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Emissions trading to combat climate change: The impact of scheme design on transaction costs

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Keywords

Climate policy, emission trading, transaction costs, European Emissions Trading Scheme, Clean Development Mechanism

Panel*:*

10. Emissions trading

Abstract

This paper explores the likely impact of emissions trading design options on transaction costs. The definition of transaction costs in the paper includes both the costs for the private sector to comply with the scheme rules and the costs of scheme administration. In economic theory transaction costs are often assumed to be zero. But transaction costs are real costs and there is no reason for treating them differently to other costs in the economy. Thus, in setting up an emissions trading scheme, transaction costs for different implementation options have to be taken into account in order to recommend the optimal design from a cost efficient perspective. Furthermore, transaction costs may reduce the level of trading, which will in turn reduce the efficiency gains from trading, and which should to be taken into account when comparing different instruments.

In the literature it is often assumed that the transaction costs of a cap and trade approach are lower than the transaction costs of a baseline and credit approach. However, today only few studies have specifically tried to measure the transaction costs of these two approaches.

In this paper, we compare transaction costs of the European Emissions Trading Scheme and the Clean Development Mechanism. The relationship between transaction costs and scheme design is assessed, and recommendations given on how transaction costs might be reduced.

Introduction

"The world of zero transaction costs turns out to be as strange as the physical world would be with zero friction."
(STIGLER, 1972)

During the last decade, market-based instruments such as emissions trading have started to displace or complement command and control policies when addressing environmental problems. Particularly with regard to global challenges, such as climate change, emissions trading schemes have become increasingly important. Emission trading schemes (ETS) assign private property rights to emitters and according to the Coase Theorem this should be sufficient to lead to an efficient outcome. However, the Coase Theorem is based on a number of assumptions, a key one being the assumption of zero transaction costs. Thus high transaction costs might be a major hurdle for an efficient trading result in the real world.

In principal, emissions trading uses the market to achieve a given environmental target at minimum cost. Polluters whose abatement costs are relatively high have an incentive to buy allowances, while polluters whose abatement costs are relatively low have an incentive to sell allowances. However, ETS are designer markets and regulators must make numerous design choices when implementing such a scheme. Many of the design choices will affect the level of transaction costs incurred by the market participants and the administrative body which might negatively impact on the efficiency of the scheme. Transaction costs can arise at various stages and might be divided into one-time costs mainly occurring during the implementation phase, and ongoing costs occurring during the operation phase. Furthermore, they might have different characters e.g. there might be fixed, proportional or degressive compared to the emissions of a company or project size.

To date two different types of ETS have been implemented (see Table 1): baseline and credit schemes or cap and trade schemes. The first creates and trades certified emission reductions compared to a hypothetical reference baseline. Under a cap and trade scheme owners of allowances are permitted to emit greenhouse gases up to a total specified level for all participants. In both schemes the units are tradable and trading will lead to equalised marginal abatement costs. Internationally, the largest cap and trade scheme is the EU Emissions Trading Scheme (EU ETS), where companies started to trade in January 2005. The Kyoto Protocol's Joint Implementation (JI) and Clean Development (CDM) mechanisms are baseline and credit schemes that have been working since 2001, introduced through a pilot phase called Activities Implemented Jointly (AIJ) . Moreover, other schemes are being implemented, such as the New South Wales Greenhouse Gas Abatement Scheme and the UK emissions trading schemes, where the latter is a hybrid scheme, including elements of cap and trade as well as baseline and credit options.

These two types of approaches are closely related, and can under some design choices be theoretically shown to achieve equivalent outcomes. In addition, they might be combined as under the EU ETS. However, their transaction costs vary greatly. In the literature it is assumed that baseline and credit schemes tend to create much higher transaction costs than cap and trade systems (Solomon 1999). This was given as the reason for the US Acid Rain programme to change from more of a baseline and credit approach, in mid 1995 to a cap and trade scheme (Hahn and Hester 1989).

Table 1: Baseline and credit versus cap and trade for emissions trading

Baseline and credit	Cap and trade
Only emissions reductions compared to baseline or target are tradable	Allocated allowances are tradable
Ex-post	*Ex-ante*
Credits are generated after verification (and certification)	Allowances are allocated to covered entities
Wide participation in credit generation	Tradable surplus of allowances can only be created by covered entities
Example: Clean Development Mechanism Canadian Offset Scheme	**Example:** EU Emissions trading

Theory of transaction costs

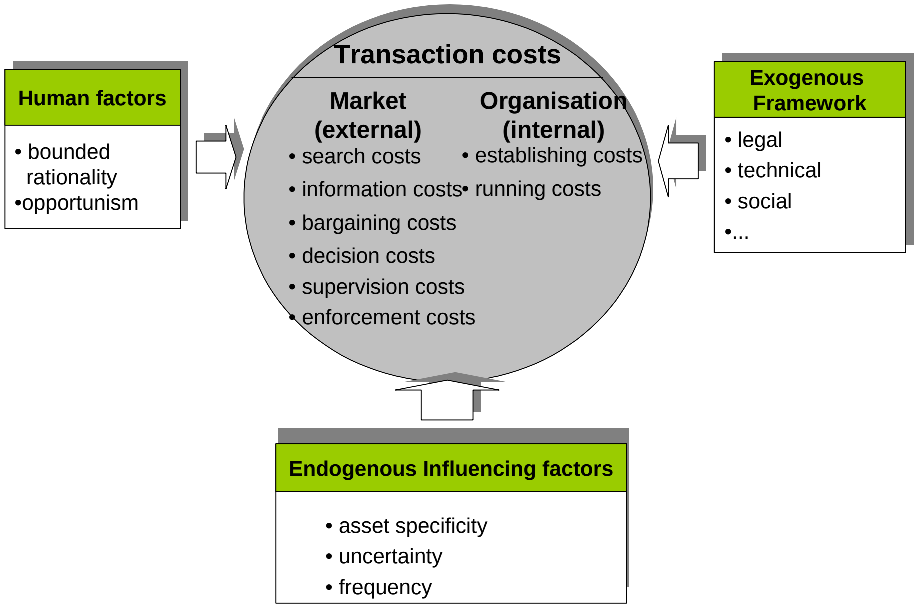
Classification of transaction costs

The theory of transaction costs was first brought up by Knight (1921) who has analysed the impact of uncertainty on the costs of undertaking transactions. However, Coase (1939) is mainly referred to as the founder whereby Williamson (1985) later formalised the theory. There are different ways to define transaction costs. In this paper we take a broader understanding of the term, which means we include all transfers of property rights, goods and services whether externally within markets or internally within organisations under transaction costs (see Figure 1). The latter also encompasses the political transaction costs in setting-up and running institutions (Furubotn and Richer 1996). Thus, transaction costs include all costs, other than the costs of abatement (e.g. technical investment), which are borne by the project proponent or institutions responsible for implementing the scheme in order to create the market for emissions allowances or credits.

Factors influencing transaction costs

Transaction costs theory abandons the neoclassical economic assumptions of rational decision making under conditions of perfect information. Instead, transaction costs are claimed to be the result of two **human factors,** namely bounded rationality, caused by limited cognitive capacity and incomplete information, and opportunism.. Verification costs can be seen as typical transaction costs since they are only needed to prevent opportunistic behaviour and because information is incomplete. Because companies have an incentive to claim for false reductions in order to receive a credit or sell additional allowances, external verification of emissions or emission reductions is required.

Figure 1: Transaction costs



In addition, **endogenous factors** such as asset specificity, uncertainty and frequency influence the level of transaction costs (Williamson 1985). Asset specificity refers to the necessary contribution of a good or service in a specified production process, which has a much lower value in alternative uses. High specificity of goods or services will require higher safeguards in the relationship between two parties (e.g. special institutional arrangements) to protect such assets from opportunistic behaviour, and will increase transaction costs. Similarly, high uncertainty will increase transaction costs since special provisions have to be made to take unanticipated changes into account. Uncertainty in the context of emissions trading could include, for example, the risk that the Executive Board refuses registration of a CDM project. This uncertainty leads to additional bargaining and negotiation costs in setting up contractual arrangements between the project proponent and the buyer of credits.[1]

[1] Sorell (2005) differentiates between environmental and behavioural uncertainty, where the first creaties an adaptation problem to changes, and the latter is a measurement problem. Both might also be handled under the single heading of complexity. In this paper we stick to the term from Williamson (1985), however both are included in the term uncertainty.

Increased frequency of transactions might have the opposite effect and so lower transaction costs due to economies of scale and scope. For example, exchanges which handle standardised contracts could be established.

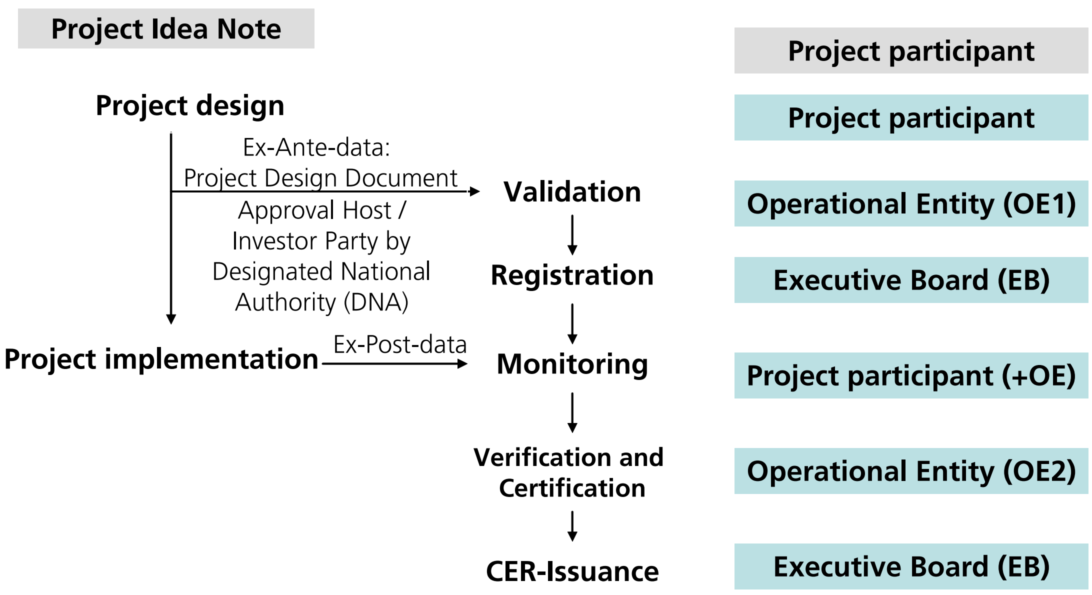
Finally, **exogenous framework factors** such as legal, social and technical aspects could influence the level of transaction costs. Legal and social framework factors might have both increasing and/or reducing effects: a very strict legal framework might reduce flexibility and increase transaction costs on the one hand, but might reduce transaction costs caused by higher standardisation options on the other. Social factors might reduce opportunistic behaviour and therefore reduce transaction costs but might also increase opportunistic behaviour e.g. if forming a competitive environment. Technical factors will reduce transaction costs since they might have a positive impact on bounded rationality and the specificity of assets. For the latter, technical innovation with regard to registry systems and electronic exchanges might significantly reduce transaction costs, compared to a situation where all transfers are registered manually.

Transaction costs of baseline and credit trading

Influence of transaction costs on baseline and credit schemes

Under a baseline and credit scheme emissions reductions are assessed against a baseline. In all schemes reductions will need to be verified and/or certified before credits can be traded. Under the Clean Development Mechanism a complex project cycle has to be passed through (see Figure 2) before project participants will be issued credits. Since the project cycle is unique to individual CDM projects with different design features, transaction costs may vary between different baseline and credit schemes (Marbek Resource Consultants et al 2004). Assessment of additionality is especially problematic and costly in baseline and credit schemes because it is inherently counter factual – it requires an estimate of what would have happened 'otherwise'. Additionality, however, is essential because otherwise the scheme is not actually delivering reductions from what would otherwise happen. If transaction costs were incurred without any change to the level of emissions, society would be worse off than without the scheme. Under the CDM, additionality is assessed rigorously, which incurs high transaction costs associated with the Executive Board and its' different panels.

Figure 2: CDM Project Cycle

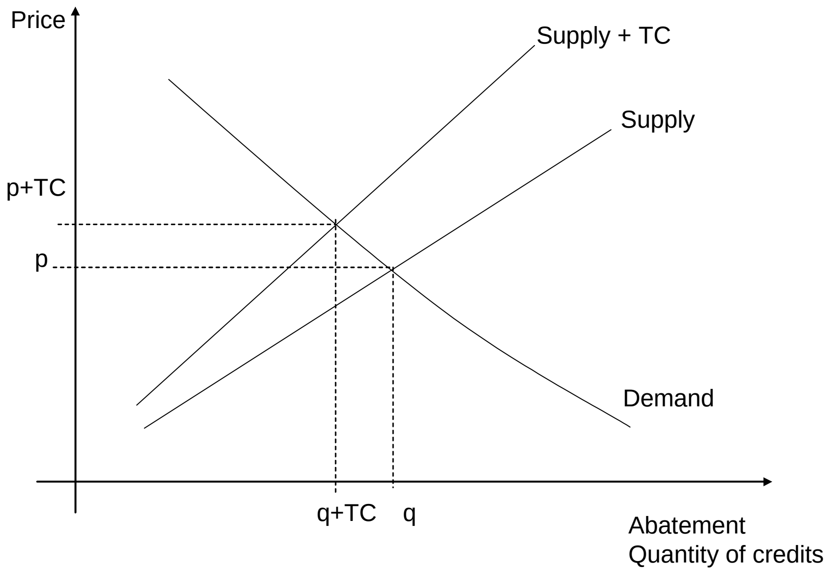


The CDM Executive Board was established as a supervisory body for the implementation of the CDM and is involved in the approval of baseline methodologies and in the registration of projects. A Designated Operational Entity (OE) has to be accredited by the CDM Executive Board and is an independent entity that is engaged by the project participants to validate the CDM project or to verify and certify its Certified Emission Reductions (CER). Once projects are validated, the OE requests their registration. Registration is the prerequisite for the verification, certification and issuance of CERs related to the project activity. Verification and certification takes place only after implementation and ensures that during a specified time period, a project achieved the GHG emission reductions and removal enhancements. Only after successful certification the Executive Board issues the achieved credits –

called CERs or for reforestation and for afforestation projects called temporary CERs (tCER) or long-term CERs (lCER) - to the project participants and subtract a share of proceeds. Furthermore a registration fee is paid to cover administrative costs, which reflects the fact that almost all transaction costs are at the end borne by the project developer.

The expected effects of transaction costs in baseline and credit schemes are illustrated in Figure 3. Compared to a world without transaction costs they tend to raise the costs for project proponents which shifts the supply cure upward and leads to an increase in equilibrium price and a decrease in quantity. However, this assumes that transaction costs are borne by the project proponents selling the credits. If the costs are passed on to the buyers of the credits, the inclusion of transaction costs will lead to a right-shift of the demand curve (Eckermann et al., 2003). Michaelowa and Jotzo (2005) argue that the CDM is much more affected by increased marginal transaction costs than a cap and trade is since project options with higher marginal abatement costs will carry higher transaction costs. Therefore transaction costs will tilt the supply curve upward, rather than just shifting it (see Figure 3).

Figure 3: Transaction costs in baseline and credit schemes



Transaction costs elements

In order to identify the key drivers of transaction costs it is necessary to break down the costs into their different elements as shown in Figure 1. This breakdown is mainly based on current experience with the costs of CDM projects and distinguishes between set-up and operating cost as well as administration costs and project-related costs. However, the differentiation between administration and project-related costs does not imply that only the latter are borne by project proponents. Some of the former costs might also be passed on by the administrative authority to project proponents. Table 2 shows that the disaggregated transaction cost components mainly reflect the project cycle of Figure 2, whereby the one-time costs are primarily associated with the pre-project-implementation phase and the ongoing costs with the after-implementation-phase. The administration costs are the internal organisational expenses which are incurred to establish and run the programme, whereas the costs for project proponents include market transaction costs in addition to the internal cost.

The following correlations are assumed regarding transaction costs and scheme design and will be assessed on the basis of empirical data in the next section:

One-time **administration costs** are most likely independent of the number of projects administered after implementation, and are mainly based on the personal costs and some material costs (e.g. registry) needed to set up the scheme. Ongoing costs will increase with an increasing number of projects but relative costs will decrease. In addition, it is assumed that transaction costs will be reduced over time when more standardised procedures are developed.

Table 2: Transaction costs elements

	Administration costs for	Project related costs for
One-time costs	(1) General set-up (program and authority, processes of accreditation of Operational Entities) (2) Development of legal framework (3) Protocols and guidance documents (4) Establishing a registry	(1) Evaluataion: Information and search costs (2) Inititation and proposal: - Negotiation and decision costs - preparation of documentation (project idea note, project design document, stakeholfer consultation including baseline and monitoring plan (3) Approval (from Designate National Authoriy of host Party) (4) Validation (by Operation Entity) (5) Registration (by Executive Board)
Ongoing costs	(5) Base annual operating e.g. Executive Board and panels (6) Operation of registry	(6) Monitoring of emissions / reductions or removals (7) Verification of reduction / removals (8) Certification of reduction / removals (9) "Market costs" - search costs for trading partner (e.g. brokerage fee) - account costs

Source: Own compilation based on Marbek Resource Consulstants et al 2004 and Michaelowa / Jotzo 2005

Project-related transaction costs depend on project type (e.g. forestry or industry), project size (measured in credits pro project) and host country:

- Transaction costs are lower for non-forestry projects, because the uncertainty for forestry projects is higher (non-permanence issue) and the special rules (temporary character) that need to be implemented will increase transaction costs.
- Transaction costs have a high fixed cost component and therefore tend to be relatively lower for big projects than small projects.
- Transaction costs depend on the institutional framework of the host country and therefore will be higher in countries with an inefficient regulatory framework (e.g. missing Designated National Authority).

Validation costs may be fixed depending on the complexity of the project. Registration costs are determined by the Executive Board and depend on the size of the project. Monitoring, verification and certification (MVC) costs depend on the frequency of undertaking each process and it is assumed that the first MVC-costs are higher than any following. Market transaction costs depend on existing trading platforms (over the counter trading or exchanges), standardisation of contracts (e.g. different risk distribution) and the number of potential trading partners: The higher the number of potential trading partners the lower these market transaction costs, since more efficient trading platforms will be developed and more standardised products traded, and account opening costs will be lower. Project-related transaction costs will be reduced over time due to learning effects.

Empirical estimates of transaction costs: baseline and credit

Transaction cost estimates and empirical data for baseline and credit schemes are very limited. Mainly two different sources have been analysed and Table 3 gives an overview of the range of estimates. One of these sources (Michaelowa and Jotzo 2005) uses estimates for the Clean Development Mechanism based on data from PricewaterHouseCoopers, the Prototype Carbon Fund or United National Convention of Climate Change. In the other, Marbek Resource Consultants et al. (2004) have estimated ex-ante transaction costs for a national offset-scheme in Canada under different implementation scenarios.

Based on Marbek Resource Consultants et al. most of the **administration-related transaction costs** seem to occur in setting up the scheme. After standardised procedures have been developed, the on-going costs are low compared to the one-time costs (which incorporate the development of standardised procedures). Marbek Resource Consultants et al. argue that compared to the project-related costs, administration-related costs of different designs vary across only a relatively narrow range . There is no documented research on these costs for the CDM, however, it can be assumed that the administration costs for setting up the scheme were much higher than for a national scheme, taking into account that around 180 countries have been involved in establishing the CDM rules. The long-time costs for the Executive Board and its panels are expected to be covered by the registration fee, therefore in order to avoid double counting these costs will not be included her and are instead listed under the project-related costs. The costs for developing the protocols and guidance documents seem to be the highest one-time costs and higher than any ongoing costs. However, by standardising the process they will reduce uncertainties and so reduce transaction costs for the project proponents.

Most of the **project-related transaction costs** will occur upfront before credits are issued. The highest costs are associated with project initiation, including negotiation of contracts and documentation of e.g. baselines and monitoring. As assumed above, part of these costs seem to be fixed and most likely depend on the complexity of the project type (e.g. forestry projects with potentially more field measurement than energy projects will have higher transaction costs). They are also influenced by the guidance provided and will therefore be higher in an early stage but decrease over time. CDM projects seem to have higher transaction costs than estimates for the Canadian offset scheme. This might be attributed to the more standardised approach of the national scheme for calculating the baseline as well as the fact that no international institution such as the Designated National Authorities or the Executive Board have to be involved in approval and registration. The ongoing costs for monitoring, verification and certification are seen to be dependant on the project type (complexity of method) and large reductions are expected over time after the initial measurement (halving the costs) (Marbek Resource Consultants et al., 2004).

Table 3: Transaction costs for baseline and credit schemes (in 1000€)

	Administration costs for	**CDM**		**National Scheme** from:	to:
One-time costs	(1) General set-up (program and authority, processes of accreditation of Operational Entities)	no estimates available		200	400
	(2) Development of legal framework			340	1070
	(3) Protocols and guidance documents			650	2000
	(4) Establishing a registry			70	200
	Total:			**1260**	**3670**
Ongoing costs (annual)	(5) Base annual operating e.g. Executive Board and panels	Financed by registration costs		540	1000
	(6) Operation of registry			120	210
	Total			**660**	**1210**
	Project related costs for	**CDM** from:	to:	**National Scheme** from:	to:
One-time costs	(10) Evaluataion: Information and search cost	15 (fixed)		1	7(pt, dc)
	(11) Inititation and proposal:	60	435	24	77 (pt, dc)
	- Negotiation and decision costs	(25, degress.)	400	(7)	(27)
	- preparation of documentation (project idea note, project design document, stakeholfer consultation including baseline and monitoring plan	(35) (fixed)		(17)	(50, fixed)
	(12) Approval (from Designate National Authoriy of host Party)	40 (proport.)		-	
	(13) Validation (by Operation Entity)	15 (fixed)	30	0.7	34 (fixed)
	(14) Registration (by Executive Board)	3 (degress.)*	24	-	
	Total:	**133**	**544**	**26**	**118**
Ongoing costs	(15) Monitoring of emissions / reductions or removals	10 (fixed)		0.3	34(pt, dc, f)
	(16) Verification of reduction / removals	8 per turn (degress.)		0.3	34(pt, dc, f)
	(17) Certification of reduction / removals	n.a. (degress.)		-	
	(18) Market				
	- search costs for trading partner	1% of price (propor.)			
	- account costs	0.2 (fixed)*			
	Total	**18.2 -**		**0.6**	**68**

Note: pt = project type; dc = design choice; f = frequency
Canadian $ has been converted into Euros using an exchange rate of 0,67105 €/Canadian$ and rounded.
National scheme oversight/audit costs (Canadian $263,000 to 921,000) have been excluded from this table, since the CDM avoids any auditing necessary because two different operational entities are involved in verification and validation of a project as well as stingent liability rules.
Source: National Scheme estimated are based on Marbek Resource Consultants et al 2004 and CDM estimates are based on Michaelowa and Jotzo 2005 (Table 1) and own estimates (* based on Executive Board and German account fees).

Based on Eckermann et al. (2003) and Michaelowa and Jotzo (2005) there seems to be a negative correlation – though not perfect - between project size and transaction costs (per t CO_2e reduced) traced back to economies of scale and the high proportion of fixed costs. Total transaction costs for large projects are estimated to be in the range of 0.3-0.7 €/t CO_2e and for small projects 0.4 – 1.1 €/t CO_2e. Based on this fact the Prototype Carbon Fund "considers any project with a volume below 3 million t CO_2 of cumulative greenhouse gas benefits unattractive due to transaction costs." (Michaelowa and Jotzo 2005, p. 515) However, there seems to be no pattern of correlation between different project types and sectors e.g. agriculture and electricity projects of the same project size. This is in contradiction to the assumptions of Marbek Resource Consultants et al. (2004) which assume a high dependability of project types for the level of different transaction costs (see Table 3) whereby landfill projects are rated as having the lowest transaction costs (0.04-0.13 €/t CO_2e), and agricultural projects (2.54-21.88 €/t CO_2e) the highest, depending on how rigorous the quantification and risk management requirements are. Regarding the institutional framework it seems that Latin American Countries have some advantages compared to Asian countries where CDM project proposals approvals need the involvement of many ministries or even approval by cabinet. Based on the Swedish AIJ programme it has been proved that transaction costs decline over time (Michaelowa and Jotzo 2005).

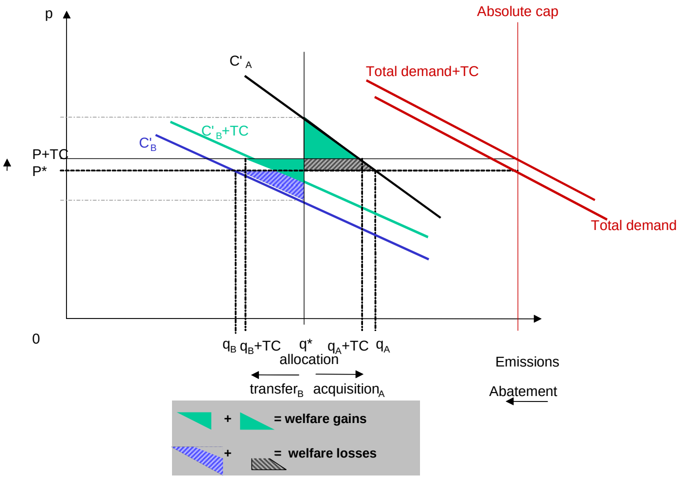
It appears that transaction costs of baseline and credit schemes can be reduced by bundling or pooling small projects to reduce fixed costs. Enhancing the standardisation of documentation and baseline requirements can reduce the transaction costs further. In national schemes there may be significant opportunities to lower transaction costs through a less frequent monitoring, verification and certification requirement. Whereas for the CDM, where there are no guidelines for frequency of MRV, improving institutional capacities and quality in host countries will certainly lower transaction costs. Whether national or international, the length of the crediting period will have a major impact on transaction costs since the fixed costs might be accounted against a longer period. However, as the study of Marbek Resource Consultants et al. (2004) has shown, there is a trade-off between accuracy in quantifying "additional" reductions and the level of transaction costs. This trade-off should carefully be considered when designing a baseline and credit scheme to avoid decreasing transaction costs at the expense of environmental integrity.

Transaction costs of cap and trade systems

Influence of transaction cost on cap and trade schemes

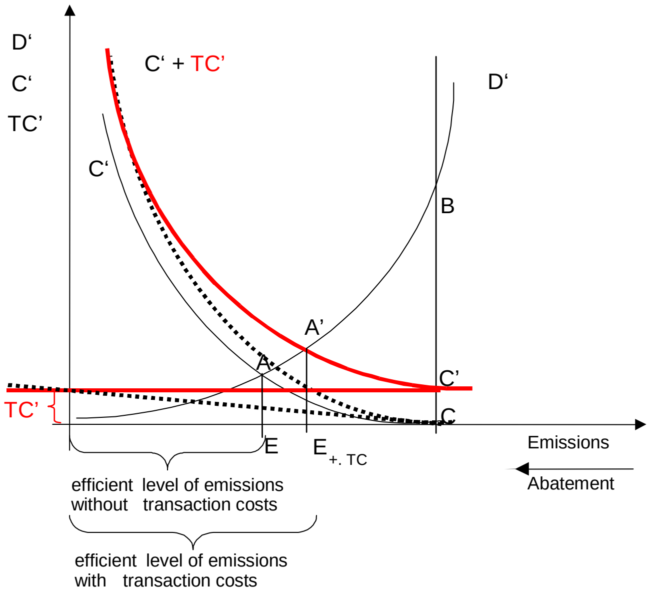
Under a cap and trade type scheme allowances are allocated for free or auctioned, and companies which can abate their emissions at low cost have an incentive to do so, because they can sell their surplus allowances to companies with high abatement costs. Since abatement measures will be realised where they are cheapest, environmental targets can – under ideal conditions – be met at minimum costs. Nevertheless, the savings in overall compliance costs may - as for the baseline and credit scheme - at least to some extent, be countered by two sources of transaction costs: costs for administrating the system and transaction costs incurred by companies regulated under the scheme (see Table 4). Some of the company's costs will be incurred even without trading allowances, such as the costs associated with monitoring, verification and reporting of emissions. Others will only occur if trading takes place and these costs will be called "market transaction costs". Thus, there are significant differences compared to baseline and credit schemes, where transaction costs only occur if credits are generated, which is illustrated in the shift of the supply curve in Figure 3. Under the cap and trade scheme only the market transaction costs will result in the shift of the curve in Figure 4 and lead to a lower trading volume and higher prices compared to the equilibrium without transaction costs. The transaction costs will reduce the welfare gains from trading and consist of a transfer of money from seller to other agents like brokers and lawyers as illustrated in Figure 4, but might also be borne by buyers (this would lead to a shift of A's marginal abatement cost curve).

Figure 4: Market transaction costs in cap and trade schemes



The other "non-market" transaction costs, which are independent to trading, will be a deadweight loss to society as such (see Figure 5), since they are real resource losses but do not affect the traded volume. In conclusion we have the market transaction costs reducing the efficiency gains from trading, and the other transaction costs which are a welfare loss, and thus have to be taken into account when setting the efficient level abatement (Betz 2003).

Figure 5: Efficient level of abatement including transaction costs



Note: D': marginal damage costs, C': marginal abatement costs, TC': marginal transaction costs

Stavins (1995) as well as Cason and Gangadharan (2003) focus on "market transaction costs" and analyse their impact on scheme efficiency assuming different marginal transaction costs curves. According to their assessment, constant marginal transaction costs (see Figure 4), compared to decreasing marginal transaction costs, will lead to a smaller deviation from the zero transaction costs competitive equilibrium when the initial allocation is not cost-effective. This occurs because a less accurate allocation will lead to higher transaction volumes which will lower the marginal transaction costs. In contrast, if transaction costs are likely to be constant, the initial allocation is more important.

In the following sections we will assess the transaction costs based on the European Emissions trading scheme (EU ETS), which is expected to be the world's largest emissions trading system at a company level. According to the EU-Directive on Emissions Trading, more than 11,000 installations of the energy industry and of most other carbon-intensive industries are covered under the scheme, which started in January 2005. The regulated installations include combustion installations exceeding 20 MW_{th}, coke ovens, refineries and – if they exceed particular thresholds – also installations from the steel industry, the pulp and paper industry and the mineral industry (e.g. cement clinker, lime, glass or ceramics). The EU ETS requires companies to annually surrender allowances corresponding to their actual CO_2 emissions in the last year, which have to be reported and verified.

Transaction costs elements

As for a baseline and credit scheme, there are two major categories of transaction costs: administration costs and transaction costs for the regulated installations, including internal organisation costs as well as external market costs (see Table 4). Lobbying costs of the companies to influence the design are excluded from this analysis but would need to be considered in an overall assessment since they might account for a significant part of one-time costs in the private sector. Betz (2003) estimated such one-time lobbying costs for Germany to be in the range of 33 million € or 98,000 € for an active bigger size company.

In most European Member States the **administration costs** will be charged to the participants. In Germany, for example, there is a digressive fee for each allowance allocated, thus big emitters pay more than small emitters. In Denmark, Ireland or Lithuania, where parts of the allowances will be auctioned off, revenues from the auctions will be used to cover administrative costs. It is assumed that the key driver for administration costs will be the number of regulated installations. In addition the method of allocation (grandfathering, benchmarking or auctioning) will have an significant impact on transaction costs, assuming that auctioning will lead to the lowest administration costs, but most likely higher up-front lobbying costs which might be the hurdle.

Transaction costs for companies will also depend on the chosen scheme design. One-time costs occur before the trading scheme starts, while ongoing costs occur after the scheme begins. As mentioned before, almost all one-time and ongoing costs will be independent of actual trading – except the market costs themselves – and will be equally paid by passive and active traders. The following correlations are assumed:

A simpler, objective and more transparent allocation process will lower the transaction costs (e.g. legal costs). Under an auction it is assumed that less trading on the secondary market will take place as the initial allocation will be cost-efficient. This will lead to lower transaction costs overall but higher transaction costs per traded unit, since less efficient trading platforms will be developed.

Simpler gas quantification processes and monitoring requirements will reduce the monitoring, reporting and verification costs.

Table 4: Transaction costs elements cap and trade

	Administration costs for	Transaction costs for
One-time costs	Set-up costs (program and authority): (1) Development of legal framework, public consultation process, dispute resolution (internal and external costs) (2) Establish all processes for monitoring and accreditation of verifiers (3) Establishment of registry (adaptation of aquired registry software) (4) Software development for allocation implementation (5) Rent expenses	Establishment of internal organisation: (1) Monitoring, reporting process (2) Quantifying emissions for base period and allocation application strategy (3) External verification costs (4) If applicable: legal costs
Ongoing costs	(6) Operation of registry, conduct oversights to check verifiers, depending on allocation: e.g. manage new entrant reserve and Sanctioning (7) Rent expenses	(5) Strategy and risk management (6) Monitoring, reporting of emissions and verification costs (7) Accounting of allowances in balance sheet (8) Familiarisation with register software and trading platforms (9) If applicable: Market transaction costs from trading (10) If applicable: Pay sanctions

Empirical estimates of transaction costs: EU Emissions Trading System

To date, few studies have estimated the transaction costs of the EU ETS and so it is difficult to assess some of the above hypotheses. In addition, the design of the scheme, especially the allocation process, is far from the efficient design promoted by textbooks since lobbying has influenced the process considerably. Most of the following data is based on the German situation, where the author was involved in implementation of the scheme and so able to gather data. For administration of the scheme a new department was founded under the Federal Environmental Agency called "German emissions trading authority" (DEHSt) based in Berlin. In addition, for approving monitoring concepts and the oversight of reported data, state-based local authorities are in charge. No cost estimates are available for these local authorities, and so the estimated administration costs will only reflect the lower cost range.

In principle the **administration costs** can be divided into personnel costs and material expenditures like new software systems or rent payments. Annual cost estimates are listed in Table 5. Assuming a preparation time of 1.5 years, the overall one-time administration costs will be around 10 million € compared to ongoing annual costs of 7 million €. It can be seen that the main costs are personnel costs which seem to stagnate over time and be equal in the pre-implementation and post-implementation phases. This might be different in other countries, where the authority is more flexible in adjusting for personal needs, and allocation processes might have been less time consuming. Due to complex allocation rules in Germany – more than 60 different variations were possible – many companies handed in more than one allocation application (sometime 3-4) and are now suing against the decision (around 1000 legal cases). Overall, assuming equal administration costs per installation, it can be estimated that annual administration costs are in the range of 4000 € per installation in the German case, 1.4 Cent / covered t CO_2e or 35 Cent / reduced t

CO_2e.[2] The question which needs to be assessed is, would a lower number of installations be more efficient? Two effects need to be distinguished to answer this question: If fixed administration costs are a realistic assumption, reducing the number of covered installations might improve the efficiency of the system. Nevertheless the more installations covered, the higher the probability of diverse abatement costs, which will increase efficiency gains from trading. To compare both effect data on share of allowances and the share of installations are analysed (see Figure 4): It shows that about 85% of allowances are allocated to the top 10% of installations in Germany . In addition, about 50% of installations receive only 1.6% of the total allocation. An analysis of the National Allocation Plans of all Member States (Betz et al. 2004) suggests that overall allocation will be fairly generous, at least in the first phase (2005-07) of the EU ETS. As a result, companies receive many allowances compared to actual emissions and additional costs for compliance are likely to be rather low. For example, German allocation rules imply that the above-mentioned installations which annually receive less than 50,000 t of CO_2-allowances will be short by less than about 1800 t per year (assuming emissions in 2005-07 will not be higher than in 2000-2002). Thus, given projected prices for allowances, which are expected, despite high prices in the past, to be well below 10 €/t CO_2 in the first period, transaction costs for these companies will be high compared to costs for compliance. As a result, small companies may not even bother spending resources to identify and appraise emission abatement measures and rather play a passive role. Thus, small companies are unlikely to invest in additional abatement measures, although some of these measures may be cost-efficient. Instead, they may just buy or have someone else buy the missing allowances on the market. Since in this case these companies increase demand for allowances in the market, costs for compliance for other participants may even be higher than if small emitters had been excluded from the EU ETS (Schleich and Betz 2004). Therefore a "de minimis threshold" such as the Netherlands have implemented, based on Article 28 (opt-out provision) excluding companies with less than 25 kt CO_2/a, could improve the overall efficiency and reduce transaction costs significantly.[3]

Table 5: Transaction costs of EU ETS in Germany (annual)

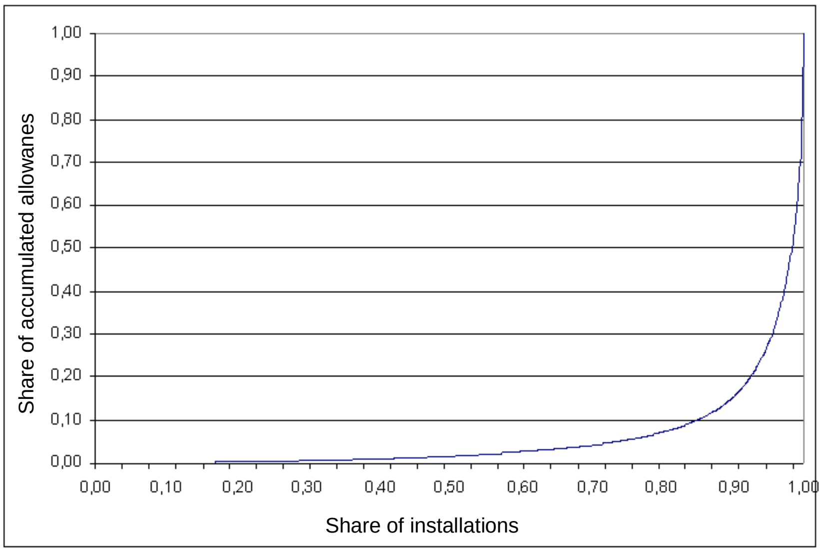
	Administration costs for	**Germany ETS (000 €/a)**
One-time costs	Set-up costs (program and authority):	
	(1) Development of legal framework, public consultation process, dispute resolution (internal and external costs)	6,800
	(2) Establish all processes for monitoring and accreditation of verifiers	200
	(3) Establishment of registry (adaptation of aquired registry software)	340
	(4) Software development for allocation implementation	53
	(5) Rent expenses	60
	Total	**7,453**
Ongoing costs	(6) Operation of registry, conduct oversights to check verifiers, depending on allocation: e.g. manage new entrant reserve and Sanctioning	7,000
	(7) Rent expenses	60
	Total	**7,060**
	Transaction costs for	**Germany ETS (000 €/a)**
One-time costs	Establishment of internal organisation:	20
	(1) Monitoring, reporting process	20 (fixed, depend on
	(2) Quantifying emissions for base period and allocation application strategy	complexity of installation)
	(3) External verification costs*	10
	(4) If applicable: legal costs	10
	Total	**50-60**
Ongoing costs	(5) Strategy and risk management	6
	(6) Monitoring, reporting of emissions and verification costs	17
	(7) Accounting of allowances in balance sheet	5
	(8) Familiarisation with register software and trading platforms	7
	(9) If applicable: Pay sanctions	(40 € per missing t CO_2e)
	Total	**35**

Source: Administration costs are based on Bergmann et al. 2005 and Betz 2003. Transaction costs for companies are based on estimates by Greening R. 2005 and onw estimates (*) based on interviews with companies.

[2] This is based on the following data for Germany: total number of installations: 1849; annual allocation: 499 Mio. t CO_2e; reduction compared to the base period: 4%.

[3] These 139 installations (of the total 333 installations in the Netherlands) contribute less than 1.5% of the total CO_2-emissions of the covered installations.

Figure 4: Distribution of allocated allowances in Germany (2005-2007)



Source: German list of installations

One-time **transaction costs for companies** mainly consist of costs associated with implementing the monitoring requirements, and quantifying and verifying emissions for the base period. In the German case, companies had to estimate their emissions twice, once in 2003 for setting the total amount of allowances (ET-budget) and the second time in 2004 for allocation to individual installations, which formed the basis for the allocation application. The ongoing costs will again mostly depend on the monitoring, reporting and verification costs. Strategy and risk management will for most companies play a rather small role. Greening (2005) estimates the one-time costs in the range of 50,000 € for an average complex installation and ongoing costs of about 35,000 € per year.

These costs do not include any market costs, which are assumed by Betz (2003) to be the highest ongoing costs in total for German companies. Assuming a trading volume of 2.5% and prices at around 5 €/t, trading costs may sum up to 23 million € per year, mainly borne by big companies being active in trading. Big companies will mainly trade over the exchange, whereas small companies are more likely to trade over the counter, since at low trading volumes it is not worthwhile to pay the exchange entrance fee. This illustrates that market transaction costs might be decreasing for big companies but rather constant for small companies, which form the majority of participants. Based on the findings of Stavins (1995) and Cason & Gangadharan (2003), the initial allocation should therefore be as close as possible to the efficient level of abatement. In a world with incomplete information this can only be achieved by an efficient auction.

Finally, multiplying the average cost estimates in Table 5 with the total number of installations covered in Germany gives costs of 65 million € per year. Comparing these costs with the estimated reduction in emissions results in transaction costs of 3 €/t CO_2e. However, the high costs per abated t CO_2 are not only the result of the high transaction costs, but also a result of lax targets. Therefore in the long run more stringent targets need be implemented to justify the high transaction costs. In addition, one-time costs could be significantly reduced by replacing the complex allocation process by an efficient auction, thereby reducing the expected trading volume and hence market transaction costs, since less trading will be necessary to achieve a cost-efficient distribution of emissions abatement. Furthermore, according to a recent survey undertaken by the European Commission, the high monitoring costs might be reduced by standardising the cost-efficiency assessments by authorities and simplifying the rule (ECOFYS 2005). More specifically, small companies may form pools to procure for services, such as for monitoring, reporting and verification or for trading allowances. Such pools may be organised for regions or they may be sector-specific.

Summary and Conclusion

Cap and trade schemes do not always lead to lower transaction costs – absolute and relative per tonne of CO_2e reduced – compared to baseline and credit schemes. The level of the costs depends mainly on the chosen design and implementation. Cap and trade schemes with high transaction costs and a lenient target will cause high transaction costs per emissions reduction compared to baseline and credit schemes, which was illustrated for the EU ETS and the CDM. However, in the long run to achieve stringent targets a cap and trade schemes should be favoured since baseline and credit schemes will most likely incur higher transaction costs because more difficult and smaller abatement options have to be implemented. Baseline and credit schemes might involve higher one-time administration costs in setting up the schemes, but will have less ongoing costs as rules and standardised processes have been established. Allowing for bundling of small projects, accepting longer crediting times and investing in capacity building in host countries could lower transaction costs for CDM projects further. However, the trade-off between accuracy in quantifying "additional" reductions and the level of transaction costs should carefully be considered when designing a baseline and credit scheme in order to avoid decreasing transaction costs at the expense of environmental integrity. Otherwise the level of abatement will be decreased which will increase the transaction costs per reduced t CO_2e.

In respect to cap and trade schemes, transaction costs per tonne of abatement might be decreased significantly if higher targets are set and auctioning replaces the time-consuming allocation process. The latter will reduce market transaction costs as well as legal costs; however, it might increase upfront lobbying costs. Deciding to allocate allowances based on an auction will need detailed assessment of different auction types in relation to efficient outcomes. Not every auction type is suitable and will lead to an efficient result (Bergmann et al., 2005). Moreover, the number of installations seems to be a key factor influencing the size of administration costs in cap and trade systems. As the above analysis has shown, introducing a "de minimus rule" for installations might considerably reduce the transaction costs without having major negative impacts on the total efficiency of the system. This is due to the fact that it can be assumed that small companies will behave passively and so may not implement abatement options and trade allowances. In order to give small companies the option to sell reduced emissions it might be worthwhile to consider their inclusion through a baseline and credit approach (called domestic projects) or as an opt-in. Under the first scenario small companies would then be able to sell their certified emissions reductions but would not be required to monitor and verify their emissions annually as under the cap and trade scheme. Under the latter scenario small companies would be able to opt-in into the system but need to prove the additionality of the reduction otherwise there will be an adverse selection process. However, to prevent any incentives to avoid being regulated under the cap and trade scheme (e.g. in splitting up installations in smaller units) aggregation rules and emissions thresholds have to be designed carefully.

Although both the ETS in Germany and the CDM are far from an efficient design, it can be assumed that their transaction costs will still be rather small compared to the efficiency gains from trading. Betz (2003) has shown on the basis of model results from Capros and Mantzos (2000) that transaction costs will equal only around 3% of the efficiency gains from trading in Germany, which are assumed to be in the range of 2,240 million € . However, since the modelling did not include market transaction costs the efficiency results will be overestimated and so further investigation of transaction costs is necessary. It would be especially interesting to compare the administration costs per installation in the different member states to find out how the different implementations (e.g. centralised authority compared to decentralised administration including local institutions) impact on transaction costs.

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