if data on the micro level is accessible export elasticities for different firms (Hill and Kriström, 2005).

According to ITPS (2004) the introduction of emission allowances will influence the relative competitiveness for European firms. Within some industries the share of

production that the European Union has, relatively to total production in the world, is large enough to affect the world price. In these industries the effect of competitiveness will decrease.

5 Paper and pulp industry in Sweden

The cost for reaching the "domestic -4 goal[6]" is estimated to be between 10 and 20 billions SEK per year and the industries expected to lose the most are industries with a large export share. The paper and pulp industry is one of them. An introduction of tradable emission allowances will affect the industry in two ways, the cost of the allowances and the increase in the price of electricity (ITPS, 2005). In 2004, the average price for all paper and pulp producers increased. The increasing returns for the producers were slightly offset by an increase in energy and fuel prices (PWC, 2005).The paper and pulp industry together with the steel industry are the ones with the largest expected loss in exports due to an increase in costs (ITPS, 2005).

The introduction of the emission trading scheme in the European Union has stressed the producers within the paper and pulp industry to use "carbon thinking". The allocation is generous this period, this might not however be the case in the future. In addition, the consumers are also getting more aware of the climate changing issues. Changes in price could lead to large differences in earnings, both within and between years, therefore a robust strategy for each firm is important in order to handle the upcoming changes that will occur within the industry (Barnden, 2006). The Scandinavian paper and pulp industry started early to consider environmental solutions in their production, and equipment suppliers such as Kamyr and Sunds have made considerable gains from being an early mover selling innovative bleaching equipment (Porter and Van der Linde, 1995).

The major pulp and paper producers in the world are:

- North America (USA and Canada)
- South America (Brazil, Chile and Argentina)
- Europe (particularly Scandinavia)
- Asia
- CIS (Commonwealth of Independent States)

The combined share of North America and Western Europe of global paper and paperboard production has declined since 1980 from about 67% to 62%, while the combined production of Latin America and Asia (excluding Japan) has increased from about 11% to 22%. This trend is expected to continue, with the focus of production growth gradually shifting closer to the regions of faster paper consumption growth (Mbendi, 2006).

Sweden is one of the leading exporters in all of the three following sectors.

- Forest Products: Europe, particularly Scandinavia, Canada, Asia, the USA, and the CIS
- Pulp production: Canada, USA, Sweden, Brazil, Chile and Finland

[6] According to domestic policy the Swedish emissions must decrease with four per cent compared to 1990's level.

- Newsprint production: Canada, Sweden, Finland and USA (Mbendi, 2006).

5.1 The price increase of electricity

An increase in the price of electricity can in many cases have a larger influence on the competitiveness than the introduction of tradable emission permits. The paper and pulp industry is electricity intensive and is therefore one of the industries affected (ITPS 2005).

The connection between the price of electricity and the price of carbon dioxide is one of the reasons behind the price increase of electricity in Sweden. This occurs since the price of electricity is determined on the margin, and the electricity produced on the margin uses fossil fuels (Hill and Kriström 2005). The increase in the price of electricity has a heavy influence on the competitiveness of the paper and pulp industry, since this is one of the electricity intensive industries (ITPS 2004). About 50 per cent of the price of a carbon dioxide allowances will impact the price of electricity; this is an insecure forecast since the supply of electricity in Sweden mainly depends of the precipitation (Hill and Kriström 2005). Figure 5.1 below displays the development of the price of electricity in Sweden since 1997. Observe the increase in price with almost 100 per cent from 1997 to 2006 (SCB, 2006)

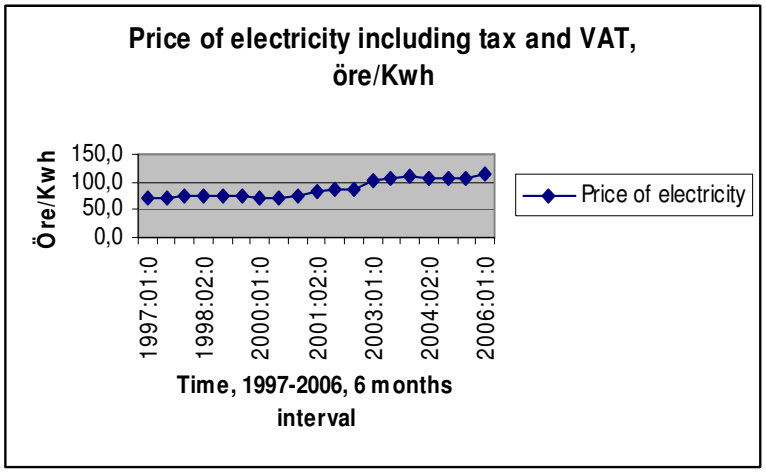

Figure 5.1 Price of electricity in Sweden from 1997-2006, the prices are calculated for customers which consume more than 20000 Kwh/year. The prices are included tax and Value Added Tax (VAT). Source: SCB

6 The environmental development in the USA

USA has experience from numerous environmental policy programs, the first one starting already in 1974 (Hill and Kriström, 2005). In 1990 a cap-and-trade system was introduced; the Acid Rain Program. This program included trade with emission allowances of sulphur dioxide, SO_2, and is strong evidence to, and supports, the belief that market-based instruments (MBI's) are advocate to keep the economic costs low, while reaching environmental goals (Ellerman, 2004). Instead of, as with uniform standards, giving equal share of emission levels to all firms, a system with MBI equalises the amount that a firm spend to reduce pollution, the marginal cost (Stavins, 2005). According to Hill and Kriström (2005) analyses even indicate that the environmental goals were reached with a better economical result than by using a regulation system. Cost savings have ranged between relatively low (5-10%) to incredibly 95 % compared to command and control regulation (Tietenberg, 2000).

The sulphur dioxide emission program covered 445 plants, together emitting approximately 8.5 million tons annually (Curtis, 2004). Voluntary participation was used, this was heartening but analysis indicates that it rather led to adverse selection. Three per cent of the total number of allowances in1995-1999 could be considered excess allowances (Ellerman, 2005). Only 2.8 per cent of the emission allowances were allocated through an auction. This was primarily done to give new firms a chance to enter the market, rather than to sell allowances to actors with highest willingness to pay (SOU 2000). Already in an early stage, revenues between 200 and 400 million dollars were expected and in the long run savings of approximately 20 billion dollars can be made (Ellerman et al. 2000). Further gain from the Acid Rain Program is a change in technology (Stavins, 2005).

Stavins (2005) points out a negative effect; the market based program gets limited due to the fact that not all firms or emissions are included. Firms are therefore not convinced that it will be a lasting component in the regulation. Thus, most American companies in the program have not reorganised the internal structure necessary to fully receive cost reductions that this instrument offers (Stavins, 2005).

In the SO_2 allowances trading program banking for future use was allowed (Stavins, 2005). Banking provides price fluctuations, since they are used to meet an unexpectedly high demand in a later period. In the Acid Rain Program where banking was unlimited, the price fluctuations never exceeded 3:1, measured as a range of the highest price to the lowest price observed (Ellerman, 2005).

In 2001 President George W. Bush declared that the USA would not be part of the Kyoto agreement. The following year the Bush Administration announced a new initiative on climate change, which was seen as weak and ineffective according to observers. Kolstad (2005) states that reducing the greenhouse gas intensity in the economy with 18 per cent to year 2012 should be an easy target to reach. Note however, that the intensity of greenhouse gases in the USA is higher than in every single European country (Kolstad, 2005). The expansion of the voluntary environmental programs like the Acid Rain Program has been sparsely proposed by President Bush (Morgenstern, 2005).

7 Empirics

In the empirical section the competitiveness will be calculated by using equation 1. A comparison of the experience from the emission trading scheme in the USA is done and the results are applied on Sweden. It is important to be aware of differences between the structures of the American and the Swedish system; the results in one country may not be achieved in the other. Data for the years 1995, 1998 and 2002 will be used; they are chosen to see how the comparative competitiveness between the two countries changed during this period, i.e. see whether the Acid Rain Program might have an influence. The period can not be extended due to lack of data.

The trade with CO_2 allowances within the European Union started in 2005, the largest cap-and-trade scheme in the world, reaching pass national policies (Zapfel, 2005). 12 000 plants which equal approximately 50 per cent of the emissions of carbon dioxide within the European Union are included. A fee of 40 euro per ton will be charged for emissions of carbon dioxide exceeding the allowances that the firm holds. A possible problem may be that not all plants are included in this trading scheme and each time the trading sector receives more allowances, the non-trading sector must decrease their emissions, in order for the European Union to reach their goal. To investigate the concern of the national economy when increasing the amount of allowances, the marginal cost for the non-trading sector must be estimated. High marginal costs might indicate that an increase in the allowances will not be economically justified for the society (Hill and Kriström, 2005). The price of one allowance of emissions was June 6th 16.10 Euros (Nordpool, 2006).

In the sulfur dioxide trading program two distinct phases appeared, which can be viewed as evidence of the market design of future tightening of emission limits together with the opportunity for firms to store the allowances from one period to another. Since most companies, expect a tighter emission limit in the future, it is in their own interest to build up a stock of permits (Liski and Montero 2005). In the Acid Rain Program unlimited banking is accepted, and the price fluctuations have varied no more than a ratio of 3:1, when measuring the highest respectively the lowest observed price (Ellerman, 2005).

Sweden received approximately 70 000 000 allowances of emission, this compared to Germany with 1 499 000 000 and Denmark at 100 500 000. Sweden will similarly to other countries earmark part of the allowances to new companies, in this case to prioritise improvements in technology (European Commission, 2003). The allowances of emission are allocated between industries as shown in Figure 7.1.

As shown in Figure 7.1 the iron and steel industry received the largest amount of allowances. The electricity intense industries (Refineries, Iron and Steel, Mineral Industry and Paper and Pulp) together received ¾ of the allowances in Sweden (Naturvårdsverket, 2006).

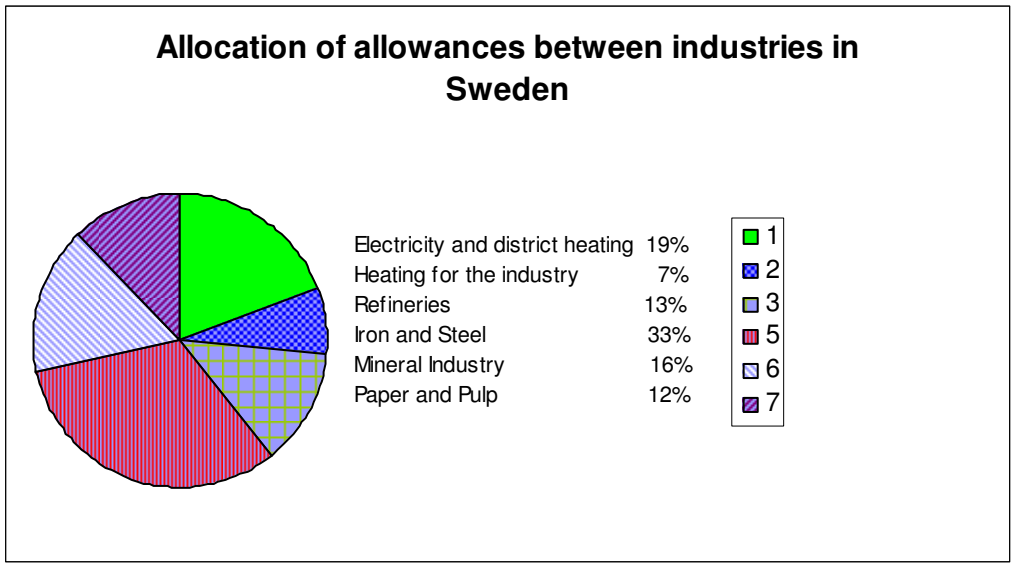

Figure 7.1 Allocation of the emission allowances between the largest Swedish industries.
Source: Naturvårdsverket, 2006

The top ten producers within the pulp industry are shown in Figure 7.2. The largest competitors to Sweden are the non European countries, the ones that will not comply with any environmental regulations (ITPS, 2004).

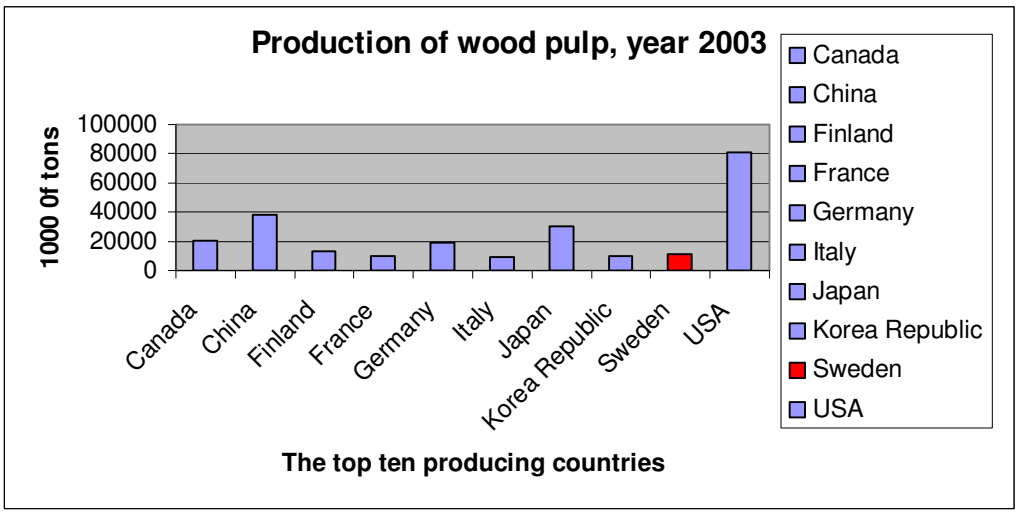

Figure 7.2 The top ten producers of wood pulp in 2003. Source: FAOSTAT database

The same is applicable for the production of paper and paperboard, as shown in Figure 7.3. Note that only three countries are European in this case, compared to five in the pulp production. It is even more important to keep the cost of production low when most of the other producers do not face the same environmental restrictions as Swedish producers, non-European countries (ITPS, 2004).

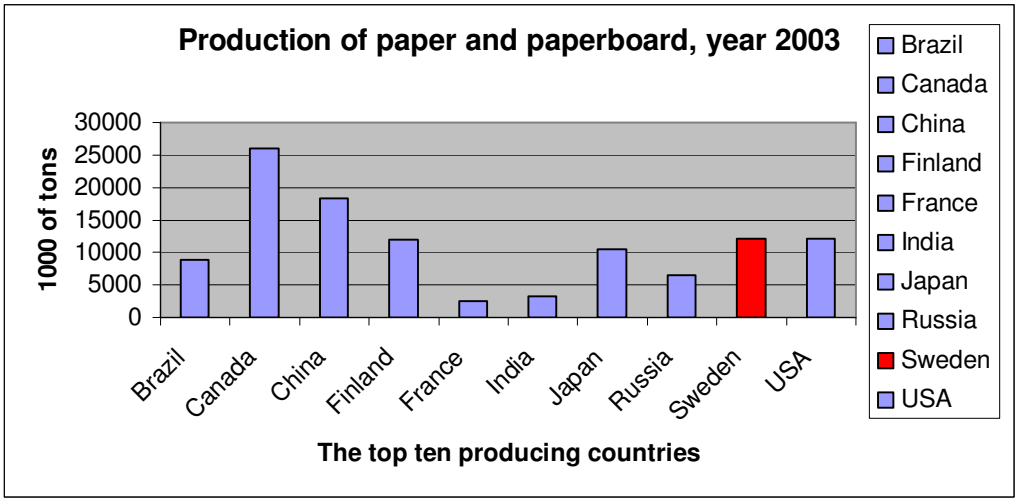

Figure 7.3 The top ten producers of paper and paperboard in 2003. Source: FAOSTAT database

Sweden is one of the main producers in the world in the paper and paperboard industry (ITPS, 2004).

7.1 The Competitiveness Model

To measure the competitiveness, equation (1) will be used. USA and Sweden are the two countries investigated, Sweden as home country and USA representing abroad. Three different years are used to see the development in the relative competitiveness between these countries. The years are 1995, 1998 and 2002.

$$C = (r^h/p^h)/(r^a/p^a)e$$

C indicates the level of competitiveness.
r = The price of the raw material used in the production in the home (h) country, a symbolizes abroad
p = The productivity, production per share of raw material input, h is home and a symbolizes abroad.
e = The price of the foreign currency.

Three different time periods has been used to see the development of the competitiveness of the paper and pulp industry in Sweden compared to the same industry in the USA. The first period is the same year as the Acid Rain Program started in the USA and this year a major increase in the price also occurred. The model will be used to estimate the relative competitiveness in the paper and paperboard production. The raw material in the production will be pulp and all pulp produced in each country plus net import is included as inputs. The price (r) is calculated per ton of dry pulp and the productivity (p) is the share of produced paper and paperboard per input. An increase in C implies that the competitiveness for the home country, in this case Sweden, has decreased.

C_{95}=4586.25/737.86 C_{95}=6.22

C_{98}=2599.04/523.75 C_{98}=4.96

C_{02}=2879.06/579.56 C_{02}=4.97

The numbers 95, 98 and 02 indicates the different years that are used. The value of C has decreased from 1995 to 1998 from 6.22 to 4.96 and then stayed more or less unaffected between 1998 and 2002.

A large share of firms is low-emitters, indicating that administrative costs from trading exceed the benefits. A proposal is put forward to eliminate them from the system, and only include firms with emissions higher than 25 000 CO_2 per year (Naturvårdsverket, 2006).

Since the increase of electricity prices are having an effect on the paper and pulp industry as well as transportation costs, these two factors could be calculated in this model as well as raw material. Electricity has been calculated in the model for year 2002 with a total Swedish consumption for the paper and pulp industry of 178561 TJ[7] per year. The average price in 2002 was 86.35 ore per KWh. Adding this cost to the price of raw material for the home country we will end up at a relative competitiveness number of 4.29. What's interesting to look at here is how a change in the price of electricity in Sweden affects the level of competitiveness for the Swedish paper and pulp industry. A 10 per cent increase in the price of electricity in the home country, ceteris paribus, would result in a 10 per cent decrease in the level of competitiveness. The cost of emission allowances could also be calculated into the price of the good, which would give us the result that a relative increase in the price of an emission allowance would decrease the competitiveness.

As Coase theorem suggest, the trade with emission allowances is realised to find the most economical solution to deal with the cost of emissions. To trade with emission allowances will lead to increases in prices but can as most economists argue cause pressure that will lead to innovations (Van der Linde, 1995).

[7] One TJ equals 3.6 GWh.

8 Conclusions

According to Porter and Van der Linde complying environmental regulations may be profitable, in the sense that a company can more than offset the costs. This requires a properly designed environmental standard and regulation program. Advantages in competitiveness rely on the possibility of innovations, and developments to be able to move the constraints. A measurement of innovations is not possible after such a short time period. Early changes, already made, towards more environmental solutions in the Scandinavian paper and pulp industry can lead to fewer instantaneous innovations.

The Coase Theorem is applicable to the trading market with emission allowances. More participants are included in the European trading scheme, which complicates the decision of property rights, but the equilibrium is set with market equilibrium. The transaction costs can be considered relatively low, as advocated by Coase (1960).

By considering different theories of how to allocate the emission allowances an increase in allowances allocated through an auction would be preferable for the consumers, since the revenue the government achieve will return to the customers. In the point of view of the paper and pulp industry it is preferable to allocate the allowances gratis since the producers receive the revenue.

For the reliability of the trading system, it is essential that the fee is a credible threat. The fee charged for not complying is 40, significantly higher than 16.10 which was the price of one allowance June 6th, 2006.

The Acid Rain Program included sulfur emissions; in the European trading scheme CO_2 is considered. The paper and pulp industry emit both sulfur and CO_2 in the production, therefore a comparison is possible. In the competitive model the prices differ widely on one ton of pulp, in Sweden it is clearly stated that the price is for one ton of dry pulp. In the USA it is not clear if the price is for wet or dry pulp, considering the diversity in price the likely answer is that it is the price for one ton of wet pulp. This will not give rise to a biased answer in the model since the development of the relative competitiveness between these countries is considered. A decrease of C from 1995 to 1998 implies an increase in the competitiveness for Sweden relative to the USA. The Acid Rain Program started 1995 and might have influenced the competitiveness for the American paper and pulp industry. Between 1998 and 2002, C can be considered unaffected. If the changes are interpreted as causes of emission trading the Swedish paper and pulp industry is expected to face a decrease in competitiveness compared to non-European countries. This decrease is expected the first years after the implementation of the emission trading program. When the price of electricity was included, the importance of it was clear. An increase in the price will lead to an equally big decrease of the competitiveness.

In the production of paper and paperboard Sweden is surrounded by many non-European countries wherefore the importance to keep the relative competitiveness constant is of high importance. In the pulp industry five out of ten of the top producers are European, therefore an influence of the market price can be possible.

The Swedish paper and pulp industry must take actions to keep the competitiveness constant through innovations. A positive change in the world price reflecting the change in Europe is preferable for Sweden.

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