Transaction Costs of the Project-based Kyoto Mechanisms

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Objective

As pointed out in the report of the JOINT working group 4 on accreditation, verification and monitoring, transaction costs might play a crucial role how the two project-based mechanisms, Joint Implementation (JI) and the Clean Development Mechanism (CDM) will be used under the Kyoto Protocol and therefore, to what extent the cost reduction potentials can be exploited through the transfer of emission reduction credits. These transaction costs are caused by the administrative process associated with JI and CDM. They are dependent on the institutional framework that has not been clearly defined yet. The primary objective of this report is to present estimates of the transaction costs. The paper will also tackle the issue of risk, sometimes only regarded as a sub-category of transaction costs. Due to the importance of this topic and the different nature it will be tackled separately in this paper.

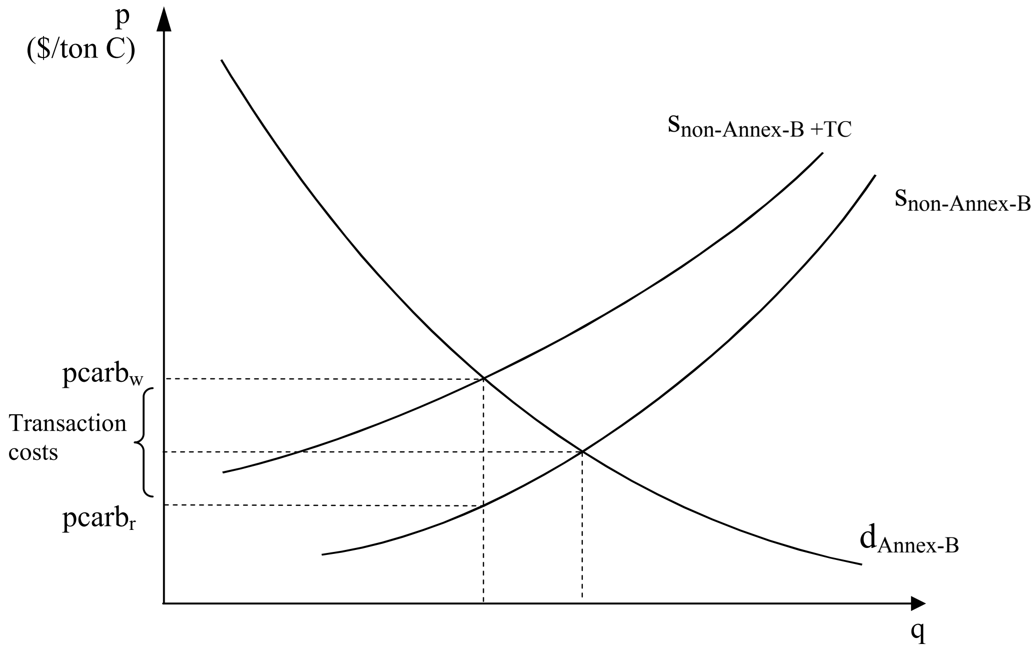
1 Introduction

The significant role of transaction costs in economic theory is reflected by the large amount of literature existing. As early as 1937 Coase defined transaction costs to be the costs that arise from initiating and completing transactions, like finding partners, holding negotiations, consulting with lawyers or other experts, monitoring agreements, etc., or opportunity costs, like lost time or resources. Thus, simply being the costs that arise from the transfer of any property right, they occur to some degree in all market economies. The most obvious impact of transaction costs is that they raise the costs for the participants of the transaction and thereby lower the trading volume or even discourage some transactions from occurring. Furthermore, if a country or company uses one of the instruments – Joint Implementation or Clean Development Mechanism – to achieve its reduction target it has to be certain that purchased emission rights will be valid. Otherwise, it will bear the risk of non-compliance and corresponding sanctions. Taking uncertainty into account might change the optimal choice between domestic and foreign actions. Since reduction measures abroad might bear higher risks this might shift the relative advantage to domestic actions.

Especially in the first stage of a permit system transaction costs may be essential. However, they decline with the accumulated amount of permit trades. This could raise first mover advantages for those countries that gained some experience in unilaterally implemented permit trade before an international scheme is introduced. On the global level, a particular interest lies on information about the impact and the development over time of the transaction costs associated with the implementation of an international scheme of tradable GHG emission permits. If these costs turn out to be a significant part of the overall emission mitigation costs, other implementation strategies might be preferable. This could lower the importance of emissions trading in favour of domestic action.

The effects of transaction costs are shown in Figure 1 where $pcarb_w$ represents the world permit price, $pcarb_{ir}$ the marginal abatement costs of region r, with r the regions of the non-Annex-B countries, and sector i. In this example, we consider those transaction costs that apply to carbon exports from non-Annex-B countries to Annex-B countries. These additional costs are imposed on the host countries. Without transaction costs the trade of emission permits between Annex-B and non-Annex-B countries will establish a world permit price that equals marginal abatement costs across countries. Including transaction costs leads to a shift of the supply curve, as is illustrated in Figure 1. This results in the obvious impact of transaction costs that the amount of emission permits traded is reduced and the price rises. This , in turn, reduces the efficiency gains from "where"-flexibility provided by the use of flexible instruments.

Figure 1: Inclusion of transaction costs



2 Transaction Costs and Risk in the Climate Change Context

Within the context of climate change transaction costs are important because they may influence the scope and extent of the use of flexibility mechanisms. These mechanisms encompass the Joint Implementation (JI) of projects among industrialised countries, joint implementation between industrialised and developing countries within the multilateral framework of the Clean Development Mechanism (CDM). The flexibility mechanisms aim mainly at reducing the costs of abating GHG emissions.

Closely linked to the problem of transaction costs is the issue of risk. To reduce or avoid risks the purchasing party might insure the projects or diversify through carbon funds. Further options would be more stringent rules for project verification and certifications. These strategies would be associated with higher transaction costs.

Furthermore, if not only international emissions trading under Article 17 is bound to a compliance regime, but also credits generated through JI- or CDM-projects, the risk depends on the design of the compliance mechanism. If seller liability is chosen as a general principle there is no risk for the buyer of emission rights. If - on the other hand – buyer liability is the driving compliance principle the use of instruments will be risky since validity of credits depends on the compliance status of the seller country.

Concerning the project-based mechanisms JI and CDM there is an additional project risk which consists in the possibility that the ex post realised net present value of emission reduction will differ from its ex ante planned value. Investment risks can be classified into technological, economic and political risks. Technological risks refer to the additional GHG reductions that have been actually achieved through projects ex post. Economic risks can be defined as risks associated with uncertain future development of prices which affect the net present value. Political risks refer to uncertain property rights regarding the assets of a company or a specific project. In a wide interpretation, political risks arise because of all risky actions or non-actions on the part of the government or the

administration in the host country. Therefore, projects should be classified into certain categories, since it is expected that, e.g. sink projects involve other risks than measures in the energy sector.
These considerations should result in a differentiated risk premium across regions and projects.
Particularly for environmental and related problems there applies a second aspect of transaction costs. The theory of externalities states, that environmental harms occur because they are "external" to market transactions, i.e. the price for some good does not reflect the harm it causes to third parties. In this case the transaction costs consist of the costs of identifying the victims and sources of pollution, of finding useful methods of reducing pollution, of negotiations among victims and polluters, of monitoring the subsequent pollution levels, etc., with the costs including the problem of free-riders. In the analysis of the impact of transaction costs in climate change, however, the aspect of transaction costs lowering the trading volume will stand in the foreground.
In contrast to the importance they receive theoretically, administrative or transaction costs are usually not taken into account when the economic efficiency of different policy measures to reduce pollution is evaluated in empirical analysis, which means that they are given a zero value. Some argue that this does not deny their importance, but rather emphasises different aspects. For Coase (1960), however, the priority is reversed. He argues that the transaction costs of implementation, enforcement, etc. determine at the outset how pollution should be controlled.

3 Transaction Costs

There are two particular constraints under which this research has been undertaken. The first is that since the Kyoto Protocol has not yet been implemented, the flexibility mechanisms are not yet in existence so no real evidence presently exists. Evidence therefore has to be based either upon the pilot phase of the UNFCCC-promoted Activities Implemented Jointly (AIJ) programme, or on hypothetical estimates of cost components that have been constructed, or on the experience from the use of similar policy instruments in other policy contexts. Second, the details of how (if!) the flexibility mechanisms are to be implemented have not yet resolved since the Conference Of Parties (COP6) have not reached full agreement on these issues. However, these details, particularly regarding the pattern of liability between parties in the project-based flexibility mechanisms, and the formulae for baseline determination, are likely to be influential in the determination of the transaction costs associated with these mechanisms.

3.1 Categorisation of Transaction Costs Focusing on Flexibility Mechanisms

Transaction costs take many forms, and different authors have used different types for describing them. Here transaction costs are defined as the costs associated with the process of obtaining Joint Implementation (JI) or Clean Development Mechanism (CDM) recognition for a project and obtaining the resulting emission credits (OECD, 2001). The categorisation of transaction costs will follow the project cycle approach, which splits the costs into a pre-implementation and implementation phase. Costs will then be identified along the stages of the project cycle. Table 1 defines these disaggregated cost components.

Table 1: Definition of Transaction Cost Components

Transaction Cost Components	**Description**
Project based (JI,CDM): Pre-implementation	
Search costs	Costs incurred by investors and hosts as they seek out partners for mutually advantageous projects

Negotiation costs	Includes those costs incurred in the preparation of the project design document that also documents assignment and scheduling of benefits over the project time period. It also includes public consultation with key stakeholders
Validation Costs	Review and revision of project design document by operational entity
Approval costs	Costs of authorisation from host country; and registration and approval by UNFCCC Executive Board
Project based (JI,CDM): Implementation	
Monitoring costs	Costs needed to ensure that participants are fulfilling their obligations, including annual verification
Certification costs	Including issue of Certified Emission Reductions (CERs for CDM) and Emission Reduction Units (ERUs for JI) by UNFCCC Executive Board
Enforcement Costs	Includes costs of administrative and legal measures incurred in the event of departure from the agreed transaction

Based on PriceWaterhouseCoopers (2000) and Dudek et. al. (1996)

3.2 Estimates of Transaction Costs

In specifying data on transaction costs associated with flexible mechanisms several problems occur. The most obvious is the fact that the Kyoto Protocol has not yet been ratified and the flexible mechanisms are not yet in operation. Therefore there is not much experience concerning the transaction costs associated with these mechanisms. The details of the implementation of the mechanisms are furthermore likely to influence the level of transaction costs.

We first present the transaction costs that have been identified in a number of different studies for AIJ/JI/CDM projects.

3.2.1 World Bank Prototype Carbon Fund (PCF)

The PCF, operated by the World Bank, provides funding to host partners who wish to develop projects consistent with the JI/CDM mechanisms under the Kyoto Protocol. It presently has 25 projects operating or in development. Some estimates of the transaction costs of these projects have been made and these are presented in Table 2 – Table 4 below. Data has been supplied by staff at the PCF and is not published as yet. Moreover, the data in Table 3 and Table 4 is based on country and project-specific data that is not yet in public circulation. We have been requested to make this data more generic and so have not specified the project host country, but instead specified the world region in which the country is located.

Table 2 presents the ranges, together with a "typical" or average, for the transaction costs associated with the pre-implementation phase of the project cycle for the PCF projects.

Table 2: PCF Range of Pre-Implementation Transaction Cost Components

Pre-Implementation phase	Typical Cost (Euro '000s)	Low Cost (Euro '000s)	High Cost (Euro '000s)
Negotiation	250	125	366
Approval	40	35	207
Validation	20	20	35
Sub-total	310	180	608

10% contingency	31	18	61
Total: Pre-Implementation	**341**	**198**	**669**

Table 3 shows, for individual projects hosted by Annex B countries, the transaction costs incurred to date. Table 4 gives the same information for non-Annex B countries where CDM projects would be located. The information on CO2 reductions resulting from these projects is not currently available in all cases. As a consequence, only five projects have their transaction costs expressed per ton of carbon abated. In these five cases, we have assumed, unless there is evidence otherwise, that annual implementation costs (e.g. monitoring, verification etc.) are 80% of year 1 costs in subsequent years of the project lifetime. This assumption – based on the fact that there is a learning curve that makes the latter years' implementation less resource-intensive – is taken from PriceWaterhouseCoopers (2000). The validity of the assumption is discussed below but we believe that for the purposes of making a first approximation of possible transaction costs this is a reasonable conservative estimate.

Table 3: JI – country projects under PCF: Transaction Costs

World Region	**Sector**	**Ton C Redn.**	**Project lifetime**	**Pre-Implementation**	**Implementation Year 1**	**Implementation Year 2**	**Total Project TCs**	**TC/Ton C**
		000s	**yrs**	**Euro (000)**		**Euro (000)**		
CEA				220	110	n/a		
CEA				220	110	n/a		
CEA				176	88	n/a		
CEA	SER	560	25	287	20	20	695	1.24

Table 4: CDM – country projects under PCF: Transaction Costs

World Region	**Sector**	**Ton C Redn.**	**Project lifetime**	**Pre-Implementation**	**Implementation Year 1**	**Implementation Year 2**	**Total Project TCs**	**TC/Ton C**
		000s	**yrs**	**Euro (000)**	**Euro (000)**	**Euro (000)**	**Euro (000)**	
N.Afr	ELE	1590	20	397	277	120	2954	1.9
CAM	AGR	684	8	482	161	321	1737	2.5
S. Asia 1				150	150	n/a		
S. Am 1				150	150	n/a		
S. Am 2				220	110	n/a		
S. Am 3	AGR	3070	21	220	110	n/a	2090	0.7
RSM				176	88	n/a		
S. Am 4	ELE	1600	20	176	88	n/a	1601	1
Asia 1				220	110	n/a		

Note: where possible the GTAP nomenclature of countries/regions is used. For countries where country data is confidential, we classify the country according to the world region. Thus, S.Asia = South Asia; S.America = South America. There are four South American projects, and there are numbered to distinguish them.

For the five projects in which there is complete data, these results show a close, though not perfect, correlation between size of project and transaction cost per ton of carbon reduced.

3.2.2 UNFCC Activities Implemented Jointly (AIJ) Projects

The UNFCC launched a pilot phase of Activities Implemented Jointly (AIJ) in 1995 – prior to the proposed implementation of the Kyoto Protocol - in order to learn more about the possible operation of JI and CDM projects under the Protocol's flexibility mechanisms. It was also hoped that this exercise will build confidence in the approach and allow a framework for international implementation of JI and CDM to be developed.

Table 5 presents a selection of the project-based AIJ evidence on transaction costs available to date[1]. Of the AIJ projects started, approximately 70 have reported transaction costs. The table includes 26 projects whose transaction costs we have been able to identify and analyse.

Table 5: AIJ Project Cycle Transaction Costs (Totals and per ton carbon reduced)

Sector	Region	Lifetime	Ton C Redn.	Total TC (Pre-Impl) '000 Euro	Pre-Impl Tran Cost/ Ton C	Total TC (Impl.) '000 Euro	Impl. Tran Cost/ Ton C	Total TC '000 Euro	Total TC/Ton C
Ser	CEA	10	228	1488	6511	814	3561	2301	10072
Ele	CEA	10	390	160	410	53	136	213	547
Ser	CEA	10	390	126	322	32	83	158	405
Ele	CEA	10	463	165	356	43	93	208	449
Ele	CEA	6	482	76	158	10	22	87	180
Ele	CEA	10	707	164	232	33	46	197	279
Ele	CEA	10	821	26	31	30	36	55	67
Ele	CEA	10	904	77	85	32	35	109	120
Ele	CEA	10	918	108	118	32	35	140	153
Dwe	CEA	10	970	141	146	62	64	203	210
Dwe	CEA	10	1041	129	124	27	26	156	150
Ele	CEA	10	1151	155	135	78	67	232	202
Dwe	CEA	10	1279	241	189	62	48	303	237
Ele	CEA	10	1589	171	107	27	17	198	125
Ele	CEA	10	2283.01	135	59	30	13	165	72
Ele	CEA	10	2603	68	26	32	12	100	39
Ele	CEA	10	3229.04	101	31	32	10	133	41
Ele	CEA	10	3410.96	116	34	43	13	159	47
Ele	CEA	10	8452	88	10	32	4	120	14
Ele	CEA	10	11191.2	154	14	30	3	184	16
Ele	CEA	10	11780.8	154	13	30	3	184	16
Ele	CEA	10	15095.9	114	8	32	2	147	10
Ele	CEA	10	19156.4	173	9	53	3	226	12
Ele	CEA	10	20818.4	35	2	30	1	65	3
Ele	CEA	10	306509	127	0.4	32	0.1	159	0.5
Agr	MEX	30	839817	153	0.2	43	0.1	196	0.2

Table 5 shows a very wide variation in transaction costs expressed per ton of carbon reduced. The variation is explained not so much by the differing absolute project transaction costs as by the differing carbon emission reductions which each project brings about. The data has been sorted so that the lowest carbon reducing (smallest) projects are listed at the top, and the largest at the bottom of the table. This indicates a very strong negative correlation between size of project and transaction cost per ton carbon of reduced. This is a pattern we would expect. However, it should be noted that the vast majority of the projects here have been undertaken by Sweden, who have presented average annual implementation costs across all projects in the individual project description. This has the effect of exacerbating the strength of the correlation between these two variables.

3.2.3 PriceWaterhouseCoopers

PWC carried out research with the objective to "present an independent private sector view of the implications of some of the key options for the design of the Clean

[1] See http://www.unfccc.int/program/aij/aijproj.html

Development Mechanism (CDM).” (PriceWaterhouseCoopers, 2000) The transaction costs given by them are ordered along three categories:

1. Types of transaction costs:
   Costs are divided into a pre-implementation and implementation phase.
2. Number of operational entities (OE’s) involved in the project:
   In order to avoid conflicts of interest validation, verification and certification may be undertaken by separate institutions. Therefore three levels are distinguished according to the number of OE’s used over the project cycle.
   (i) One OE is responsible for the whole project cycle (validation, verification and certification)
   (ii) One OE is responsible for the validation in the pre-implementation phase, one other OE provides verification and certification services in the implementation phase
   (iii) Three OE’s undertake validation, verification and certification respectively
3. Project type, project size and host country

PWC has estimated the additional costs incurred by project developers in gaining CDM credits. The costs are short run foresights and are expected to decrease in the long run, due to experience. The transaction costs for five generic project types, a Combined Cycle Gas Turbine (CCGT) plant, Retrofit CCGT project, Wind project and two Photovoltaic projects with 1MW and 100kW capacity, are presented in Table 6 – 10. Assumptions about day rates are:

- project developers : range Euro 750 – 1200; central value Euro 1000;
- project consultants -local engineers/NGOs in host country: Euro 200;
- International management consultancy in host country: Euro 300;
- International management consultancy in OECD states: Euro 1500.

These assumptions result in a range of estimates for each project. The figures given are mid-range estimates.

Table 6: Transaction Costs (TCs) for new Combined Cycle Gas Turbine (CCGT) Plant

CDM Structure	Total TCs ($ 000s)	$/Ton Carbon	Phase 1 TCs ($ 000s)	$/Ton Carbon	Phase 2 TCs ($ 000s)	$/Ton Carbon
Level 1	558	0.11	103	0.02,	455	0.09
Level 2	675	0.14	103	0.02	582	0.12
Level 3	1057	0.21	103	0.02	986	0.20

Table 7: Transaction Costs (TCs) for Retrofit project

CDM Structure	Total TCs ($ 000s)	$/Ton Carbon	Phase 1 TCs ($ 000s)	$/Ton Carbon	Phase 2 TCs ($ 000s)	$/Ton Carbon
Level 1	489	0.10	73	0.02	416	0.08
Level 2	584	0.11	73	0.02	511	0.10
Level 3	897	0.18	73	0.02	824	0.17

Table 8: Transaction Costs (TCs) for Wind project

CDM Structure	Total TCs ($ 000s)	$/Ton Carbon	Phase 1 TCs ($ 000s)	$/Ton Carbon	Phase 2 TCs ($ 000s)	$/Ton Carbon
Level 1	392	0.91	61	0.14	331	0.77
Level 2	446	1.03	61	0.14	385	0.89
Level 3	610	1.41	61	0.14	549	1.27

Table 9: Transaction Costs (TCs) for 1MW PV project

CDM Structure	Total TCs ($ 000s)	$/Ton Carbon	Phase 1 TCs ($ 000s)	$/Ton Carbon	Phase 2 TCs ($ 000s)	$/Ton Carbon
Level 1	387	79.0	57	11.6	330	67.4
Level 2	441	90.1	57	11.6	386	78.8
Level 3	605	123.6	57	11.6	548	111.9

Table 10: Transaction Costs (TCs) for 100 kW PV project

CDM Structure	Total TCs ($ 000s)	$/Ton Carbon	Phase 1 TCs ($ 000s)	$/Ton Carbon	Phase 2 TCs ($ 000s)	$/Ton Carbon
Level 1	387	790	57	116	330	674
Level 2	441	900	57	116	386	788
Level 3	605	1235	57	116	548	1119

PWC gives total costs over the project cycle (in thousand USD) and total days for phase 1 (pre-implementation) and phase 2 (implementation). The lifetime of each of the projects is 15 years. As the division into the separate day rate categories is not given by PWC we calculate the costs for Phases 1 and 2 simply by using the percentages of the split of days.
The emissions reduction figure is obtained by multiplication of energy (per lifetime) for the new plant (capacity x load factor x 131400 h) with the difference between old and new emissions. Table 11 provides the data for these calculations. Adjustment from CO_2 to Carbon is achieved through division by 3.65.

Table 11: Carbon reduction

	g/kWh	load factor	Reduction (t/lifetime)	Reduction (t/a)
base (400MW)	800			
CCGT (400MW)	365	0.79	4,948,560	329,904
RetrofitCCGT (")	365	0.79	4,948,560	329,904
Wind (50MW)	0	0.30	432,000	28,800
PV (1MW)	0	0.17	4,896	326
PV (100kW)	0	0.17	490	33

As a baseline for emissions we chose 800g/kWh for a coal burning power station. PWC suggest a baseline of 944g/kWh for an Indian coal powered energy generator. However, with many power stations having emissions much below that this appeared to be too high.
The figures for the load factor are rough estimates based on IKARUS (KFA, 1994), a comprehensive techno-economic data base which has been developed for the German Ministry for Technology and Research over the last few years.
It can easily be seen that costs rise with the number of OE's involved and, more significantly, that the costs per ton of carbon reduction are negligible for big, but significant for smaller projects. For the renewable energy projects, i.e. wind and PV, less effort is required in absolute terms than for the large-scale fossil projects. This is due to the fact that the projects with zero emissions require minimal verification effort in the implementation phase.
The estimates don't take socio-economic or political conditions in different host countries into account. The data is averaged over a number of CDM-projects in different countries and is thus not country specific.

3.2.4 EcoSecurities

The report by EcoSecurities examines transaction costs that arise for JI electricity generation projects. The data gives ranges of transaction costs based on several projects. Examples for a typical small and large project within these ranges are:

- a 150MW gas plant, 20 year lifetime, resulting in reductions of 350,000 tCO_2/year;
- a 2MW biomass plant, 20 year lifetime, resulting in reductions of 35,000 tCO_2/year.

Table 12: JI Transaction Cost Estimates

JI Project Cycle	**Transaction Cost ($)**
Pre-Implementation phase	
Search	12,000 – 20,000
Negotiation	25,000 – 45,000
Validation	10,000 – 15,000
Approval	10,000
Total Pre-Implementation Phase	57,000 – 90,000
Implementation phase	
Monitoring (annual)	3,000 – 15,000
Certification	5-10% of ERU value
Enforcement (annual)	1-3% of ERU value
Total Implementation Phase*	3,000 – 15,000 *
Total Project Cycle	60,000 – 105,000*

Source: Ecosecurities (2000)

* Note that the total implementation phase costs do not include certification and enforcement and therefore represent minimum cost estimates.

The single stages of the pre-implementation and implementation phase are considered, however, the estimates are not country specific and there are no details given concerning the single projects underlying the transaction cost ranges. EcoSecurities believes that absolute transaction costs will be approximately the same for all project, independent of the size of the project. This means that costs per ton of carbon reduced will be much higher for smaller projects and may make them less attractive to investors. The two above mentioned projects are both medium or large sized projects with small costs per ton of carbon reduced.

Comparison of Estimates

It's difficult to compare the results, as the reports stress different aspects. However, all surveys make clear that the size of the project is significant for the costs per ton of carbon reduced. Table 13 tries to summarise the correlation between project size and transaction costs. Since PWC provides the most consistent data set with regard to this relation, Table 13 is mainly based on the PWC-study. However, the other results fit more or less well in this picture. They were used to determine the upper and lower bounds of the five categories. But, it should be stressed that this is only a rough picture and further research is necessary in order to come up with better data.

Table 13: Project size and transaction costs

Type	**Reduction (ton C/a)**	**USD/ton C**

Very large	> 50,000	0.1
Large	5,000 – 50,000	1
Medium – upper	500 – 5,000	10
Medium – lower	50 – 500	100
Small	< 50	1,000

As already mentioned the implementation of the flexible mechanisms in the Kyoto Protocol is likely to influence the size of the transaction costs. Crucial factors are the final specification of liability and the provision of regulating institutions. Especially for the small projects any such institutions or streamlining will reduce transaction costs significantly. In view of Table 13 and considering the prices paid under the Dutch Emissions Reduction Procurement Tender (ERU-PT), the decision concerning the treatment of small-scale projects under the CDM agreed upon in Bonn during COP 6bis seems not to be inappropriate. The Parties agreed that projects emitting less than 15 kilotons of CO2 annually, i.e. around 4,000 tons of carbon, shall follow simplified modalities and procedures. The prices for individual transactions under ERU-PT ranged between USD 4.46 and USD 8.10 per ton of carbon dioxide equivalent, i.e. 16 to 30 USD per ton of carbon. Under these assumptions it will be hard for projects of the category "medium – upper" to earn additional revenues from permit sales.
Another crucial aspect is the determination of the baseline. We calculated the emission reduction against a coal-fired power plant. Table 14 shows that profitability will change significantly if different baselines are chosen.

Table 14: Impact of baseline setting on profitability

Baseline	Emissions (g CO_2/kWh)	Total TC [USD/a]	Reductions [t_C/a]	Revenues [USD/a]	TC [USD/t_C]	Total TC vs. Revenues [%]
Germany						
Coal	800	40,000	28,800	288,000	1.39	13.89
Average	430	40,000	15,480	154,800	2.58	25.84
Gas	370	40,000	13,320	133,200	3.00	30.03
OECD-Benchmarks						
Poland	760	40,000	27,360	273,600	1.46	14.62
Slovenia	270	40,000	9,720	97,200	4.12	41.15

Notes: 50 MW wind plant; basic assumptions taken from PWC; permit price = 10 USD per ton of carbon; OECD-benchmarks taken from the JOINT working group 2 report on generic baselines.

According to Shell (2001), transaction should not be more than 25 % of proceeds from permit sales in order to make a project viable. In three cases this threshold will be exceeded.

4 Risk

Up to now; uncertainty associated with project-based activities was completely neglected. Assessing the relative risk factor involved in financing of carbon-reducing projects may be central to determining the effectiveness of the flexibility mechanisms under the Kyoto Protocol. The need for verification of carbon reductions and the issue of liability rules under the Kyoto framework (Haites and Missfeldt, 2000) will require effective risk management on the part of international investors, particularly with respect to JI and CDM.
Projects in different sovereign states may face different risk premia owing to the perceived level of risk of default or project failure due to the general nature of the economy or the nature of the government. Past actions, such as default on loans and so forth, may impact

upon this perceived level of risk, as may macroeconomic variables such as inflation and the perceived level of development.

4.1 Determining the Risk Premia

Dailami and Liepziger (1999) suggest that it is possible to estimate the required rate of return for a project in a given country using the following equation:

$i= r+s$

where i is the required rate of return, r is the risk-free interest rate and s reflects the market's assessment of country and project risk. This paper will evaluate factors that determine s, and present potential estimates for risk premia in different countries.
Different techniques may be applied to estimate the risk premia at both country and project level. These include:

- Econometric Analysis of past projects: This technique covers both country and project level risk, and separates these two levels of risk through the use of macroeconomic and project level indicators as explanatory variables in regression analysis.
- Monte Carlo Simulation of risks of projects: Monte Carlo simulations may include country level risk aspects, though project level risks are probably easier to model under this framework.
- Econometric analysis of sovereign debt ratings
- Estimation of risk premia based on equity values and risk of default

Econometric analysis of sovereign debt ratings and estimation of equity values, considering risk of default, give a first indication of the country level risk aspects. Only the latter one will be presented within this report. Especially the studies trying to define a project-level risk premium lack clarity and often don't account for country level risk factors which would be a precondition in order to identify the risk premium for a certain type of project activity irrespective of where it is located.

4.2 Estimation of Risk Premia based on Equity Values and Risk of Default

Given that CDM and JI projects are to be placed in developing countries and economies in transition, differential risk premia may have to be used in project analysis. One possible technique that presents itself is to calculate risk premia for different countries using equity returns and risk of default compared to a base country. Damadoran (undated) presents a methodological framework from which the risk premia for equities in different countries can be estimated. Damadoran (1999) calculates this for the USA relative to a number of other countries in the world, using average default spreads for different credit rankings. The results of this analysis are presented in Table 15 below.
The estimates presented below can be used as rough estimates of the country risk element to be applied to projects in the different countries, as they relate the risk of failure to the countries own rating. The credit rating of an individual firm within a nation, and thus the cost of financing a project, is unlikely to be below that of the national government, given the financial resources open to the government.
Table 16 reports the average risk premium attributed to countries of different credit ratings are applied. As can be seen from the table, the level of risk rises as the credit rating falls, which is as one would expect.
These estimates of risk premia in different countries may provide the basis for first estimations of the country risk premia to which projects under JI and CDM are exposed.

Table 15: Estimates of Country Risk Premia for Equities

Country	Long-Term Rating	Adj. Default Spread	Total Risk Premium	Country Risk Premium
Alderney	Aaa	0	5.51%	0.00%
Andorra	Aa1	60	6.11%	0.60%
Argentina	B2	550	11.01%	5.50%
Australia	Aa2	65	6.16%	0.65%
Austria	Aaa	0	5.51%	0.00%
Bahamas	A3	95	6.46%	0.95%
Bahamas - Off Shore Banking Center	Aaa	0	5.51%	0.00%
Bahrain	Ba1	250	8.01%	2.50%
Bahrain - Off Shore Banking Center	A3	95	6.46%	0.95%
Barbados	Baa2	130	6.81%	1.30%
Belgium	Aaa	0	5.51%	0.00%
Belize	Ba2	300	8.51%	3.00%
Bermuda	Aa1	60	6.11%	0.60%
Bolivia	B1	450	10.01%	4.50%
Botswana	A2	90	6.41%	0.90%
Brazil	B1	450	10.01%	4.50%
Bulgaria	B2	550	11.01%	5.50%
Canada	Aa1	60	6.11%	0.60%
Cayman Islands	Aa3	70	6.21%	0.70%
Cayman Islands - Off Shore Banking Center	Aaa	0	5.51%	0.00%
Chile	Baa1	120	6.71%	1.20%
China	A3	95	6.46%	0.95%
Colombia	Ba2	300	8.51%	3.00%
Costa Rica	Ba1	250	8.01%	2.50%
Croatia	Baa3	145	6.96%	1.45%
Cuba	Caa1	750	13.01%	7.50%
Cyprus	A2	90	6.41%	0.90%
Czech Republic	Baa1	120	6.71%	1.20%
Denmark	Aaa	0	5.51%	0.00%
Dominican Republic	B1	450	10.01%	4.50%
Ecuador	Caa2	750	13.01%	7.50%
Egypt	Ba1	250	8.01%	2.50%
El Salvador	Baa3	145	6.96%	1.45%
Estonia	Baa1	120	6.71%	1.20%
Eurozone	Aaa	0	5.51%	0.00%
Fiji Islands	Ba2	300	8.51%	3.00%
Finland	Aaa	0	5.51%	0.00%
France	Aaa	0	5.51%	0.00%
Germany	Aaa	0	5.51%	0.00%
Gibraltar	Aaa	0	5.51%	0.00%
Greece	WR	750	13.01%	7.50%
Guatemala	Ba2	300	8.51%	3.00%
Guernsey	Aaa	0	5.51%	0.00%
Honduras	B2	550	11.01%	5.50%
Hong Kong	A3	95	6.46%	0.95%
Hungary	A3	95	6.46%	0.95%
Iceland	Aa3	70	6.21%	0.70%
India	Ba2	300	8.51%	3.00%
Indonesia	B3	650	12.01%	6.50%
Iran	B2	550	11.01%	5.50%
Ireland	AA2	65	6.16%	0.65%
Isle of Man	Aaa	0	5.51%	0.00%
Israel	A2	90	6.41%	0.90%
Italy	WR	750	13.01%	7.50%
Jamaica	Ba3	400	9.51%	4.00%
Japan	Aa1	60	6.11%	0.60%
Jersey	Aaa	0	5.51%	0.00%
Jordan	Ba3	400	9.51%	4.00%
Kazakhstan	B1*	450	10.01%	4.50%
Korea	Baa2	130	6.81%	1.30%

Source: Damodaran (1999)

Table 15 cont…

Country	Long-Term Rating	Adj. Default Spread	Total Risk Premium	Country Risk Premium
Kuwait	Baa1	120	6.71%	1.20%
Latvia	Baa2	130	6.81%	1.30%
Lebanon	B1	450	10.01%	4.50%
Liechtenstein	Aaa	0	5.51%	0.00%
Lithuania	Ba1	250	8.01%	2.50%
Luxembourg	Aaa	0	5.51%	0.00%
Macau	Baa1	120	6.71%	1.20%
Malaysia	Baa2	130	6.81%	1.30%
Malta	A3	95	6.46%	0.95%
Mauritius	Baa2	130	6.81%	1.30%
Mexico	Baa3	145	6.96%	1.45%
Moldova	B3	650	12.01%	6.50%
Monaco	Aaa	0	5.51%	0.00%
Morocco	Ba1	250	8.01%	2.50%
Netherlands	Aaa	0	5.51%	0.00%
New Zealand	Aa2	65	6.16%	0.65%
Nicaragua	B2	550	11.01%	5.50%
Norway	Aaa	0	5.51%	0.00%
Oman	Baa2	130	6.81%	1.30%
Pakistan	Caa1	750	13.01%	7.50%
Panama	Baa1	120	6.71%	1.20%
Panama - Off Shore Banking Center	Aa2	65	6.16%	0.65%
Papua New Guinea	B1	450	10.01%	4.50%
Paraguay	B2	550	11.01%	5.50%
Peru	Ba3	400	9.51%	4.00%
Philippines	Ba1	250	8.01%	2.50%
Poland	Baa1	120	6.71%	1.20%
Portugal	A3	95	6.46%	0.95%
Qatar	Baa2	130	6.81%	1.30%
Romania	B3	650	12.01%	6.50%

Country	Long-Term Rating	Adj. Default Spread	Total Risk Premium	Country Risk Premium
Russia	B2	550	11.01%	5.50%
San Marino	A2	90	6.41%	0.90%
Sark	Aaa	0	5.51%	0.00%
Saudi Arabia	Baa3	145	6.96%	1.45%
Singapore	Aa1	60	6.11%	0.60%
Slovakia	Ba1	250	8.01%	2.50%
Slovenia	A2	90	6.41%	0.90%
South Africa	Baa3	145	6.96%	1.45%
Spain	Aa1	60	6.11%	0.60%
Sweden	Aa1	60	6.11%	0.60%
Switzerland	Aaa	0	5.51%	0.00%
Taiwan	Aa3	70	6.21%	0.70%
Thailand	Baa3	145	6.96%	1.45%
Trinidad & Tobago	Baa3	145	6.96%	1.45%
Tunisia	Baa3	145	6.96%	1.45%
Turkey	B1	450	10.01%	4.50%
Turkmenistan	B2	550	11.01%	5.50%
Ukraine	Caa1	750	13.01%	7.50%
United Arab Emirates	A2	90	6.41%	0.90%
United Kingdom	Aaa	0	5.51%	0.00%
United States of America	Aaa	0	5.51%	0.00%
Uruguay	Baa3	145	6.96%	1.45%
Venezuela	B2	550	11.01%	5.50%
Vietnam	B1	450	10.01%	4.50%

Source: Damodaran (1999)

Table 16: Average Risk Premia by Credit Ranking

Credit Ranking	Ave Risk premia
Aaa	0.00%
Aa1	0.60%
Aa2	0.65%
Aa3	0.70%
A2	0.90%
A3	0.95%
Baa1	1.20%
Baa2	1.30%
Baa3	1.45%
Ba1	2.50%
Ba2	3.00%
Ba3	4.00%
B1	4.50%
B2	5.50%
B3	6.50%
Caa	7.50%

Source: Authors own estimates based on Damodaran (1999)

5 Conclusions

The analysis has shown that both – transaction costs and risk – may have a significant influence on whether a project goes ahead or not. With regard to transaction costs, a negative correlation between project size and costs is obvious. In light of the reported estimates, the Bonn decision on simplified rules for small-scale projects and the agreed threshold (less than 15 kilotons of CO2 reduced annually) seems reasonable. Looking at the category "small" in Table 13, it might be a good idea to introduce a third track for very small projects (e.g. PV) in order to make them viable. These projects bear a very high transaction cost burden. Usually, they will not cause any indirect effects. Therefore, very simple modalities and procedures should be applied.

On top of the transaction costs, the project usually has to bear a higher risk since projects are carried out in developing countries and economies in transition. This will drive up the required rate of return for an investor.

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